



SPECIAL! 64-PAGE YEAR-OUT SECTION
Auto Racing Guide for 1970

POPULAR MECHANICS

JAN. 1970
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**'Shooting' Elephants With the World's
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FORD ECONOLINE VANS



POPULAR MECHANICS

1970

Racing Guide



TO REMOVE SECTION, lift gently along this edge.

This One



1C88-J9J-6Y08



Just the Greatest

Few sports were as fragmented as automobile racing only a few years ago. Most Americans, Southerners excepted, believed Indianapolis racing the only kind there was. Europeans thought road-racing was all that counted. Stock-car drivers thought sports-car drivers were dudes and dilettantes. Sports-car drivers considered stock-car drivers hillbilly moonshiners making a few bucks on the side.

Somehow all this has changed. It began, perhaps, when European stars like Jim Clark, Graham Hill, Jack Brabham, and Jackie Stewart and New Zealander Denis Hulme tried for Indianapolis money and took some of it home. Two of them, Clark and Innes Ireland, even took on the "good ol' boys" of NASCAR. After considerable frustration, a couple of Indy drivers cracked stock-car racing's Camelot. A. J. Foyt won the Daytona Firecracker in '63 and '64; Mario Andretti outwiggled NASCAR's new breed of gentlemen like Freddie Lorenzen and Richard Petty in the '67 "500." Sports-car stars Mark Donohue and Peter Revson shook up the Indianapolis "establishment" with high finishes last year and NASCAR's Lee Roy Yarbrough was a real threat until his exhaust header gave out. Bobby Johns, in eclipse at NASCAR, drove one of Colin Chapman's Lotuses, of all things, to seventh place in 1965. And stock-car star Dick Hutcherson finished third with Ronnie Bucknum at Le Mans in 1966.

But most of all, "a man for all seasons," Dan Gurney, by monopolizing the Riverside 500 stock-car race, capturing Le Mans with A. J. Foyt, finishing second the last two years at Indy, and giving the United States its first Grand Prix victory in an American-built car—his own—since 1921, made racing a truly homogenized sport.

Our first love was stock-car racing on Daytona's Big D. We loved the noise, the sheer power, the bumper-to-bumper drafting, the constant lead-changing and the last-lap "slingshots." We shared a little of Joe Weatherly's disdain for open cars with "hay-rake wheels." We distrusted sports-car buffs with their funny caps and tight-pants girl friends in the pits, and the Grand Prix crowd with their esoteric talk about "esses" and "chicanes." We got *our* thrill from watching David Pearson drafting Buddy Baker.

We still do—but last fall we saw the other side. We had a chance to drive—or be driven—on four of Europe's famous road courses: Zandvoort, Spa, Hockenheim and the legendary Nurburgring. They made believers of us—the Nurburgring, especially. As John Fitch, who had raced there for Mercedes, pointed out each of the 165 turns a driver has to memorize, we realized the unbelievable skill and concentration road racing demands.

In oval racing, stock cars especially, a driver is driving against other drivers. What counts is his ability to maneuver in heavy traffic at 180 miles an hour. In road racing a driver is driving against the track—and himself. It's every bit as demanding in a different way.

Sport in the World

In preparing PM's First Annual Racing Guide, Auto Editor Bill Kilpatrick and Technical Auto Editor Bill Hartford put in hours of research. Both racing enthusiasts, they have, we think, produced the most complete racing guide ever published in a magazine. We think you'll want to tear it out and keep it.

Obviously, they could include only so many tracks and so many drivers, even in a book of 64 pages, and they probably left out some of your favorites. We recognize that for every Parnelli Jones or Cale Yarborough or Mark Donohue or Don Garlits there are a hundred dedicated competitors driving midgets, modifieds, sportsmen, Formula Vees, even 1954 Hudsons on 1/2-mile dirt tracks and obscure drag strips. Some will be the Gurneys and the Garlitses of the 1970s. But even those who will never make it big help make racing the great sport that it is. To them and to the hundreds of hard-working, unsung mechanics who sweat over everything from Funny Cars to Ferraris, PM's First Annual Racing Guide is affectionately dedicated.



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CHAMPIONSHIP



Championship cars are most often known as "Indy cars," the Memorial Day Indianapolis 500 being the most prestigious of the series of races (the Championship Trail) in which they compete.

Design of the cars and the events in which they run are conducted by the United States Auto Club, which also sanctions three other classes of auto racing: midgets, sprints and stocks. On the Championship Trail, in addition to the 500-miler, roughly a dozen shorter events—from 100 to 300 miles—are run on paved or dirt ovals; a few are run on road courses; and an annual hill climb is held at Pikes Peak. Events on dirt run a championship car of front-engine configuration. A point-scoring system for finishing drivers in the races decides the national driving champion.



MARIO ANDRETTI—Winner of the 1969 Indy 500, he also took the National Driving Championship for the third time last year. Champion in '65 and '66, he drove his first USAC race in 1964 after starting in modified stocks in 1958. Versatile driver. Has won NASCAR's Daytona 500. Competes in Can-Am and on the F1 Grand Prix circuit.



A. J. FOYT—Only five-time winner of National Championship and a three-time winner of the Indy 500. To that achievement add over 40 wins on the Championship Trail for an incredible record. Strictly a USAC driver, he has more championship points than any other. Has driven every Indy 500 since '58. Aims to be the only four-time winner.



DAN GURNEY—Second-place finisher at Indy last two years. Started racing in 1955 driving a Triumph TR2. Winner of more F1 GP races than any other American driver, repetitive winner of Riverside 500 stock-car race, winner of '66 Bridgehampton Can-Am, he's won in every type of auto racing. His All-American Racers builds the Eagle chassis.



GORDON JOHNCOCK—Started racing in stocks in the Great Lakes area in 1955. Went on to log outstanding record in popular modified competition. Went sprint and championship in '64. In his first Indy competition ('65) he started in 15th slot, finished 5th. Was a close-trailing 4th in '66. Near end of last year was third in championship point standings.



JOE LEONARD—National motorcycle champion in 1954, '56, '57; runner-up in '53, '58, '60, '61. AMA record breaker. Went to midgets, modifieds and stocks, NASCAR Rookie of the Year, '63; USAC stocks Rookie of the Year, '64. At Indy took third in '67; was headed for win in '68 in STP turbine car until fuel-pump shaft broke; finished fifth in '69.



ROGER McCLUSKEY—The United States Auto Club's sprint-car champion in 1963 and '66; just missed in '62. Runner-up in 1968 on the stock-car circuit, he was again running a hot second near the end of last season. Championship Trail driver since 1960, he has been plagued by mechanical difficulties in seven of his eight starts at Indy since 1961.



LLOYD RUBY—Veteran USAC driver. Has driven more miles in Indy 500 events than any other active driver; always missed victory due to bad luck. High in total championship points. Consummate driver. Won '65 and '66 Daytona Continental with Ken Miles in Ford GT, Sebring 12-hour in '66. Won the 150 and 200-milers at Milwaukee in '68.



BOBBY UNSER—Prominent member of a racing family. Moved to midgets and sprints after winning modified stocks championship in home state of New Mexico in 1950, '51. 1968 USAC national champion and winner Indy 500. Known as "King of the Hill" from repeated wins of Pikes Peak Hill Climb. Among top three drivers in point standings for past three years.

OTHER STARS: Sonny Ates, Gary Bettenhausen, Wally Dallenbach, Larry Dickson, Mark Donohue, George Follmer, Jerry Grant, Bobby Grim, Bob Harkey, Graham Hill, Denis Hulme, Jim Hurtubise, Bobby Johns, Mel Kenyon, Arnie Knepper, Jim Malloy, Jim McElreath, Al Miller, Mike Mosley, Art Pollard, Peter Revson, Jochen Rindt, Johnny Rutherford, Sammy Sessions, George Snyder, Jackie Stewart, Bud Tinglestad, Al Unser, Bob Veith, Bill Yukovich, Bob Wente, Carl Williams, Lee Roy Yarbrough.

EQUIPMENT

Standard: Rear-deck airfoil • Front air dam • Striping • Special mag-type wheels • Blacked-out grille • G70-14 black fiberglass-belted tires • Special "The Judge" emblems • Front stabilizer bar—1½" • Rear stabilizer bar—¾" • Firm ride and handling package

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Horsepower366 @ 5100 rpm
Torque445 lb.-ft. @ 3600 rpm

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Deck Clearance023
Compression Ratio10.5:1
Chamber Volume66.27 cc.
CarburetionQuadra-jet, 4-bbl.
ExhaustPerformance duals
Valve LiftersHydraulic

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Standard 3-speed Heavy-duty

MakeMuncie
ShifterHurst

Available 4-speed Wide-ratio

MakeMuncie
ShifterHurst

Available 4-speed Close-ratio

MakeMuncie
ShifterHurst

Available 3-speed Turbo Hydra-matic

RAM AIR AXLE RATIOS

Standard3.55
With Air Conditioning3.23
Available3.90 & 4.33

AVAILABLE RAM AIR IV

Displacement400 cu. in.
Horsepower370 @ 5500 rpm
Torque445 lb.-ft. @ 3900 rpm
Bore & Stroke4.12 x 3.75
Deck Clearance023
Compression Ratio10.5:1
Chamber Volume69.12 cc.
CarburetionQuadra-jet, 4-bbl.
ExhaustPerformance duals
Valve LiftersHydraulic limited travel with manual transmission

RAM AIR IV TRANSMISSIONS

Standard 4-speed Close-ratio

MakeMuncie
ShifterHurst

Available 3-speed Turbo Hydra-matic

RAM AIR IV AXLE RATIOS

Standard3.90
Available4.33

**After a few moments of respectful silence,
you may turn the page.**



**The Judge: a special GTO from Pontiac.
(We take the fun of driving seriously. Very seriously.)**

Winners of Indianapolis 500

The Indianapolis 500 is the longest continually-held auto race in the United States and is often called the most prestigious event of its type in the world. First held in 1911, it has been run every year since, with the exception of the war years 1917-18, 1942-45. The race is rich in tradition, practically a running history of U.S. auto racing. All the great names have competed, its winners knowing great joy, fame, wealth; its losers disappointment, often heartbreak, sometimes death.

YEAR	DRIVER	CAR	AVERAGE MPH
1911	Ray Horroun	Marmon	74.59
1912	Joe Dawson	National	74.29
1913	Jules Goux	Peugeot	75.93
1914	Rene Thomas	Delage	82.47
1915	Ralph DePalma	Mercedes	89.84
1916	Dario Resta	Peugeot	84.00
1919	Howdy Wilcox	Peugeot	88.05
1920	Gaston Chevrolet	Monroe	88.62
1921	Tom Milton	Frontenac	89.62
1922	Jim Murphy	Murphy Special	94.48
1923	Tom Milton	H.C.S. Special	90.95
1924	L. L. Corum and Joe Boyer	Duesenberg	98.23
1925	Pete DePaolo	Duesenberg Special	101.13
1926	Frank Lockhart	Miller Special	95.90
1927	George Souders	Duesenberg	97.55
1928	Lou Meyer	Miller Special	99.48
1929	Ray Keech	Simplex Piston Ring Special	97.59
1930	Bill Arnold	Miller Hartz Special	100.45
1931	Louis Schneider	Bowes Seal Fast Special	96.63
1932	Fred Frame	Miller Hartz Special	104.14
1933	Lou Meyer	Tydol Special	104.16
1934	Wm. Cummings	Boyle Production Special	104.86
1935	Kelly Petillo	Gilmore Speedway Special	106.24
1936	Lou Meyer	Ring Free Special	109.07
1937	Wilbur Shaw	Shaw Gilmore Special	113.58
1938	Floyd Roberts	Burd Piston Ring Special	117.20
1939	Wilbur Shaw	Boyle Special	115.04
1940	Wilbur Shaw	Boyle Special	114.28
1941	Mauri Rose and Floyd Davis	Noc-Out Hose Clamp Special	115.11
1946	George Robinson	Thorne Engineering Special	114.82
1947	Mauri Rose	Blue Crown Spark Plug Special	116.34
1948	Mauri Rose	Blue Crown Spark Plug Special	119.81
1949	Bill Holland	Blue Crown Spark Plug Special	121.33
1950	John Parsons	Wynn's Friction Proofing Special	124.00
1951	Lee Wallard	Belanger Special	126.24
1952	Troy Ruttman	Agajanian Special	128.92
1953	Bill Vukovich	Fuel Injection Special	128.74
1954	Bill Vukovich	Fuel Injection Special	130.84
1955	Bob Sweikert	John Zink Special	128.21
1956	Pat Flaherty	John Zink Special	128.49
1957	Sam Hanks	Belond Exhaust Special	135.60
1958	Jimmy Bryan	Belond AP Special	133.79
1959	Rodger Ward	Leader Card 500 Roadster	135.86
1960	Jim Rathmann	Ken-Paul Special	138.77
1961	A. J. Foyt	Bowes Seal Fast Special	139.13
1962	Rodger Ward	Leader Card 500 Roadster	140.29
1963	Parnelli Jones	Agajanian Willard	143.14
1964	A. J. Foyt	Sheraton-Thompson Special	147.35
1965	Jim Clark	Lotus Ford	150.69
1966	Graham Hill	American Red Ball Special	144.317
1967	A. J. Foyt	Sheraton-Thompson Special	151.207
1968	Bobby Unser	Rislone Special	152.882
1969	Mario Andretti	STP Hawk/Ford	156.867

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**Quaker State your car
to keep it running young.**

STOCK CARS



Most popular form of U.S. auto racing. Ranges from Detroit's latest to severely cobbled, much modified cars dating back to mid-'30s. Cars classified as Grand National, Late Model, Late Model Sportsman, Modified, Hobby. Racing conducted by NASCAR, USAC, ARCA, IMCA, plus regional, local organizations. Big hotbeds are Midwest, South (where stock-car racing is a major sport). Frequency of events means more overall prize money than any other form of racing. Purses range from a few hundred dollars to more than \$50,000 for such major events as the Daytona 500, which draws crowds of up to 100,000.



BOBBY ALLISON—Known as gentleman along pit row, one of NASCAR's most popular stars. Started in jalopies in '55, was big winner in Modifieds from '62 through '65. Entered first GN—Daytona 500—in '60. Biggest win to date was 500-miler at Rockingham in '68. Drives Mario Rossi-prepared Dodge. President of Pure-Darlington Record Club for '69-'70.



RICHARD PETTY—A stock-car-racing "great," winner of more GN races than any driver in NASCAR history. Won 27 of 48 races in '67—a record. Was GN points champ in '64, '67, was runner-up three times. Son of all-time great Lee Petty. Began career in 1958. Has won most of the big ones, including Daytona 500—'64, '66. Quiet, popular. PDA president.



CHARLIE GLOTZBACH—1969 was supposed to be "The Year of the Glotzbach," but a fleeting flurry with NASCAR over rule interpretation set plan back at least a season. Maybe 1970. Started in jalopies in '57, went on GN circuit in '60. Dodge driver, very fast, he took first in National 500 at Charlotte in 1968. Lapped Talladega at 199.987 mph, a record.



DON WHITE—This year marks his 20th as an all-out racing competitor. Was IMCA stocker champ in '54, '55, '58. Has campaigned USAC stock circuit since '59, was point champion in '63, '67. Leads '69 season as we lock up. Affable and easy-going off track, White is a tough man once the flag drops. Driver for Dodge, occasionally runs big NASCAR events.



BOBBY ISAAC—Consistent, always runs with leaders, has led big ones many times, still looking for first superspeedway win. Always in thick of GN point champ race. Compiler of outstanding record on shorter tracks. Began racing in '55, first GN race Daytona 500 in '63. One of NASCAR's toughest when his Dodge is at peak. Soft-spoken, rugged, dedicated.



CALE YARBOROUGH—A soapbox racer at age 10, has been racing ever since. Became a Sportsman star while still in teens, ran first GN at age 17 (illegally). Won Firecracker 400 in '67, immediate superspeedway stardom. Has won just about all the big ones. Was leading NASCAR money-winner in '68. Drives for Wood Brothers. Always a contender, crowd favorite.



DAVID PEARSON—Graduate of Sportsman ranks, compiler of outstanding NASCAR win record. Was GN points champ in '66, '68, '69, always contender. Named NASCAR "Rookie of the Year" in '60. Drives Holman-Moody Ford. A flat-out charger, whiz on dirt. Has competed in Trans-Am, handles road courses with aplomb. Link between moderns, "good ol' boys."



LEE ROY YARBROUGH—Began career in 1957 in a Sportsman, won his very first race. NASCAR driver since 1960, won 37 Sportsman races in 1963. NASCAR's leading money-winner in 1969, won more superspeedway events in single season than any driver in stock-car history. A charger, consistent; is winner, top finisher or goes bust. Also runs Indy 500.

OTHER STARS: Donnie Allison, Buddy Baker, Ernie Derr, A. J. Foyt, Dan Gurney, Jim Hurtubise, James Hylton, Bobby Johns, Iggy Katona, Dave Marcis, Roger McCluskey, Benny Parsons, Tom Pistone, Wendell Scott, Ramo Stott, Al Unser, Bobby Unser.

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 **Millions and millions
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just like yours.**

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any engine run
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longer!

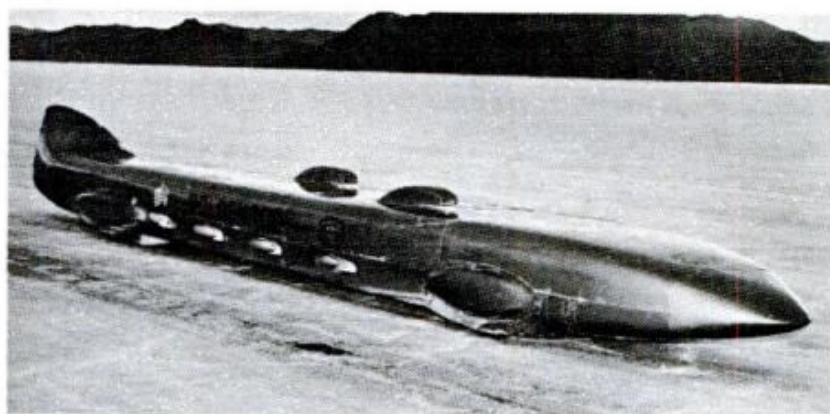
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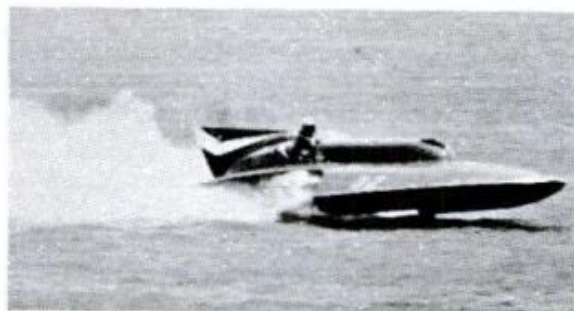
Winners of Major NASCAR Races

	YEAR	DRIVER	CAR	AVERAGE MPH
ATLANTA 500 Very important race on annual schedule—first big one after Daytona. Cars have been sorted out and competition is fierce. Early spring.	1960	Bobby Johns	'60 Pontiac	108.624
	1961	Bob Burdick	'61 Pontiac	124.172
	1962	Fred Lorenzen	'62 Ford	101.983
	1963	Fred Lorenzen	'63 Ford	130.582
	1964	Fred Lorenzen	'64 Ford	132.959
	1965	Marvin Panch	'65 Ford	129.410
	1966	Jim Hurtubise	'66 Plymouth	131.266
	1967	Cale Yarborough	'67 Ford	131.238
	1968	Cale Yarborough	'68 Mercury	125.564
	1969	Cale Yarborough	'69 Mercury	132.759
WORLD 600 Longest race on NASCAR schedule—tremendous test of stamina for both driver and car. Run at Charlotte in May in a delightful spring setting.	1960	Joe Lee Johnson	'60 Chevrolet	107.752
	1961	David Pearson	'61 Pontiac	111.634
	1962	Nelson Stacy	'62 Ford	125.552
	1963	Fred Lorenzen	'63 Ford	132.418
	1964	Jim Paschal	'64 Plymouth	125.772
	1965	Fred Lorenzen	'65 Ford	121.772
	1966	Marvin Panch	'65 Plymouth	135.042
	1967	Jim Paschal	'67 Plymouth	135.832
	1968	Buddy Baker	'68 Dodge	104.207
	1969	Lee Roy Yarbrough	'69 Mercury	134.361
SOUTHERN 500 Oldest major NASCAR GN race—it's the one all drivers want to win. Roster of winners reads pretty much like a list of stock-car racing's Hall of Fame. Run on Labor Day at Darlington.	1950	Johnny Mantz	'50 Plymouth	76.26
	1951	Herb Thomas	'51 Hudson	76.90
	1952	Fonty Flock	'52 Oldsmobile	74.51
	1953	Buck Baker	'53 Oldsmobile	92.78
	1954	Herb Thomas	'54 Hudson	94.73
	1955	Herb Thomas	'55 Chevrolet	92.281
	1956	Curtis Turner	'56 Ford	95.067
	1957	Speedy Thompson	'57 Chevrolet	100.100
	1958	Fireball Roberts	'57 Chevrolet	102.590
	1959	Jim Reed	'59 Chevrolet	111.836
	1960	Buck Baker	'60 Pontiac	105.901
	1961	Nelson Stacy	'61 Ford	117.880
	1962	Larry Frank	'62 Ford	117.965
	1963	Fireball Roberts	'63 Ford	129.784
	1964	Buck Baker	'64 Dodge	117.757
	1965	Ned Jarrett	'65 Ford	115.924
	1966	Darel Dieringer	'66 Mercury	114.830
	1967	Richard Petty	'67 Plymouth	130.423
	1968	Cale Yarborough	'68 Mercury	126.132
1969	Lee Roy Yarbrough	'69 Mercury	105.000	
DAYTONA 500 Most prestigious, richest GN race of the season. Winning this one is every driver's dream. Event caps three weeks of racing, draws tremendous crowds. Late February.	1959	Lee Petty	'59 Oldsmobile	135.521
	1960	Junior Johnson	'59 Chevrolet	124.740
	1961	Marvin Panch	'60 Pontiac	149.601
	1962	Fireball Roberts	'62 Pontiac	152.529
	1963	Tiny Lund	'63 Ford	151.566
	1964	Richard Petty	'64 Plymouth	154.334
	1965	Fred Lorenzen	'65 Ford	141.539
	1966	Richard Petty	'66 Plymouth	160.627
	1967	Mario Andretti	'67 Ford	146.926
	1968	Cale Yarborough	'68 Mercury	143.251
1969	Lee Roy Yarbrough	'69 Ford	157.950	
RIVERSIDE 500 Season's first big one; run January. Longest road race on NASCAR Grand National schedule.	1963	Dan Gurney	'63 Ford	84.965
	1964	Dan Gurney	'64 Ford	91.154
	1965	Dan Gurney	'65 Ford	87.708
	1966	Dan Gurney	'66 Ford	97.946
	1967	Parnelli Jones	'67 Ford	91.080
	1968	Dan Gurney	'68 Ford	100.598
	1969	Richard Petty	'69 Ford	105.516

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These world speed records were sparked by Champions, giving more proof Champions deliver maximum performance in every engine. Good reason for you to specify Champions for your engines.



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CAN-AM CARS



The Canadian-American Challenge Cup is a series of SCCA and Canadian Automobile Sports Club-sanctioned FIA international events for sports racing (Group 7) cars. Unlike other formulae, the rules for the car design place no restrictions on weight or overall size, and wings are allowed. There is no limit on engine displacement. Fantastic power-to-weight ratios are the result of teaming 7 and 8-liter engines putting out 600 to 700 hp with cars weighing as little as 1500 pounds. Since the series began in 1966, the number of races annually has increased from 6 to 11 in 1970, with purse now nearing \$1 million. The 1969 season was dominated by "Team McLaren"—Bruce McLaren and Denis Hulme, driving McLaren M8Bs.



JO BONNIER—Seasoned international driver, has been racing for over 20 years. Drove for Maserati in mid-'50s; later was star driver of Porsche factory team. Won his first Grand Prix in 1959—the Dutch championship race. First U.S. competition was at Watkins Glen in '58 when he won in a Maserati. In a Chaparral in '66 he and Phil Hill won Nurburgring.



BRUCE MCLAREN—His youthful looks belie his racing experience. Has been in F1 competition since 1958, finished second to Brabham for the World Championship in 1960 and won the 24 Hours of Le Mans in 1966. Consistently Can-Am champion or runner-up since 1967, he drives the cars he builds and is top manufacturer of Group 7 sports-racing cars.



GEORGE EATON—Began racing in a Sunbeam Alpine in his native Canada at age 19. Before his first Can-Am in 1967 in a McLaren Mk. 3 he was Ontario's big-sedan champion. His best finish in the 1968 series was a third at Laguna Seca. A steady finisher in last year's 11-race series, he was among the handful of drivers at the top in point standings.



LOTHAR MOTSCHENBACHER—A force in U.S. road racing since 1966 when he moved from 33 straight formula victories in a junior car to big sports-racing machines. That year he scored a fifth-place finish at the Las Vegas Can-Am, driving a McLaren Mk. 2. He finished fourth in standings in 1968 in the SCCA's U.S. road-racing championship.



JIM HALL—U.S. Road-Racing Champion in 1964. Has long and colorful history of racing in a wide variety of machinery, the latest cars being "Chaparrals" of his own design. He took two second places in '66, two seconds and a fourth in '67, and a second, third and fifth in '68 before being sidelined in a crash. Watch for his new Chaparral this year.



CHUCK PARSONS—High in point standings for the 1969 season, won the U.S. road-racing championship in 1966. That year his best Can-Am finish was third in a McLaren Mk. 2 at Mosport. For three consecutive years (1966-68) at Elkhart Lake, he captured the Road America 500 in SCCA's now discontinued U.S. road-racing championship series.



DENIS HULME—New Zealander based in London, is international driving star who has won more Can-Am races than any other man, driving for Team McLaren. World Driving Champion in 1967 in a Brabham-Repco, he remains a tough competitor in Formula 1 events and in Indy 500 where he finished fourth in 1967 (his first year there) and fourth again in '68.



PEDRO RODRIGUEZ—An international driver. Began racing career as motorcycle champion in his native Mexico in 1954 and '55. He won the G.P. of South Africa in '67, and took a second and two third places in the 1968 F1 races driving for BRM. Driving a Ford GT 40, he was a winning driver in the 24 Hours of Le Mans. The '69 Can-Am saw him in a Ferrari.

OTHER STARS: Chris Amon, Mario Andretti, Fred Baker, Dick Brown, Ronnie Bucknum, John Cannon, John Cordts, Ron Courtney, Jacques Couture, Tony Dean, Bob Dini, Mark Donohue, Tom Dutton, Jerry Entin, Bill Eve, George Follmer, Rich Galloway, J. Servoz-Gavin, Ron Goldleaf, Dan Gurney, Jerry Hansen, Kris Harrison, Charlie Hayes, Leonard Janke, Oscar Koveleski, Joe Leonard, Frank Match, Bob Nagel, Sam Posey, Peter Revson, Swede Savage, Skip Scott, Jo Siffert, Jeff Stevens, John Surtees, Jerry Titus, Gary Wilson, Bill Wonder.

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Outstanding

The world Land Speed Record (LSR) is held by Craig Breedlove, who, on Nov. 16, 1965, drove his jet-powered *Spirit of America* over the Bonneville Salt Flats at an average speed of 600.601 mph. The engine used in setting the record was a General Electric J-79 GE-3 turbojet capable of approximately 15,000 lbs. thrust.



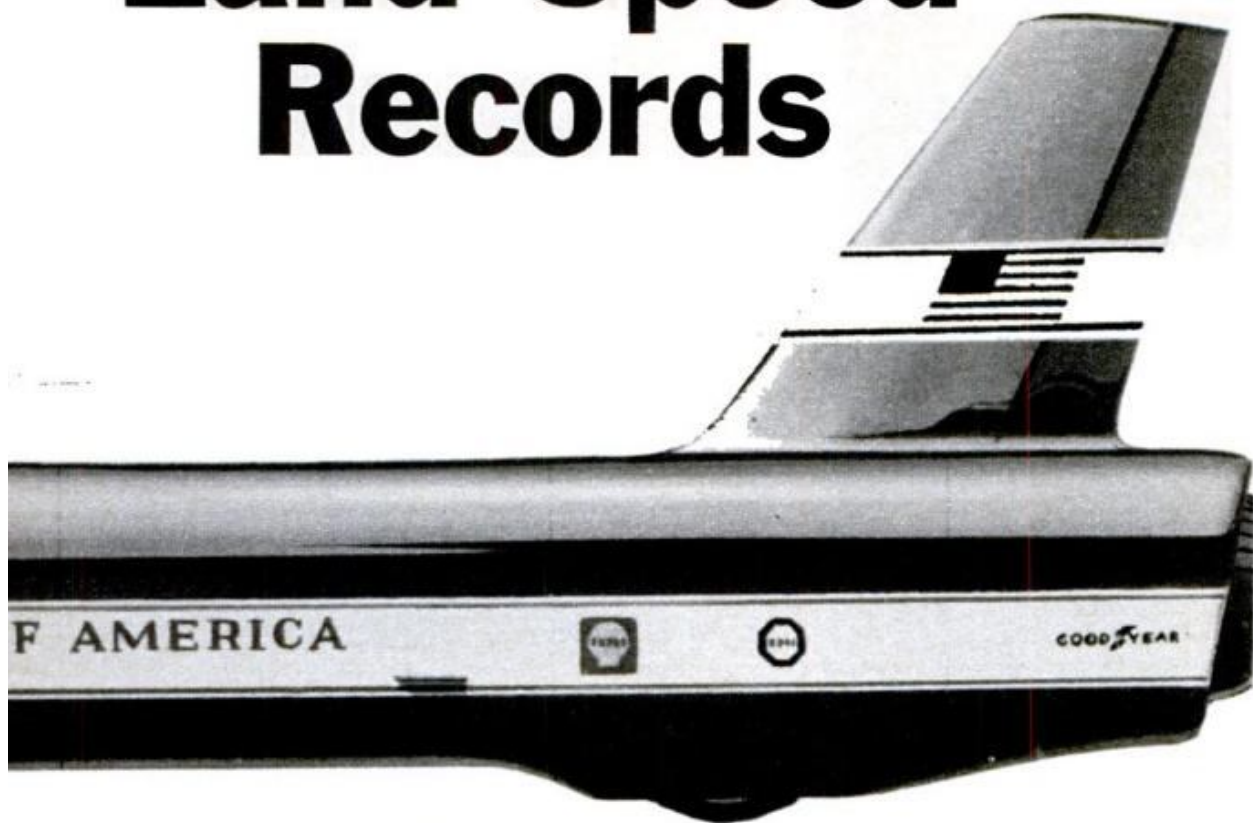
The fastest official speed ever attained on the famed sands of Daytona Beach was 276.82 mph, an LSR set by Britain's Sir Malcolm Campbell on March 7, 1935. Later that same year—on Sept. 3—Campbell set a new LSR of 301.13 at Bonneville. The March mark was the last LSR established at Daytona.

The fastest speed ever established on a closed racing course was 199.466 set by Charlie Glotzbach in a Dodge Daytona Charger on Sept. 11, 1969 in qualifying for the first running of the Talladega 500 at Alabama International Speedway.

The LSR for cars driven by internal combustion power is held by Bob Summers, who, on Nov. 12, 1965, drove a special car called *Goldenrod* over the Bonneville Salt Flats at an average speed of 409.277 mph. The wheel-driven *Goldenrod* was powered by four Chrysler Hemi engines mounted in-line.

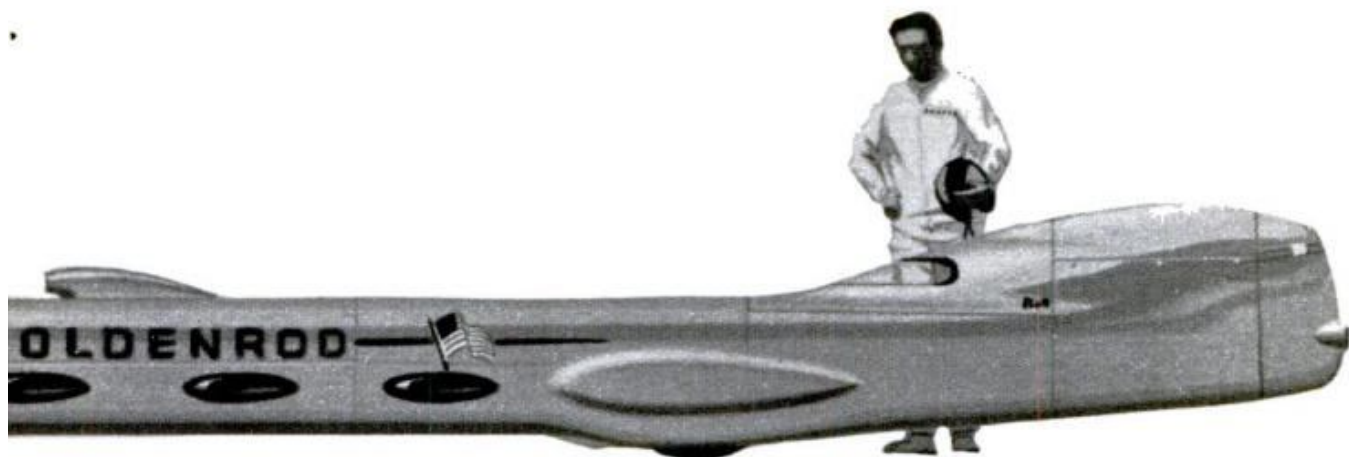


Land Speed Records



The world speed record for cars powered by electricity is 138.862 mph, set by Jerry Kugel at Bonneville on Nov. 19, 1968 in Ford's Autolite "Lead Wedge." The car was powered by 20 special Autolite batteries.

Although not universally recognized as a Land Speed Record, Fred Marriott drove a Stanley steam car at a speed of 127.66 mph at Daytona Beach on Jan. 26, 1906. He was the first man to go faster than two miles a minute. Following Marriott's record, steam was never again a factor in LSR attempts.



TRANS-AM / NASCAR GT



Professional racing in two classes—over and under two-liter CID engines. The former involves so-called "pony" (e.g., Mustang) cars, the latter small sedans of both U.S. and foreign manufacture (e.g., Porsche 911). The Trans-Am series is run on road courses, is sanctioned and administered by SCCA. NASCAR runs, sanctions its GT series on oval tracks, sometimes combined with a road course, often as a prelude to Grand National events. Type of racing is new, growing. Many entries are factory-backed, at least benefit from factory "cooperation." Both Trans-Am, NASCAR series involve drivers who star in other forms of racing. NASCAR crowns an annual finish-points champion, also honors owner of overall points-winning car. SCCA conducts Trans-Am series as manufacturers' championship, meaning drivers, teams win races, prize money, but point standings are awarded only to manufacturers.



RONNIE BUCKNUM—A graduate of sports cars, he won 27 out of 28 starts in '62, 25 out of 28 in '63. Competed in F1 for Honda in '64-'66, best finish being fifth in Mexican GP in '65. Has run Indy since '66, dogged by mechanical troubles. Won Michigan track inaugural in '68 in championship car. Third at Le Mans in '66 (with Dick Hutcherson).



MARK DONOHUE—Racing's "Captain Nice," he began career in '59, was a national sports-car champion in '61. Won two national championships in '65, was named SCCA's "Driver of the Year." Was USRRC champion in '67, '68, Trans-Am champ in '68. Finished third in Can-Am point standings in '67 and '68. Finished seventh in 1969 Indianapolis 500.



GEORGE FOLLMER—Started out in sports cars in 1960. In '65, drove Lotus/Porsche of his own design, won six out of nine and the U.S. Road-Racing Championship. Was first in class (under two liters) at Sebring in '66. Drove at Le Mans, competed in Can-Am in which he finished sixth in point standings in '67. Competes at Indy, other championship races.



PETE HAMILTON—Personable young charger joined NASCAR GN ranks in '68 after winning '67 national Sportsman championship. Right off the bat he ran with the leaders, won GN "Rookie of the Year" honors. Of 16 GN races in '68, he finished in top ten six times; best was second, highest purse seventh at Charlotte. Won several NASCAR GT races in '69.



PARNELLI JONES—An all-time racing great, won Indy 500 in '63, was second in '65, was far ahead in '67 when turbine car failed on 94th lap. Began career in '52 in stocks, has since compiled outstanding record in several types of car—championship, sprint, midget, stock, even off-road. Now concentrates on GTs, stocks. Cool, smooth, an all-out goer.



TINY LUND—Far from "tiny," was NASCAR's GT champion in '68. Began career in sprint cars, entered GN racing in '55. Biggest GN win to date was Daytona 500 in '63. To gain '68 GT title, he won 9 of 18 races entered, finished in top ten 15 times. Lund holds Carnegie Medal for heroism for aiding in rescue of Marvin Panch from burning car.




JIM PASCHAL—A real veteran of the racing wars, he began his career on Daytona's old beach course in 1947. One of the few active drivers to have competed in the first Southern 500 at Darlington in '50. Winner of more than 30 NASCAR races including World 600 in '64 and '67. In '69, won five of 22 races he entered, finished in the top five 11 times.



PETER REVSON—Up from sports-car ranks, he drove superbly to finish fifth in '69 Indy 500. Began in '60, learned trade in series of F3, F2, F1 events in Europe in which he compiled very successful record. He drove a Cougar in the '67 Trans-Am, a Javelin in '68, spent 1969 behind wheel of a Mustang. Won Mount Fuji race in '68. Competes Can-Am.

OTHER STARS: (Trans-Am) Ron Grable, Peter Gregg, Rusty Jowett, Horst Kwech, Milt Minter, Jerry Titus; (NASCAR) Buck Baker, Charlie Blanton, Lee Cutler, Peter Gregg, C. B. Gwyn, T. C. Hunt, Randy Hutchison, Marty Robbins, Ken Rush, John Ryan, Frank Sessoms, Jim Vandiver, Don Yenke.

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World Speed Records on Land

MPH	NAME	CAR	PLACE	DATE
63.10	C. S. Rolls	Mors	Acheres	April 9, 1902
65.79	W. K. Vanderbilt	Mercedes-Simplex	Acheres	April 9, 1902
75.06	L. Serpollet	Serpollet (steam)	Nice	April 13, 1902
67.78	W. K. Vanderbilt	Mercedes-Simplex	Ablis	April 21, 1902
69.04	W. K. Vanderbilt	Mercedes-Simplex	Ablis	April 21, 1902
75.06	P. de Caters	Mors	Bruges	July, 1902
76.08	W. K. Vanderbilt	Mors	Ablis	Aug. 5, 1902
76.60	H. Fournier	Mors	Dourdan	Nov. 5, 1902
77.13	Augieres	Mors	Dourdan	Nov. 17, 1902
82.84	C. S. Rolls	Mors	Clipstone	March 7, 1903
83.47	A. Duray	Gobron-Brillie	Ostend	July 17, 1903
84.09	de Forest	Mors	Phoenix Park	July, 1903
84.73	C. S. Rolls	Mors	Clipstone	Oct., 1903
84.73	A. Duray	Gobron Brillie	Dourdan	Nov. 5, 1903
91.37	H. Ford	Ford	Lake St. Clair	Jan. 12, 1904
92.30	W. K. Vanderbilt	Mercedes	Daytona	Jan. 27, 1904
94.78	L. Rigolly	Gobron-Brillie	Nice	March 31, 1904
97.25	P. deCaters	Mercedes	Ostend	May 25, 1904
103.55	L. Rigolly	Gobron-Brillie	Ostend	July 21, 1904
104.52	P. Baras	Darracq	Ostend	Nov. 13, 1904
104.65	A. MacDonald	Napier	Daytona	Jan. 25, 1905
109.75	H. L. Bowden	Mercedes	Daytona	Jan. 25, 1905
109.65	V. Hemery	Darracq	Arles	Dec. 30, 1905
127.66	F. Marriott	Stanley (steam)	Daytona	Jan. 26, 1906
125.95	V. Hemery	Benz	Brooklands	Nov. 8, 1909
131.72	B. Oldfield	Benz	Daytona	March 16, 1910
140.87	R. Burman	Benz	Daytona	April 23, 1911
132.37	A. Duray	Fiat	Ostend	Dec. 8, 1913
124.10	L. G. Hornsted	Benz	Brooklands	June 24, 1914
156.03	T. Milton	Duesenberg	Daytona	April 27, 1920
133.75	K. Lee Guinness	Sunbeam	Brooklands	May 17, 1922
143.31	R. Thomas	Delage	Arpajon	July 6, 1924
146.01	E. A. Eldridge	Fiat	Arpajon	July 12, 1924
146.16	M. Campbell	Sunbeam	Pendine	Sept. 25, 1924
150.87	M. Campbell	Sunbeam	Pendine	July 21, 1925
152.33	H. O. D. Segrave	Sunbeam	Southport	March 16, 1926
169.30	J. G. Parry Thomas	Thomas Special	Pendine	April 27, 1926
171.02	J. G. Parry Thomas	Thomas Special	Pendine	April 28, 1926
174.88	M. Campbell	Napier-Campbell	Pendine	Feb. 4, 1927
203.79	H. O. D. Segrave	Sunbeam	Daytona	March 29, 1927
206.96	M. Campbell	Napier-Campbell	Daytona	Feb. 19, 1928
207.55	R. Keech	White Triplex	Daytona	April 22, 1928
231.44	H. O. D. Segrave	Irving-Napier	Daytona	March 11, 1929
246.09	M. Campbell	Napier-Campbell	Daytona	Feb. 5, 1931
253.97	M. Campbell	Napier-Campbell	Daytona	Feb. 24, 1932
272.46	M. Campbell	Campbell Special	Daytona	Feb. 22, 1933
276.82	M. Campbell	Campbell Special	Daytona	March 7, 1935
301.13	M. Campbell	Campbell Special	Bonneville	Sept. 3, 1935
312.00	G. E. T. Eyston	Thunderbolt	Bonneville	Nov. 19, 1937
345.50	G. E. T. Eyston	Thunderbolt	Bonneville	Aug. 27, 1938
350.20	J. R. Cobb	Railton	Bonneville	Sept. 15, 1938
357.50	G. E. T. Eyston	Thunderbolt	Bonneville	Sept. 16, 1938
369.70	J. R. Cobb	Railton	Bonneville	Aug. 23, 1939
394.20	J. R. Cobb	Railton	Bonneville	Sept. 16, 1947
407.45	C. Breedlove	Spirit of America	Bonneville	Aug. 5, 1963
403.1	D. Campbell	Proteus Blue Bird	Lake Eyre	July 17, 1964
413.20	T. Green	Wingfoot Express	Bonneville	Oct. 2, 1964
434.02	A. Arfons	Green Monster	Bonneville	Oct. 5, 1964
468.72	C. Breedlove	Spirit of America	Bonneville	Oct. 13, 1964
526.28	C. Breedlove	Spirit of America	Bonneville	Oct. 15, 1964
536.71	A. Arfons	Green Monster	Bonneville	Oct. 27, 1964
555.127	C. Breedlove	Spirit of America	Bonneville	Nov. 2, 1965
576.553	A. Arfons	Green Monster	Bonneville	Nov. 7, 1965
409.277	B. Summers	Goldenrod	Bonneville	Nov. 12, 1965
600.601	C. Breedlove	Spirit of America	Bonneville	Nov. 15, 1965

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FORMULA 1



Traditional Grand Prix racing, Formula 1 events are run over road courses, principally in Europe. The U.S. Grand Prix for F1 cars is held each fall at Watkins Glen, N.Y. Originally, races were conducted on city streets, now are run on special circuits with one exception—the Grand Prix of Monaco. Series each year crowns a “world champion” on a points-finish basis. Scotland’s Jackie Stewart is the current champion. Only American to win the world championship was Phil Hill in 1961. Two U.S. cars have won Grand Prix events—Jimmy Murphy’s Duesenberg the Grand Prix of France in 1921, Dan Gurney’s Eagle the Grand Prix of Belgium in 1967. At present, no American cars or drivers compete regularly in F1 events. Grand Prix racing is rich in a tradition of great cars, outstanding drivers.



CHRIS AMON—From New Zealand, every inch the heads-up professional driver. Is Numero Uno on Ferrari F1 team. Has been racing F1 competition since 1963, is still well under 30. Co-drove winning Ferrari at 24 Hours of Daytona in '67. Also drives Ferrari on Can-Am circuit, is looked on as best bet to crack series dominance by Team McLaren.



JOCHEN RINDT—An Austrian, began in sports cars in '62, went to F1 in '63, won first time out. Switched to F2 in '64, dominates class. Entered F1 with Cooper, went on with Brabham, this past season drove for Lotus. In '69, took pole in five of first eight GP races, lost Italian GP by fraction, won U.S. GP. Fast, a charger. Competes at Indy.



JEAN-PIERRE BELTOISE—Won 11 championships in France on motorcycles before winning French F3 title in '65. Won the European F2 title in '68, also campaigned in F1. In '69 was second in French GP, third in Spanish, Italian GPs. Still seeking first GP win. A charger, very fast, drives Matra/Ford as a teammate of world champion Jackie Stewart.



JO SIFFERT—From Switzerland, a top-ranked independent on the F1 circuit for past five years. To date has won one GP event—the '68 British GP. Campaigned in '69 in a Lotus Ford. Began race career in 1960. Now the No. 1 factory driver for Porsche, led team to International Manufacturers' Championship in '69. Is also a Porsche dealer.



GRAHAM HILL—The ultimate professional in every way. Winner of more Grand Prix races than any other active driver. Began in F3 in '54. Was world champion in '62 and '68, lost by 1 point in '64. Won Indy 500 as “rookie” in '66, successfully threading way through first lap pile-up. Drives for Lotus. Urbane, witty, well-liked by crowd, other drivers.



JACKIE STEWART—From Scotland, the current world champion. Began career in '61, by '63 had won more amateur races than anyone else in Britain. Was F3 champ in '64, won first F1 event in '65. Twice in contention at Indy, was foiled by mechanical failure. Is consistently brilliant driver, personable, a great crowd favorite. Drives a Matra/Ford. The best.



JACKY ICKX—From Belgium, youngest driver on F1 circuit. Began F1 career in 1967 in a Cooper, went to Ferrari in 1968, this past season drove for Jack Brabham. Won '68 French GP (in the pouring rain), last year won the German GP. Co-winner of '69 LeMans. Won European F2 title in '67. Very much the “new breed” of competitor. Open, exuberant.



JOHN SURTEES—Veteran motorcycle star, won seven cycle world championships. Driving a Ferrari, won F1 World Championship in 1964. Swept first Can-Am series ('66) in a Lola. Now drives for BRM in F1, for Chaparral in Can-Am. Has driven for Cooper, Honda, bringing each a GP victory. Was runner-up for F1 title in 1966. Knowledgeable, a contender.

OTHER STARS: Mario Andretti, Richard Atwood, Piers Courage, Vic Elford, Denis Hulme, Pete Lovely, Bruce McLaren, Jackie Oliver, Pedro Rodriguez, Johnny Servoz-Gavin.



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the car's not the business

Dodge Six Pack

Grand Prix Racing

Long before the 1969 Formula 1 season was over, colorful, long-haired Jackie Stewart had logged enough points in his blue Matra-Ford to clinch the World Championship. But the GP is more than choosing a champ. This time the Flying Scotsman was the man; the Anglo-French Matra-Ford the machine; Ken Tyrrel's British-based Matra International the team. An international combination of man, machine, mechanics and money is what Grand Prix racing is all about. Driving skill is rewarded grandly when an F1 pilot gets a strong car that will go the distance. To see if it will, fans flood the circuits from Australia to Zandvoort. Strong stuff. Only one to a country.

1969 WINNERS

Grand Prix of South Africa, March 1

1. Jackie Stewart, Scotland (Matra-Ford)
2. Graham Hill, England (Lotus-Ford)
3. Denis Hulme, New Zealand (McLaren-Ford)

Grand Prix of Spain, May 4

1. Jackie Stewart, Scotland (Matra-Ford)
2. Bruce McLaren, N. Zealand (McLaren-Ford)
3. Jean-Pierre Beltoise, France (Matra-Ford)

Grand Prix of Monaco, May 18

1. Graham Hill, England (Lotus-Ford)
2. Piers Courage, England (Brabham-Ford)
3. Jo Siffert, Switzerland (Lotus-Ford)

Grand Prix of Holland, June 22

1. Jackie Stewart, Scotland (Matra-Ford)
2. Jo Siffert, Switzerland (Lotus-Ford)
3. Chris Amon, New Zealand (Ferrari)

Grand Prix of France, July 6

1. Jackie Stewart, Scotland (Matra-Ford)
2. Jean-Pierre Beltoise, France (Matra-Ford)
3. Jacky Ickx, Belgium (Brabham-Ford)

Grand Prix of England, July 19

1. Jackie Stewart, Scotland (Matra-Ford)
2. Jacky Ickx, Belgium (Brabham-Ford)
3. Bruce McLaren, N. Zealand (McLaren-Ford)

Grand Prix of Germany, Aug. 3

1. Jacky Ickx, Belgium (Brabham-Ford)
2. Jackie Stewart, Scotland (Matra-Ford)
3. Bruce McLaren, N. Zealand (McLaren-Ford)

Grand Prix of Italy, Sept. 7

1. Jackie Stewart, Scotland (Matra-Ford)
2. Jochen Rindt, England (Lotus-Ford)
3. Jean-Pierre Beltoise, France (Matra-Ford)

Grand Prix of Canada, Sept. 20

1. Jacky Ickx, Belgium (Brabham-Ford)
2. Jack Brabham, Australia (Brabham-Ford)
3. Jochen Rindt, England (Lotus-Ford)

Grand Prix of the United States, Oct. 5

1. Jochen Rindt, England (Lotus-Ford)
2. Piers Courage, England (Brabham-Ford)
3. John Surtees, England (BRM)

Grand Prix of Mexico, Oct. 19

1. Denis Hulme, New Zealand (McLaren-Ford)
2. Jacky Ickx, Belgium (Brabham-Ford)
3. Jack Brabham, Australia (Brabham-Ford)

FINAL 1969 POINT STANDINGS

1. Jackie Stewart	63	7. Graham Hill	19	13. Richard Attwood	3
2. Jacky Ickx	37	8. Piers Courage	16	Vic Elford	3
3. Bruce McLaren	26	9. Jack Brabham	14	Pedro Rodriguez	3
4. Jochen Rindt	22	10. Jo Siffert	13	16. Johnny Servoz-Gavin	1
5. Jean-Pierre Beltoise	20	11. John Surtees	6	Silvio Moser	1
Denis Hulme	20	12. Chris Amon	4	Jackie Oliver	1

1970 Grand Prix Schedule

South Africa	March 7	France	July 5	Canada	Sept. 19 or 20
Spain	April 19	England	July 18 or 19	United States	Oct. 4
Monaco	May 10	Germany	Aug. 2	Mexico	Oct. 25
Belgium	June 7	Austria	Aug. 16	Australia	Nov. 22
Holland	June 21	Italy	Sept. 6		

Auto Racing Glossary

ACCUS—Automobile Competition Committee for the United States. 433 Main St., Stamford, Conn., 06901. Represents United States racing to the FIA.

AHRA—American Hot Rod Assn., 8133 State Line Rd., Kansas City, Mo. 64114.

AMA—Automobile Manufacturers Assn. Also American Motorcycle Assn.

ARCA—Auto Racing Club of America.

ARRC—American Road Race of Champions. Annual race for SCCA divisions to determine national amateur champions.

BLOWN ENGINE—Supercharged engine, or engine that has failed due to major mechanical breakdown.

BOX—Gearbox or transmission.

BRM—British Racing Motors.

CAR IDENTIFICATION—Chassis designer and/or builder given first and then origin of engine: e.g., Lotus/Ford, McLaren/Chevy.

C.A.S.C.—Canadian Automobile Sports Club.

CHASSIS—Racing-car setup exclusive of engine. Major marques of cars built exclusively for racing: Brabham, BRM, Caldwell, Chaparral, Cooper, Eagle, Lola, Matra, McLaren, Penske, others.

CHICANE—Difficult turn built into road-racing circuit, usually to slow the field.

CHRISTMAS TREE—Countdown starter for drag racing using various colored lights electronically actuated.

CHUTE—A straightaway or portion of circuit leading into a straight.

CID—Cubic-inch displacement.

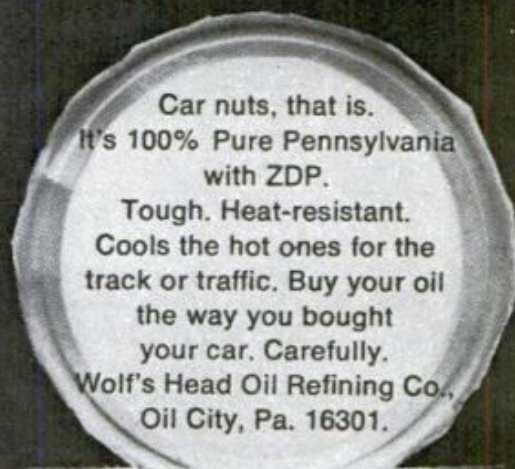
DICING—Intense competition usually between two drivers, one intent on passing, the other on keeping the lead.

DRAFTING—Hitching a ride on the car ahead by following closely to benefit from its breaking the wind and the suction effect of its wake.

DRIFT—Four-wheel slide of a car through a curve that is intentional and controlled by the driver.

(Please turn to page S31)

Soup for nuts



Car nuts, that is.
It's 100% Pure Pennsylvania
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Cools the hot ones for the
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the way you bought
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Wolf's Head Oil Refining Co.,
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MOTOR OIL
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the uncommon motor oil
Exceeds car makers'
warranty requirements.

FORMULA A



The SCCA Continental Championship, America's Grand Prix, is open to open-wheeled, open-cockpit Formula A cars, most powerful of formula cars. Emphasis is on driving skill; cars themselves are closely competitive: stock-block V8s limited to 5 liters; no supercharging allowed; two-wheel drive mandatory. Cars are unmistakably designed for road circuits: wings, very wide tires allowed. Continental Championship, only begun in 1967, is up to 13 races from five. A success here and abroad: England, for example, has Formula 5000 (for 5000 cc or 5 liters).

The SCCA Continental Championship, America's Grand Prix, is open to open-wheeled, open-cockpit Formula A cars, most powerful of formula cars. Emphasis is on driving skill; cars themselves are closely competitive: stock-block V8s limited to 5 liters; no supercharging allowed; two-wheel drive mandatory. Cars are unmistakably designed for road circuits: wings, very wide tires allowed. Continental Championship, only begun in 1967, is up to 13 races from five. A success here and abroad: England, for example, has Formula 5000 (for 5000 cc or 5 liters).



TONY ADAMOWICZ—After five years of road-racing competition, emerged from 1968 Trans-Am series as new star: six first places and two seconds driving a Porsche 911 in the under-2-liter class, giving Porsche the title. Campaigning an Eagle-Chevy FA for '69 season, he was running 1-2 with Sam Posey for the Continental title (decided Dec. 28 at Sebring).



BOB BROWN—Racing since 1961 driving Camaros, Corvettes and Cobras. In a Lola-Chevrolet he ranked third on final standings for the 1968 FA. Three strong second-place finishes at Thompson, Lime Rock and Donnybrooke gave him most of 23 points for position. He started in single-seat competition in a Brabham and was driving an Eagle-Chevy in 1969.



JOHN CANNON—Driving with increasing success since 1960. In 1966 he finished fifth in the USRRC. He was sixth in 1968 Can-Am standings. He took opener at Laguna Seca that year in steady downpour driving a three-year-old McLaren. In '69, he won the Continental opener at Riverside in his Eagle. He was tied for third place near the end of the season.



PETER GETHIN—Was leader in British Guards series for Formula 5000 cars in 1969. An Englishman who visited the United States to run a McLaren in Continental, he promptly won at Lime Rock. Has returned to British racing. Was followed here for FA racing by Andrea de Adamich, Italian competitor, in what could become an international trend.



DAVID HOBBS—An Englishman who invaded the FA series mid-season and promptly chalked up impressive finishes at Lime Rock and three victories (Donnybrooke, Mount Tremblant and Thompson), driving a Surtees TS5. He's a leader in the F5000 in his home country and has an excellent record at Le Mans and in other endurance races.



BUD MORLEY—In his 10 years of road racing, he has held two SCCA divisional championships. In 1966 he moved to big cars, a McLaren Mk. 2 specifically. On USRRC trail in 1967 he took sixth at Riverside and fourth at Bridgehampton. He finished a fourth and two fifths in '68. In a Lola for the '69 Continental, he has been a consistent finisher.



SAM POSEY—Moved up to professional racing fast. Four years ago he started racing Formula Vees, quickly advanced to Porsches and honors at Watkins Glen and Sebring. Third in final standings for '67 USRRC, he dropped to seventh in '68, but took a fourth and fifth in the Can-Am series and second in Mount Fuji Group 7. He's a driver to watch in FA.



GEORGE WINTERSTEEN—Outstanding young driver who has won regional and national "most improved driver" awards since 1963. Was Northeast FB champ in '67 and moved to SCCA Grand Prix series in 1968 when he drove to second place behind champ Lou Sell. Steady finisher, he was tied for third in FA near the end of '69 without winning a race.

OTHER STARS: Andrea de Adamich, Bill Brack, John Cordts, Ron Courtney, Chuck Dietrich, Nick Dioguardi, Steve Durst, George Eaton, Bruce Eglinton, Jack Eiteljorg, Jerry Entin, Bill Eve, Lew Florence, George Follmer, Lyle Fosgren, Rich Galloway, Mike Goth, Ron Grable, John Gunn, Jerry Hansen, Mike Hiss, Sherwood Johnston, Dave Jordan, Art Kijek, Karl Knapp, Harold Krech, Horst Kroll, Horst Kwech, Ed Leslie, Pete Lovely, John Mahler, Roger McCaig, Stew McMillan, Bill Moore, Lothar Motschenbacher, Jim Mulhall, Dick Negley, Brian O'Neill, Chuck Parsons, Scooter Patrick, Pierre Philips, Clif Phillips, Rex Ramsey, Pete Rehl, Kurt Reinold, Nick Reynolds, Skip Scott, Lou Sell, Tony Settember, Vernon Shields, Dick Simon, Bill Simpson, Dick Smothers, Chuck Trowbridge, Eppie Weitzes.



1970 Chevelle SS 396.

It's getting tougher and tougher to resist. The standard V8 has been kicked up to 350 hp.

A new air-gulping Cowl Induction Hood awaits your order.

You can also order your choice of a floor-mounted 4-speed or the 3-range Turbo Hydra-matic.

Under that lean and hungry look is a lean and agile suspension. F70 x 14 white-lettered wide oval treads. 7"-wide mag-type wheels. And power disc brakes.

Your mission is to infiltrate your Chevy dealer's and escape with this car. It will go willingly.

Putting you first, keeps us first.



**In ten seconds,
your resistance will
self-destruct.**

Other Formulas and Classes

As with any other sport, motor sport has its big leagues and little leagues—lesser leagues is a better term. Not lesser to the skilled participants to be sure, but the machinery is a little less powerful, a little less sophisticated—scaled down from the big-time, big-car, big-purse spectacles. The cars go by a little less blurred, with a little less roar, so there are fewer spectators.

Still other classes of auto racing, too numerous to detail, are not scaled-down forms of anything, but are unique events in themselves. The only thing the many variations have in common is the contest of getting from start to finish in the shortest time and therefore at the fastest speed.

FORMULA B

All such cars have single seat, open wheel, open cockpit; use pump fuel, on-board starters and dual braking systems. Engines are between 1101 and 1600 cc, fuel capacity is 19 gallons and minimum weight 848 pounds, as formulated by the Sports Car Club of America. Races run on some road courses as FA events, with winners averaging around 100 mph. Mike Eyerly in a Brabham BT18 was '69 champion of 13-race Formula B-C championship series.

FORMULA C

SCCA formula allows engines up to 1100 cc, with no mechanical restrictions. Fuel capacity is 16 gallons; minimum weight, 750 pounds. Run with formula B cars in Formula B-C Championship that accompanies the Continental Championship for FA.

FORMULA VEE

The "V" is for Volkswagen in this formula for single-seat, open-wheel cars, based on VW sedan engines of 1200 cc maximum displacement. Minimum weight of an F/V, less fuel and driver, is 825 pounds. Wheelbase must be 81.5 to 83.5 inches. One of SCCA's most popular racing formulas, Formula Vee attracts devoted fans, is a growing participant sport.

FORMULA F

The "F" is for Ford. This is a new formula that was first established for the 1969 season by the SCCA for single-seat, open wheel cars with 1600-cc English Ford Cortina engines. More expensive for the participant than F/V racing, but with attendant increases in acceleration and speed. Next step up for F/V drivers with aspirations.

CLUB RACING

This term means amateur racing with no cash rewards; in the United States it also means the SCCA. At the club level are interdivisional, national, divisional and regional events in which SCCA members participate in their own cars. There are also drivers' schools and so-called Solo 1 events in which cars run one at a time against the clock—in hill climbs, for example. Cars in a popular SCCA category are production sports. Production classes A through H place mass-produced sports cars with same racing potential in same category. A-Production includes cars like Corvettes, Shelby GTs; H-Production, cars such as MG Midgets, Fiat 850 Spiders.

OFF-ROAD RACING

Still in its infancy. Start of a race looks like a free-for-all; a couple of hundred anything-goes vehicles are off in a cloud of dust. Actually, under the auspices of either the National Off-Road Racing Assn. or the International Desert Racing Assn. it is strictly organized. Vehicles fall into many classes. The basic types competing (all in one event!) are: Two-wheel drives, dune buggies, four-wheel drives and motorcycles. Two big events are Mint 400 in Nevada and the Mexican 1000, which is down the Baja Peninsula.

FORMULA 2

The international F2 class limits engines to 1.6 liters, with six cylinders maximum. Minimum weight of single-seat, open-wheel cars is 924 pounds in running order without fuel. No F2 races are run in the United States. The 1.6-liter Formula 2 cars also compete in the Tasman series, a popular seven-race series run in Australia and New Zealand during January and February. The engine limit in the F2 chassis for the Tasman Series is 2.5 liters: Some competitors (who can afford it) use 3-liter F1 engines reduced to 2.5 liters as powerplants. 1969 Tasman champion was Chris Amon in a 2.4 liter V-6 Ferrari.

FORMULA 3

Smallest of the international formula cars. Engine is limited to a single liter which must be derived from a mass-produced touring-car engine. Minimum weight is 880 pounds. As with the lesser American formula cars, F3 is the training ground of potential Grand Prix drivers.

International Manufacturers' Championship

A series of international endurance events for sports cars, sports-prototypes, grand touring and touring cars with points going to the winning marque. Last year Porsche swept the series with Ford second. Events in the United States, with their dates for 1970, include: The 24 Hours of Daytona, Jan. 31-Feb. 1; 12 Hours of Sebring, March 20-21; and 6 Hours of Watkins Glen, July 11-12. Among the other races in the series are Le Mans, France; Monza, Italy and Targa Florio, Sicily.

The HOT WHEELS to watch in '70

Watch the dust fly in '70. Watch Motor Wheel's muscle wheels on the street and at the strip.

You'll see Magnum 500, Spyder, Multi-Style and more. One look will tell you why Motor Wheel gets the checkered flag in styling and quality.

Gentlemen - You'll understand why more cars run on Motor Wheel than any other custom wheels. Make your wheels the ones to watch in '70.

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LANSING, MICHIGAN 48914



MAGNUM 500, SPYDER, MULTI-STYLE TRADEMARKS, MOTOR WHEEL CORPORATION

JANUARY 1970

S27

DRAG RACING



Fuel/Gas Dragster

The all-out exotica of drag racing, cars of this type—sometimes called "rails" or "slingshots"—are divided into two classes. The fastest, most powerful run on special fuels such as nitromethane and compete as "fuel eliminators," meaning they are designed to "eliminate" (i.e., beat) other competitors, thus win designation as "top fuel eliminator" at a given drag racing meet. A bit slower, but otherwise very much similar are "gas eliminators," dragsters set up for and required to run on gasoline. Cars are super-potent, fuel eliminators being able to consistently turn speeds above 220 mph in less than seven seconds at the end of a quarter-mile, gas eliminators about 200 mph. Competition in both classes is strictly head-to-head, meaning no handicaps, even starts. Engines, usually a supercharged Ford or Chrysler, can develop 1500 hp.



GORDON COLLETT—Nickname is "Collecting Collett," one of drag racing's consistent winners. He is the only driver to score a "grand slam" in drag racing, having won Top Gas Eliminator honors in NHRA Winternationals, Springnationals, Nationals and World Finals. Known for steadiness at the line, he drives a Chrysler-powered gas "rail."



BENNIE OSBORN—Called "Oz" all his life, is naturally known as "The Wizard." Is only driver to twice win NHRA world championship ('67, '68). Subject of a colorful legend—that he can point at a rival's car and "hex" it. His "ray" has worked a couple of times, fanning the story. Wife, children are all part of his team. From Sand Springs, Okla.



DON GARLITS—Known as "Big Daddy," is the only man in drag-racing history to win the Top Fuel Eliminator title three times—'67, '68 and '69. Was pulled from a burning car in '59, told he'd never drive again. Came back to dominate the sport by becoming one of its most consistent winners. "Big Daddy" and his big Dodge personify drag racing.



DON PRUDHOMME—By winning NHRA Nationals this year, he joins Don Garlits as one of two men to win Top Fuel Eliminator titles more than once. Known as "The Snake," was the first driver to win back-to-back victories in Nationals, Winternationals. Still seeking his first World Finals title. Hits line in Plymouth-powered AA/Fuel "rail."



CONNIE KALITTA—Called "The Bounty Hunter," won nickname when, years ago, he listed on the side of his dragster the names of those he wanted to beat. As he did so, a line was drawn through each name. Is credited as the first to break 200 mph for the quarter-mile. Has only one eye, a remarkable thing in a sport that requires such quick reflexes.



PETE ROBINSON—A graduate engineer, known as "Sneaky Pete" since '61 when, out of nowhere, he showed up at Indianapolis Nationals, ran consistently and walked off with top honors. Won world title as Top Fuel Eliminator. Does a lot of dragster development work, also does his own engine, chassis work. Drives a factory-backed OHC Ford.



BOB MURAVEZ—Began career using pseudonym "Floyd Lippencote, Jr." to keep family from knowing of his racing activities. Now drives "rail" known as "Freight Train," name stemming from twin-Chevy engines mounted in line. Has won NHRA Winternationals, World Finals. With car-builder John Peters, makes up one of the most colorful teams in drag racing.



HANK WESTMORELAND—Another virtual unknown until last year when he took Top Fuel Eliminator honors at NHRA's Springnationals. Is from the Los Angeles region beach areas, an avid surfer. Car is known as "The Beachcomber." Gives every indication of remaining a top star for years to come, is always a potential winner at any meet he enters.

OTHER STARS: Larry Bowers, Don Cain, Dave Chenevert, Gary Cochran, Preston Davis, Larry Dixon, Leroy Goldstein, Dave Grassi, Phil Hobbs, Tom Hoover, Tommy Ivo, Ray Lundy, Tom McEwen, Jack Mitchell, Bob Noice, Mark Peri, Dave Powers, Walt Rhoades, Mike Snively, John Wiebe.



TRIAL BY JURY

Race drivers are a most critical jury. Valvoline® Motor Oil proves its ability in racing: delivering the toughest defense against wear at high engine temperatures. Put Valvoline in *your* car and then you be the judge.

Race proved for your car

VALVOLINE OIL COMPANY, Ashland, Ky.  Division of Ashland Oil & Refining Company



Drag Racing Records*

	CLASS	ENTRY/DRIVER	CAR	ET	MPH
TOP FUEL ELIMINATOR	AA/F	Raley & Lee	'58 Chry.	6.64	229.59
	AA/F	Beebe & Mulligan	'56 Chry.		
TOP GAS ELIMINATOR	AA/D	Larry Bowers	'58 Chry.	7.49	202.70
	AA/D	John Peters	'66 Chevy		
SUPER ELIMINATOR	A/F	Adams-Enriquez	'56 Chry.	7.46	202.24
	A/F	Don Enriquez	'55 DeSoto		
COMPETITION ELIMINATOR	A/D	Bob Stratman	NA	8.26	184.04
	A/D	Leo Dunn	NA		
STREET ELIMINATOR	A/G	Bill Drake	'65 Dodge	9.25	150.00
	A/G	Bill Drake	'65 Dodge		
SUPER STOCK ELIMINATOR	SS/B	Arlen Vanke	'68 Barracuda	10.61	135.54
	SS/B	Ronnie Sox	'68 Barracuda		
	SS/BA**	Denny's Dyno	'68 Dodge	10.66	134.87
	SS/BA**	Larry Cooper	'68 Dodge		
STOCK ELIMINATOR	A/S	Stenzel & Greene	'69 Camaro		120.80
	A/SA**	Herb Lang	'63 Plym.		119.36

*—As per NHRA, Oct. 1969

**—Automatic transmission

1970 Drag Racing MAJOR EVENTS

Date	Auspices	Place
Jan. 22-25	AHRA	Phoenix, Ariz.
Jan. 30-Feb. 1	NHRA	Pomona, Calif.
Feb. 13-15	NHRA	Gainesville, Fla.
Mar. 22-24	AHRA	Long Beach, Calif.
May 22-24	AHRA	Detroit, Mich.
June 5-7	AHRA	Bristol, Tenn.
June 12-14	NHRA	Dallas, Tex.
July 10-12	AHRA	Minneapolis, Minn.
July 17-19	NHRA	York, Pa.
Aug. 14-16	AHRA	New York (L.I.), N.Y.
Aug. 27-30	AHRA	Dallas, Tex.
Sept. 3-7	NHRA	Indianapolis, Ind.
Sept. 12-13	AHRA	Bristol, Tenn.
Sept. 25-27	AHRA	Rockingham, N.C.
Oct. 24-25	NHRA	Dallas, Tex.
Nov. 21-22	NHRA	Ontario, Calif.

Auto Racing Glossary

(Continued from page S23)

DRY SUMP—Engine design that omits crankcase oil reservoir. Lubricating oil is carried in separate tank and pumped through engine.

ESSES—A series of left and right turns in a road-racing circuit.

ET—Elapsed time for quarter-mile runs. Used in drag racing competition.

FIA—Federation Internationale de l'Automobile. 8 Place de la Concorde, Paris, France. International governing body for auto racing.

FLAG—Communication technique used by race-circuit officials to inform drivers of condition of course, hazards, start, finish, to pit. (See Racing Rules, page S62.)

FORMULA CAR—Single-seat, open-wheel, open-cockpit racing cars built according to a set of rules or formulas established by a racing sanctioning body. (Abbrev.: F1, F2, FA, and so forth.)

GN—Grand National stock cars (NASCAR).

GRAND PRIX—Term applied exclusively to a race of Formula 1 cars for the World Championship. Limit is one Grand Prix per country. United States Grand Prix is held in October at Watkins Glen, N.Y.

GROOVE—Best way around race circuit. Depends on configuration of circuit, speed, degree of bank if any, handling characteristics of car, driver's technique.

GT—Grand Touring. Term taken from the Italian, *Gran Turismo*, meaning a coupe with good handling and performance for comfortable touring.

HAIRPIN—A turn of more than 90° in a road-racing circuit.

HEEL AND TOE—Driving technique that allows simultaneous use of brake and accelerator pedals.

HEMI—Engine with hemispherical shaped combustion chambers.

HOMOLOGATED—Guarantee by the manufacturer that a racing car has been produced in a series that meets FIA rules for number produced in a given period.

IDRA—International Desert Racing Assn.

IMCA—International Motor Contest Assn.

LE MANS START—Start of a race where

drivers run across the track, get in their cars, start them, and go.

LINE—The route a driver takes through a curve in road racing.

LITER—Applied to engine displacement: Equals 1000 cubic centimeters (cc) or about 61 cubic inches.

MAG WHEELS—Lightweight cast magnesium wheels for racing.

MARQUE—Car name. Also Mark (abbrev.: Mk.) for successive models in a series, i.e., Mk. 2 or Mk. 3.

MONOCOQUE—Chassis design that omits a frame. The skin is structural. In some racing cars, the engine is a structural part of the chassis.

NASCAR—National Assn. for Stock Car Racing. P.O. Bin K, Daytona Beach, Fla. 32015.

NERF BAR—Racing car bumpers, if any.

NHRA—National Hot Rod Assn. 3418 W. 1st St., Los Angeles, Calif. 90004.

NOMEX—A material used for fireproof clothing for drivers.

NORMALLY ASPIRATED—Engine with no supercharging or turbocharging.

NORRA—National Off Road Racing Assn.

OFFY—A four-cylinder, 16-valve, DOHC engine that runs at Indy in a turbocharged configuration. Originally produced by Miller racing-engine firm, engine carries name of Fred Offenhauser who made engine in '30s and '40s. Drake Engineering & Sales Corp. makes it now.

OHC—Overhead camshaft. (DOHC—Double overhead camshaft.)

OHV—Overhead valves.

OUT OF SHAPE—A car out of the groove on the circuit. Can be as mild as a driver breaking the rhythm of his laps, or as serious as his getting loose, spinning and actually winding up pointing the wrong way on the track.

PDA—Professional Drivers Assn.

PIT—Area set aside off the race circuit for a competitor's crew, spare tires, equipment, fuel.

PIT ROAD—Road parallel to race circuit for access to and from pits.

PIT STOP—Leaving the race circuit for fuel, consultation, mechanical difficulty, and so on.

(Please turn to page S56)

Your Guide to the Winning Fords



**TORINO
COBRA**

Cobra's a whole new thing for '70. That SportsRoof shape is as good as it looks. We proved it in our own wind tunnel. It's a top-gun muscle car with no frills that puts 429 cu. in. of stocker in your driveway for very little money; 360 horsepower is standard. So is competition suspension and 4-speed box. With Hurst® Shifter. Cobra—this one's for real!

Grand National Wins:

- Riverside
- Daytona 500
- Carolina 500
- Firecracker 400
- Virginia 500
- Yankee 600
- Dixie 500
- Southern 500



BOSS 302

Trans-Am Triumphs:

- Michigan International
- Lime Rock
- Bridgehampton
- Donnybrooke

Setting up Mustangs for two Trans-Am championships showed us how to build Boss 302 for the road.

It goes quick, hangs tight and stops quicker. Standard specs read like a \$9000 European sports job instead of a reasonably priced, reliable American Pony car. Boss 302—one for the road.

FORD 

MACH 1



The name that echoed like a bellowing exhaust note at Bonneville, when Mickey Thompson broke 295 records in his specially modified Mach I. '70 Mach I power begins with a 351 V-8 and goes up to a 428 Cobra Jet Ram-Air V-8. The only thing cool about Mach I is its looks.

Bonneville Records*:

Set by Mickey Thompson in Sept., 1968
(Class B—305 to 488 CID)

- Flying Start—
25 to 500 km.
25 to 500 miles
- Standing Start—
25 to 500 km.
25 to 500 miles

**partial listing only*

“With a 16-to-1 ratio, the pressure on the to shatter bricks. We’re tough on spark plugs.”

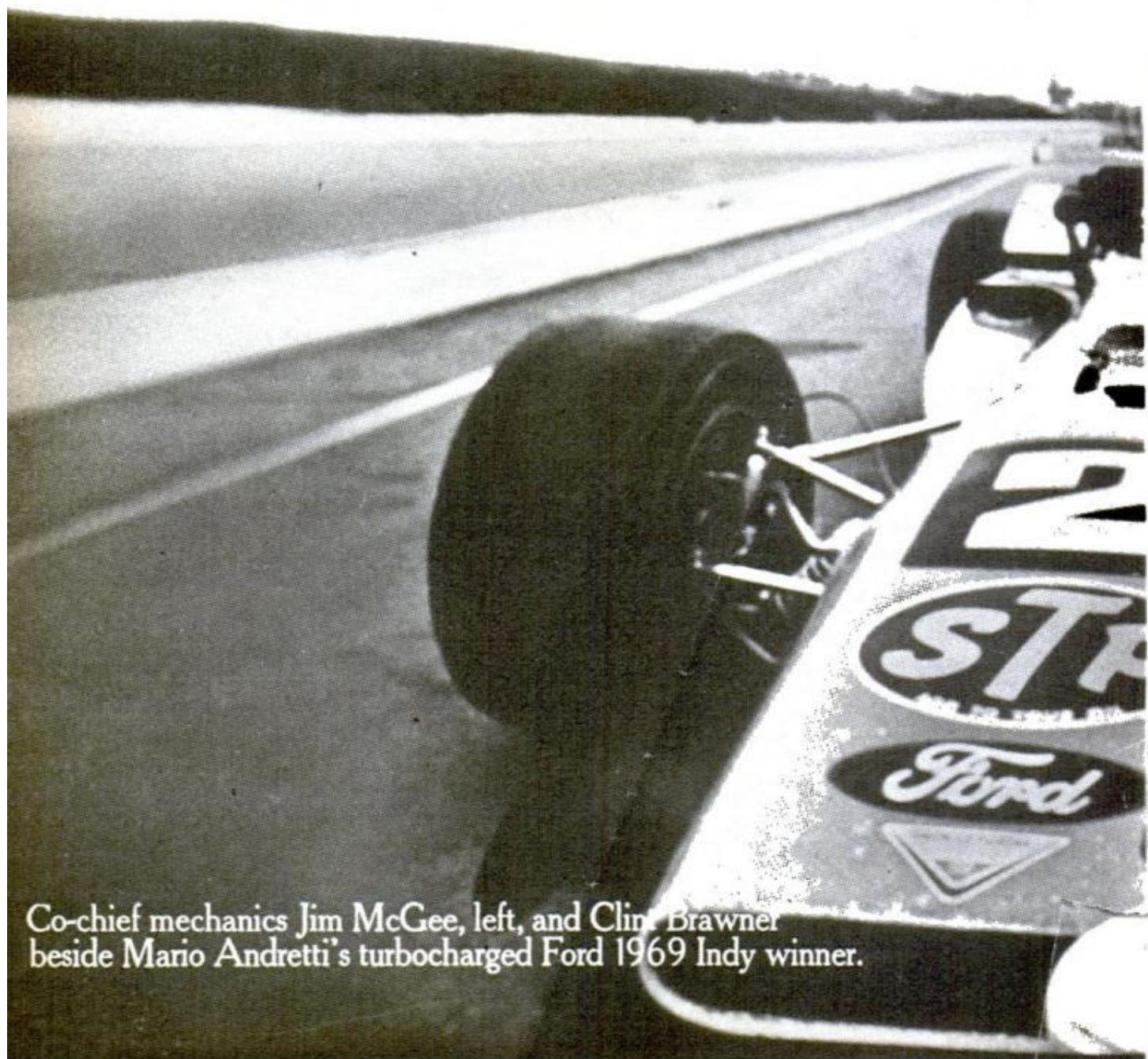
Clint Brawner and Jim McGee were co-chief mechanics for Mario Andretti's record-busting 1969 Indy 500 championship car. When these experts talk, it pays to listen.

“The heat and compression in our turbocharged Ford engine is tremendous,” says Clint Brawner. **“Our Autolite plugs have to survive 37,000**

brick-busting ignitions a minute. Yet I’ve never seen one fail.”

Autolite spark plugs have a special hermetic seal that prevents compression loss under all operating conditions. They stay sealed despite extremes in heat and pressure.

“Racing may be hell on plugs. But you’re tougher,” says



Co-chief mechanics Jim McGee, left, and Clint Brawner beside Mario Andretti's turbocharged Ford 1969 Indy winner.

Autolite plugs in our Indy winner was enough But you're tougher on yours."

Jim McGee. "When you crawl in traffic, ash deposits build up in the cylinders. Then you speed up, and those deposits splash around and heat bakes them onto the plug tips. You get shorts. Lose power. Waste gas."

With Autolite, no problem. Autolite originated spark plugs that clean

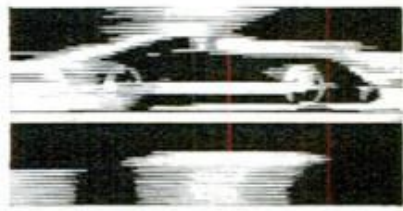
themselves. Their extended Power Tips reach down into the hottest engine gasses. Fouling deposits are burned off before they get a chance to build up.

"You got clean plugs, buddy, you got max power."

Next time ask for Autolite spark plugs. They pass the toughest test in racing. And the toughest test there is. Your kind of driving.



Autolite 



pass the toughest test.

When you've got \$18,000 going 230 mph it's no time to sweat the small stuff.

Double A fuel dragster. Does a quarter mile in 6.6 seconds. Tough to build and even tougher to rebuild.

You don't want to think about all the little parts inside the engine. Or the little particles in the oil that can tear the engine apart.

So you use a Fram oil filter. And forget it.

It's the same with your everyday car. You don't want to think about all the little things inside it.

So you use a Fram oil filter. And forget it.

Just remember Fram. And you won't have to sweat the small stuff.

We will.



FRAM

FILTERS

Fram Corporation, Providence, R.I. 02916

DRAG RACING

"Funny" Car



Anything but "funny," these cars are highly specialized racing machines built for all-out acceleration and as sophisticated as the more potent dragsters. The principal feature of such cars is a fiberglass replica of a standard production-model body. In some cars the driver sits in what would normally be the back seat, the rule requiring only that he be within the confines of the normal passenger area. Comparatively new to drag racing, "funny" cars are great fan favorites, probably constitute the fastest-growing class of out-and-out competition cars. Overall class is divided into two subdivisions: AA, determined by total car weight, and A, total car weight divided by cubic-inch engine displacement. Fuel type is optional, although most run on special mixtures.



JACK CHRISMAN—One of the few drag-racing pioneers still active as a driver. Began in days of running on Southern California dry lakes. Won national championship in 1962. Although now primarily a "funny" car star (in fact, he was an original in the class), he once ran "rails." Toured country in '69 in special Coca-Cola "funny" car show.



BUD FAUBEL—Began career as a stock-car driver. Competed on the old Daytona beach course. After switching to dragsters, won many honors, mostly on East Coast. Is a car dealer in Pennsylvania, a coin collector. Drives a Dodge Charger called "The Honker," the sides of which feature a picture of a duck. A veteran, is still a top competitor.



JIM LIBERMAN—Known as "Jungle Jim," has been a Chevy booster for many years. Runs a pair of blue Chevy Novas, both of which are fuel-injected and supercharged. Very steady, very fast, a great favorite with a crowd, particularly youngsters. A frequent competitor, he tours the country regularly, wins top honors at a variety of events.



ROGER LINDAMOOD—Rarely seen without a cigar, is one of the country's top "funny" car drivers. Won class at Summernationals in '64, is a top match race driver. Drives an extremely colorful car called "Color Me Gone—Psychedelic," a design featuring mod, mad extremes of blues, reds, purples. Tours country, is always a threat, crowd-pleaser.



DANNY ONGAIS—Extremely thorough, methodical, is known as a man who considers all angles before bringing car to line. Winner of class events at Nationals, Springnationals, qualified for World Finals. Has done well in both gas, fuel dragsters, also has driven ovals. Drives for Mickey Thompson, with whom he once set Bonneville records.



GAS RONDA—A name practically synonymous with Ford in Southern California drag racing. The "Gas" is short for Gaston. Began career in straight stock cars, moved up the line to super stocks, then to "funny" cars, a class in which he was one of the first to run. Is known as a steady driver, a top-line match racer. All Ford, he's even a Ford salesman.



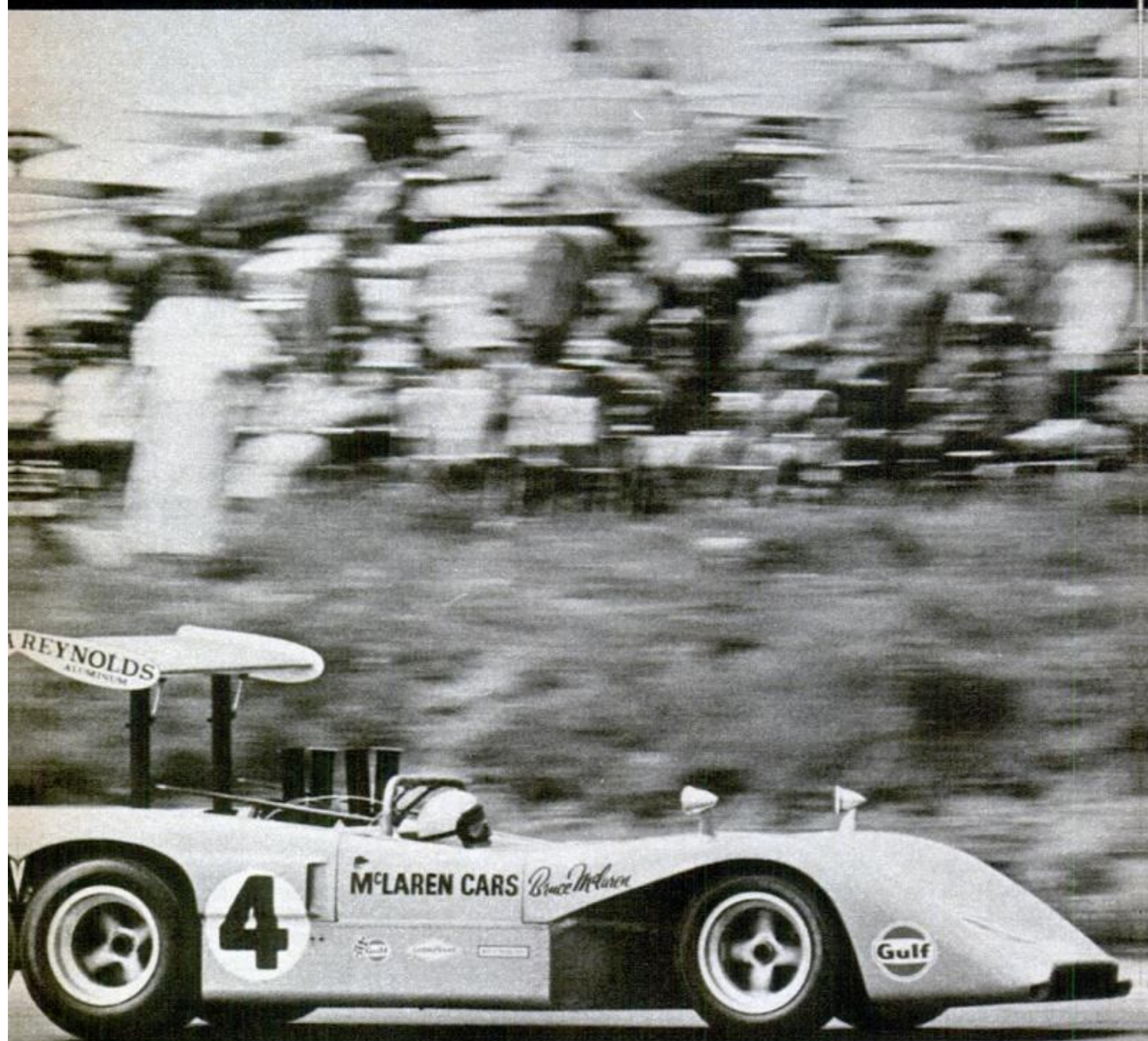
RICH SIROONIAN—A comparatively new star in West Coast drag racing, drives for well-known car owner John "Big John" Mazmanian. Siroonian's racing background includes extensive experience in cars known as "blown gassers" (i.e., supercharged cars that run on gasoline). Winner of many match races, is very fast, always consistent competitor.



AL VANDER WOUDE—Both he and his car are known as "The Flying Dutchman." A pioneer of "funny" cars, enjoys a wide reputation as one of drag racing's finest innovators. Was first to advance the "engine back" configuration. Drives destroyed Hemi-powered Dodge Charger. Does all his own engine and chassis work, is known as engine wizard.

OTHER STARS: Charlie Allen, Ray Alley, Mike Burkhart, Sidney Foster, Don Gay, Dick Harrell, Leonard Hughes, Ronnie Hunter, Connie Kalitta, Bruce Larson, Dick Loehr, Tom McEwen, Ed Schartman, Don Schumacher, Gene Snow, Bobby Wood.

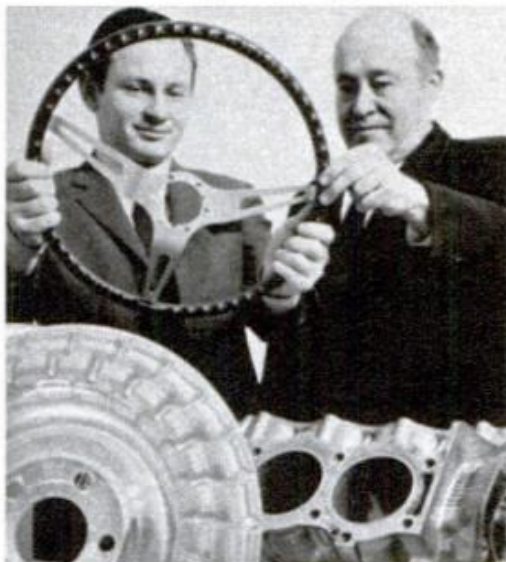
When they said,
"Look who joined the
RAT Patrol!"...the men at Reynolds
replied, "That's
Bruce McLaren
behind the wheel."



Champion race drivers Bruce McLaren and Denis Hulme have joined the RAT Patrol, the Reynolds Automotive Team. And Reynolds Aluminum is in the Formula I and Group 7 cars.

With their sponsorship of Can-Am Champions McLaren and Hulme, the men at Reynolds are taking another step in their continuing program to develop new and better uses for aluminum in automobiles. And there's no tougher test for any material than the grueling circuits the McLaren team drives.

For years, the lightweight



Racing car builder and driver Bruce McLaren (left) with W. G. Reynolds, executive vice president for research and development, at Reynolds Automotive Research and Development Center, in Richmond, Virginia.

strength of aluminum has proved itself in dozens of working parts in racing and passenger cars. Now the men at Reynolds, working with Mr. McLaren, plan to rev-up the development of automotive aluminum to an even more intensified pitch.

Their purpose, as always, is to serve the automotive industry more completely and effectively in its task of designing and building better performing cars for the American public.

The RAT patrol is proud to have Bruce McLaren aboard. It shows that the "patrol" is even bigger than Reynolds, including the people we work with throughout the automotive industry—suppliers, designers, manufacturers, and now, drivers. They've made us the biggest supplier of aluminum for automotive use.

Reynolds congratulates Bruce and Denis on their winning performances during 1969. And we're looking forward to the 1970 race season. *Reynolds Metals Company, P.O. Box 2346-MG, Richmond, Virginia 23218.*



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DRAG RACING



Altered Roadster

The ultimate in classic "hot rods." Interest in these cars has dropped off in recent years as new emphasis has been placed on the more exotic "rails" and cars that resemble current production models. Those that still compete professionally usually run on fuel in all-out head-to-head bursts, often in a mixed-bag category called Super Eliminator.



WILLIE BORSCH—Known as "Wild Willie" and "One-Armed Willie" (because of his driving style), an almost legendary figure in drag racing. Has been at it a long time, driven just about all types of cars. Now drives a wild amalgam consisting of a much-modified '23 Model T roadster body and supercharged fuel-burning Chrysler engine. Top showman.



SUSH MATSUBARA—Very shy (e.g., doesn't like having his picture taken), drives hot AA/Fuel Altered consisting of Fiat body on a special chassis powered by a full-blown fuel-burning Chevrolet engine. Because of a short wheelbase and tremendous power, type of car is very hard to handle. But he does it well, is admired for his driving skill.

Super Eliminator

In this category, NHRA specifies a number of subdivisions—Fuel and Gas Dragsters, Competition Cars, Altered, "Funny" Cars, Supercharged Gas Coupes/Sedans. The dragsters differ from Top Fuel and Gas Eliminators in that they are heavier, somewhat slower. The subdivision designated Competition Cars is reserved for cars with production bodies which nevertheless can be extensively modified, as can be the engine. Altered are designed specifically for drag racing, but production bodies can be only slightly modified. "Funny" Cars feature fiberglass replicas of standard production model bodies. Supercharged Gas Coupes/Sedans must be self-starting and suitable for street use. Cars in this category run in various classes of competition, all determined by the total weight divided by cubic inches of supercharged and nonsupercharged engine displacement.

Competition Eliminator

NHRA's subdivisions within this category include Gas Dragsters, Competition Cars, Altered Cars. The Gas Dragsters run in four classes of competition for nonsupercharged cars, each class determined by total car weight divided by total cubic inches of engine displacement. Competition Cars run in a single class, are the same type as those specified for the Super Eliminator category, but weigh 3.50 lbs. p.c.i. of engine displacement (as opposed to 2.50 lbs. p.c.i. for SE cars). Altered in this category run in five classes of competition (as opposed to four classes for SE cars), again with each class determined by total car weight divided by total cubic inches of engine displacement. Engines in this CE subdivision of Altered may not be supercharged. In general, these cars are very close to those described under the Super Eliminator heading, the primary difference being that engines cannot be supercharged.

FORMULA 2+2 COCO CAR MATS

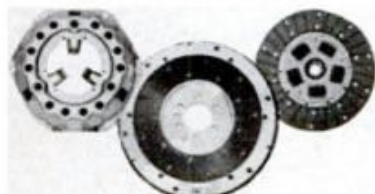
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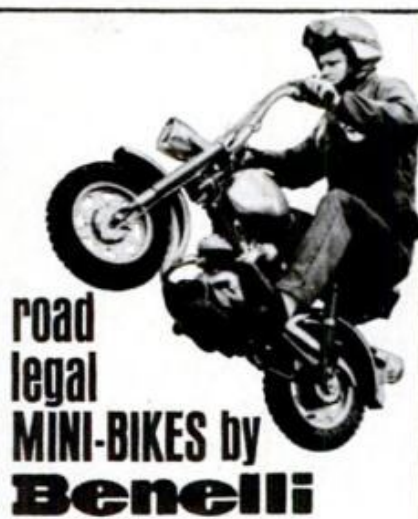
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Indianapolis 500 Pole Winners

1911	Louis Strang	NA	1940	Rex Mays	127.850
1912	Gil Anderson	86.13	1941	Mauri Rose*	128.691
1913	Caleb Bragg	87.34	1942-45	NO RACE	
1914	Jean Chassagne	88.31	1946	Cliff Bergere	126.471
1915	Howdy Wilcox	98.90	1947	Ted Horn	126.564
1916	Johnny Aitken	96.69	1948	Rex Mays	130.577
1917-18	NO RACE		1949	Duke Nalon	132.939
1919	Rene Thomas	104.78	1950	Walt Faulkner	134.343
1920	Ralph DePalma	99.15	1951	Duke Nalon	136.498
1921	Ralph DePalma	100.75	1952	Fred Agabashian	138.010
1922	Jimmy Murphy*	100.50	1953	Bill Vukovich*	138.392
1923	Tommy Milton*	108.17	1954	Jack McGrath	141.033
1924	Jimmy Murphy	108.037	1955	Jerry Hoyt	140.045
1925	Leon Duray	113.196	1956	Pat Flaherty*	145.596
1926	Earl Cooper	111.735	1957	Pat O'Connor	143.948
1927	Frank Lockhart	120.100	1958	Dick Rathmann	145.974
1928	Leon Duray	122.391	1959	Johnny Thomson	145.908
1929	Cliff Woodbury	120.599	1960	Eddie Sachs	146.592
1930	Billy Arnold*	113.268	1961	Eddie Sachs	147.481
1931	Russ Snowberger	112.796	1962	Parnelli Jones	150.370
1932	Lou Moore	117.363	1963	Parnelli Jones*	151.153
1933	Bill Cummings	118.530	1964	Jim Clark	158.828
1934	Kelly Petillo	119.329	1965	A. J. Foyt	161.233
1935	Rex Mays	120.736	1966	Mario Andretti	165.899
1936	Rex Mays	119.644	1967	Mario Andretti	168.982
1937	Bill Cummings	123.343	1968	Joe Leonard	171.559
1938	Floyd Roberts*	125.681	1969	A. J. Foyt	170.568
1939	Jimmy Snyder	130.138			

*Denotes race winner ('41—with Floyd Davis)

DRAG RACING continued

Street Eliminator

Three subdivisions are within this category—Gas Coupes/Sedans and Street Roadsters, Modified Production Cars, Stock Sports Cars. The first is for self-starting cars suitable for street use. There are ten classes of competition, again determined by dividing total weight by total CID. Cars are not supercharged and bodies may be only slightly modified. The second is for American-built cars of at least 98-in. wheelbase capable of both street and strip use. Cars are not supercharged and compete in six classes. Moderate customizing permitted. The third is for factory-production sports cars and stock imports. No engine swaps permitted, only stock chassis/engine combinations allowed in five classes.

Super Stock Eliminator

One of drag racing's most popular categories of competition, Super Stock Eliminators are late-model ('64 or later), high-performance production cars, commonly known as "muscle cars." Cars run in 20 classes of competition, again determined by total weight divided by total cubic inches of engine displacement. Actually, according to NHRA rules, the 20 classes consist of two groups of ten, the difference being whether a car is equipped with a manual or automatic transmission. Handicap starts are common to this category—e.g., a car capable of running the quarter-mile in, say, 11 seconds is given a half-second handicap start over a car able to run the same distance in 10.5 seconds.

Stock Eliminator

Cars in this category are about the most "stock" in drag racing. They must be factory production cars, available in dealer showrooms to the public. Competition is restricted to cars produced after June 1, 1961. Most of the cars are American-made, but some imports are allowed to compete. Moderate customizing is permitted, but not if doing so gives a competitor any advantage (e.g., aerodynamics) over another. Engines may be slightly modified, but only with kits, accessories, or equipment available to the public. Again, these cars are divided into two groups—manual and automatic transmissions. There are 35 classes of competition, and handicap starts are used. The backbone of drag racing.

Other Drag Racing Stars

As must be obvious, drag racing is a vast, complex undertaking with literally thousands of participants in just about every part of the country. It would be impossible within the limits of this guide to mention—even list—all the sport's outstanding performers. So only a few are mentioned, and if we appear to have overlooked a particular favorite, be assured the omission is simply for lack of space.



DICK ARONS
Super Stock



MIKE FONTS
Modified Production



DICK LANDY
Super Stock



DON NICHOLSON
"Funny" Car/Street



HUBERT PLATT
Super Stock/Street



SHIRLEY SHAHAN
Super Stock



RONNIE SOX
Stock/Super Stock



ARLEN VANKE
Super Stock

Argument Settlers

Winner of the first Daytona 500 for stock cars held at Daytona's famed International Speedway was Lee Petty, who in 1959 won in an Oldsmobile at an average speed of 135.52 mph.

The "winningest" driver in the history of the National Assn. for Stock Car Auto Racing (NASCAR) is Richard Petty. Still a top NASCAR star, Petty has over 100 victories to his credit in a career dating back to 1958. Second on the all-time win list with 54 victories is Lee Petty, Richard's father, now retired.

The first generally accepted world land speed record was set by Count Gaston de Chasseloup-Laubat in an electric Jeantaud at Achères, France, on December 18, 1898. He averaged 39.24 mph over a measured kilometer.

The first official NASCAR Grand National race was held June 19, 1949 on a ¾-mi. dirt track at the Charlotte, N.C. fairgrounds. It was won by Jim Roper, driving a Lincoln. Roper won when Glen Dunaway, driving a Ford, was disqualified for illegal modifications on his car.

The first stock car race on Daytona's old beach/road course was held in 1936. The winner was Milt Marion, driving a Ford. He completed 75 of the scheduled 78 laps—incoming tides forced a halt to the race.

The last major stock car race run on Daytona's famed beach course was won in 1958 by Paul Goldsmith in a '58 Pontiac at an average speed of 101.18 mph.

Juan Manuel Fangio, now an auto dealer in his native Argentina, is one of the superstars of auto racing history. He won five world championships—'51, '54, '55, '56 and '57.

The first turbine-powered race car to be entered in the Indianapolis 500 was the John Zink Trackburner in 1962. Despite a heroic

effort by the car's crew and driver Dan Gurney (then a rookie at Indy), it failed to qualify. (Gurney later qualified eighth that year in a Buick-powered car owned by Mickey Thompson.)

The last riding mechanics to appear in the Indianapolis 500 were aboard in 1937. The winner that year was Wilbur Shaw and his riding mechanic was Jigger Johnson.

Bobby Unser currently holds all divisional records for the annual Pike's Peak Hillclimb. In 1968 he set a record for championship cars at a speed of 62.526 mph. He won the stock car record this past year at a speed of 54.509 mph. He also holds the now-discontinued sports car record—55.940 mph.

The first major race conducted by SCCA was for sports cars over the streets and by-roads of Watkins Glen, N.Y., in 1948. Forerunner of today's U.S. Grand Prix, the race was won by Frank Griswold, driving a pre-World War II Alfa-Romeo.

The famed Novi engine, always a bridesmaid but never a winner, made its last appearance at Indianapolis in 1966. Greg Weld, taking a final warm-up lap before attempting to qualify the car, crashed it into the wall on Turn Three; the end of the Novi, an engine whose best finish was Duke Nalon's Third in 1948.

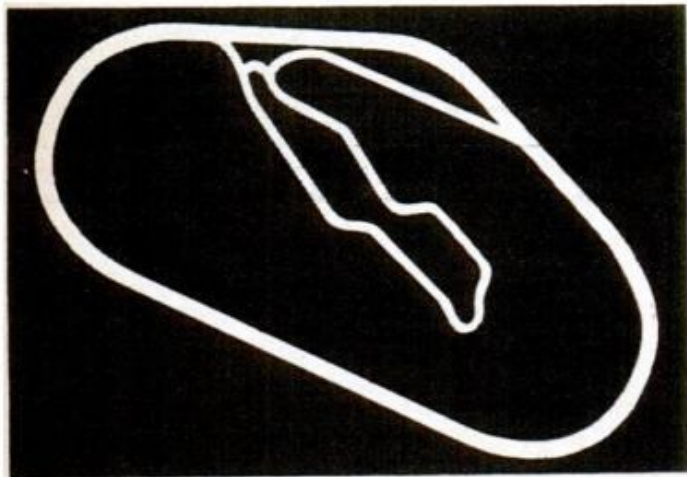
Generally accepted as the world's first auto race was an event run from Paris to Bordeaux and back—a distance of 732 miles—in June, 1895. The winner was Emile Levassor in a Panhard/Daimler in 48 hours, 47 minutes at an average speed of 15.01 mph.

The longest race course in the world was the Mexican Carrera Pan-Americana—1932 miles. The race, run in daily stages, was from Tuxtla Gutierrez to Ciudad Juarez. First held in 1951, the event was discontinued following the 1954 race in which a record overall average speed was set at 107.94 mph.

THE TOP TRACKS

1970 schedules of main events, 1969 winners and track record holders at major raceways in the United States and Canada

ALABAMA INTERNATIONAL MOTOR SPEEDWAY



Talladega, Ala. Asphalt, 2.66 mi., 33° banks, 4-mi. road course. Seats 70,000, infield 50,000. Opened 1969.

1970 SCHEDULE

APR. 12—500-MILE RACE: NASCAR GN (tent.). Not run in '69.

SEPT. 1—'BAMA 500: NASCAR GT ('69—Ken Rush, '68 Camaro, 156.271 mph.)

SEPT. 27—TALLADEGA 500: GN. ('69—Richard Brickhouse, '69 Dodge, 153.778 mph.)

RECORDS

'Bama 500—1969 (see above). Talladega 500—1969 (see above). One Lap—1969, Charlie Glotzbach, '69 Dodge, 199.987 mph.

ATLANTA INTERNATIONAL RACEWAY

Asphalt, 1.5 mi., 24° banks. Seats 38,500, infield 24,000 plus. Opened 1960.

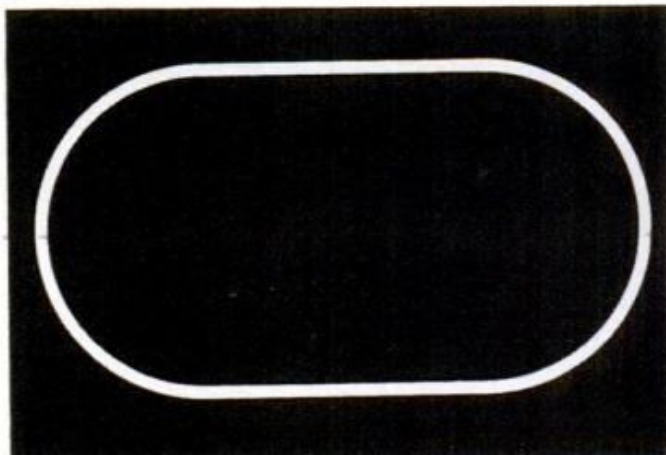
1970 SCHEDULE

MAR. 22—ATLANTA 500: GN. ('69—Cale Yarborough, '69 Mercury, 132.759 mph.)

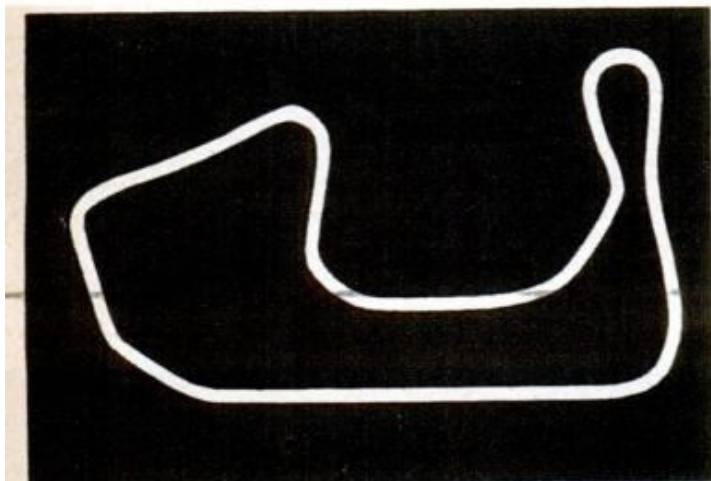
AUG. 4—DIXIE 500: GN. ('69—Lee Roy Yarborough, '69 Ford, 133.001 mph.)

RECORDS

Atlanta 500—1964, Fred Lorenzen, '64 Ford, 134.146 mph. Dixie 500—1969 (see above). One Lap—1969, Buddy Baker, '69 Dodge, 158.730 mph.



BRIDGEHAMPTON RACE CIRCUIT



Bridgehampton, N.Y. Asphalt/concrete, 2.85-mi. road course. Field seating. Opened 1958.

1970 SCHEDULE

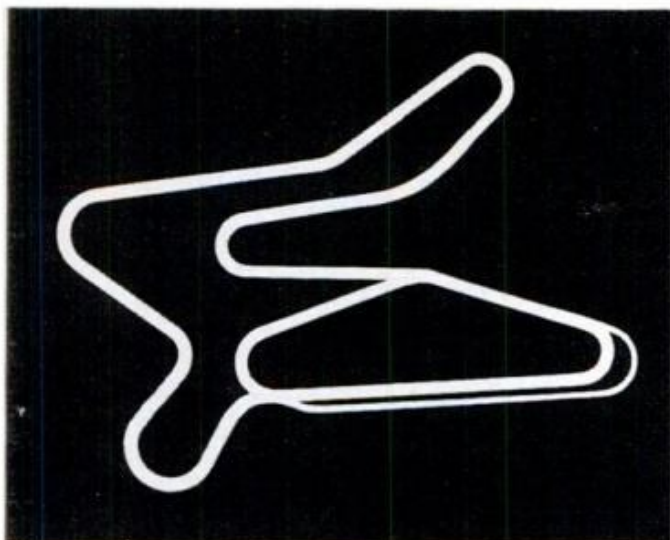
JUNE 21—250-MILE RACE: Trans-Am, GT. ('69—George Follmer, Mustang, 96.535 mph.)

SEPT. 13—70-LAP RACE: Can-Am, Group 7. ('69—Denis Hulme, McLaren/Chevrolet, 113.723 mph.)

RECORDS

Trans-Am—1969 (see above). Can-Am—1969 (see above). One Lap—1969, Denis Hulme, McLaren/Chevrolet, 118.949 mph.

BRYAR MOTORSPORT PARK



Loudon-Laconia, N.H. Asphalt, 1.6-mi. road course. Seats 7500, unlimited field seating. Opened 1965.

1970 SCHEDULE

JULY 19—200-MILE RACE: Trans-Am, GT. ('69—Mark Donohue, Camaro, 76.35 mph.)

RECORDS

Trans-Am—1969 (see above). **One Lap**—1969, Mark Donohue, Camaro, 113.8 mph.

CHARLOTTE MOTOR SPEEDWAY

Charlotte, N.C. Asphalt, 1.5 mi., 24° banks. Seats 51,558, infield 40,000 plus. Opened 1960.

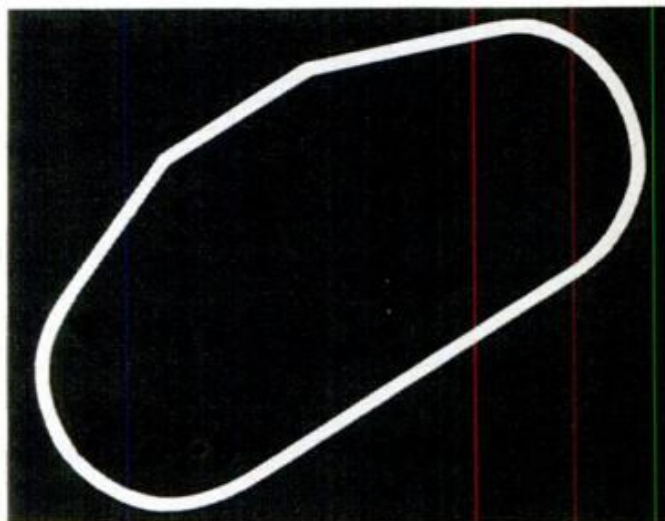
1970 SCHEDULE

MAY 24—WORLD 600: GN. ('69—Lee Roy Yarborough, '69 Mercury, 134.361 mph.)

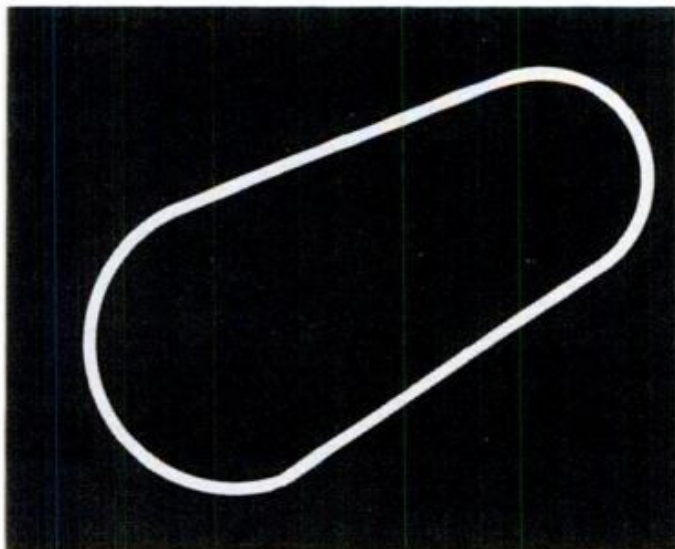
OCT. 11—NATIONAL 500: GN. ('69—Donnie Allison, '69 Ford, 131.271 mph.)

RECORDS

World 600—1967, Jim Paschal, '67 Plymouth 135.832 mph. **National 500**—1968, Charlie Glotzbach, '68 Dodge, 135.324 mph. **One Lap**—1969, Cale Yarborough, '69 Mercury, 162.162 mph.



DARLINGTON RACEWAY



Darlington, S.C. Asphalt, 1 $\frac{3}{8}$ mi., 26° banks. Seats 50,000, infield 30,000 (approx.). Opened 1950.

1970 SCHEDULE

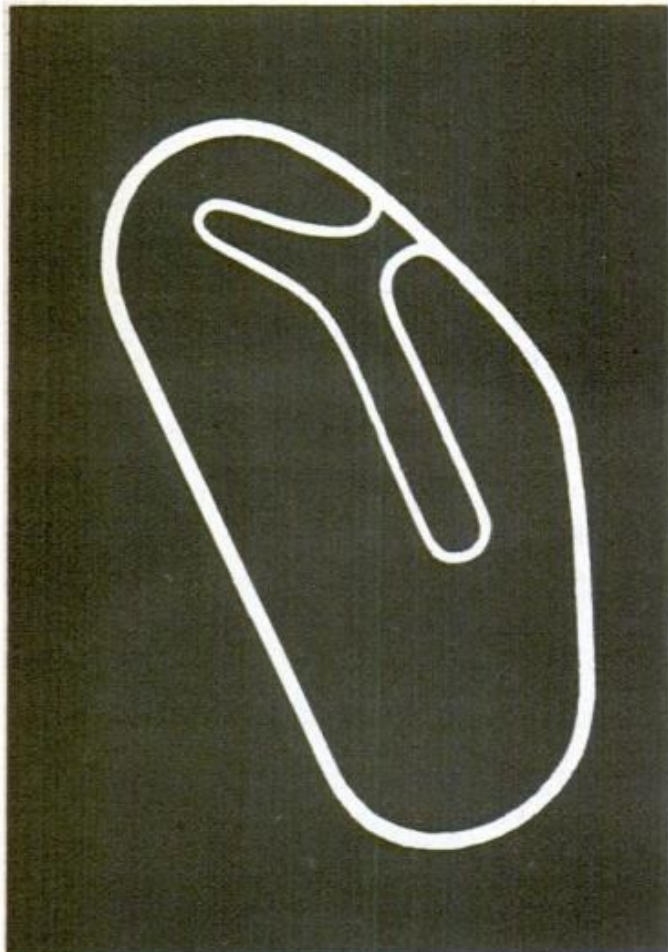
MAY 9—REBEL 400: NASCAR GN. ('69—Lee Roy Yarborough, '69 Mercury, 131.571 mph.)

SEPT. 7—SOUTHERN 500: NASCAR GN. ('69—Lee Roy Yarborough, '69 Mercury, 105 mph.)

RECORDS

Rebel 400—1968, David Pearson, '68 Ford, 132.000 mph. **Southern 500**—1967, Richard Petty, '67 Plymouth, 130.000 mph. **One Lap**—1969, Cale Yarborough, '69 Mercury, 152.293 mph.

DAYTONA INTERNATIONAL SPEEDWAY



Asphalt, 2.5 mi., 31° banks. Road courses: 3.81, 3.10, 1.63 mi. Seats 50,000, infield 50,000 (approx.). Opened 1959.

1970 SCHEDULE

JAN. 31—24 HOURS OF DAYTONA: Sports, Sports Protos., GT, Touring. ('69—Mark Donohue/Chuck Parsons, Lola/Chev., 99.268 mph.)

FEB. 15—ARCA LATE MODEL RACE: Stocks, 300 mi. ('69—Benny Parsons, '69 Ford, 147.985 mph.)

FEB. 20—FLORIDA CITRUS 250: NASCAR GT. ('69—Don Yenke, '69 Camaro, 104.363 mph.)

FEB. 21—PERMATEX 300: Late Model Sportsman. ('69—Lee Roy Yarbrough, '66 Ford, 105.368 mph.)

FEB. 22—DAYTONA 500: NASCAR GN. ('69—Lee Roy Yarbrough, '69 Ford, 157.950 mph.)

JULY 4—FIRECRACKER 400 (Medal of Honor): NASCAR GN. ('69—Lee Roy Yarbrough, '69 Ford, 160.875 mph.)

RECORDS

24 Hours of Daytona—Ken Miles/Lloyd Ruby, 1966, '66 Ford Proto Mk II, 108.020 mph. **ARCA Late Model Race**—Andy Hampton, 1968, '67 Dodge, 152.730 mph. **Florida Citrus 250**—1969 (see above). **Permatex 300**—Jim Paschal, 1967, '64 Plymouth, 148.188 mph. **Daytona 500**—1969 (see above). **Firecracker 400**—1969 (see above). **One Lap**—1969, Cale Yarborough, '69 Mercury, 190.706 mph.

DONNYBROOKE INTERNATIONAL

Brainerd, Minn. Asphalt, 3 mi., road course. Field seating (5000 grandstand). Opened '68.

1970 SCHEDULE

JUNE 14 (tent.)—"INDY WEEKEND": USAC Championship, 200 mi. ('69—Dan Gurney, Eagle/Ford, 113.925 mph.)

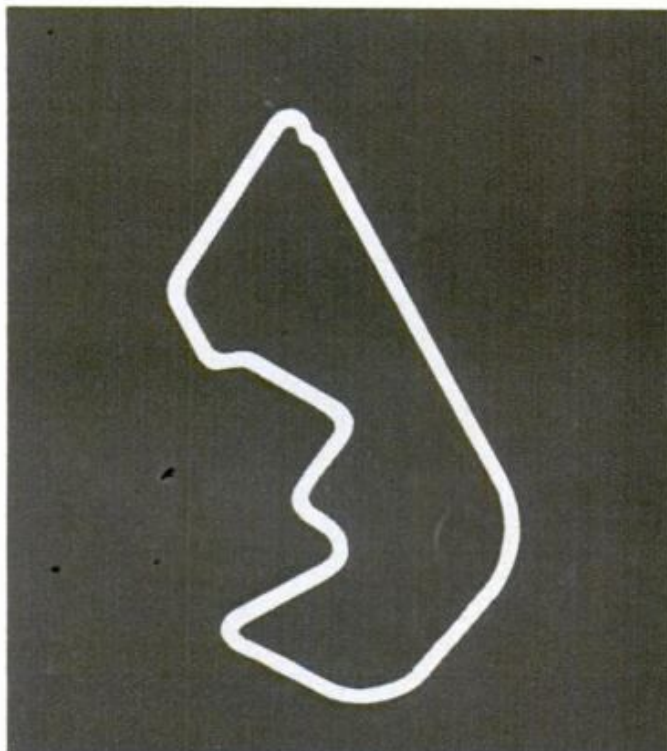
JULY 5—TRANS-AM: GT, 250 mi. ('69—Parnelli Jones, Mustang, 98.94 mph.)

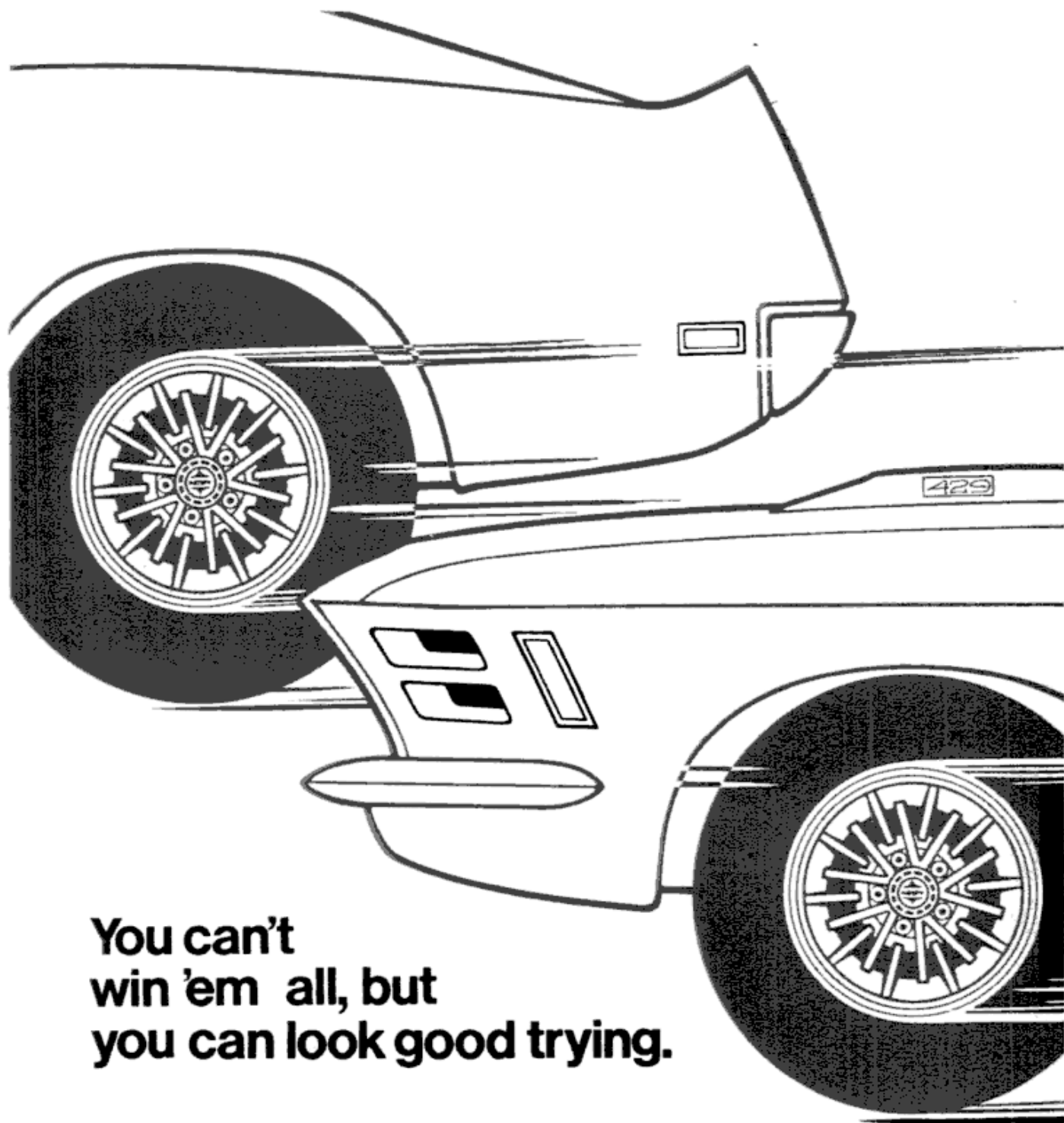
AUG. 9—DONNYBROOKE GP: FA, 200 mi. ('69—David Hobbs, Surtees TS5/Chevrolet, 108.62 mph.)

SEPT. 13 (tent.)—CAN-AM: Group 7, 250 mi. ('69—Not run.)

RECORDS

Trans-Am—1969 (see above). **Donnybrooke GP**—1969 (see above). **One Lap**—1969, Al Unser, Lola/Ford, 116.717.





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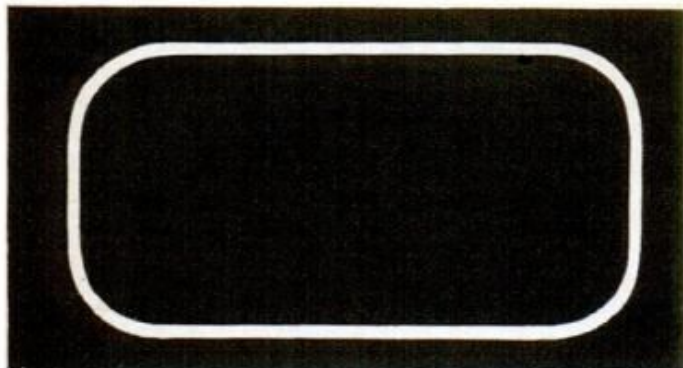
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INDIANAPOLIS MOTOR SPEEDWAY



Asphalt, 2.5 mi., 9+° banks. Seats 215,000, infield 100,000. Opened 1909.

1970 SCHEDULE

MAY 30—INDIANAPOLIS 500: USAC Championship. ('69—Mario Andretti, Hawk/Ford, 156.867 mph.)

RECORDS

Indianapolis 500—1969 (see above). **One Lap—1968**, Joe Leonard, Lotus/Turbine, 171.953 mph.

INDIANAPOLIS RACEWAY PARK

Asphalt, 5/8-mi. oval, 17° banks max., 2½-mi. road course, 4500-ft. drag strip. Seats 30,000, infield 20,000. Opened 1960.

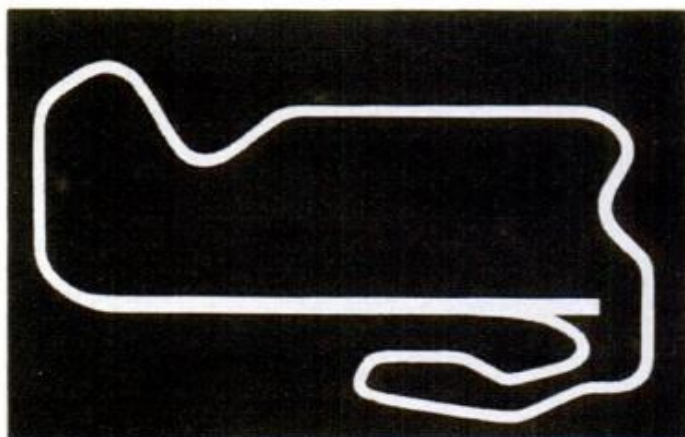
1970 SCHEDULE

MAY 4—YANKEE 250, USAC Late Model Stocks, 250 mi. ('69—Parnelli Jones, '69 Ford Torino, 82.377 mph.)

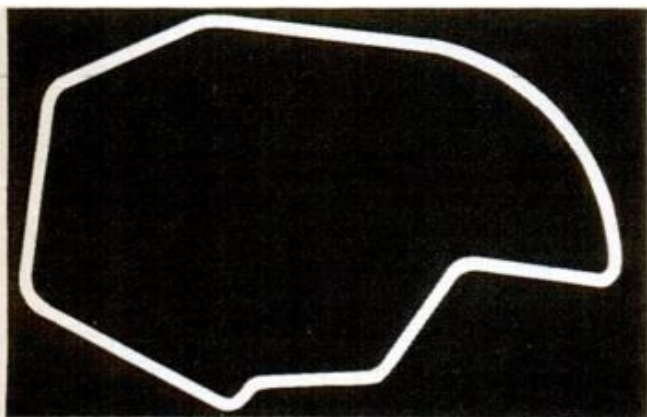
JULY 26—INDY 200, Championship, 200 mi. ('69—Peter Revson, Brabham/Repco, 92.275.)

SEPT. 2-7—Natl. Championship Drag Races.

RECORDS: Yankee 250—1969 (see above). **Indy 200—1968**, Al Unser, Lola/Ford 4wd, 200 mi., 96.800 mph. **One Lap—(Championship) 1969**, Dan Gurney, Eagle/Ford, 101.408 mph; **(USAC Stock) 1969**, Parnelli Jones, '69 Ford Torino, 2½-mi. road course, 86.430 mph.



LAGUNA SECA RACEWAY



Monterey, Calif. Asphalt, road course 1.9 mi. Field seating. Opened 1957.

1970 SCHEDULE

MAY 3—CONTINENTAL SERIES: FA, 100 mi. ('69—Sam Posey, Eagle/Chevy, 102.1 mph.)

AUG. 30—TRANS-AM: GT, 225 mi. ('69—Mark Donohue, Camaro, 90.43 mph.)

OCT. 11—CAN-AM: Group 7, 152 mi. ('69—Bruce McLaren, McLaren/Chevy, 104.8 mph.)

RECORDS: Continental GP—1969 (see above). **Trans-Am—1969** (see above). **Can-Am—1969** (see above). **One Lap—1969**, Bruce McLaren, McLaren/Chevy, 114.9 mph.

LIME ROCK PARK

Lime Rock, Conn. Asphalt, road course 1.53 mi. Field seating. Opened 1957.

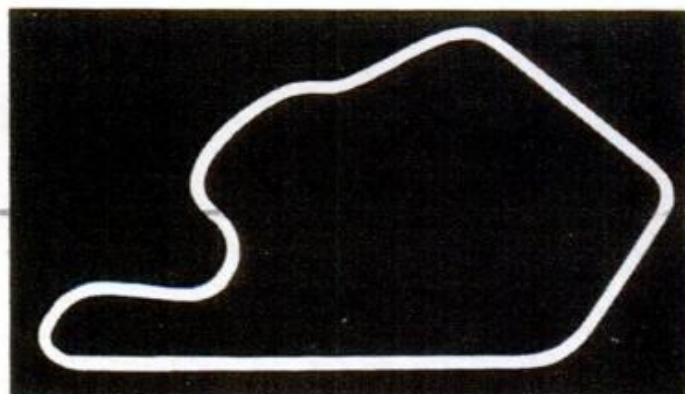
1970 SCHEDULE

DATE NA—TRANS-AM: GT ('69—Sam Posey, '69 Mustang, 87.27 mph.)

DATE NA—CONTINENTAL SERIES: FA, 70 laps ('69—Peter Gethin, McLaren/Chevy, 101.08.)

RECORDS

Continental—1969 (see above). **One lap—1969**, Peter Gethin, McLaren/Chevy, 104.1 mph.



MICHIGAN INTERNATIONAL SPEEDWAY



Irish Hills, Mich. Asphalt, 2 mi., 18° banks. 3-mi. road course. Seats 25,000, infield 50,000 plus. Opened 1968.

1970 SCHEDULE

MAY 10 (tent.)—**TRANS-AM**: GT, 4 hrs. ('69—Parnelli Jones, Mustang, 85.49 mph.)

JUNE 7—**MOTOR STATE 500**: GN. ('69—Cale Yarborough, '69 Mercury, 139.254 mph.)

AUG. 16—**YANKEE 600**: GN. ('69—David Pearson, '69 Ford, 115.508 mph.)

SEPT. 27 (tent.)—**CAN-AM**: Group 7, 200 mi. ('69—Bruce McLaren, McLaren/Chevy, 108.098 mph.)

RECORDS: Trans-Am (Wolverine)—1969 (see above). Motor State 500—1969 (see above). Yankee 600—1969 (see above). Can-Am—1969 (see above). **One Lap**—(Championship) 1968, Mario Andretti, Hawk/Offy, 183.67 mph; (GT) 1969, Parnelli Jones, Mustang, 91.72 mph; (GN) 1969, David Pearson, '69 Ford, 161.714 mph.

MID-OHIO SPORTS CAR COURSE

Lexington, Ohio. Asphalt, 2.5-mi. road course. Field seating. Opened 1962.

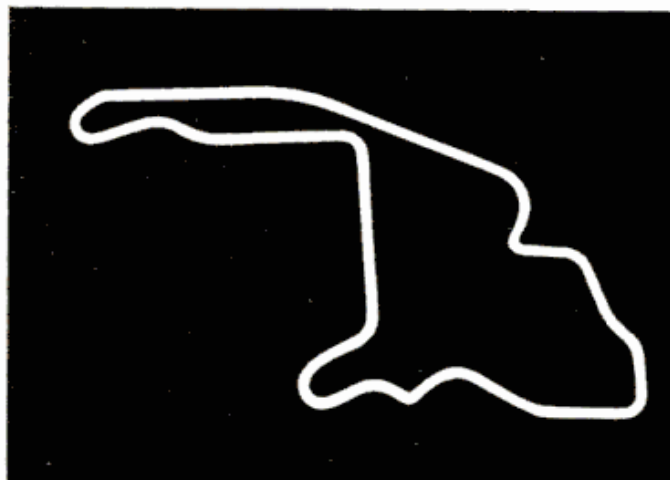
1970 SCHEDULE

JUNE 7—**TRANS-AM**: GT ('69—Ronnie Bucknum, '69 Camaro, 83.53 mph.)

AUG. 23—**CAN-AM**: Group 7 ('69—Denis Hulme, McLaren/Chevy, 94.212 mph.)

RECORDS

Trans-Am—1969 (see above).



MONT TREMBLANT



St. Jovite, Quebec, Canada. Asphalt, 2.65-mile road course, 4° banks, max. Seating 1000, unlimited field seating. Opened 1964.

1970 SCHEDULE

JUNE 28—**CAN-AM**: Group 7, 60 laps. ('69—Denis Hulme, McLaren/Chevy, 97.55 mph.)

AUG. 1-2—**TRANS-AM**: GT, 97 laps. ('69—Mark Donohue, Camaro, 85.16 mph.)

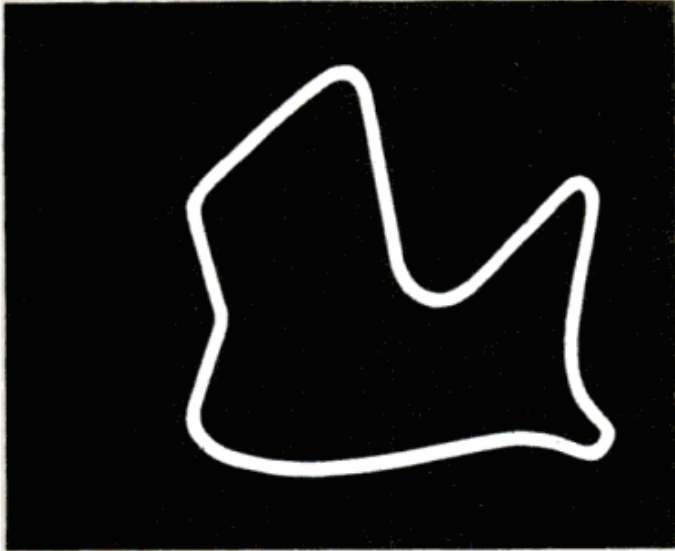
DATE NA—**CONTINENTAL SERIES**: FA. ('69—David Hobbs, Surtees TS5/Chevy, 72.38 mph.)

SEPT. 20—**CANADIAN GRAND PRIX**: F1, 90 laps. ('68—Denis Hulme, McLaren/Ford, 97.55 mph.) (This race and 6 Hours of Canada are run alternately at the Mosport and Mont Tremblant circuits.)

RECORDS

Can-Am—1969 (see above). **One Lap**—1969, Denis Hulme, McLaren/Chevy, 101.7 mph.

MOSPORT PARK



Bowmanville, Ontario, Canada. Asphalt, 2.5-mi. road course. Seats 7500, unlimited field seating. Opened 1961.

1970 SCHEDULE

JUNE 14—CAN-AM: Group 7, 200-mile. ('69—Bruce McLaren, McLaren/Chevrolet, 105.9 mph.)

AUG. 9—6 HOURS OF CANADA: World Manufacturers Championship. (First running in Canada; alternately run with Canadian Grand Prix at Mosport Park and Mont Tremblant circuits.)

RECORDS

Can-Am—1969 (see above). **One Lap—1969,** Bruce McLaren, McLaren/Chevrolet, 119.5 mph.)

NORTH CAROLINA MOTOR SPEEDWAY

Rockingham, N.C. Asphalt, 1-mi., 22° banks, turns 1 and 2; 25°, turns 3 and 4. Seats 30,000, infield 12,000 plus. Opened 1965.

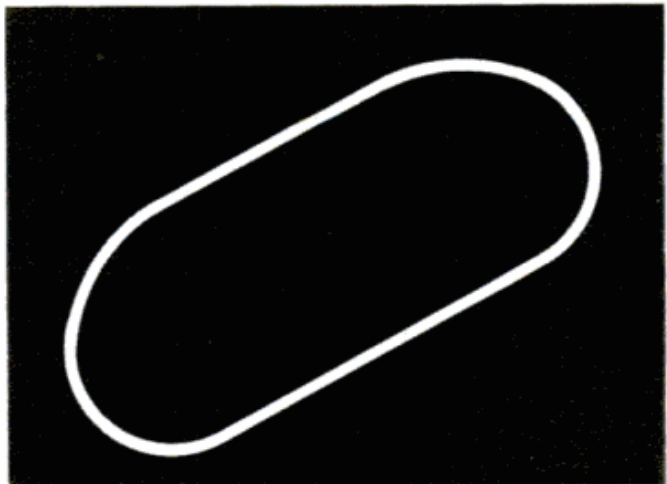
1970 SCHEDULE

MAR. 8—CAROLINA 500: GN. ('69—David Pearson, '69 Ford, 102.569 mph.)

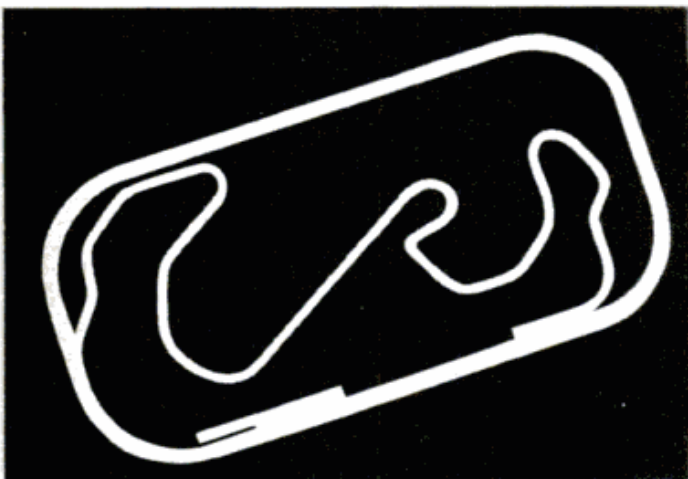
OCT. 25—AMERICAN 500, GN ('69—Too late for Racing Guide deadline.)

RECORDS

Carolina 500—1967, Richard Petty, '67 Plymouth, 104.682 mph. **American 500** (does not include '69 race)—1968, Richard Petty, '68 Plymouth, 105.060 mph. **One Lap—1969,** David Pearson, '69 Ford, 119.916 mph. (Does not include '69 American 500 qualifying and race.)



ONTARIO MOTOR SPEEDWAY



Ontario, Calif. Asphalt, 2.5 mi., 9° banks. 3.23-mi. road course, ¼-mi. drag strip plus shutdown. Seats 140,000, infield 60,000 plus. Will open Sept. 6, 1970.

1970 SCHEDULE

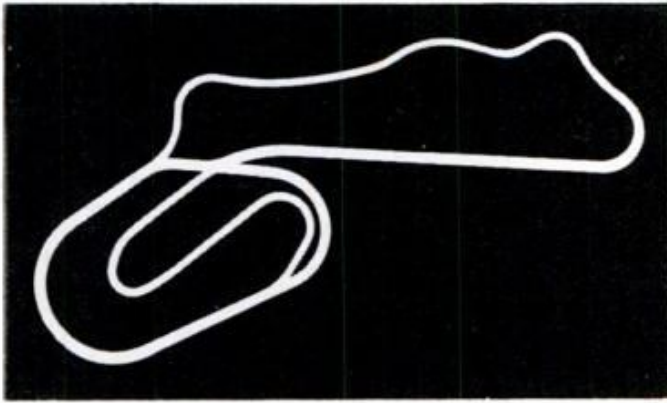
SEPT. 6—CALIFORNIA 500: USAC Championship. Not run in '69.

NOV. 22—NHRA DRAGS INVITATIONAL: Not run in '69.

RECORDS

Track opens this year.

PHOENIX INTERNATIONAL RACEWAY



Asphalt, 1 mi., 13° banks. 2.9-mi. road course, 1320-ft. drag strip plus shutdown. Seats 14,000, infield 4000. Opened 1964.

1970 SCHEDULE

MARCH 29—PHOENIX 150, USAC Championship. ('69—George Follmer, Follmer/Chevy, 109.853 mph.)

DATE NA—BOBBY BALL 200, USAC Championship. ('69—Held Nov., after Guide deadline.)

RECORDS: Phoenix 150—1969 (see above). One Lap—1969, Al Unser, Ford, 126.939 mph.

POCONO INTERNATIONAL RACEWAY

Long Pond, Pa. Asphalt, ¾-mi. oval, 6° banks, 2.5-mi. tri-oval, 14° banks max. (due for completion in '70), 1.8, 3.3-mi. road courses. Seats 16,000 plus, infield 15,000 plus. Opened 1969.

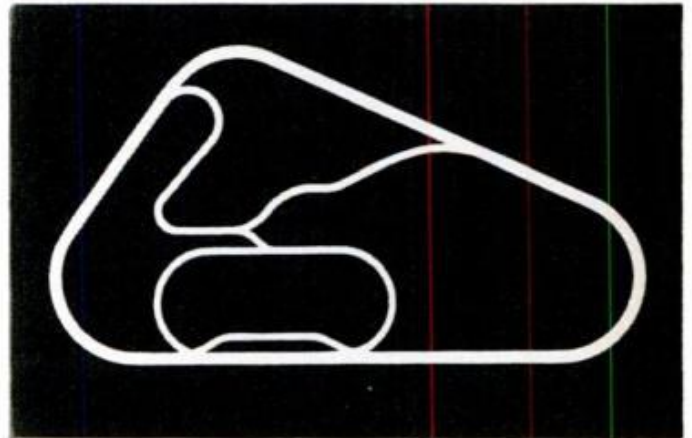
1970 SCHEDULE

JULY 17—MODIFIED SPORTSMAN, 150 laps of ¾-mi. oval. ('69—Brian Osgood, '63 Plymouth, speed NA.)

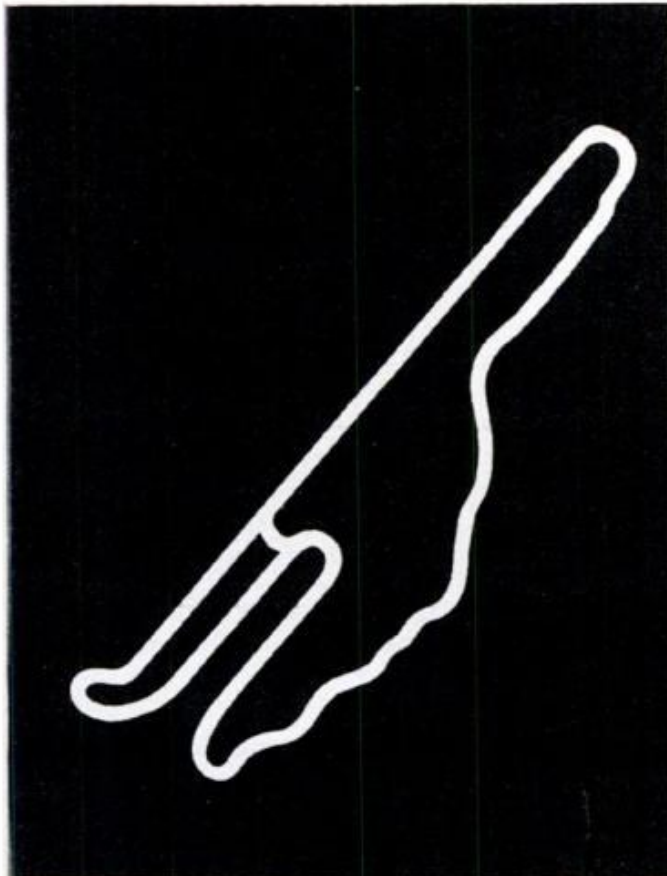
DATE NA—TRANS-AM, GT.

DATE NA—CONTINENTAL SERIES, FA.

RECORDS: NA.



RIVERSIDE INTERNATIONAL RACEWAY



Riverside, Calif. Asphalt, road courses 2.5, 2.6, 3.3 mi., 8° banks max. Seats 24,000, infield 80,000 plus. Opened 1957.

1970 SCHEDULE

JAN. 18—RIVERSIDE 500: GN. ('69—Richard Petty, '69 Ford, 105.516 mph.)

APRIL 19—CONTINENTAL GP: FA, 117 mi. ('69—John Cannon, Eagle/Chevy, 112.998 mph.)

JUNE 14—GOLDEN STATE 400: GN. (New race.)

OCT. 4—MISSION BELL 250: Trans-Am, GT, ('69—Mark Donohue, Camaro, 95.785 mph.)

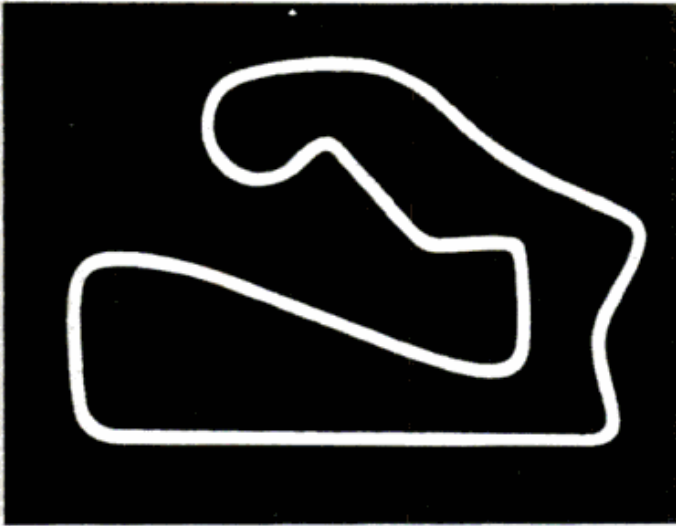
OCT. 25—L.A. TIMES GP: Group 7, 2,200 mi. ('69—Held too late for Guide deadline.)

DEC. 6—REX MAYS 300, Championship. ('69—Held too late for Guide deadline.)

RECORDS

Riverside 500—1969 (see above). **Continental GP—1969** (see above). **Mission Bell 250—1969** (see above). **LA Times GP—1968**, Bruce McLaren, McLaren/Chevy, 114.353 mph. **Rex Mays 300—1968**, Dan Gurney, Eagle/Ford, 108.391 mph. **One Lap—(Championship) 1968**, Dan Gurney, Eagle/Ford, 118.556 mph; **(Group 7) 1968**, Bruce McLaren, McLaren/Chevy, 119.693 mph; **(GN) 1969**, A. J. Foyt, '69 Ford, 110.366 mph.

ROAD AMERICA



Elkhart Lake, Wis. Asphalt, 4-mi. road course. Field seating (plus 2000 grandstand). Opened 1955.

1970 SCHEDULE

JULY 17—CONTINENTAL SERIES: SCCA, FA, 300 mi. ('69—Tony Adamowicz, Eagle/Chevy, 82.051 mph.)

DATE NA—TRANS-AM, GT. (Details not as yet set, would be initial race in Series for Road America.)

AUG. 30—ROAD AMERICA: Can-Am, Group 7, 200 mi. ('69—Denis Hulme; McLaren/Chevy, 107.479 mph.)

RECORDS: Continental—1969 (see above). Can-Am—1969 (see above). **One Lap—1969,** Denis Hulme, McLaren/Chevy, 114.014 mph.

SEARS POINT INTERNATIONAL RACEWAY

Sonoma, Calif. Asphalt, 2.523-mi. road course, ½-mi. drag strip. Seating 5000, unlimited field seating. Opened 1969.

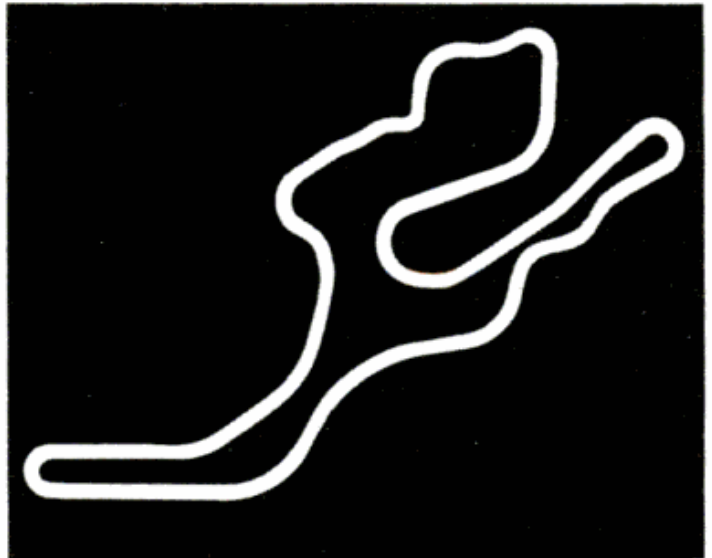
1970 SCHEDULE

JUNE 21—CONTINENTAL SERIES: FA, 49 laps. ('69—John Cannon, Eagle-Chevy, 91.537 mph.)

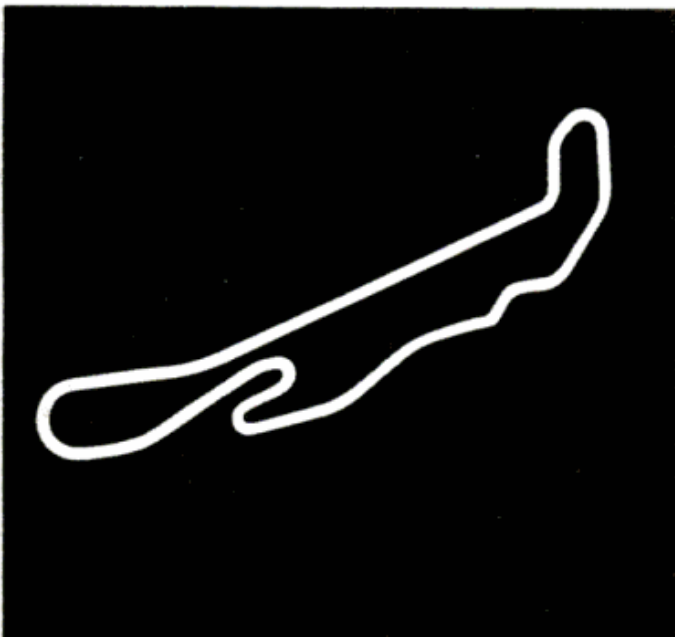
SEPT. 20—TRANS-AM, GT, 80 laps ('69—Mark Donohue, Camaro, 83.591 mph.)

RECORDS

Continental—1969 (see above). Trans-Am—1969 (see above).



SEATTLE INTERNATIONAL RACEWAY



Kent, Wash. Asphalt, 2.25-mi. road course, 1-mi. drag strip. Seating 3500, unlimited field seating. Opened 1959.

1970 SCHEDULE

APRIL 5—NATIONAL OPEN: NHRA-sanctioned drag races.

JUNE 14—Continental Series: FA, 100 mi. ('69—Tony Adamowicz, Eagle-Chevy, 101.92 mph.)

SEPT. 6—KENT 300: Trans-Am, GT, 300 mi. ('69—Ronnie Bucknum, Camaro, 89.15 mph.)

OCT. 18—DAN GURNEY 200: Championship.

RECORDS

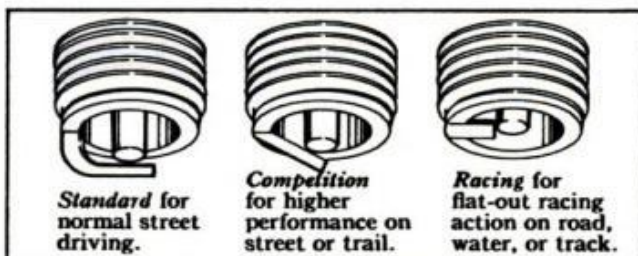
Continental—1969 (see above). Trans-Am—1969 (see above). **One lap—(FA) 1969,** John Cannon, Eagle-Chevy, 116.1 mph; (GT) 1969, Mark Donohue, Camaro, 125.2 mph.

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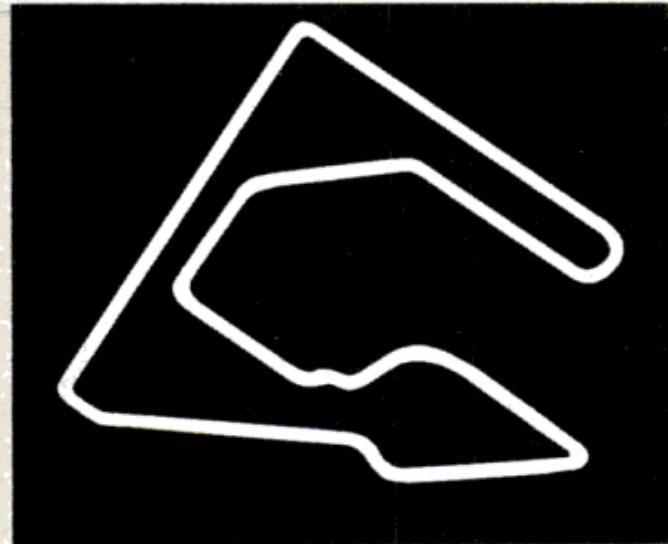
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Address _____

City _____ State _____ Zip _____



SEBRING



Sebring, Fla. Concrete and asphalt, 5.2-mi. road course. Seats 15,000, infield 50,000. Opened 1950.

1970 SCHEDULE

MARCH 21—12 HOURS OF SEBRING: Proto., Sports, GT, Touring, 12 hrs. ('69—Jacky Ickx/Jack Oliver, Ford GT 40, 103.4 mph.)

DEC. 27—CONTINENTAL SERIES (L&M GP): FA, 200 mi. ('69—NA.)

RECORDS

12 Hours of Sebring—1969 (see above). **One Lap—1969**, Chris Amon, Ferrari, 115.64 mph.

TEXAS INTERNATIONAL SPEEDWAY

College Station, Tex. Asphalt, 2-mi., 22° banks. Road course 3 mi. Seats 26,000, infield 25,000 plus. Opened 1969.

1970 SCHEDULE

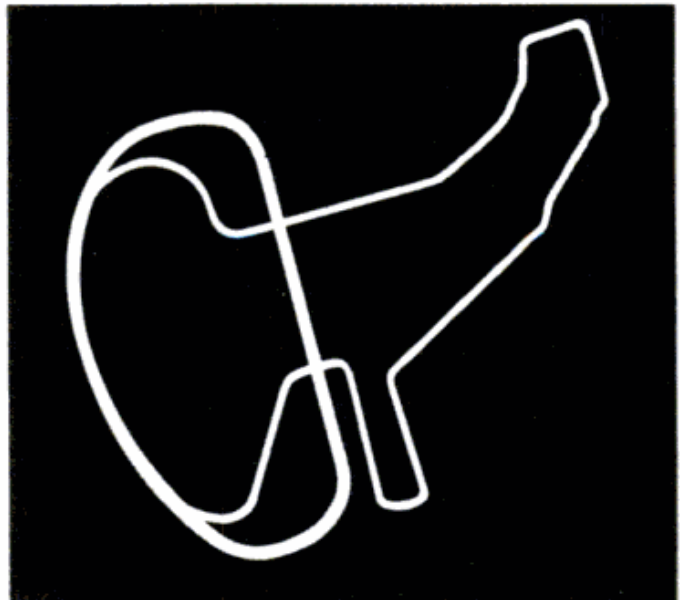
JUNE 21—NASCAR GN: 500 mi. Not run in '69.

NOV. 8—CAN-AM: Group 7, 210 mi. ('69—NA. Too late for Racing Guide deadline.

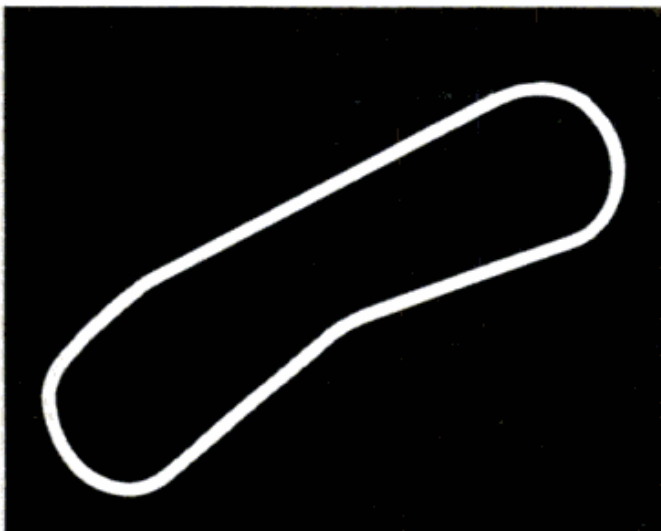
DEC. 6—NASCAR GN, 500 mi. ('69—NA).

RECORDS

Track opened too late for Guide deadline.



TRENTON SPEEDWAY



Trenton, N.J. Asphalt, 1.5-mi., 10° turns 1 & 2, 15° turns 3 & 4. Seats 22,000, paddock 10,000. Present track opened 1969.

1970 SCHEDULE (Dates NA)

TRENTON 200: USAC Championship. ('69—Mario Andretti, Hawk/Ford, 139.591 mph.)

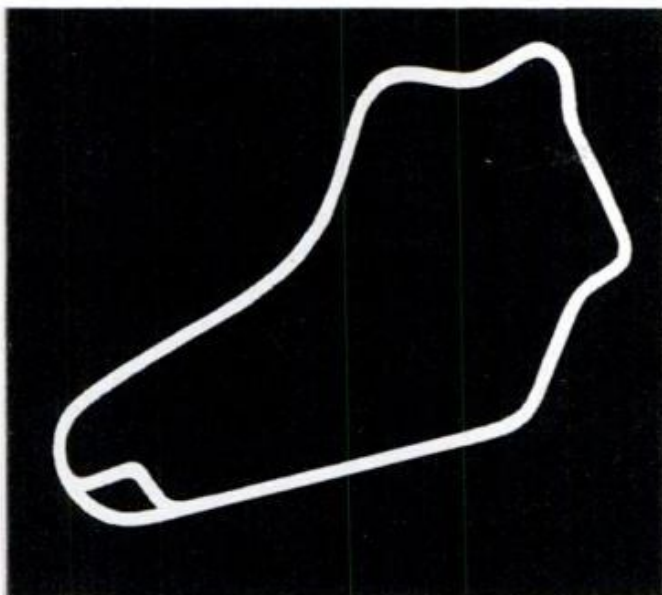
TRENTON 300: USAC Championship. ('69—Mario Andretti, Hawk/Ford, 134.281 mph.)

TRENTON 300: GN. ('69—David Pearson, '69 Ford, 121.088 mph.)

RECORDS

Trenton 200—1969 (see above). **Trenton 300 (Championship)—1969** (see above). **Trenton 300 (GN Stocks)—1969** (see above). **One Lap (Championship)—1969**, Bobby Unser, Bardahl Spl./Offy, 154.710 mph. **(GN Stocks)—1969**, Bobby Isaac, '69 Dodge, 132.668 mph.

WATKINS GLEN GRAND PRIX CIRCUIT



Watkins Glen, N.Y. Asphalt, 2.3-in. road course. Seats 11,000, also field seating. Opened 1956.

1970 SCHEDULE

JULY 12—THE GLEN CAN-AM 200: Group 7. ('69—Bruce McLaren, McLaren/Chevy, 125.99 mph.)
AUG. 16—GLEN TRANS-AM 500: GT, 2½ hrs. ('69—Mark Donohue, Camaro, 107.33 mph.)
OCT. 4—GRAND PRIX OF U.S.: F1, 250 mi. (approx.) ('69—Jochen Rindt, Lotus/Ford, 126.36 mph.)

RECORDS

Can-Am 200—1969 (see above). **Glen Trans-Am 500—1969** (see above). **Grand Prix of U.S.—1969** (see above). **One Lap—(F1) 1969,** Jochen Rindt, Lotus/Ford, 130.15 mph; (Can-Am) 1969, Bruce McLaren, McLaren/Chevy, 133.10 mph; (GT) 1969, Mark Donohue, Camaro, 110.70 mph.

WISCONSIN STATE FAIR PARK SPEEDWAY

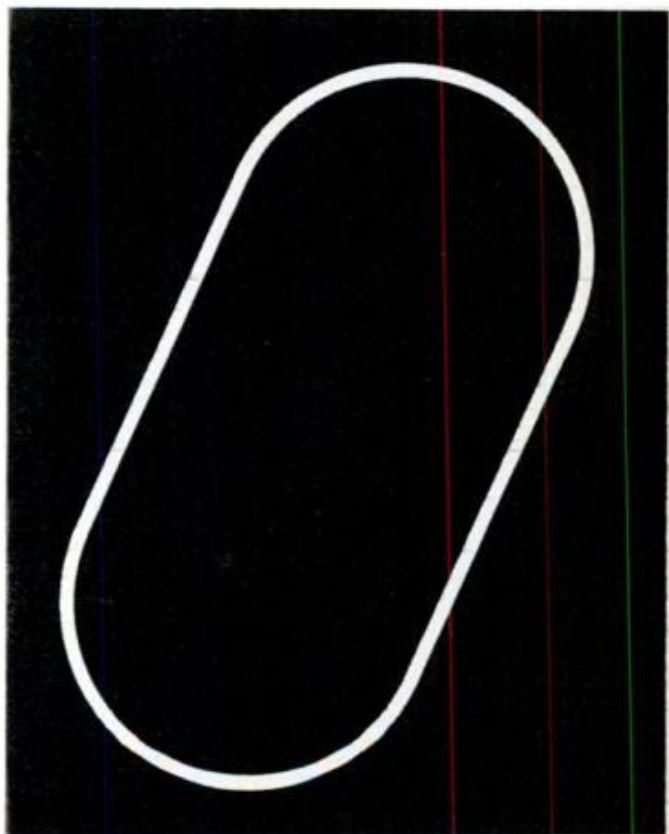
West Allis, Wis. Asphalt, 1 mi., 9° banks. 1.9-mi. road course. Seats 40,000, infield 10,000. Opened 1903.

1970 SCHEDULE (Dates NA)

REX MAYS CLASSIC: USAC Championship, 150 mi. ('69—Art Pollard, STP/Offy, 112.157 mph.)
"MILLER 200": USAC stocks. ('69—Bobby Unser, '69 Ford, 94.270 mph.)
FAIR WEEK 150: USAC Stocks. ('69—Don White, '69 Dodge, 98.369 mph.)
FAIR WEEK 200: USAC Stocks. ('69—Roger McCluskey, '69 Plymouth, 97.553 mph.)
TONY BETTENHAUSEN 200: USAC Championship. ('69—Al Unser, Lola/Ford, 106.600 mph.)
USAC STOCKS: 250 mi. ('69—Don White, '69 Dodge, 95.987 mph.)

RECORDS

Rex Mays Classic—1969 (see above). **"Miller 200"—1969** (see above). **Fair Week 150—1969** (see above). **Fair Week 200—1969** (see above). **Bettenhausen 200—1968,** Lloyd Ruby, Laycock/Offy, 108.735 mph. **One Lap—1969,** Al Unser, Turbo Ford, 119.600 mph.



OTHER TRACKS

Action Track—Terre Haute, Ind.
 Beltsville Speedway—Beltsville, Md.
 Bristol International Speedway—Tenn.
 Continental Divide—Castle Rock, Colo.
 Davenport Fairgrounds—Davenport, Iowa
 Dover Downs International Speedway—Del.
 DuQuoin Fairgrounds—DuQuoin, Ill.
 Hanford Speedway—Hanford, Calif.
 Langhorne Speedway—Langhorne, Pa.
 Magdalena-Mixhuca—Mexico City

Martinsville Speedway—Martinsville, Va.
 Nazareth Speedway—Nazareth, Pa.
 New Asheville Speedway—Asheville, N.C.
 New Thompson Speedways—Thompson, Conn.
 Sacramento Fairgrounds—Sacramento, Calif.
 Sedalia Fairgrounds—Sedalia, Mo.
 Speedway International—Edmonton, Alberta
 Springfield Fairgrounds—Springfield, Ill.
 Tri-County Speedway—Cincinnati, Ohio
 Winchester Speedway—Winchester, Ind.

Auto Racing Glossary

(Continued from page S31)

PROTO—Prototype. A sports-racing car that doesn't conform to homologation requirements for production sports cars.

ROLL BAR—Structural member(s) to keep car off driver in case car overturns.

ROOKIE—A driver running in particular competition or track for first time.

SAE—Society of Automotive Engineers, 2 Pennsylvania Plaza, New York, N.Y. 10001.

SCCA—Sports Car Club of America, Box 791, Westport, Conn. 06880.

SCRUTINEER—Inspecting official(s) of sanctioning body for a racing event.

SLINGSHOTTING—Riding in draft of car ahead (thus being able to throttle down), then using full power to pass.

SPOILER—Slipstream deflector mounted usually on rear deck to assist aerodynamically in stabilizing car at speed.

STOCK BLOCK—Mass-produced passenger-car engine block, usually with valves operated by pushrods.

SUPERCHARGING—Forcing increased air for combustion into an engine by means of a mechanically driven blower.

SWITCHBACK—A turn of approximately 180° in a road-racing circuit.

TIME TRIALS—Motor sports other than all-out speed contests. Includes rallies, navigating over an unknown course as close to a specified average speed as possible; and time and maneuverability events or slaloms which run one car at a time. Includes gymkhanas, autocrosses.

TRAPS—Measuring system for drag racer's top speed at end of the course.

TURBOCHARGING—Forcing increased air for combustion into engine with turbine driven by engine exhaust gases.

USAC—United States Auto Club. Box 24001, Indianapolis, Ind. 46224.

USRRC—United States Road Racing Championship. Series of SCCA races discontinued in 1968. Was for Group 7 cars that now run in Can-Am series.

WING—Airfoil mounted above racing car to utilize aerodynamic forces to hold car against the road.

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The winner's triangle at the NHRA Nationals

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Tritak & Morgan
E.T./12.01 MPH/115.80
- Super Eliminator**
George Montgomery
E.T./8.59 MPH/164.23
- Street Eliminator**
Glen Self
E.T./12.35 MPH/109.89
- Funny Car Eliminator**
Ongais & Thompson
E.T./7.26 MPH/203.61
- Low E.T. of Meet**
Beebe & Mulligan
E.T./6.43
- Super Stock Eliminator**
Sox & Martin
E.T./10.89 MPH/124.82



Racing Rules

ENGINES

Late Model Stocks (NASCAR GN, USAC, ARCA, IMCA)—Must be U.S. factory production, at least 2500 (or 1/250th of previous year's production) made, at least 500 installed in car for which catalogued and available to public. No half-year models approved. NASCAR GNs must be '68, '69, '70 models, 430-CID maximum with 1-in. overbore allowed. One 4-bbl. carburetor, 1 11/16-in. throttle bore. No supercharger or fuel injection. Engine cannot be relocated. All parts stock except pistons, camshafts. Heads, certain other parts may be modified within specific rules. USAC stocks practically same except engine may be moved fore or aft 1 1/2 in. Parts must be stock, but can be modified, including pistons, camshaft. ARCA allows .030-in. overbore, but otherwise is same. IMCA, no CID limit.

Sportsman (NASCAR)—U.S. cars, '55 through '67, engine year optional. No OHCs, certain CID restrictions pertaining to given makes, years. Parts may be altered within limits.

Modified (NASCAR)—U.S. cars, '35 through '67. CID unlimited, engines may be interchanged within any maker's line. Superchargers, fuel injection allowed. Any carburetion, pistons, camshafts and so on are okay.

Hobby (NASCAR)—U.S. cars, '36-'60, any engine okay, but no OHCs. CID 318 with .060-in. overbore. Multiple carbs okay on flatheads, one carb for OHV engines. No fuel injection, superchargers.

Championship (USAC)—CID 256.284 OHC, supercharged 161.703, stock block 320.355 or 203.4 supercharged. Special rocker-arm engine—no OHC, no supercharger—305.1. Two-cycle, 170.856. Diesel, 305.1, 203.4 supercharged. Turbines, 11.999-sq.-in. annulus area at first moving compressor stage.

Sprint (USAC)—OHC CID 256.284, 170.856 supercharged. U.S. stock block 305.1 non-OHC, 203.4 if supercharged. Two-cycle-CID 170.856. One percent overbore allowed, all classes. IMCA sprints unlimited.

Midget (USAC)—OHC CID 114, 76 supercharged. Two-cycle 105. Stock block, no OHC, 155, 104 supercharged. Must be factory-built, installed in production car.

Trans-Am—U.S. and foreign production. CID 305 maximum. Racing in two classes—over, under two liters (122-CID). Engine CID may

be sleeved-down or destroked to 305. Carburetion, one 4-bbl. for over two-liters, production specs. for under two liters.

Can-Am—CID unlimited, carburetion optional.

Grand Touring (NASCAR)—U.S., foreign cars, '68-'70, 305-CID max. with .047 overbore okay. Two 4-bbls. allowed. Other specs practically same as GNs.

Formula 1—CID 183 max., 91 1/2 if supercharged.

Formula A (SCCA)—CID on U.S. production pushrod engines restricted to 305, on engines of unrestricted origin to 183 (91 1/2 if supercharged).

Drag Racing—Rules extremely flexible within specific class limits, very complex. Best bet is to check NHRA, AHRA rules.

CHASSIS/BODY

Late Model Stocks (NASCAR GN, USAC, ARCA, IMCA)—U.S. cars, at least 2500 (or 1/250th of previous year's production) made. No wheelbase changes (minimum 119 in.) Body must be as manufactured except plastic may be substituted for rear glass. Steel roll cages, reinforced and bolted doors mandatory. Nonadjustable front lower and upper rear-deck spoilers allowed. Frame may be reinforced. Weight-jacking okay, but not by driver while car in motion. Left side minimum ground clearance 6 1/2 in., not more than 2 in. higher on right. No mufflers. Fire extinguisher in car mandatory. Overall weight 3900 lbs. minimum. In USAC, wheelbase minimum is 115 in., can be within 1/2-in. of factory specs. Ground clearance about 2 in. less than above. Mufflers optional. ARCA is generally same as NASCAR, but reserves right to prohibit special options (e.g., Dodge Daytona, Ford Talladega). IMCA same as NASCAR.

Sportsman (NASCAR)—Steel-top U.S. cars '55-'67. Minimum wheelbase 115 in., minimum weight 9 lbs. per CID. Intermediate bodies '62-'67 may be used on earlier model frames, but frame brands not interchangeable. Same safety requirements as GNs.

Modified (NASCAR)—U.S. cars '35-'67, steel tops, 109-in. minimum wheelbase, 2900 lbs. minimum weight. Fenders, hoods required. Same safety requirements as GNs.

Hobby (NASCAR)—Again, steel top, U.S. cars '36-'60, fenders, hoods required, same safety requirements.

Championship (USAC)—Open wheel, open cockpit body, not over 16 ft. long, 80 in.

wide. Minimum wheelbase 96 in. Minimum weight 1350 lbs. No spoiler wings. Four-wheel brakes, steel roll bar mandatory.

Sprint (USAC)—Same as above, except wheelbase restricted to 84 in. No restrictions on IMCA sprints.

Midget (USAC)—Again, open wheel, open cockpit. Wheelbase between 66 and 76 in. Safety requirements the same as Championship cars.

Can-Am—Cars designed for road racing, must have seats for driver, one passenger. Must have two doors at least 12 by 20 in., fenders must cover wheels, tires. Adjustable spoilers okay, roll bars a must.

Trans-Am (SCCA)—U.S., foreign small production sedans. Maximum wheelbase 116 in. Over two-liter cars must weigh 2900 lbs. At least one main door window must be open during race. Roll bars (cage) mandatory. No body alterations.

Grand Touring (NASCAR)—Cars same as above, '68-'70. Maximum wheelbase 112 in., minimum weight for over two-liter cars 2950 lbs., under two liters, factory-published street weight plus 75 lbs. for roll cage. Body dimensions unchanged except for nonadjustable

spoiler 1½ in. high on rear deck, spoiler under front at least 6½ in. off ground.

Formula 1—Single open seat, open wheels. Minimum weight 928 lbs.

Formula A (SCCA)—Single open seat, open wheels. Minimum weights 1105 lbs. for cars under three liters, 1250 for cars three to five liters.

Drag Racing—Chassis, body requirements depend upon class of racing. See NHRA, AHRA rulebooks.

TIRES/WHEELS

Late Model Stocks (NASCAR GN, USAC, ARCA, IMCA)—All four GN tires must be same size, tread, make. Racing tires okay, but no specials (e.g., slicks). Wheel diameter 14 or 15 in., rim width 9, tire tread 10. Safety liners a must. Race must be started on tires used for qualifying. Same with USAC except rim width—8½-in. maximum. ARCA same as GNs. IMCA okays different tires, sets rim width at 10 in.

Sportsman (NASCAR)—Same as GN for big tracks. On tracks less than one mile in length, 10-in. rim width okay. (Turn to page S60)

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Racing Rules *continued*

Modified, Hobby (NASCAR)—Generally same as above.

Championship (USAC)—Racing tires, no recaps, no special qualifying tires. Minimum wheel diameter 15 in., front rims 10 in., rear rims 14 in. width.

Sprint (USAC)—Same as above except maximum rim width is 9½ in. IMCA sprints allowed snow-type racing tires on some dirt tracks.

Midget (USAC)—Wheel dia. 12 or 13 in., rim width 8 in. Racing tires. IMCA 13-in. wheels.

Can-Am—No restrictions on wheels or tires except fronts must be identical, rears identical.

Trans-Am (SCCA)—Maximum rim width on cars over two liters is 8 in.; under two liters, 7 in. Substitute wheels okay, except no variations from stock.

Grand Touring (NASCAR)—Wheels and tires, all four the same. Wheel dia. 14 or 15 in., maximum rim width 8½ in., tread 10 in.

Formula 1—Unrestricted.

Formula A (SCCA)—Racing tires. Recaps of same okay. No slicks. No restrictions on size.

Drag Racing—Magnesium wheels widely used, as are special motorcycle and/or wire wheels. Again, depends upon class of competition.

FUELS/LUBRICANTS

NASCAR (GN, GT, Sportsman, Modified, Hobby)—GN, GT's Sportsman, gasoline only. Can require same gas brand. Maximum fuel-cell capacity 22 gals. Modifieds can run on any fuel, Hobbies on any fuel except one with an alcohol base. Any oil can be used in all classes. Dry sump oiling okay for GNs, GTs. Oil may be added during race.

USAC (Championship, Sprint, Midget, Late Model Stocks)—Championship, Sprint, Midget cars may use any fuel. Fuel cells required for all classes. Championship tank capacity cannot exceed 75 gals. Any oil okay. Dry sump musts for Championship, Sprint cars. No oil may be added during race. Stocks same as NASCAR, except no oil added during race.

SCCA—Pump gasoline for all classes, including Can-Am, Trans-Am. Fuel cells mandatory. Formula A, maximum fuel capacity 30 gals.,

Boss Man of the Glass Packs.

It's the Cherry Bomb, America's high performance muffler with the exciting, low throaty snarl. A straight-through design pushes back pressure down to push performance and gas mileage up. And the Cherry Bomb's fiberglass packing lasts longer. For new life on an older car, or more excitement on a new one, blast off with Cherry Bomb.

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Trans-Am, 22 gals. In SCCA racing, if you go dry on course, you must walk to pits, get fuel, walk back to car. No assistance allowed.

ARCA—Gas only. Max. capacity 22 gal. Any oil, may be added. Dry sump system prohibited.

IMCA—Same as ARCA for stocks. For sprint cars, any fuel okay except nitromethane.

Drag Racing—Anything goes that will go, except some ultra-exotic fuels. Again, depends upon class, type of competition.

DRIVER REQUIREMENTS

NASCAR—Minimum age 18. Under 21, parents or guardian must sign release. Valid state driver's license a must. Physical exam required. No driving test per se, but drivers under official surveillance at all times.

USAC—Minimum age 21. Championship cars, at least four years' racing experience, one in USAC. Sprint cars, three years' experience required. Midget cars, two years. All may be waived for prominent international drivers. Physical, written examination required. Same for stocks. Must take driver test for Indy.

SCCA—Minimum age 21. Valid state driver's

license required. For national competition, minimum experience of four regional races in last two years a must. For regional competition, must be graduate of SCCA driver's school, race two regional events under novice license. A novice license admits driver to SCCA school and two regional events.

ARCA—Same as NASCAR.

IMCA—Minimum age 21. Annual physical. Must prove ability to officials in first race.

NHRA—No minimum age. Physical required. Driver's test is oral exam at drag strip followed by actual driving at progressively higher speeds over longer distances.

AHRA—No minimum age. State driver's license required. Physical, written exam. On-strip driving test under surveillance of experienced drivers.

DRIVING RULES

NASCAR—To qualify, two solo laps, fastest lap counts. Overall fastest is pole winner, may sit inside, outside of front row. Cars line up two abreast, order determined by qualifying speeds. Under yellow caution flag, pace car goes on track in front of race leader,

Racing Rules *continued*

others line up in order. If race is stopped (e.g., for a rain shower), cars line up single file, no work allowed (even if car was in pits). Pit area considered track for scoring purposes. Race ends when winner crosses line, all others being flagged and scored on the basis of laps completed. Race called for any reason is considered completed if half of the race distance has been run by the leading car.

USAC—To qualify at Indianapolis and Ontario (Calif.), average speed of four laps determines starting order. Otherwise, qualification is on basis of fastest of two consecutive laps. At Indy, Ontario, second-day qualifiers line up behind first-day's, and so on. When 33 cars have qualified, the slowest car—regardless of the day it qualified—is the first to be "bumped," that is, taken out of the race. On yellow caution flag, cars bunch up behind pace car except at Indy and Ontario, where each driver is supposed to hold position, the same distance behind the car in front of him. Other race rules are generally the same as for NASCAR.

SCCA—No standing or LeMans-type starts this year; cars will be rolling at a moderate speed. To qualify, cars are timed during specific practice runs, the fastest lap determining position in starting order.

ARCA—Fastest of two laps determines qualification. Under yellow flag, cars bunch up, no car allowed in pit (if already in pit, crew can continue work). If car runs out of gas under yellow flag, can go to pit, but can't be serviced until green flag drops (five lap scoring penalty for violation).

IMCA—Essentially the same as NASCAR.

NHRA, AHRA—Elimination match races, two cars each race, standing starts. Cars go on green light. In NHRA, lights can be handicapped to allow smaller, less powerful car to get green light before bigger, faster car. In AHRA, faster cars are handicapped by addition of weight.

SIGNAL FLAGS

NASCAR, USAC, ARCA, IMCA—GREEN starts race. BLUE with YELLOW stripe, move over, let faster car pass. BLACK, come into pit area (usually used if car shows signs of mechanical trouble). YELLOW, caution, single file, hold position. RED, race stopped, clear track. WHITE, one lap to go. CHECKERED (black and white), end of race. USAC also uses a WHITE flag with a RED diagonal stripe to warn that an ambulance is on the track.

SCCA—GREEN starts race. BLUE with diagonal YELLOW stripe held motionless means another car is following close. If waved, flag means move over, let faster car pass. BLACK, go to pit; furred, improper driving. BLACK with ORANGE ball, come in, something wrong with the car. YELLOW, caution, no passing in danger area. YELLOW waved, great danger, no passing. RED, race stopped. WHITE, ambulance on track. CHECKERED (black and white), end of race.

Indy 500 Facts

The first driver to better 100 mph in winning the Indianapolis 500 was Peter DePaolo, who in 1925 was first across the finish line in a Duesenberg Special at an average speed of 101.13 mph. DePaolo's record wasn't equalled or surpassed until 1932 when Fred Frame won at an average speed of 104.14.

The first man to win the Indianapolis 500 three times was Lou Meyer, who won in 1928, 1933 and 1935. Other three-time winners include Wilbur Shaw (1937, 1939, 1940), Mauri Rose (1941, with Floyd Davis, 1947, 1948), and A. J. Foyt (1961, 1964, 1967).

Although never winners of the Indianapolis 500, two men—Cliff Bergere and Chet Miller—share the honor of having participated in the most races. Bergere and Miller started the race 16 times.

Winner of the most lap prize money in the history of the Indianapolis 500 is Parnelli Jones—\$75,050.

The first qualifier for the Indianapolis 500 to exceed 150 mph was Parnelli Jones in 1962—150.730.

Among currently active drivers, A. J. Foyt has competed in the most Indianapolis 500 sweepstakes—12.

Holder of the all-time miles-completed record in the history of the Indianapolis 500 is Cliff Bergere—6142.5.

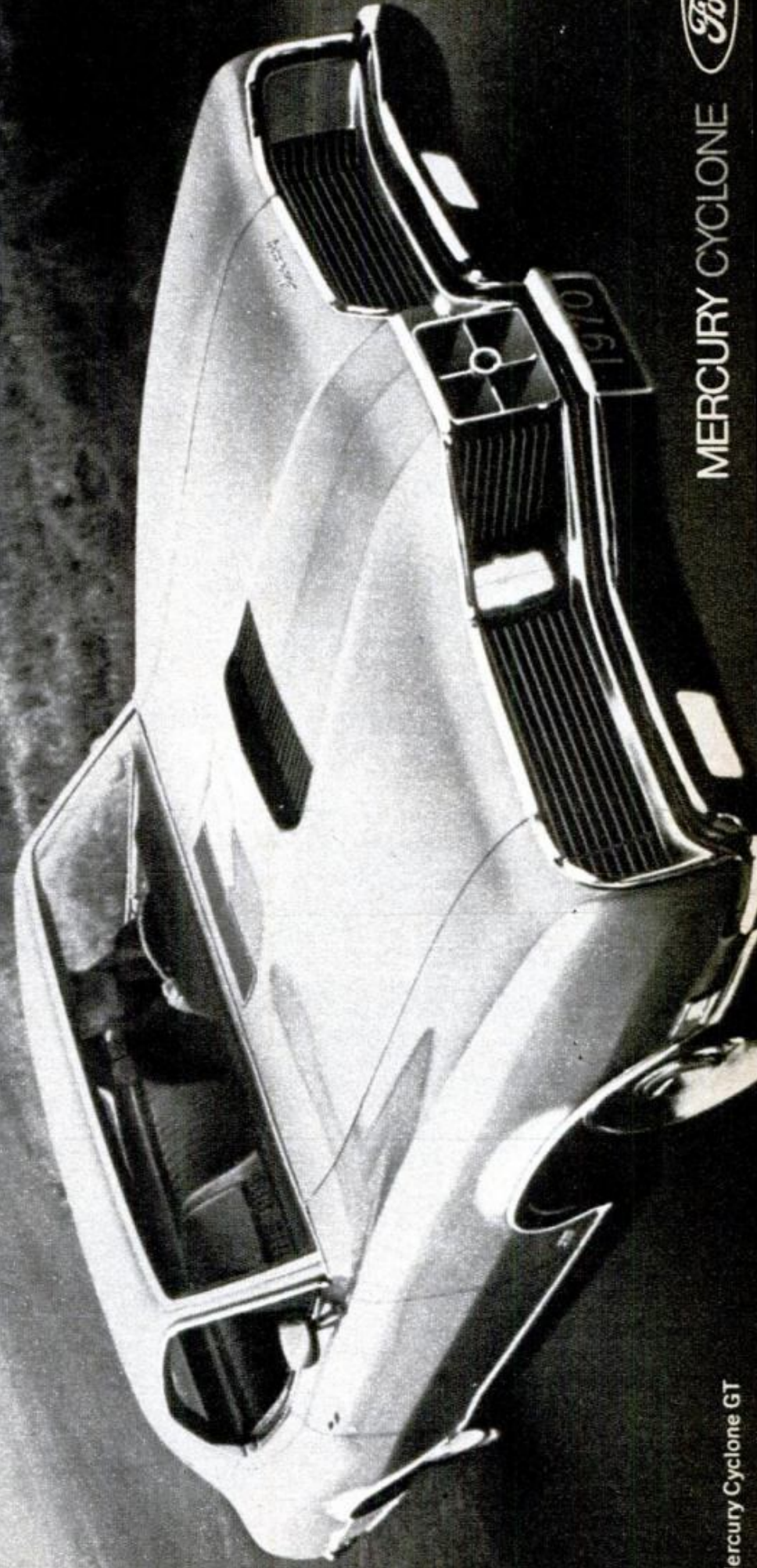
Among active drivers, A. J. Foyt has completed the most miles in the Indianapolis 500—4282.5. Close behind Foyt is Lloyd Ruby—4165 mi.

Ralph DePalma, who entered his first Indianapolis 500 in 1911, his last in 1925, still holds the record for having led the race the most number of laps—613. DePalma won the race only once, in 1915.

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New Cyclone GT. The street machine for men on both sides of 30. Scooped hood. Concealed headlights. Hi-back buckets. Cyclone running lights. F70 x 14 belted tires. 351 V-8. All standard. This

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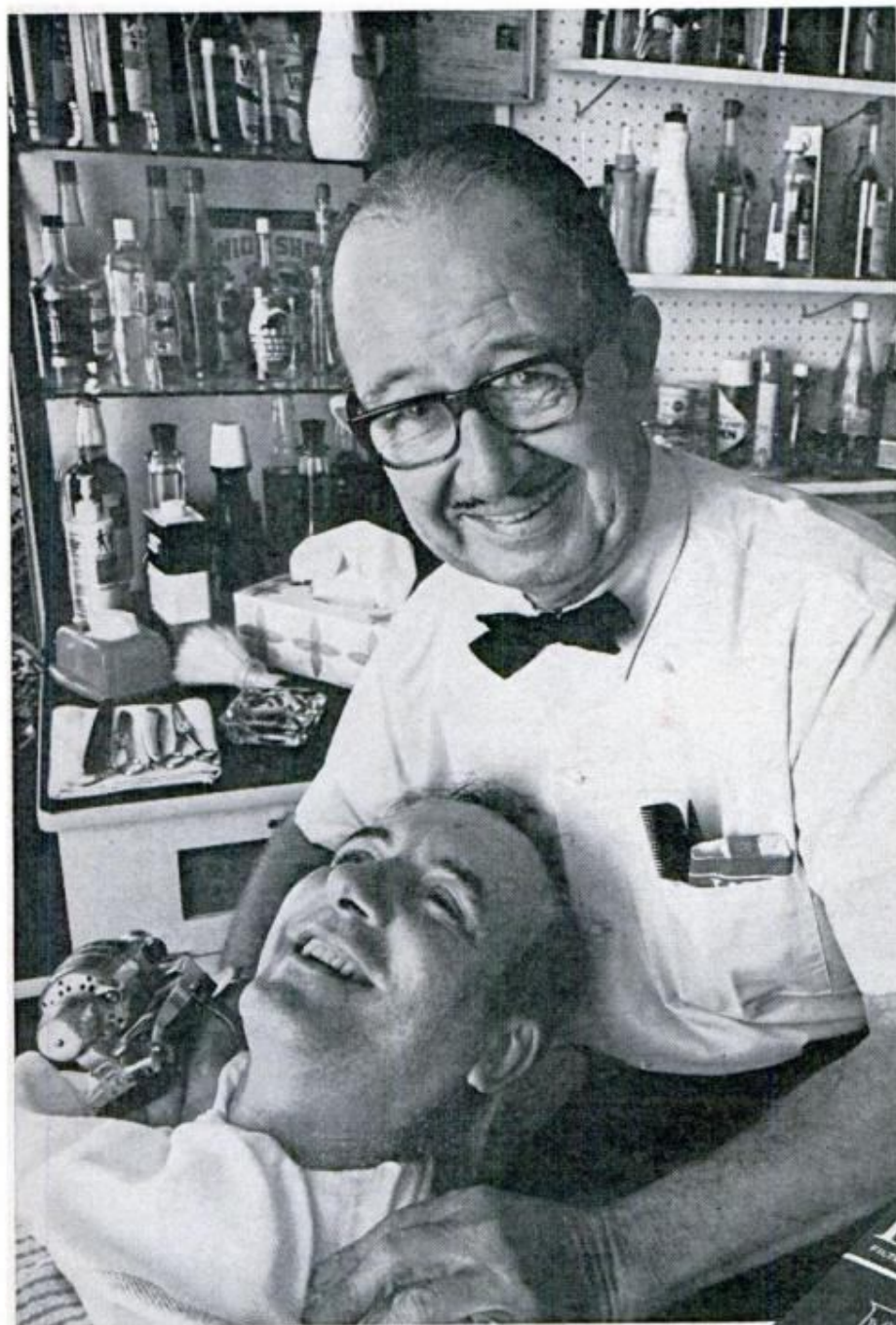


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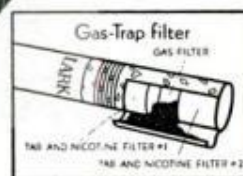
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The reversing feature lets you remove screws and bolts, or back out if the drill gets stuck in problem materials.

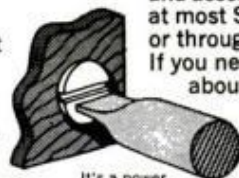
This drill has a tough aluminum alloy housing, ball-bearing

construction, a 1/2 horsepower motor, an eight-foot cord (that's two feet longer than most), and is UL listed. With the right accessories it can do the work of a sander, a polisher, a screwdriver, even a saw.

This is the kind of tool that can make the around-the-house handyman look like a pro. And it's just one of the thousands of fine Craftsman tools

and accessories available at most Sears stores or through the catalog. If you need a tool, just

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LETTERS

TO THE EDITOR

Everybody is happy

Your editorial, *Everybody's Happy But Esquire* (page 48, Nov. PM), was great. I agree with you entirely. Thanks for factual, intelligent editorials; they are rare. SPRING VALLEY, N.Y. CHARLES H. GARGIULO

In this crazy world of ours, thank God for human beings still left in it like you. Your editorial is the greatest. When your magazine is still being published, *Esquire's* will be in the trash can.

RENTON, WASH. MRS. DORIS G. BROWN

Expensive lesson

I enjoyed *How to Read an Oil Can* (page 134, Nov. PM). Even though I am well acquainted with the markings on oil-can labels, I had an expensive lesson in choosing oil.

A friend had several quarts of out-board-motor oil, so I figured that if a pint sells for 55 cents, it must be highly refined. I put it in my car and drove 1000 miles. The result: The shaft had to be reground and new bearings put in.

Let others take heed. Not only is oil different in density, but also in character.

NEW YORK STUDLEY FOSTER

'Fairway' in Fun City

The correct name of our P.G.A. pro is Frank Malara Jr. (*Electronic Golf Analyzer*, page 115, Nov. PM). And readers who try to locate the analyzer for proper fitting of custom golf heads will need additional information: It can be seen at the World of Golf, 147 East 47th St., New York. NEW YORK ANNE BRAHAM

Hall clock

After reading *PM's Handsome Hall Clock* (page 124, Oct. PM), I decided to tackle the project. However, upon contacting the lumber source you mentioned, I found the cost would be considerably higher than you stated. Also, I was informed they would not sell widths smaller than 5½ inches. Was I misinformed?

CHICAGO JAMES G. GIBSON

We'll answer with an unequivocal yes and no. The "yes" because we goofed in giving that \$30 price for wood. That's what it cost the author three years ago. Today, with prices skyrocketing, it's more like

(Please turn to page 8)

Special \$5 Offer

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Don't take *our* word for it—prove it to yourself! If you don't agree with every word we say about ICS's new TV Servicing/Repair course—we lose the bet and *you lose nothing*.

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Worth Much More

As a part of the complete course, this text is worth much more than \$5. This special trial is simply our way of showing you how completely confident we are that the ICS TV Servicing/Repair course can stand up to *any* TV Repair training you can get *anywhere*, at *any price*—yet the full cost is only \$99.

In just a few months you can be trouble-shooting on color sets. Just the first two texts combined will enable you to repair 70 percent of *all* TV troubles. Instruction is simple, very easy to grasp. Photos show you what a TV screen looks like when everything is normal, and what it looks like when trouble fouls it up. The texts tell you how to remedy the problem and why that remedy is best. What's more, quizzes are spotted throughout the course so you can check your progress.

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All in all, the course consists of 6 texts . . . 936 pages of concise, easy-to-follow instruction . . . plus 329 detailed illustrations . . . a dictionary of TV terms geared directly to course material—which will be invaluable during the course and later.

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Send the full course. I've included \$99—plus state tax. (And I'll still have the 10 day trial refund privilege.)

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Soup up your engine.

Here's the soup.



GUMOUT. A canful in the tank does the job. Cleans your carburetor as you drive. Dissolves gum and varnish in the fuel system on contact.

You'll start faster. Idle smoother. Get more power on less gas.

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Available in Canada

Send self-addressed, stamped envelope
for your free GUMOUT racing decal.

LETTERS

(Continued from page 6)

\$100. And "no" because the dimensions shown in the materials list are work-pieces; it's not a shopping list. You'll have to cut, rip and sometimes edge-glue to make up the sizes.

Caution for chess builders

A word of caution to those planning to build the chess set (*Make this Handsome Chess Set*, page 162, Nov. PM).

Chess is played with the red (or light colored) square in the right-hand corner of the checkerboard facing the player. The color photo on page 163 has the men set up wrong in relation to the board. They should be set up so that the open drawers are to the right and the left of the board (and the players).

Furthermore, the diagrams on pages 164-165 show the red (light colored) square placed the opposite of the picture on page 163.

A builder should decide which way he will place the board before he stains the checkerboard squares. I would assume he would want to stain the squares the way you show in the color photos for two reasons: The drawers can be left open to the right and left of the players and the captured chessmen placed in them; thus both players can see what pieces have been captured. And the players can get closer to the board (some chess players tend to huddle over the board).

IOWA CITY, IOWA

WILLIAM ALSTON

Error on page 162 diagram: four knights, not two.

LOUISVILLE, KY.

J. ROBERT GRACE, D.V.M.

Not all that new

As I receive my issue of PM from a friend in Canada, it's usually behind time, so I trust you'll excuse the delay.

In *Stretches Tire Mileage* (page 16, July PM), the "new British toy" is not a new one at all. As a child of 8 (I'm 40 now), I used a toy exactly like the Buffer Roll About, getting much enjoyment from rolling down the neighborhood's hilly streets until I bumped into a kerb. The type of tyre used in those days was usually from a Glasgow Corp. doubled-decker bus.

Your illustration shows a wooden disc inside the rim of the tyre. In my day, the wood was nailed across the edges of the tyre, and instead of four casters being used, it was usually two roller skates.

Our parents didn't call it a toy, but insisted it was a damned menace to others.

LANARKSHIRE, SCOTLAND IAIN T. PATERSON

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"What started as a hobby, now pays me \$10 an hour"

Yes, many MUI graduates make better than \$10 an hour turning old wornout furniture into bright new decorator pieces! Stack it up against what you're doing now! Are you making \$150 a week? \$200? \$250? Do you put in long hours of dull work, with small raises? Is that the way you want to spend the rest of your life? Just imagine, you can make \$150, \$200, \$250 upholstering just one chair or sofa these days! And if you're the kind of person who likes to work and earn, you can sometimes finish a job like this in a day. That's pay, ... and it beats what most college graduates make!

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When you read the papers you see there's a strike here, a lockout there, Detroit lays off 150,000 men. A plant is shut down and moved out of state. A new automated machine eliminates 5,000 jobs. They talk about dislocated workers and try to do something about it. What pays the bills if you get caught up in one of these situations? When you know upholstering, life gets very simple and lots of fun. It's simple because where there are people, there are upholstery jobs and lots of them. It's fun because life is fun when the bills are paid and there's money in the bank, even enough to buy those things you've always wanted for yourself.

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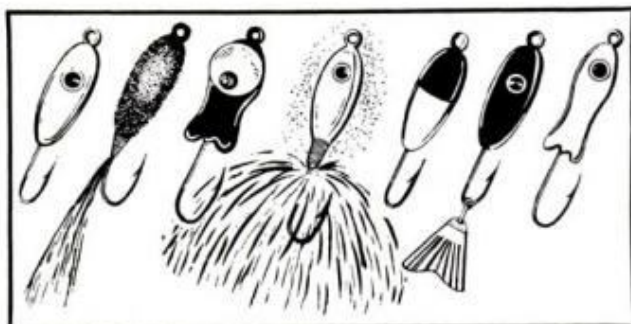
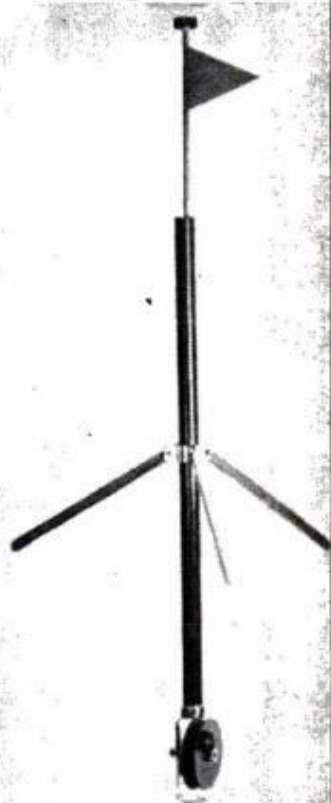
WHAT'S NEW OUTDOORS

BY GEORGE REIGER

ST. BERNARDS REPLACED? A new electronic device, 7½ inches long and slim enough to be carried in a parka, has been developed by Cornell Aeronautical Laboratory to assist in the rescue of skiers or climbers buried in mountain snows. The instrument, known as the SKADI beacon, emits a beeping signal that can be detected from above even if victim is trapped under many feet of snow. The same device can be switched to receive emitted beeps. It's now being evaluated by ski patrols and snow wardens, but it may be some time before SKADI is commercially available.

NEW FOR ICE FISHERMEN. A magnetic tip-up claims to be both freeze and fool-proof. Called the Pop-Up, the mechanism is set when a small but powerful magnet at the base of the pennant shaft is pushed in contact with another magnet on spool. When a fish strikes, the two magnets separate, and a pennant springs up from concealment within the tube. List price is \$5.49 from the Worth Co., Stevens Point, Wis. 54481.

Fin Baits, a subsidiary of Fred Arbogast, is offering a 12-lure pack of ice jigs for \$4.30. All Fin jigs have heavy, plated finishes—metal with baked-on enamel and lacquer finishes—and use Mustad hooks. For additional information and catalog, write to Fin Baits, 1000 Fairview Ave., Hamilton, Ohio 45015. ★★★





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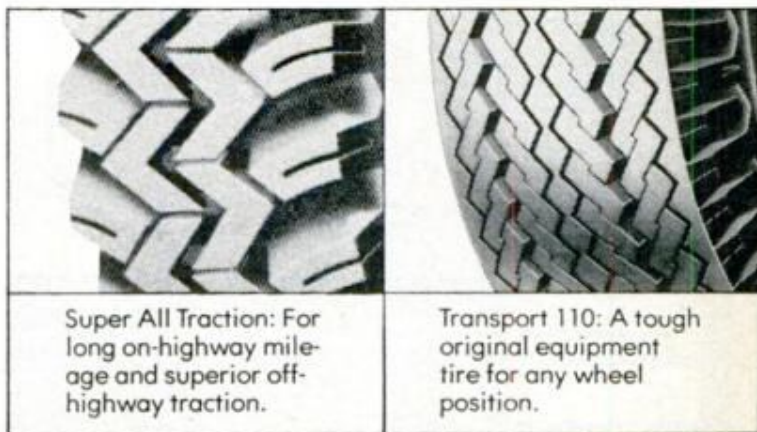
For example, there's the Transport 110, an all-wheel tire from Firestone with quiet running and long mileage built right in. Moreover, a tire with remarkable impact resistance, and construction that minimizes flex damage.

And for a brawny tire that will really dig in and grab in mud, snow and deep ruts, Firestone makes the Super All Traction. This rear-wheel tire just plain eats up the unexpected!

Firestone makes both these tires with its exclusive Triple-Strength Construction. That's the special way Firestone bonds the tread to the body, reinforces the sidewalls and insulates every cord.

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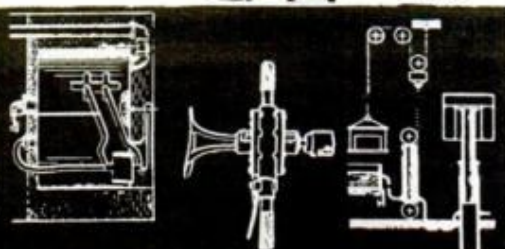
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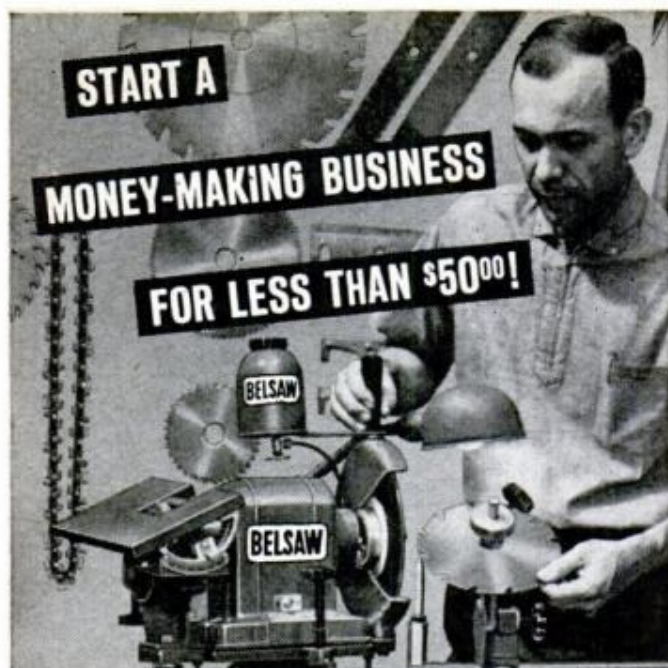
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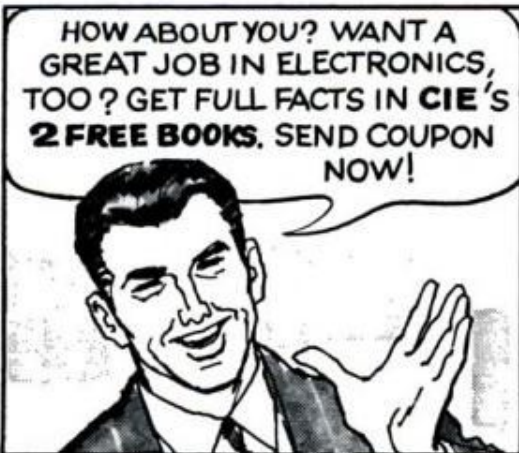


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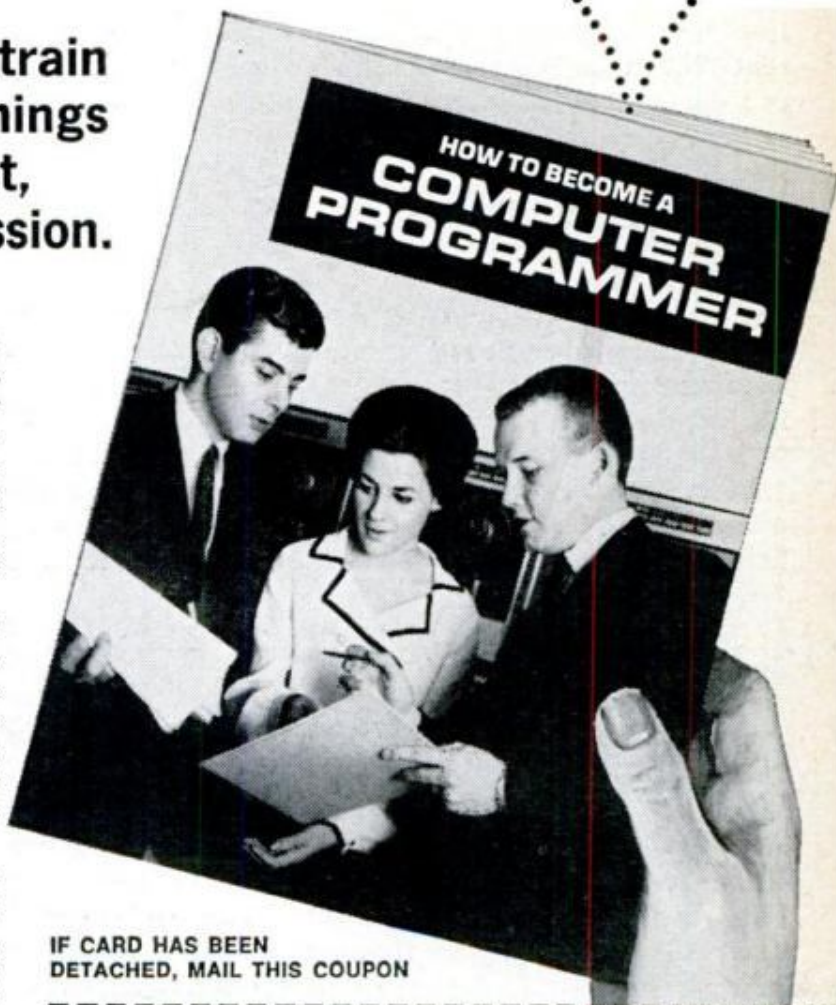
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Science Worldwide BY JOHN F. PEARSON

Drastic global climate changes will occur within the next 50 years if the use of fossil fuels keeps rising at current rates. That warning comes from Eugene K. Peterson of the Department of the Interior's Bureau of Land Management. Increased levels of carbon dioxide would raise worldwide temperatures 9° through a "greenhouse" effect: CO₂ traps heat reflected from the Earth's surface, warming the atmosphere. The temperature rise, says Peterson, is likely to cause a virtual disappearance of snow from the U.S. mainland; an increase in earthquakes and volcanic eruptions, the latter adding to the CO₂ problem; a four-foot rise in ocean levels, and an absence of ice in the Arctic Ocean for six months of every year.

Ordinary fluorescent lights are used to treat jaundice in infants at Duke University Medical Center, Durham, N.C. Invisible rays emitted by the lights break down the jaundice-causing substance, bilirubin, so that it can be excreted without doing harm. Twelve 40-watt fluorescent tubes hang over the treatment bassinet, and the baby is blindfolded to protect against eye damage. In newborns, jaundice can lead to damage of the brain and central nervous system.

Precast concrete planks may provide a solution to a chronic bridge problem: the tendency of concrete surfaces to crack, making the structure vulnerable to further damage as de-icing salts seep in and attack reinforcing steel. In a method developed by Purdue University engineers, concrete is cast into planks that have a projecting rib on one side and a groove on the other. They fit together in much the same fashion as do boards in tongue-and-groove flooring. Once bridge supports are up, claim the Purdue engineers, an entire concrete plank-ing deck can be laid in 24 hours. The planks are said to be more durable than concrete poured on site because they are made under controlled conditions and are prestressed. (Prestressing is accomplished by casting the plank around a wire under tension. As curing progresses, the tension is released and the wire shortens, compressing the concrete along the axis of the plank.) The system is scheduled to be field-tested next spring.

Careful when you open that bottle of bubbly. A New York lab, retained in a legal case involving an eye injury, recently determined that pressures in champagne bottles kept at room temperature ranged from 69 to 86 pounds per square inch. Refrigeration cuts the pressure in half, but that's still enough force to permit a popped cork to dent acoustical tile in a ceiling.

A new 120-foot radio telescope is under construction near the Danville, Ill., site of the University of Illinois astronomy facility. Made of steel and aluminum, the instrument will be a steerable parabolic dish. Noteworthy is the fact that the work is being done solely by university staff members, students and nonacademic employees, all working part-time.

"Pot hounds" are being trained by the Army at Fort Gordon, Ga. Assigned to search teams, the dogs are trained to react only to the scent of marijuana. "If we walk a dog through a building and he doesn't smell anything, we're relatively sure the place is clean," says one of the trainers. It takes about 12 weeks to turn a dog into an effective snooter that can spot 8 out of 10 hidden caches of the weed. Eight teams of men and dogs are being trained in a pilot program designed to help stop the marijuana traffic within the armed services.

The "quakes" detected by the seismometer left on the moon by Apollo 11 astronauts may be nothing more than rumbles from the abandoned descent stage of the lunar module. According to Dr. Gary Latham of Columbia University, director of the seismometer experiment, a new look at collected data indicates that many shock waves were caused by leaking gases and "creaks and pops" of contracting and expanding metal in the LM stage. ★★★

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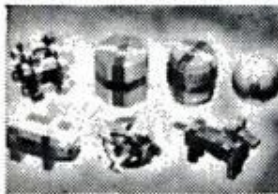
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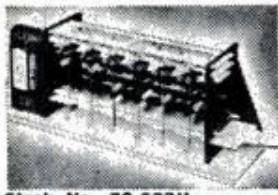
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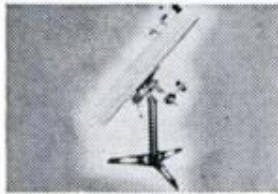
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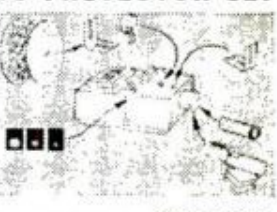
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DETROIT

LISTENING POST

BY BILL KILPATRICK

BATTLE CLOUDS are forming as the industry and insurance companies square off over the issue of basing premiums on frequency-of-accident data and repair costs for specific models. That's the way the insurance companies want to go, but automakers don't like the idea. They're afraid that ratings by insurance companies would downgrade their more expensive models. New-car buyers, they fear, might opt for low-line cars pretty much to the exclusion of medium and luxury units in order to take advantage of lower insurance rates. No one is certain yet as to how the battle will be fought, but some insiders guess the final result will be a compromise involving specific models.

A MAJOR EFFORT is underway throughout the industry to scale down the size and complexity of car components and accessories. No secret to car owners—particularly of higher-priced models—is the baffling maze of wires, belts and “things” to be found under the hood. The industry knows engine compartments are crowded, appreciates that complexity boosts service costs all down the line. As a result, management is leaning on engineering departments and suppliers to come up with smaller, simpler rigs to do the various jobs now done by comparatively bulky units. Breakthroughs in the field are still a long way down the pike, but one source told us the next ten years would result in “outstanding progress toward miniaturization of most components and accessories.”

CAR BUYERS in increasing number are reported as unhappy over the skimpy trunk room provided on many high-volume cars. Gripe mail indicates they like the generally sporty styling, but take a dim view of trying to pack enough for, say, a two-week trip in a luggage compartment able to handle little more than a couple of suitcases (if that). It could lead to an industry-wide kiss-off of “long hood, short rear deck” styling.

BIG DRAWBACK in the development of turbine engines for car use right now, according to GM headman Ed Cole, is “the exorbitant cost of fabricating and inspecting (gas turbine) wheels produced by a conventional high-temperature casting process.” Cole, speaking recently before a Philadelphia gathering of material engineers, said the need in turbine development is for “a new material and process combination which will reduce the cost of a small turbine wheel by 80 to 90 percent to make it competitive with major components of the internal combustion engine.”

Breakthroughs in the materials field over the next three decades, Cole added, could help solve some of the most critical problems facing the auto industry. He cited as priorities such developments as materials that would be “strong but yielding,” enabling engineers to fabricate a completely safe instrument panel; a material capable of a temperature change from under 100° up to 2200° F. in a matter of seconds with minimum expansion, making possible complete combustion of any unburned fuels moving through the exhaust system, and a material with “the capability of remembering its original shape after being deformed.” He said the latter material, which could be restored to its correct shape by gentle heat or pressure, could substantially reduce car repair costs.

Cole told the engineers that advances in materials technology in the near future “will open up entirely new avenues for improving the traditional type of automobile, or even for developing completely new concepts of design, propulsion and versatility.”

PLYMOUTH, out of big-time stock-car racing last year following superstar Richard Petty's “defection” to Ford, will make a full-scale, factory-backed return this season with the recently introduced SuperBird, a special version of the Road Runner. Featuring a “shark nosed” front end and a high (25 in. above the rear deck) rear stabilizer that is very much like the setup on Dodge's Daytona Charger, the Plymouth Super-

(Please turn to page 26)

How to get rich

How can you get rich some day? Make a hit record . . . a killing on the stock market . . . or invent a gadget like the hula hoop?

For most of us, these are just dreams. But have you ever stopped to think that there is a way to get rich—possibly only one sure way? Most fortunes, as you know, are made by people who own their own business.

Perhaps you've thought of starting a small business of your own . . . a franchised drive-in, or maybe a service business. Trouble is, you need \$10,000 to \$15,000 to get started and even then it's a gamble—with slim chances of ever making really big money.

But there is *one* business which could make you rich—almost overnight! And the beauty of it is, you can start on a shoestring during your spare time, even while holding your regular job.

Cash by Mail

The business is Mail Order—and it's fabulous! Come up with a 'hot' new item . . . and WHAM!

It strikes like a bolt of lightning! Suddenly, you are deluged with cash orders from all over the country . . . MORE MONEY than you could ever make in a lifetime!

Like the Vermont dealer who ran one ad in Sports Afield Magazine. His ad pulled 22,000 orders—over A HALF MILLION DOLLARS IN CASH!

There is no other business where you can make a fortune so quickly!

● A beginner from Newark, N.J., ran his first small ad in House Beautiful—offering an auto clothes rack. Business Week reported that his ad brought in \$5,000 in orders. By the end of his first year in Mail Order, he had grossed over \$100,000!

● Another beginner—a lawyer from the midwest, sold an idea by mail to fishermen. Specialty Salesman Magazine reveals, "he made \$70,000 the first three months!"

Proof

It's a fascinating business! Running ads in newspapers and magazines . . . mailing gift catalogs . . . getting cash orders in your daily mail—steady as clockwork.

There is no other business where you can start on a shoestring and pyramid your profits—without investing in merchandise! One husband and wife mail order team took in \$40,000 selling one item. They obtained FREE ads in national magazines . . . didn't invest a cent in merchandise, and even got the supplier to ship all orders for them!

These exceptional cases are absolute proof that you can get rich in your own Mail Order business. Very rich. Even a U.S. Gov. Report stated: "A number of

one-man Mail Order enterprises make up to \$50,000!"

Pick up any magazine. Notice how the same mail order ads are repeated . . . month after month? That's concrete proof! You know those ads wouldn't be repeated over and over again—unless they were bringing in big cash profits to their owners.

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The secret of getting rich in Mail Order lies in *financial leverage*. It's a little-known, almost secret method—using other people's capital to make money for you!

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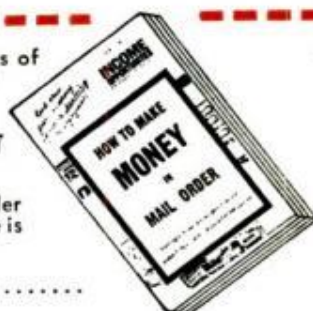
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DETROIT LISTENING POST

(Continued from page 24)

Bird (below) will have three engine choices—426 Hemi and two versions of the 440. Overall length is 17.2 in. longer than the standard Road Runner. Plymouth plans to build at least 2000 units by mid-month in order to qualify the car for sanctioned



events this year. And don't be surprised (in fact, it may have been announced by the time this appears) if Petty is once again on the Plymouth team.

A NEW SPORTS/LUXURY two-seater—Datsun's 240-Z—has been introduced in this country by Nissan Motor Co., further evidence that Japanese automakers, already making noteworthy inroads into the U.S. import market, have their eyes on an even bigger slice of the pie. The new car (below) brings to six the number of Datsun models available here, the others be-



ing a 510 sedan or station wagon, a 1600 sports car or pickup, and a 2000 sports car.

The 240-Z is powered by an all-new 2.4-liter (146-CID) Six said to produce 150 hp and a top speed of 125 mph. Weighing 2238 lbs. on an 89.9-in. wheelbase, the 240-Z features four-wheel independent suspension and four-wheel disc brakes. Overall length is 161.3 in., width 63.6 in., height 49.1 in. The price? Under \$3500.

IF YOU normally note such things, you'll be interested to know Chevrolet produced its 250,000th Corvette as of last Nov. 7. First brought out in 1953, the Corvette remains Detroit's only stab at an all-out sports car. As of this writing, the car's best sales year was 1968—28,874 units. ★★

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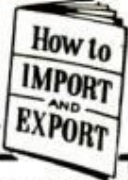
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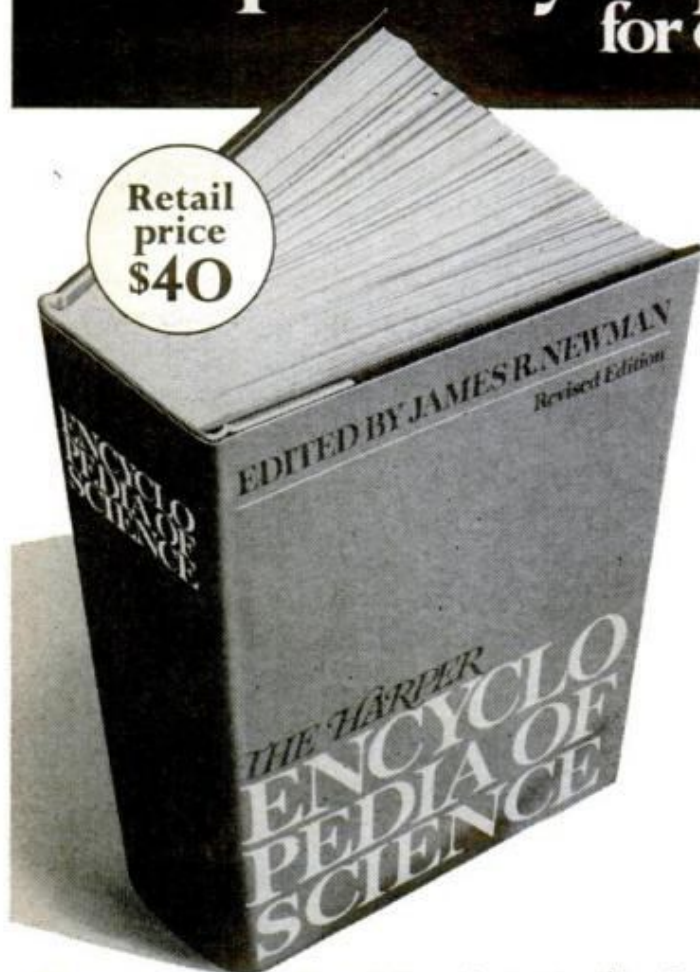
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Drivin' with Dan

What do pit-crew signals mean to a driver? How much does a NASCAR stocker and equipment cost? Can top speed be calculated if gear ratios are known? Dan Gurney answers these and other automotive questions

Q. At the U.S. Grand Prix this year, I could see the pit crews signaling their drivers, but I couldn't understand what they were saying. Could you explain what information drivers get and how it is coded to them?—John McMenamin, Collingswood, N.J.

A. It usually consists of how many laps remain to be run to the finish in the form of a number. Your position in the race, usually shown as P-3 (third position), the distance in time behind 2nd place, usually shown as -12 (you were running 12 seconds behind 2nd place on the previous lap), the distance in time you are ahead of 4th place, usually shown as +7 (meaning you are seven seconds ahead of 4th place). If they gave you -12 Stewart, +7 Jones, you would also know who the men ahead and behind are.

Q. How much does a NASCAR stocker—plus equipment like truck, trailer, tools and spare parts—cost? And what Ford street engine has the most power?—Bill Shuman, Athens, Ga.

A. My guess is approximately \$65,000, not

including the costs of transportation or labor during the season, also not including repairs or spare parts for more than one or two races. I'd say the Boss 429, but, I think the 429 Cobra Jet has better performance on the street.

Q. What kind of shoes do you wear when you're driving in a race?—Jim Epp, Freeman, S.D.

A. Blue tennis-shoe-style sneakers.

Q. Which would be more powerful, an engine producing 230 hp at 4400 rpm, or one producing 220 hp at 5000 rpm? How does rpm affect power?—Kevin Staff, San Diego, Calif.

A. 230 at 4400. Horsepower is a product of torque and rpm. Torque is the amount of force that an engine can exert on a scale, or, how much weight it can lift at a particular rpm. An engine that can lift 200 pounds at 6000 rpm has the same horsepower as another that can lift 400 pounds at 3000

(Please turn to page 34)



SOMETHING NEW for the 1970 racing season will be Dan Gurney driving a Plymouth Barracuda in the Trans-Am series. Dan and Glenn E. White, Chrysler-Plymouth general manager, symbolically link new Barracuda with All-American Racers via an AAR decal



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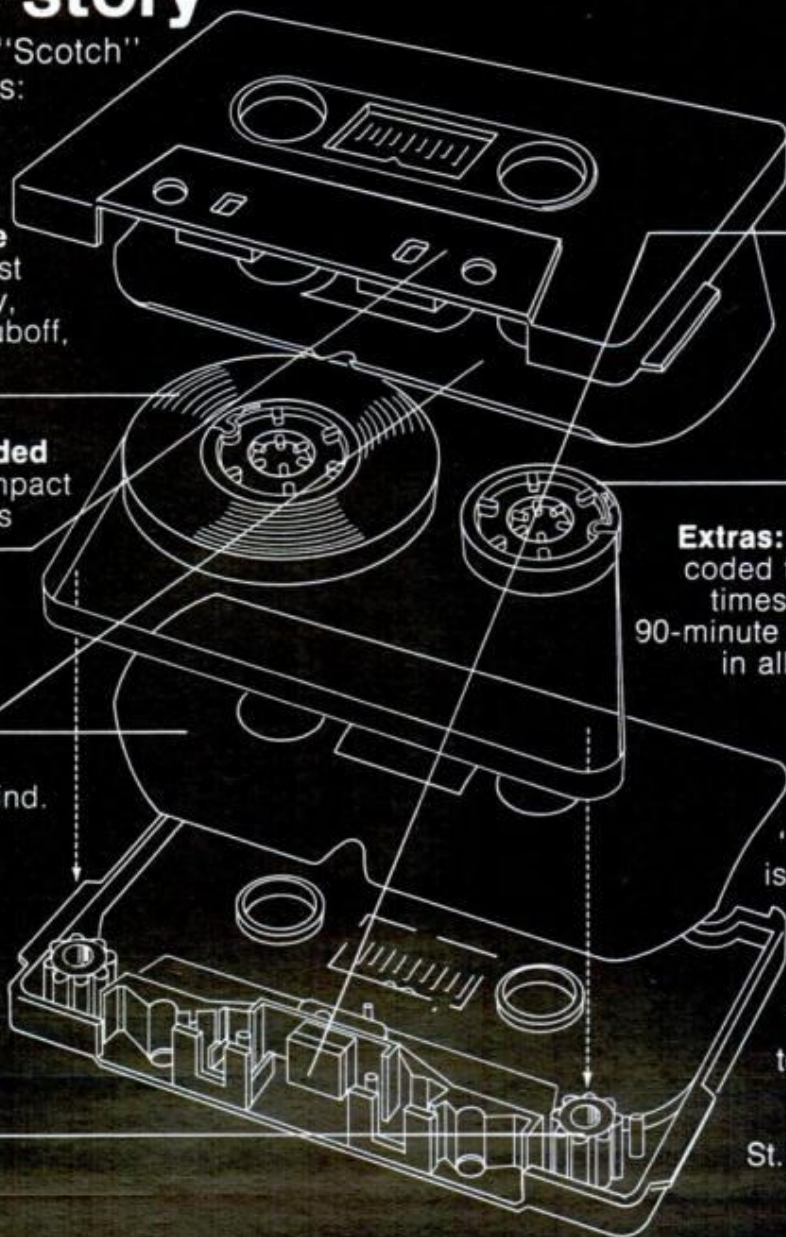
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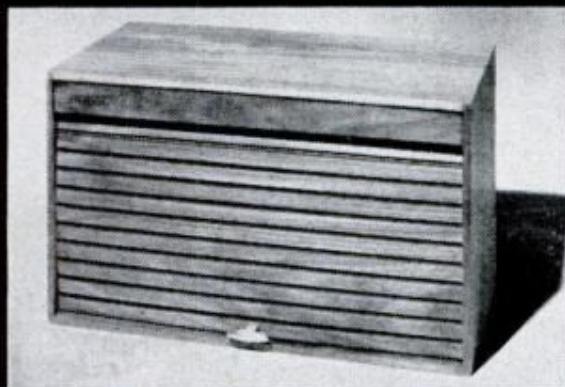
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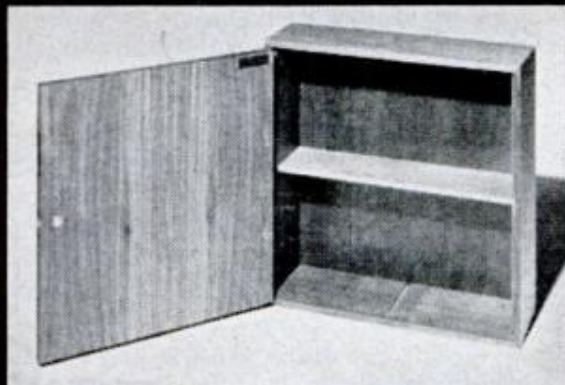
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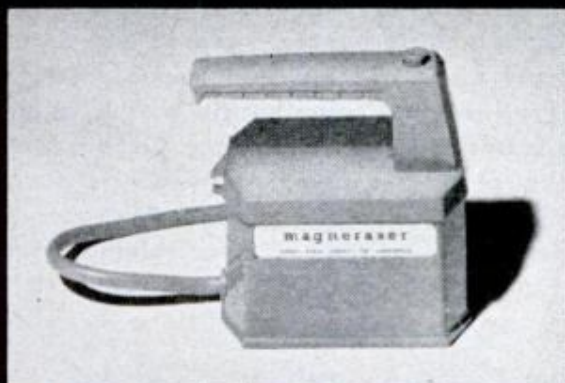
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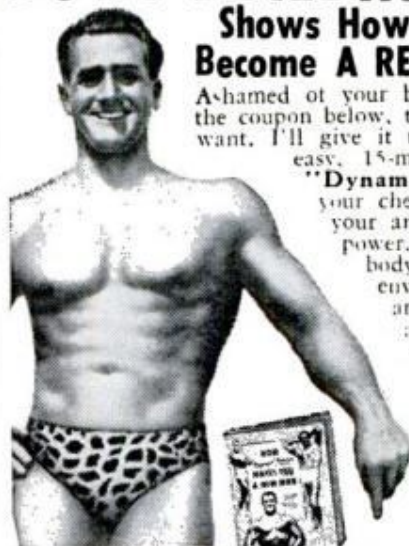
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DRIVIN' WITH DAN

(Continued from page 30)

rpm; or, if you hooked up the 3000 rpm engine to a 2-to-1 rear axle or final drive, it would have the same power available at the rear wheels as the above-mentioned 6000-rpm engine would deliver at the rear wheels with a 4-to-1 rear end or final drive ratio.

Q. Can I compute my maximum speed in each gear with a three-speed automatic if I know the tire size and gear ratios? If so, how?—Donald Revson, Fort Francis, Ont.

A. Yes. You do it in the same way as you would compute your speed in top gear using the ring and pinion ratios. In the lower gears you multiply the first or second gear ratio by the final drive ratio, then divide the rpm by that number to see how many rpm your wheels make at a given engine rpm. Allow for two mph slippage in an automatic, but that's just a guess.

Q. I saw you drive a team McLaren car from last to third in the Michigan Can-Am. What are your thoughts on the car you drove and the McLaren domination of Can-Am so far?—William K. Horton, Somerville, Mass.

A. Very good question. I must say that it was an excellent car; however, it did not have any extremely outstanding characteristics. It just seemed to be very good in every department, and I could not uncover any real faults. If I think harder, I would say that it had the ability to get the power down on the road without spinning the wheels, and it was very good over hard bumps in that it did not bottom the suspension easily. The power was good, but not excellent. The car absorbed a real beating without coming apart. They are the best, and they will be hard to beat, but it certainly can be done.

Q. I will start driving soon. What kind of emergency equipment (tools, spares, and so on) should I carry in my car?—Stephen McFarland, Clermont, Ind.

A. Good spare tire and jack, a flashlight, rags—a dime for a phone call. After that you can go on and on, depending on where you're going and what conditions you can expect to encounter.

Q. In cars with a fully synchromesh four-speed, *(Please turn to page 38)*

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DRIVIN' WITH DAN

(Continued from page 34)

it's possible to shift without the clutch by pulling the shift lever out of gear and holding it lightly against the next gear. As the engine speed decreases or increases to the right speed, the lever slips into gear. Is this harmful to the car or good for it?—John Hermack, Emerson, N.J.

A. It puts an added strain on the synchro mechanism unless you do it perfectly. It will wear the synchro more than normal shifting. If you can do it perfectly, you won't wear out your clutch pedal and mechanism as fast as you would normally but—she just wasn't designed to operate that way, and I'd say it's good for your left leg muscles to use them once in awhile.

Q. Why does Graham Hill compete only in Grand Prix races?—Craig Barnett, Fresno, Calif.

A. He also competes at Indy (he won once), and in Formula II events. I have driven against him at Le Mans, Sebring and Nurburgring in sports cars and prototypes. I've also raced him in Saloons (British stock cars). He also plays Ping-Pong and squash, is an extremely talented speaker. He is a businessman, flies his own plane, and has a very nice family with two children. At present he's recovering from two broken legs incurred in the U.S. Grand Prix and hopes to be back racing again this year.

Q. What is the proper way to put a car in a four-wheel drift?—Arthur Siegel, Rego Park, N.Y.

A. As I see it, a drift occurs in NASCAR Grand National oval racing more than anywhere else. I don't know the proper procedure for putting a car into one, but I'm convinced you can't do it with all cars. It requires a careful balancing of the tires and suspension and aerodynamics and power, so that the front and rear wheels maintain similar slip angles. Front wheels should be pushing or plowing (mild understeer) a bit. It is different for each car, usually; it happens when you get very near the maximum cornering potential of the car. ★ ★ ★

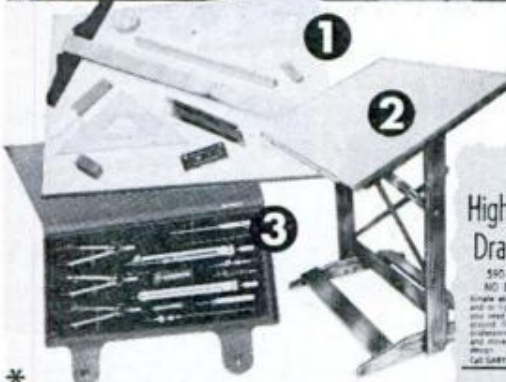
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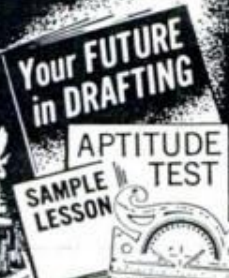
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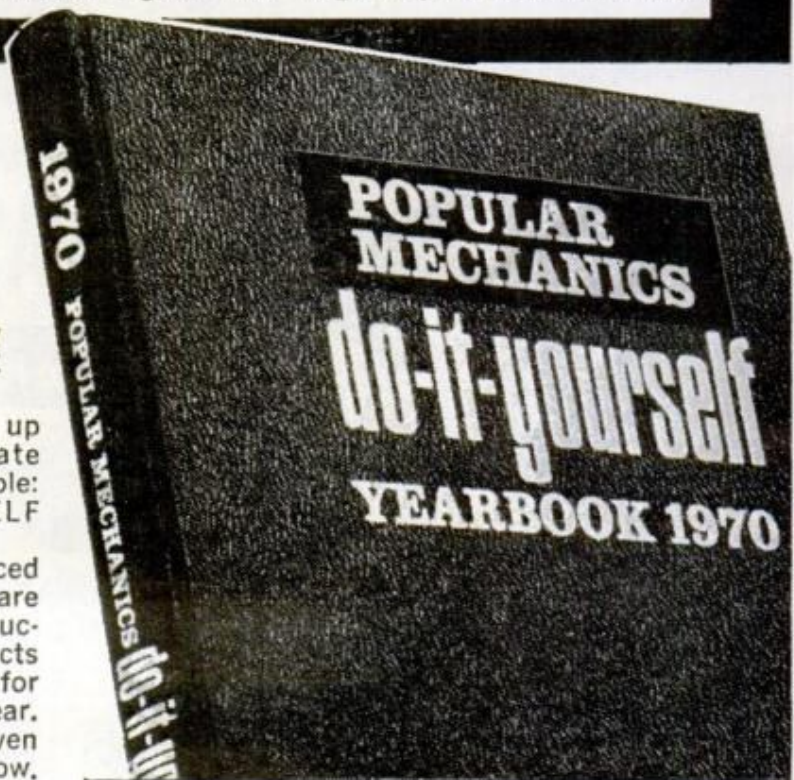
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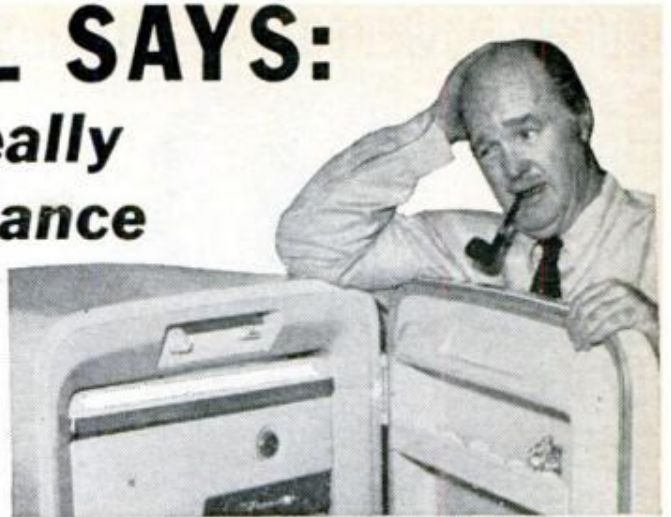
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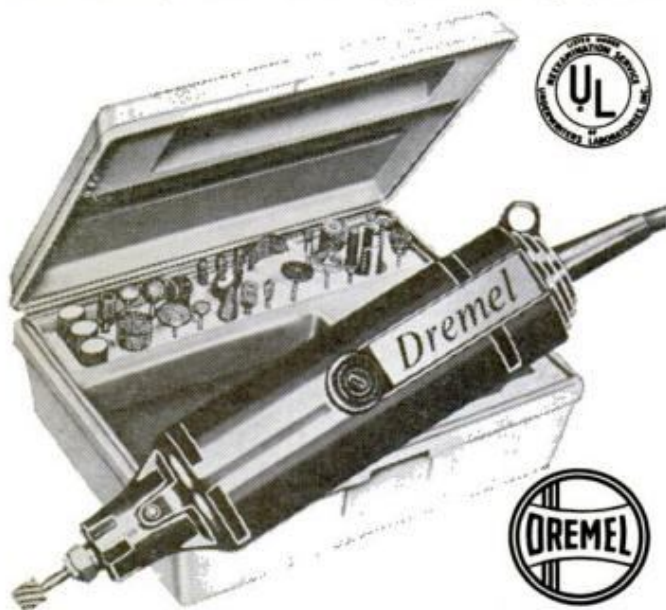
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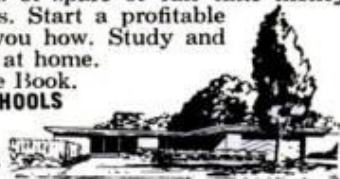
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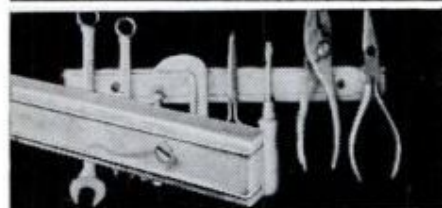
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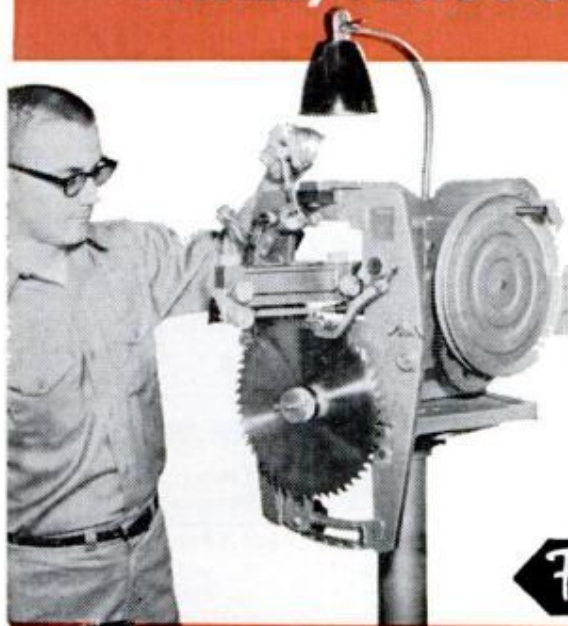
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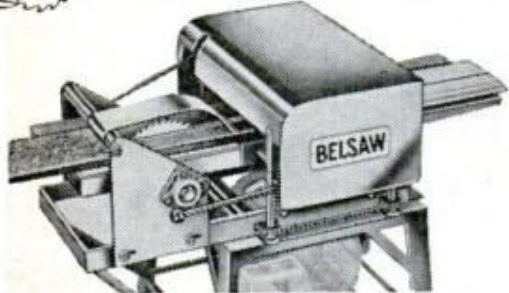
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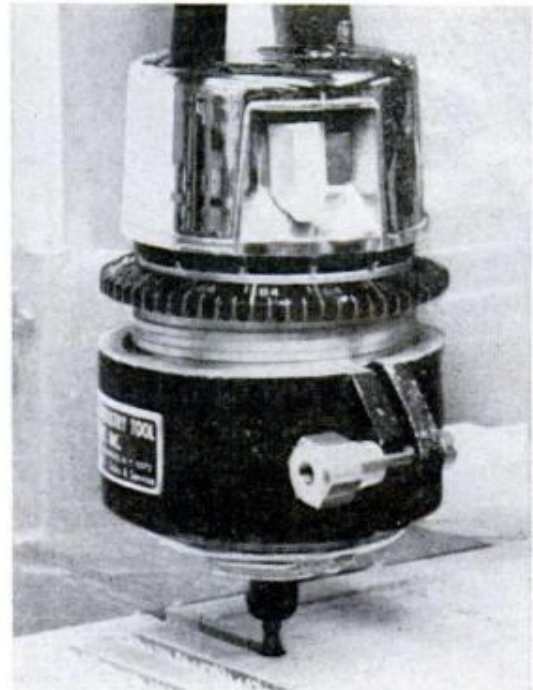
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UTILITY KNIFE features front-loading blade change that eliminates need to take knife apart. Button is simply pushed forward and to right, and blade falls free. Replacement blades store in handle, are readily accessible. Knife and three blades, \$1.75. Stanley Works, 195 Lake St., New Britain, Conn. 06050.



INSECT FOGGER powered by 6-oz. can of butane gas produces dense white fog, kills insect pests on contact. Heating coil in "nose" of the tool vaporizes insecticide, forces the fog out through nozzle. The treated areas can be occupied immediately. Burgess Vibrocrafters, Inc., Grayslake, Ill. 60030 is the maker.

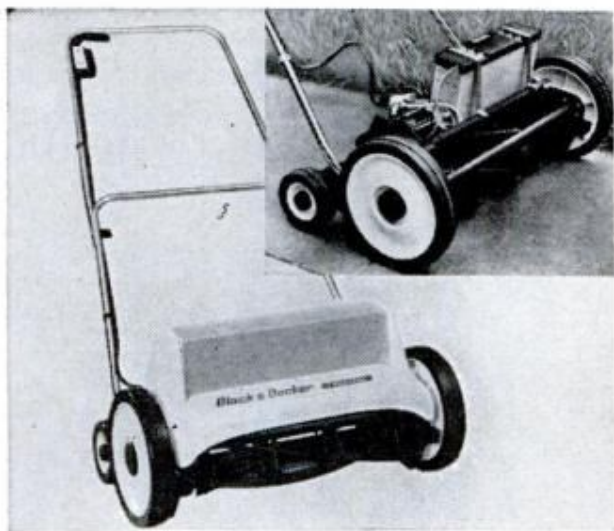
3



SCRIPT HOUSE NUMBERS go on quickly because they are self-sticking, use no screws or nails. Custom cast in rustproof metal, numerals (in black only) come in 3 and 5-in. heights. Gem Marketing Corp., Atlantic City, N.J.

Hardware Show

PM editors scouted the National Hardware Show last fall to see what new and updated items would be available for home, yard and shop in 1970. Here's what they found



CORDLESS MOWER introduced by Black & Decker is claimed to be the nation's first battery-powered, four-wheel reel-type mower. In 18-in. cutting width, it is priced at \$130, including battery and charger, six cutting heights from $\frac{1}{2}$ to 3 in., self-sharpening, shock-absorbing clutch and fold-down handle.



PORTABLE GRILL dubbed Hi-Rise is designed for picnic-table as well as ground locations—it has an adjustable center post that attaches to a tripod base. Legs move up and down to adjust grill height from 18 to 26 in. Sold through hardware and department stores. Structo Div. of King-Seeley Thermos Co.



QUICKER SAWING is possible with this handsaw since it cuts on both push and pull strokes. Induction-hardened teeth never need sharpening. Black Prince saw, about \$9. Spear & Jackson Inc., 30 Church St., New York, N.Y.



STEEL HANDLED SHOVELS, said to be an industry first, will add years of service, according to the maker, True Temper Corp., 1623 Euclid Ave., Cleveland, Ohio 44115. The Rocket model comes in round or square-point blades.



SPIKE SPRINKLERS provide gentle, even watering where needed, can remain in place when not in use. Bright yellow 6 and 10-in. models are \$1.50 and \$1.75 respectively. Burgess Vibrocrafters, Inc.

(Please turn to page 76)

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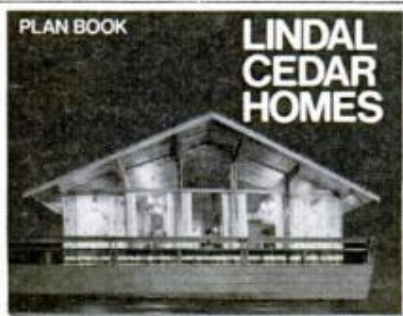
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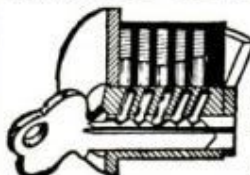
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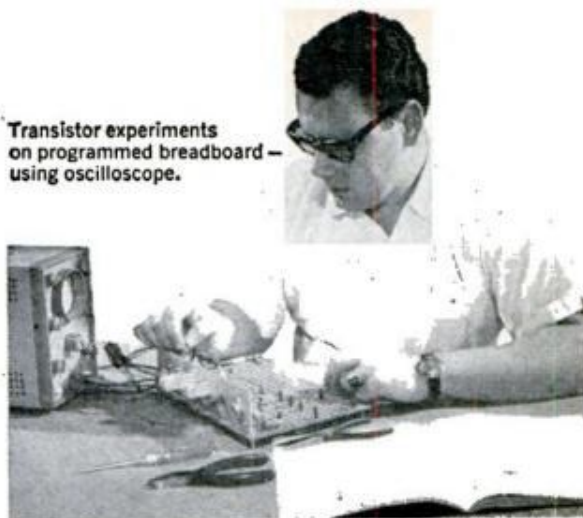
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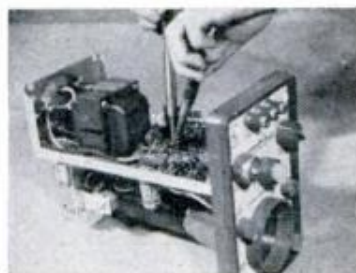
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HARDWARE SHOW

(Continued from page 51)



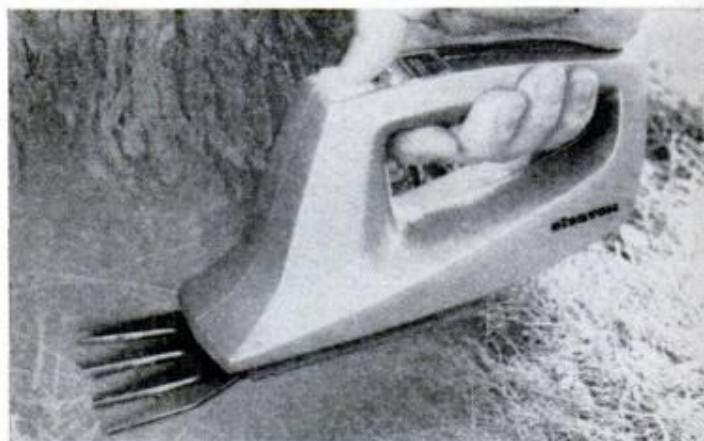
PRUNING SHEAR with "ratchet-cut" action lets you snip $\frac{3}{4}$ -in.-thick branches effortlessly. In use, blade is placed on a branch and handles squeezed. When handles are opened, toggle advances to next notch; when closed a second time, cut is completed. Pruner PR-19 is \$5.95 at hardware stores and garden centers. The Stanley Works, New Britain, Conn.



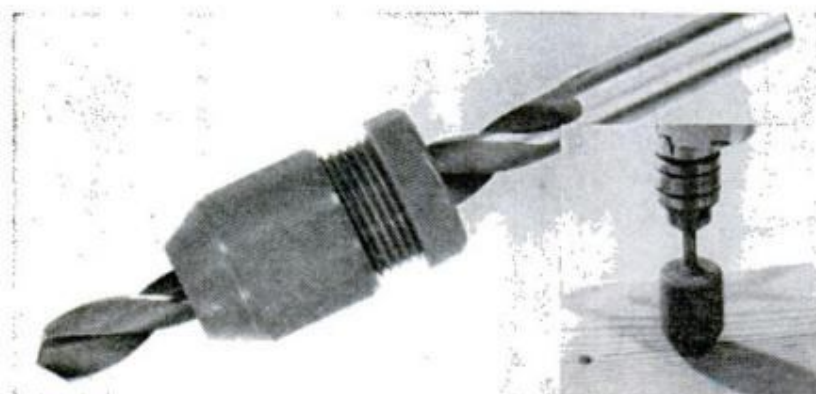
ELECTRIC HIBACHI from Meteor Div. of NuRod, Inc., 135 East Railroad Ave., Monrovia, Calif. 91016, is said to be the gourmet way to infrared cooking. UL-approved, self-cleaning heat element draws 1500 watts to insure quick searing to seal-in tenderizing juices. Rest of unit is easily washable. Model M-185, about \$20 with a year's guarantee.



SOLDERING IRON-GUN combines advantages of a lightweight pencil-type iron and a fast-heating gun for efficient handling of both light and heavy-duty soldering with tip temperature control. Two powerheads are available to fit the 7-oz. tool: 700° F. 3/16-in. chisel point and 600° F. conical point. Weller Electric Corp., Easton, Pa., is the maker.



LIGHTWEIGHT ELECTRIC SHEAR—without cord—introduced by H. K. Porter Co., Inc., is powered by nickel-cadmium batteries that can be recharged indefinitely. The maker claims that one charge lasts for an hour, more than enough for the average lawn. The recharger can be plugged into an ordinary outlet to recharge battery overnight. \$34.95.



DRILL-DEPTH CONTROL is easy when drilling many similar holes if you slip a Drill-Stop on the bit and lock it by turning a threaded collar. This hard-plastic stop comes in two sizes to fit bits ranging from 1/16 to 1/4 in. and from 1/4 to 1/2 in., costs \$1 and \$1.25, respectively. Made by Central Drill & Tool Co., Chicago, Ill. 60607.

(Please turn to page 78)

Be a LOCKSMITH



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**"\$642
WHILE
LEARNING**



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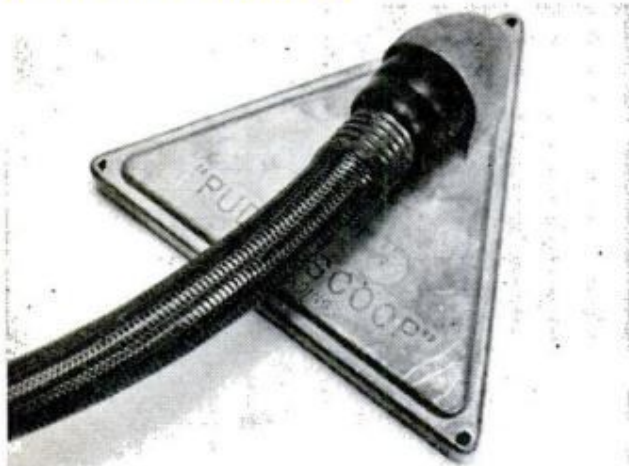
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HARDWARE SHOW

(Continued from page 76)



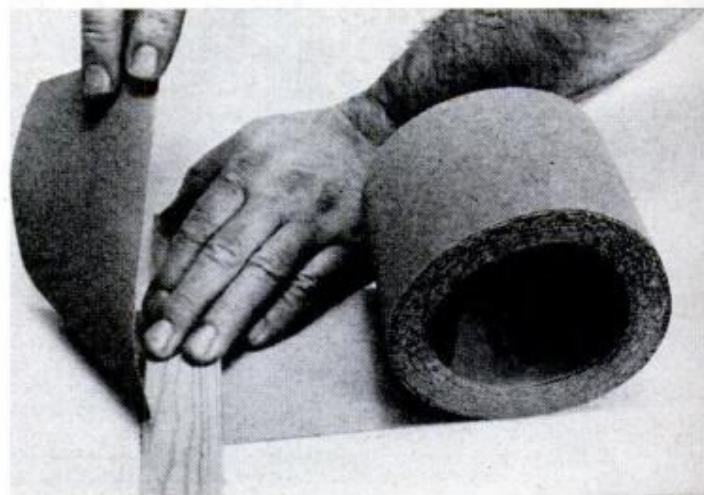
SUCTION STRAINER operates like a vacuum cleaner attachment when used with any suction pump, will pick up puddles from floors, boat bilges, pools, roofs and the like. Just push the threadless rubber connector onto male end of a garden hose (as shown) or $\frac{3}{4}$ -in. pipe. Pud-L-Scoop, \$3.29. Simer Pump Co. 207 Humboldt Ave. N., Minneapolis, Minn.



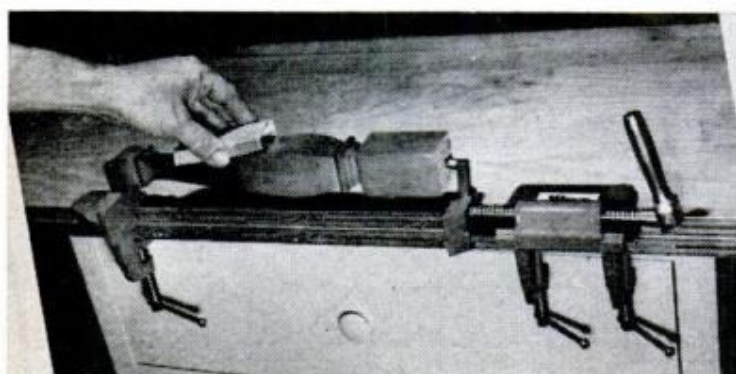
LATEST SHELVING eliminates need for vertical standards because shelf brackets with keyhole hardware (inset) hook over wall-mounted screws. The Mediterranean-design shelf system will blend with nearly any decor, and solid-core construction insures sagfree shelving. Edgecraft, 4351 Valley Blvd., Los Angeles, Calif. 90032, is the maker.



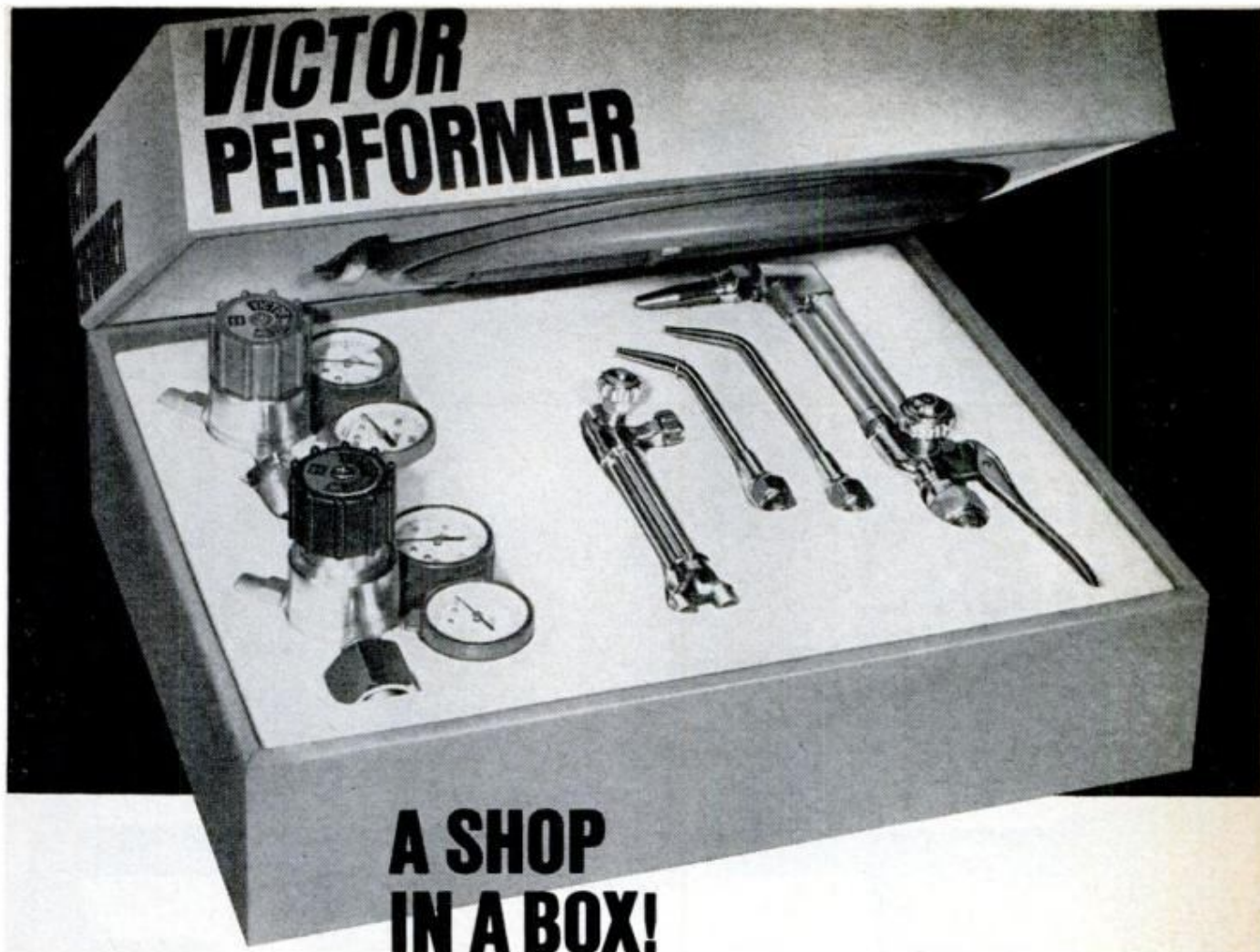
WIRE-REEL PACKAGE said to prevent snarling and waste is the Reel-O-Wire, available in three gauges. Wire packed in steel frame can be reeled off like ball of twine and cut to desired length at special cutter notch. Sold through hardware stores at \$1.29 for nylon-coated, \$1.19 galvanized. USM Corp., 22 Oley St., Reading, Pa. 19601.



ROLL-FORM SANDPAPER does away with the old-fashioned way of tearing sheets in half to fit a pad sander. You just roll out the length you need and cut it off. In fine, medium and coarse grits 35, 30 and 25-ft. long, respectively, rolls cost 88 cents or three for \$2.49 at hardware stores. Coastal Abrasive & Tool Co., Box 337, Trumbull, Conn. 06611.



VERSATILE HEAVY-DUTY VISE will hold any size workpiece (e.g., door, leg, square object) when its two separate components are clamped on edge of a workbench. Two jaws with special milled centers can be raised to clamp round objects such as dowels or rods—tightening device in one jaw provides firm, solid grip. It's priced at \$20. Witherby Tool Co., Inc., Trumbull, Conn. 06611.



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AUTOMOBILE CLINIC

BY MORT SCHULTZ

Disc brake trouble

After 16,000 miles I got very jerky braking action with my 1967 Mercury with disc brakes. A dealer corrected whatever the problem was. Now at 31,000 miles I have the same trouble. What's wrong and how can I stop it from repeating?—Nathan J. Hunsicker, Allentown, Pa.

One or more of the rotors have probably gone out-of-round because of too much stress caused by improper braking action. A rotor in this condition can be trued by machining if damage isn't too severe. I suggest you examine the way that you're braking the car. Frequent heavy braking and engaging the brake when going over railroad tracks will put stress on the rotors and cause this problem.

Getting his bearings

I burned out a set of rear-wheel bearings in my 1966 Buick station wagon. It happened at 50,000 miles. Isn't this premature? Does the fact that the car has a limited-slip differential have anything to do with it?—Terry L. Moll, Shamokin, Pa.

Many things have an effect on rear-wheel bearing life, including use of vehicles over different types of terrain, weights of loads carried, conditions and speed of operation—high speeds cause faster wear. Buick tests show that bearings can fail at any point up to 150,000 miles. This doesn't mean they will; many times bearing life exceeds this. The fact that the car has a limited-slip rear end has no effect on the life of the rear-wheel bearings.

Too hot to start

Why is my 1968 Chrysler with 440-cu.-in. engine so hard to start when it's hot? Then, when it does start, it idles very rough. The dealer has been unable to help.—James Duane, Phoenix, Ariz.

You don't say so, Jim, but I'll bet the car's equipped with a four-barrel Holley carburetor. Arriving almost simultaneously with your letter was a Chrysler-Plymouth (and Dodge) service bulletin, describing the same trouble. According to Chrysler, the problem is probably a warped secondary metering block. It's happening to 1969 models, too. A modification kit has been issued under part No. 3514459. The service bulletin explaining it to Chrysler-Plymouth shops is D69-14-4. The number of the Dodge bulletin is D69-14-5.

The car is a 1967 Oldsmobile Cutlass with 330-cu.-in. engine. The problem occurs when I first start off with the car cold. If I floor the accelerator, the engine dies completely. When it's warmed up, there's no trouble. A tune-up, new choke mechanism and rebuilding the carburetor haven't helped. What will?—Al Hallam, Baltimore.

Post mortem

Reading your owner's manual and following the "rules." If your carburetor is a four-barrel, as I assume it is, the rear barrel doesn't open until the engine is warmed up. It operates by a thermostatic coil. Thus, a cold engine rapidly accelerated will starve for fuel and stall. The owner's manual cautions you not to go past half-throttle until engine is warm. Anyway, what good are you doing that engine by floorboarding it when it's cold?

I bought a 1967 Ford LTD with 21,000 miles on its 289-cu.-in. engine. Valve lifters are clicking something fierce, especially at idle. The dealer's garage told me I should run the car for several more thousand miles and the noise will go away. What do you say?—Robert J. Watt, New Brunswick, Canada.

Troubles don't disappear

They wouldn't print it. The five-year or 50,000-mile warranty is still in effect on this car, isn't it? Tell the dealer to put in the new type of rocker arm distributed by Ford as a replacement for the one originally put into this motor.

The only thing wrong with my 1966 Chevrolet Caprice four-door hardtop is hopping of the front end on a blacktop or concrete road that's the least bit wavy. It runs smooth on an expressway. Wheels

A shocker

(Please turn to page 82F)

KNOCK KNOCK

Loose piston pin? Or is it a loose rod bearing?
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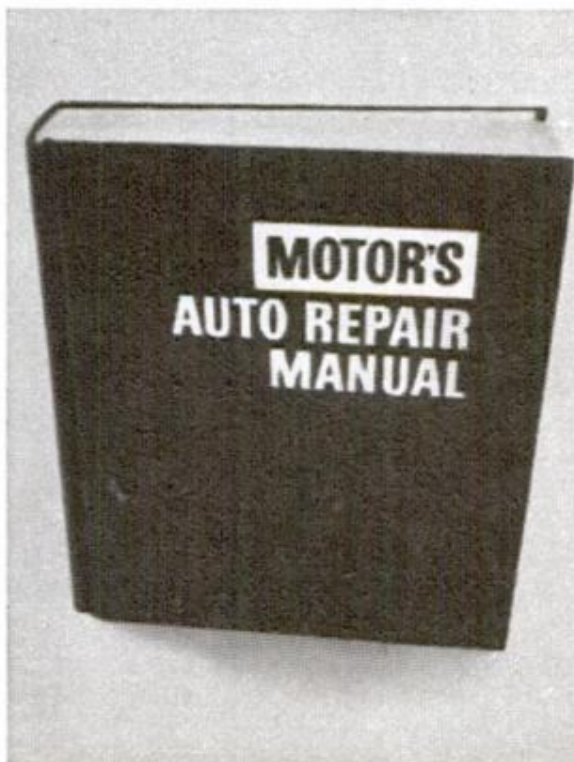
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Thunderbolt (no points at all) from the 135 down through the 40 hp. Mercs from 20 through the 4 hp have new *Maker-Point* Thunderbolt: the plug is fired by the points making contact. This reduces arcing and increases point life. Result: points used in the Mercs from 20 hp down are designed to last the life of the engine. Both systems are capacitor-discharge type and have the incredibly fast Thunderbolt rise time, which zaps up to 40,000 volts to the spark plugs in microseconds. With Thunderbolt, Mercury continues to have the fastest, hottest spark in the industry—fastest, surest starts for every Mercury in the line.

135 hp. That's right. 135 hp.

Sleek slim powerhouse—world's most advanced family outboard. Mercury's exclusive 6-cylinder in-line design. Direct Charging and Thunderbolt ignition. With an engine no larger than last year's 125 hp, the Merc 1350 gives you all this additional power, plus amazing fuel economy. And it has all the engineering integrity you expect from Mercury. New Merc 1350—nobody else even comes close.

Four new Direct Charging Mercurys.

Two sixes, a four, a two. In addition to the 6-cylinder Merc 1350, three more Mercs for '70 feature Direct Charging: the 6-cylinder Merc 1150, the 4-cylinder Merc 800, and the 2-cylinder Merc 400. Technically, what happens inside a Direct Charging Mercury engine is this: the unique design of the transfer passages, inlet ports and piston shape gives precise control of the incoming fuel-air charge for most efficient cylinder filling and elimination of exhaust gases, giving

Ignition—with spark plugs to last the life of the engine!



tremendously increased power and efficiency. Coupled with Mercury's Thunderbolt ignition system, this produces more horsepower per cubic inch—more miles per gallon—more horsepower per pound—more horsepower per dollar. Put very simply, Direct Charging means a lot more power in a lighter, more compact package, with less investment and lower operating costs. Again in 1970—a Mercury exclusive.

New Perma-Gap spark plugs designed to last the lifetime of the engine.

With ordinary spark plugs, the center electrode is gradually eroded away by the spark. Now Kiekhaefer engineers have come up with a new, super-tough metal alloy for the center electrode that resists spark erosion. Under normal operating conditions, your new Perma-Gap spark plugs will last the lifetime of the engine. Hard to believe, but it's true. All new 1970 Mercurys are equipped with Perma-Gap spark plugs. Another Kiekhaefer

engineering first and a Mercury exclusive.

Thunderbolt ignition and Perma-Gap spark plugs prevent spark plug fouling and preignition due to lead deposit. Because of this, you can now take advantage of the wide availability and uniform consistency of regular automotive gasoline recommended for every model in the 1970 Mercury line.

See your Mercury dealer now. Pick up your copy of the exciting new Mercury Catalog. You may just want to put your order in early. And avoid the rush. Because—for 1970—it's going to be a Mercury year all the way.



COMPLETE RANGE OF POWER: 4, 7½, 9.8, 20, 40, 50, 65, 80, 115, 135 HP.
For Nearest Mercury Dealer, see the Yellow Pages under "Outboard Motors."
Kiekhaefer Mercury/Fond du Lac, Wisconsin/Canada, Ltd./Australis Pty. Ltd.

AUTOMOBILE CLINIC

(Continued from page 82B)

have been balanced, front end aligned and new shock absorbers installed. The dealer says he's done everything. Oh, yes—tires are new 8.25x14s with 28 p.s.i. Help!—Miss Jean Rouse, Chillicothe, Ill.

According to Chevrolet, Jean, the cause of your trouble is "front tires that are not within limits insofar as out-of-round is concerned." Have your tires checked by a Chevy or tire dealer with a radial run-out gauge. Tires should not exceed 5/64-in. runout. The check should be made with the tire mounted on the wheel.

Bottoms down

I have a 1968 Pontiac Firebird that has a serious bottoming condition. The dealer has no solution. Is there one?—Edward Pickett, Holtsville, N.Y.

Yes, but now it's going to cost you more money to do what should have been done when the car was first ordered. You need heavy-duty shocks and springs. It's advisable for anyone buying a sports car to drive the demonstration model to make sure he can live with the ride.

Pressure pains

I installed a set of gauges in my 1967 Corvair, and now I'm worried by what I see with the oil pressure. The gauge reads 40 p.s.i., which is okay I suppose, but when I slow down to idle, it drops to 20 p.s.i. Is there something wrong?—William S. Charin, Fairfax, Va.

The figures are right in the ball park.

Tips from readers

Here are a couple of helpful hints from *Auto Clinicians*:

J.W. of Pheasant, Mich., writes that owners of 1969 Ambassadors who have trouble heating the car in winter should close all the dash outlets. Turn the heat on high and the blower on full blast. Then, he says, turn the defroster on halfway, and you'll get all the heat you need.

Buddy E. Raines of Albuquerque, N.M., warns you to be careful when buying a new coil to replace an original equipment part which has burned out. If you get a hot coil and install it without an appropri-

ate resistor, you'll burn up the distributor points.

Thanks for your help, gentlemen.

Telltale fluid

I was just told that the automatic transmission of my 1966 Mustang was brown in color and should be changed because it was burned. Can you tell me why this happened in only 22,000 miles?—S. B. Ohrenstein, Burbank, Calif.

If things have gone too far, I'm afraid you have a problem. The clutch and brake bands of the transmission are coated with a substance to help combat friction. The brown in your fluid indicates that this substance has been burned away. If too much has been lost, a transmission overhaul is going to be needed. You'll know it when the transmission starts to slip. To try to avert it, drain the fluid, clean the filter screen, clean the pan, clean the valve body and adjust the bands. Why did it happen? The most common reason is improper use of the transmission—things such as rocking it back and forth, or putting a load on it by improper shifting methods while traveling.

Service Tips

● 1969 Plymouth service manuals may be leading you astray—if you're using them to time the ignition of your Valiant with 170-cu.-in. engine and automatic transmission. The timing spec in the manual is wrong. It calls for timing to TDC (top dead center). The basic timing setting for this engine is 2½° ATC (after top center).

● Oldsmobile V8 engine head gaskets should never be coated with a spray-on sealer before installation. Olds says the sealer won't hold and the gasket will fail. It recommends coating both sides of a head gasket with GM sealer (part No. 1050026).

● Some Chrysler Corp. cars with 318 and 383-cu.-in. engines and two-barrel carburetors have been experiencing detonation knock under light acceleration. The company says the adjusting screw in the distributor vacuum advance must be turned one turn counter-clockwise (383 engine) or two turns counter-clockwise (318 engine) to reduce the spark advance by 4°. The procedure is outlined in Chrysler-Plymouth service bulletin 69-9-7 and Dodge service bulletin 69-8-9. ★★

GOT A PROBLEM WITH YOUR CAR? Ask Mort about it. Send your question to Auto Clinic, *Popular Mechanics*, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of general interest will be published in the column.



I'd like to give this to my fellow men... while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my

summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest \$15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

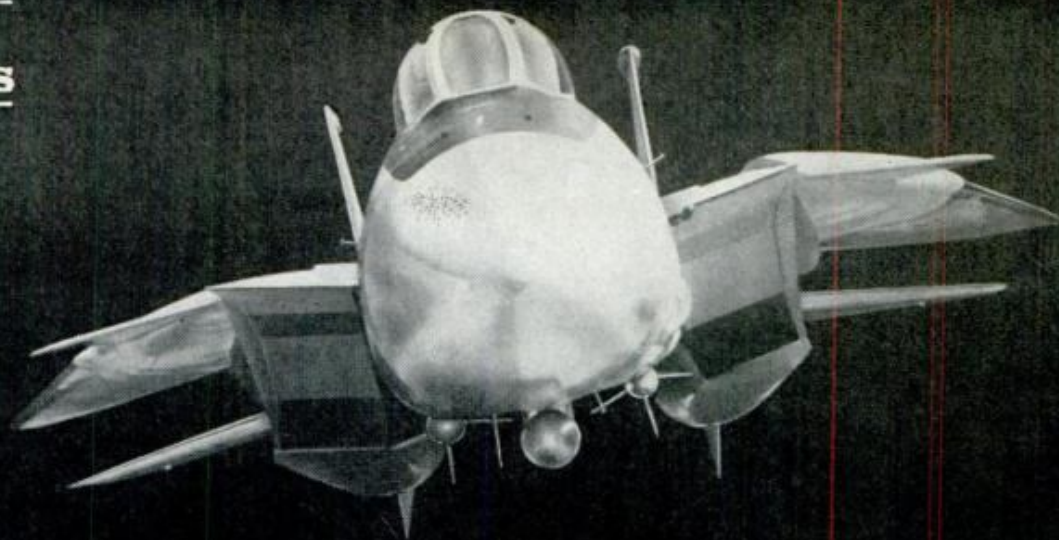
VICTOR B. MASON
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CHICAGO, ILLINOIS 60626

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KOOL

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A Hot New Fighter For the Navy

By KEVIN V. BROWN

The F-14 is designed to roll and turn at supersonic speeds and outshoot planes threatening our fleet. It's the Navy's substitute for the controversial F-111

A PLANE OF REVOLUTIONARY DESIGN was conceived some years ago, a plane meant to be all things to all military men. It would fly high or skim treetops, fly slow or faster than sound. It would fire missiles, shoot cannons or drop bombs, and it would operate from landlocked airfields as well as carriers far at sea. It was the F-111, a craft that caused a ruckus, political and military, that has yet to fully subside. Some dubbed it "McNamara's Folly," a slap at the former secretary of defense who championed it.

Nevertheless, the F-111 found a home with the United States Air Force. But the Navy, also slated to adopt it, finally said no. Among other complaints, the Navy said the plane was too hefty for carrier service. The Navy went hunting for a substitute—and Grumman came up with the F-14.

First and foremost, the Navy explains, the F-14 will not try to be a plane that does everything. It will be just what its designation implies, a fighter—a dogfighter in the old tradition. It will turn and roll with the best of them, even at supersonic speeds, keep up with most of them straight-and-level, and outshoot any

of them with guns, rockets and missiles. It will fly fast and it will fly long.

In short, the F-14 is an air-superiority fighter, designed to clear the skies of anything that might threaten the fleet.

Of course, the Navy quickly adds, with the boys from the budget bureau breathing down their necks, the F-14 will also be able to strap on extra "garbage," like bombs, for air-to-ground missions, thus proving its versatility. Are we back to the F-111?

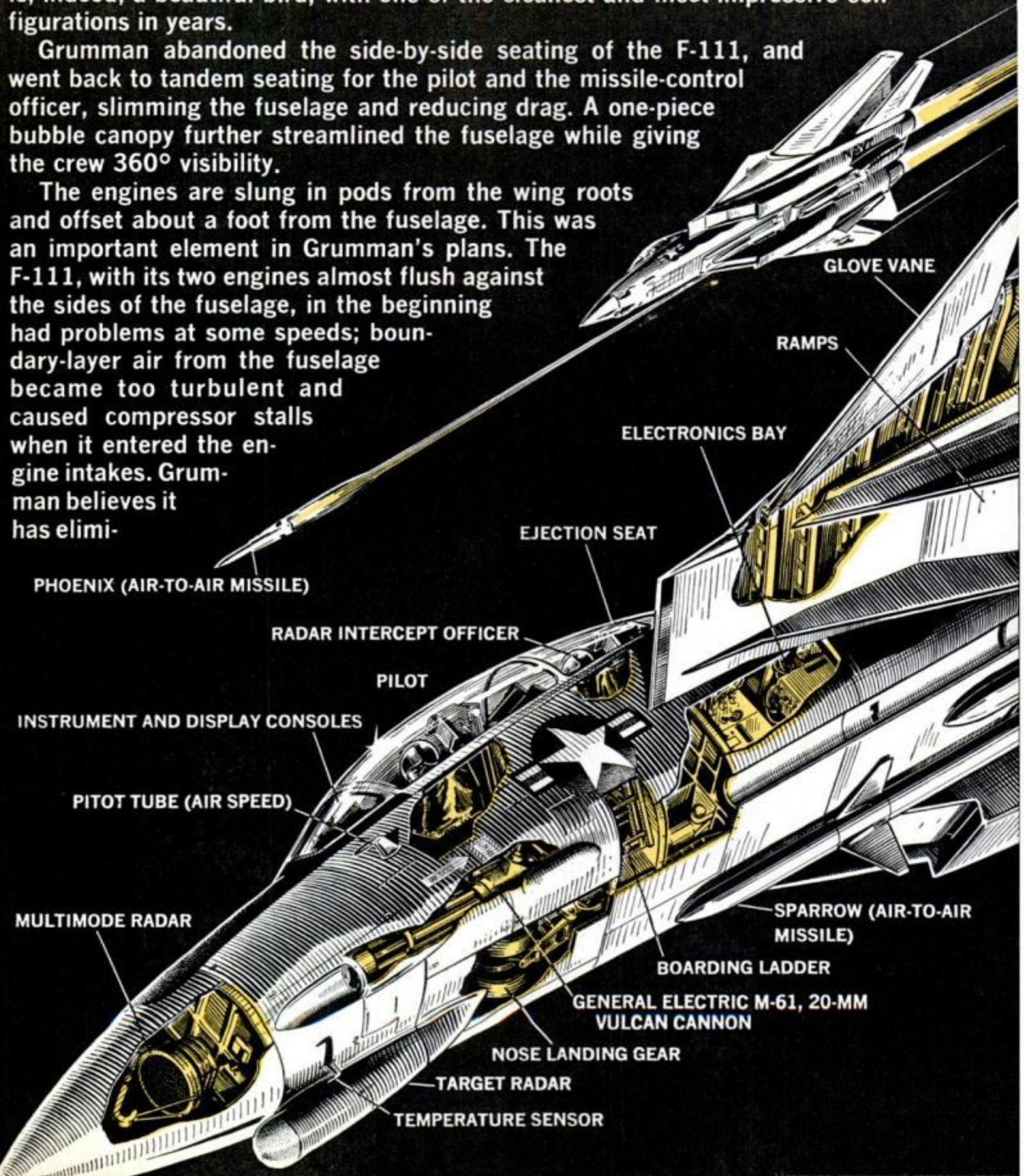
Not quite. The F-111 is a superior air-to-ground attack aircraft and, as such, probably should have been designated the A-111. But, in the air, the F-14 could probably run rings around it.

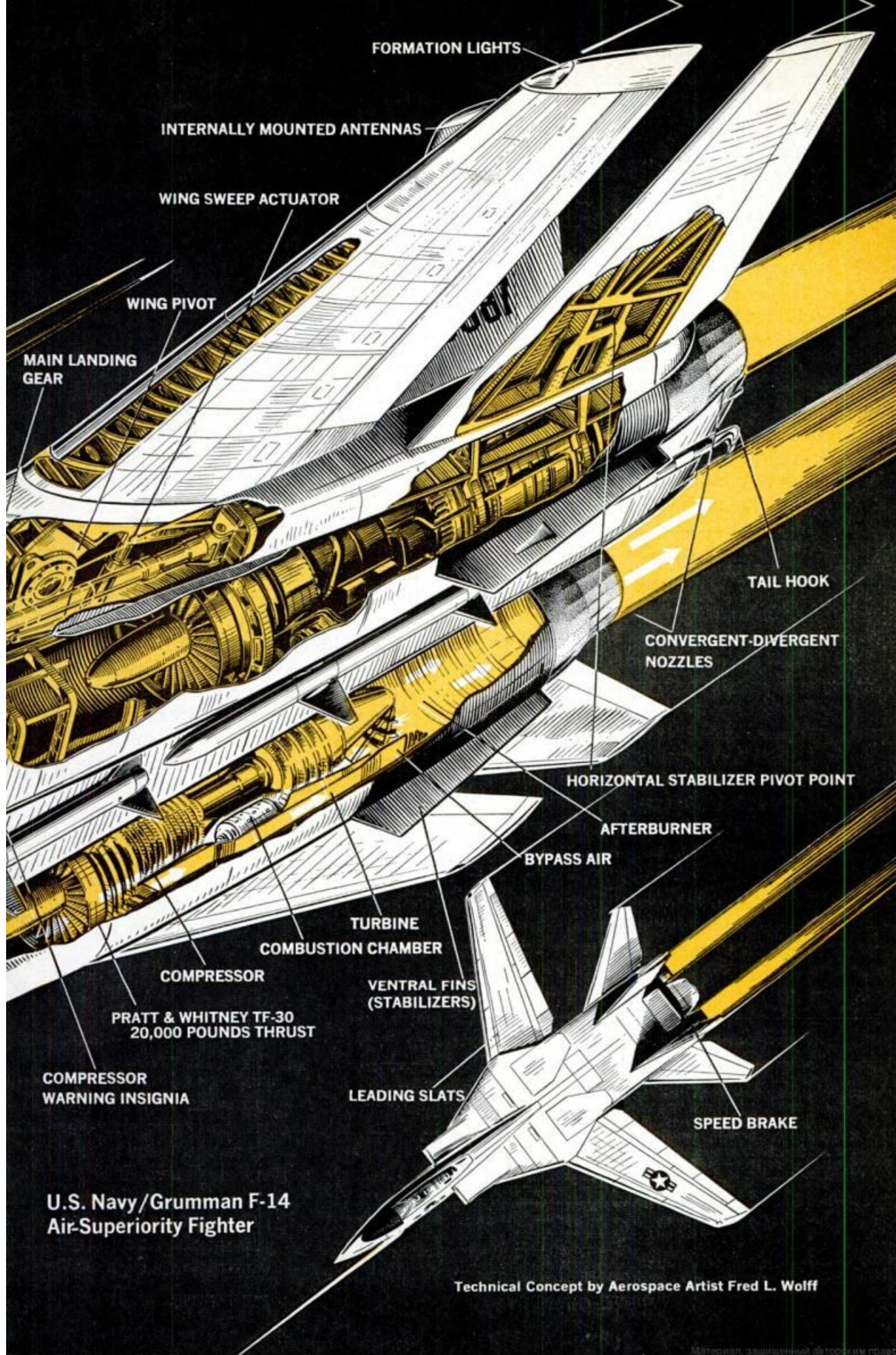
What, then, will the F-14 have that the Navy wants, and that the F-111 lacked?

In any study of this newest of aircraft, you almost have to start with its looks. It is, indeed, a beautiful bird, with one of the cleanest and most-impressive configurations in years.

Grumman abandoned the side-by-side seating of the F-111, and went back to tandem seating for the pilot and the missile-control officer, slimming the fuselage and reducing drag. A one-piece bubble canopy further streamlined the fuselage while giving the crew 360° visibility.

The engines are slung in pods from the wing roots and offset about a foot from the fuselage. This was an important element in Grumman's plans. The F-111, with its two engines almost flush against the sides of the fuselage, in the beginning had problems at some speeds; boundary-layer air from the fuselage became too turbulent and caused compressor stalls when it entered the engine intakes. Grumman believes it has elimi-





FORMATION LIGHTS

INTERNALLY MOUNTED ANTENNAS

WING SWEEP ACTUATOR

WING PIVOT

MAIN LANDING GEAR

TAIL HOOK

CONVERGENT-DIVERGENT NOZZLES

HORIZONTAL STABILIZER PIVOT POINT

AFTERBURNER

BYPASS AIR

TURBINE COMBUSTION CHAMBER

COMPRESSOR

PRATT & WHITNEY TF-30
20,000 POUNDS THRUST

COMPRESSOR WARNING INSIGNIA

VENTRAL FINS (STABILIZERS)

LEADING SLATS

SPEED BRAKE

U.S. Navy/Grumman F-14
Air-Superiority Fighter

Technical Concept by Aerospace Artist Fred L. Wolff

nated this problem by moving the air intakes away from the fuselage and canting them slightly away from the plane's body. Thus, air will have a straight-line flow, through the intake and straight back to the compressor. Grumman calls it a "two-dimensional flow," meaning that there's no "dirty air" coming in and that the clean air has no curves to go around.

The engine pods go back to the tail section and support the twin vertical stabilizers and the horizontal stabilizers, which double as ailerons at certain speeds. Grumman had toyed with the idea of a single vertical stabilizer, but gave it up. By mounting twin stabilizers on the engine pods, engineers eliminated any bulky structural buildup between the pods. All that connects the

Twin stabilizers on engine pods eliminate bulky structural buildup between pods

pod at the tail is a thin "pancake" section that holds the tail hook for carrier landings and four speed brakes. Also, a single vertical stabilizer would have been too tall for the between-deck space available on carriers.

The wings of the F-14, perhaps its most important feature, are both similar to and different from those of the F-111, the first of the swing-wing planes. Like the F-111, the wings swing from front to rear for subsonic, transonic and supersonic speeds, and have full-span slats and flaps for lift control, and spoilers (no ailerons) for roll control at subsonic speeds. The horizontal stabilizers, which are mounted below the wings even when they are fully swept, double as ailerons at supersonic speeds. The wings, in fact, are "double jointed"; they also swing up over the stabilizers to cut down on carrier storage space required to park the planes.

The F-14's wings differ from the F-111's in several respects. The outer (swinging) panels are shorter than those on the F-111 because the inner

wing root is much larger. The pivot points are twice as far apart, to make room for the engine pods and the main landing gear, so the swing wings are stubbier and don't need to swing as far. In normal operation they'll rotate from 20° full forward to 68° fully swept, compared to 16° to 72° on the F-111.

Also, the mechanisms for swinging the wings on the two planes work differently. Each aircraft has a yoke which rides the back of the fuselage and holds the pivots for the swing wings. Grumman calls it a "carry-through structure." On the F-111 a single actuating arm in front of the yoke pushes out and in, swinging the wings backward and forward. On the F-14, two actuating arms behind the yoke perform the same function.

At high speeds, new control surfaces called glove vanes will swing out from the leading edge of the wing root to help stabilize the plane when the wing sweeps back, shifting the aircraft's aerodynamic center. Without it the stabilizers would require larger trim angles, increasing drag.

The most important part of the structure of the F-14, however, isn't readily apparent. Grumman, which has been studying titanium for years, claims that about one-fourth of the structural parts are made of the lightweight, high-strength metal. It also claims the F-14 is about 30,000 pounds lighter than the F-111 because of it. Weight was a big factor in the F-111's final rejection by the Navy for carrier use.

All of these factors—the clean lines, the efficient air intakes and the big savings in weight—will permit the F-14's engines, identical to those of the F-111, to operate much more efficiently, giving more thrust per unit of weight, more loiter time or range, and better rate-of-climb than the F-111.

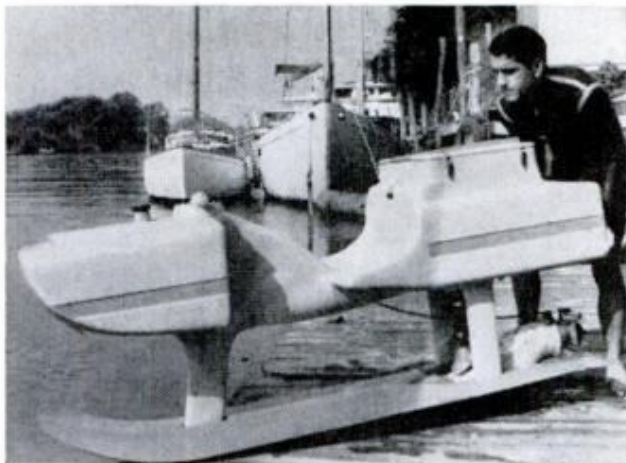
Though exact performance characteristics are classified, it's known that the plane will be a Mach-2-plus fighter and operate up to around 70,000 feet. Exact specifications are also classified, but

(Please turn to page 190)



Paris police suit up for scrimmage at the barricades

Paris police marched in a recent parade wearing their protective gear for skirmishes with demonstrators; also displayed was a new vehicle designed to knock down barricades.



Easy water skiing

Shown riding his invention for sit-down water skiing is Luigi Celani of Ostia, Italy, who demonstrated the powered vehicle on the Tiber River. The "Pink Blitz," as he calls it, can zip along over the water at a speed of some 37 mph.



It'll take lots of steam

Traveling in a 43-year-old steam wagon, the *Britannia*, miniskirted Carol Heaney, 21, and two friends plan to visit 26 countries on a two-year journey around the world. Their purpose in driving the six-ton Fodens-built vehicle is to "boost Britain's image."



An Old Pro Tries Out The World's Most Advanced Car

The only American to race for Mercedes-Benz in the glorious days of Fangio and Moss takes some fast laps at Hockenheim in Mercedes' experimental mid-engine sports car

By JOHN FITCH

MY FIRST IMPRESSION of Mercedes' new C-111 was how small it looked and how it hugged the ground. Its flat, sloping nose rose gracefully to a severely raked windshield. Then the waist-high cab "fastbacks" over the engine to a brutally truncated Kamm tail, aerodynamically efficient no doubt, but blunt and stubby to a styling purist. This is typical of Mercedes' form-follows-function thinking: Beauty where function permits, ruthlessness in the pursuit of performance where it doesn't.

I got in carefully so as not to knock my head on the gull-wing door—a hazard familiar from my 300 SL racing days. The reclining, contoured seats were comfortable, and the entire interior suggested purposeful efficiency done in simple good taste. None of the frugality of a pure racing car, but a touring-car complement of controls for heat and ventilation, cigaret lighter, windshield washers, four-way flashers and the like. Familiar instrumentation

included oil pressure, water temperature, ammeter, tachometer and a speedometer in kilometers. So far, familiar enough to one brought up on reciprocating engines.

Having been told by Mercedes' durable director of passenger-car development, Rudi Uhlenhaut, to drive it like a conventional-engined sports car, I cracked the accelerator and engaged the starter. The idle was a bit lumpy but little different than a wide overlap cam in an equivalent high-performance reciprocating engine would be.

I noted that visibility was exceptionally good for such a low car as I slipped the lever into the first of five gears and induced plenty of revs before engaging the clutch. The slightly lethargic throttle response coming off idle under no load suggested this procedure.

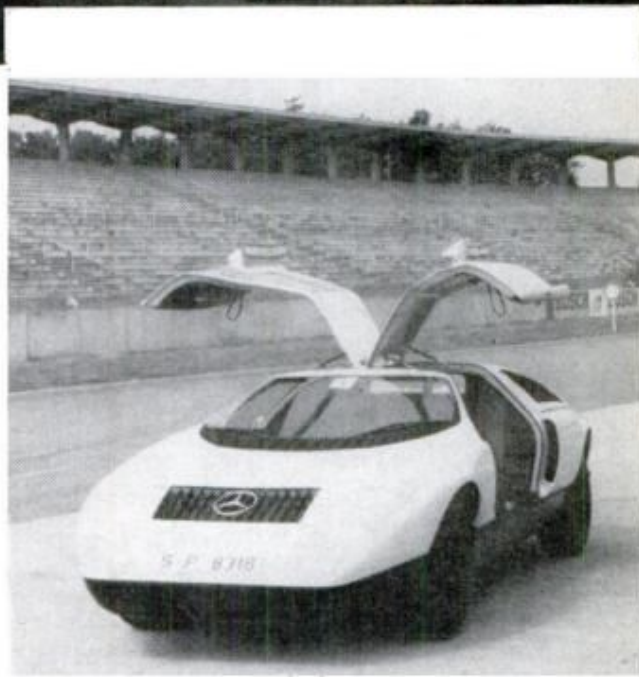
The full permitted 7000 rpm in a long-legged first gear produced an unexpected velocity, and the same in second put an uneventful negotiation of the



PM EDITOR BOB CROSSLEY took this shot through windshield. (He wasn't driving.) Concrete grandstands seat 80,000. Though extremely fast, Hockenheim is not as challenging as older, more famous Nurburgring

first turn at Hockenheim in question. I would guess this to be normally a comfortable 90-mph right turn in the crook of the concrete grandstands. The Wankel exceeded this in the few hundred feet from the pit area. I bent it into the corner with the wide-eyed anticipation that befits a first experience with a new car and was at once delighted that Mercedes had not forgotten how to build a car that would handle.

With a reassuring degree of understeer the little car tracked through the corner with a tire-under-stress rumble, more felt than heard, generating a high degree of lateral acceleration with a reassuring predictability that we were going to make it. To me this demonstrated that Mercedes had mastered the latest wide-rim wheel and tire develop-



GULL-WING DOORS make C-111 appear poised for flight. Mercedes denies it'll be raced. Below: Unlike Mazda and NSU Wankels, Mercedes version uses only one sparkplug per rotor. Fuel is injected at upper right

TECHNICAL HIGHLIGHTS OF MERCEDES C-111

Engine: Three-rotor Wankel, mounted behind seat forward of rear wheels. Displacement 600 cc per working chamber. (Said to be equivalent to 3.6-liter reciprocating engine.) Fuel is injected directly into combustion space instead of into inlet manifold as on other Wankels. Transistorized ignition, one sparkplug per working chamber. Engine is water-cooled, lubricated by circulating oil system. Horsepower 330 SAE at 7000 rpm. Torque 217 ft.-lb. at 5000 rpm.

Transmission: 5-speed.

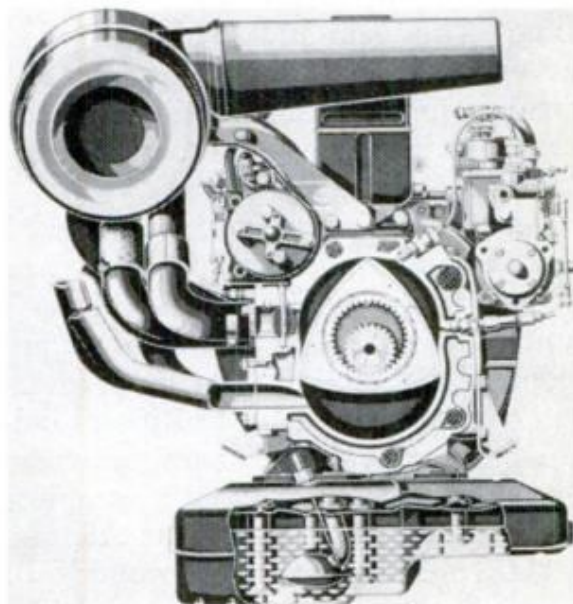
Brakes: Ventilated discs.

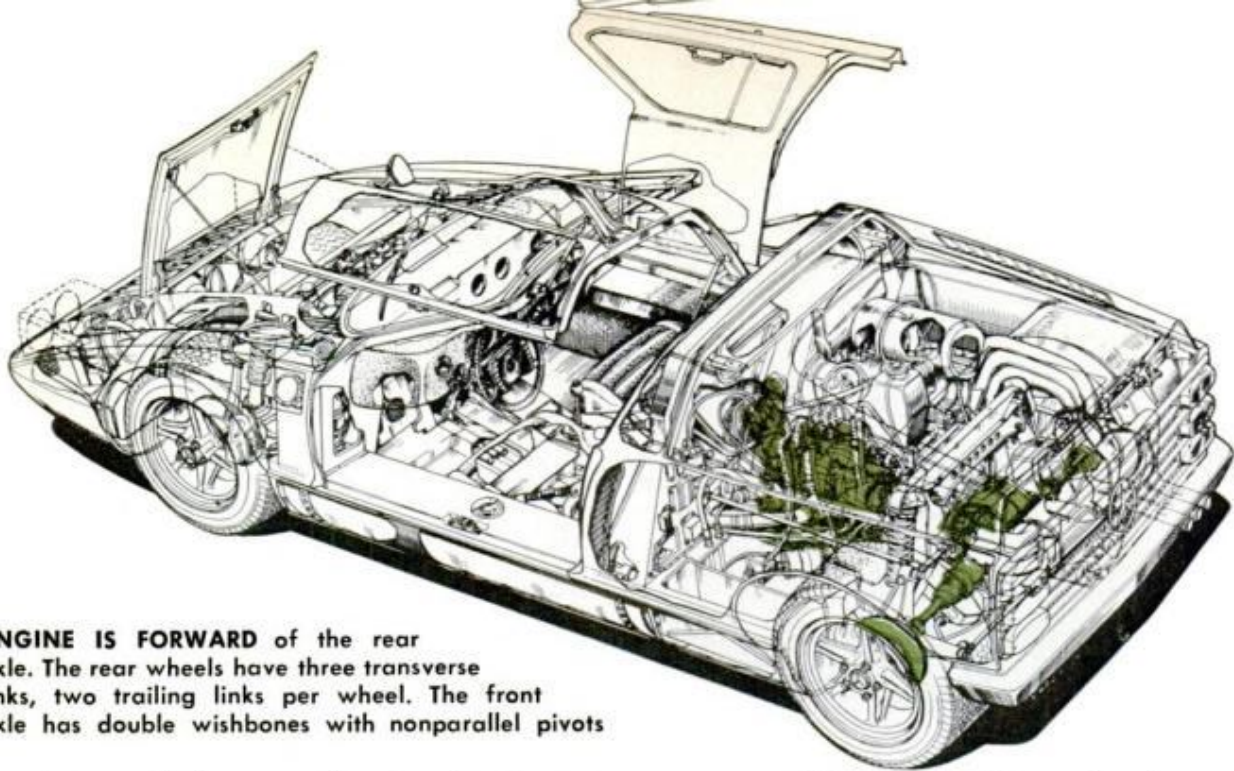
Fuel tanks: One 13-gallon tank on each side.

Acceleration: 0 to 60 mph in 5 seconds.

Top speed: 162 mph.

Chassis and body: Chassis welded and riveted steel with integral rollbar. Body panels reinforced fiberglass.





ENGINE IS FORWARD of the rear axle. The rear wheels have three transverse links, two trailing links per wheel. The front axle has double wishbones with nonparallel pivots

ments, a whole new chapter in the art of high-performance behavior that has emerged since its last official racing activity 15 years ago. A right kink in the road over a bridge appeared and passed in the same uncomplicated way in third gear before a long, sweeping, high-speed bend began.

The bend is nearly two miles in length, and I was able to let the Wankel "wind out" to top speed while I concentrated on staying on the road. A few moments later the needle was wavering at the 250 kph mark (156 mph), and although the Mercedes required little correction to hold an incipient drift, I realized I was gripping the wheel too tightly and reminded myself to settle down to a more relaxed manner of driving. The sun-and-shade dappled bend opened briefly at a gap in the towering pines. A small stone on the outside, marking the spot where Jimmy Clark died, flashed by.

The wind noise was such that, had I had a passenger, I would have had to speak up to be heard. Still you can't complain about this when you're approaching 160 mph on a sunny afternoon, coat-and-tie drive with no helmet. Aside from that transmitted from the road surface there was a complete absence of vibration, and the impression the engine gave when wound out was one of unlimited rpm potential. For

reasons of its own, Mercedes has put the limit for now at 7000 rpm, but my guess is that this engine with relatively minor refinements would be capable of about twice that, with a commensurate increase in power.

The tribunes outside the U turn at the end of the curving straight came up, and I waited until the first warning markers were quite close before braking. The four discs smoothly pulled my speed down with no trace of rumble. Shifting from third to fifth on the next straight brought the speedometer close to 250 kph again before I had to brake, this time harder, for the right corner

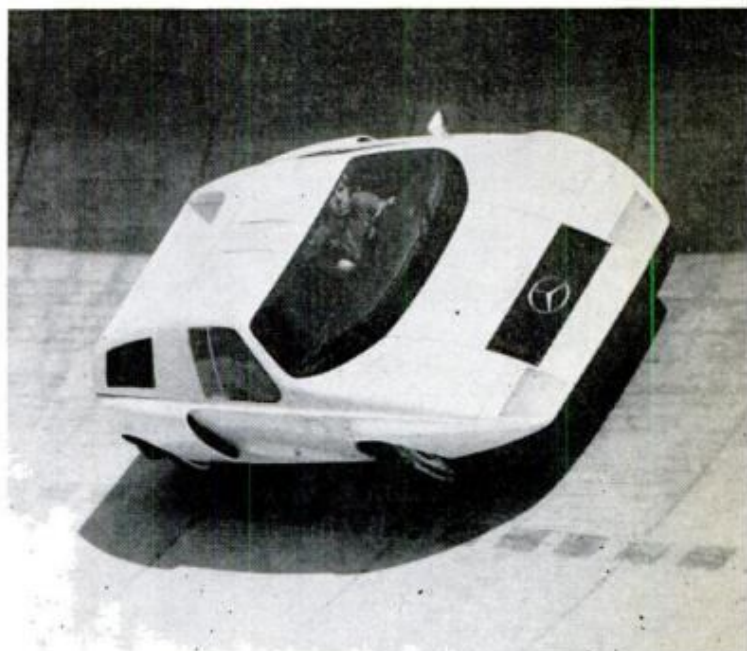


C-111 IS BABY of veteran engineer Rudi Uhlenhaut, seen with one of engine's three combustion chambers

and two hairpins put there to slow you down for pit row.

I found this a thrilling automobile, partly because it may be the last great car one can drive in the grand manner, at least in Europe. The superb super-highways of Europe, whether they are called Autobahns, Autostradas, Autoroutes or what, are safe, high-speed motorways through magnificent countryside. But how long will it be before regional week-end speed limits are extended to all roads at all times as in the United States? Or worse yet, how long until Europe's booming car population simply overwhelms its road capacity?

It would be a crying shame not to be able to use a safe instrument of private transportation such as the C-111 to its full design capacity. Its combination of near-race-car performance with the taut, yet nimble, handling qualities of a supersports car make it unique on the automotive scene. It is not the first practical Wankel-engined car, but it is the first three-rotor Wankel sports car. The Wankel engine cuts in half the weight and space requirement of the powerplant, dealing the passenger-car designer a new hand. And because it was developed by Mercedes-Benz, a company with a history of practical innovation, the C-111 could be the immediate predecessor of a grand-touring sedan for you and me. You could sign me up for such a car right now. ★★



C-111 HUGS 90° BANK at Stuttgart test track. Fitch found same road-holding ability at Hockenheim



SMALL STONE to left of Hockenheim's long curve marks where world champion Jim Clark died in 1968

PM first reported on Mercedes-Benz' exciting mid-engined, three-rotor sports car, the C-111, in October. In mid-September, too late for the October issue, we had a chance to drive it at the Hockenheim race track in Southern Germany and to visit Mercedes-Benz' engineering department in Stuttgart, where the C-111's Wankel engines are under development.

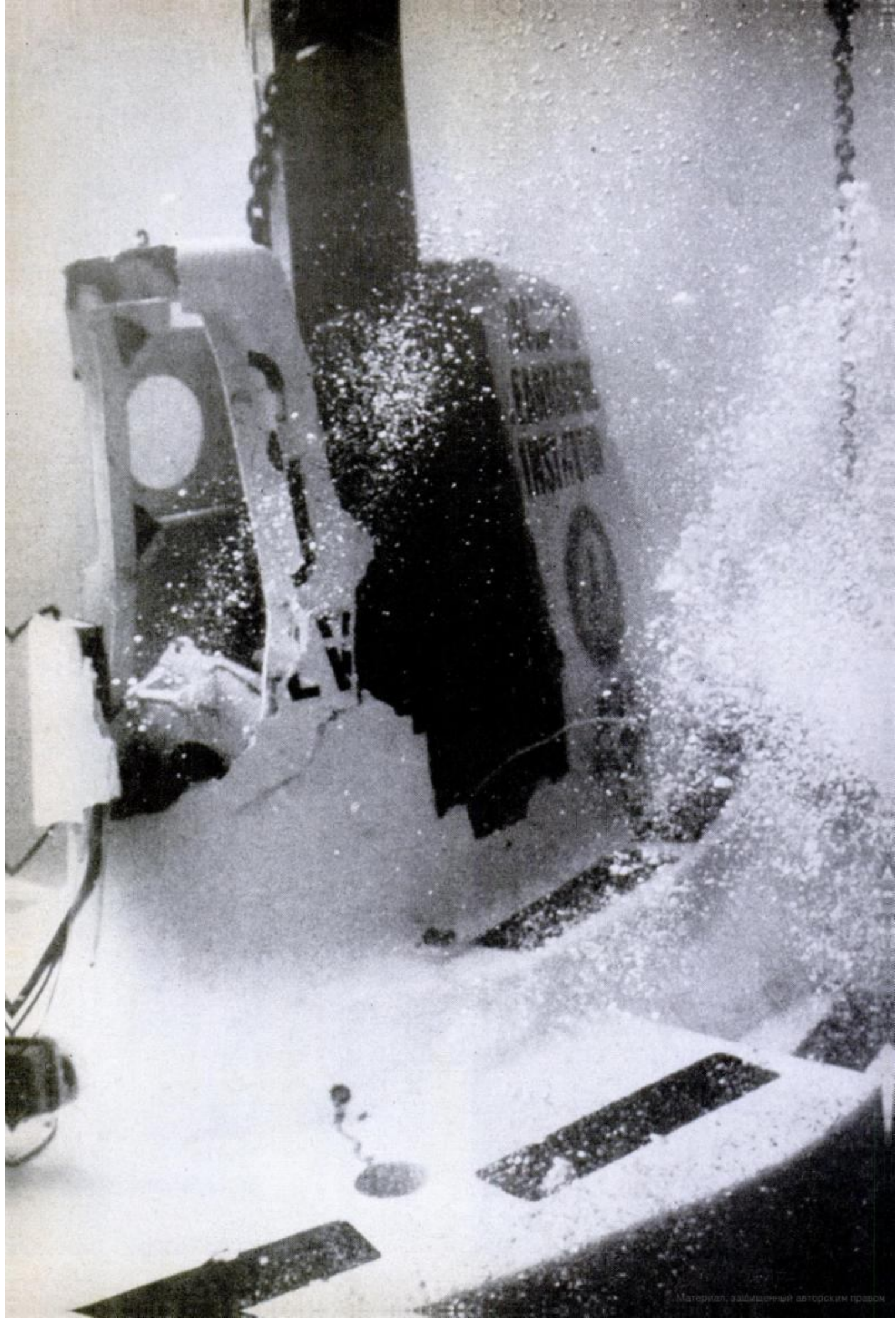
Mercedes had three cars at Hockenheim, says it will build 50 altogether. None will be for sale.

We took a lap with a factory driver at 150 mph, and one alone at about 110. Let us just say it was a thrill. Because we are more experienced at testing Volkswagens and an occasional Barracuda, we asked John Fitch, an American who raced for Mercedes at Le Mans and the Nurburgring, to record his impressions of the C-111 for *Popular Mechanics*. But the picture at right proves we aren't lying.

Robert P. Crowley

Editor





How We Raised the Alvin From 5000 Feet

By WILLIAM O. RAINNIE and
Lt. Cmdr. WILLIAM I. MILWEE Jr.

The deep-diving submersible is the largest object ever recovered from the ocean depths—a feat that may point toward the rescue of big subs. In this exclusive report, two men who helped to raise the *Alvin* tell how it was done



NAVY AND CIVILIAN experts collaborated in recovery operation. Lt. Cmdr. William I. Milwee Jr. (above, right) was in overall charge at scene. William O. Rainnie, section head of deep submergence operations at Woods Hole, handled communications with crew of the *Aluminaut*

THERE WAS NOTHING unusual or difficult about the mission. The *Alvin*, a deep-diving Navy submersible, was scheduled to dive on a deep-moored buoy to inspect the line holding it. The site was 135 miles southeast of *Alvin's* home port, Woods Hole, Mass., in an area where the Atlantic Ocean bottoms at about 5000 feet.

Alvin dove but surfaced almost immediately. Water was seeping into an electrical connector, shorting the sub's cameras. There was enough sea

to prevent fixing the connector with *Alvin* still in the water. She was lifted up on the cradle between the twin hulls of the *Lulu*, her catamaran tender, and the repair made.

At 12:20 p.m., Oct. 16, 1968, the cradle started to descend. Two men were down in the sub's personnel sphere and the pilot was standing in the sail, ready to maneuver the vessel once it hit the water.

But what had been a routine launching suddenly turned into a disaster. Two forward restraining cables snapped and the sub plunged forward into the gray sea. It went under, water pouring into the open hatch. Seconds ticked by. Then *Alvin* reappeared between *Lulu's* hulls.

"The ballast tanks have ruptured!" someone yelled.

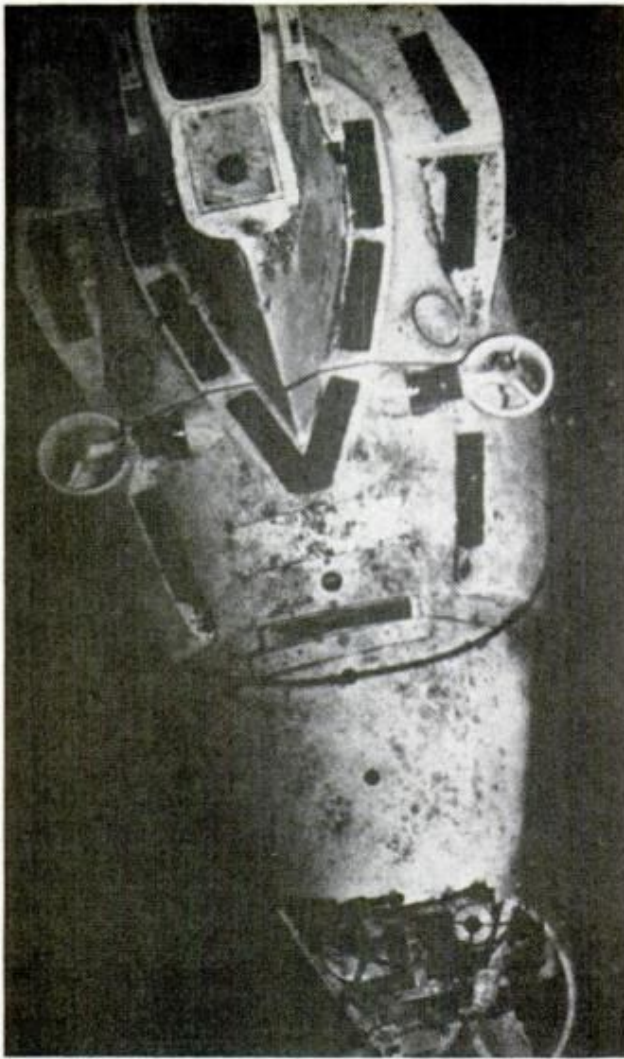
Alvin's three crewmen barely had time to scramble out and hop aboard the *Lulu* before the sub went under again, this time for keeps.

Alvin's loss was a tough break for the deep-submergence men and scientists of the Woods Hole Oceanographic Institution. They had

made 307 successful dives in

Alvin since she was commissioned in 1964, including dives that helped in the recovery of the H-bomb lost off the coast of Spain

WITH TOGGLE BAR sticking out from her broken sail (opposite page), *Alvin* is lifted toward surface after more than 10 months on ocean floor. Artist's concept (left) shows the *Aluminaut* hovering to get a look at hatch cover of *Alvin's* personnel sphere



FANTASTICALLY SHARP PHOTO of *Alvin* resting on bottom 5000 feet below surface was taken by camera on "fish" towed by the *Mizar*. Photo showed that, except for loose rear prop hanging by its hydraulic lines, the sub was in good shape. The "fish" is a 2000-pound vehicle loaded with cameras, strobe lights, magnetometer, transponder and telemetry system that's towed at great depths by *Mizar*. Tow cable also doubles as carrier of electronic signals

in 1966 (*How We Found the Missing H-Bomb*, page 72, Aug. '66 PM).

The bomb had been brought up from some 2800 feet. Sometime later *Alvin* had recovered her own mechanical arm, lost in water 4500 feet deep. But nothing as large as the 23-foot-long *Alvin* and as heavy—16 tons—had ever been recovered from great depths.

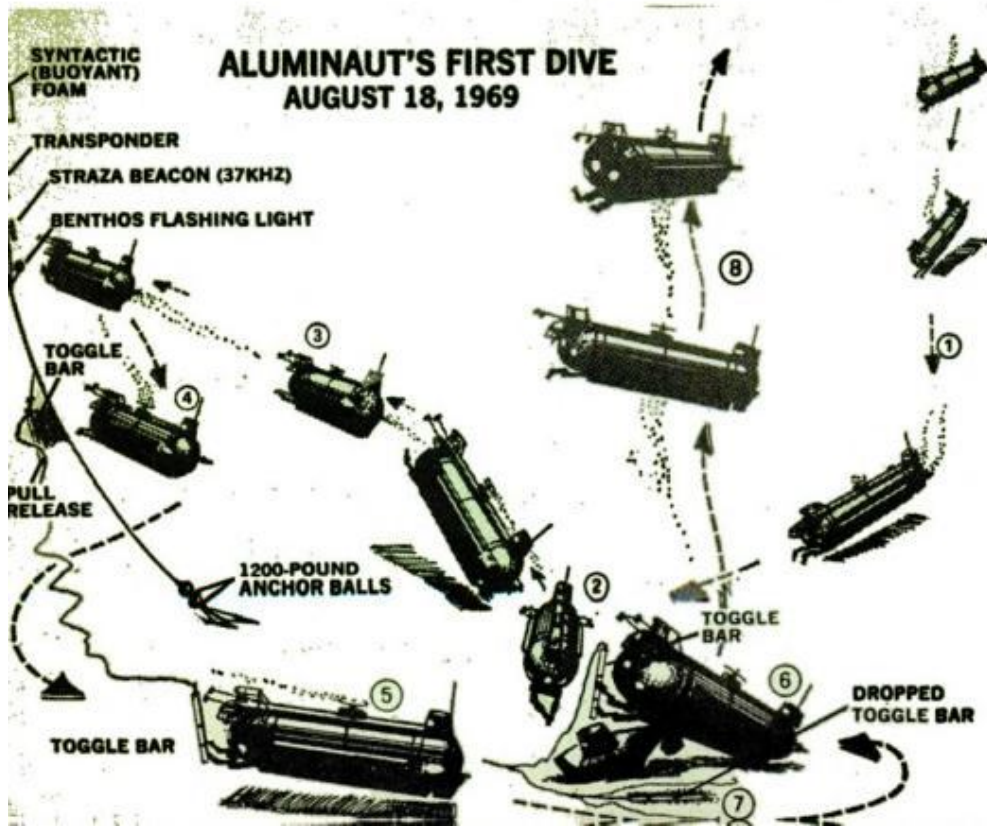
A plus factor was that the Woods Hole men had a ballpark idea of where *Alvin* was. Shortly after the sinking, the *Lulu* and the R/V *Gosnold*, escort ship for *Alvin*, made an echo-sounding survey of a three-by-six-mile area, in the center of which was the buoy *Alvin* had been diving on. The survey allowed Woods Hole scientists to make a detailed profile of the bottom.

On this profile there was an easily recognizable gulley of a major canyon just to the east of the loss site. A satellite navigation fix made on the buoy provided latitude and longitude.

Though *Alvin* was a \$1,500,000 chunk of hardware, there was no way of knowing whether she now was worth an expensive salvage effort. She'd hit bottom with enough speed—an estimated 5 to 20 knots—to cause damage.

In the fall, weather along the New England coast is erratic and can be violent. If any kind of operation—reconnaissance or salvage—was to be mount-

ALUMINAUT'S FIRST DIVE AUGUST 18, 1969



SALVAGE CREW had good idea of *Alvin's* location when they made initial dive (1) in the *Aluminaut*. Reaching bottom, they were vectored-in right at target (2) via surface control from USNS *Mizar*; loss of *Aluminaut's* own sonar did not hamper the operation. After inspecting *Alvin*, the recovery submersible headed for the "clump" 300 feet away (3) and located the toggle bar and its bundle of line (4). Pulling bar loose with one of its manipulators, the sub moved back to *Alvin* (5) and attempted to insert the bar (6) in *Alvin's* hatch. After 12 hours, the build-up of CO₂ in air and other problems forced the men on the *Aluminaut* to abort the dive, leaving toggle bar (7) behind. *Aluminaut* surfaced (8) for repairs, battery recharge

ed, the Woods Hole people would have to move fast.

They learned that the *DOWB*, a two-man research submersible operated by General Motors, was available. Flown from California, the *DOWB* arrived at Massachusetts' Otis Air Force Base on Oct. 23. A number of modifications had to be made to the sub, including the addition of a three-fingered claw-type hand to the manipulator arm.

Salvage crews made three sorties between Nov. 1 and 22, but the *DOWB* failed to sight *Alvin*, due to weather and mechanical problems. One sortie was aborted when mountainous seas boiled up, driven by 100-knot winds.

Time had run out. No further recovery attempts were made in 1968.

In June, 1969, USNS *Mizar*, a 3880-ton oceanographic ship operated by the Military Sea Transportation Service for the Naval Research Laboratory, made a reconnaissance of the area where *Alvin* had gone down. The *Mizar* used a special piece of sensing equipment developed at the Naval lab—a 2000-pound "fish" studded with gear: cameras, strobe lights, a magnetometer, telemetry system, and a transponder. Towed at great depths, the fish can be tracked by means of its transponder: In response to electronic signals sent through the tow cable, this instrument sends out detectable acoustic signals.

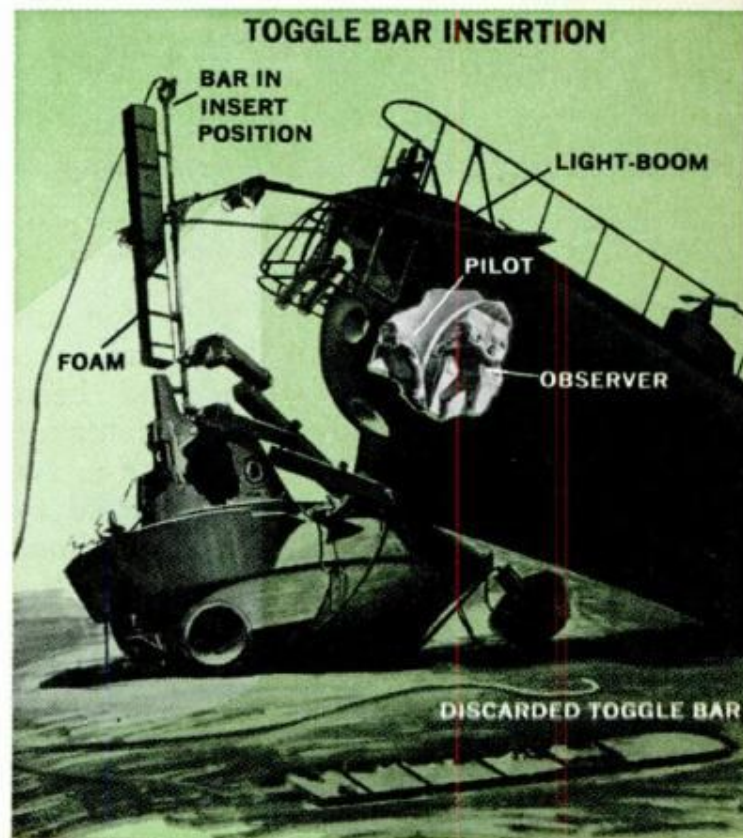
Photos taken by the fish showed that *Alvin* was in good shape. The major apparent damage had occurred to the rear prop assembly; torn loose, it hung limply from its hydraulic lines. But there was a big question the photos did not answer: Was *Alvin's* hatch open? If not, it would make recovery tough.

The pictures convinced Office of Naval Research officials that a salvage try should be made and they asked the Naval Ship Systems Command's supervisor of salvage, Capt. Eugene Mitchell, to work out a plan. ONR's interest was more than academic; though *Alvin* is operated by the Woods Hole Institution, ONR owns it.

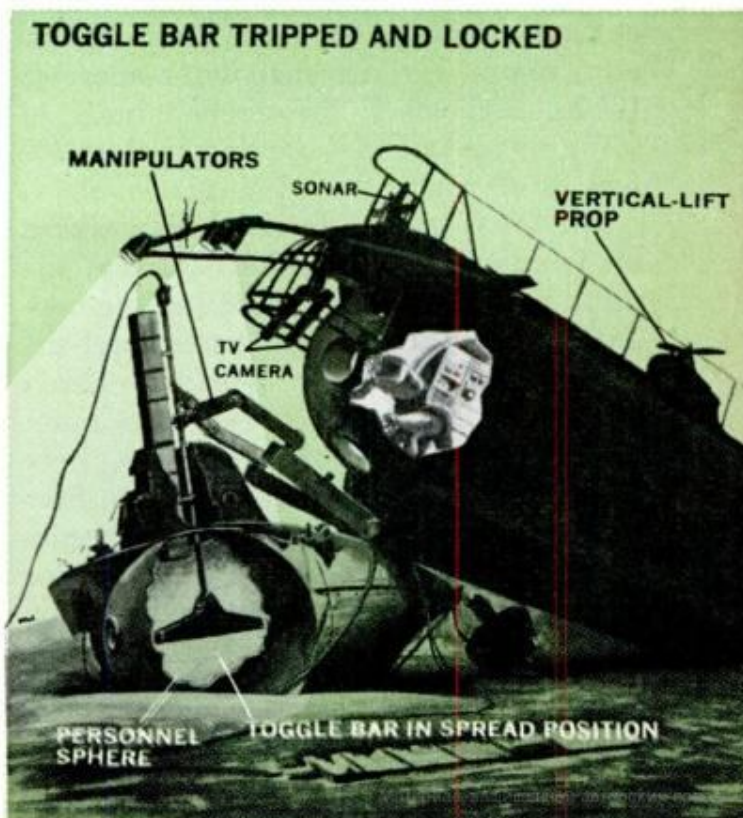
On Aug. 16, a small task force was

assembled 135 miles southeast of Woods Hole. In addition to the *Mizar*, the primary support ship, there were the *Aluminaut* and her support ship, the *Stacey Tide*, and the *Crawford*, a ship carrying engineers and scientists from Woods Hole.

The *Aluminaut* had been brought up from Florida. Owned by Reynolds



ON FINAL DIVE *Aluminaut* carried new toggle bar on light-boom. Using its manipulators, sub pulled bar free (above), pushed it into personnel sphere (below), and triggered it into "T" configuration





FROM POST AT FORWARD PORT, Bob Canary piloted the *Aluminaut* during the two long, tough dives



ALUMINAUT'S MANIPULATOR ARMS are seen in photo taken through port. Near arm tugs at *Alvin's* sail

Metals Co., she is a 51-foot, 81-ton sub designed for diving to 15,000 feet.

Two recovery methods had been worked out. In one, the *Aluminaut* would dive with a toggle bar and insert it in *Alvin's* hatch. As it returned to the surface, the sub would reel out 7000 feet of lift line. The second plan called for the *Mizar* to drop a line and toggle bar close to *Alvin*. The bar would then be picked up by the *Aluminaut* and inserted in the hatch.

The first method was abandoned after a lively sea damaged the reel and brackets installed on *Aluminaut's* bow.

At 11:10 a.m., Monday, Aug. 18, the *Mizar* lowered a "clump" attached to 7000 feet of 4½-inch nylon line. The clump—made up of a nine-foot aluminum toggle bar, a transponder and two 1200-pound steel "headache" balls to serve as an anchor—landed within 300 feet of *Alvin* at the 5000-foot level.

At 8:05 p.m., Monday, *Aluminaut* made her first dive. Bob Canary, the pilot, was up forward handling the controls for the propulsion system and the two manipulator arms. Working closely with him was M.J. (Mac) McCamis, *Alvin* senior pilot. There were three *Aluminaut* crew members—Bob Serfass, copilot; George Tyler, electronics technician, and Keith Cook, senior technician—and a naval observer, Lt. Cmdr. James Finlen.

The plan was for the sub to dive to

the bottom, get vectored-in close to *Alvin*, then home in on its target using its own sonar. The vectoring would be done from the *Mizar*, whose sensitive tracking system would pick up signals from three separate transponders: one on the *Aluminaut*, a second that had been dropped in the area earlier and a third that was part of the clump. The submersible and the support ship had voice communications by underwater telephone.

A slight hitch developed when *Aluminaut's* sonar failed. *Mizar's* tracking system took over again, and within 20 minutes the men on the *Aluminaut* had spotted *Alvin*.

Aluminaut's lights cut through the murk, allowing the submariners to see for a distance of about 50 feet. They could see that *Alvin's* viewing ports were intact, her mechanical arm still attached—and that her hatch was open.

"She's nose down in about two feet of silt," the sub reported to *Mizar*, "and at about a 5° angle."

The rendezvous at 5000 feet had an ironic aspect. The last time these two research subs had been this close was when they had collaborated on the H-bomb recovery. That time, too, they'd had the expert support of the *Mizar*.

After photographing *Alvin*, the *Aluminaut* was vectored over to the clump. About 20 feet above the bottom, hanging from the lift line, was the tog-

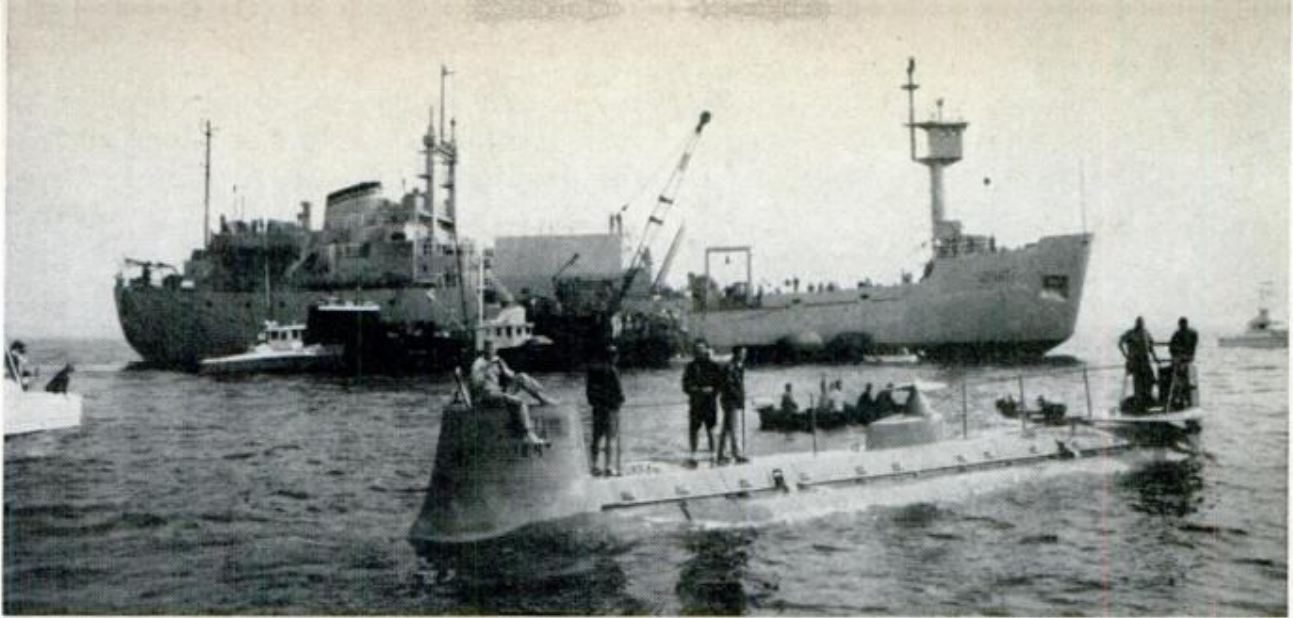


PHOTO BY LAURO BOCCIOLETTI

WHILE ALVIN IS LIFTED TO SURFACE by winch aboard the *Mizar*, men on the *Aluminaut* (foreground) have a chance to relax. An oceanographic research vessel, the *Mizar* has a highly sophisticated tracking system

gle bar and 500 feet of line gathered in a loose bundle. Using *Aluminaut's* manipulators, Bob Canary loosened the toggle bar and carried it back to *Alvin*.

Now the *Aluminaut* suffered another setback: its vertical propulsion motor failed, making maneuvering difficult. Thus, when the toggle-bar line became fouled around *Alvin's* hull, there wasn't much that could be done about it. But the crew wasn't about to give up.

They used the *Aluminaut's* free manipulator—the other gripped the toggle bar—to pull the bigger sub up onto *Alvin*. Slowly, laboriously, the *Aluminaut* worked herself up by gripping steps and padeyes (steel rings) on *Alvin's* hull. Finally, with her bow at about a 20° angle, the *Aluminaut* had her arms above the open hatch.

The aluminum toggle bar was spring-loaded and had a pivot near its bottom end. Once inserted, the pivot could be triggered, causing the bottom section to swing 90° to form an inverted "T" inside *Alvin's* personnel sphere. If the T were wedged firmly enough, the bar would hold for a lift.

That was the theory. The *Aluminaut* made three attempts to insert the bar, but all were failures. The tangled line made the bar hard to manipulate. So did the loss of some of the syntactic, a plastic material put on the bar to make it lighter in water.

The *Aluminaut* had been down for

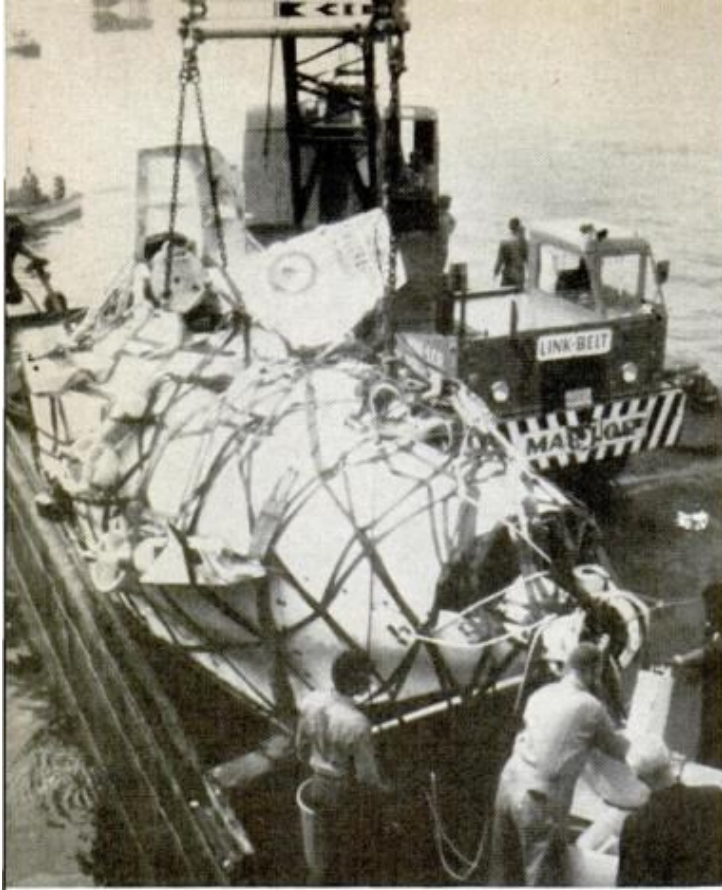
12 hours when the dive was aborted. A problem had developed in the manipulator power system and the CO₂ content was building up in the air. The sub surfaced about 8:30 a.m. Tuesday to recharge batteries and make repairs.

But high winds and heavy seas made the battery recharge impossible. Waves poured seawater into the sub's hatches, which have to remain open during this operation. The decision was made to return to Woods Hole. Before leaving, Navy men added two buoys to the lift line, lashed to a big rubber pontoon.

The task force reassembled at the recovery site early Wednesday morning,

WHEN ALVIN REACHED 85-foot level, Navy divers went down to secure sub with lines and a lift sling





BATTERED SUB rests on barge, wrapped in net divers put on to prevent loss of props and other gear

Aug. 27, the sea as flat as a table. The *Aluminaut's* systems had been repaired and a light-boom replaced on the bow. (It had been removed to make room for the brackets and reel.) A new toggle bar had been built. It was lashed to the light-boom when the *Aluminaut* submerged at 1:23 p.m.

The sub reached bottom at a point three miles from *Alvin*. The distant dive was decided on to prevent possible damage to the bar by waves during a long surface tow. At 6:43 p.m. the *Aluminaut* told *Mizar*: "We've got *Alvin* on our starboard bow. Here we go."

This time the *Aluminaut* used both manipulators to pull herself up. The toggle bar was yanked from the boom and the job of insertion was started. But it was far from easy—even with two manipulator arms pushing the bar in "hand over hand." One problem: Syntactic material made the bar so thick there was little clearance at the hatch. Another, the syntactic gave the bar so much buoyancy that it floated out several times after insertion.

The operation required skill and stubbornness. The *Aluminaut* made one

try after another, sometimes having to wait half an hour for the silt to settle; the props stirred it up, turning the water into a dense cloud. Part of the *Alvin's* sail ripped away in the struggle.

Finally, at 3:03 a.m., Thursday, Aug. 28, the *Mizar* got the long-awaited message: The toggle bar was in place.

The bar was connected to a 25-foot length of line with a snap hook at its end. The *Aluminaut* grasped the hook in one of its manipulators, carried it to a ring at the end of the main lift line and snapped it into the ring.

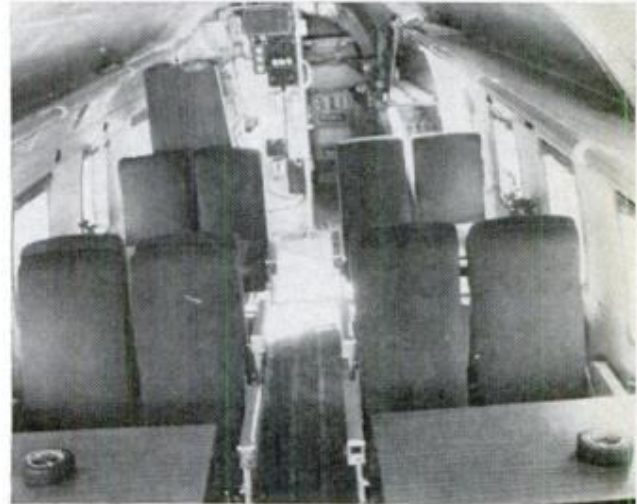
To make sure that the toggle bar was firmly wedged in place, the *Aluminaut* then ascended and tugged on the 25-foot line. The bar held!

Aluminaut's crew wanted to locate the two 1200-pound "headache" balls to cut them from the line so as to lighten the total load. But the *Mizar* said no and ordered the sub to surface. The crew of six had been down 17 tough hours.

The lift, made by a winch on the *Mizar*, was started. At 2:41 p.m., Thursday, *Alvin* reached a depth of 85 feet below the *Mizar*. A diving team from the Newport, R.I., Naval Underwater Weapons Research and Engineering Station went down with more lines to secure the sub. After more than 10 months on the ocean floor, *Alvin* was almost home. Still under water, she was slowly towed to a point off Martha's Vineyard where, on Sept. 1, a barge-mounted crane made a final lift.

To stem corrosion, *Alvin* was immediately washed down with fresh water and chemicals. A preliminary inspection revealed that the personnel sphere—*Alvin's* most important structure—was in excellent shape. It was estimated that the sub could be made ready for service within a year.

Alvin's recovery by the Navy was a record-breaking feat and everyone connected with it should be proud. This success points the way to the recovery of even larger objects from the ocean depths. Someday, we'll have the ability to bring back full-sized subs. But that'll take a little time. ★★★



Restaurant created from grounded planes and parachutes

When a grounded Viking airplane was offered to him free of charge, John Bouvy of Soesterberg, Holland, decided to go into the restaurant business with it. Since then, he has acquired two other planes which help attract overflow crowds for such delicacies as "Cockpit Cocktails" and "Propeller Steaks." Those who can't get in the planes dine under parachute canopies outside. Bouvy's main problem: souvenir hunters who make off with cockpit fittings.



Tankful of football

The top of a partially completed oil-storage tank became a football (British style) field recently when two teams of British Petroleum workers played a match on Kharg Island in the Persian Gulf. The tank, 360 feet in diameter, will hold a million barrels of oil when finished (after the football season).



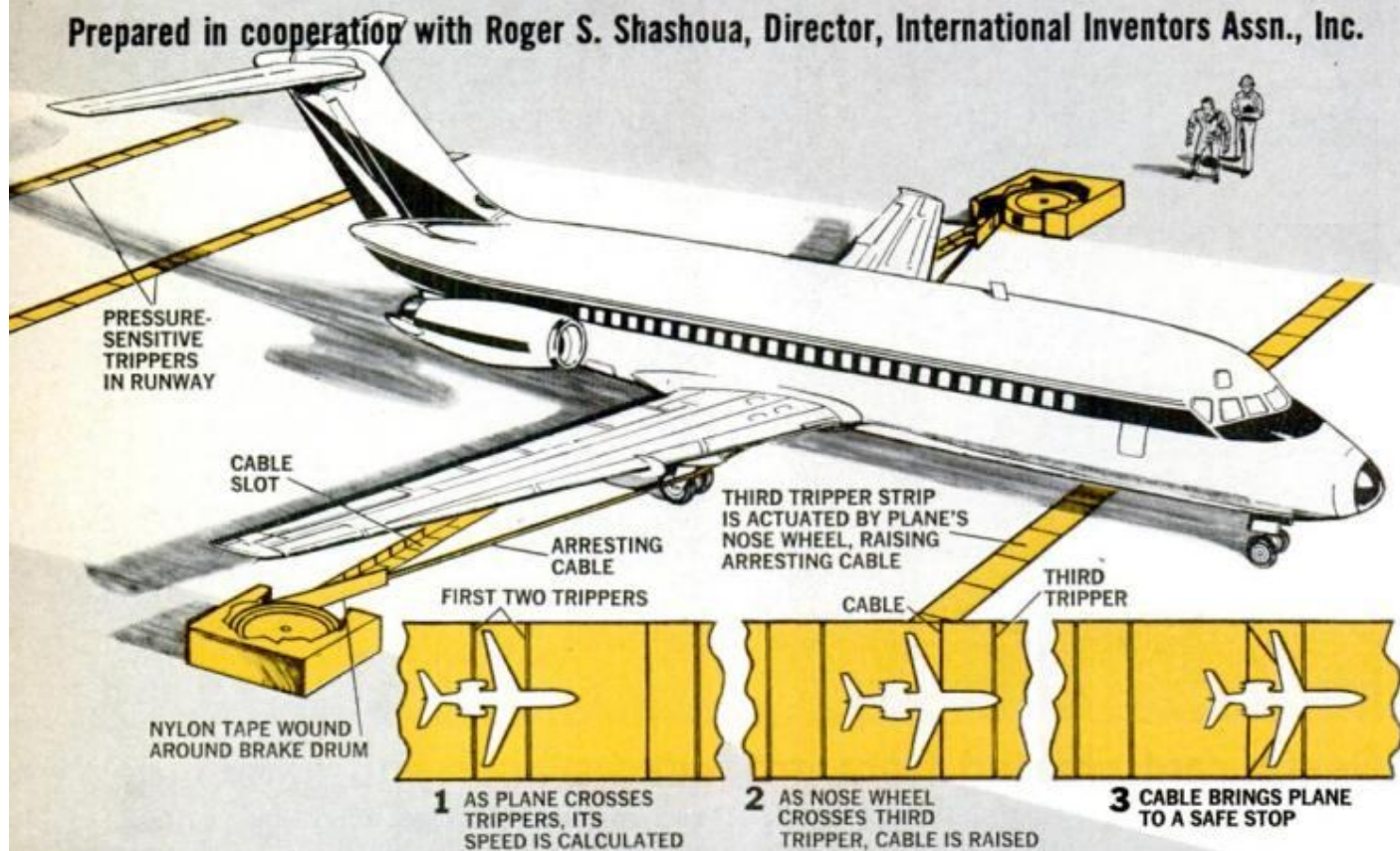
Versatile underwater tool

An electric tool, the Seapower, that enables a diver to take on almost any mechanical task—drilling, driving nuts, sawing, chipping, reaming and tapping—is being tested by the Navy. Accessories can be changed in two seconds. The tool is a product of Oceanautic Manufacturing and Research Co.

Just patented

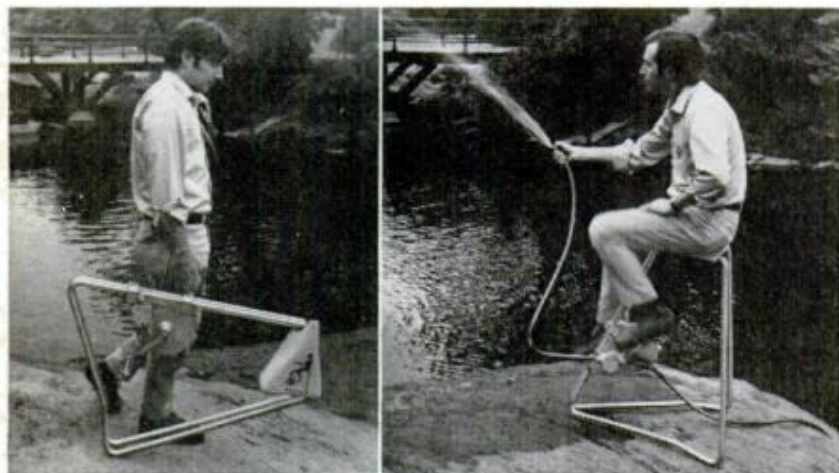
PM'S PICK OF THE NEW INVENTIONS

Prepared in cooperation with Roger S. Shashoua, Director, International Inventors Assn., Inc.



1. A RUNWAY AIRLINER wouldn't overshoot the landing strip and crash with this automatic emergency barrier. The barrier works like the arresting cables on an aircraft carrier except that the plane itself actuates the release if it's traveling too fast to stop within the runway's limits. As it rolls over two tripper strips in the concrete, a computer measures its speed and determines whether

it can stop in time or not. If it can't, a third tripper is actuated farther ahead. When the plane's nose wheel crosses this, the cable pops up from a slot in the runway, catching on the main landing gear and bringing the ship to a gradual stop. This ingenious double-trip system keeps the cable from flying up too soon and striking the nose wheel, possibly smashing the gear and causing an accident

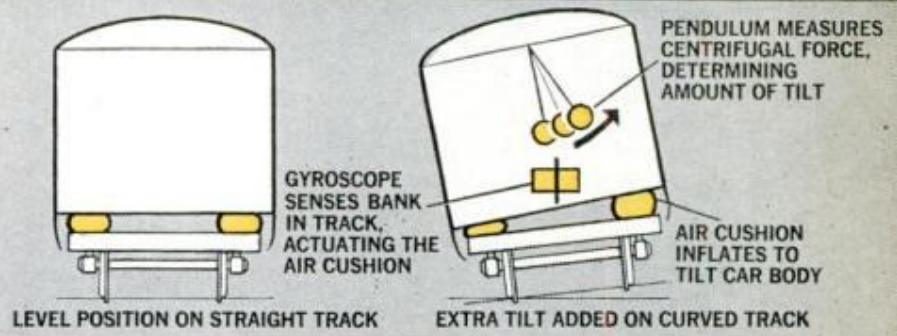
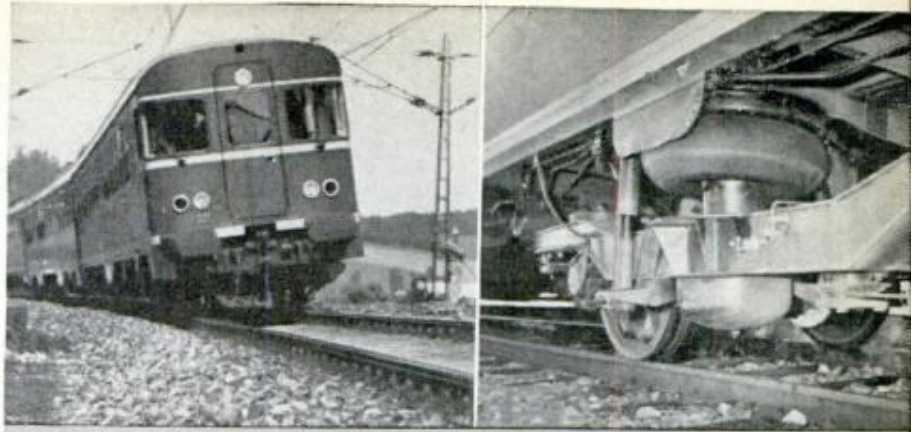


2. YOU PEDAL THIS PUMP like a bicycle. The action, much more powerful and less tiring than turning a crank by hand, is able to lift water to a height of 22 feet and throw a stream nearly 200 feet. A lightweight tubular frame folds flat for easy carrying. The pump can deliver 14 gallons a minute and is designed for irrigation work on farms, fighting brush fires, watering large lawns and gardens, and pumping water to a campsite from a nearby pond or brook. It's said to take so little effort that a person can operate it for hours without fatigue

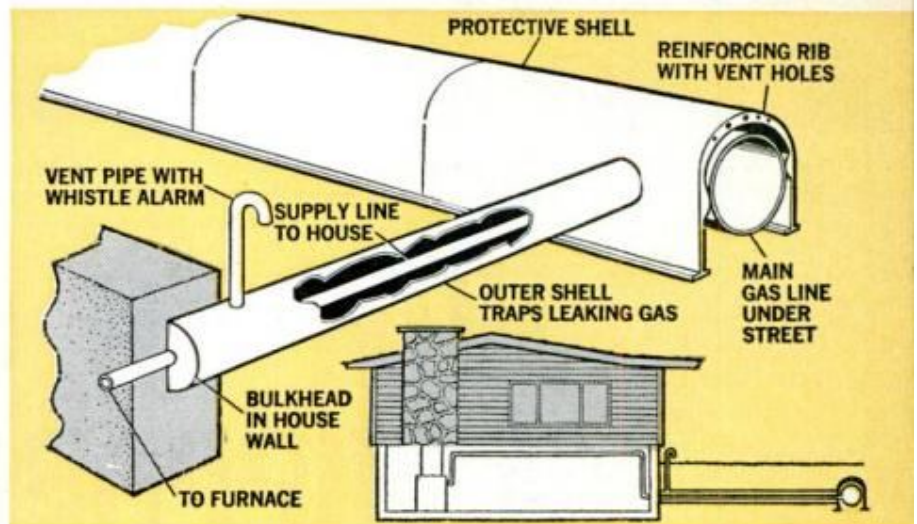
Inventors of the items shown on these pages are as follows: 1. Research, Inc., Hopkins, Minn. and American Machine & Foundry Co., York, Pa.; 2. John Frassinato, London, England; 3. F. Hegenbarth, German Federal Railway,

Munich; 4. John A. Regal, Rockaway Valley Rd., Boonton, N.J.; 5. Charles C. Mayhew, Griffith, Ind. Roger Shashoua can be reached at the International Inventors Assn, Inc., 680 Fifth Ave., New York, N. Y. 10019.

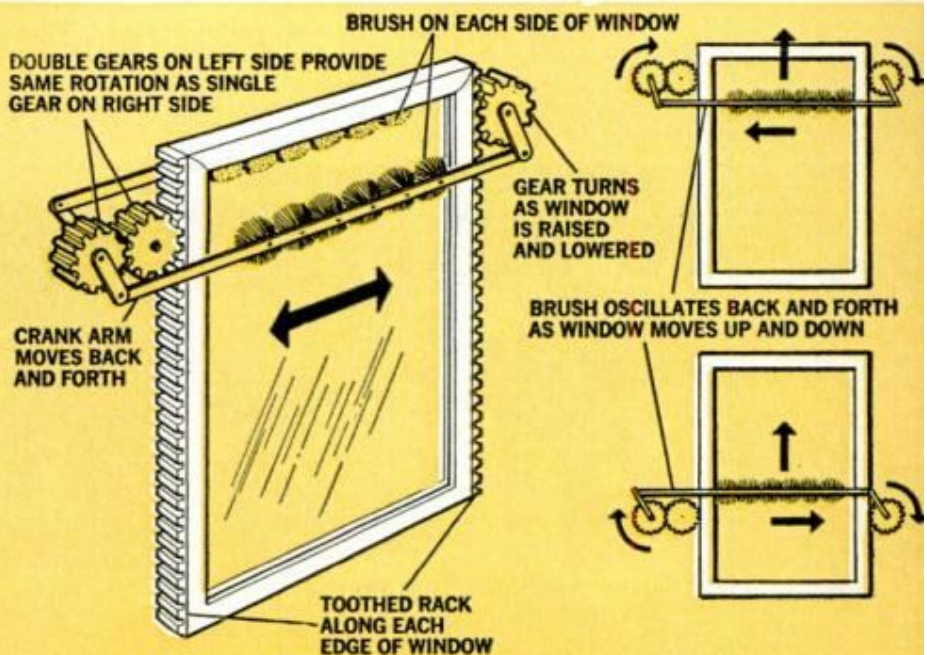
3. HIGH-SPEED TRAINS are possible with this clever system for tilting the cars on curves. On properly banked tracks, a train can safely travel much faster than it actually does, but centrifugal force causes passenger discomfort and nervousness, making it necessary for the engineer to slow down. By adding extra tilt to the cars as they pass through a curve, the centrifugal force is counteracted and the train can take the curve faster. Each car body is supported on inflatable air cushions at the sides. A gyroscope senses the amount and direction of bank as the train enters a curve, and a pendulum-actuated device measures the degree of centrifugal force on the car. Working together, they inflate the air cushions on one side until the car's angle of tilt exactly cancels out the effect of the centrifugal force, thus making it possible for the engineer to maintain a high speed



4. DANGEROUS EXPLOSIONS from leaking gas mains couldn't happen with this idea for a double-walled pipeline. Any gas escaping from the inner supply pipe is trapped inside the outer shell instead of seeping into the ground. Gas detectors installed along the main pipeline quickly sound an alarm if a leak occurs and pinpoint its location so repairs can be made. In addition, there's a whistle alarm vent at each house that warns the owner if pressure builds up in the protective shell. A bulkhead cap sealing off the shell in the foundation wall keeps leaking gas from entering the house itself



5. SELF-CLEANING WINDOW at right gets a thorough wiping every time you raise or lower it. Rows of brushes mounted on the inside and outside of the glass move back and forth as the window slides up and down, automatically keeping the pane free from dust and dirt. The edges of the window sash are fitted with toothed strips that engage small gear wheels at the sides. The gears turn crank arms, driving the brushes like piston rods on a steam engine. The brushes and gear mechanism are designed to be hidden from view inside the window casing





HE WON'T KNOW WHAT HIT HIM—and he won't care. Soon he'll be glassy-eyed from dart carrying immobilizing drugs, docile enough to be approached and captured, yet conscious enough not to roll over and drown

HOW TO CATCH A HIPPOPOTAMUS

By **ROBERT P. CROSSLEY**, Editor

LOADED FOR HIPPO, road grader pulls into river. Ranger with crossbow will shoot immobilizing darts from roof of cab. Length of needle varies with thickness of animal's hide. Hippos usually get a three-incher





STILL WOOZY, young hippo rests on mudbank after being towed ashore by grader. Rangers remove dart and disinfect wound, but before stepping into crate he may need another shot of tranquilizer "for the road"

... or an elephant or a zebra or a buffalo. Game wardens in South Africa's Kruger National Park do it every day. All you need is a helicopter or a road grader, a crossbow, a quiver of tranquilizing darts and a steady aim. It also helps to take a tranquilizer yourself.

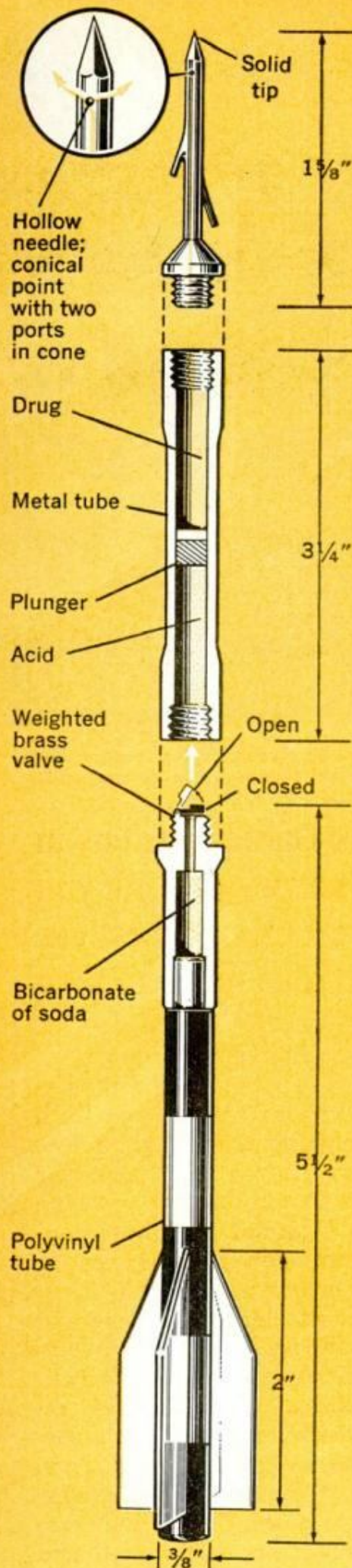
THE FIRST THING YOU NEED is a road grader. You need a road grader so you can drive out in the river and put salt on his tail. Not salt, really, but a central nervous depressant called Sernylan, mixed with a tranquilizer like chlorpromazine. You don't exactly sprinkle these on his tail. You shoot them into him with a barbed dart. You don't use a gun. You use a crossbow, and the drugs work faster if you hit him in the neck instead of the tail.

When you drive the grader into the river, make sure it isn't too deep. The hippos will raise up out of the water to see what's going on. That's when you

pick out the one you want, usually a youngster weighing about half a ton. You climb up on the cab, cock the crossbow, and let him have it with the dart. In 10 to 15 minutes he'll get pop-eyed and swim slowly in circles or stumble into shallow water.

You don't want him to fall down and drown; that's the reason you use Sernylan instead of quicker-acting "knock-out" drugs used on elephants. So you guide the grader over to him and throw a lasso around his pudgy neck. Then you lash him to the side of the grader and drag him to shore. Before you crate him you disinfect his dart-wound and

CROSSBOW DART



CHIEF BIOLOGIST Dr. U. de V. Pienaar shows how to cock world's most powerful crossbow. When shot from Land Rover or copter, it's accurate to 120 yards



BUFFALO, the most feared of Africa's animals, can actually be ridden after being hit with a dart from a helicopter. This one got a stronger dose, but will revive quickly after he gets a shot of antidote

shoot him with 12 million i.u. of penicillin. If his grunts bring his mama or the herd bull charging after you, you rev up the grader motor so they can't hear him.

That's the way they do it in Kruger National Park, South Africa, where 2200 hippo live more or less happily with 7700 elephants, 16,695 zebra, 2700 giraffes, 15,300 blue wildebeests, 5000 kudu, 132,500 impala, 15,800 buffalo, 1200 lions, 650 leopards, 260 cheetahs, 4000 warthogs, and other antelope, baboons, monkeys, and assorted predators. If these figures seem awfully precise, they are. To manage one of the world's greatest herds of wild animals in the park's 40-by-200-mile expanse of low hills, scrubby woods and grasslands



MARKED ELEPHANT (top) rises within seconds after 60-milligram dose of antidote. In lower photo, Rangers use truck to roll elephant on side so it can breathe. Large elephants may suffocate if left on stomach

G. VAN ROOYEN developed crossbow and darts (see opposite page) in Natal. Now he makes both in well-equipped shop at Skukuza in Kruger Park. Another version of dart can be fitted into barrel of a shotgun

stretching along the Mozambique border from the Limpopo River south to the Crocodile, Dr. U. de V. Pienaar, the park's chief biologist, and the rangers who work with him, have to know exactly how each species is doing. They count them by helicopter.

Because no hunting is permitted, and because diseases have been controlled, and because dams and wells provide plenty of water, the population of most species has literally exploded.

There were no elephants in the area when the original game reserve was established in 1898. Poachers and ivory hunters had wiped them out. By 1905 a herd of 10 had roamed across the border from Mozambique.

When the park was officially estab-



lished in 1931, there were 135. In 1960 there were 1000. Last fall the rangers counted 7700 from the air.

The lions, cheetahs, and leopards are supposed to keep down the antelope explosion, but they can't keep up with it. Even though the park is six times as big as Rhode Island, surplus animals have to be culled to keep it from being overgrazed. Big ones like elephants and hippos are captured alive and sold or given to zoos and to other parks.

Drugs to immobilize wild animals for safe handling were risky and unreliable when they were first tried 16 years ago.

The first real breakthrough came in 1959 when Dr. Tony Harthoorn immobilized a herd of white rhinos in Natal and moved them safely to Kruger Park, where the species had become extinct.

Today, after much experimenting, Dr. Pienaar and his associates have

Dr. Pienaar . . . cocks the crossbow, leans out of the copter—and zap!

determined effective combinations of drugs and safe dosages for virtually every species in the park. The one they use the most is M-99 (Propylorvinol hydrochloride) mixed with acetylpromazine maleate. It's great for elephants, but it can't be used on hippos because they'd drown, or on the big cats. Another drug, Fentanyl, is used on giraffes. It calms them without causing them to fall. A groggy giraffe can die of exhaustion trying to get up.

A tranquilized animal can be measured or weighed or moved to better grazing. Veterinarians can treat injuries, examine for diseases, take blood and tissue samples and destroy parasites. By marking immobilized animals, biologists can study migration patterns, reproduction, growth rates and longevity. A small transmitter can be inserted so an animal's movements can be followed by telemetry. When culling is necessary, an unconscious animal can

be killed cleanly with a knife, instead of being shot by a rifle with the chance of being wounded but not killed.

The drugs have to work fast so darted animals won't get lost in the tall brush before they take effect. They must have a wide margin of safety, because it's hard to estimate the weight of big individuals to prepare a precise dose. And they have to be potent in relatively small amounts so they can be loaded into a dart.

Elephants present the biggest challenge, because they're so big and so fierce, and because they're so prolific, increasing at an unbelievable 11.3 percent a year. They knock trees down to get at the tender top branches and chase smaller animals away from waterholes in dry weather.

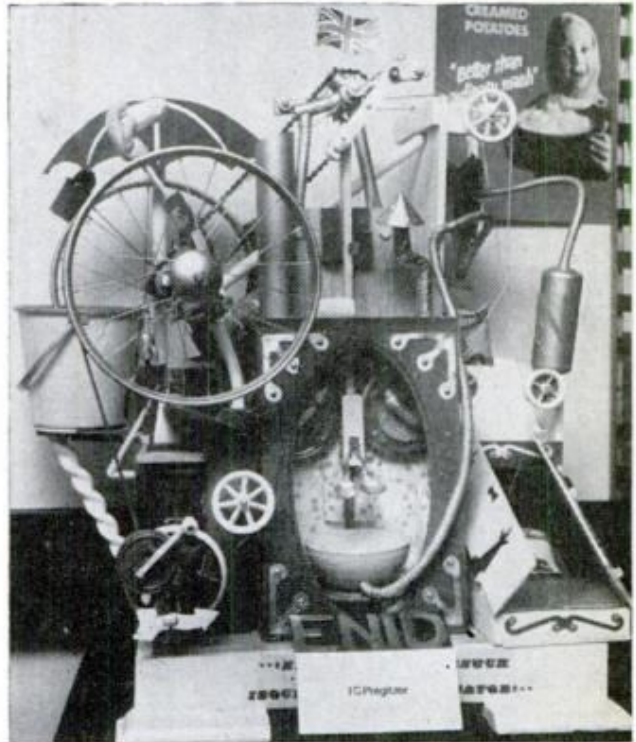
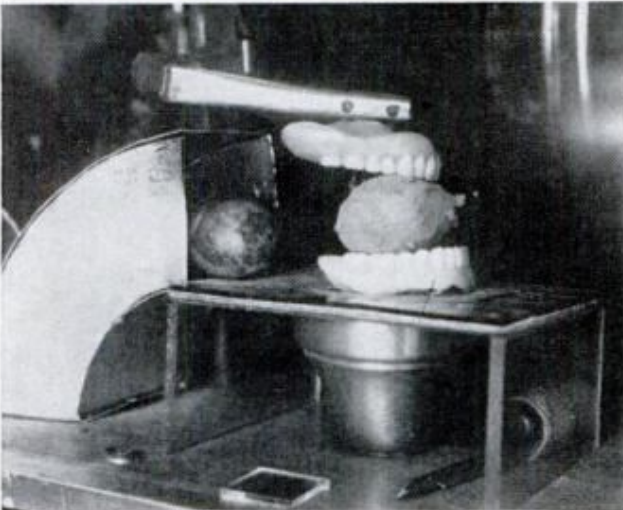
Capturing an elephant is a little more complicated than catching a hippo. Instead of a road grader, Dr. Pienaar climbs into a three-place Bell helicopter from which the doors have been removed so he can lean out with his crossbow. From the copter he has two-way radio communication with a ground party in Land Rovers and pickups.

I didn't get to look for elephants with Dr. Pienaar, but I did get a helicopter ride over a wild section of the park. We spotted large herds of zebra and wildebeests and a pride of 17 lions lying in tall grass. I didn't try to count the zebra and wildebeests, but it would have been easy.

The pilot takes Dr. Pienaar on a quick reconnaissance flight to locate a herd of elephants. When he finds it, Dr. Pienaar directs the ground party to the area. The helicopter lands nearby so he can confer with the ground party. Then it goes aloft again. Dr. Pienaar picks out the calves he wants to capture or examine, cocks the crossbow, leans out of the copter—and zap! (He once made 17 hits in a row.)

The helicopter moves higher and away a bit so the herd will calm down. In 10 to 15 minutes the calf will col-

(Please turn to page 195)



First, take a potato . . .

While it might take a bit of study to determine just how they do it, the student of such matters will know on sight what these machines do: Mash potatoes. They were entries in a contest sponsored by a London maker of instant mashed potatoes. The idea was to design a machine that appeared to duplicate the factory process. Rowland Emmett (designer of the car in the film, *Chitty Chitty Bang Bang*) selected the winners, but no one revealed how closely the machines resembled the factory. Second-place winner John Wilkinson designed a battery-powered machine (above) that could be recharged in three days of nonstop pedaling. The closeup shows his mashing operation. At upper right is first-place winner Michael Haynes's concoction of clocks, vacuum cleaner and other things. Another machine (center, right) used an elaborate series of movements, including a robot hand, to process a potato. Another hummed audibly through earphones (right).



PM Tests Snow Eagle— First of the Fast ATVs

By JAMES JOSEPH



A new machine that clambers over boulder and snow-strewn mountains yet does 45 mph in the straightaway

EVEN AT FIRST GLANCE, the Snow Eagle (ATV-600) looks like a fast machine. Fitted with a streamlined fiberglass body (high-impact plastic in production models), dual 15-inch-wide tracks and powered by a two-cylinder, air-cooled German-built 634-cc Hirth gasoline engine (equivalent to 39 hp which is considerably more power than found in most ATVs), the McCormack Snow Eagle seemed on the go just standing still!

But it wasn't until after several hours of boisterous running (the dual-muffled engine is quieter than many of its competitors, but the industry is still a long way from a silent engine) we became convinced that the Snow Eagle is an entirely



IMPROVED SLEIGH RIDE for this youngster is no problem for Snow Eagle's powerful 39-hp Hirth engine



THE EAGLE SKITTERS over rough woods road at better than 30 mph. Battery headlight is for night driving

new and exciting breed of adverse-terrain, any-season fun vehicle.

It's the first—and certainly not the last—of a lickety-split genre of ATV that can swoop over snowpacks at upward of 45 mph, charge through pine woods with the speed of a trail bike, climb sand dunes that would mire all but the heftiest dune buggies—and, on hinterland roadways (were it licensed to tread them; ours wasn't) might run rings around the family flivver.

Snow Eagle is gifted with "bulldozer" steering. This doesn't mean that it's hard to steer; only that turning the handlebars left or right automatically brakes one track or the other, swinging the ATV around in its tracks. Turn the handlebars quickly and far enough, and this little two-track-minded ATV spins about in its own 80-inch length.

This maneuver, however, is one we'd recommend only for stunt drivers and not when Snow Eagle is carrying its maximum load of two adults and a child riding its single, 36-inch-long, 13-inch-wide foam-cushioned seat.

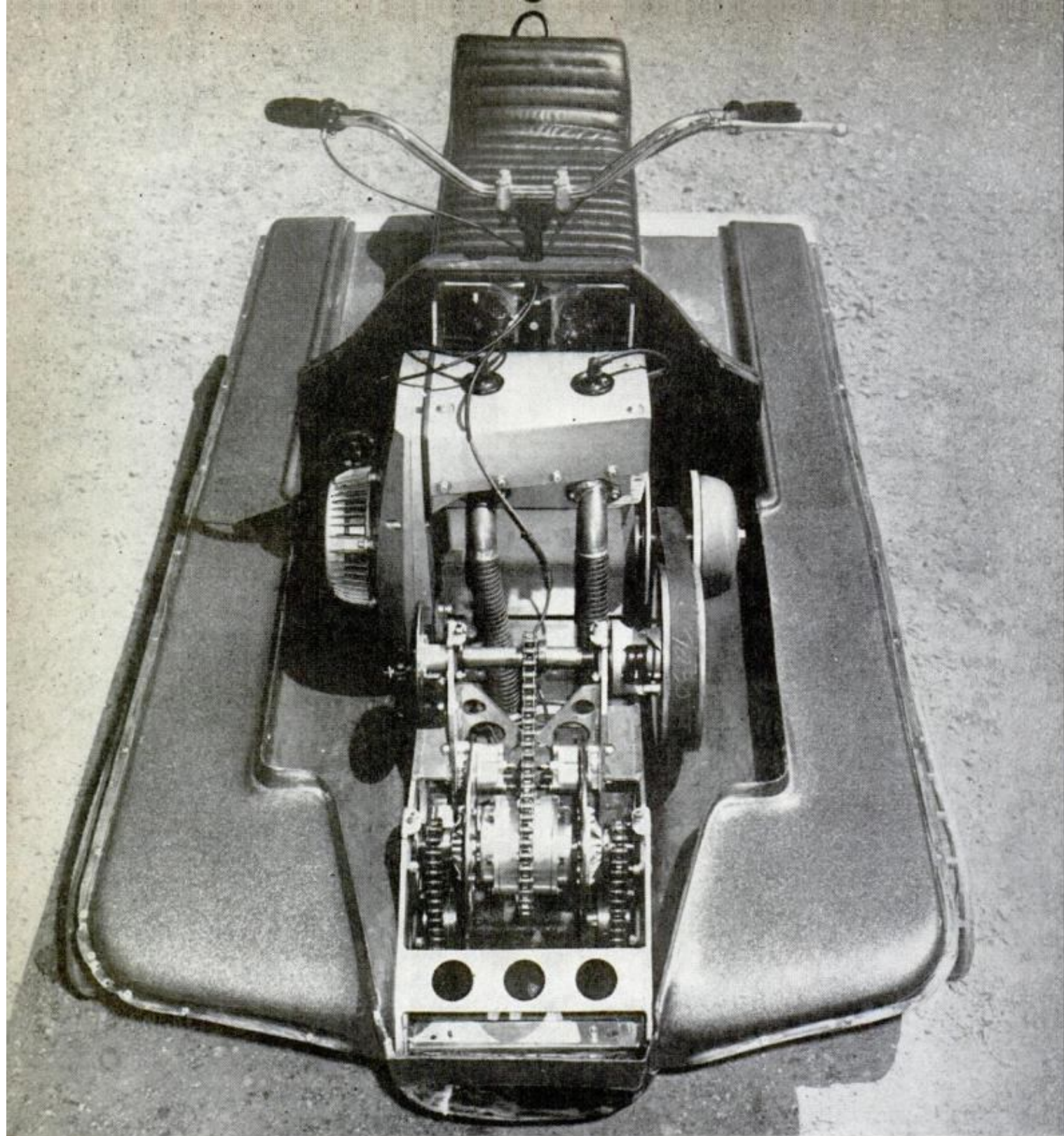
Snow Eagle's really unique feature, though, is its speed. It could probably do 50 mph given some gear tinkering. We estimated our test machine's top speed at about 40 mph. Formerly, all-track machines provided sure-footed-

ness, but hardly the speeds of a trail-bike. Snow Eagle delivers both.

We jumped this 465-pound (when fueled with seven gallons of gasoline) fun buggy at 35 mph over snowy ridges and tracked up 45° snow slopes at a respectable 20-25 mph. Then, for some tough-terrain diversion, we took to bone-dry (and snowless) woods trails. Snow Eagle leapfrogged sizable logs with ease—and with just as much speed as when hurdling snow banks. It climbed hills with equal facility.

We didn't test this rugged little ATV in powder snow, but by our reckoning it shouldn't find much trouble with any surface, be it powdery snow, sand or goo. Standing still and without riders, Snow Eagle exerts only about one-third pound of pressure per square inch of track surface. With a 150-pound driver aboard, it still has a "footprint" of less than one-half pound per square inch. The usual single-track snow machine often has double, even triple its tread pressure, but Snow Eagle literally surfs the snow.

That alone won't explain its extraordinary speed for a tracked vehicle. What does, though is its combination of increased power, a high-speed gear ratio, a center of balance that's just about even fore and aft with two riders



SNOW EAGLE WEIGHS 465 POUNDS fueled (fiberglass gas tank holds seven gallons), has integral cooling fan, pull starter. Production models will offer optional electric starters, may be longer for extra seating room

aboard, and this ATV's habit of keeping both tracks firmly planted, rather than planing or nosing into drifts, as some snow buggies will do.

Add, too, her relatively high eight inches of ground clearance fitted with a fiberglass belly pan (one of three major bolt-together body members), and she'll ride over snags and snowy outcrops which would sap the speed of other snow-and-go vehicles.

In many respects, "Snow Eagle" seems a misnomer. It's much more than a snow machine, and one that you don't have to put away in the spring. What you get is two, even three or four vehicles in one—ATV, dunebuggy, trail-goer, you name it. Why its makers tagged it with a winter-oriented moniker is puzzling. And as for the "600" part of the name, that's apparently a holdover from its prototype days when it was powered

by a 600-cc engine, rather than the present 634-cc scheduled for production.

Also, while Snow Eagle is mostly for fun and frolic, it has all the earmarks (and some of the built-in conveniences) of a hinterlands workhorse. Its hinged seat, for example, opens up to reveal a handy 1¼-cubic-foot storage compartment. A towing eye (not installed on the machine we tested) should make the Eagle suitable for pulling either sleds or wheeled trailers.

Towing would also be especially easy with the fast-track's ready-at-hand controls. With this ATV's speed you need both hands on the handlebars. And that's where Snow Eagle's controls are. A motorcycle-type twist grip throttle on the right handlebar nudges the engine from 1000 rpm idle, through normal 2800 revs for cruising, and on up to a top, ungoverned maximum of about 5500 rpm. Overall braking (which stops both tracks simultaneously) is accomplished with a squeeze-lever brake on the left bar.

The instrument panel will be generally uncluttered. Our test machine's dashboard sported only a choke, but production instrumentation will include an engine tach, temperature gauge, headlight switch and, possibly, a speedometer. Electric-start (optional) will add a keyed ignition to the instrument panel and, under the hood, a 12-volt starter battery to keep company with the standard 12-volt, 70 watt alternator—which incidentally, powers Snow Eagle's single, Cyclops-like headlight for night roaming. Also standard is a handy but unobtrusive pull-starter, installed in the body's fire wall just behind the engine and ankle-high on the driver's right. Pull-to-start machines have only forward speeds, though electric-start models will include a reverse.

Under the hood is the fast-go gear: an air-cooled Hirth engine which belt-drives a torque converter which also acts as an automatic clutch. The converter powers a husky one-inch-diameter steel jackshaft which, in turn, chain-drives a differential track-drive

system. Idea, of course, is to drive both tracks' seven-inch-diameter nylon drive sprockets at equal speed on the straight-aways, yet permit either track, when turning, to be slowed or stopped. Snow Eagle's designers employ independent track-drive axles, each separately powered from the differential. Each axle is slowed or stopped by an 11½-inch-diameter hydraulically actuated disc brake. What makes the whole "bulldozer" process automatic are two master hydraulic cylinders controlled by the handlebars.

Turn the handlebars left for a left turn, for example, and the left track's hydraulic master cylinder pressures a couple of disc brake shoes. The faster

What makes whole "bulldozer" process automatic are two master hydraulic cylinders

and farther you turn the handle grips, the greater the hydraulic pressure—and faster the braking of the "inside" or turning track. If anything, say Snow Eagle's designers, the opposite track is speeded up a bit. All of which makes for some tingling, fast turns.

Overall braking is likewise by disc brake. The only difference being that what's braked is the jackshaft (thus braking both tracks together) and it's done manually from the handlebar's braking squeeze-lever.

In the prototype we drove, each track (synthetic rubber, reinforced with fabric, resin and steel) was supported by six axles carrying 24 5½-inch-diameter bogies. Production machines may add an axle to each suspension, firming support over the roughest terrain. And the present spring-loaded bogie-axle support arms will get torsion shock absorbers: long-lived, shock-smoothing rubber springs.

Snow Eagle's trump is its versatility: here's the first snowmobile you don't have to store away come the first spring thaw. Its recommended retail price will be about \$1395. ★★★

Studded Tires Take Hold



CAR WITH FOUR STUDDED TIRES stops in 103 feet in 20 mph test on frozen lake. Car with rear tires studded travels 17 feet farther

Because studs on all four tires improve steering and cornering as well as braking and traction, they've won new friends farther south

TYPICAL STUD

By **MICHAEL LAMM** / *Technical Art by Hank Tomkalski*

THIS SEASON, dealers will roll out some 18.5 million new winter tires, 35 percent of them studded. Studs are tiny metal spikes embedded in the treads. They've been shown to give definite improvements in traction, braking, steering and cornering at certain temperatures on glare ice and packed snow. Yet they aren't for everyone.

The big push this year will be to sell you studded tires for all four wheels, not just the rear two. But in some areas of the country two studded tires will be all you need. In others, you won't need studs at all. More often than not, though, you'll be wise to spend the extra \$6 to \$12 per tire that studs cost.

Cornell Aeronautical Labs (CAL) conducted tests recently that showed some interesting results. At 32° F. on glare ice, studded tires on the rear wheels reduced braking distances of

full-sized American sedans 12 to 30 percent, this as compared with unstudded snow tires. When CAL researchers put studded tires on all four wheels, they found stopping distances were cut 32 to 50 percent.

In terms easier to visualize, one stud manufacturer, Kennametal, gives the following stopping distances. These figures were taken at 20 mph on solid ice, 32° F., using snow tires in the rear, conventional highway treads in front:

No studs at all.....151 feet;
 rear studs only.....120 feet;
 four-wheel studs.....103 feet.

Studs all around do a pretty impressive job. It's not surprising, either, considering the front tires of any car put down most of the braking force. Studs on the rear tires only, though, do help prevent fishtailing.

Yet—and get this—at 0° F., CAL

scientists noted almost no difference in braking distances between studded and unstudded tires. It's the temperature that's important here. At 32° F., there's a big difference. At minus 10° F., they calculate there'd be no difference at all.

Why? Because as temperature drops, the effectiveness of studs also drops and the effectiveness of plain rubber increases to compensate. At minus 10° F. and below, you're just as well off with unstudded tires. Studs are most useful from 32° F. to about 5° above.

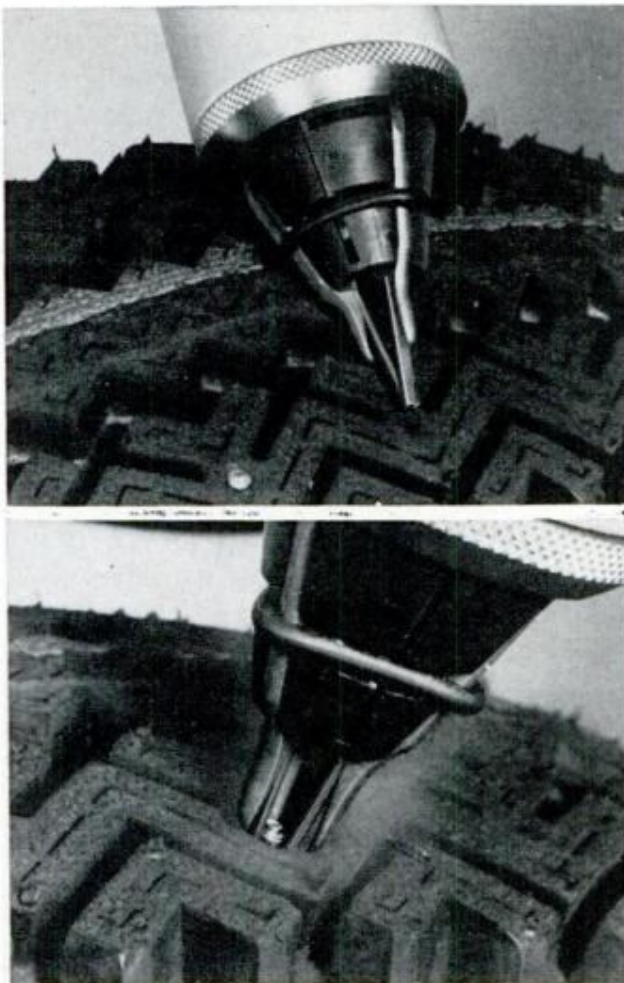
This isn't to say that braking spans increase at the colder temperatures, only that rubber alone will give you just as short a stopping distance as studs will at higher temperatures. In practical terms, this means if you do most of your driving in below zero weather, studs may not be worth the extra expense. Also keep in mind that studded tires do no good on dry or wet pavement, in mud, slush, or soft snow.

Studs do their job only on glare ice or hard-packed snow.

So much for braking; now how about traction? With studded tires, the drive wheels get more traction but again only on ice or hard snow. Authorities differ on the amount of increase, but it seems you can expect two to three times the tractive force to go up a hill or to accelerate from standstill.

Better traction, not better braking, is the main reason people buy studded tires. Traction *can* be important to safety as well as to convenience—the kind of traction that gets you out of your driveway in the morning. Some 90 percent of all drivers in the Minneapolis-St. Paul area now reportedly use studs on at least the rear tires for traction.

But remember, says the National Safety Council, that studs on all four wheels improve steering and cornering as well as braking and dead-ahead trac-



STUDS ARE INSERTED with compressed air gun. Stud gun fingers spread pinhole (top). When trigger is squeezed, a piston advances, driving stud into hole. Professional studding equipment (right) is needed



BITE OF STUDS in acceleration gives straight-line start. Bottom tracks were left on ice after stop

tion. Studs all around let you negotiate a curve at 40 mph that you'd slide off in a skid at 30 mph with regular snow tires.

To give another example of improved cornering, the National Safety Council says you can turn through a 213-foot arc on glare ice about 25 percent faster with four-wheel studs than with studs in the rear tires only. Steering, of course, becomes more sure. Again, studs lose traction and cornering effectiveness below 0° F., same as with braking.

The trade magazine *Tire Review* makes the case for four-wheel studs this way, "The dollar savings, even ignoring the safety aspects, are incalculable. One minor collision avoided through use of studded tires will more than pay for their cost." True enough.

BEFORE AND AFTER BREAK-IN



SHOULDER OF STUD SHELL is firmly clenched by rubber when tire is broken in during first 50 miles



WINTER TREAD with studs bites clean on snow. Studs are mounted only on shoulder of the tire tread

But what about the safety aspects? A study on the Pennsylvania Turnpike showed that you're almost eight times more likely to have an accident on an icy road than on dry pavement.

Studs look innocent and simple enough—aluminum, plastic, or steel outer shells house a supertough tungsten carbide core. Together, shell and core fit tightly into a tire, normally 72 to 120 studs per tread.

Theoretically, if you mate the right stud to the proper tire, the stud should wear at exactly the same rate as the rubber. Actual tests have shown that a good studded tire will outwear an unstudded one by a slight margin. Poorly studded tires, or those mounted backward after their first season, wear faster than treads without studs.

A stud's tungsten carbide core normally protrudes about $\frac{3}{32}$ inch beyond the tread surface. This is all you need. Studs that stick out too far wear too fast and probably harm dry road surfaces. It's practically impossible to shake a stud loose from its hole if it has been properly inserted and broken in. One engineer calculated that you'd have to drive at a speed of 300 mph to make a stud fly out of its hole by centrifugal force.

Studded tires go back more than 50 years, but the use of studded tires

began in 1965. In 1964, barely three million studs (not tires, *studs*) were sold in the United States. In 1965, the figure rose to 30 million. By 1967, it reached 600 million. And for the current winter of 1969-70, stud producers predict 800 million stud sales.

The method of inserting studs has changed drastically in the past few years. As recently as 1965, studded tires were supplied to dealers with the studs already in place. This meant that each dealer had to stock a double inventory—one selection of snow tires without studs and one with. To cut duplication and warehousing, the stud manufacturers recently came out with simple, inexpensive machines to let dealers insert studs themselves. This is now almost the universal practice. The dealer studs your tires while you wait.

Today, all tire manufacturers design their winter treads with little holes in the pattern. This is called "pinning," and the holes are there to accept studs. The studding pattern is predetermined by the tire maker, not the dealer, and pinholes are usually staggered. The optimum configuration puts 8 to 12 studs in contact with the road at all times. This requires 72 to 120 studs per tire,

depending on tire size and pattern. It's possible to design too many studs into a tire. More than about 250, while a trifle more effective on a frozen lake, can make a car skid on wet or dry pavement.

While it's no problem to buy studded tires for the rear wheels of a conventional car it's a little tougher when it comes to the front. The snow treads used for rear wheels can, of course, be used on the front, but you're paying for more rubber than necessary for wheels that aren't used for traction. However most conventional highway treads are not studdable because they lack rubber depth. The bottom of a stud hole must not be any closer to the tire cord than $\frac{3}{32}$ of an inch. And pinholes can be drilled or molded in the tread only where there is a diameter of at least $\frac{5}{8}$ inch of solid rubber free from any sipe or rib.

A few tire manufacturers now offer studdable highway treads. Among them, Firestone lists the Town & Country Frontrunner, although company spokesmen quickly admit they're not yet available in all parts of the country. Goodyear offers the studdable Pathfinder Polyglas tire, designed exclusive-

STUDED TIRE TIPS

- Drive carefully on frozen roads. When a studded tire spins, it loses traction.
- Every 9°F. drop in temperature lowers tire pressure by one pound. Underinflated studded tires get less grip on glare ice. Know the recommended p.s.i. and check tires often.
- Never stud a used tire. Dirt in the pinholes can be ground through the carcass by the studs. Studs don't seat well in dirt-clogged holes; they can easily be ejected by centrifugal force. Even a "new" tire with 10-20 miles of use may be too dirty to stud.
- Break in new studs at speeds under 50 mph for 50 miles. No quick stops or jackrabbit starts. Give the studs a chance to seat and begin a correct wear pattern.
- When you remove studded tires in the spring, mark each with chalk so you can replace it on the same wheel. If you remove tires from rims, mark the **direction of rotation** with arrows. Studs wear at a slant. Mounted backwards, they wear in the opposite direction. This cuts their effectiveness and life. Or they'll try to turn 180° in their holes, which can cause them to wobble or be thrown out.
- Never rotate studded tires.
- If you store winter tires on wheels, lower pressures about half. To help reduce checking and cracking caused by ozone, don't store tires near electric motors—freezers, dryers and such.
- Don't leave winter tires, studded or not, on for summer driving. Their thicker tread causes more friction in flexing, thus heat buildup. They'll wear faster; the heat can cause blowouts.
- For maximum stud effectiveness and tire life, be sure all wheels are tracking true and that they are in balance.
- Never try to insert studs yourself. Leave studding to a pro. He has the equipment and know-how.

ly for front-wheel application and compatible with either Polyglas or bias-ply rear snow tires.

Other tires suitable for front and rear use include the Goodrich Sun-N-Snow, Seiberling's Four Seasons, Co-ops' Country Squire, and a retread design made by Super Mold called the GTS-422. There are surely others, so ask your dealer. Chances are that all tire manufacturers will supply pinned front tires next year.

What about front-wheel-drive cars like the Toronado, Eldorado, Saab and others? Studded winter treads go on the drive wheels and studs are needed on the rear to prevent fishtailing when braking.

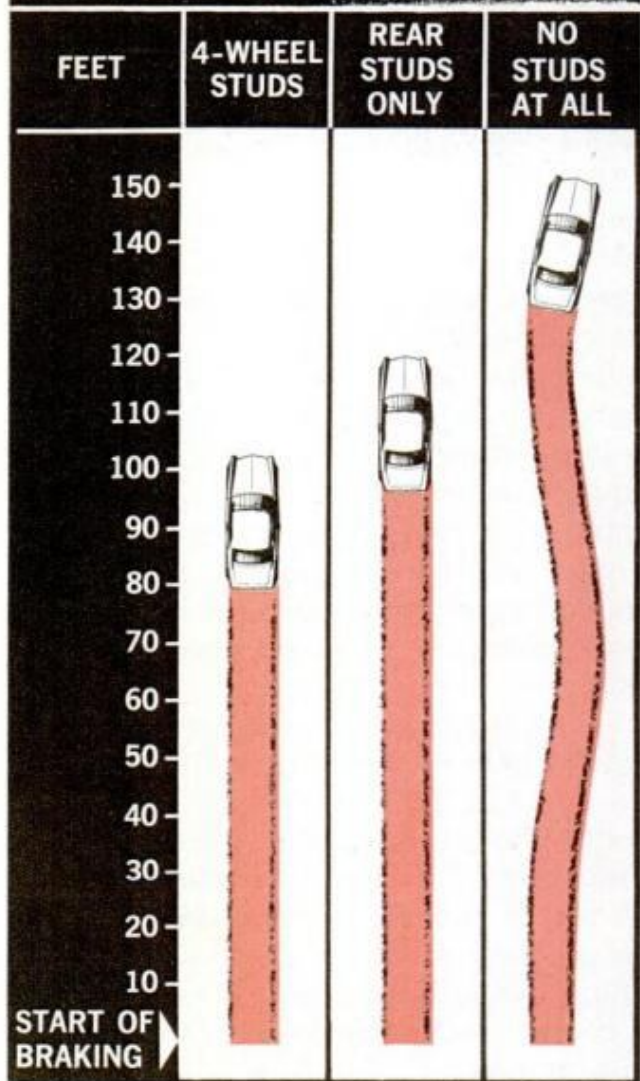
It's most important that studs be inserted properly. Any dirt in the pin-hole will give poor results, so both the stud and the tire must be new and unused. Equally important is that the stud be matched to the rubber formulation to get the proper wear characteristics. Finally, it has to be just the right stud. If it's too big, it can split the rubber and be tossed out. If too small, it's thrown out right away. Too long and the protrusion is wrong—the tire becomes like a dog walking on its claws. Too short and the stud might as well not be there. You're a lot better off letting a pro put in your studs.

The Tire Stud Manufacturers Institute is trying to establish guidelines for studs, including color coding and a system for sizing and nomenclature.

Not long ago, quite a few states had laws against driving on paved highways with studded tires. Today only three states specifically outlaw studs—Georgia, Mississippi, and Louisiana. The rest allow them, except Hawaii, where you don't need them anyway. Texas and Arkansas have rather ambiguous wording in their laws, so it's hard to tell their precise position, but most people feel that if you need them there, you're within the law to use studs.

The reason for any legislative mumbling remains the unconfirmed opinion that winter studs harm highway pave-

**AUTOMOBILE BRAKING PERFORMANCE
BASED ON VEHICLE GOING 20 MPH ON
SOLID ICE AT 32°F.**



TESTS SHOW braking advantage of four-wheel studs—103 feet; rear studs, 120 feet; no studs, 151 feet

ment. So far, no one's come up with conclusive evidence one way or the other. Preliminary tests, seem to show that studs don't harm pavement.

A number of states—20, in fact—limit the months in which you may drive on public roads with studded tires. Most of these restrict use to the months between September and June. Then, too seven states limit contact area of the stud to a definite percentage of the tire footprint. This is nearly impossible to calculate, so the law has relatively little practical value, but it's on the books anyway. Twenty states limit stud protrusion, and nine states limit or prohibit studded tire use on trucks.

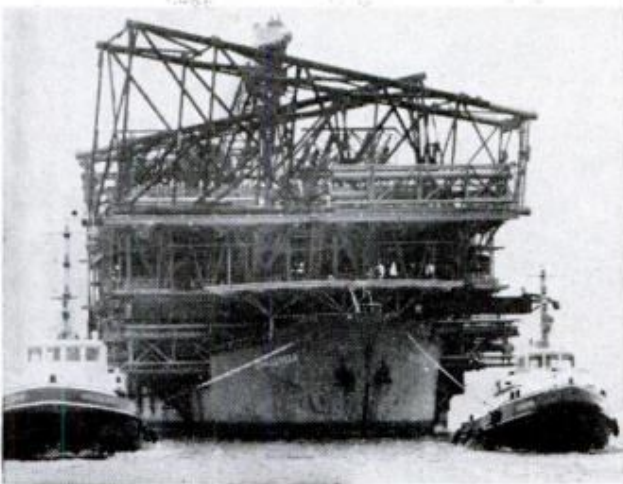
Your tire dealer should be able to

(Please turn to page 190)



New Zealanders build propjet agricultural plane

Described as the first turboprop plane to be developed for agricultural dusting, the Prop-Jet Fletcher was recently introduced by Air Parts New Zealand, Ltd. The 500-hp plane carries a 47-cubic-foot hopper and has dual wheels on its undercarriage.



Obstructed view

Officers stationed on a bow platform radio steering instructions to the captain of the *Challenger*, whose cargo of oil-drilling equipment obscures the view from the bridge.



Quality control for towers

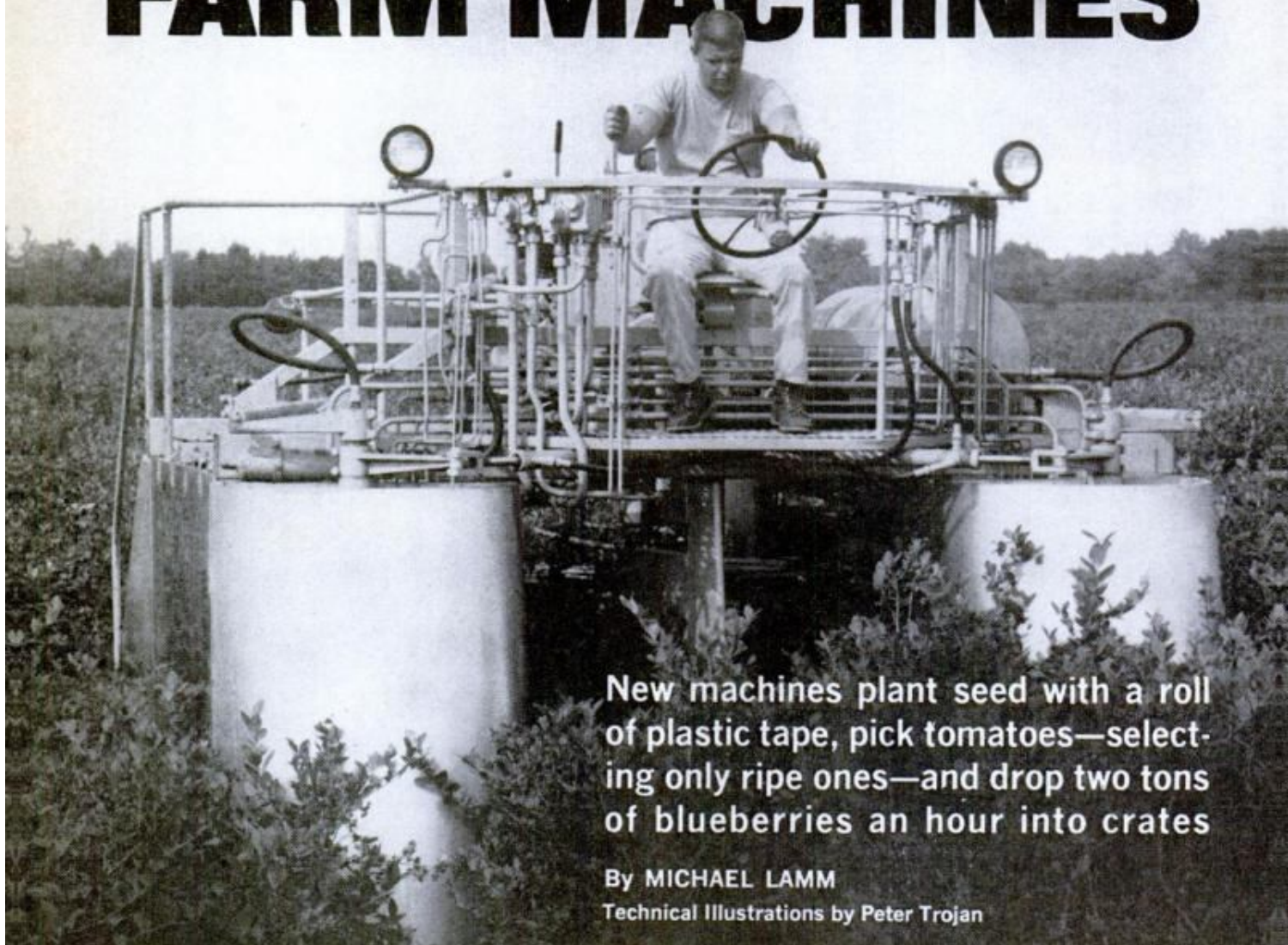
Welds in the 110-story World Trade Center towers are checked for flaws during construction. When completed, the buildings, in New York, will be the world's tallest.



Heavy light tower sails off to sea to be sunk

A 4000-ton light tower, built on shore, was recently towed to its permanent location off the coast of England and sunk on its seabed site. The tower guards the Royal Sovereign Reef, just off Eastbourne, next to one of the busiest shipping lanes in the world.

FANTASTIC NEW FARM MACHINES



New machines plant seed with a roll of plastic tape, pick tomatoes—selecting only ripe ones—and drop two tons of blueberries an hour into crates

By MICHAEL LAMM

Technical Illustrations by Peter Trojan

THE DAY of the automated farm may be close at hand. Farm machines that run themselves are currently in prototype.

At the University of Missouri, experimenters have developed a windrower (a tractor-towed circular rake that gathers hay into long, loose piles before baling) that needs no driver. It follows a magnetic tape laid on the ground. This tape keeps the tractor crisscrossing the field. When the tractor reaches the end of a row, the tape tells it to turn around, lower its rakes again, and head down another row. The only human nudge this machine needs is the push of a button to start it. The automated windrower even turns itself off after it has finished the field.

A second prototype uses radio beacons and triangulation to keep it on course. Triangulation is detected by an antenna on the tractor and monitored by a small computer.

While such developments are in the experimental stage, some fantastic new machines are already in the fields, solving the problem of the farm labor shortage in the harvesting of crops that require laborious handpicking. The Harvey Harvester for blueberries is a behemoth that, despite its gargantuan size and five-ton weight, treads so lightly that it compacts the soil less than a man on foot.

The Harvey uses three different hydraulic systems. One drives all four wheels and adjusts four struts for

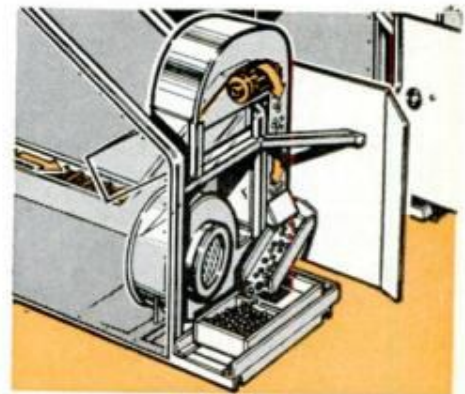
proper picking height. Each strut has a 15-inch travel range. The second circuit controls the power steering, which turns all four wheels and gives an inner turning radius of a bare 16 inches. The third powers a shaker assembly, conveyor and blower-separator.

The machine straddles a row of 10-foot blueberry bushes and a divider at the front guides the bushes to each side, where they come into contact with vibrating shaker fingers. There are four sets of fingers on each side, revolving on a shaft. They shake horizontally but freewheel around their axes so they move through the bushes at whatever speed the driver decides. The shaking

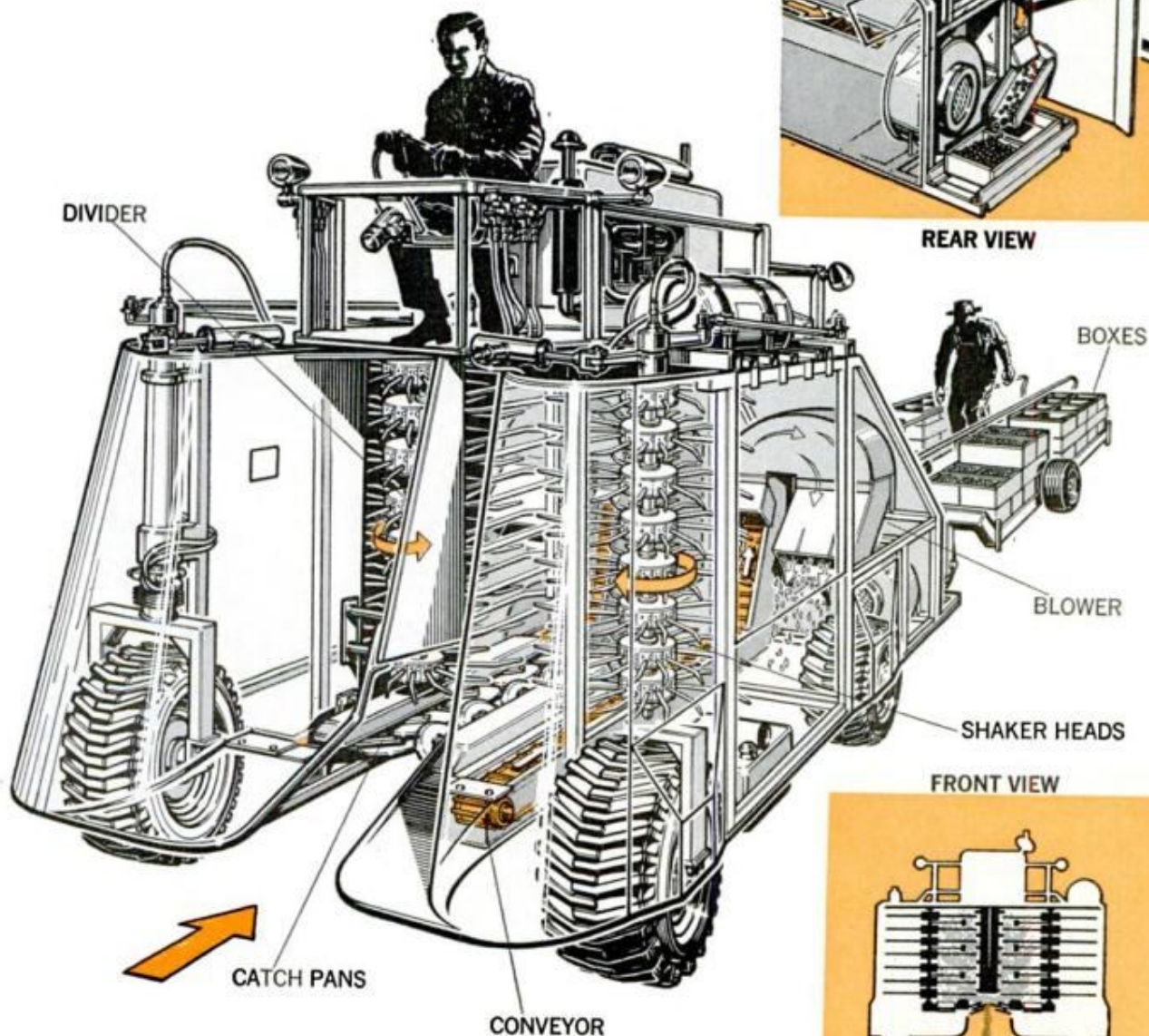
action makes the berries drop into catch pans below, and from there they're carried on conveyors past a blower that separates berries from chaff. Finally, the berries pour into boxes at the rear of the machine. The harvester can pick two tons of blueberries an hour.

In the future, human pickers may be eliminated entirely; the farmhand will become a technical assistant. Electronic scanners will be able to "read" colors and thereby let the machine distinguish between ripe fruit, green fruit and leaves. There is now a tomato harvester equipped with such a scanner and the machine may lend itself to automation. Mechanical harvesters still need crews

GIANT BLUEBERRY PICKER, the Harvey Harvester, straddles bushes, shakes them with horizontally revolving fingers. Berries then drop into catch pans and are carried by conveyors to boxes at the rear of the machine



REAR VIEW



BOXES

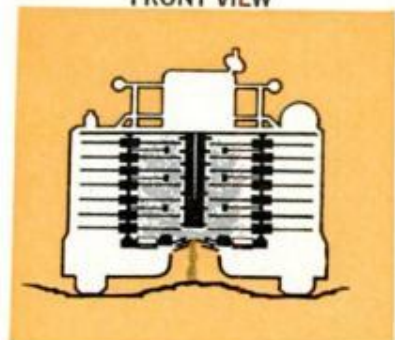
BLOWER

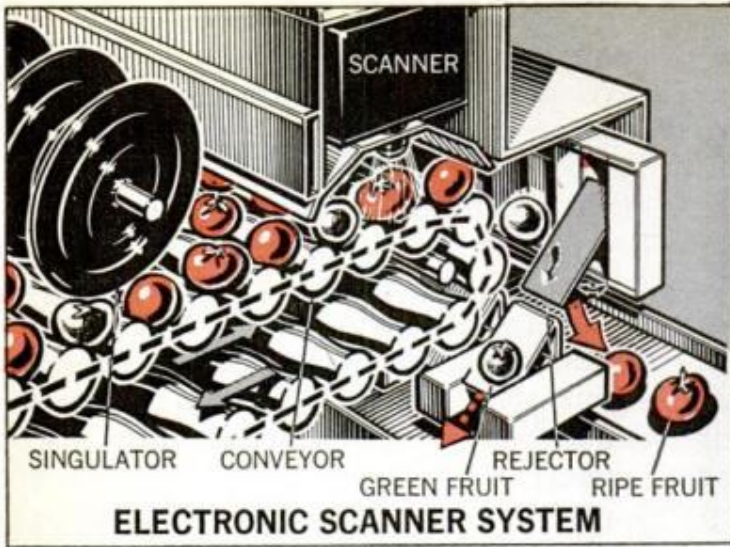
SHAKER HEADS

FRONT VIEW

CATCH PANS

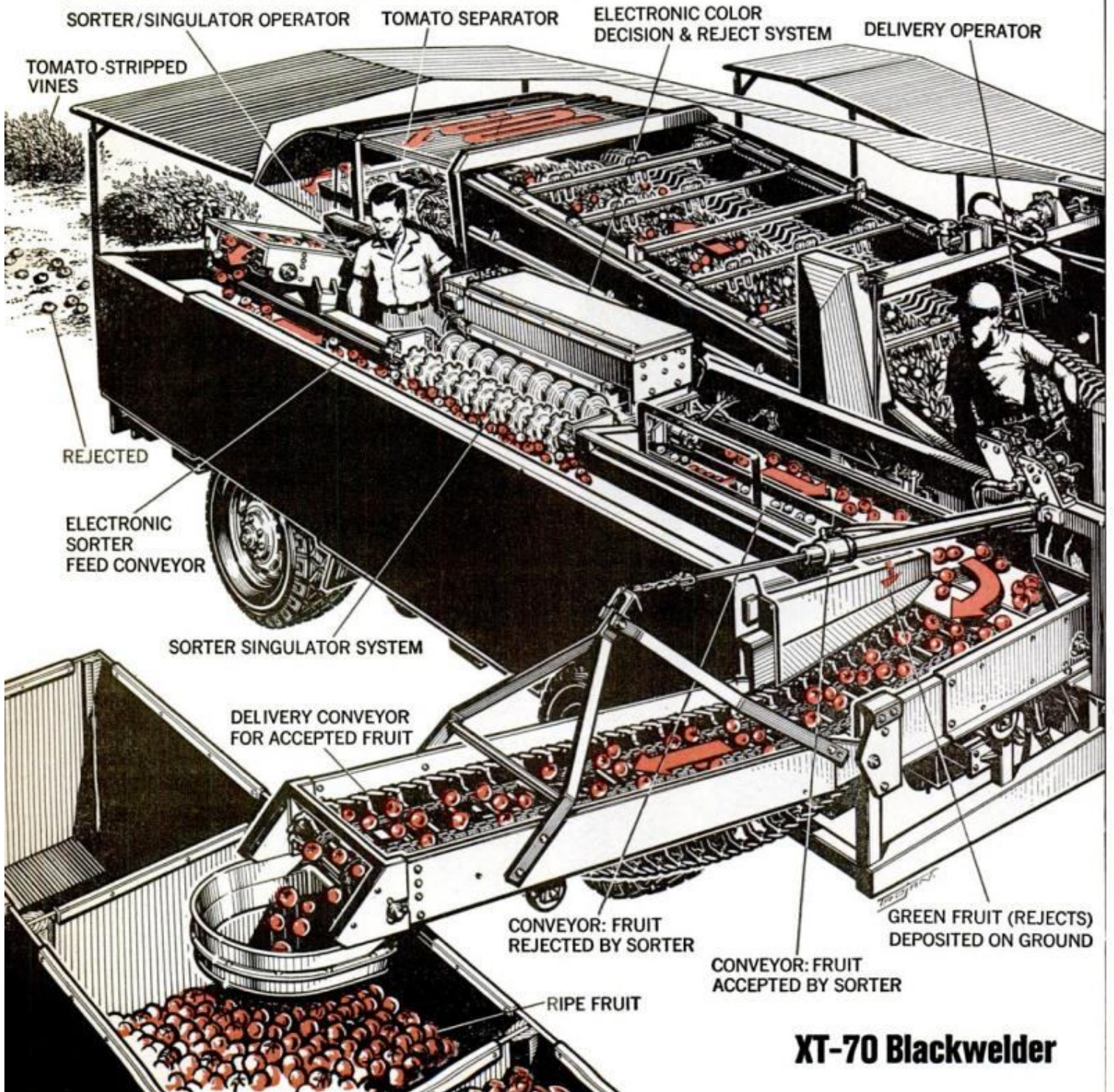
CONVEYOR





to pick out greens, clods and foreign matter that comes aboard, but much of this work can be eliminated by adding more shunts activated by electronic scanners. To make mechanical tomato

TOMATO VINES cut by blade at ground level are conveyed to separator which shakes fruit loose. On another conveyor, fruit is aligned by sorter-singulator to enter electric scanner. Latter (preset for degree of redness) rejects green fruit through trap door operated by compressed air. Accepted fruit proceeds to delivery conveyor and waiting truck



XT-70 Blackwelder

POPULAR MECHANICS

Материал, защищенный авторским правом

harvesting practical, agronomists had to develop a new type of tomato that could withstand the rigors of machine picking. This tomato had to snap off its vine under the right pressure, ripen evenly, resist certain wilts, and be plantable so machines could pick it. "Old" tomatoes wouldn't do any of these things. When tomatoes were hand-harvested, workers would go through each field several times to pick previous greens. Now, with machine harvesters, it's too expensive to make two or three trips, so everything has to come ripe at once.

After more than 10 years of early breeding work, the first machine-pick-

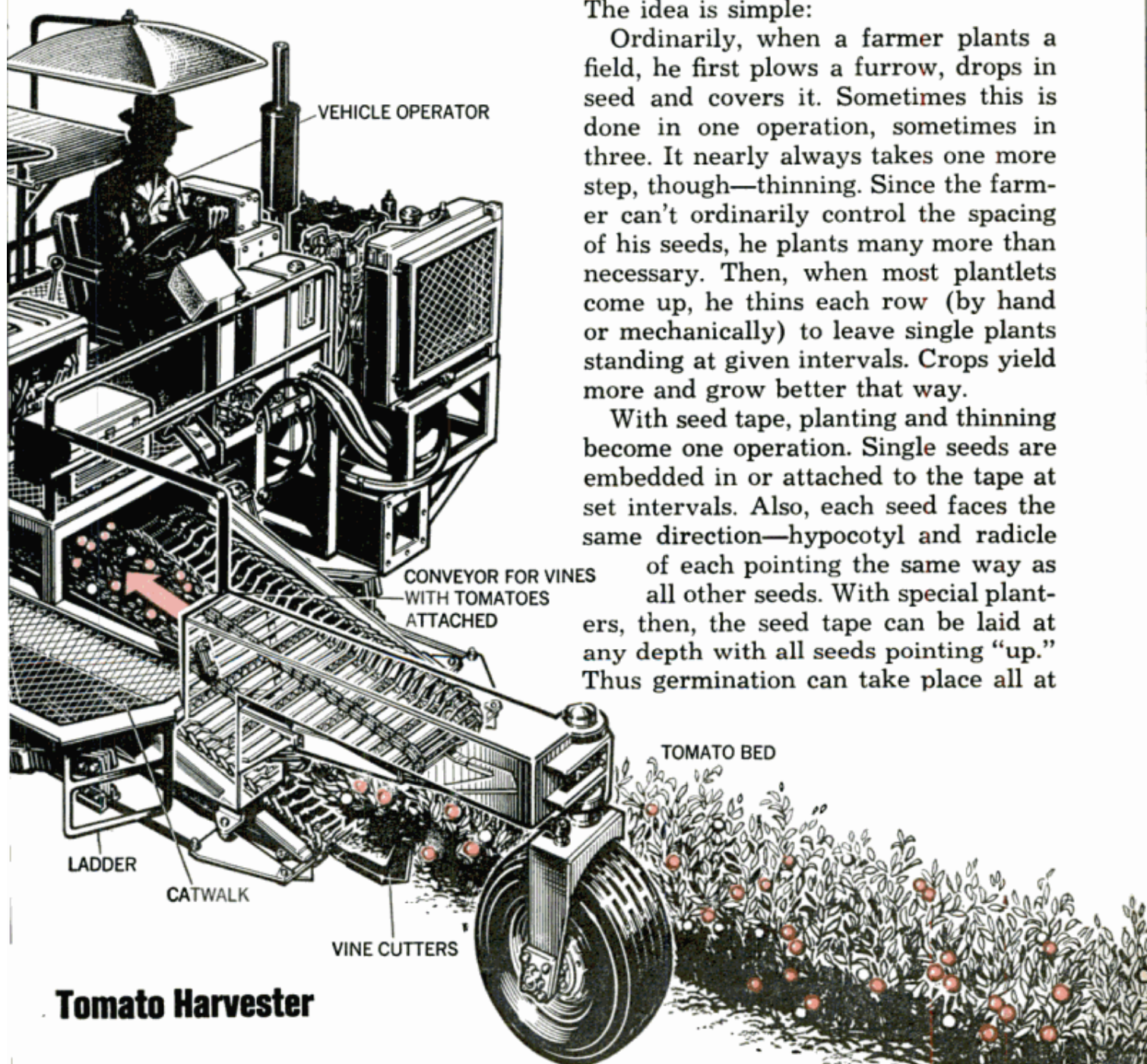
able commercial strain of tomatoes was produced in 1961 at the University of California at Davis. It was called VF-145. This tomato was entirely unlike any grown up to that time. Since then, many "offspring" strains have come along. Their refinements are based on local soil and weather conditions. Mechanical tomato harvesting wouldn't be possible without these new, refined strains.

Planting by tape

Tape is currently being used to plant seed. Union Carbide has developed a new tape called Radel. Various companies use Radel to implant their seeds. The idea is simple:

Ordinarily, when a farmer plants a field, he first plows a furrow, drops in seed and covers it. Sometimes this is done in one operation, sometimes in three. It nearly always takes one more step, though—thinning. Since the farmer can't ordinarily control the spacing of his seeds, he plants many more than necessary. Then, when most plantlets come up, he thins each row (by hand or mechanically) to leave single plants standing at given intervals. Crops yield more and grow better that way.

With seed tape, planting and thinning become one operation. Single seeds are embedded in or attached to the tape at set intervals. Also, each seed faces the same direction—hypocotyl and radicle of each pointing the same way as all other seeds. With special planters, then, the seed tape can be laid at any depth with all seeds pointing "up." Thus germination can take place all at



Tomato Harvester

JANUARY 1970

once throughout the field. Plant spacing is uniform, and the field doesn't need a special once-over for thinning. The Radel tape itself dissolves harmlessly during the field's first irrigation.

Developing even something as "simple" as the seed-tape planting system, chemists had to work with agronomists, horticulturists, engineers, geneticists, and soil experts. The tape itself was developed by a chemist. It couldn't work, though, until agronomists and geneticists created seed strains compatible with the planting methods.

These seeds had to have certain unusual qualities—a high germination rate, uniform emergence, and had to be genetically true to type. Then, too, mechanical engineers had to figure out how to build machines that could place seeds in the tape one at a time. This wasn't simple. Other engineers meanwhile invented machines to place the tape into the ground. For that they needed a hand from soil experts. So the process got pretty involved. Nearly all modern farm machines evolve from this sort of cooperative invention.

There are some differences in farming you can't help noticing. Like cubed orange trees. They're the coming thing.

In Southern California, horticulturists have been toying with pruned citrus trees since 1961. Crowding among trees plus the thick inner foliage was cutting down productivity in certain orchards. Sunshine simply couldn't penetrate.

The University of California Extension Service decided to stage some supervised, controlled experiments to see what pruning orange trees would do. Since 1961 they've been pruning trees in different ways to see how this would affect yield and fruit quality. Results have been successful and amazing.

After studying and comparing yields

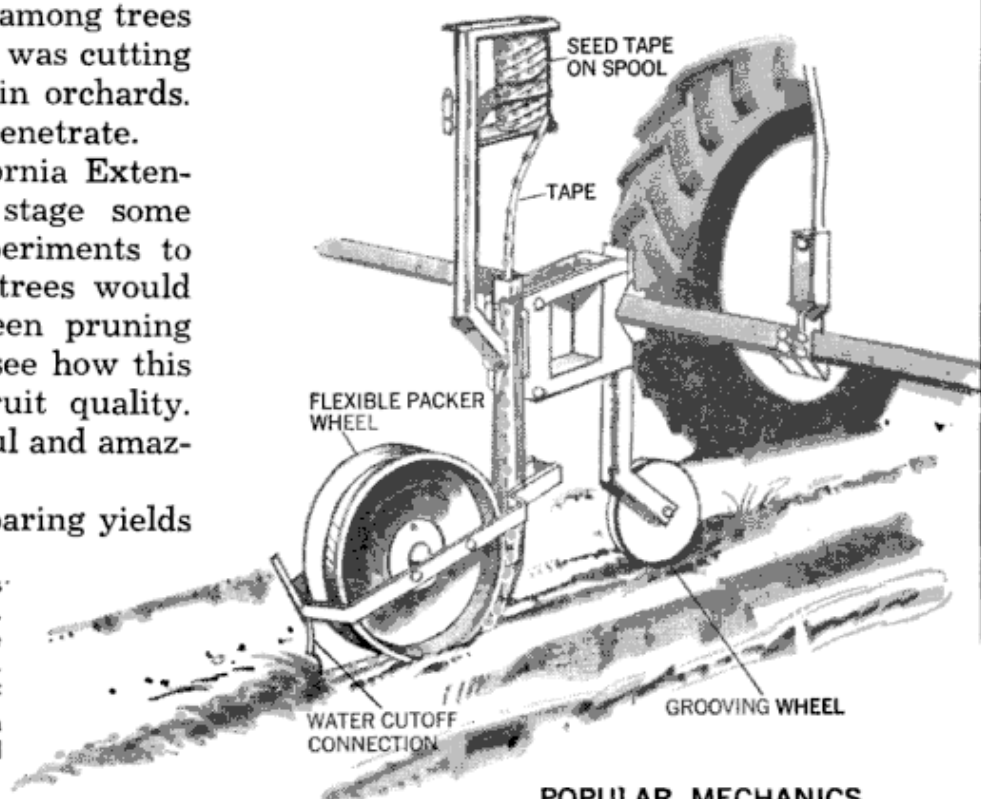
WATER-SOLUBLE PLASTIC TAPE makes possible perfect spacing of seeds. Grooving wheel digs furrow, tape unreels into furrow and is covered by packer wheel. At end of row, tape is cut by water jet from a nozzle behind the packer wheel

from 1964 through 1967, the experimenters found that trees topped and hedged on all four sides produced 7.04 boxes of oranges as against 6.30 boxes for untouched trees. Fruit was of a better quality—bigger and juicier—from the square trees. For purposes of comparison, some trees were pruned on one or two sides, some were topped and others not. No pruning had the effect of complete cubing.

Machines used for cubing the trees are big, whirling circular knives set on vertical arms (for hedging) and overhead beams (for topping). These knives are adapted to ordinary orchard tractors.

Another benefit of cube-shaped trees comes in harvesting. With old-fashioned methods, each picker works from a tall ladder with a bag over his shoulder. To pick, he positions his ladder, climbs up, puts the fruit in the bag, climbs back down, repositions the ladder and continues until his bag is full. Then he empties it at a central place in the orchard. In all, more than half his time is taken up with chores other than harvesting.

With square trees, new harvesting machines can be developed. One that's currently in use is a tractor-drawn carrier with human pickers aboard it. This



HARVESTING ORANGES

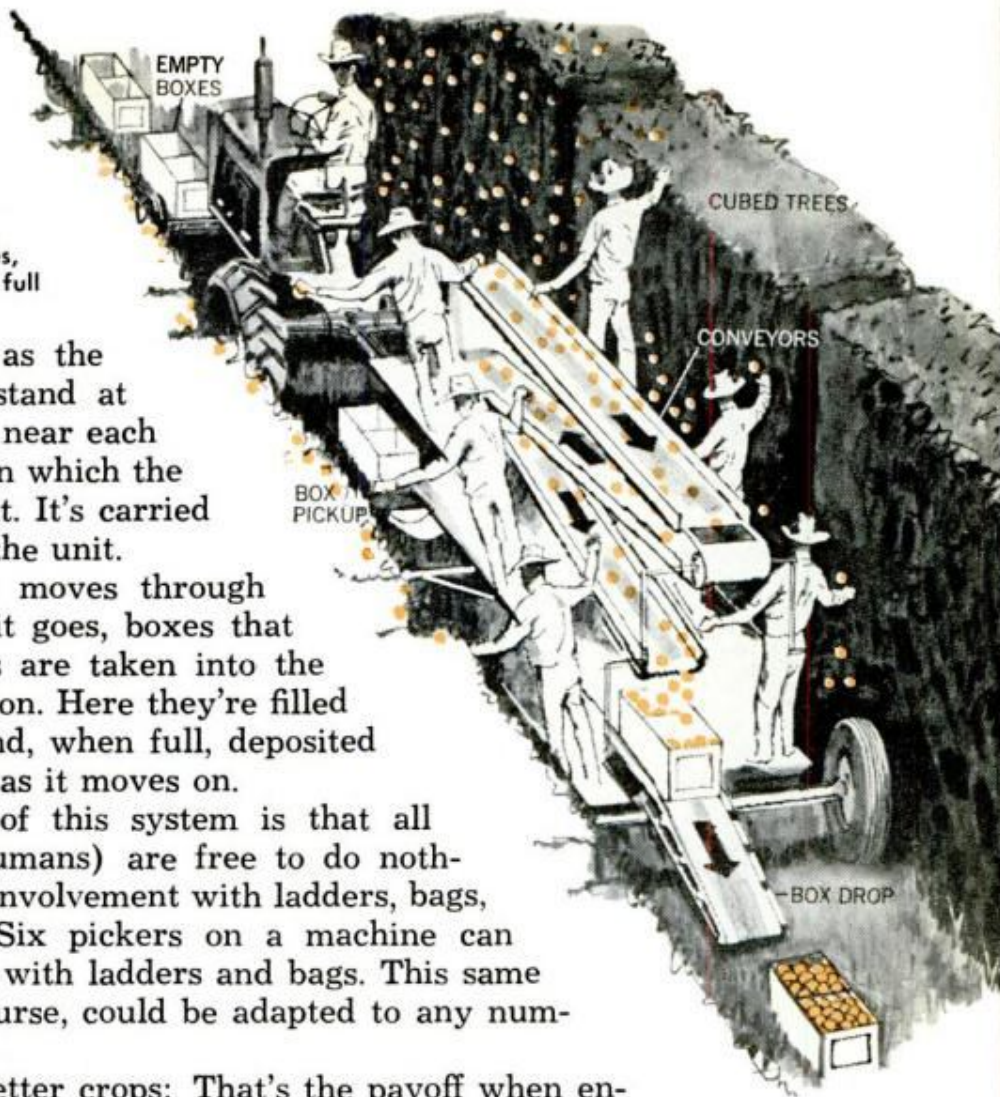
from cubed trees, pickers ride a conveyor wagon. Lead pickers work the top branches, others middle and lower areas, drop fruit onto conveyor belts. Wagon straddles empty boxes, picks them up, drops them when full

device rises up as tall as the top of the trees. Men stand at various levels on it, and near each man is a conveyor belt on which the picker can place his fruit. It's carried down into the center of the unit.

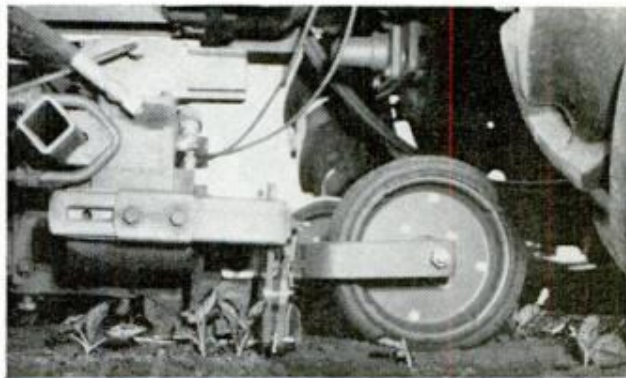
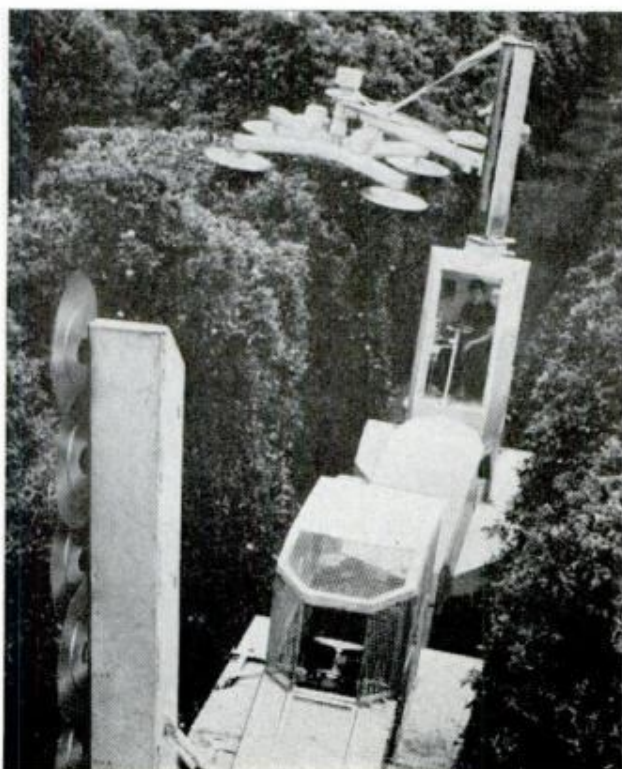
This picking machine moves through the orchard slowly. As it goes, boxes that lie in the orchard aisles are taken into the hollow center of the wagon. Here they're filled by the conveyor belts and, when full, deposited again behind the wagon as it moves on.

The main advantage of this system is that all pickers (in this case, humans) are free to do nothing but pick. There's no involvement with ladders, bags, climbing and walking. Six pickers on a machine can outperform a crew of 30 with ladders and bags. This same cubed-tree system, of course, could be adapted to any number of other fruit crops.

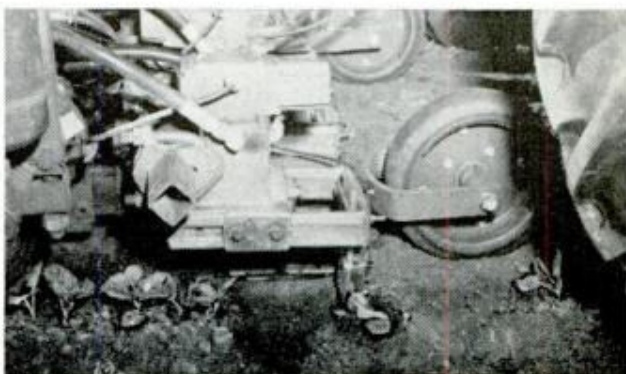
Easier harvesting of better crops: That's the payoff when engineers and scientists make their fantastic changes in farming. ★ ★ ★



CUBING ORANGE TREES is done with vertical-cutting hedger (foreground) and a horizontal-cutting topper (background). University of California tests show that cubed trees produce more—and larger—oranges



ELECTRONIC THINNER leaves desired plants spaced at proper intervals, cuts out those in between. As probe on John Deere thinner (above) touches plant to be saved, knife arm (below) clears out excess growth



A Laser 'Knife' for Bloodless Surgery

The argon laser is a scalpel so delicate it can be pinpointed on a spot half the thickness of a human hair and 'walk around' blood vessels.

By ARTHUR FREESE

EARLY ON MARCH 20, 1968, 10-year-old Elliott Wilson was wheeled into an operating room at the Institute of Ophthalmology, Columbia-Presbyterian Medical Center, New York City. There were no shining trays of instruments, no scalpels or scissors or hemostats. The surgeon and his assistants wore no face-masks or rubber gloves, but yellow shooting glasses. Dr. Francis A. L'Esperance Jr., associate professor of ophthalmology at Columbia University's College of Physicians

and Surgeons, would operate with an instrument whose focused point was about one-tenth the thickness of a human hair. This was photon-surgery—the harnessing of the power of light, the laser, for medicine.

Elliott had undergone a dozen operations in his short lifetime, having already lost the sight of one eye. Ever since, surgeons had fought a membrane, fed by enlarged blood vessels, which threatened his only good eye. Conventional surgery was impossible

because of the threat of hemorrhage.

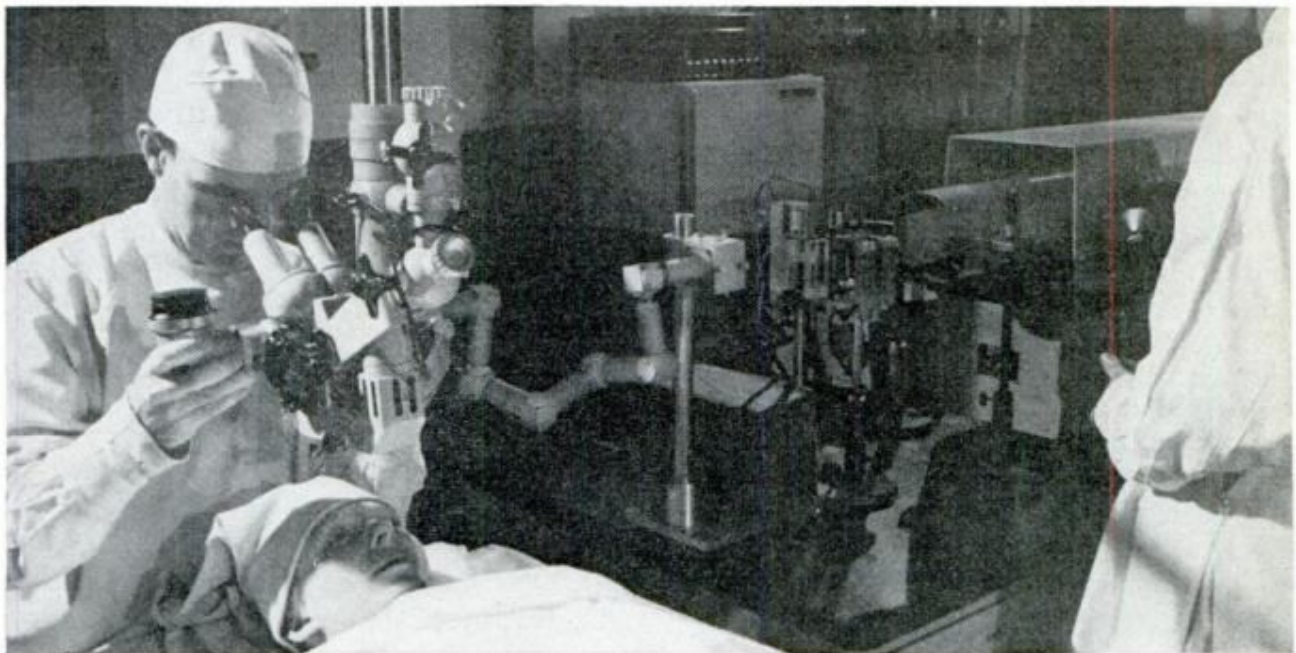
Sitting at the binocular eyepieces of a special horizontal microscope was Dr. L'Esperance, also director of the Institute's Argon Laser Research Laboratory. Attached at right angles to his microscope was an odd-looking device—a series of small jointed arms, the Bell "light knife"—which led back to a machine 12 feet long, a foot wide and not much higher—the most powerful medical argon-ion laser ever built.

At the ophthalmologist's command, there was a sharp crack and a fine stream of blue-green light shot into Elliott's good eye. In an instant the blood vessels were cauterized, the membrane cut through and his vision restored; one of the first such operations.

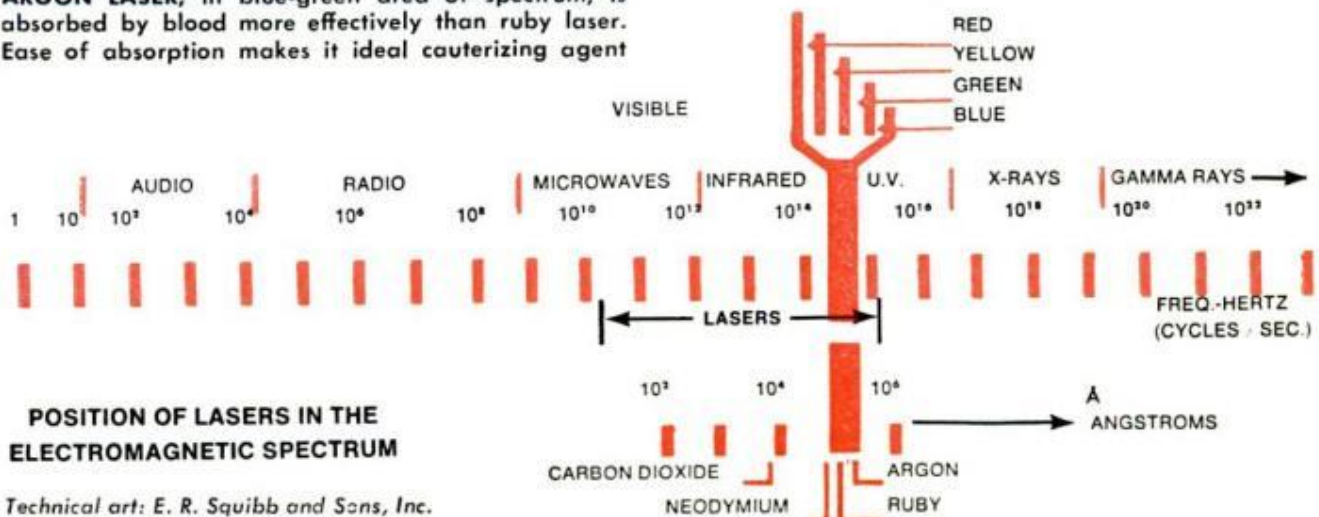
The laser device itself is a new tool:



WEARING SHOOTING GLASSES, Dr. L'Esperance and assistant prepare to obliterate a vascular eye tumor using an argon-ion laser. Light from the laser is guided through the arm by prisms mounted in the corner cubes. Hollow, jointed arm can be moved in any direction. Operating microscope (below) is used for examining the tumor. This array of electronic gear replaces a tray of surgical instruments



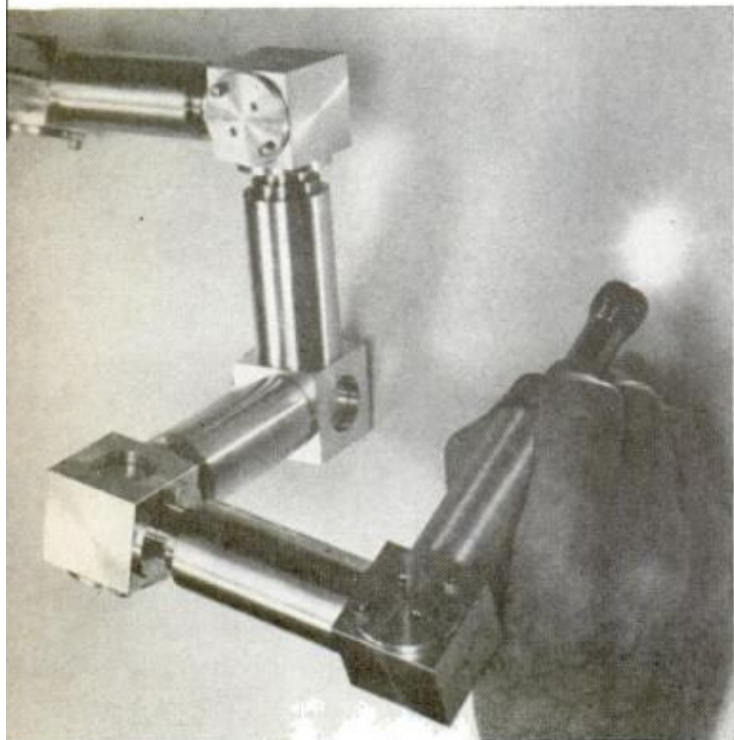
ARGON LASER, in blue-green area of spectrum, is absorbed by blood more effectively than ruby laser. Ease of absorption makes it ideal cauterizing agent



the first working laser was introduced in 1960 by Theodore H. Maiman. The name was coined from the way it works—"Light Amplification by Stimulated Emission of Radiation." Innumerable solids, gases and liquids can be made to "lase" by adding energy in the form of light or electricity. This lifts the atoms, molecules or ions (depending on the lasing material) to a higher energy level for perhaps a millionth of a second; then they drop back spontaneously to their ground level to give off a unit of light, a "photon." These photons bounce back and forth between a totally reflecting mirror at the rear and a partially reflecting mirror at the front of the laser. As they do this, they knock loose more photons until their energy becomes so great that they burst through the front mirror—and the powerful laser beam is on its way.

Light, like water, moves in waves with crests and troughs. Laser light is collimated and coherent, moving in the same direction and in a straight narrow line with its crests and troughs all coinciding. This produces a beam of such tremendous energy and power that its light is a million times as intense as that at the sun's surface. Such light is of one

BEAM MANIPULATOR, a hollow, jointed arm, carries laser light to focused output in compact handpiece



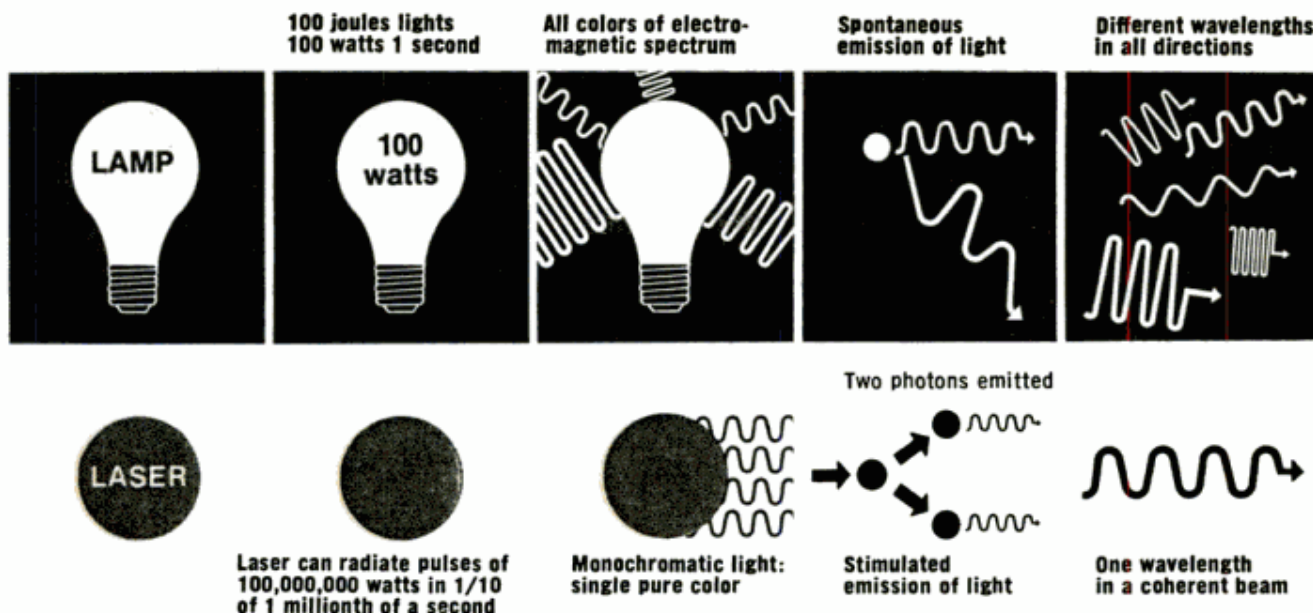
wavelength and so is a single pure color.

Just recently, the *Journal of the American Medical Assn.* reported that Dr. L'Esperance was believed to be the only investigator in the United States using the argon laser for patients. However, this technique of photocoagulation (clotting of blood or destruction of tissue by light) is a recognized and accepted procedure. The *Journal* estimated there are some 250 to 300 ruby laser and xenon-arc lamp photocoagulators in use in America alone.

School children learn that light produces intense heat when a teacher shows them how the sun's rays, concentrated by a magnifying lens, can burn paper. Cauterizing a wound with a red-hot poker was the old way to stop bleeding. Photocoagulators combine these actions to cauterize or coagulate by the heat of light. The action of the laser beam, used medically or industrially, is actually a heat phenomenon.

However, the argon laser beam can be pinpointed so precisely that it will hit spots safely no matter how close to vital structures. It will coagulate a spot 50 microns in diameter (half the thickness of a human hair) while the xenon-arc can't affect a spot smaller than 200 microns, and the ruby laser—80. One ophthalmologist explained that with this device "we can actually walk in and out of and around blood vessels."

A pioneer in the use of the ruby laser, Dr. H. Christian Zweng of the Stanford University School of Medicine, outlined the uses of photocoagulation in ophthalmology: it can "weld" a detached retina (that tissue in the back of your eye which actually does the seeing) to the underlying tissues; it can seal off holes and tears in the retina to prevent their spreading (like a run in a woman's stocking); it can obliterate retinal aneurysms (a ballooning-out of weakened artery walls); it can create a new pupil and be used for certain types of retinal tumors. Still, as Dr. Zweng commented, "The ruby laser light is not well absorbed by the blood," limiting its usefulness.



COMPARISON OF LIGHT with laser—Light Amplification by Stimulated Emission of Radiation—light shows laser's energy and coherence. Solids, gases and liquids can be made to "lase" and give off photons

On the other hand, the new argon laser radiation is in the blue-green area and absorbed by blood at least eight times more effectively than any other laser light and five times more than incandescent light. This makes the argon beam an effective cauterizing agent and made possible the successful treatment of Elliott's eye. Moreover, argon radiation requires only $\frac{1}{5}$ the energy needed for the xenon-arc lamp to coagulate blood vessels and $\frac{1}{11}$ that for the ruby laser.

In an extended interview, Dr. L'Esperance explained to me his hopes: "For the retinopathies (diseases of the retina) that cause so much havoc . . . the argon laser's big effect is on the blood vessels and we think we can set up barriers so as to redirect the blood flow, shunting and channeling it from one part of the eye to another which needs it more."

But there is an even newer and more exciting possibility! In the dreaded eye disease, glaucoma, fluid produced in the eye does not drain out properly. Dr. L'Esperance has proven the practicability *in animals* of making a drainage hole with his laser. His technique needs a lot more refinement before it is ready for humans. As the surgeon said: "If we succeed, which seems likely, we will eliminate the need for conventional

surgery and hospitalization—the patient will only come in for a few hours!"

Another area of research at Argon Laser Research Laboratory is the "bloodless surgery of the future." These Investigators have already used this argon laser in experimental animals for cutting the liver, one of the most vascular (full of blood vessels) organs in the body, without bleeding; and they think of its use eventually for organs where bleeding is a problem, such as kidney, heart or brain. This laboratory has four lasers, funded by contributions exceeding \$250,000 from the John A. Hartford Foundation.

This research laboratory has the most powerful medical argon laser built. The powerful argon device—12 feet long, 18 inches high and 12 inches wide—has an inner discharge tube less than $\frac{1}{5}$ inch in diameter and 60 inches long. It takes five gallons of water at 100 p.s.i. to keep it cool, for the heat it generates in 20 minutes could warm an entire house for a day.

Fiber optics were first tried for delivering the laser beam to the patient, then a hand-held spherical mirror to focus the beam on a point. I handled the latest, most sophisticated delivery system at Bell Telephone Laboratories in Murray Hill, N.J., where it was de-

(Please turn to page 192)

Shoot Glareless Pictures With Polarized Light

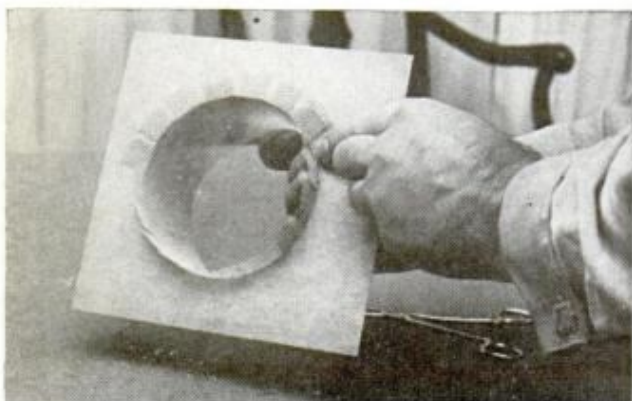
By JOHN D. GRIFFITH

Those annoying reflections you get off glass and other shiny surfaces can be eliminated with easy-to-make filters over your lights.

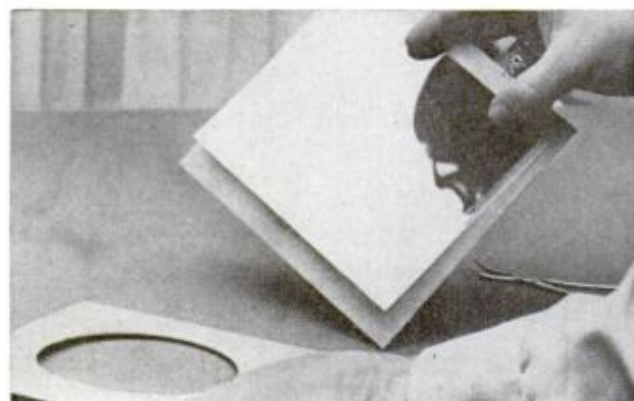


EVER TRY TO TAKE a picture of a shiny oil painting, a glass fish tank or a highly polished piece of wood? If you have, you know that harsh reflections can ruin the photo. The secret of glareless pictures lies in the use of polarizing filters—one over the camera lens and one over each of your floodlights.

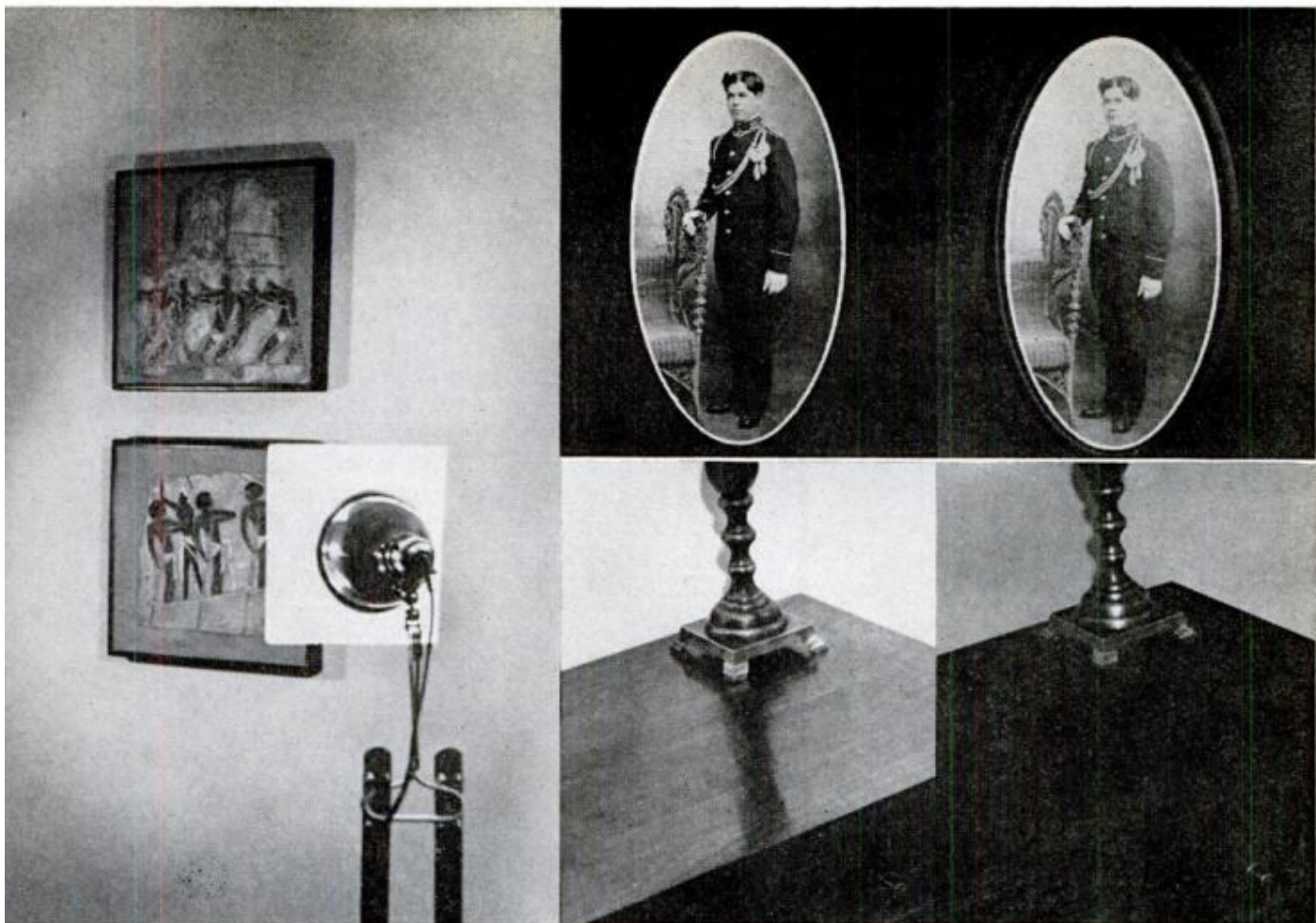
Polarizing filters are like tiny Venetian blinds. Their slits let light through in one plane. When the filter on the camera is rotated in a different direction from those on your lights, the slits don't line up and the reflections can't get through. The ex-



WIRE SCREENING is stapled into a cylinder and one end is slit to form small tabs. Cut hole in a cardboard square, slip the cylinder into the opening, then bend over the tabs against the cardboard



POLARIZING FILTER is sandwiched between two cardboard squares—one with the mesh cylinder in it and a second backup piece. Cut cardboard squares slightly larger than the sheet of filter material

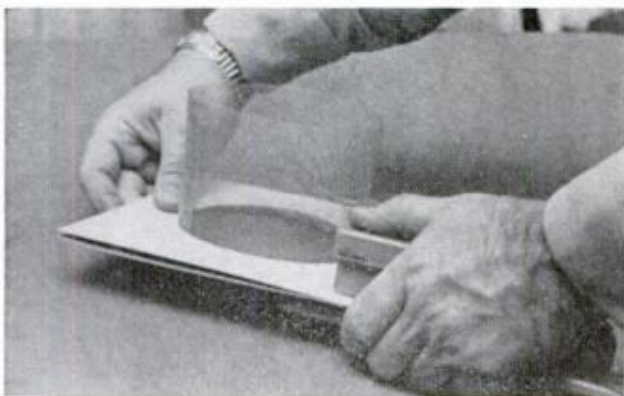


amples above show how much difference polarized light can make. Without the filters, the old-time portrait looks faded and washed out on the right, and the polished wood surface shines like a mirror on the left.

Commercial polarizing filters big enough to fit over photofloods are costly, but you can make your own for \$3. That's the price of four 6x6-inch sheets of polarizing material from Edmund Scientific Co., 400 Edscorp Building, Barrington, N.J. 08007. The sheets are mounted in simple holders you can fashion from cardboard

and wire insect screening stapled together.

For the camera filter, you can fit a small piece of the material into a standard filter holder or use a commercial filter, such as Kodak's Pola-Screen. Be sure the filters on your photofloods are all turned so they're polarizing the light in the same direction. Look through the camera filter and turn it until you see the reflections disappear, then place it over the lens in that position. Because polarizing filters hold back some light, you'll have to increase the normal exposure $1\frac{1}{2}$ to 2 stops to compensate. ★★★



STAPLE CARDBOARD SANDWICH around the edges to hold it firmly together. Run staples through a few of the tabs on the wire screening to lock the cylinder in place. For added neatness, tape the edges



FINISHED HOLDER should fit snugly over photoflood reflector. Where reflectors aren't used, holder can slip directly over lamp. Position filter several inches away from bulb to avoid heat damage

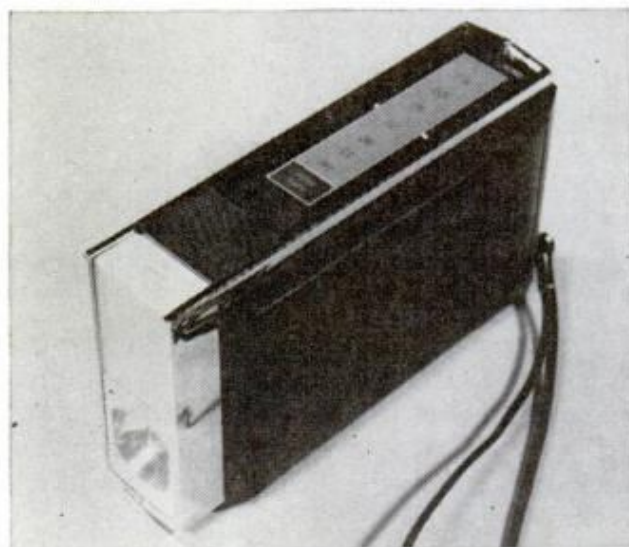
NEW IN ELECTRONICS



TINY TELEPHONE AMPLIFIER slips over the receiver's earpiece and makes it easier to hear the other party. Small enough to be carried in a pocket, the battery-powered device is designed for use by persons with hearing difficulties or in high-noise areas such as near city traffic or construction sites. About \$10 from Continental Telephone Supply Co., 17 W. 46th St., New York, N.Y., or Stadri Products, 147-47 Sixth Ave., Whitestone, N.Y.

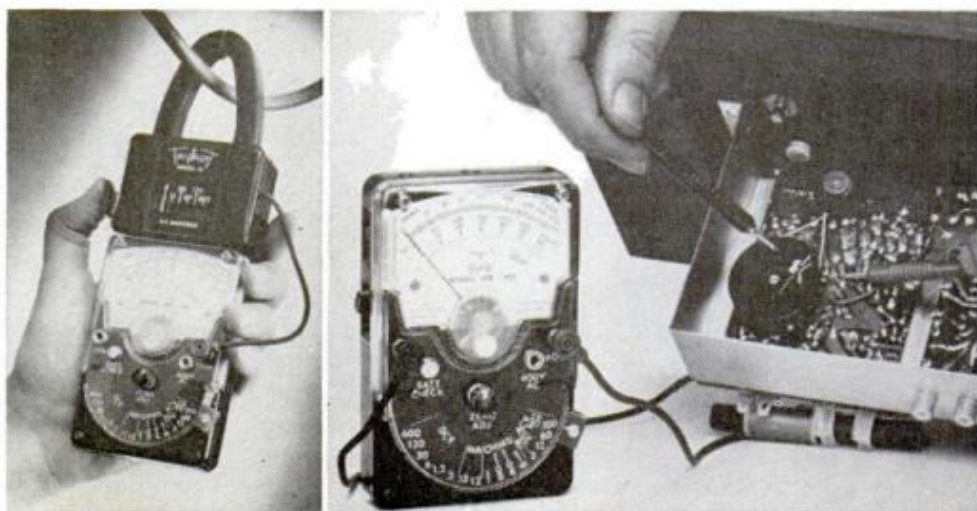


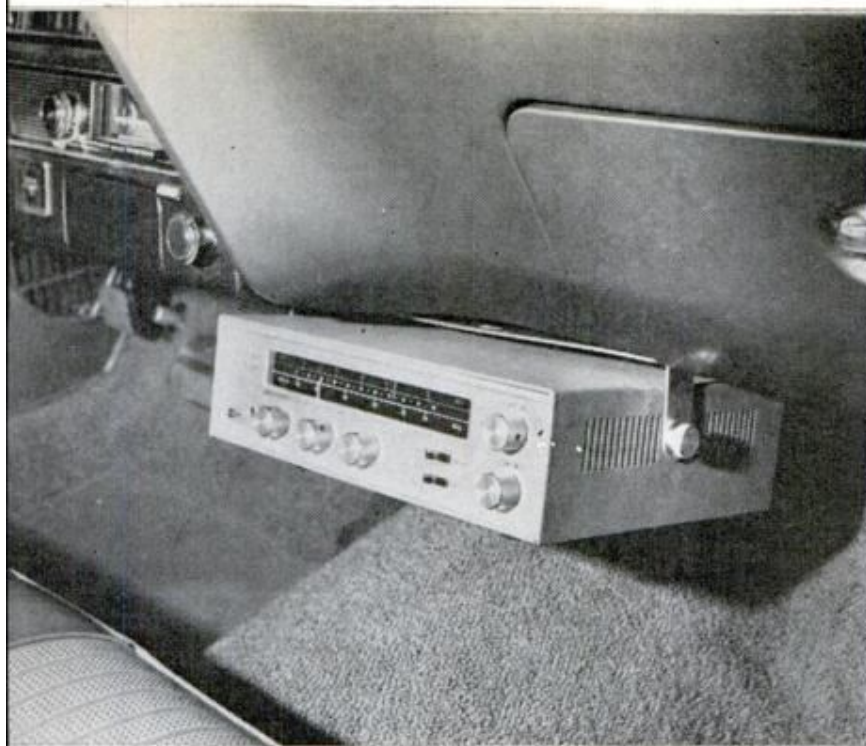
LOW-COST FOUR-BAND RADIO offers both AM and shortwave reception in a compact table model priced at \$59.95. The solid-state S-120A Star Quest covers .54 to 31 MHz in four bands—one for commercial broadcasts and three for international shortwave, ship-to-shore, aircraft, citizen's band and ham. Hallicrafters Co., Rolling Meadows, Ill.



YOU CAN SEE IN THE DARK as well as listen to music with this unusual portable AM radio. It has a built-in flashlight to help you find your way on camping trips or other nighttime outings. Both the flashlight and radio operate on two C-type batteries. About the size of a small book, the RCA portable has a wrist strap for carrying, sells for around \$20.

SLIM ENOUGH to slip in a shirt pocket, the new hand-held volt-ohm-milliammeter at right is said to be the smallest on the market. Made by Triplet, the battery-powered VOM weighs 14 ounces and is only a little over an inch thick. It will measure resistances from 1 ohm to 5000 megohms, and voltage ranges are available up to 600 volts in both a.c. and d.c. A clamp-on-type adapter fits on top (near right) for measuring a.c. current. \$70. Triplet, Bluffton, Ohio.





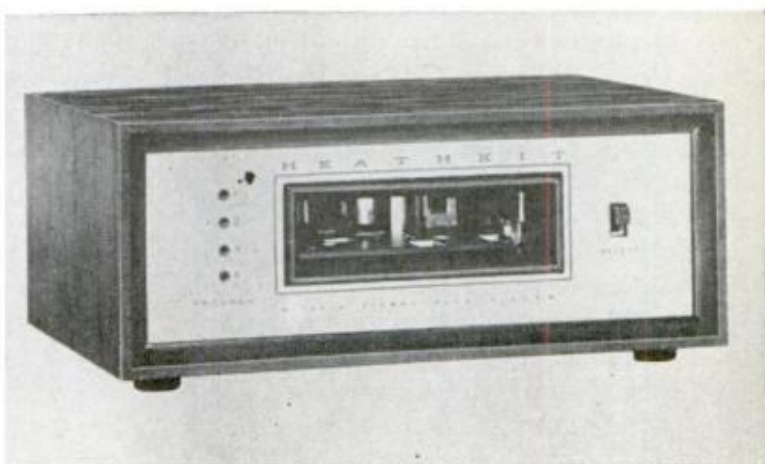
MOBILE SHORTWAVE RECEIVER runs on 12 volts d.c. for use in a car or boat or on 115-volt a.c. for listening to at home. Two tuning bands cover 30 to 52 MHz and 152 to 174 MHz. These bring in police, fire and other emergency calls as well as ship-to-shore and general mobile communications. You can tune in the new around-the-clock U.S. Weather Bureau broadcasts at 162.55 MHz. A front-panel

jack takes headphones or an external speaker, and an accessory antenna plugs into the back. There's also provision for piping the audio into a hi-fi amplifier. A quick-release bracket lets you mount the set under a car dash and remove it easily for home use. The dual-band Patrolman PRO-2 is \$99.95. Single-band models with high or low-band coverage are \$79.95. Radio Shack, Boston.



NEW HI-FI COMPACT from Scott is designed to serve as an all-around sound center for anything you want to play or hear. The AM/FM stereo receiver features front-panel jacks for plugging in headphones, microphones, and electronic musical instruments like an electric guitar. On the back are inputs for a tape player, recorder and remote speakers. Mounted on top is an automatic turntable for playing records. Price, including twin speakers, is \$399.95. H. H. Scott, Inc., Maynard, Mass.

YOU CAN BUILD your own stereo tape player from a new kit by Heath. Shown at right, the accessory unit plays 8-track tape cartridges through any home hi-fi system. You just plug it into one of your amplifier inputs like a phonograph. The player automatically switches from one tape track to another, or you can select the track you want manually. The kit takes about six hours to assemble. \$59.95. Heath Co., Benton Harbor, Mich.





INSTRUCTIONS for using a test record are included with each one, usually on back of jacket. Some of popular test discs are shown at right

TEST RECORDS: Torture Tracks For Your Hi-Fi System

Simple listening checks you can make yourself, without instruments, let you spot hidden flaws and make adjustments to correct them. Here's a rundown on what the discs do and how they work

By HANS FANTEL

YOU MAY THINK your stereo rig has a fine tone, plenty of bass and walloping power. But have you ever measured its performance by objective standards? Do you know if it really gets *all* the music out of the record groove? Does it reach rock bottom and top highs? Does it separate and balance the two stereo channels throughout the whole frequency spectrum? Can it keep a steady pitch?

To get the answers, spin a test record. Within the hour or so that it takes to run through one of these 12-inch LP discs, you'll get a true performance profile of your sound system. A test record is a torture track for your stereo rig, designed to

show up its weak points. The information you gain is valuable in three ways: 1. For spotting trouble that can be eliminated by making adjustments; 2. For upgrading your system by pinpointing a weak component; and 3. For ego boosting if your system passes victoriously through even the toughest test.

Test records come in two basic types. One kind is intended mainly as a lab tool. You need special instruments to interpret the signal. The other kind is strictly for home use. The only instruments you need are your ears. Recent improvements in these discs have made ear checks almost as accurate and sometimes more



HOMEMADE BALANCE for checking stylus force can be fashioned from a lead pencil, tongue depressor and several pennies like this. Using pencil as a fulcrum, balance the depressor across it like a seesaw and place the stylus tip on one end. Add one penny at a time to the other end until their weight



raises the arm. One penny—about three grams—should lift a high-quality lightweight turntable arm. Changer arms usually require four to six grams or two pennies. If three or more pennies won't lift arm (left, above), stylus force is excessive and will result in poor tracking and rapid record wear

revealing than intricate instrument tests.

I have sampled most of the test-by-ear records currently available and found them ranging from highly useful to nearly worthless. Two are standouts—Columbia's *Seven Steps to Better Listening* (STR-101) and the Stereo Review SR-12 Test Record. If your record dealer doesn't stock them, you can get the Columbia disc for \$4.79 by writing to CBS Laboratories, 227 High Ridge Road, Stamford, Conn. 06905. The SR-12 sells for \$4.98 and you can get it from Stereo Review, Box 2336, Church St. Station, New York, N.Y. 10008.

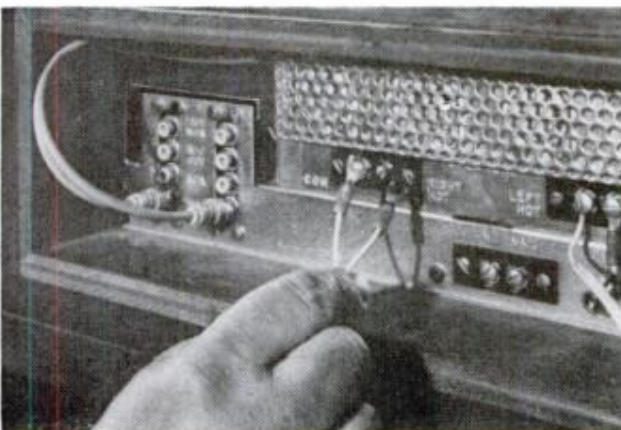
The Columbia record offers seven basic tests: Left-right channel identification, speaker phasing, stereo balance, tone control setting, left-right separation, buzz and rattle check, and a cartridge tracking test. The Stereo Review record is technically more sophisticated. By far the most comprehensive of all test discs, it

offers a total of 20 tests, including separate frequency response, turntable flutter, and a tone-arm skating test. In addition, the SR-12 contains a number of instrument tests for those who have an output meter, oscilloscope or distortion analyzer.

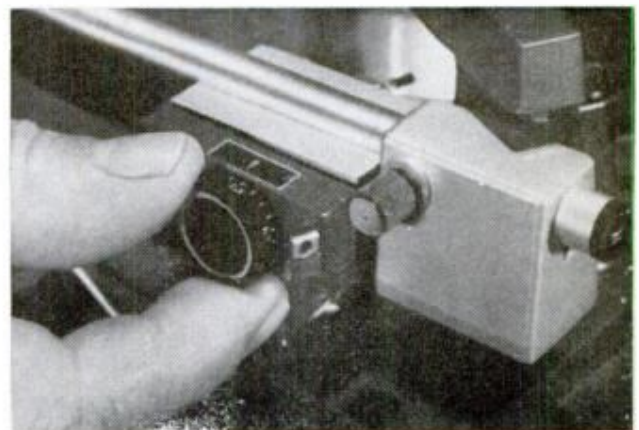
Each test disc comes with a clearly written instruction booklet that tells you exactly what each test is for and how to perform it. London and Westminster also make useful test records. Shure's *Audio Obstacle Course* (a test record obtainable from Shure Bros., Inc., 222 Hartrey Ave., Evanston, Ill. 60204) is excellent as far as it goes, but it concentrates on just one basic test: cartridge tracking.

Regardless of their differences, most multitest records share certain basic features. A rundown of these fundamental routines will show how test records work.

Phasing and balance. These are good tests to start with because if your system



SIMPLE CHECKS with a test record can determine proper speaker phasing and left-right orientation. If speakers are out of phase or crossed, reversing connections at back of set quickly solves problem



TRACKING TESTS make it easy to set the stylus force adjustment on your tone arm for best reproduction. Stylus force should be backed off to lowest point that still gives good tracking of grooves

is off balance or out of phase, it will throw off your judgment in later tests. At the outset, most test records give you channel identification. "This is the left channel," says the announcer. If you hear him saying it from the right speaker, you know you have the speakers hooked up backwards. In this case, reverse your speaker connections.

Next comes phasing. This is to make sure your speakers are pushing and pulling in tandem—not working against each other. To determine phasing, most test records give you some deliberately out-of-phase tones in the left and right channels. These alternate with properly phased test tones. If the out-of-phase tones sound stronger and richer than the in-phase tones, you know that one of your speakers is out of step. You correct this by reversing the wires on *one* of your speakers. (Don't do it on both or you'll again wind up with the same backward phase relation as before).

For the balance check, most test records present identical tones in both channels. You stand midway between the speakers and adjust the balance control until both speakers are equal in volume. At that point, the test tone seems to come not from the left and right speakers but from an imaginary sound source midway between the speakers.

This balance check—a key feature of most test records—works only if your speakers are matched. If, for example, one speaker puts out more highs than the other, it will sound closer and louder even though its midrange and bass are perfectly balanced to the other speaker. You can even things out between two unlike speakers by fiddling with the treble and bass controls on the amplifier until both speakers sound the same.

To help you hit a perfect balance between speakers, the Columbia and Stereo Review records offer a neat innovation: "pink noise." This is engineer's lingo for a test tone that contains all musical frequencies thrown together at random but with equal strength in every octave. With this type of test signal, you can balance your speakers for the entire frequency spectrum with a single adjustment.

Frequency response. Most test records give you a series of test tones ranging from about 30 to 15,000 cycles—roughly the total range of musical frequencies.



CHECKING FREQUENCY RESPONSE is easily done with VTVM or VOM calibrated in decibels. Meter leads are merely held against speaker terminals to show readings as the record's test tones change in pitch

This reveals three vital factors about your system: 1. The top frequency it can handle; 2. The bottom frequency; and 3. The evenness of response for the frequencies in between.

The top and bottom checks are simple. If, instead of rolling out a rich 50-cycle bass note, your speakers only cough up a hoarse rattle—or if all sound vanishes above 10,000 cycles—you know your system is holding out on you. Not all the music is getting through.

Uniformity of response is harder to judge. It tells you whether your system is playing every note between top and bottom with the right amount of emphasis. That's what is meant by "flat frequency response." You might think that to check for "flat response" you merely had to determine if all the test tones are equally loud. But this can be misleading because the human ear itself does not have flat response. The notes in the midrange—from about 1000 to 4000 cycles—seem louder than bass or treble notes of the same actual volume. As a result, you might think that your treble and bass are weak—compared to midrange—when in fact they are just what they ought to be.

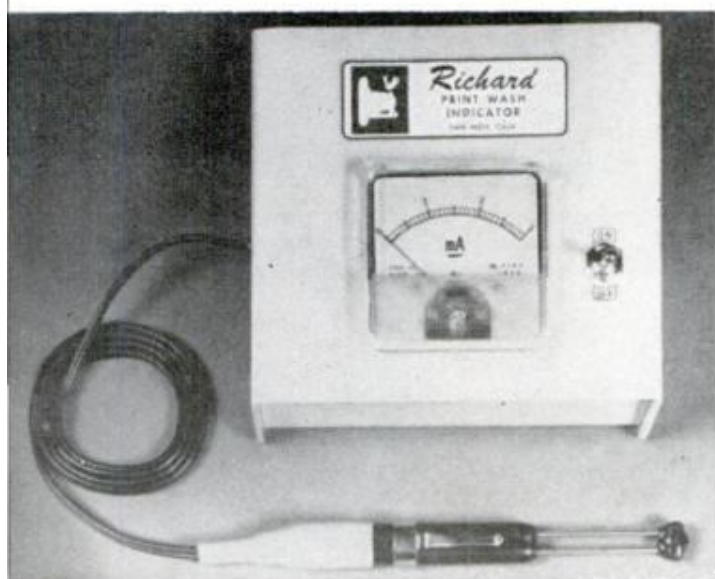
To get around this trap, Columbia and Stereo Review have again come up with an ingenious innovation. Their test records compensate for these quirks of human hearing. A separate midrange pilot

(Please turn to page 192)

New in Photography



THREE-WAY MOVIE EDITOR at left takes Super-8, Regular-8 and Single-8 film interchangeably—a handy feature if you have built up a collection of several different types over the years. The Honeywell-Elmo unit has an adjustable-focus lens and sells for \$54.50. A similar two-way model accommodates Super-8 and Single-8 film and has a fixed-focus lens for \$44.50. Both models have $2\frac{7}{8} \times 3\frac{7}{8}$ -in. viewing screens, high-speed rewind spindles with a gear ratio of 3 to 1, adjustable framing and single-frame viewing. A built-in film puncher makes it easy to mark locations for editing and splicing cuts. The editors are sold by Honeywell Photographic Products, 5501 S. Broadway, Littleton, Colo.



CONVERSION attachment at right turns any E-250 Ultrablitz-Bauer electronic flash into an automatic model. Unit plugs into the top and measures amount of light reflected from a subject, regulating flash duration to provide correct illumination. \$24.95. Also sold is a flash with automatic control built in for \$89.95. Allied Impex, 168 Glen Cove Rd., Carle Place, N.Y.



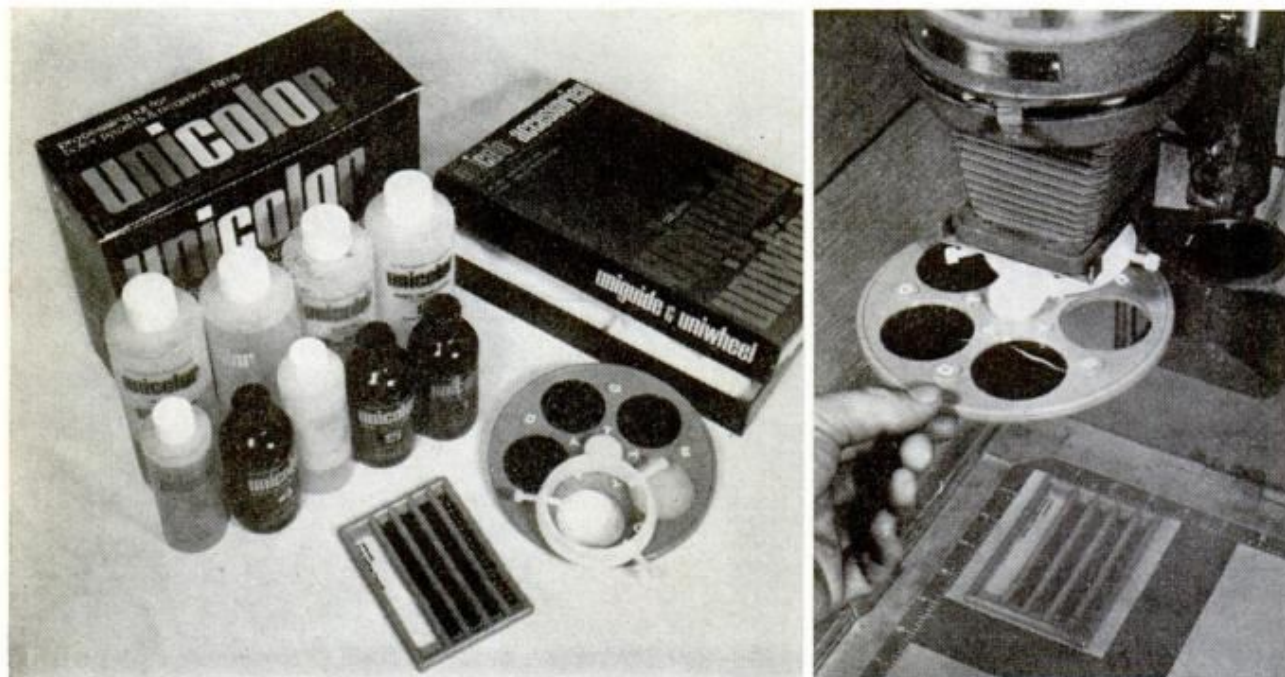
ELECTRONIC WASH INDICATOR above tells you at a glance when your prints have been rinsed clean and the last traces of hypo are gone. A probe is suspended in the washing tank and measures the electrical resistance of the water. This varies according to amount of hypo present, thus indicating when water is clean. \$24.95. Richard Mfg. Co., Box 2041, Van Nuys, Calif.

NEW COMPACT SLR at right looks like a 35-mm camera but actually produces negatives $2\frac{1}{4} \times 2\frac{1}{4}$ in. square. Called the Warner 6x6, it takes 120 or 220 roll film and is said to be only 18 percent larger than the average 35-mm single-lens reflex. It has speeds to 1/500th of a second and an f/2 80-mm lens. \$495. Graflex, Rochester, N.Y.



THREE CLEVER NEW AIDS

A kit that converts any black-and-white enlarger to color, an exposure control you can build yourself and an ingenious processing tray make this once-difficult job easier and more fun than ever



YOU GET A COMPLETE SYSTEM for color printing with this Unicolor outfit. It consists of a color filter wheel and a set of simplified processing chemicals.

The wheel mounts under the enlarger lens (right, above) and an exposure guide on the easel determines the correct exposure time for each filter

By **JOHN A. LINKLETTER** and **SHELDON M. GALLAGER**

DARKROOM BUFFS have long dreamed of making their own color blowups, but most have shied away from the attempt because the equipment has been costly, the process time-consuming and the results often less than spectacular. Now manufacturers are coming up with new darkroom aids that make the job easier and the results more reliable. With care, you can produce exciting color enlargements right in your own home and at a reasonable cost.

In the past, color printing has required an expensive enlarger with a special color head to permit the use of separation filters. Today, there's a new system, called Unicolor, that makes it possible to turn out color prints with an ordinary black-and-white enlarger. This consists of a rotating filter wheel that attaches under the enlarger lens and a set of processing

chemicals designed especially for use with the wheel.

The wheel contains three separation filters—red, blue and green. You just rotate the wheel, exposing the printing-paper under each of the color filters in turn. The three colors combine in the print to produce a full-color image when the paper is developed. Proper exposure time for each filter is determined by using an accompanying exposure guide.

The Unicolor system is intended for use with negative-type color film—the kind that yields positive color prints. The chemicals work with standard color printing papers, such as Ektacolor, Ansco color and Agfacolor, and can also be used to develop negative color film. Using the special chemicals, it takes only four steps and about seven minutes to turn out a finished color print—that's considerably faster than

FOR MAKING COLOR PRINTS



KIT-BUILT ELECTRONIC CALCULATOR from Heath gives you precise control over color balancing and exposure time for making color prints. Color probe placed under the enlarger lens tells you automatically when right combination of filters has been reached to provide proper rendering of color negative

with a conventional processing procedure.

The wheel is priced at \$17.95, including exposure guide and step-by-step instructions. The kit of chemicals sells separately for \$14.95. Both are available from Photo Science Products, KMS Industries, Ann Arbor, Mich. 48106.

For accurate exposure control, Heath has an electronic calculator you can build from a kit. A meter records the amount of light transmitted by various portions of a color negative. By comparing these readings with those for known test samples, you can arrive at the correct combination of filters and exposure times.

The Heath control is designed for use with conventional color-balancing filters. It will work with a regular color-head enlarger or with a black-and-white enlarger if you devise a way to hold the filters under the lens. Cold-light enlargers are



COLOR CANOE, a new type of curved processing tray, simplifies the job of developing prints. Rocking the tray sloshes chemicals evenly over the print—critical in making good color enlargements. A second tray of warm water underneath keeps chemicals at required temperature—also very important

not recommended, however, because of their low light output. The control, for both color and black-and-white printing, is \$99.95 as a kit and \$137.50 assembled.

Also from Heath is a new processing tray aptly called a "Color Canoe" because its ends curve up like those on a real canoe. You rock the tray like a cradle to get an even distribution of chemical over the print—important in color work. Because the chemical is sloshed over the print instead of filling the entire tray, only a small amount is needed. This saves chemical and helps to cut the cost.

The tray, which can be used with either conventional processing chemicals or the Uicolor type, comes in three sizes—8x10 for \$23.50, 11x14 for \$31.50 and 16x20 for \$44.95. The trays and the exposure control are available from Heath Co., Benton Harbor, Mich. 49022. ★★ ★



Put a Speed Control On Your Windshield Wipers

Slowing down your blades' sweep rate gives you a clearer, safer view in light rain or muddy road spatter.

This easy-to-make device will work on any car with electric wipers.

By RUDOLF F. GRAF and GEORGE J. WHALEN

Technical Art by Peter Trojan

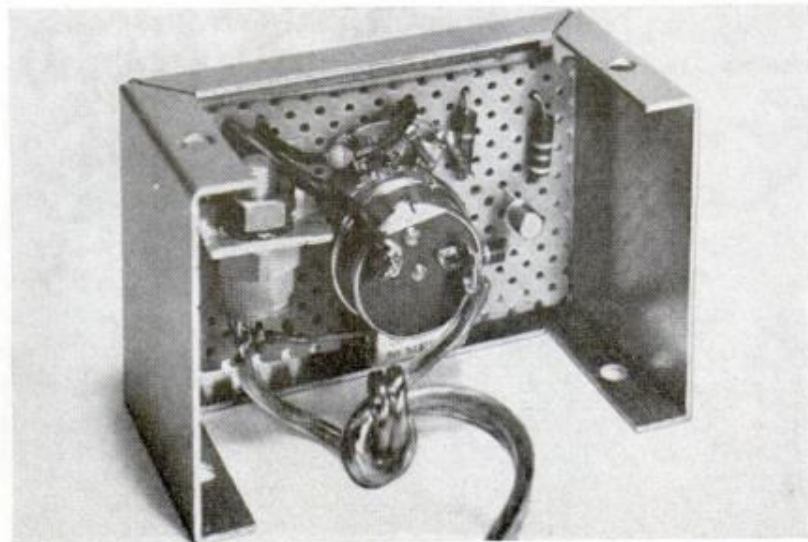
A LIGHT DRIZZLE or snow is falling, and occasional spatter from passing cars peppers your windshield. It's that in-between situation—you can't leave your wipers off completely, yet your windshield isn't wet enough for them to work smoothly. The fast-moving blades stick and squeak, smearing the drops into dirty streaks. You inevitably find yourself reaching down to turn the wipers on and off ever few seconds. This is not only annoying, but takes your attention off the road.

The answer is this simple speed control that lets you slow your wipers down so they go on only when there's enough moisture for a clean sweep. Depending on conditions, you can adjust the rate to as little as one stroke every 15 seconds. The control requires only two connections to your regular wiper switch and in no way affects normal wiper operation.

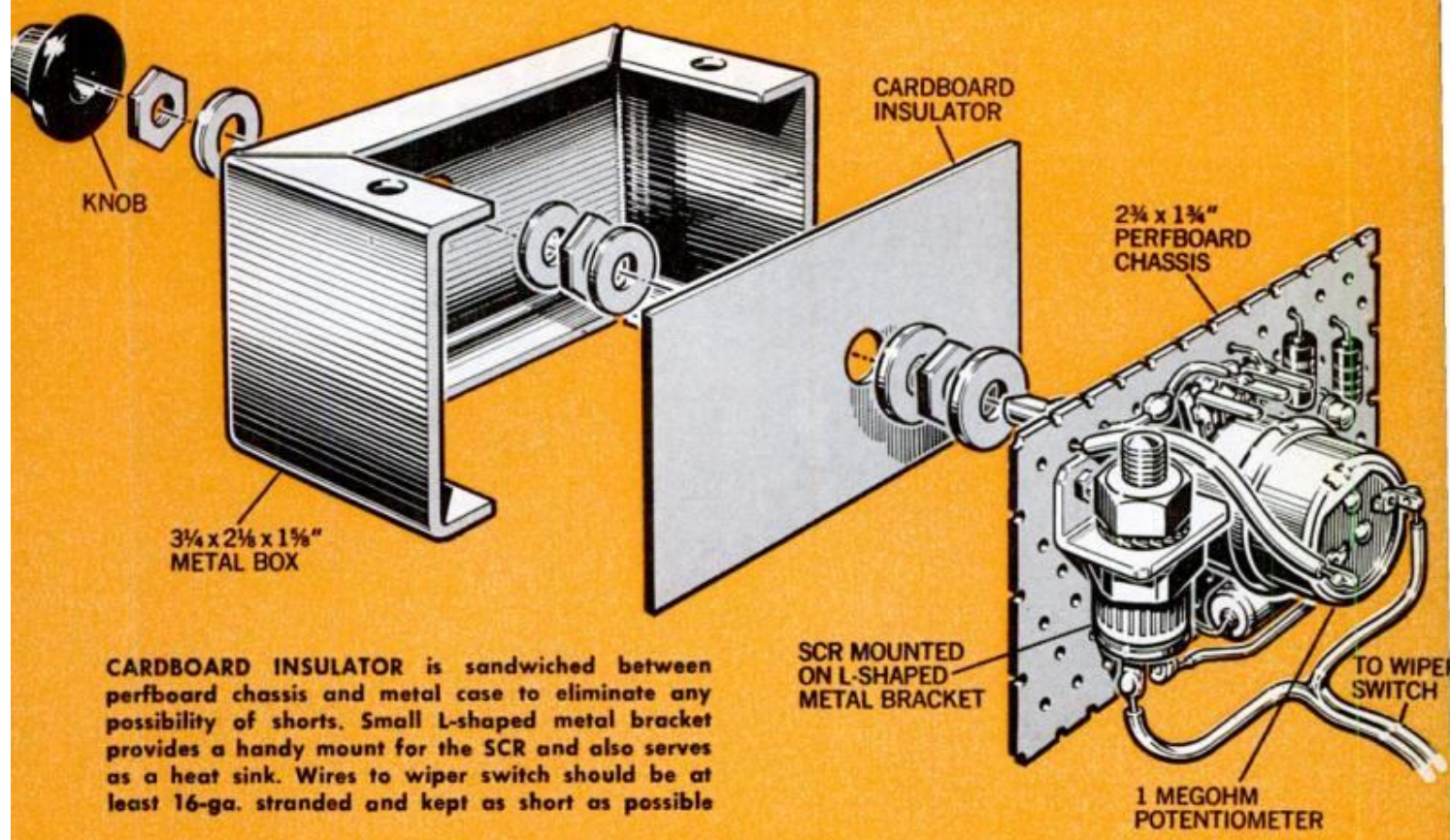
All parts are arranged on a piece of phenolic perforated board in a small metal box. The box can be mounted under the



MOUNTED UNDER DASHBOARD, speed control turns wipers on and off and varies the sweep rate with a



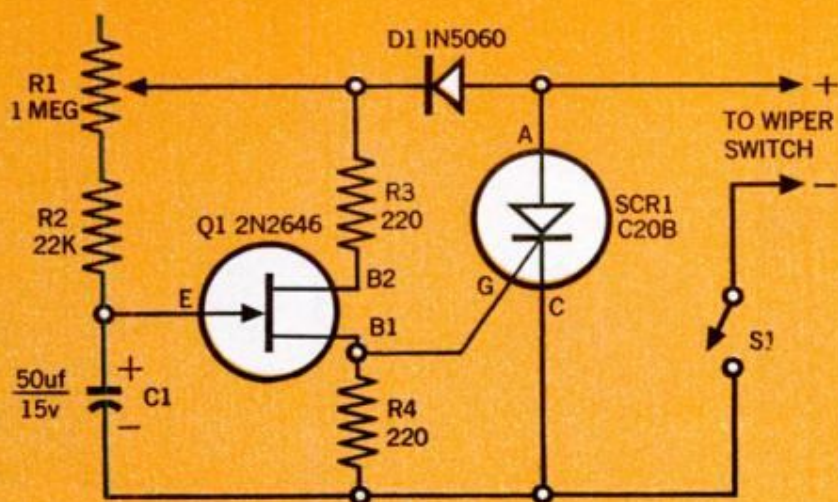
single knob. Parts are arranged on small perfboard chassis in a metal box, as shown at right, above



dashboard or in any other convenient location. A single knob turns the wipers on and adjusts their sweep rate to the desired speed. This consists of a 1-megohm potentiometer (R1) with a rotary on-off switch (S1) mounted on the back.

The wiper-triggering circuit consists of a transistor (Q1) that fires at a rate determined by a capacitor (C1) and resistors R1 and R2. The transistor's pulses are applied to a silicon-controlled rectifier (SCR1) that closes the circuit and

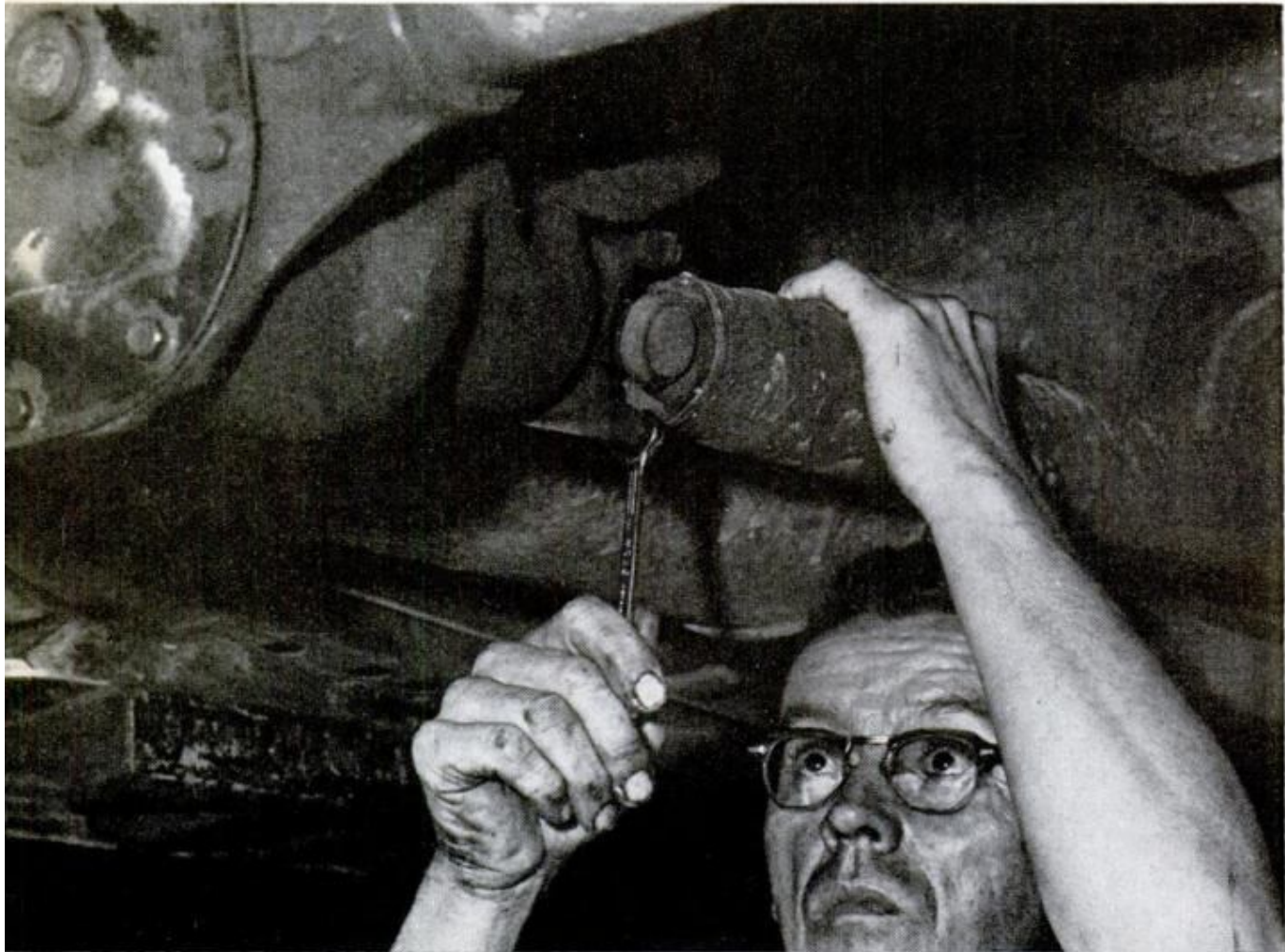
turns on the wipers every time the transistor fires. After each sweep, the wipers come to rest, turning off the SCR, and the capacitor begins to recharge for the next cycle. You can check out the device by connecting a 12-volt bulb in place of the wiper mechanism. The bulb will go on after a delay determined by the potentiometer setting. Do not, however, connect the control to a 12-volt source without a load as this will burn out the silicon-controlled rectifier. ★★★



PARTS LIST

- C1—50-uf, 15-v. electrolytic capacitor
- D1—GE-Type IN5060 silicon diode
- R1—1 megohm potentiometer, linear taper (Clarostat Type A47)
- R2—22K, 1/2-watt resistor
- R3, R4—220 ohm, 1/2-watt resistors
- Q1—transistor Type 2N2646
- S1—rotary on-off switch on potentiometer (Clarostat Type SWE-12)
- SCR1—General Electric Type C208 silicon-controlled rectifier
- Case—3 1/4 x 2 1/2 x 1 1/2-in. metal box (Premier Type PMC-1001)
- Misc.—phenolic perfboard, angle bracket for SCR, sleeving for diode leads, 16-ga. stranded hookup wire, nuts and washers for potentiometer shaft, cardboard shim

How to Troubleshoot



DRIVESHAFT must be disconnected before repair work can be performed on the differential. The shaft is secured to the differential U-joint flange by bolts



DIFFERENTIAL CASE has a plug in the rear half that may require a special tool for opening. Hole is for checking lubricant, adding when necessary



SPIN WHEELS by hand and listen when you suspect that a front-wheel bearing or axle-shaft bearing is causing noise. You may be able to pinpoint trouble

a Differential

By MORT SCHULTZ

You have to know what to listen for and where to listen; then you can start the repair job without any wasted effort

DON'T LET MYSTERIOUS NOISES that sound as if they're coming from the back end of your car stampede you into doing an expensive differential overhaul. A growl that sounds as if it's caused by worn drive pinion bearings may actually start in a rough front-wheel bearing!

Sound that is actually caused by a noisy gear in the differential can usually be heard from 20 to 60 mph under heavy acceleration, at cruising speed and when coasting. (Coasting is having the throttle closed and transmission in gear.) The noise is normally most prominent from 30 to 40 mph and from 50 to 60 mph.

Noise made by a bad bearing in the differential is tougher to diagnose, because a bad front-wheel bearing and axle-shaft bearing sound the same. The noise is a rough growl or grating.

Noise from wheel and axle-shaft bearings isn't the only sound that gives the impression of a bad rear end. A noise you think is coming from the differential may actually originate from tires, engine or even the road surface. Further complicating matters is the fact that all differentials, because they contain gears which are revolving, make *some* noise.

This noise is what automotive engineers call a "commercially acceptable noise level." It's a light sound—more like a tone than a noise. It occurs within a narrow range between 40 to 60 mph. Exactly where it appears depends on road and load conditions, gear ratio and tire size. No amount of repair will get rid of it.

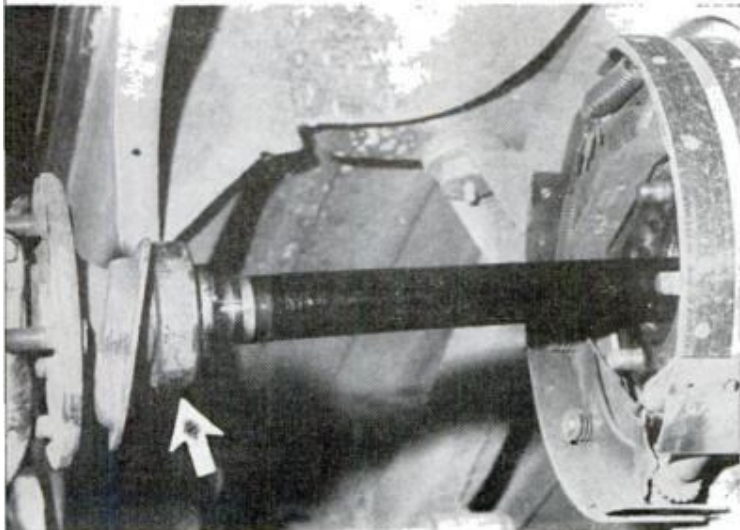
Suppose, though, that the noise you hear is not normal. Before you spend time and money to tear apart the differential, you want to make sure the noise comes from there.

Find a level tarred or asphalt road and accelerate slowly. Note the speed at which the noise occurs.

Stop the car, and with the clutch disengaged or the automatic transmission in neutral, run the engine slowly up and down through the engine speed at which you heard the noise. If you now hear the noise, it is *not* coming from the differential.

Instead it could be exhaust noise or an engine condition, such as a noisy alternator or power-steering pump. Noise originating from the engine is often "telegraphed" through parts of the car to give the idea it's coming from the differential.

Tire noise can be distinguished from



AXLE-SHAFT BEARINGS are part of the rear end but are not enclosed in the differential case. Check them before the differential when diagnosing noise



RING GEAR-TO-PINION BACKLASH is checked with a dial indicator. Too much or too little play between these two gears can be corrected by shimming

rear-end noise by driving the car on different types of road surfaces. Tire noise will change with the surface, but differential noise will stay the same.

Another way to distinguish tire noise from rear-end noise is to temporarily inflate all tires to about 50 pounds pressure. If the noise is being caused by tires, it will be noticeably altered. Rear-end noise stays the same.

You can usually detect a bad front-wheel bearing by lightly applying the brakes while holding car speed steady. Since some load is taken off the bearing, the noise will be diminished. A bearing that's turning at 40 mph, say, has more stress on it than one turning at 35 mph. Still and all, jack up the wheels and spin each by hand to confirm your diagnosis. The bad bearing will usually sound off.

Make sure, too, that the noise isn't coming from a bad axle-shaft bearing—the toughest of all noises to distinguish from a rear-end noise, since the bearing is so closely allied with the differential.

One of the best ways of finding out whether an axle-shaft bearing is bad is to accelerate to cruising speed and turn off the engine. Put the transmission into neutral. Now, vary the load on the rear wheels by swerving from side to side. If the noise increases, it's possibly coming from the bearing on the loaded side.

You can try to confirm your diagnosis by jacking up the rear wheels and spinning them by hand. Listen at the hubs for evidence of the rough bearing.

Once you've decided that the noise is coming from the differential, it's time to take the part apart or have it taken apart by a mechanic. The trouble may be as simple as a worn drive pinion bearing (about \$75 to repair). In this case, don't get caught for a complete overhaul, which includes putting in a new ring and pinion gear set for about \$175. All parts which are in good condition can be re-used.

One of the most important checks to make is ring gear to pinion backlash. Too much or too little will result in a major differential breakdown soon after you get the car back on the road. Correct backlash of most differentials is between .005 and .009 in. If backlash is not within these specs, readjust it by adding or subtracting shims to the rear of the pinion.

The two things that cause differential failure faster than all other things com-



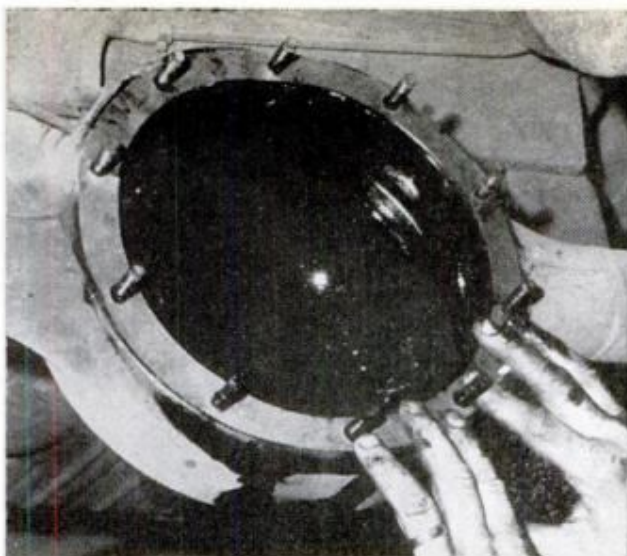
PINKY TEST is used to check lubricant level. The level hole can be used to drain and fill differential case if you have a goosenecked suction gun



LUBRICANT LEAK caused by a faulty gasket is easily repaired. First step is to remove all the differential cover bolts. Catch remaining lubricant in a pan



FLANGES of both the differential case and cover are scraped and cleaned thoroughly of pieces of gasket and sealer. Use solvent if necessary; wipe dry



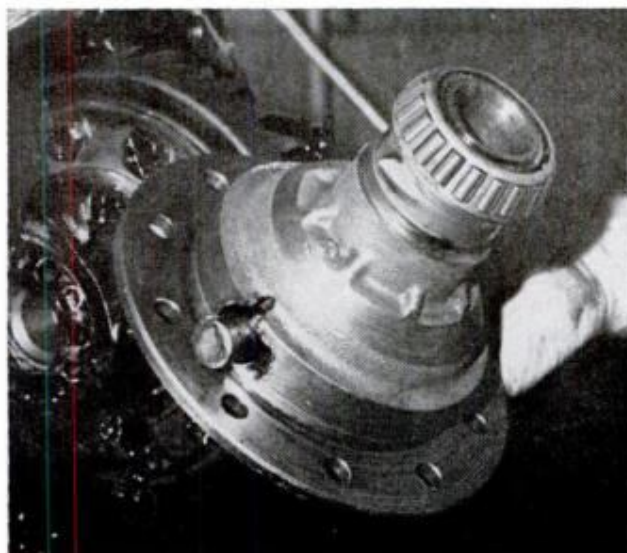
NEW GASKET is pressed into place after sealer has been applied to flange of the differential. Apply more sealer to the gasket before replacing cover

bined are lack of lubricant and putting unusual stress on the part.

Lubricant level should be no less than a pinky-length below the bottom of the filler plug hole. Also be sure to inspect the differential housing for leaks. If fluid is coming from the cover-housing joint, replace the gasket between the two.

If you want your differential to outlast the car, watch those sudden slam-bang starts. Be careful especially in snow. Rocking the car can cause differential trouble. So can spinning your wheels. A differential case can be destroyed when abnormal stress on the pinion shaft causes the shaft to crack the case. The situation is illustrated in the photo below. The stress in this case was caused by excessive backlash when the driver accelerated too

PINION SHAFT can crack a differential case if you abuse rear end. Cause of damage here was wheels spinning in snow, then hitting a dry patch of road



quickly in snow so that the rear wheels started to spin rapidly. Then, he suddenly hit a patch of dry pavement.

Basically, limited-slip differentials are conventional differentials which incorporate built-in friction devices, such as disc or cone clutches. These limit or restrict differentiation up to a certain torque which is high enough to assist a vehicle in negotiating a problem, such as snow, but low enough to permit normal differentiation without tire scuffing.

Limited-slip differentials, which look the same as conventional units, are often identified by a code stamping on a metal tag on the rear-axle housing or by a code stamped into the housing itself.

Another way to identify one is to raise both rear wheels off the floor, put the transmission in gear, and rotate one wheel by hand in a forward direction. Since the friction devices in the differential, in effect, couple the two axle shafts together, both wheels will turn in the same direction when one is rotated. With the conventional differential, the opposite wheel will rotate in a reverse direction.

Don't let normal noise from an LSD be alarming. It's caused when the conventional parts of the differential push to overcome clutch resistance so that differentiation can take place. This sets up a vibration heard as a chatter or moan.

Innocent noise usually occurs when you first start the car or after a continuous high-speed drive followed by slow-speed turns.

Noise that signifies a malfunction is a continuous chatter that comes from the rear axle whenever you corner. Another indication of trouble is a seesawing of the vehicle on a slick surface.

One of the best methods of testing to determine whether a limited-slip differential is in need of servicing is to jack up one rear wheel. With the handbrake released and the transmission in neutral, try to turn the wheel manually. If there's no resistance to rotation, the clutch pack probably needs replacing.

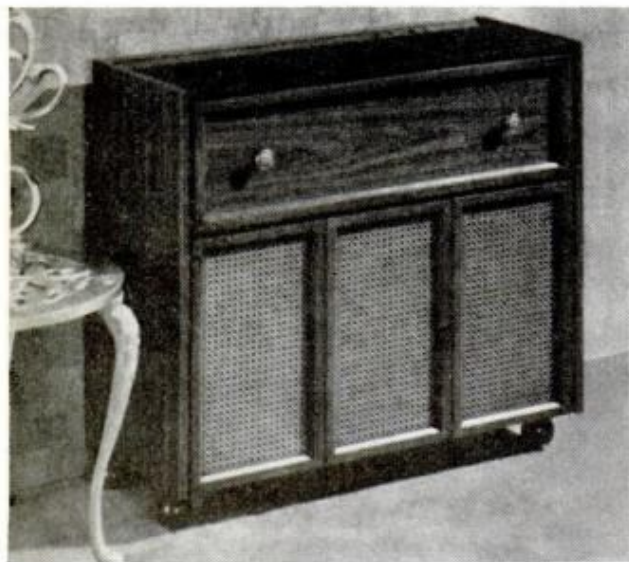
Limited-slip differentials require special lubricants because of the friction devices which would chatter and squeal when they weren't engaged if lubricated with conventional gear oil. Limited-slip differential lubricants possess greater lubricating power than conventional gear lubes to keep clutching devices quiet. ★★ ★

EXCITING NEW PRODUCTS

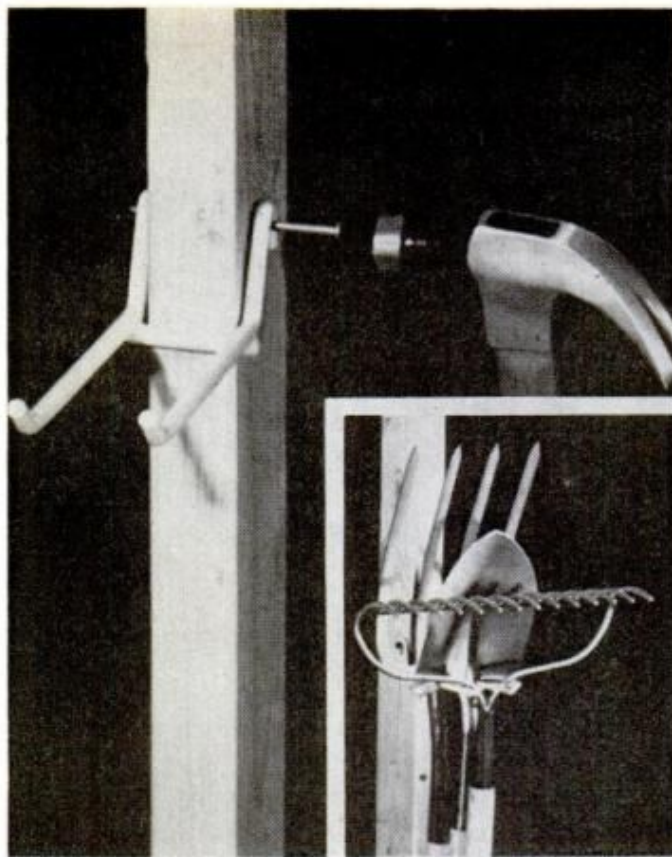
By CATHERINE BILSKI



ADD A TOUCH OF Early Americana to any room in your home with this authentic reproduction of Ben Franklin's famous fireplace. The unit features a heat-resistant porcelain finish that can't fade, peel or chip and can be installed either standing or as a built-in. It burns coal, wood or gas logs. Made by Roesch Enamel & Mfg. Co., Belleville, Ill. 62222, it retails for \$379.



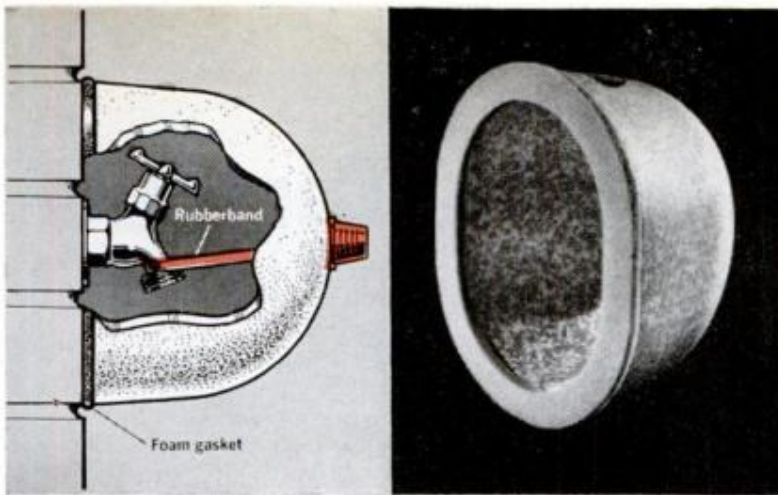
A ROOM HUMIDIFIER that takes on the look of fine furniture is now being introduced by the West Bend Co., West Bend, Wis. 53095. It features an exclusive modulating solid-state sensor system that monitors and maintains any desired level of humidity. "Water wheel" action will properly humidify a big four-bedroom house. Available in three models ranging from \$79.95 to \$119.95.



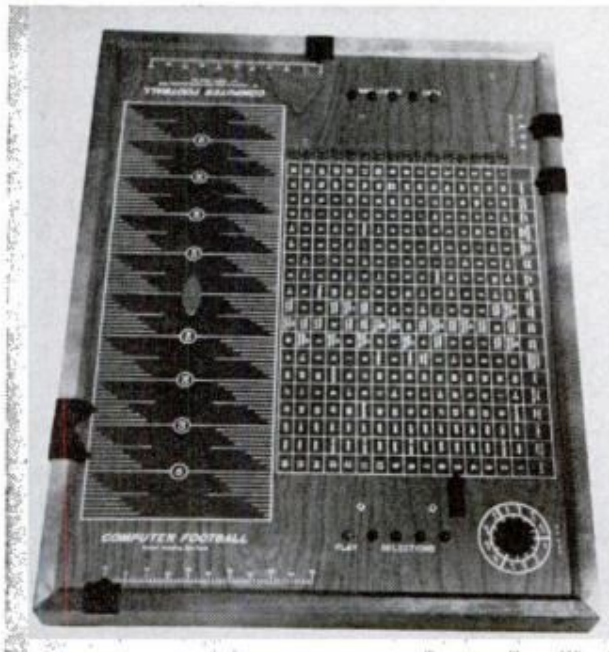
KEEP THOSE BIG YARD TOOLS safely and neatly up and out of the way with the F-CO Safety Hook. It's made of heavy-gauge steel and is ideal for ladders, hoses, rakes, shovels and many other items stored in garages. Price is two for \$1, plus 30 cents for handling and postage. These handy hooks are made by the Fearing Manufacturing Co., Box 6572, St. Paul, Minn. 55106.



PUT FIRE PROTECTION in the palm of your hand with a Presto fire extinguisher. It's small and light enough for a child to operate, yet the maker says it's as powerful as a larger extinguisher. It needs no recharging or periodic inspection and is claimed to be effective against all types of fire. Made by Celtic Industries, 603 Wayne St., St. Joseph, Mich., the extinguisher costs \$5.95.



END PLUMBING FREEZE-UPS with Cold Weather Hose-Faucet Covers that protect outside faucets during winter. They install in seconds with extra heavy rubber bands. The bands pull the Styrofoam cover tightly against the wall to assure a snug seal. Made by Nation Wide Products Co., Box 14334, Fort Worth, Tex. 76117. Available at most hardware and variety stores; also by mail order from the manufacturer at a cost of \$3.49 for two.



FROM THE WORLD OF COMPUTERS comes a game called Computer Football. It works on computer-type circuitry and, like the real game, it constantly challenges your imagination, skill and ingenuity. Priced at \$29.95, it's made by Computer Games Div. of Electronic Data Controls Corp., Winston-Salem, N.C.



STORAGE OF SMALL ITEMS such as jewelry, office supplies, and shop hardware need not be a problem with "Skotch Kabinettes." They're made of rugged steel with clear-plastic drawers that have multiple slots for adjustable compartments. Dividers lock tightly and each Kabinette is equipped with index labels and spacers. They're manufactured in a variety of sizes priced from \$4.95 to \$7.49 by the Hamilton-Skotch Corp., 295 Fifth Ave., New York 10016.



HERE'S A WAY to put everything in its place and keep your dashboard, visor and glove compartment free from clutter. Named Auto-Mate, this device fits the transmission tunnel of your car. The top comes with tissues, memo paper and pencil, and has compartments for change, sunglasses, cigarets, road maps, receipts, whatever. Also included in the bottom section of this unusually compact unit is a first-aid kit, flashlight, fire extinguisher and flat and recessed screwdrivers. It retails for \$10, from Bently Gifts, Inc., 1331 Newbridge Rd., North Bellmore, N.Y.

Fun for the Family: A Bumper-Pool Table You Can Build

Taking approximately one-third the space that a conventional table requires, it means that apartment dwellers can now enjoy the game as well as homeowners with spacious rec rooms

By JOHN CAPOTOSTO

POOl HAS LONG BEEN FAVORED as an American family pastime, but two obstacles—cost and space—have kept pool tables out of most homes. Now, by building a regulation-size bumper-pool table yourself, you too can get in on the fun of skillful pool playing.

The most important feature of a good pool table is rigidity. Our version, with its $\frac{3}{4}$ -in. particleboard bed, stacks up against tables that sell commercially for \$250 or more. Also, the one shown boasts aprons and legs of $\frac{5}{4}$ ($1\frac{1}{8}$ -in.) stock. Though designed so that construction is simple, quality has not been sacrificed. And, to make shopping for materials an easy task, all the specialty pool items are available by mail order from one source.

The pool table measures 32x48 in. Some lumberyards will (and some won't) sell you the particleboard cut to size. When buying, it's important to make sure that the board is free of any warp.

Lay out the hole locations for the bumpers and drill them with a $1\frac{3}{8}$ -in. bit. Cup holes will have to be cut with a sabre saw, but before sawing them in the particleboard, check for size on a piece of

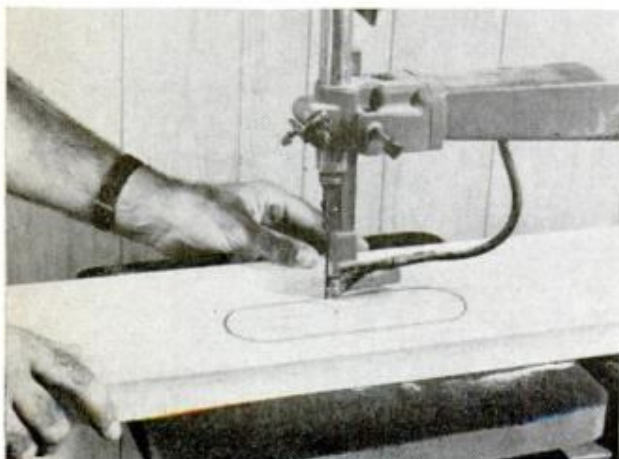
scrap. When testing the cup liners for fit, drape several pieces of cloth over the holes; the fit should be fairly snug.

Apron members are cut to size next. Choice of lumber is optional but, if you plan to paint your table, a less expensive wood (such as fir) will do. If you prefer stain, consider a hardwood with an attractive grain (walnut or birch, for example). Lay out the oval ball return openings on the end panels and cut them with a sabre saw or jigsaw.

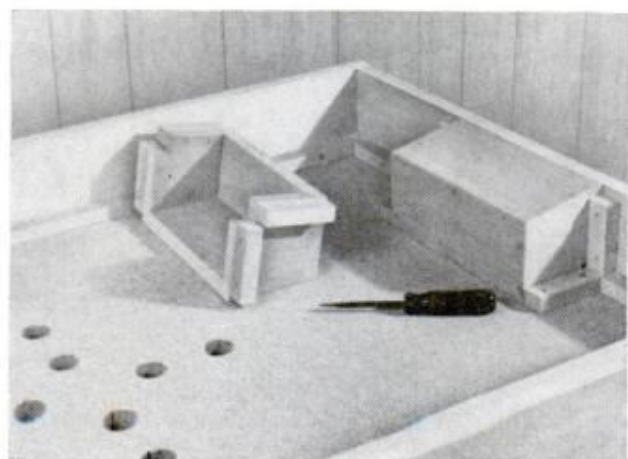
Add the cleats to the apron members, using flathead screws and glue. Position the cleats accurately as they will indirectly determine the cushion height, which is very important. Notice the counter-bored holes drilled in the cushion liner for the bed-to-liner screws.

Next, cut and assemble the legs. These are attached to the 2x3-in. frame as shown. Drill the clearance holes for the leg levelers and then drive home the special Teenuts. Use lagscrews to join the leg assembly to the bed. *Caution:* Take care when working with particleboard—overtightening a screw can strip the hole.

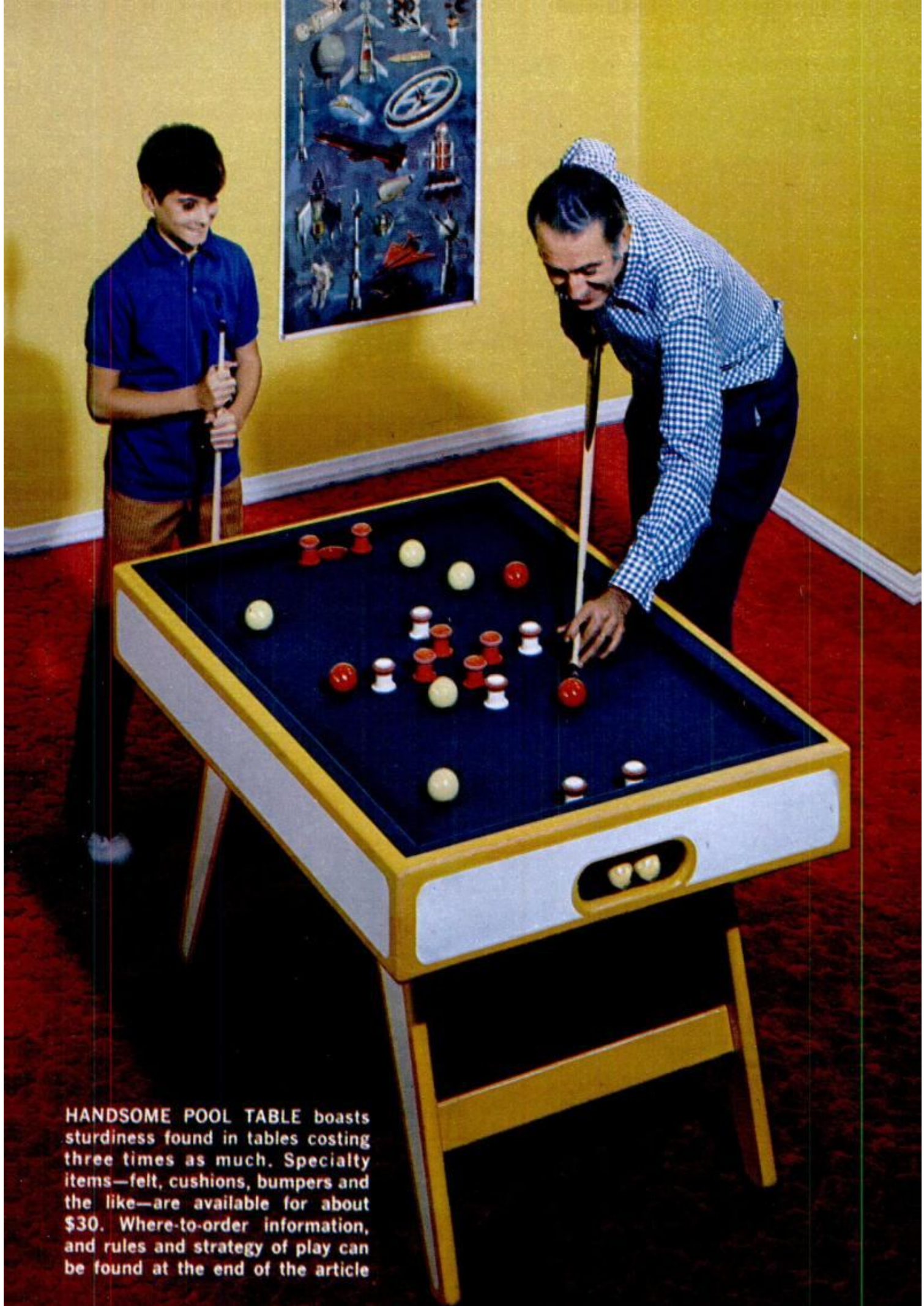
Cut the wood cushion liner to size, mi-



OVAL CUTOUT for ball return in end panel is made before assembly. Use a jig or sabre saw to make it

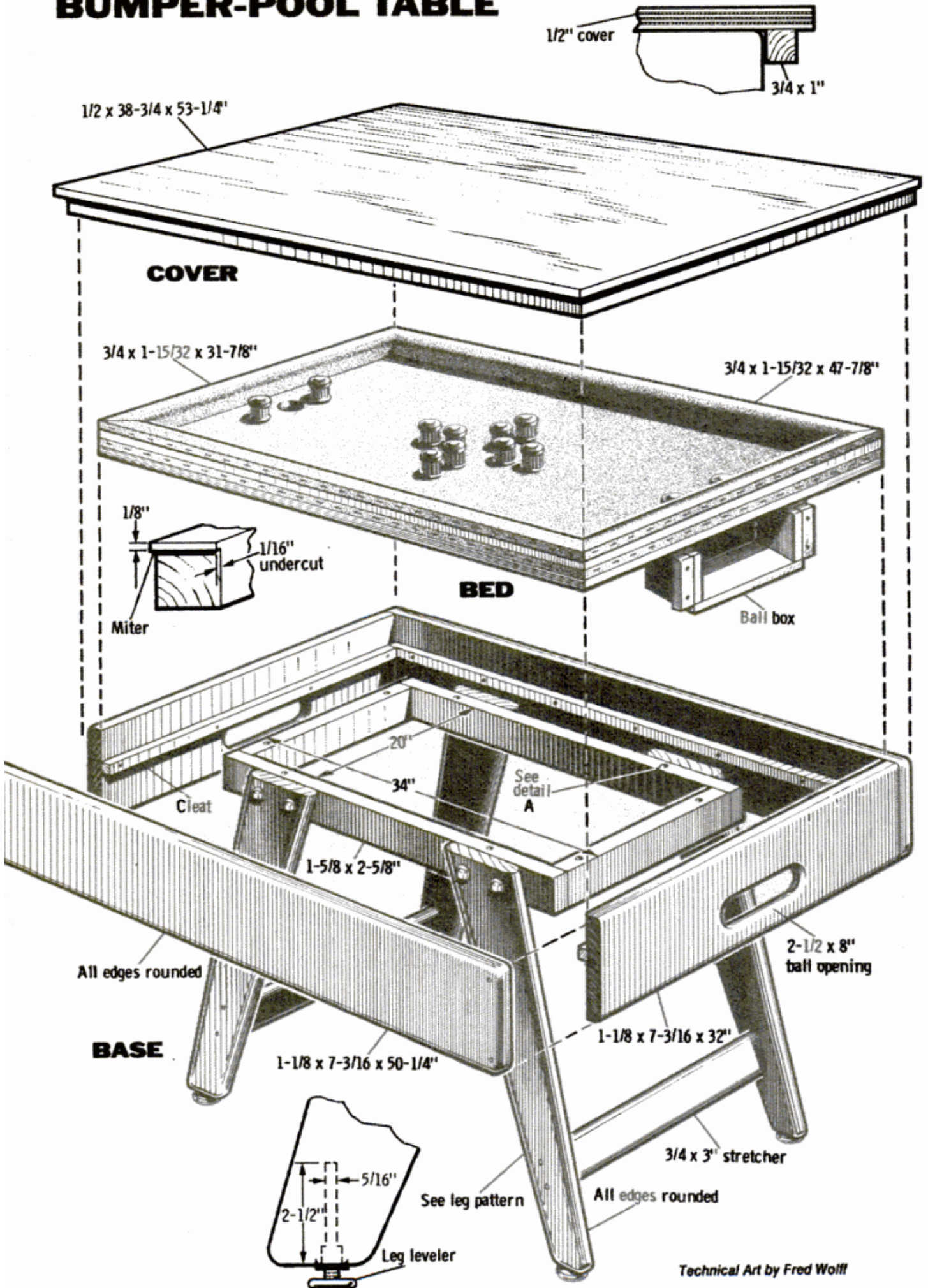


BALL-RETURN BOX is simply constructed with butt joints. Box bottom slopes slightly toward opening



HANDSOME POOL TABLE boasts sturdiness found in tables costing three times as much. Specialty items—felt, cushions, bumpers and the like—are available for about \$30. Where-to-order information, and rules and strategy of play can be found at the end of the article

BUMPER-POOL TABLE



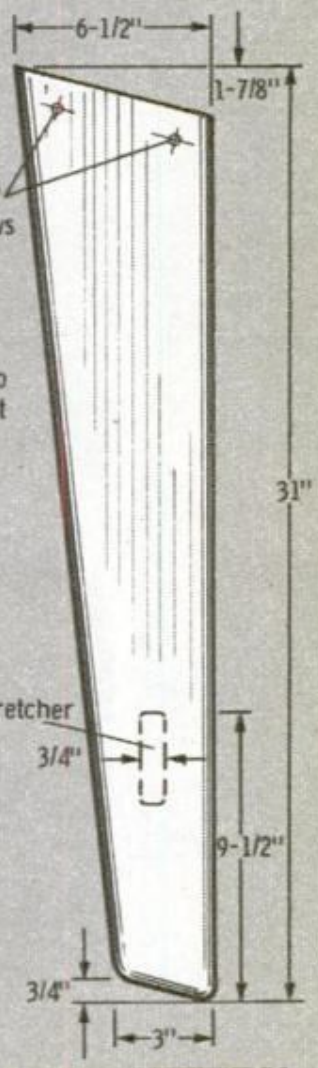
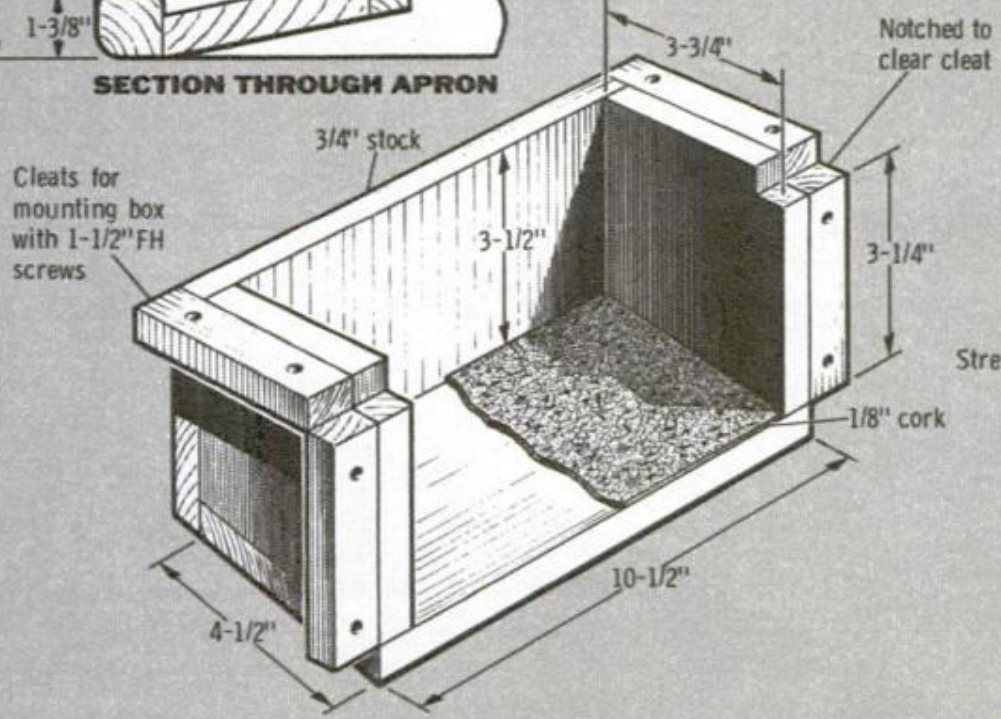
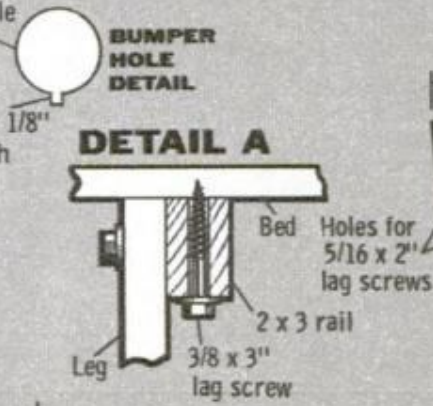
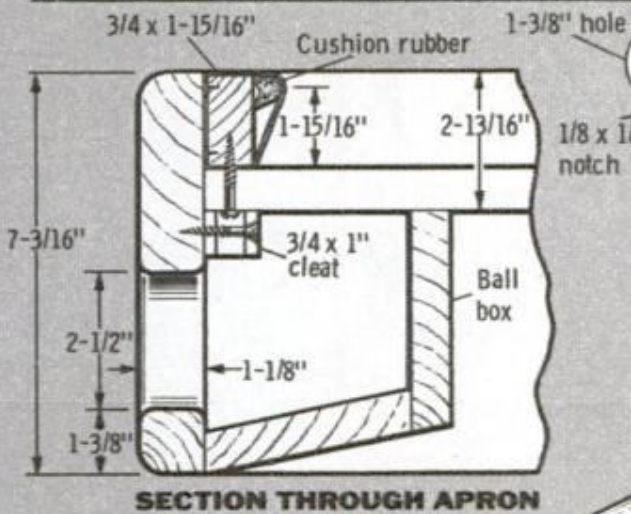
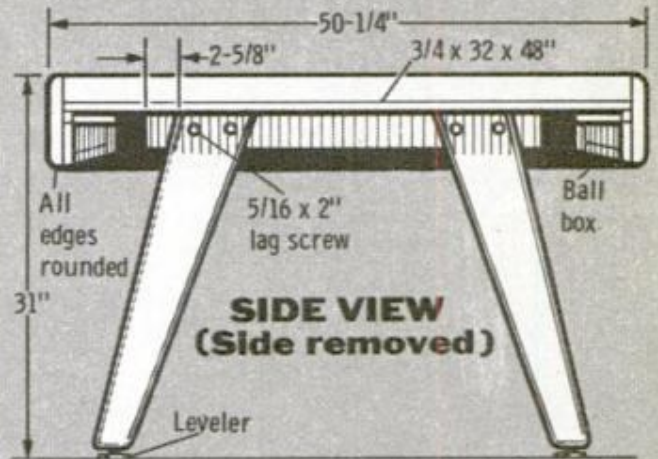
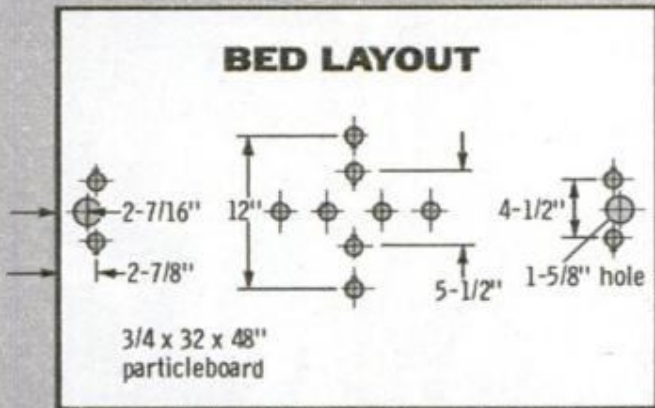
tering the corners, then undercut the ends (see inset in photo at top right of page 148). The undercut is necessary to allow clearance for the gathered felt at the ends of the cushions. After mitering the lines, lower the blade $\frac{1}{8}$ in. and recut the ends.

The cushions are now added. Cut the strips a trifle longer than the liner and apply a coat of contact cement to both surfaces. Allow this to set, then join the

pieces carefully. If you examine the rubber in cross section, you'll notice it has a shallow and a deep curve. The shallow part is the top, therefore mount it accordingly to the liner. Trim ends to match the mitered liner. Use a sharp knife, after dipping it in water, to lubricate the blade or you'll have trouble cutting the rubber.

Cover the cushions and bed next. If the

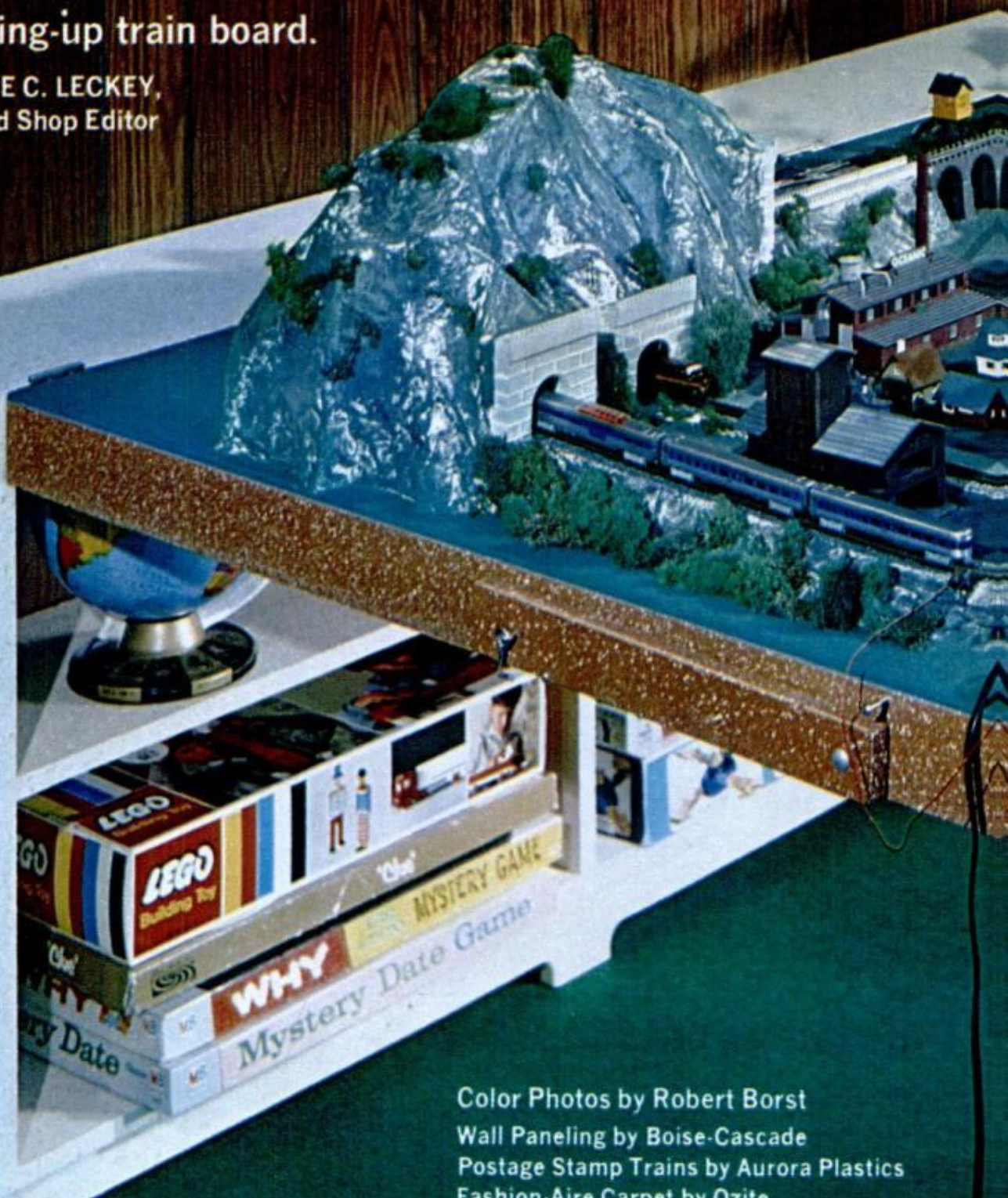
(Please turn to page 194)



A Lot of Railroad In a Little Space

Taking only one-fourth the room of HO, the new N-gauge trains let you build a complete railroad system in a minimum of space. Part 1 details the swing-up train board.

By WAYNE C. LECKEY,
Home and Shop Editor

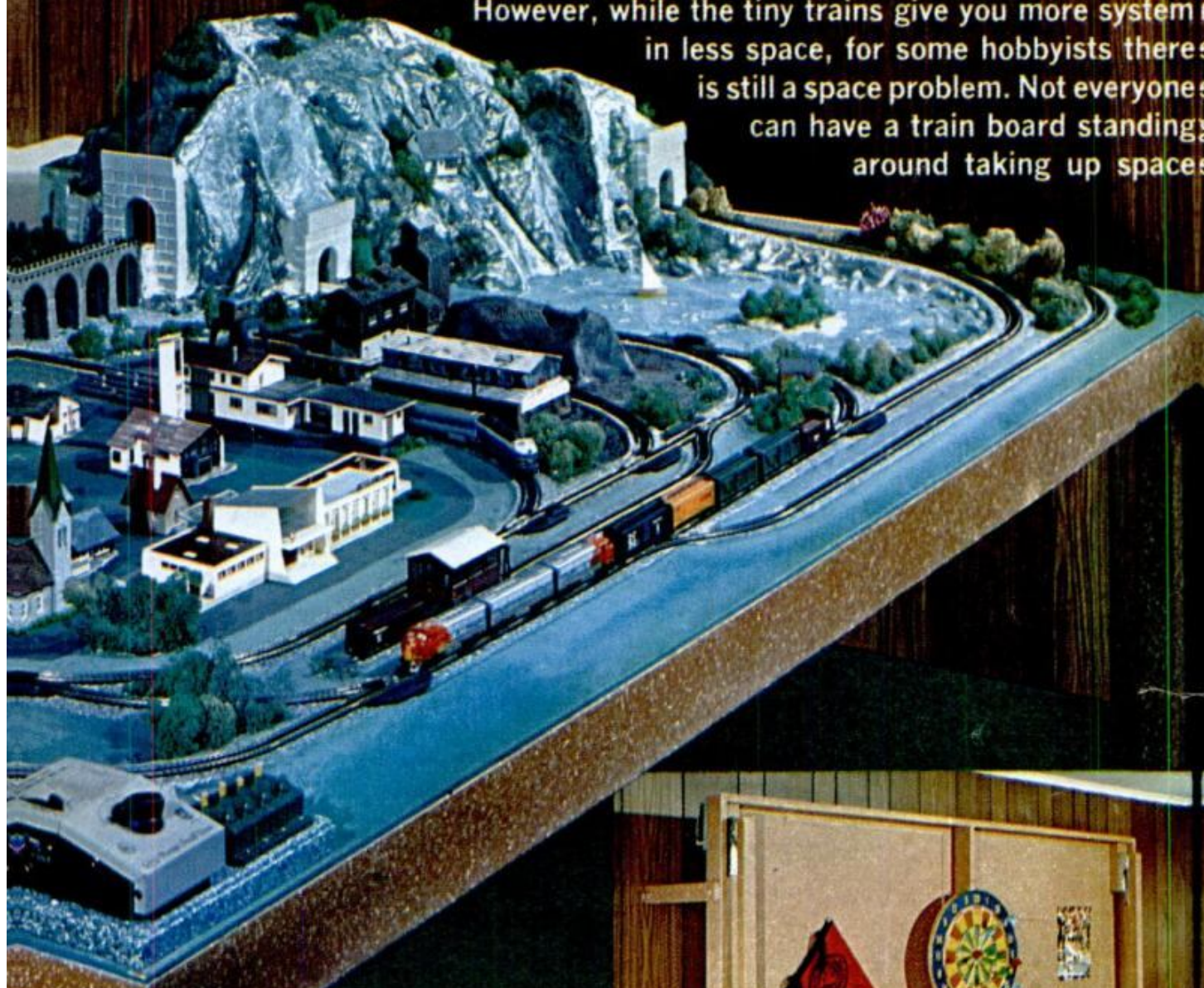


Color Photos by Robert Borst
Wall Paneling by Boise-Cascade
Postage Stamp Trains by Aurora Plastics
Fashion-Aire Carpet by Ozite

THE REALISM of N-gauge trains is truly something in itself. But there's more than just their watchlike detail that has made these tiny trains so popular. It's their size!

Compared to the now "giant" HO-gauge trains, the new lilliputian ones let you operate a railroad practically on the top of a coffee table. Being 1:1600 scale they need only one-quarter the space formerly required—which means you can expand your basic layout into a railroad empire in a minimum of space.

However, while the tiny trains give you more system in less space, for some hobbyists there is still a space problem. Not everyone can have a train board standing around taking up space

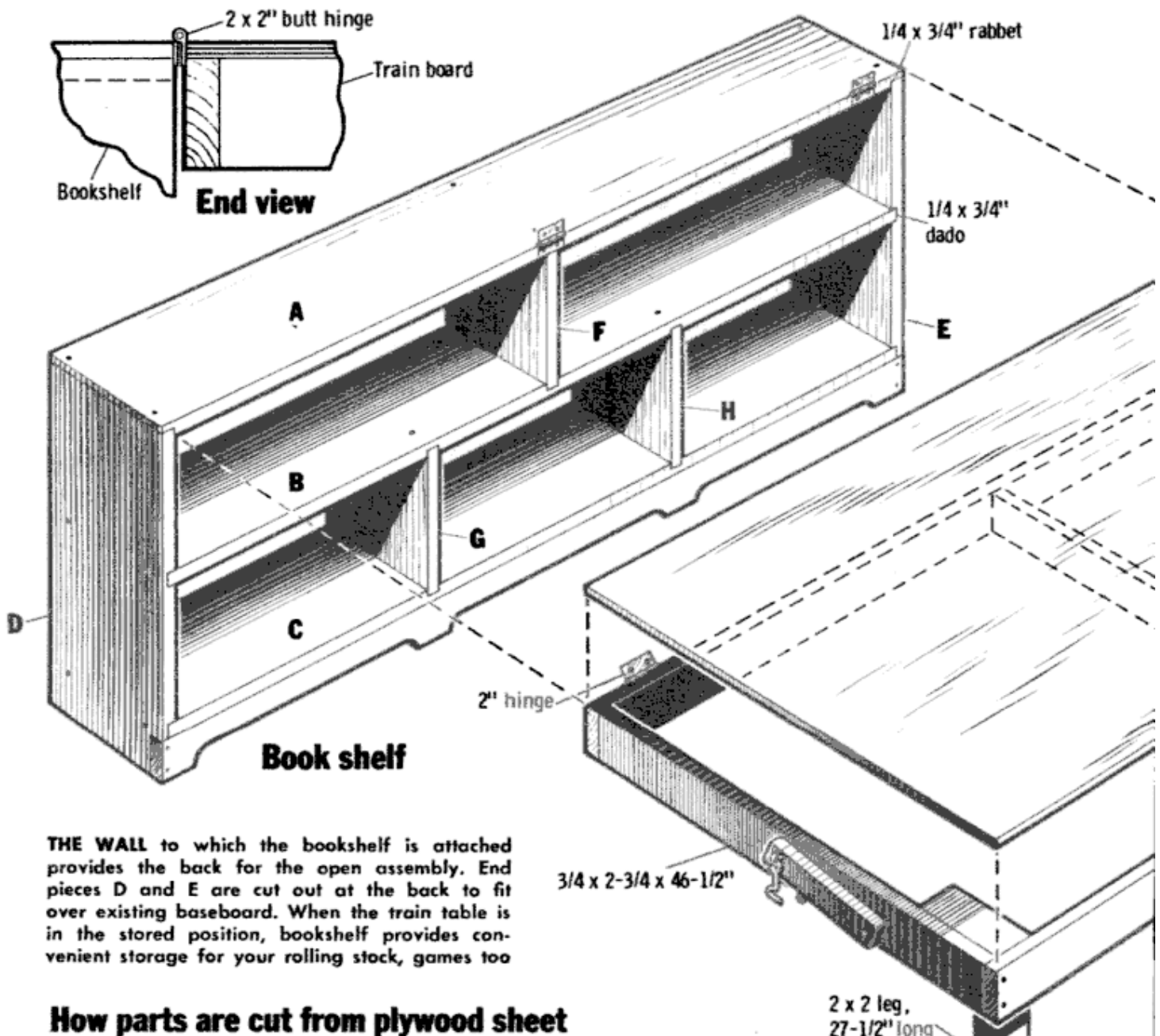


THE BIG BUGABOO with most train boards is that they're always standing around taking up space. That's not so with this one. It swings up and hooks to the wall to do double duty between hobbies. Shelf provides clearance for the mountains, towns and scenery



SWING-UP TRAIN BOARD

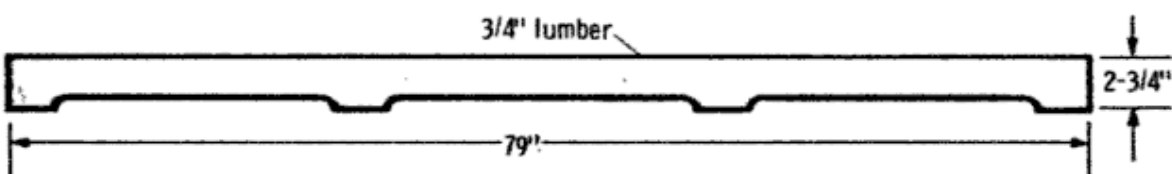
Technical Art by Fred Wolff

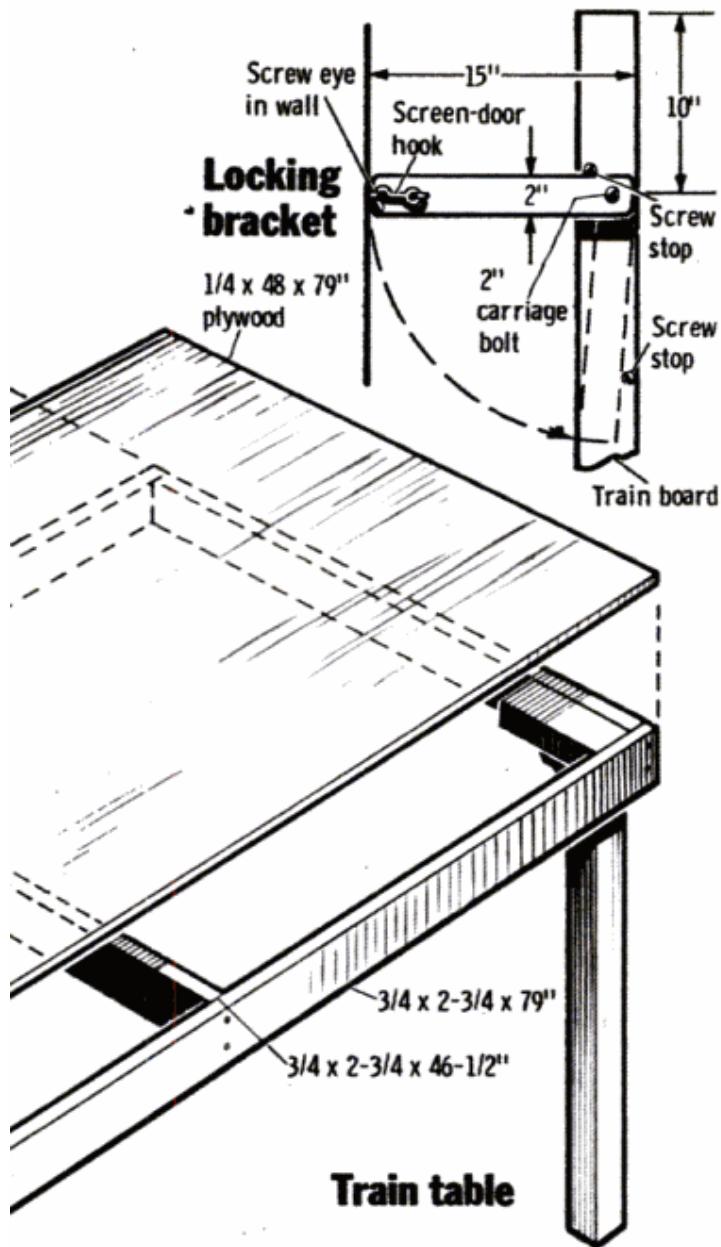


THE WALL to which the bookshelf is attached provides the back for the open assembly. End pieces D and E are cut out at the back to fit over existing baseboard. When the train table is in the stored position, bookshelf provides convenient storage for your rolling stock, games too

How parts are cut from plywood sheet

3/4 x 48 x 96" plywood	A	11-7/8 x 79"	F	11-7/8" x 13"
	B	11-7/8 x 78"	G	11-7/8 x 13
	C	11-7/8 x 78"	H	11-7/8 x 13
D	11-7/8 x 29-3/4"	E	11-7/8 x 29-3/4"	Waste





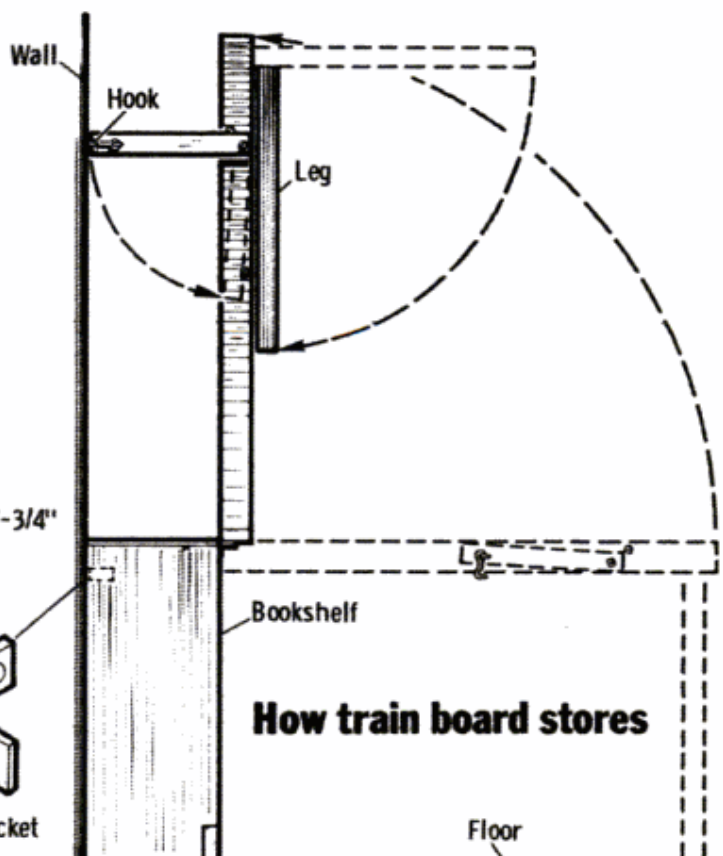
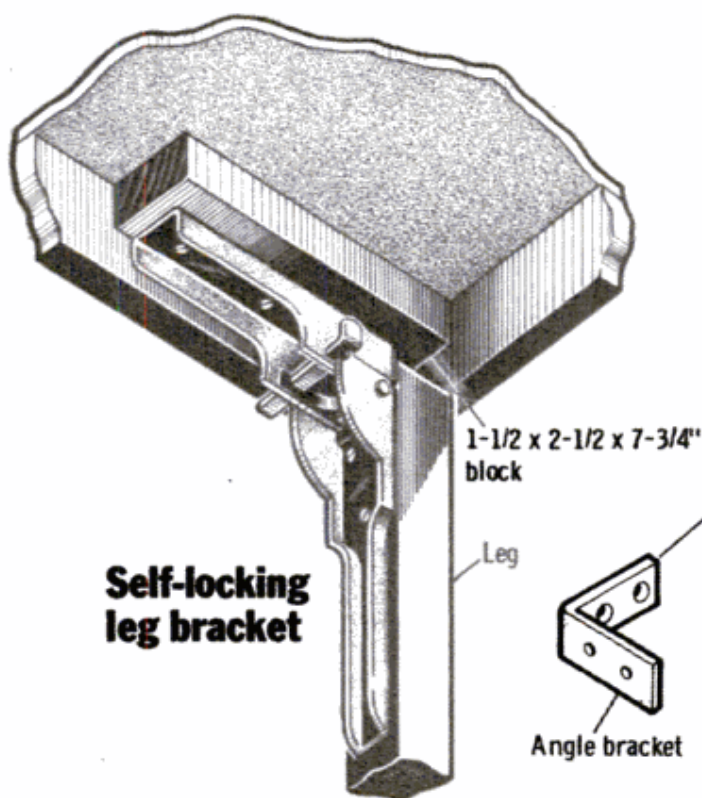
when not being used. The problem is solved, of course, with a swing-up railroad like the one shown here. It's hinged along the back to a handy storage shelf anchored to the wall and supported at the front by two folding "card-table" legs. When the railroad is swung up against the wall and held by screen-door hooks it extends but 12 in. from the wall, yet it's ready to operate in the time it takes to lower it and set up your rolling stock.

The microgauge engines, passenger and freight cars, track, switches and buildings I used are from Aurora's Postage Stamp line which PM first told you about in *New Mini-Trains* (page 144, Dec. '67). They operate off any 12-16-v.d.c. power pack used for model railroading. Revel, Atlas, Kemtron, Lima and Lone Star are other manufacturers.

For limited space reasons I started building my system on a 4x7 1/2-ft. board. The size of yours could be longer or shorter, possibly narrower. As you see, it's a sheet of 1/4-in. plywood supported at the edges and across the center with a 1x3 frame. Front-corner blocks anchor the self-locking leg brackets which are used to attach the two fold-up legs.

The depth you build the storage shelf is determined by the height of the mountain scenery which you plan to add to your track layout. My mountains were almost

(Please turn to page 191)





ALL TIME GREATS No. 2

A Cabinet for Your Guns

Great projects never die, but sometimes we forget how popular they were. Here's one that made a hit in PM 11 years ago, updated and restyled for 1970

IF YOU TAKE PRIDE in showing off the guns you own, wait until you see them displayed in this beautiful solid-oak cabinet.

A truly fine piece of furniture in Mediterranean design, it's a project the advanced craftsman will be eager to tackle—a piece which demands your best workmanship in both woodworking and finishing skills.

It's the second in a series of "all-time greats" which we plan to publish from time to time (see *A Game Table for Your Playroom*, page 148, Aug. '69 PM) and is patterned after a gun cabinet that made a hit with countless readers in July, 1958.

The cabinet will hold up to six guns and has storage for ammunition, scopes and cleaning gear. Doors lock to keep ammunition and guns out of reach, and sliding doors of polished glass keep them dust-free.

If you couldn't care less about guns, you'll find the cabinet equally useful when fitted with shelves and used as a trophy cabinet, a place for your wife to keep her best china and table linens or a case for your fine bound books.

The cabinet consists of two separate assemblies, a top and a bottom. We used solid stock throughout in building the one you see on the opposite page although hardwood-faced plywood would be adequate for the side panels of each assembly.

Start the top assembly first by cutting the sides to size and rabbeting the top and back edges. The top board is cut $\frac{1}{4}$ in. narrower than the side members to accommodate the $\frac{1}{4}$ -in. plywood back, and the back member is cut $\frac{3}{4}$ in. longer than the sides so it can be fastened to the bottom assembly.

Glue and nail the parts together and

then face the front edges with a three-piece frame. This is made the same width as the assembled unit ($31\frac{1}{2}$ in.) but is cut $\frac{3}{4}$ in. shorter. It's doweled at the corners, then glued and clamped to the unit. You can use a few nails across the top in pre-drilled holes since they will be hidden. The top is finished with a molding that's mitered at the corners, glued and brought flush with the top board. So much for the upper assembly.

The bottom assembly is built similarly in that the top and rear edges of the sides are rabbeted as before. In addition, a $\frac{1}{8} \times \frac{3}{4}$ -in. dado is made in each side member for a bottom shelf. The latter is notched at the front corners so it will project $\frac{3}{4}$ in. across the front. Facing rows of $\frac{1}{4}$ -in. blind holes (fitted with shelf brackets) hold the adjustable center shelf.

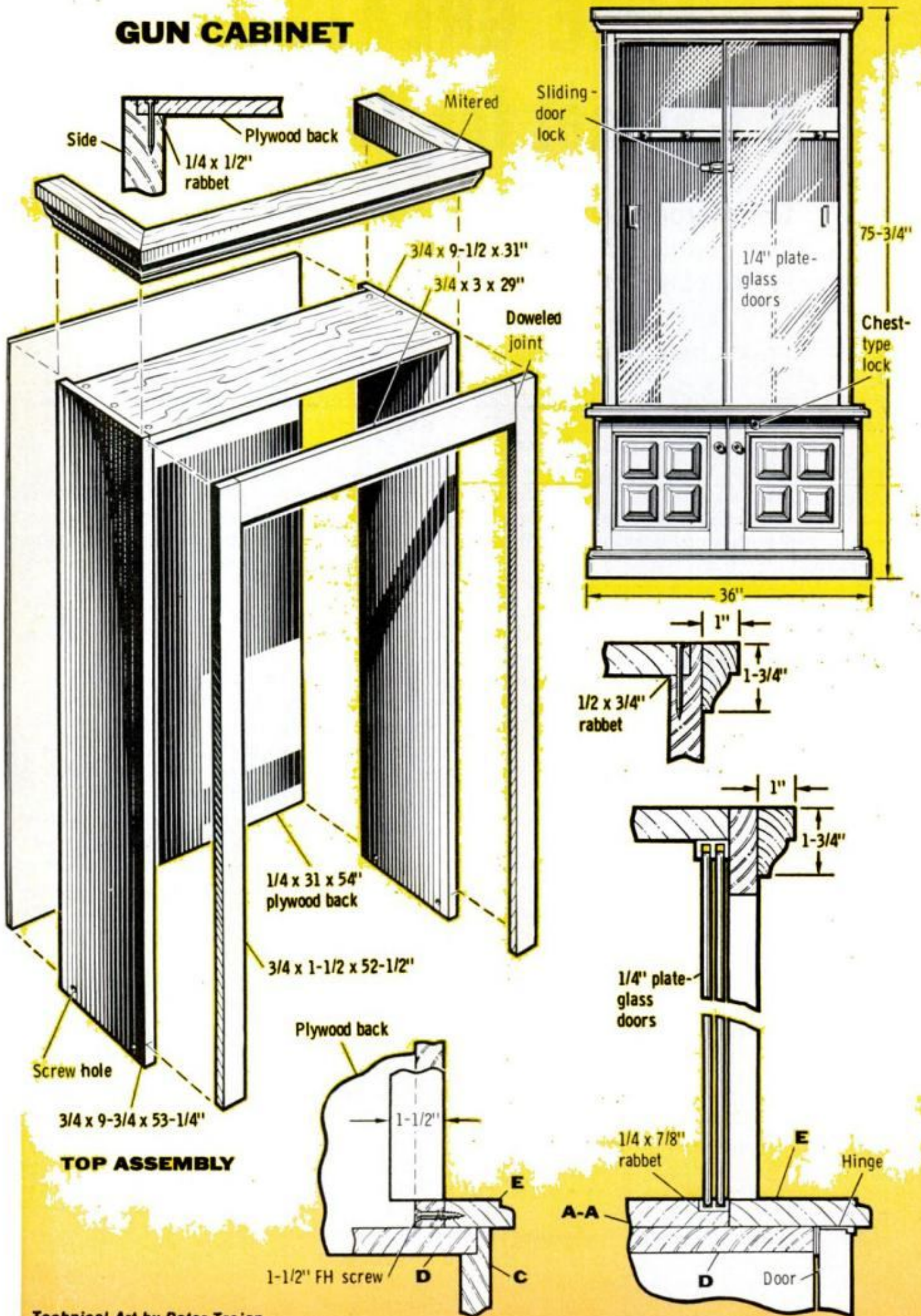
After the parts are glued and nailed together, a $\frac{3}{4} \times 3\frac{1}{4}$ -in. base molding is mitered and glued around the bottom. Finally, the three pieces which make up the top sill (E), are mitered and doweled, then shaped with a router along the outer edge. It's attached to the base with glue and screws, the latter being driven through pieces A and D from the underside.

The top assembly is attached to the bottom with four screws driven through the side members from the inside. Nails can be used to fasten the plywood across the back.

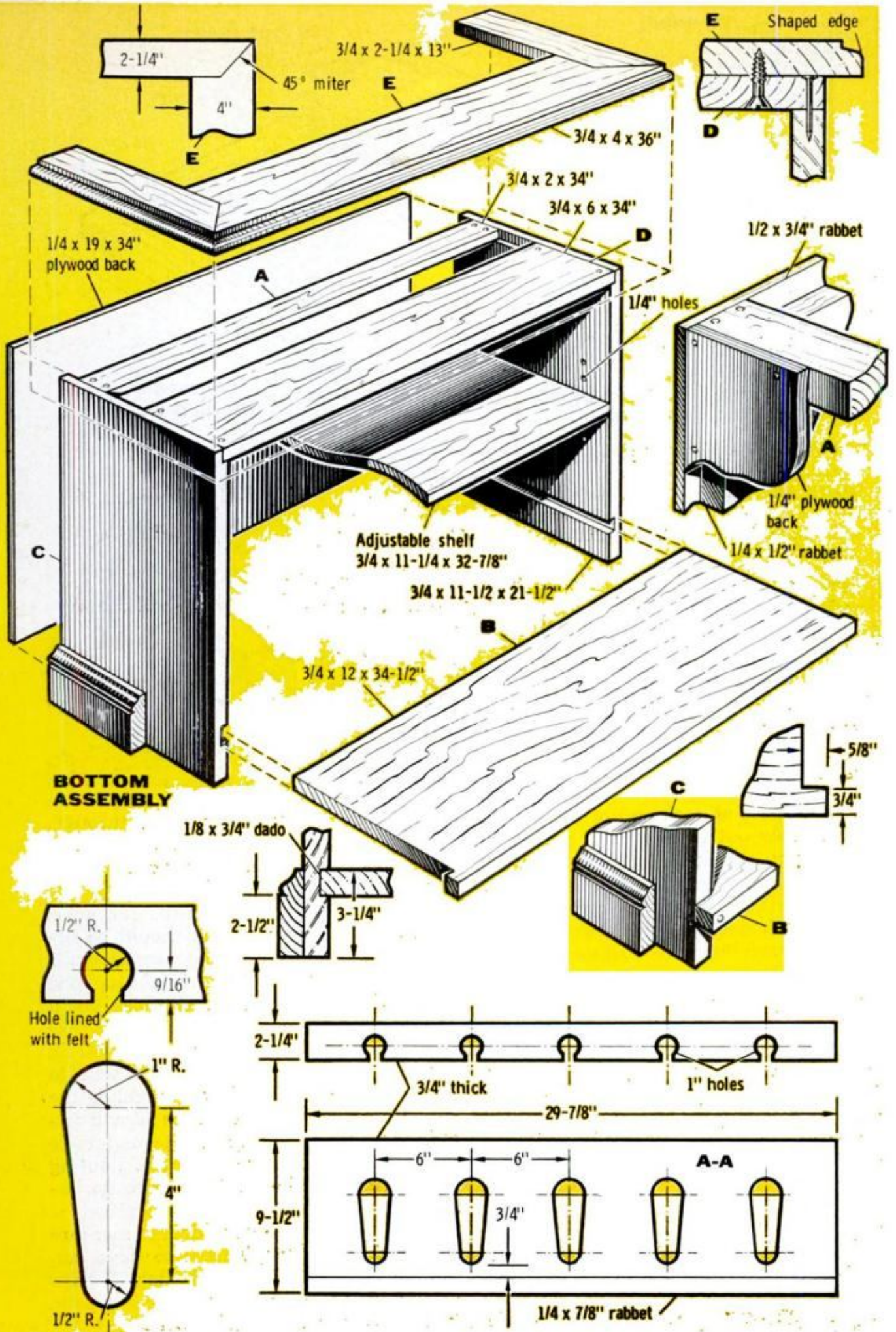
Part A-A slips in place behind part E. While in each case it's rabbeted across the front for a plastic door slide, you can forget about cutting the gunstock pits in it if you plan to use the cabinet as a bookcase or china cabinet.

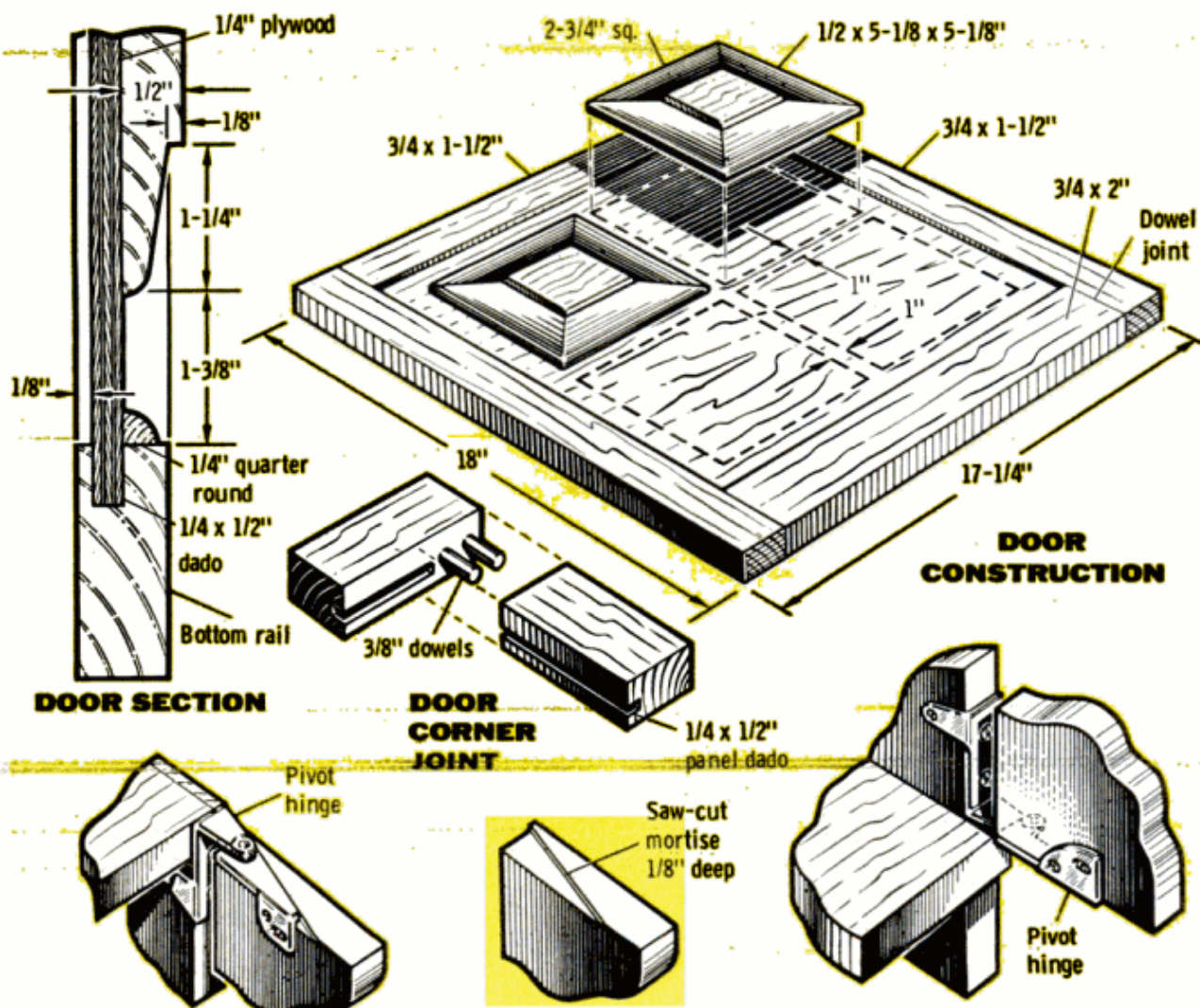
The stock pits are cut completely through the board, then backed up on the bottom. The neatest way to cut the pits

GUN CABINET



Technical Art by Peter Trojan





HOW OVERLAPPING DOORS ARE HINGED

is to bore holes at each end of the cutout and then saw out the waste. If you have a router, you can do the job quickly with a jig you make to guide the machine. Pieces of felt are later cut and glued to line the bottom of the pits. Part A-A is left loose, and the space between pieces A and D permits piece A-A to be pushed out to give future access to the four screws which hold the top section.

This leaves the doors, which are detailed above. Each consists of a 1/4-in. plywood panel framed on four sides with grooved members. Four square overlays cut from 1/2-in. solid stock are glued to the center panel. These are beveled by tilting the blade on your table saw and running the work on edge. A sandpaper block is used to round off the outer edges.

The details show how the doors are attached at the top and bottom with pivoting pin hinges.

The notches in the barrel rack are made

with a 1-in. drill and then sawed through. The size of the notches and the location of the rack in the case are governed by the size of your guns.

If the cabinet is to be used for guns, both glass and wood doors should be fitted with locks. If one of the wood doors is fitted with an overlapping metal stop, one lock will lock both doors. The lock you'll need for the glass doors is a showcase lock, whereas a regular chest lock will do for the wooden doors. Here it is wise to have the latter on hand before adding the sill piece E to the base since it will require cutting a mortise on the underside of the piece to receive the latch. Routing the mortise will be a lot easier to do before E is glued and screwed in place.

The two plate-glass doors measure 15x51 1/2". These you'll have to have cut, with edges rounded and finger grips ground in the surface. They slide in plastic tracks placed at top and bottom. ★★★

Portable Sink Makes Hot Water

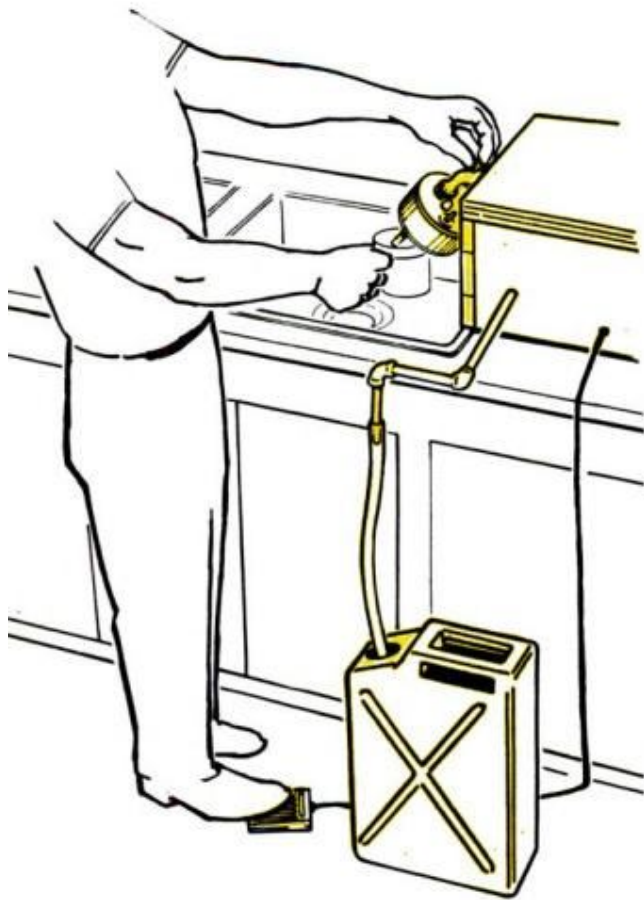
By HANK CLARK

MOST COUNTRY VACATION HOMES are unheated and that means, come Labor Day, the water supply must be turned off to save pipes and pump from winter freezing. Thus, if you decide to visit your weekend retreat during the chilly months, you must cart your fresh water supply along with you.

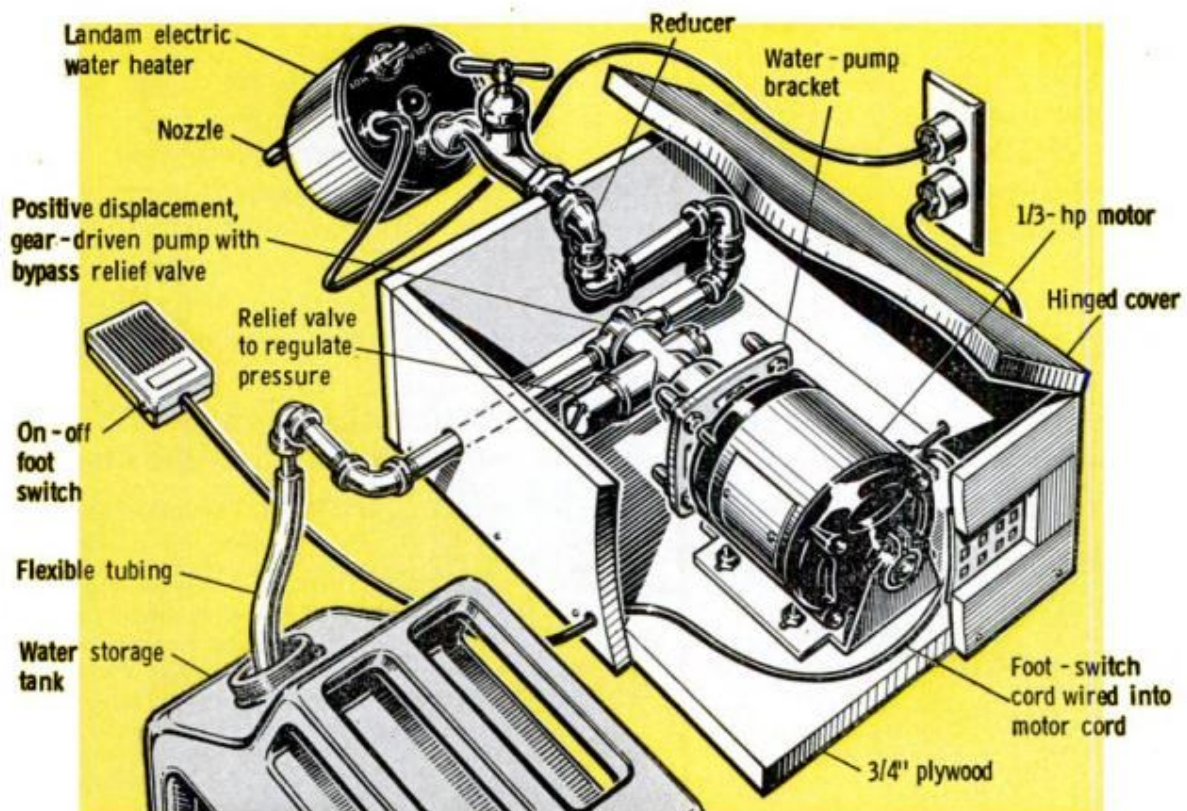
Build this little powerplant and you'll have a self-contained, ready-to-plug-in hot-water tap. The unit features a faucet, hose, electric water pump and an instant water heater complete with its own spout. The floor switch is a luxury, but it does leave both hands free for washing, shaving, pouring a cup of coffee and the like.

Use an adjustable bracket to make alignment easy when joining up the electric motor and water pump. The pump used is an Oberdorfer positive-displacement gear-drive unit with a built-in bypass relief valve which protects the pump against water overload.

Since the heating unit will not operate unless adequate pressure is fed to it, make certain that all pipe joints are watertight. This prerequisite obviously rules out gravity as the method of water feed. ★★★



FAUCET CONTROLS water temperature. By adjusting the flow you can have hot, medium or tepid. For cold water, simply flip the switch



You Can Build Your Own Spiral Stairs

Invest a couple of Saturdays and about \$60 and you can put up a circular stairway that equals those that sell for over \$200

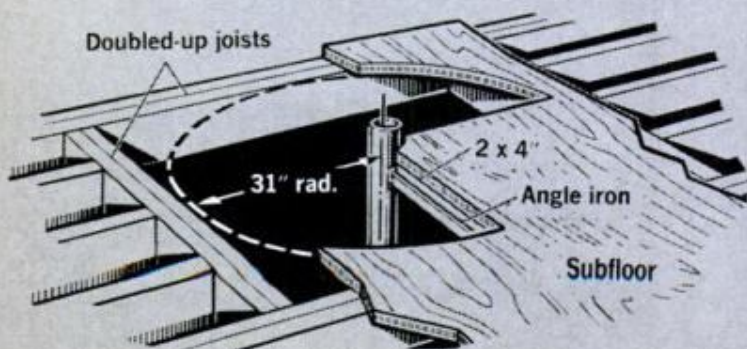
By TOM JONES

Technical Art.
By Peter Trojan

FOR UNDER \$60 you can build this wrought-iron circular staircase that takes up less space than a conventional stairway, is easier to keep clean, and will add beauty and value to your home. And you don't have to be a journeyman metalsmith to build it.

The materials needed are mostly black iron pipe and angle iron; both are available at most hardware stores. If you don't own an arc welder or a nailing gun, they can be rented for a small fee from a tool rental agency.

The amount of material needed will depend upon the height of the room and should be computed before any purchases are made. To build the stairs in an



AFTER PROVIDING ADEQUATE SUPPORT beneath the floor joists, make the cutout and spike headers and trimmers in place. Flooring has been omitted in the sketch so that header and trimmer details can be clearly seen. The landing (actually the sub-floor) is held by two pieces of angle iron which are welded to the center column

average 8-ft.-high room you will need 12 ft. of 2-in. pipe, 5 ft. of 2x2-in. angle iron and 35 ft. of 1x1-in. angle iron.

Using a sabre or keyhole saw, cut out the three-quarter circle and the two radii. Box in the quarter-circle radii with 2x4-in. stringers nailed into the subflooring and floor joists. Then cut two pieces of 2x2-in. angle iron to fit over the 2x4 stringers. Weld clips on one end of each angle iron and drill holes for bolting into the joists. Trim the opposite ends of the angle iron to a 2-in. radius for fastening to the center column.

The center column is a piece of 2-in. pipe with a pad welded on the bottom. Stand the pipe in the center of the cutout and weld it to the angle iron on the stringers, then bolt the stringers into the floor joists. Finally, check the column for plumb and shoot masonry nails through the pad and into the cement floor or anchor with bolts. Weld the nailheads to the pad and the main supporting structure of your staircase is complete.

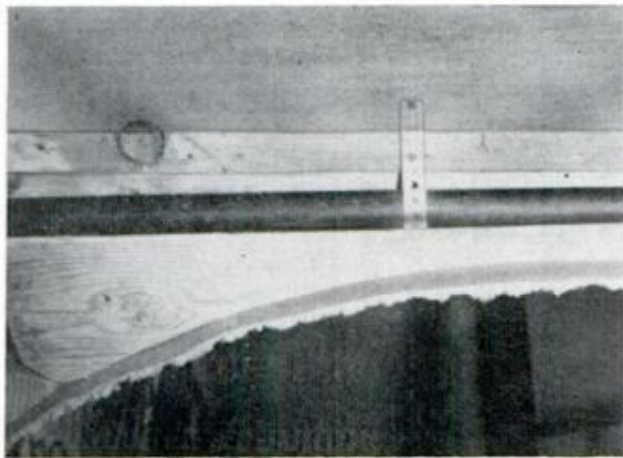
The stephangers are made up of three pieces; the balusters or vertical supports,

the rear supports that are welded to the bottom of the balusters, and the nosings which support the fronts of the treads. The balusters and rear supports are made of $\frac{3}{4}$ -in. pipe and the nosing is made of 1x1-in. angle iron.

In order to determine the lengths of the balusters, first calculate the height of the risers (distance from the top of one tread to the top of the next tread). To find riser height measure the distance in inches from the lower floor level to the top of the upper level. Since $7\frac{1}{2}$ in. is the desirable riser height, divide the total rise by that figure. The answer (if the number is fractional use the nearest whole number), gives the number of risers with a rise near $7\frac{1}{2}$ in.

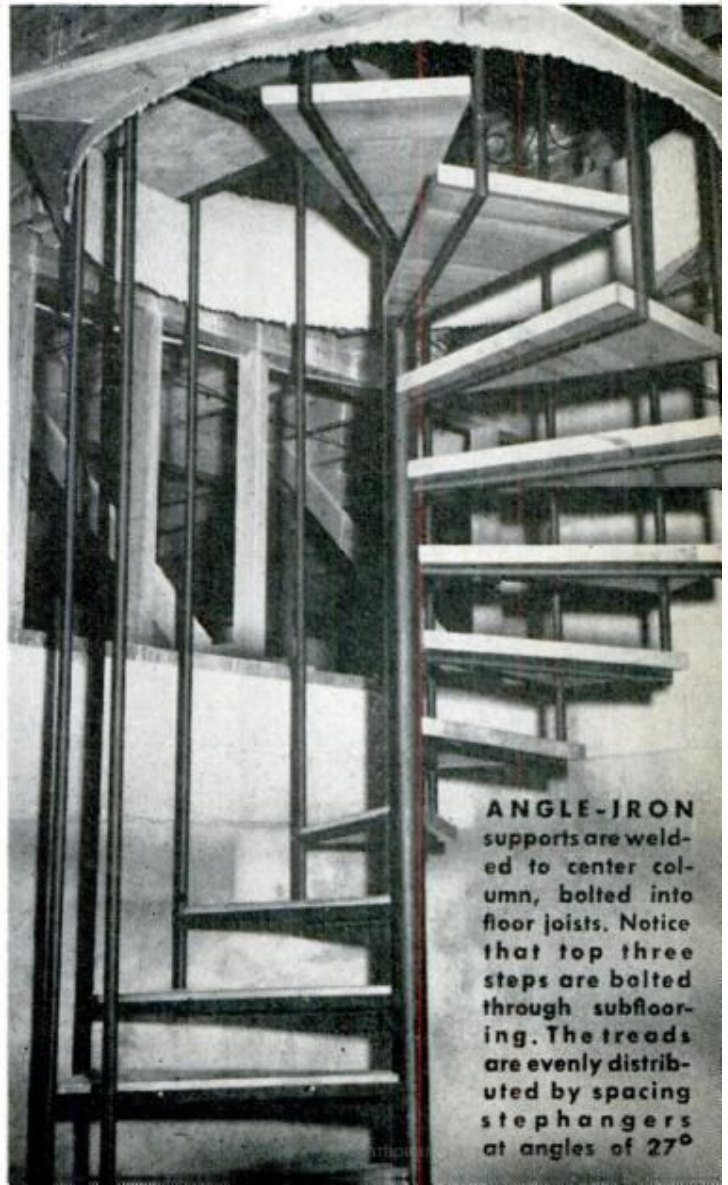
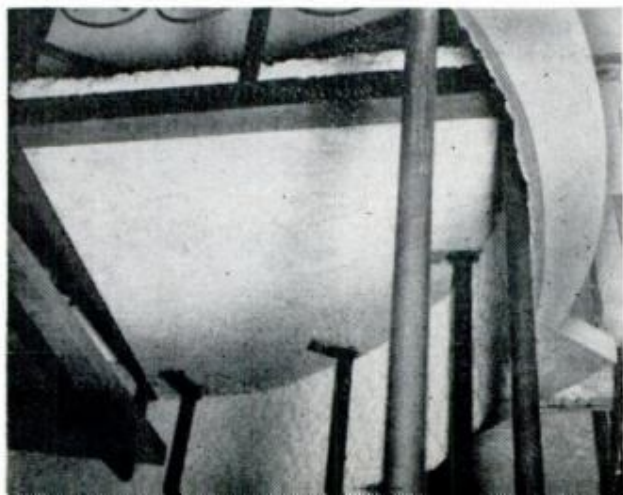
To find the length of the first (top) baluster, add the rise to 38 in. (for the tread thickness, 45° bevel, and the height of the baluster above the upper floor level). On the first baluster only, add another inch to allow for a 45° miter on the top of the pipe; the rest are all cut square on one end and 45° on the other.

On each succeeding baluster, add the



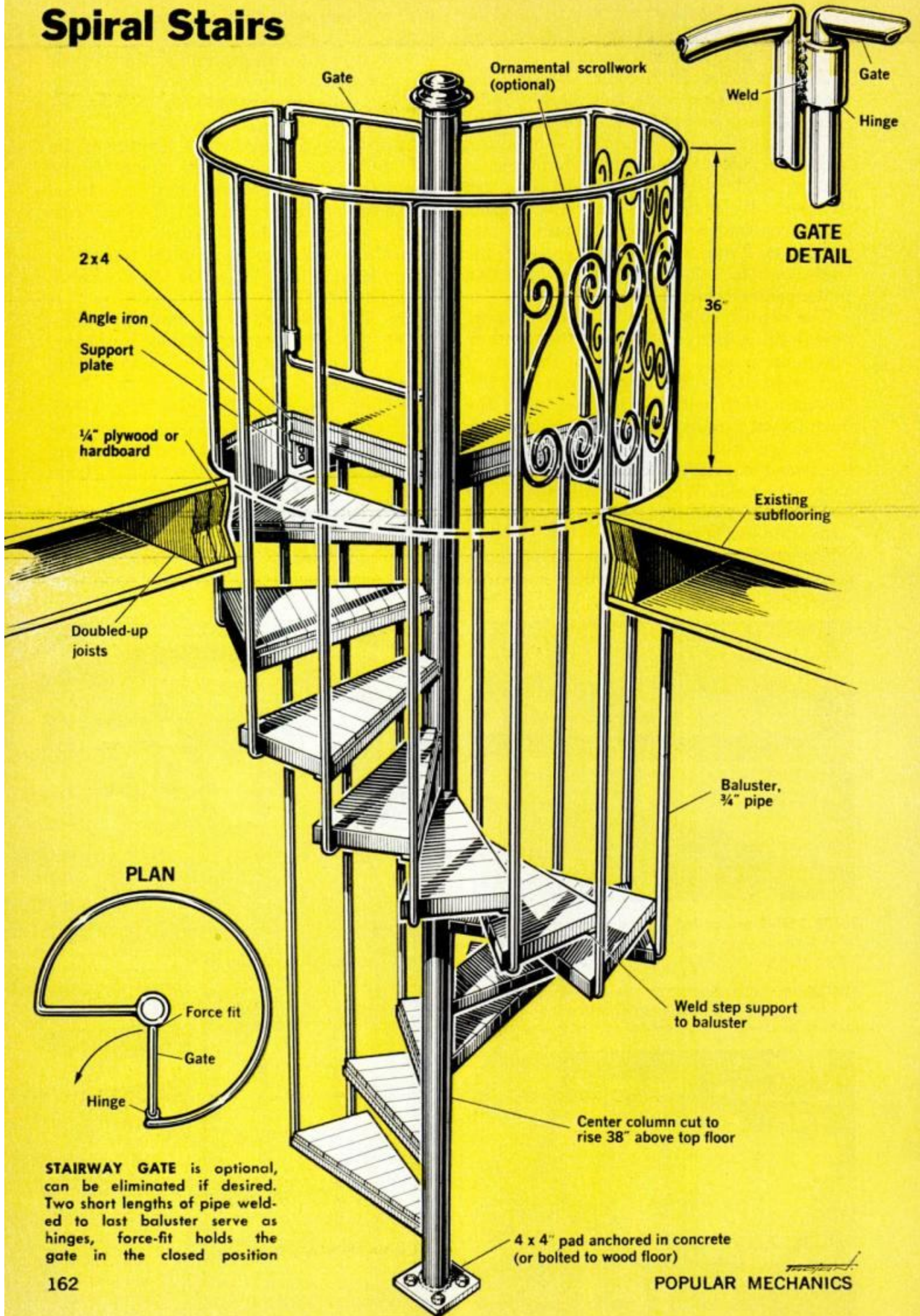
FILLER STRIPS are nailed around opening to provide solid base for plywood that covers. Use carpeting from cutout to finish off the plywood circle

SUBFLOOR HELD SECURELY by angle bears the weight of the top three steps. Flooring can be painted to match the carpeting or the ceiling below



ANGLE-IRON supports are welded to center column, bolted into floor joists. Notice that top three steps are bolted through subflooring. The treads are evenly distributed by spacing stephangers at angles of 27°

Spiral Stairs



STAIRWAY GATE is optional, can be eliminated if desired. Two short lengths of pipe welded to last baluster serve as hinges, force-fit holds the gate in the closed position

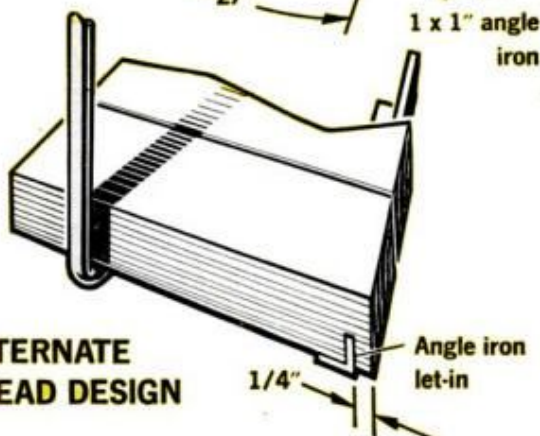


DESIGN FLEXIBILITY

Space treads to satisfy rise requirement. See text for formula.



STEP DETAIL



ALTERNATE TREAD DESIGN

1/4"

Angle iron let-in

riser height to the length of the preceding baluster up to the tenth stephanger. Stephanger No. 10 should be approximately at the three-quarter point of the circle and should provide at least 6 ft. of headroom at that point.

To make the rear supports, cut 14 pieces of 3/4-in. pipe 30 in. long with a 90° angle on one end and a 45° angle on the other. Match the 45s of the stringers and balusters together and weld square. Check with a level and weld the supports to the center column in descending order with 27° angles between supports (approximately 14 in. apart at the outer circle). Make certain that 36 in. of the balusters are protruding above the upper floor level.

Help needed for balustrade

The balustrade forms the top railing of the staircase and ties the balusters together. Here, lacking the right equipment you'll need help from a pro. To make it, cut a 3/4-in. piece of iron pipe 170 in. long. Take the length to a structural ironworking shop and have it rolled into a 5-ft.-dia. arc. Mark a spot back several inches on the arc to where the circumference begins to smooth out and cut a 45° angle in the vertical plane when the arc is lying flat. Trim a 45° angle on the first baluster and weld the two 45s together. Work the balustrade in an arc around the balusters, tack welding as you go.

After you've tacked the balustrade to the tenth baluster, cut off the excess railing on a 45° angle facing the center column and weld all joints. Cut a piece of 3/4-in. pipe 30 in. long with a 90° angle on one end and a 45° angle on the other and weld between the end of the balustrade and the center column on a level with the top of the opposite side of the balustrade.

The tread braces are made of 1x1-in. angle iron cut to fit between the baluster and the center column. They should be welded in place level with the supports and screw holes drilled in them for fastening the treads.

The last three steps are installed by making up stephangers with clips welded on the upper end for bolting through the bottom of the subflooring.

Treads are made by gluing random lengths of 2x4s together, cutting them into wedges and installing them with screws.

★★★

Teflon-S Makes The Cutting Great

More and more, manufacturers are making their yard and shop tools easier to use by adding this slippery coating. Here's what it means to you

By RICHARD SICKLER



THIS SEAL goes on products coated with Teflon-S

THOUGH HOUSEWIVES have long enjoyed the worksaving advantages of slick Teflon on kitchen utensils, the man of the house has had to wait awhile for a tougher version of this coating that would make his yard and workshop chores less arm-wearying. With Teflon-S on the scene, the waiting is over.

Like other Teflon finishes, the new product is a combination of complicated fluorocarbons (chemically called polytetrafluoroethylene). The similarity ends there however. The newer coating is extremely resistant to scratching and abrasion, and can be firmly bonded to its base metal. This makes it virtually impossible to remove through wear or misuse. Most major makers have al-



LABORATORY TECHNICIANS inspect and test applied Teflon-S. If it's not up to snuff for scratch resistance and adhesion, Du Pont withholds approval seal

ready added the slippery coating to one or more products in their lines. A quick check in a local hardware store will turn up such items as putty knives, pruning saws, axes, circular saw blades and hand and power tool bases (shoes) coated with the stuff.

And, though you may never be faced with the Bunyanesque cutting-chore of the lumberjack shown on the opposite page, you will find (as he did) that the performance of coated tools is a pleasant surprise when you're up against a job that calls for continuous arm use. With this finish added, the tools cut cleaner, don't bind or gum-up in wood, and the cutting edges stay sharp longer and resist rust better than uncoated edges. If you forget to clean a tool—or just don't have the time—immediately after using it, the tool will still be easy to clean days later.

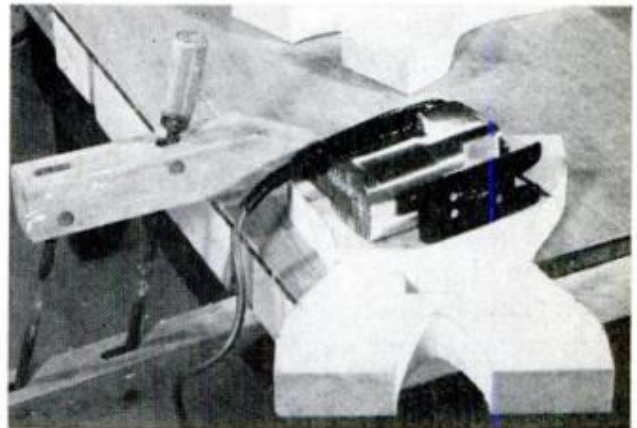
Here's a quick review of the claims made for Teflon-S:

Nonstick. Very few substances that you are likely to work with will stick to it. Glue, varnish, paint, stain, grease, oil and even sap can be wiped off.

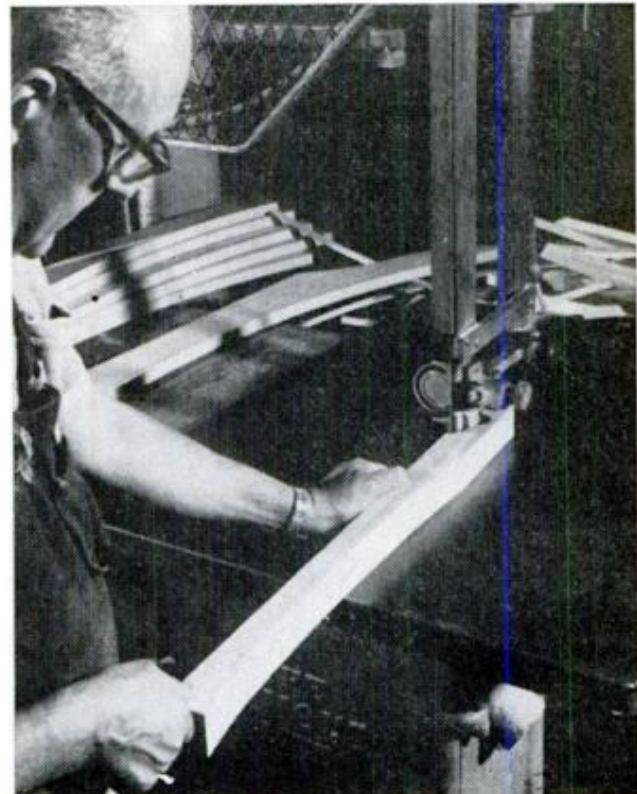
Nonwetting. Since the surface is self-lubricating it is not necessary to apply oil or other liquid preservatives to the tool. Thus time spent in wiping a saw blade, for example, before using it on a piece of clean pine is eliminated.

Heat-resistance. The coating will not deteriorate at the high temperatures built up by continuous friction (long run on a table saw). It continues to perform at temperatures exceeding 400°F.

Electrical properties. It has a high di-



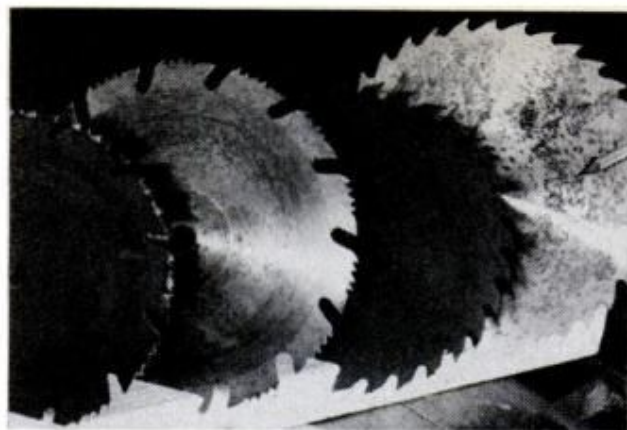
MOST MANUFACTURERS now offer at least one power tool featuring Teflon-S. Above, Stanley's sabre saw



BAND-SAW BLADES feed up to 50 percent faster, won't rust or gum up, require little or no cleaning



BOW SAWS coated with slick material don't bind, even in green wood. This 36-incher is by Disston



TWO UNCOATED BLADES show deterioration even though oiled for storage. Coated blades resist tar

electric strength, important on items where resistance to the conduction of electricity is a factor.

Basically, Teflon-S goes on about the same way as any other baked-on coating (paint or lacquer). The piece to be coated is cleaned and the finish sprayed on. The resin-type film is then cured by baking at temperatures up to 700°F.

This is a stratified finish, meaning that it is formed in layers on the surface it covers. The bottom layer penetrates into and firmly attaches itself to the substrate

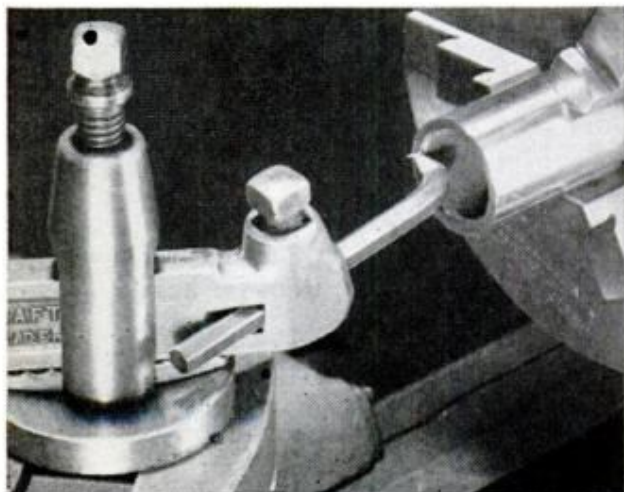
to give abrasion resistance. The top layer is pure Teflon which provides the non-stick feature that make tools easier to work with.

To insure that the coating is applied properly by the various manufacturers, Du Pont inspects all products on a regular basis. Should an unscrupulous manufacturer attempt to cheat on the covering, Du Pont inspectors withhold their stamp of approval, shown on page 164. So, if you buy any Teflon-coated tool, be sure it bears the Teflon-S tag. ★★★

HINTS FROM READERS

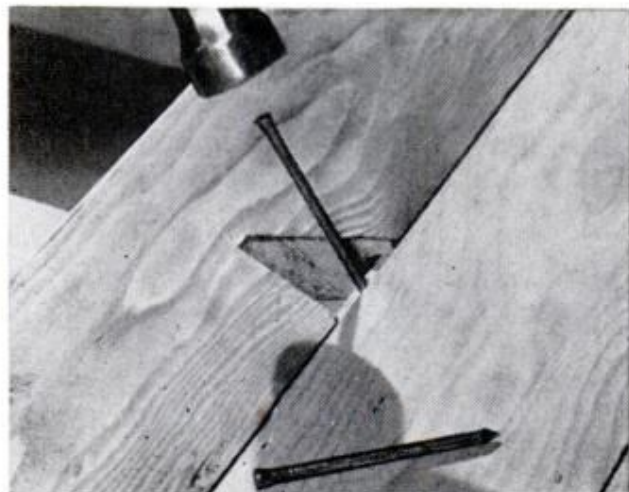
Shop-made boring bar

Lacking the right boring bar for turning a brass piece, I made what I needed from an Allen wrench. To do it, simply reduce the length of the shorter leg, then sharpen the leg correctly for the material it is to cut. Short length bars can be mounted in the tool-bit holder but longer bars must be bushed to fit the regular boring-bar holder.—*Peter Legon*



Notched board aids nailing

When laying a floor with tongue-and-groove flooring, you will often find it necessary to use a short length of scrap flooring material as a hammering aid to close joints tightly. But often, when you remove the scrap, the pushed-in flooring springs back out again. If you cut a large v-notch in the scrap for nail and hammer-head clearance, the pusher-board can be held in place until the nail is practically driven home.—*Ray Moore*



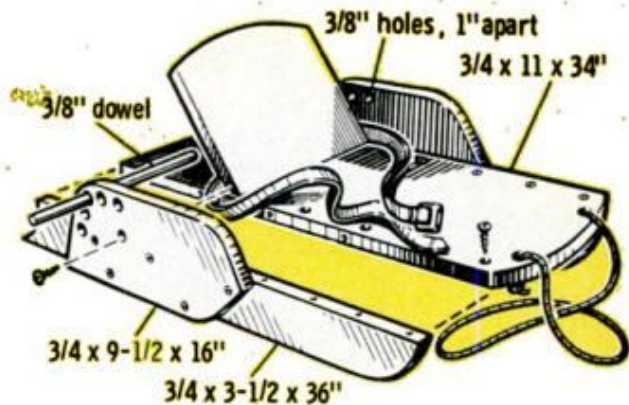
'Hammer and Saw' Sled for Junior Has Safety Belt



When our little guy was old enough for his first snow ride, we found you couldn't buy a sled in which you could strap him in. A regular sled just wouldn't do.

The quickie open sleigh you see here is one I made in about two hours from scrap boards I had in the basement. Best of all, you don't need a whole shop full of tools to make it; it's that simple.

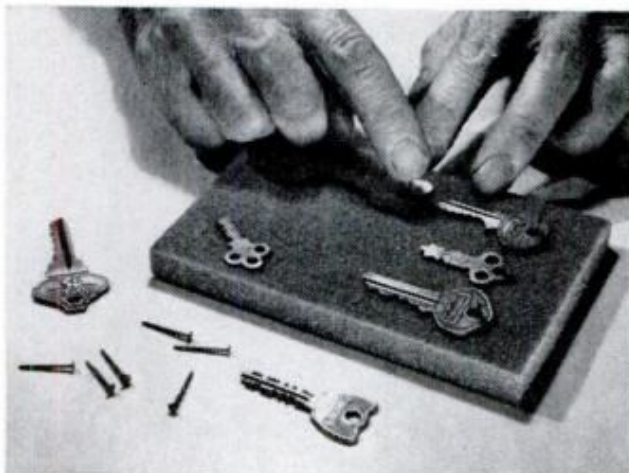
Start by making one side rail and use it as a pattern to mark and drill the other. Space the $\frac{3}{8}$ -in.-dowel holes about 1 in.



apart. Here the dowel is sanded a bit so it can be pulled out easily in switching from one hole to another.

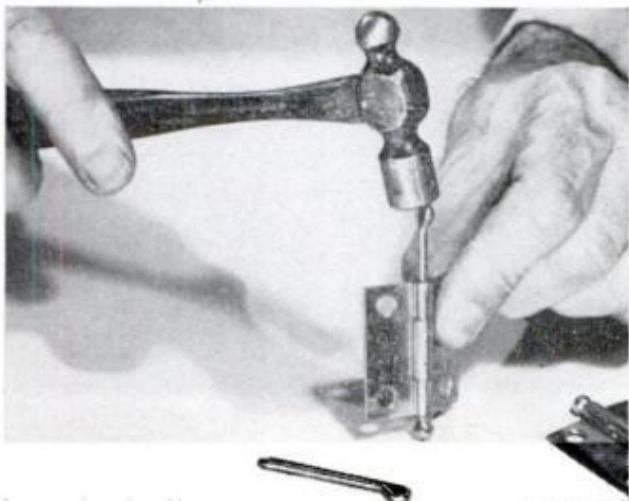
The two runners are rounded at both ends and are attached to the bottom board, even with the edge, with screws. Wax is all you'll need on the runners to keep the snow from sticking.

Two screws through the side rails pivot the tilting back. The bottom edge is beveled 45°. I used an old trouser belt for a seat belt. —Charles D. Burgess Jr.



Plastic foam speeds layout

When determining the best arrangement of pegs, nails or pins to hold a decorative collection on a permanent plaque, you'll find that plastic foam can save time and prevent wasted materials. Simply arrange the collection (keys shown) until satisfied with the design, then punch holes into the foam where nails will be required. Tape foam in place over the plaque and punch the holes through to scribe the marks where they're needed to hang the fixtures. —Walter E. Burton



Cotter pin becomes hinge pin

Often, when it's necessary to remove a door for planing or painting, one or both of the hinge pins manage to get lost. But, it is not always necessary to run to the hardware store for a new pair of hinges. Try substituting a cotter pin of approximately the same diameter and length as the wayward hinge pin. The cotter pin, which can be spread slightly if necessary for a snug fit, should be lightly coated with oil and simply pressed in or driven home with a hammer. —Walter E. Burton

Build This Tom Thumb Mini-Bike

This vest-pocket, 2-foot motorbike zips along at 11 mph. It's small enough to store in a school locker or a VW.

By GENE SCHATZLEIN

Technical Art by Fred Wolff



THOUGH it will never challenge its bigger, more powerful commercially produced cousins, this shop-built micromini-bike will get you where you want to go for peanuts. Putting along—powered by its $\frac{3}{4}$ -hp powerplant—the rig hits a racy 11 mph when flat out—more than enough to get you out on that backwoods jaunt or—with modification for street use—to class, football practice or part-time job with time to spare.

I used a $\frac{3}{4}$ -hp Olson and Rice engine (now manufactured as O&R) mounted on an $\frac{1}{8}$ -in. sheet of aluminum. The aluminum sheet in turn is attached to the frame with four $4\frac{1}{4}$ -in. U-bolts. (The bolts permit quick adjustment of the chain tension.) Depending upon the rider's bulk, the little bike may or may not take a steep hill. On occasion I've had to dismount and tote her up a hill under my arm.

The beauty of the bike is the practicality of its size. It gives me comfortable, efficient commutation to and from school, and there's no parking problem. I simply chain it to a parking meter or telephone pole.

To make it, you'll need at least 12 to 15 ft.



TO ILLUSTRATE SMALL SIZE, bike-builder Schatzlein is shown parking his mini-bike in school locker

of $\frac{5}{8}$ -in. thinwall tubing for the frame. Build the frame in two sections and, for strength, join them with $\frac{5}{8}$ -in. steel pins inserted in the tubing at the joints. Where the pins cannot be used, wrap steel bands around the frame and braze for added strength.

The brackets which support the rear wheel are bent into a U-shape, slipped into the frame and brazed. The handlebars are two pieces of the thinwall tubing joined in the middle with two pieces of metal $\frac{1}{8}$ x $1\frac{1}{2}$ x 5 in. spaced $3\frac{1}{4}$ in. apart. The latter are drilled out at center to receive the $\frac{5}{8}$ x $4\frac{1}{2}$ -in. bolt which serves as the turning spindle. To receive the front axle, the ends of the forks are flattened and drilled. To complete the front fork, bend the upper portions to form the handlebars. For leg clearance, bend forks slightly forward.

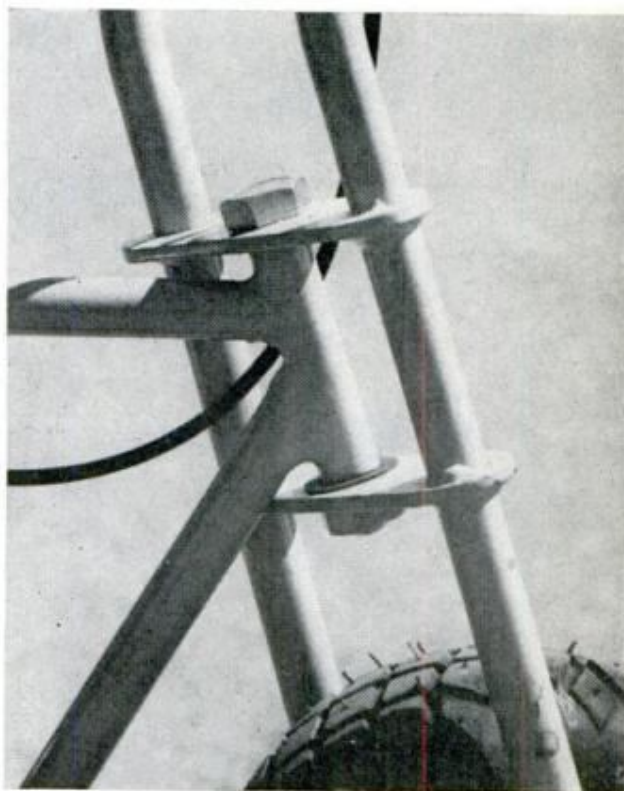
I used a Fairbanks-Morse centrifugal clutch with an inside diameter of $\frac{1}{2}$ in. Thus, I had to use a $\frac{5}{8}$ -in. adapter to install the clutch on the engine.

The drive is provided by a No. 35 link chain. The engine sprocket has 11 teeth geared to the large sprocket on the 36-tooth jackshaft. Turning on the other end of the jackshaft is a 10-tooth sprocket geared to the 60-tooth sprocket on the rear wheel. This setup makes up a 20-to-1 gear ratio.

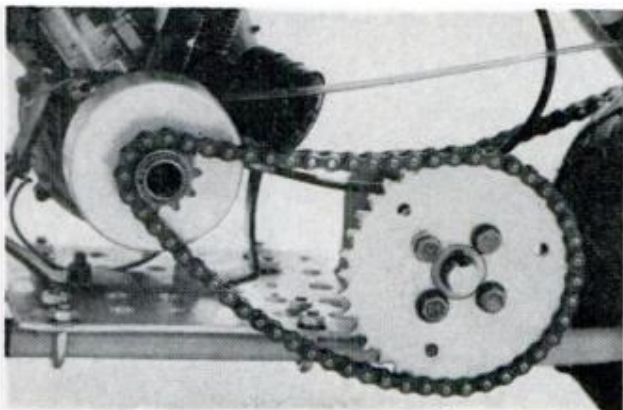
The baby-carriage-size wheels are four-inchers fitted with pneumatic tires and $\frac{1}{2}$ -in. bearings. Mount the gas tank on the frame stiffener—the piece of $\frac{1}{2}$ -in. flat-iron across the frame just behind the seat. Use two $3\frac{1}{2}$ -in. stainless steel hose clamps to hold it secure. The seat on the bike shown was bought ready-made and fastened to the frame with four screws turned up through the metal bike-frame into its wooden base. The throttle control (and the cable) were fabricated from



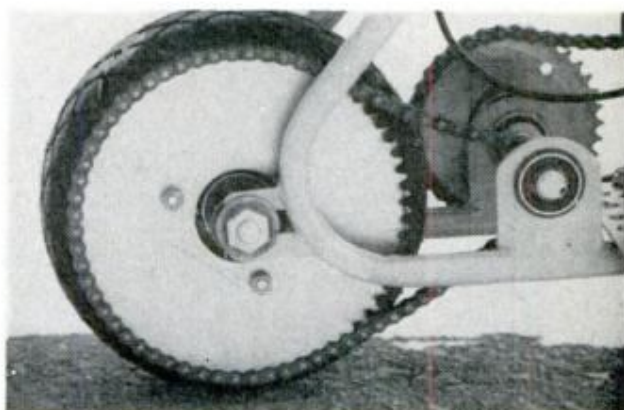
BIKE IS EASILY HEFTED into Volkswagen trunk for hauling to Sunday meet of local mini-bike enthusiasts



TURNING SPINDLE is a $\frac{5}{8}$ x $4\frac{1}{2}$ -in. machine bolt through frame, on which two-piece handlebars turn

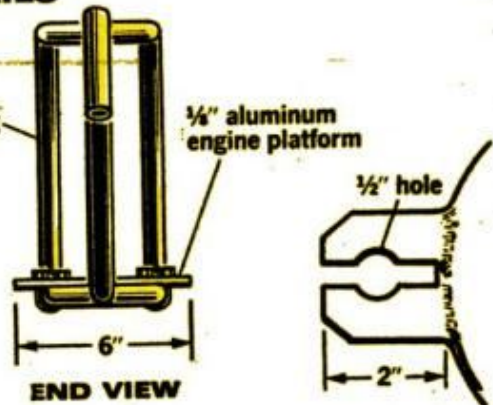
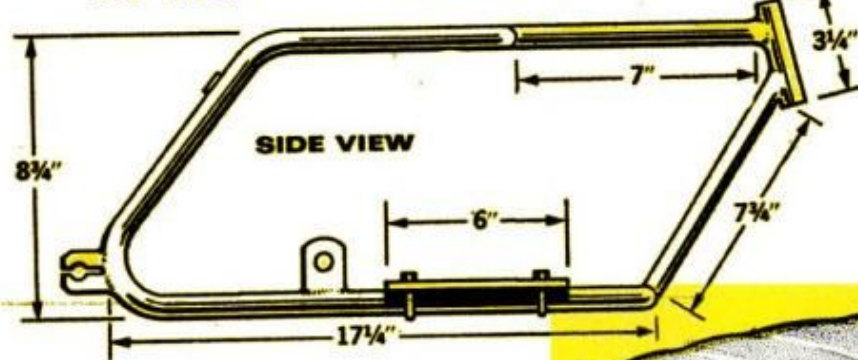
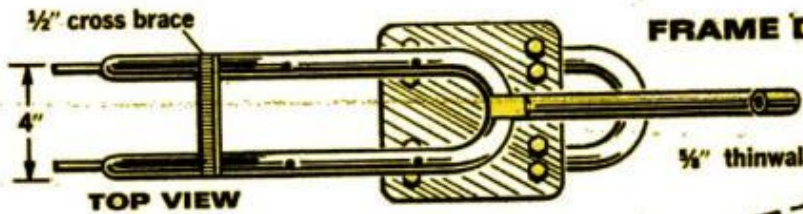


SPROCKETS ARE SET up to provide 20 to 1 gear ratio. All parts for the bike shown were purchased locally

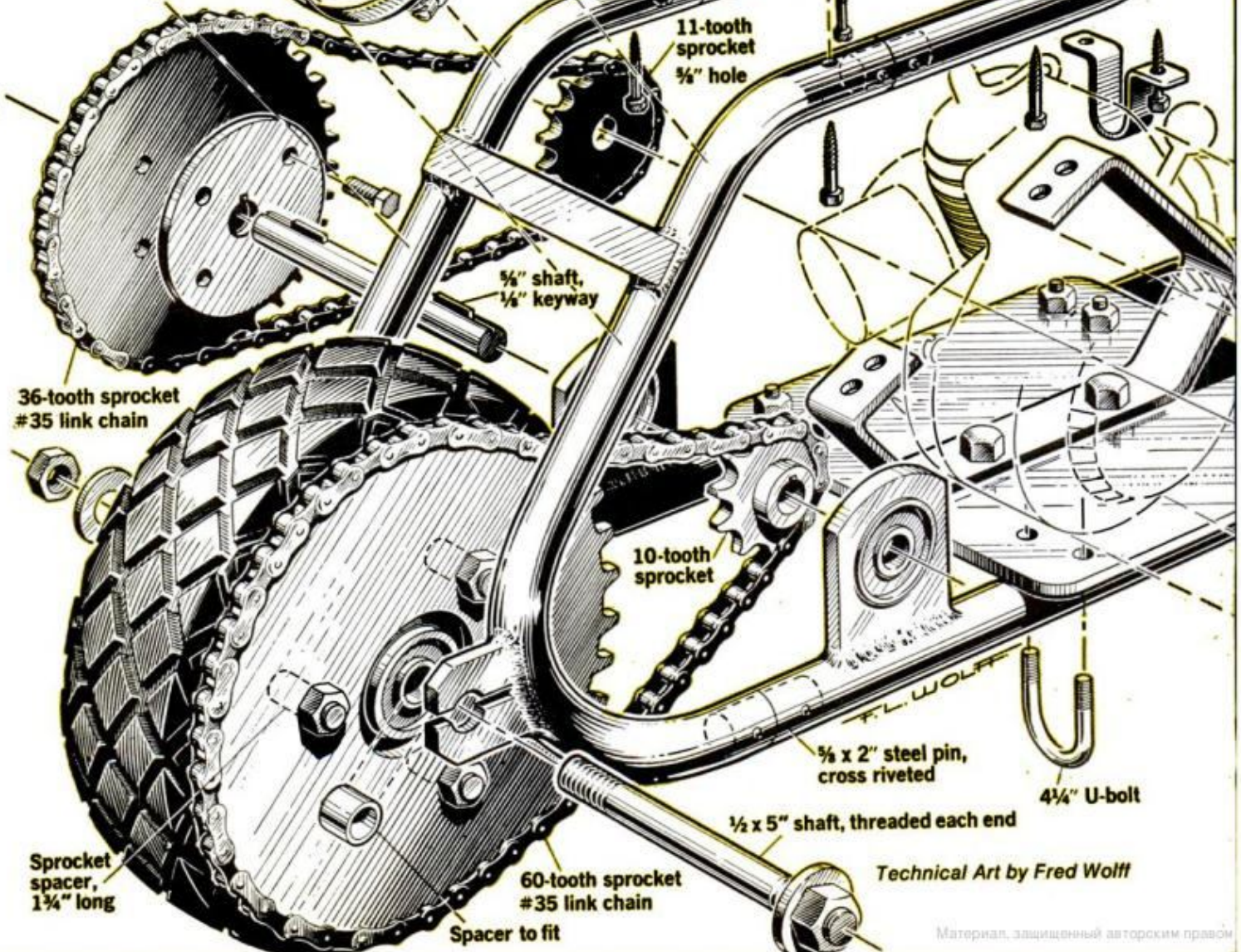


FITTINGS THAT HOLD REAR AXLE are bent into U-shape, then brazed onto frame for added strength

FRAME DETAILS



Ready-made seat



MICRO MINI-BIKE

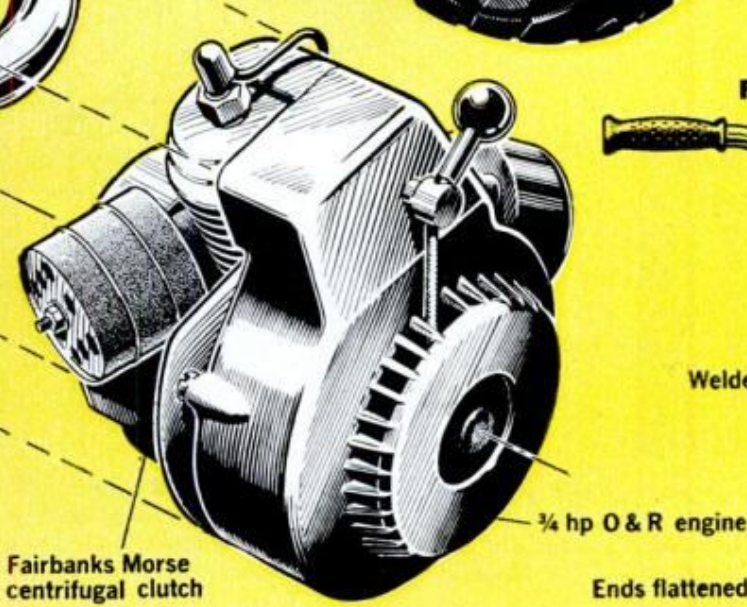
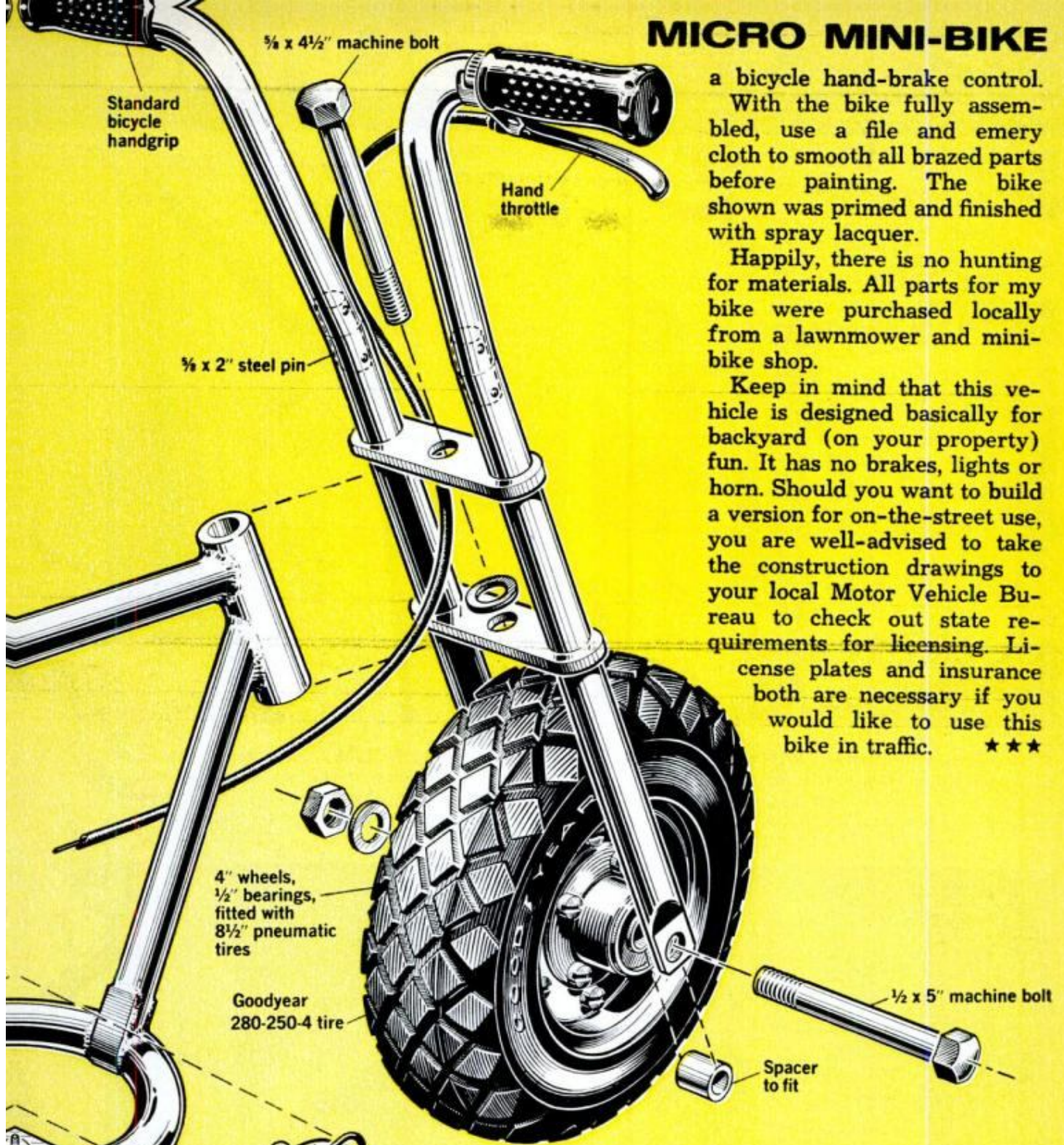
a bicycle hand-brake control.

With the bike fully assembled, use a file and emery cloth to smooth all brazed parts before painting. The bike shown was primed and finished with spray lacquer.

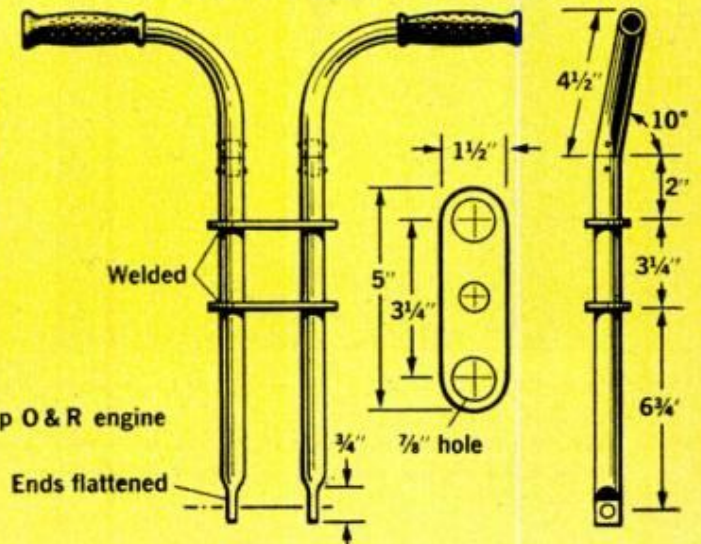
Happily, there is no hunting for materials. All parts for my bike were purchased locally from a lawnmower and mini-bike shop.

Keep in mind that this vehicle is designed basically for backyard (on your property) fun. It has no brakes, lights or horn. Should you want to build a version for on-the-street use, you are well-advised to take the construction drawings to your local Motor Vehicle Bureau to check out state requirements for licensing.

License plates and insurance both are necessary if you would like to use this bike in traffic. ★★★



FRONT FORK DETAILS

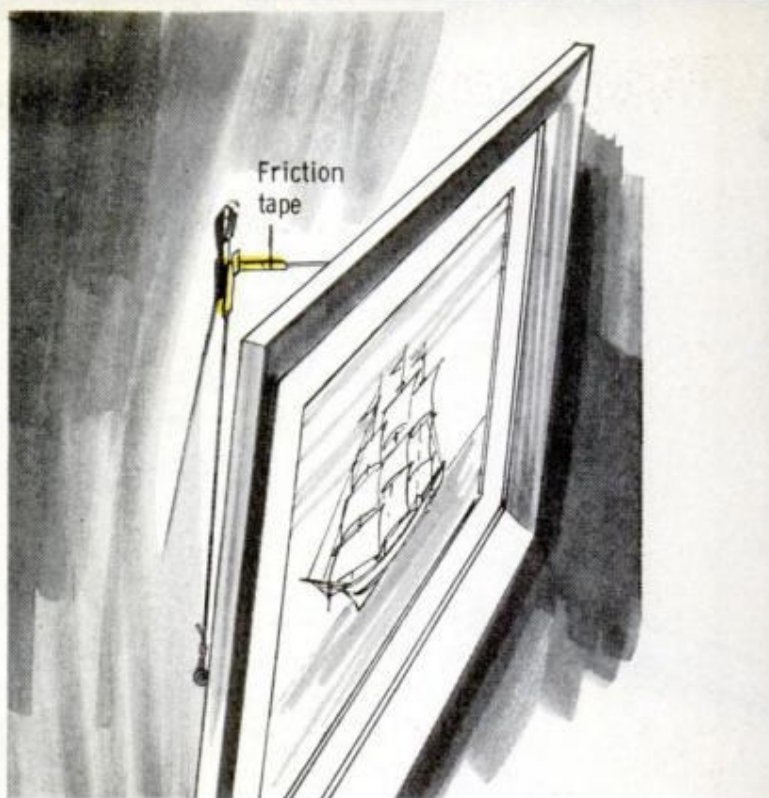




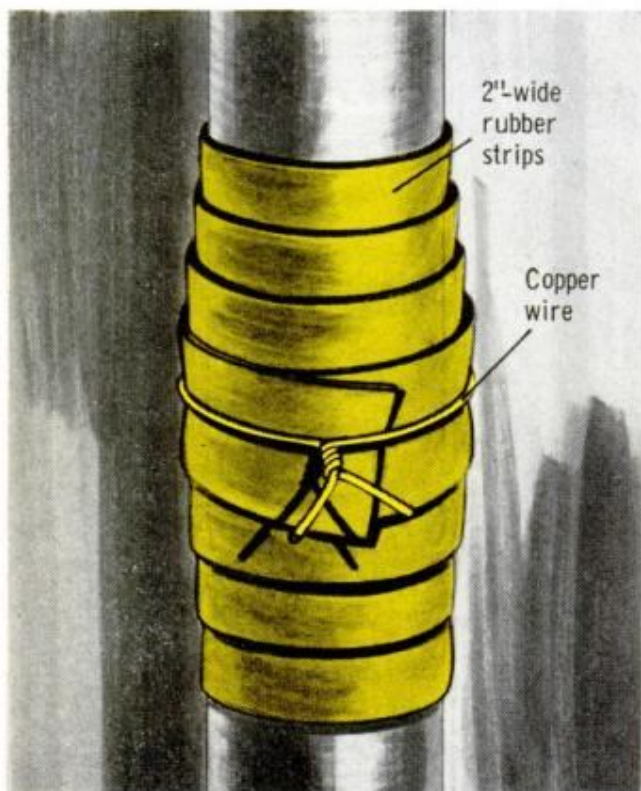
SOLVING



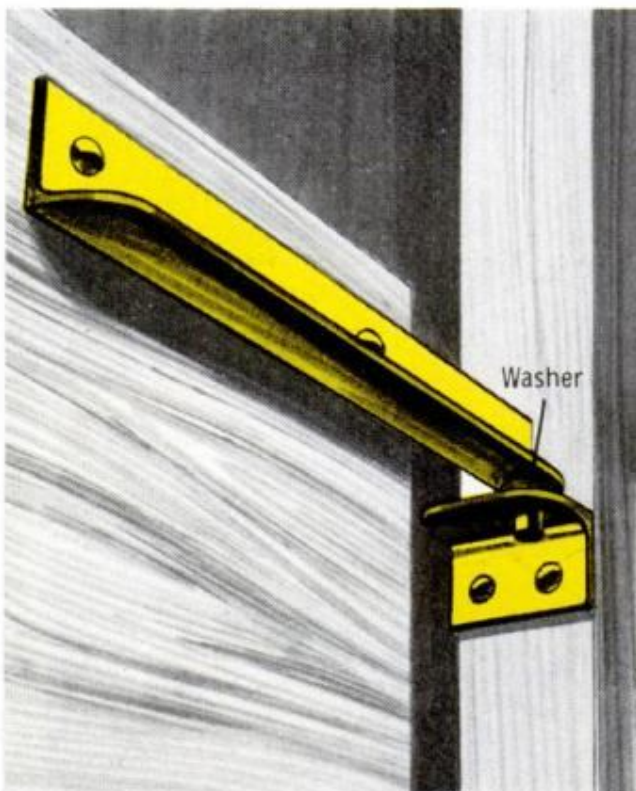
QUICK AND CONVENIENT WAY to collect and dispose of sawdust from the top of your workbench is to tape a large plastic leaf bag to the end. Debris is brushed right into the bag.—*Eugene E. Florida*



KEEPING A LONG PICTURE from hanging crooked on its hook is no problem if you wrap the wire with a bit of friction tape where it passes over the hook. The sticky surface does the trick.—*Victor H. Lamoy*



YOU CAN STOP A LEAK in a pipe in an emergency by wrapping it with a 3-ft. length of inner tube, 1 in. wide. Stretch it as you wrap and lap it as you go. Finally, bind tightly with wire.—*Joseph S. Moore*



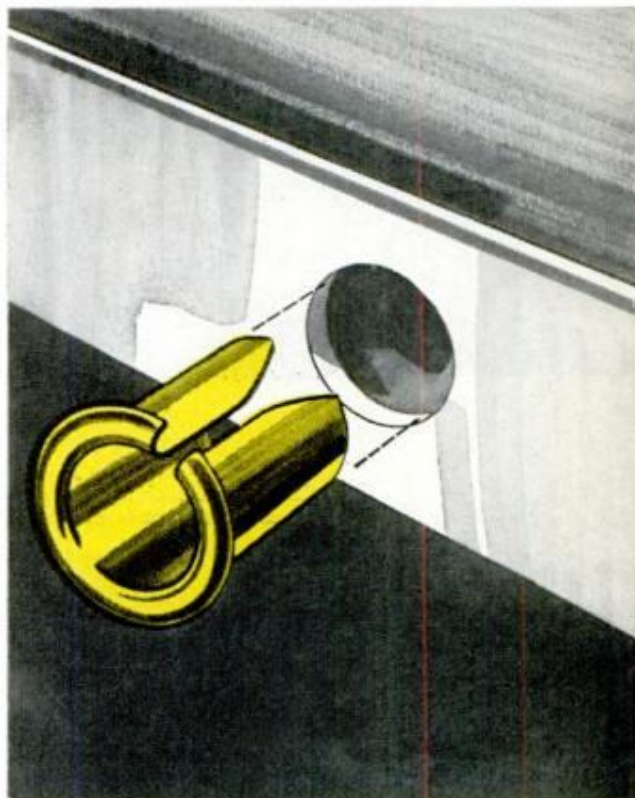
AN EXCEPTIONALLY STRONG HINGE for a heavy shed door can be made from two pieces of angle iron, a pin and brass washer. The long leaf is bolted to door and supported by a short bracket.—*Anton M. Barkey*

HOME PROBLEMS

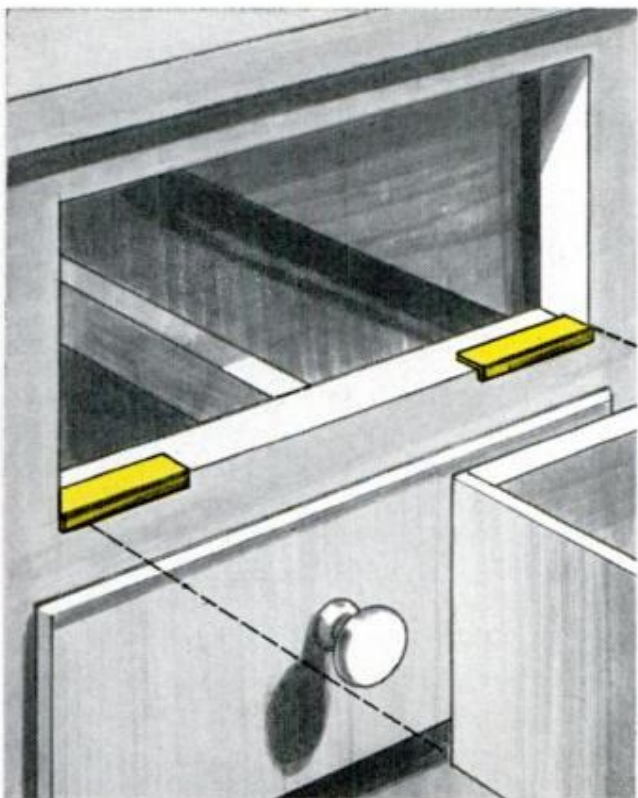
Illustrations by Adolph Brotman, Worman Associates



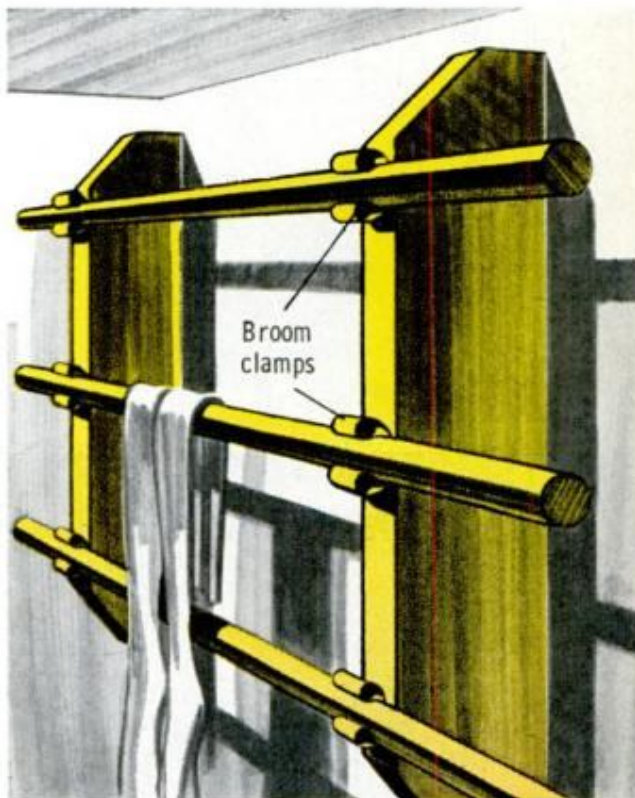
YOU'LL HAVE STORAGE GALORE for countless cans of paint, jars and other items if you nail 1x12 boards to the bottom edges of the ceiling joists in the basement. Skip every other joist for easy access.—*J. L. Pangle*



WHEN YOU ARE LOOKING for something to insulate the hole in a metal box and a regular rubber grommet is not at hand, you'll find that a BX-cable bushing will provide a perfect substitute.—*Joseph Braunstein*



HEAVILY LADEN DRAWERS will slide more easily if you provide pieces of plastic bleach bottle at the front corners of the drawer openings. Heat pieces, form 1/4-in. lips, and cement in place.—*J. Van Eerde*



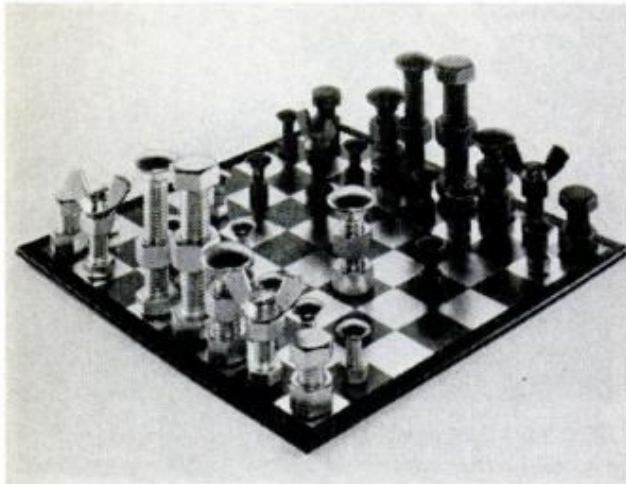
YOUR WIFE WILL FIND this wall rack extra handy for finish-drying items from the clothes dryer. It consists of 1-in. dowels which are held by broom clamps attached to vertical pieces of 2x4.—*G. Woods*



HINTS FROM READERS

Thinking ahead saves mess

I have found it's almost a sure bet that whenever I start a job that will get my hands messy (such as painting), the telephone will ring. And, by the time I get my hands sufficiently clean to handle the phone, all I get is a dialtone. To avoid this frustration, I now keep several napkins by the phone for quick handling without mess.—*William Swallow*



Easy-to-make chess set

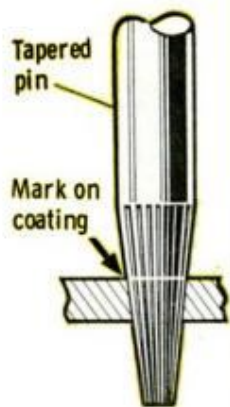
Wanting an out-of-the ordinary chess set, I decided to make my own. The set shown, using chrome nuts and bolts for one army and brass for the other, will become a conversation piece for any rec room. You can also dream up your own designs. The playing board is hardboard spray-enameled black, with silver squares of Arno aluminum tape affixed.

—*Mike Marlow*

Measuring small-hole diameter

Using an outside micrometer, diameters of both large and small holes can be measured accurately and quickly by this method. Simply coat a tapered rod with smoke from a candle and place it in the hole to be measured. Give the pin a slight turn to mark the coated surface, remove and measure with an outside micrometer.

—*Charles Haberman*



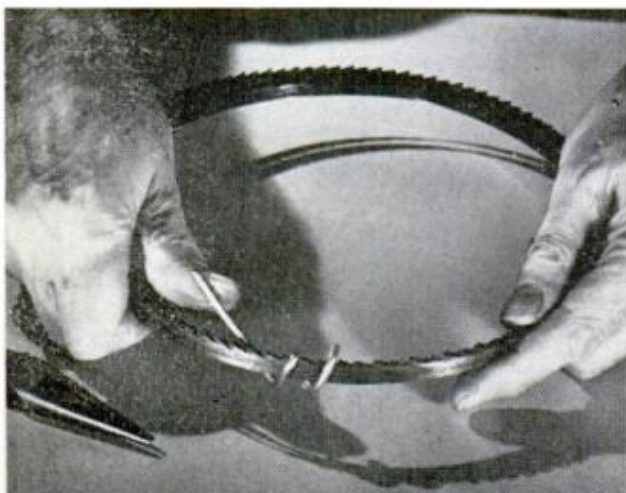
Can opener aids caulking

While repairing my boat I found that an ordinary can opener is an efficient tool for forcing fiberglass putty into small, tight seams. Used right side up, the sharp point easily ploughs a small V-groove to receive the putty. The slightly curved triangular point can then be used to force the caulking into the seam for a water-proof seal.—*Lewis C. Van Huben*

Storing bandsaw blades

Bandsaw blades are sold in coiled form and they are best stored that way. One method of holding them safely in a coil is to wrap wire solder around one end of the loop. Such soft "wire" grips the blade more securely than hard wire, yet it will not dull the steel teeth of the saw.

—*Wilfred Beaver*



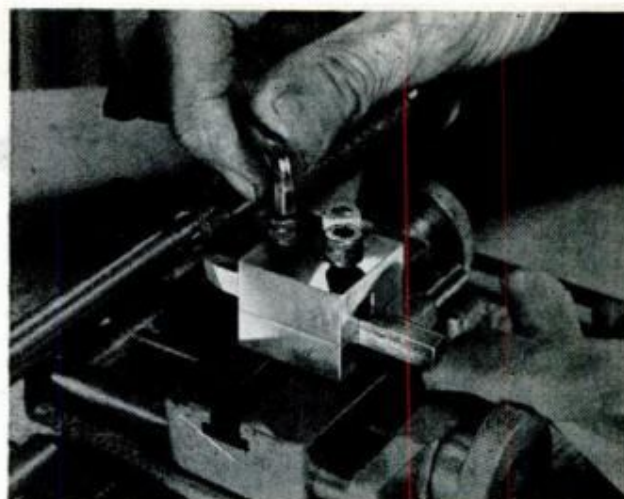
Adjustable Toolholder for Your Unimat

YOU CAN INCREASE the versatility of your American Edelstaal Unimat by customizing a toolholder so that the height of the cutting end of the tool bit can be adjusted up or down.

Though the toolholder shown does just that, it does not totally replace the standard toolholder. The latter still does the best job when you are turning work close to the faceplate or chuck.

To make it, start by cutting the clamp and base blocks to size. On the base, scribe the centerlines and sides of the keyslot and center-punch the hole centers and sides of the slot. Finally, punch the outline of the slot on both ends. On the clamp block, only the outline of the keyslot need be marked out.

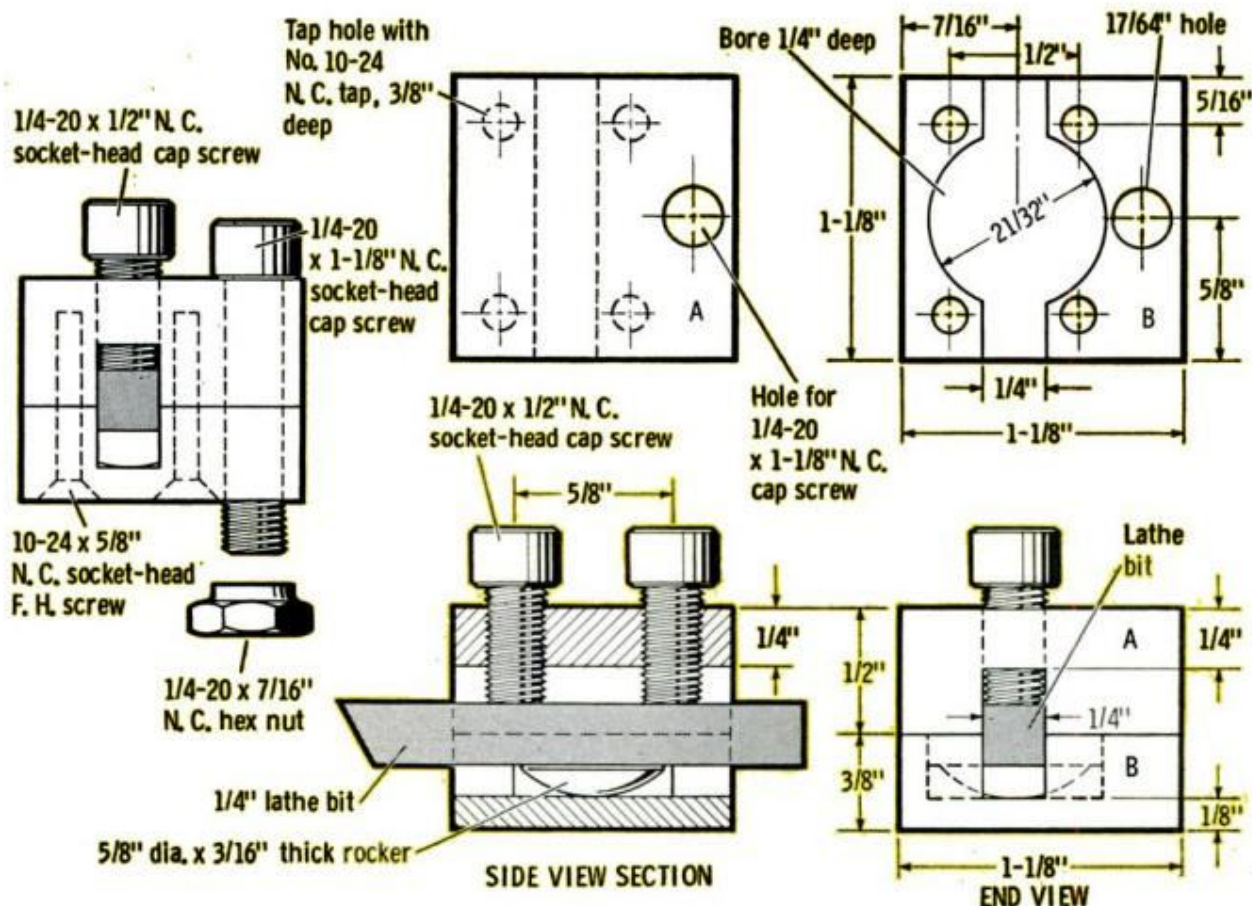
Mount the headstock of the Unimat in a vertical position for drilling with a 1/4-in. endmill. With the milling table on the cross-slide, clamp the two blocks (making certain that sides are in line and parallel) in position with the keyslots lined up and parallel with the lead-screw travel. Mill through both blocks to a depth of 1/4 in. Remove the clamp block and continue to mill the slot in the base block another 1/8



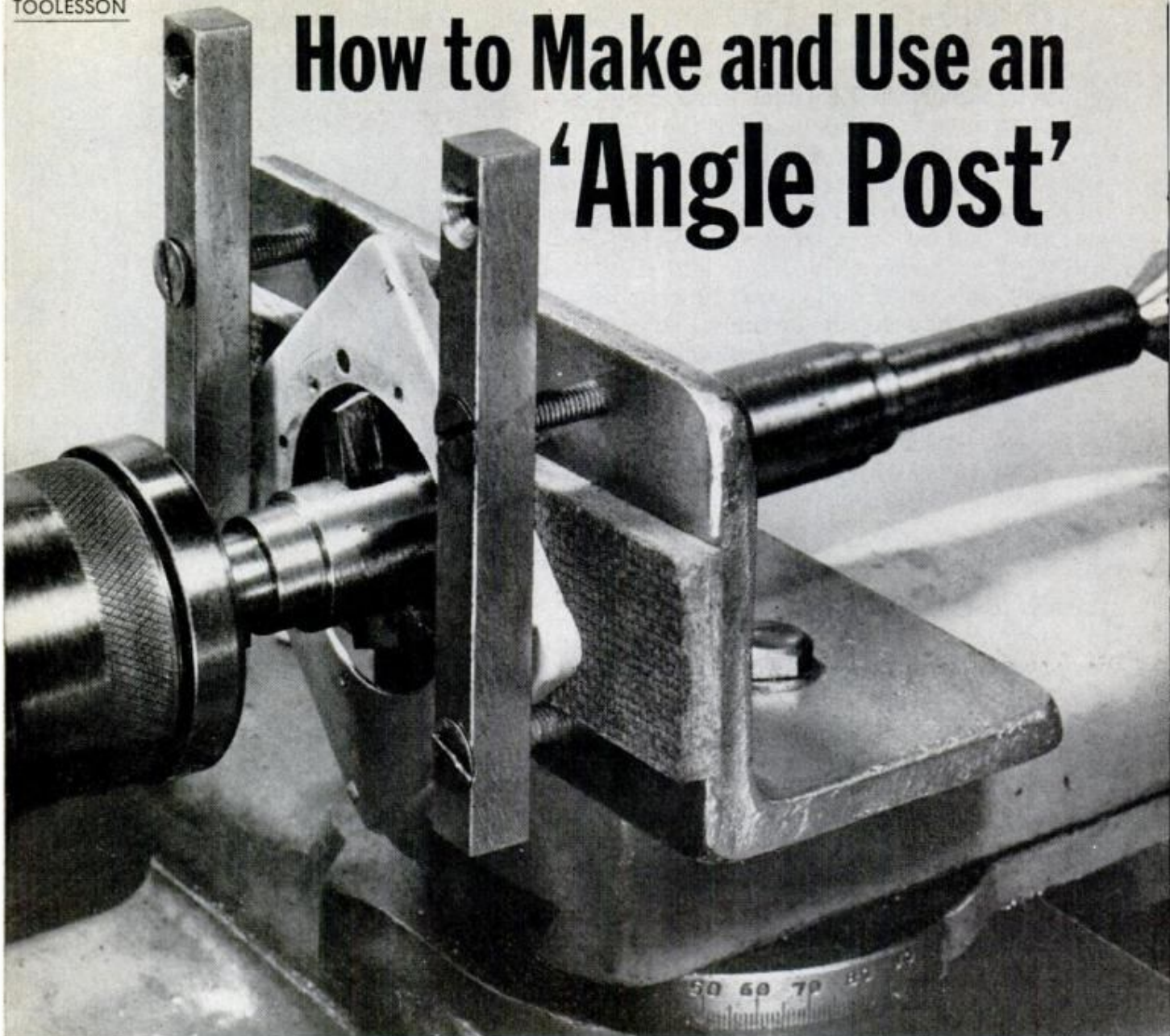
in. After drilling and countersinking the five holes in the base block, use it to lay out the holes on the clamp block.

To make the "rocker," chuck a thick 5/8-in. washer, and face one surface perfectly flat. Reverse the washer and chuck the piece with as much material as possible protruding from the chuck face. Turn the headstock to approximately a 10° position (with the lead screw travel) and face the washer to a flat cone profile. Then use a file to trim the face to a spherical profile.

—Gilbert H. Hannon



How to Make and Use an 'Angle Post'



It's an apt name for a useful gadget that replaces the regular toolpost on your lathe.

By WALTER E. BURTON

ANGLE POSTS have been around for years and are used in many ways, including the supporting of work on various machine tools other than lathes. Though you could clamp a lathe tool to it and do conventional turning, a lathe angle post is basically useful as a sort of "poor man's" milling attachment.

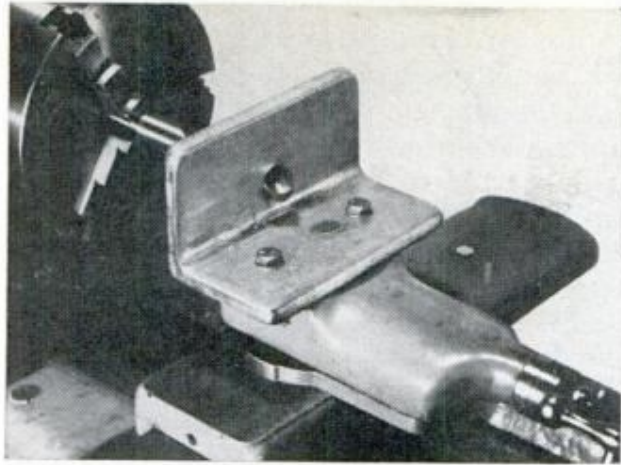
In this capacity it serves as a holder for the work being machined. It lets you use precision horizontal movement controlled by the cross-feed screw and micrometer collar of the compound. But it does not provide similar vertical feed. To achieve vertical or some types of angular control, you'll find that it will be necessary to

shift the workpiece on the angle holder.

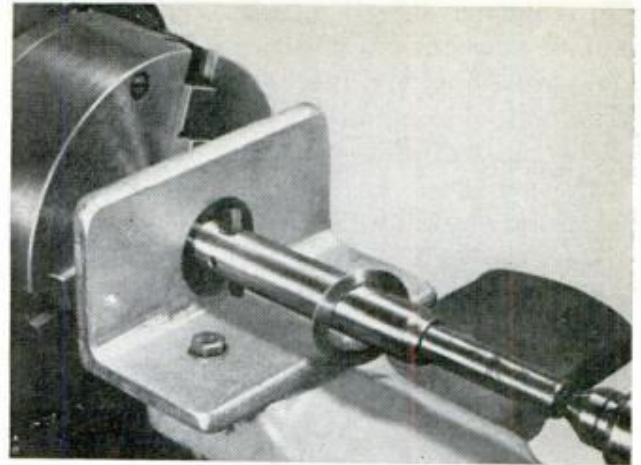
If your lathe is equipped with an angle post you'll be able to drill precisely spaced holes in a straight line, drill and bore large holes with a small lathe, ream holes to precise diameters, do various kinds of end milling such as the machining of slots in flat bar stock, tubes and cylinders, cut openings in sheet material with hole saws, and form Woodruff and other types of keyseats.

One leg of the steel angle shown is drilled for bolts that clamp it to the toolpost. The holes are positioned so the vertical face of the piece is flush with the end of the compound slide—a help when

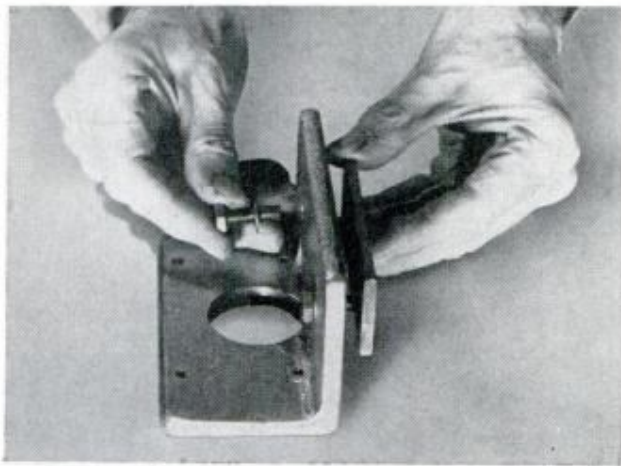
HOW TO MAKE AN ANGLE POST



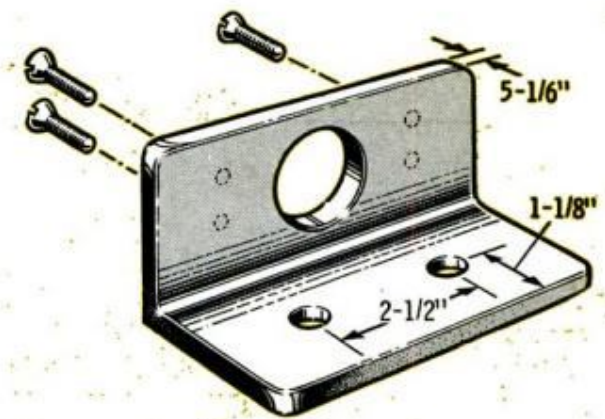
WITH CENTER DRILL mounted in chuck, move the cross slide until drill is centered on angle. Make a starting hole, then drill $\frac{3}{4}$ -in. hole through



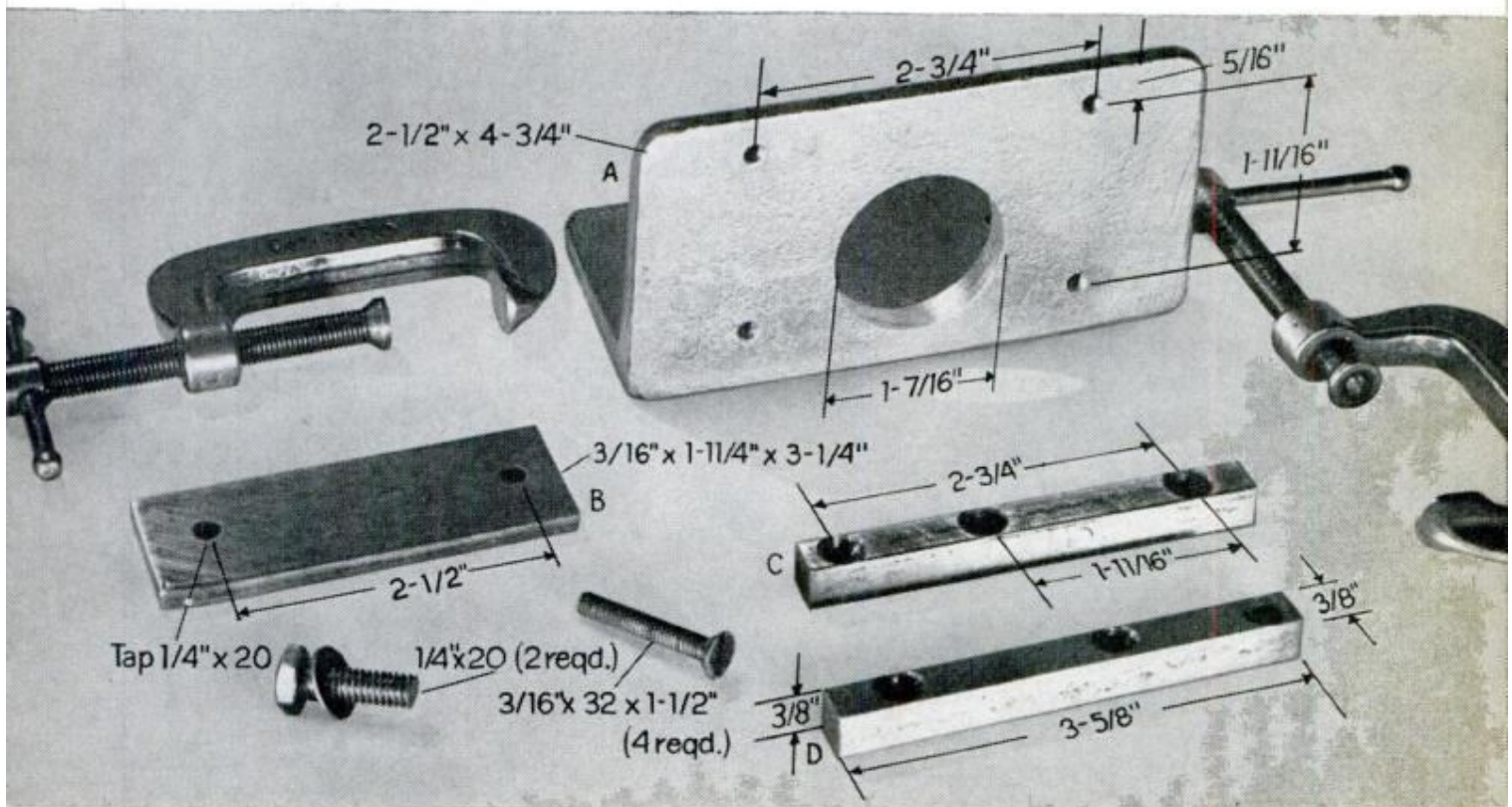
SINGLE CUT with between-center boring bar enlarges hole to about $1\frac{1}{2}$ in. The ring is typical by-product, results as the hole-cut is being completed



BAR AT RIGHT fits in toolpost slot. The two bolts engaging it pass through holes in angle base to anchor piece securely to compound slide



ESSENTIAL PARTS of a typical angle post (below). Dimensions indicated, are for use on a 9-in. South Bend lathe. Rear view of part A is sketched above



mounting long pieces vertically. Use of two bolts will lessen interference with the central opening in the vertical leg. For some work, where interference is unlikely and the compound is angle-operated, it might be desirable to add a central hole so the piece can be secured with a single bolt at an angle to the toolpost slot.

Start by drilling the large hole in the angle. With the piece firmly anchored, swing the compound slide until the face of the vertical leg is at right angles to the lathe axis. Mount a center drill in the headstock-spindle chuck, and move the cross slide until the drill contacts the angle piece halfway between its ends. Make a starting hole, enlarge it, and bore it to a diameter as large as the distance of the angle-piece bottom from the lathe center line permits.

While a lot of work can be mounted on the angle-post piece with C-clamps, it is convenient to provide a pair of clamping bars. (Parts C and D, photo.) These are square or rectangular steel bars having holes to receive screws that engage tapped holes in the face of the angle post. Screws may have any type head, but hex-heads are easier to manipulate. The four holes shown are spaced so bars can be used vertically or horizontally; more holes can be drilled and tapped to suit a particular job. Though bolt length can be whatever is needed, 1½ in. will cover a wide range of work thicknesses.

Typical angle-post operations

To drill a straight row of precision holes, mount the workpiece so the line along which holes are to be positioned coincides with lathe center line. Scribing a center-line position on the angle post as a guide is helpful. Clamp a sharp-pointed tool in the headstock chuck, bring it against the angle and operate the cross-feed screw to "draw" the line.

With the workpiece positioned, use the cross-feed micrometer collar to control hole spacing. Use a center drill to spot a hole, then switch to a twist drill. If the series of holes is longer than the diameter of the angle-post opening, use a piece of scrap metal, hardboard or plywood as a backing between work and angle piece. Then feed the drill only far enough to penetrate the workpiece.

To drill, bore or ream large holes, first drill a starting hole. Then enlarge it with

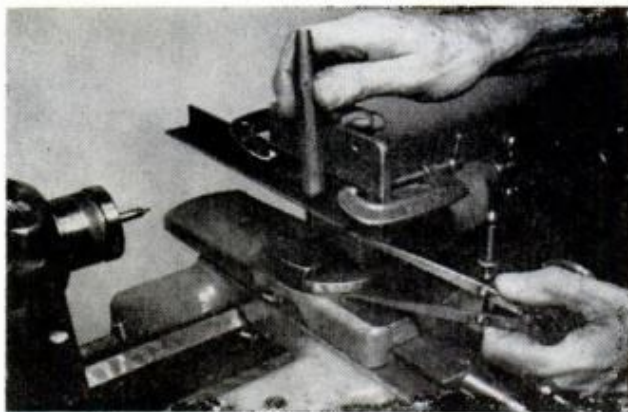
larger drills to finished size or to a size that allows the body of a between-centers boring bar to pass through.

If the finished size of the bore is greater than the diameter of the angle-post opening, mount the work about ½ in. from the angle-post face by using hardboard or similar material, and then bore only as far as this spacer. When using a double-point boring-bar cutter to increase the hole diameter considerably in a single pass, it may be desirable to provide an opening in the spacing material for release of the final ring of metal which is often produced.

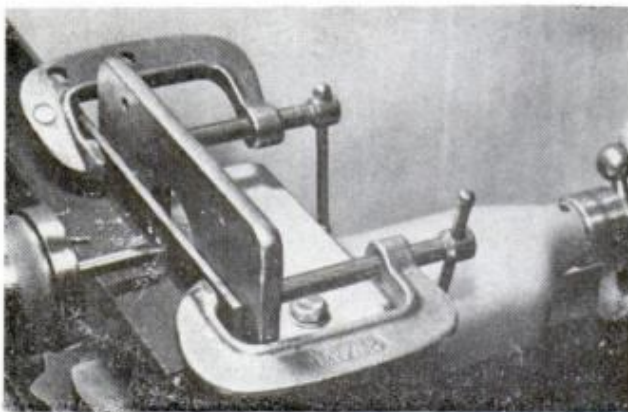
A single-point boring tool may tend to push the workpiece out of line. If there is play in the cross slide, as from a worn cross-feed nut, the tool—especially if taking sizable bites—it may cause the work to oscillate like a connecting rod in an engine. To discourage this, tighten cross-slide gib screws: Loosen them after boring is finished.

• *Milling slots.* An end mill in a headstock

HOW TO USE



ADJUSTING HEIGHT of workpiece in which a series of holes will be drilled. Reference surface for calipers is machined top of cross slide; use punch to tap piece



CENTER DRILL in collect chuck spots precise holes along horizontal line of workpiece. Here, C-clamps which hold piece were preferable to clamp bars

POPULAR MECHANICS

chuck will make a straight cut in a workpiece controlled by cross-slide movement. Keyways and other slots are thus readily formed. With end, shell, angular and other types of chuckable milling cutters, you can square, chamfer, bevel or round edges; smooth the face of a workpiece, cut Woodruff keyseats, machine projecting rivet ends flush with a surface, and more.

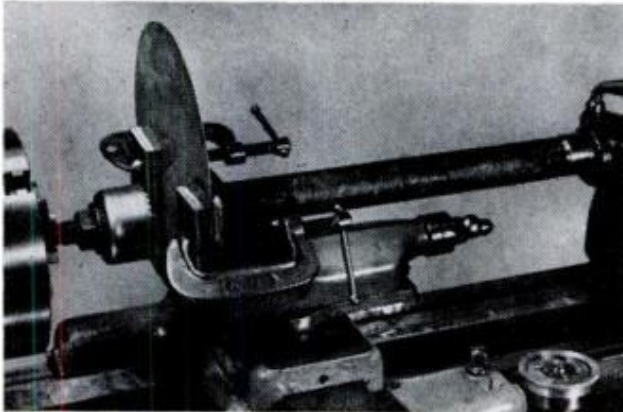
When the job (such as face milling) involves an area greater than the cut width made in a single pass, the workpiece can be shifted up or down between passes. In making such shifts where precision with respect to total cut width is required, the flat, top surface of the cross slide can be used as a reference surface for measuring with calipers.

● *Sawing holes.* A hole saw with pilot drill is simply clamped in a headstock chuck and the work is fed against it. A hole saw, particularly one of large diameter, should not be run too fast. Back off the work frequently and clean the saw with a stiff brush.

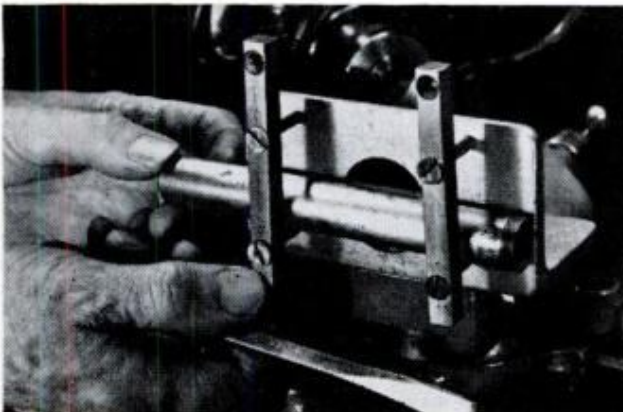
● *Feeding hint.* Some operations (making a hole with a large-diameter drill for example) require considerable pressure. This pressure tends to tilt the angle post and put stress on the carriage. A trick that makes the tailstock do much of the feeding—thus relieving the carriage-feed mechanism and angle post of stress—is to place a piece of pipe between the tailstock spindle and the angle plate. A center projecting into the pipe holds one end against the tailstock spindle while the other bears against a wooden block bridging the opening. The tailstock handwheel is used to apply feed pressure, while the carriage wheel is operated chiefly to ease the carriage along in step with tailstock spindle movement.

These are only a few of the ways in which a simple angle attachment mounted on a lathe carriage can magnify the abilities of an already versatile tool. The next time a tricky job comes up in your workshop, perhaps an "angle-post" will be the most convenient way of doing it. ★★★

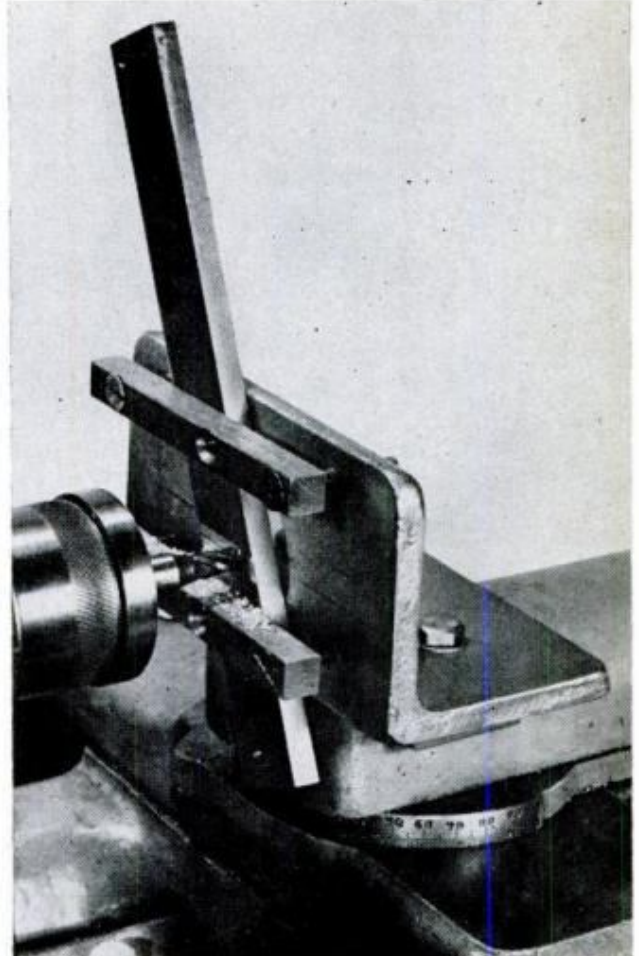
THE ANGLE POST



HOLE SAW is used to cut opening in sheet-aluminum disc backed up by hardboard. Setup shows how the tailstock spindle, through pipe, provides push



CLAMPING BARS hold steel tube in which a longitudinal slot is milled. Shallow 90° notches on inside surfaces make it easier to align such pieces



POSITIONED HORIZONTALLY, clamping bars hold long pieces nearly vertical. Here, a diagonal slot is shown being milled in a ¼ x 1-in. bar

HINTS FROM READERS

Put lost space to use

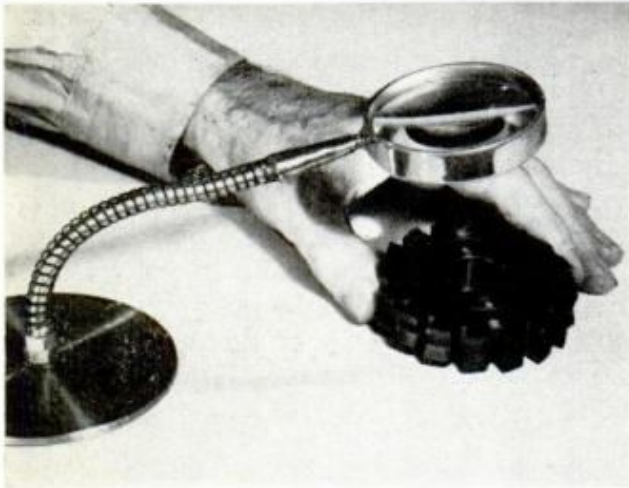
Just about every workbench has a top that cantilevers (overhangs) the legs at both ends. Instead of letting that space go to waste, you can add shelves below with vertical "walls" to keep sawdust off the tools that are stored there. The shelves can be built from benchtop to floor, or just enough of them can be added to store the portable power tools you own.



Flexible spout holds magnifier

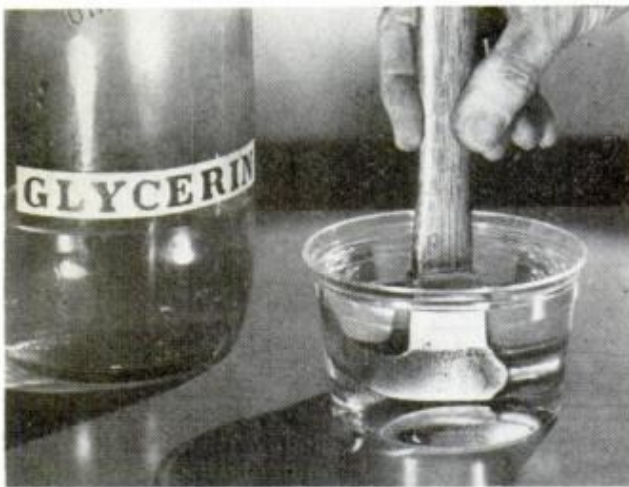
You can make an adjustable arm for a magnifying glass from a flexible oil-can spout. To do it, either weight the can with sand, or mount it on a metal disc as shown. After cutting off the tip, thread the end to accept the stud of the lens, then thread the other end to fit a 1/4-20 bolt extending through the disc.

—Walter E. Burton



Cure for 'sick' hammer handle

When a hammer handle becomes loose, a quick soaking in water will swell it enough to let you finish the job at hand. But, to tighten the handle permanently, try immersing the hammerhead and part of the handle in glycerine overnight. Be sure to protect eyes and skin, and make certain children cannot possibly get near the stuff.—Hi Sibley



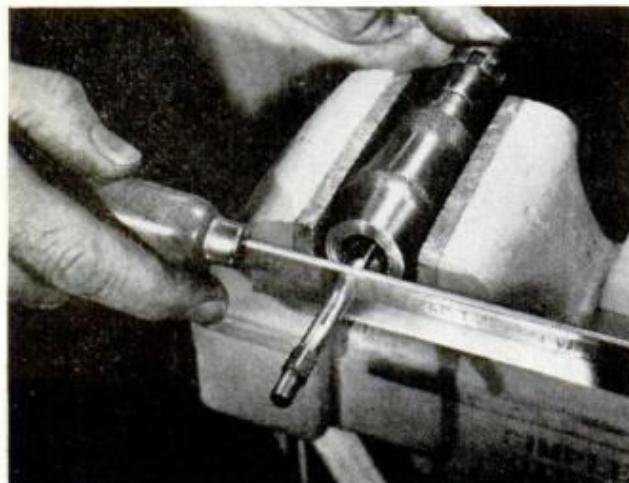
Tape tunes out carrier hum

Annoying hum from metal cartop carriers can be eliminated by using this trick. With the carriers mounted on the car, locate the points which vibrate most by tapping each bar with a screwdriver. As you pinpoint each spot, wrap it with electrician's tape. Usually, two or three bands of tape on each bar will quiet the noisiest hum.—David Munroe

Brace protects tubing

If you have ever had to cut a length of soft tubing, you know that your biggest worry is that you will crush the material. Next time you're faced with this task, try chucking one end of the tubing in an auger brace. The brace can then be held in a vise and you will have both hands free to do a neat, damageproof job.

—Wilfred Beaver

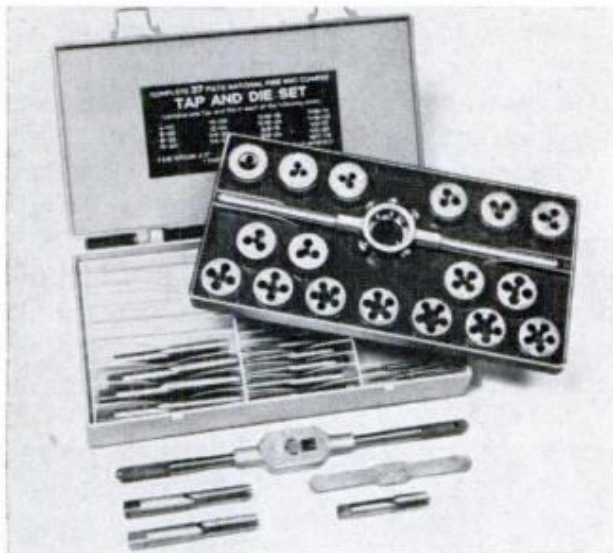


New tools you should know about



Clogged-drain cleaner

This easy-to-use snake for clearing clogged drains features a flexible plastic, friction-free casing for its high-tensile-strength music-wire core. Power Rooter, in 6, 10, 15 and 25-ft. lengths, fits any electric drill, costs \$4.50 to \$10.95. Melard Manufacturing Corp., 2901 White Plains Rd., Bronx, N.Y. 10467 makes it.



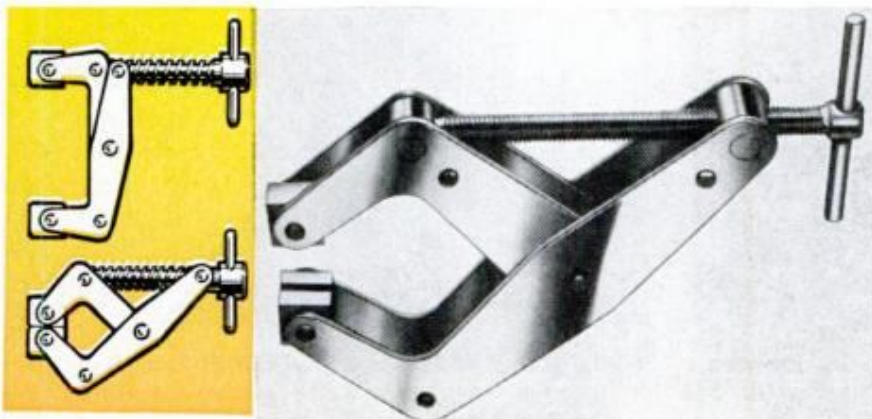
Tap and die sets

Claimed to be of highest-quality-alloy tool steel, three tap-and-die sets offer one-piece construction with 1-in. diameters. They are DT 12 (National coarse), 12 pieces; DT 24 (National fine and coarse), 24 pieces, and DT 37 (N.F. and C.), 37 pieces. Great Neck Saw Manufacturers, Mineola, N.Y. \$12 up.



Low-cost router

Rated at $\frac{1}{3}$ hp, Skil's latest low-price router will accept routing bits through $\frac{1}{4}$ -in. size. Model 548, 6 in. high, is powered by a 3.7-amp. motor operating at 25,000 rpm. It has a built-in spindle lock for easy bit changing and a plastic eyeshield for added safety. Weight, 4 $\frac{1}{2}$ pounds; cost, \$39.95.



Stainless-steel clamps

Combining the best features of C-clamps and parallel clamps, Kant-Twist clamps clear the work area as well as eliminate twisting and distorting. Clamps are sold in five sizes—1, 2, 3, 4 $\frac{1}{2}$ (deep throat) and 6 in.—with prices beginning at \$8.45. Clamp Manufacturing Div., 1517 Potrero Ave., South El Monte, Calif.

How to Resurface



WHAT DO YOU DO when you own a boat with a bad deck—one which is too good to put the ax to, yet not good enough to leave as is? One answer is set a match to the whole boat. My solution was to do a complete resurfacing job, using a vinyl marine decking fabric.

The problem first presented itself the Saturday morning that I went aboard our wood-hull sailboat after a week-long rainy spell. Though the boat had been buttoned up tight, everything in the cabin was sodden. I spread the preservers, sails, and cushions to dry in the cockpit, then went forward to take a close look at the canvas deck covering. It was in terrible shape.

Recanvassing seemed to be the obvious method of replacement. However, this would require some structural work because the canvas itself was not bonded to the deck's wood undersurface except by a coat of wet paint laid down at installation. It was fastened mechanically only at the edges where it was wrapped under or behind adjacent structural and trim pieces such as cockpit coamings and cuddy sides.

Each of these wooden pieces would first have to be removed to install the new canvas, and then the wood would have to be refastened to hold that canvas. I just felt there must be a better way. The dealer suggested a marine vinyl-decking fabric would fulfill all my require-



FIRST STEP is to remove old canvas decking carefully. Next, it is taped face down on the back of the new vinyl to serve as an exact cutting pattern



RESULTING ONE-PIECE HALF-DECKING is duplicate of the worn-out surface it replaces at right. Fit is exact; material closely simulates the planking

Your Deck With Vinyl

BOATING

By LINN DAVIDSON

ments. Available in a number of wood-grains and colors, the vinyl could be matched to the character and color scheme of the boat. The woodgrained vinyls I saw also were embossed with caulking lines to imitate planking and had embossed grain-pores and wood plugs to simulate the real thing.

A simple adhesive is used to install the vinyls. Colors are sun-fast and the surface is soft to resist weathering. Required maintenance is nothing more than an occasional mopping with soap and water.

Two companies make these marine vinyl deckings: Burlington Marine Vinyl Fabrics of the Goodall Div., Burlington Industries, Greensboro, N.C., and the Nautolex Vinyl Fabrics Div. of General Tire and Rubber Co., 1708 Englewood Ave., Akron, Ohio.

In addition to the fabric you'll need about ½ pint of adhesive per yard of 54-in.-wide material, a pair of ordinary scissors, a razor-knife, a 3-in. paintbrush or roller, a homemade smoothing pad and a staple gun. My smoothing pad was made of a length of 2x4—slightly shorter than the narrowest width of deck—covered

with a scrap of ordinary pile carpeting.

From start to finish, the job took about 10 hours. After carefully removing the old deck canvas with a razor-knife, I taped the old canvas decking face down on the back of the new vinyl. This gave me an exact cutting pattern. Hold-down tapes were spaced at about 8-in. intervals, and a line was penciled on the vinyl just in case the tapes didn't hold properly. While you're at it, mark the holes for the hardware.

The boat's foredeck center line is a raised king plank. For best appearance, I planned to butt the vinyl to the king plank, with the planking lines in the material running exactly parallel. I took extreme care in the taping and cutting to make sure that the center line edge and the planking direction coincided. The result was a perfect fit with the vinyl. I preferred to lay each half in one piece to avoid having any more joints than necessary where water could eventually seep through.

On the cabin top, it was necessary to cut and lay the vinyl in two butted halves to avoid structural involvement



HEAVY-DUTY BELT SANDER is used to rough plywood undersurface before installing the vinyl. Plywood was wiped with acetone to clean it and dry out moisture



COTTON-FABRIC-BACKED DECKING has good body and handles easily without stretching. Glue used dries transparent and leaves no ugly splashes or spots

with the mast partners. I made sure that the planking lines in both halves would coincide with each other exactly and run parallel with the lines in the adjacent decking.

Preparing the surface

Because the old canvas had been removed some time prior to installation day, the plywood undersurface was thoroughly dry. I swabbed the surface with acetone to remove any traces of grease and dirt and to drive out any possible lingering moisture.

The new vinyl decking pieces were then installed dry as a check for fit. Then each piece was rolled up from each end toward the middle. Athwartships, at the center line of each piece, I ran a line of thumbtacks to hold the vinyl exactly in position.

Laying the vinyl

Installation directions suggest a thick application of adhesive so it looks like a heavy coat of white house paint. The adhesive does dry clear so it won't mar the vinyl or surrounding surfaces. This also provides a reliable gauge of the glue's working time limit. The glue must be completely opaque-white when the vinyl is laid into it. Therefore, brush on two coats of adhesive (it can also be applied with a roller), one right after the other.

The first coat fills the pores of the plywood undersurface. The second gives a completely wet surface to the vinyl. The two coats give excellent coverage. While prefitting the vinyl and tackholding it guard against its slipping around.

The adhesive should be spread and the vinyl laid while working from the center toward each end, one section at a time. I started at the center and worked toward the bow first, covering only small areas about 12x24 in. at each spreading and laying sequence. When I reached the extreme bow of the boat, I went back to the center and worked aft to the stern.

Into each small section of wet adhesive I unrolled enough vinyl to cover. Using the smoothing pad I pressed out all air bubbles, working toward each side and the front to get good "squeeze" all around. Use turpentine and a soft cloth to clean the vinyl at the edges, and be careful not to get the adhesive on the smoothing pad's carpet covering.

As a warning flag I should add that I experimented with a number of solvents for cleaning before I started the job. Here's what I found out: *water* will clean wet adhesive and brushes, but since I was working in the hot sun, the adhesive "squeeze" and spills dried too fast; *acetone* will take up all the squeeze and spills

(Please turn to page 190)



ADHESIVE RESEMBLES WHITE GLUE. Two coats are applied with a brush to insure a thick covering. Work small sections at a time, starting at the center

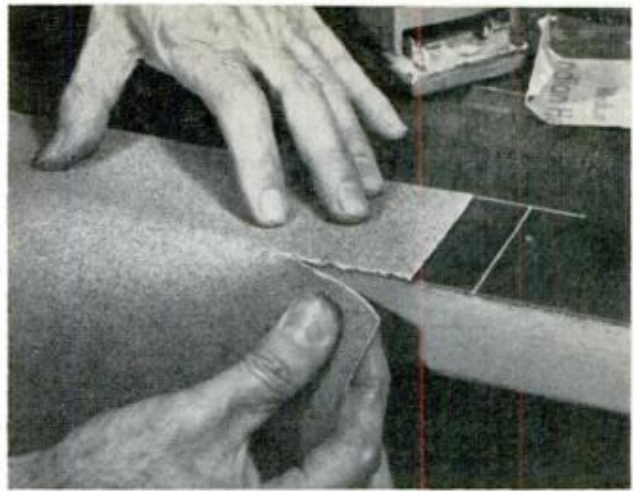


NEXT-TO-LAST STEP is to fasten edges with staples to hold vinyl until glue sets. By working carefully, deck-seam lines were matched for best effect

HINTS FROM READERS

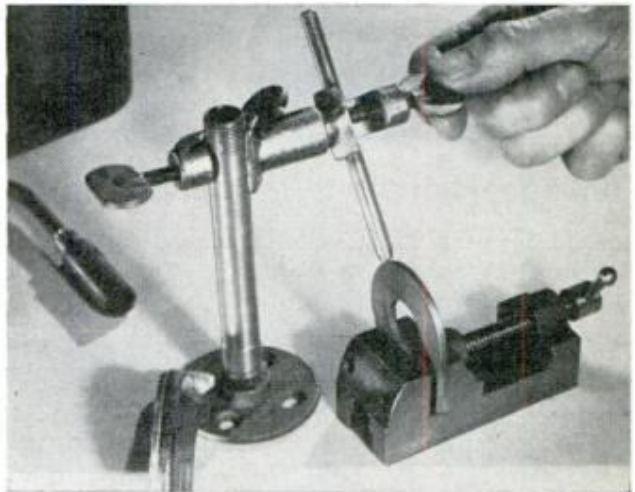
Handy sandpaper cutter

Most saw tables have a right-angle edge that is perfect for tearing sandpaper to desired size. Simply scribe lines on the table surface to mark the width and length of the sheets that your pad sander calls for, and use a framing square to insure that the scribes are accurate. Make the marks with a sharpened awl, icepick or nail.—*R. S. Tupper*



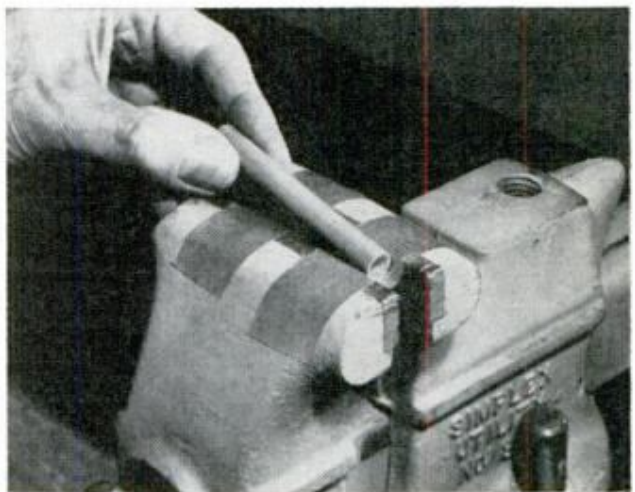
Lab clamp in the workshop

A handy gadget on a workbench is a swiveling laboratory clamp that's supported by a length of vertical pipe. The clamp can be used to hold rods and other parts in the precise position for filing, soldering, brazing and welding. To locate a source for this type of clamp, check the Yellow Pages under Equipment, Laboratory.—*Walter E. Burton*



Tape improves vise

Masking, or any similar self-adhering tape, can help you position and hold small pieces, such as rods and tubes, in a bench vise. It serves as a sort of sling between the vise jaws to keep a piece level and at a predetermined distance down from the top—as for filing a flat along the top. The tape also minimizes marring of work by rough jaws.—*Walter E. Burton*

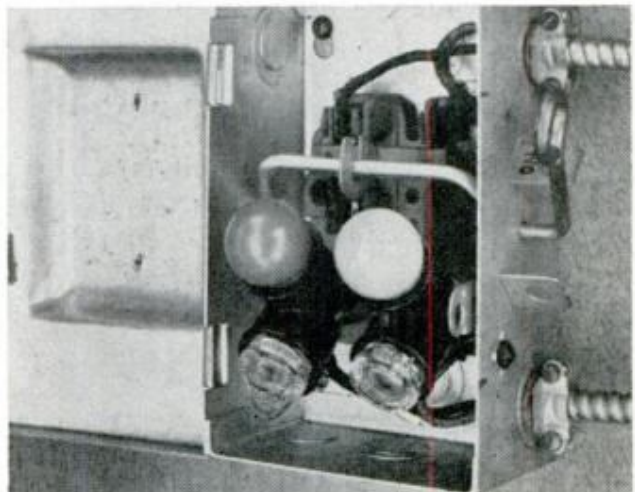


Emergency spray-can nozzle

Before you toss out *any* empty aerosol spray-can (bug or hair spray for example), take time to first remove and save the nozzle. Since spray-can nozzles are of universal size, should you ever be faced with a clogged one during a Sunday workshop spray session, you can simply replace it with the saved nozzle and finish the job.—*Joseph Braunstein*

Lamp signals defective circuit

For important circuits that you don't check regularly—a home freezer or burglar alarm, for example—here's a trick that lets you know immediately when the fuse has blown. Simply insert a double-socket in the fuse cutout, then put a 10 to 15-watt lamp in one receptacle and the fuse in the other. When the fuse blows, the lamp lights up.—*Joseph Braunstein*



HINTS FROM READERS



Film-spool handle

You can make a sturdy handle for a file or other small shop tool by using a roll-film spool of at least 120 size. Simply fill the hole half-full with iron cement and insert the tool tang (preferably notched for better bite). Keep the setup in alignment until the filler hardens, and to prevent the cement from oozing through the film slots, use wrapping paper.

—Walter E. Burton



Fast pickups

When tacks, clips or tiny brads are kept in a jar, you'll find it's a lot easier to pick them out if you line the top of the jar with a strip of 1/2-in. magnetic tape. To use it, you turn the jar upside down before opening. The metal objects will "hug" the magnetic collar and be readily accessible for removal. Cut the tape so it tends to spring open when placed in the jar.—Joseph Braunstein



Small parts 'washer'

The percolator basket from a discarded aluminum or stainless-steel coffee pot makes an ideal "washer" for small parts. If it's in one piece, simply cut off the pump stem near the bottom of the basket, install an appropriate bolt and secure with a knob for holding the washer. Now parts can be placed in the basket and cleaned by immersion and agitation in solvent.—Victor H. Lamoy

NEXT MONTH IN SHOPS AND CRAFTS

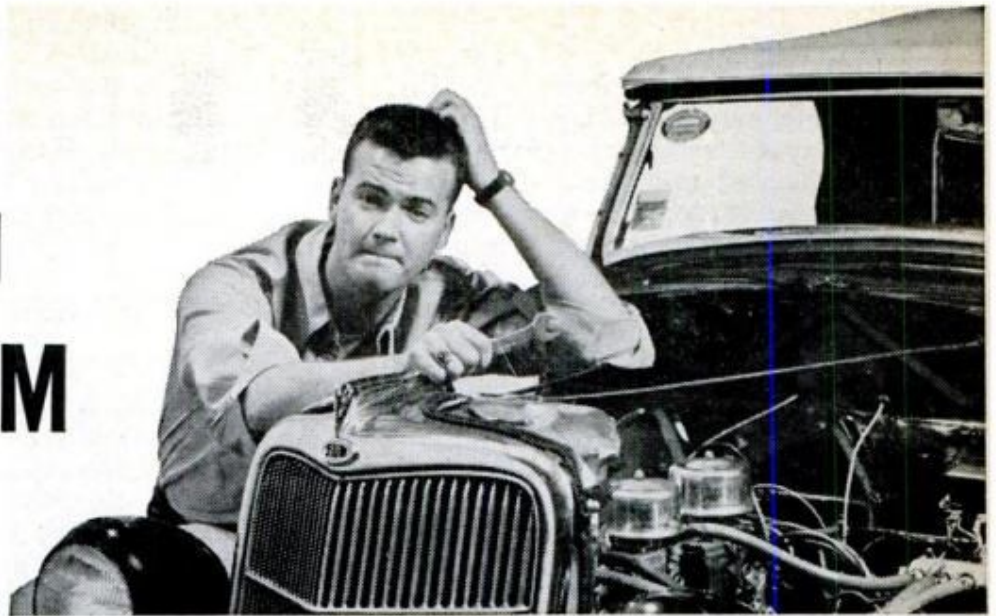
HOW TO INSTALL A CIRCUIT FOR A 230-V. ARC WELDER. There are few machines that will expand your capabilities like a shop welder can. But, before you buy one you should make sure that your shop is adequately powered. If it isn't, you'll find all the installation facts in the February issue of PM.

NOW: PREBUILT SAUNAS THAT GO TOGETHER IN AN HOUR. An easy way to keep up with the "slim-look" craze is to erect a sauna in your home for convenient daily use. This version comes in prepackaged panels that lock together, using a special wrench. It comes apart just as easily so you can take it with you if you ever decide to move.

BUILD THIS THREE-WAY 'TRAVELPOD.' It's a boat, it's a camper, it's a luggage carrier all in one. And, for on-the-road jaunts between lakes and campsites, it closes up like a box for convenient top-of-car travel. To find out how you can build your own, read February PM.

ALL-TIME GREATS NO. 3. Though great projects never die, sometimes we forget just how popular they were. Here are four woodworking projects that, judging by our reader mail, have proven popular with PM readers over the years: a sewing cabinet, serving caddy, stepladder chair and planter coffee table. Complete plans for building all four are in the February issue of PM.

WHERE DO YOU GO FROM HERE?



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- Sign Painting & Design
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HOT NEW FIGHTER FOR THE NAVY

(Continued from page 86)

it's obvious that the F-14 is smaller than the F-111 and considerably lighter.

Its role can be assumed from some of the planned armament. First of all, the Navy insisted that the F-14 carry an internally mounted, 20-mm machine gun. This was in response to complaints from combat pilots: they said that other aircraft they flew left them nothing to defend themselves with after they'd expended their externally mounted weaponry. On the F-14 they will always have a gun with them.

Additional weapons will be carried externally. Four Sparrow missiles for medium-range attacks will be partially buried in the flat underside of the fuselage. But other weapons will have to be hung. Two pylons on the wing roots can carry either medium-range Sidewinder missiles or extra drop tanks for fuel. (The normal fuel supply is carried in the fuselage and wings.) The long-range, and very secret, Phoenix missile system will be attached to the underside of the fuselage on special streamlined pallets that will house the missiles' auxiliary systems.

And, as mentioned earlier, provisions will also be made to strap air-to-ground weapons on the F-14—500, 1000 or 2000-pound bombs or rocket-launching pods.

For all the air-to-air weapons, the F-14's electronic systems, housed in the nose, can detect and track multiple targets at extremely long ranges and attack on a priority basis.

A major feature of the Grumman design is that 80 percent of the necessary maintenance can be done from ground level; that is, the easily reachable hatches can be opened by a member of the ground crew standing with both feet on the ground. Even the engines are interchangeable, meaning any engine coming off the assembly line can go in either the left or right pod. All of this makes the F-14 a "quick turn-around" plane. It can go out on one mission, return to the carrier and be fueled up, and rigged for an altogether different mission with a minimum of lost time.

And the F-14 has a future. Both B and C models now planned require no major configuration changes. The F-14B will have new, smaller and more powerful engines, giving even more thrust to weight, using basically the same pods as the A model. And the F-14C will accept new, not-yet-built electronics for even more sophisticated attack capability, again with no basic change in the configuration. So the Navy hopes the basic F-14 will clear

the skies for our fleet well into the 1970s.

The F-14 is expected to fly in 1971 and join the fleet in 1973. Primarily, it will replace the F-4 Phantom II, a craft dating back to the mid-fifties, that has reached the saturation point so far as improvement goes. The Phantom was a great war-horse in its day. The Navy hopes the F-14 will carve out an even finer record. ★★★

HOW TO RESURFACE YOUR DECK

(Continued from page 184)

—and the pattern on the vinyl (don't use it!); turpentine seems to work best because it removes only the adhesive but doesn't affect the print on the vinyl.

As you press the vinyl into the wet adhesive, make sure that the edges are smoothed out right to the edges of the deck. Then fasten the vinyl temporarily at the edges with a stapling gun. Though the steel staples are certainly self-sacrificing (they rust away), they serve perfectly to hold the vinyl till the glue is dry.

While the adhesive is still wet, you can walk very carefully in stocking feet on the vinyl. But, I found out the hard way that it is not a good idea to walk at all on a crowned surface, such as the cuddy roof, because the vinyl slips and bends the straight seam-lines out of true. They can be straightened but the vinyl has to be lifted and relaid to do it.

When the forward half of the decking is completed, remove the center line of thumbtacks and do the after half. Perhaps because I was working on a hot day in direct sun the vinyl seemed to shrink slightly in length. Whatever the cause, it was 3 in. too short at the stern. Fortunately, there is plenty of give to the material and I was able to smooth it out the last few inches for a perfect fit.

Working on the cabin top, I trimmed the center butt-joint with a piece of half-round stained to match the color of the teak. Then I sealed the edges of the new vinyl by installing half or quarter-round molding on top of the staples at the edge of all deck areas. The molding was bedded in the regular adhesive to seal it against later water seepage (bedding compound would probably work as well). Finally, I taped the molding from the vinyl decking and gave all new wood a priming and painting in white to contrast with the teak color.

The resurfaced deck has required no maintenance of any kind, it looks and feels like the real thing and there has been no sign of loosening. Best of all, passengers and cargo now stay dry in any kind of weather. ★★★

A LOT OF RAILROAD

(Continued from page 153)

10 in. high, so I made the shelf about 12 in. wide to assure ample clearance between the board and the wall.

If you build your shelf the same size, the cutting diagram on page 152 shows how you can get all the parts (with a bit to spare) from a 4x8-ft. sheet of plywood. Two little angle brackets under the top or inside the ends will hold the completed shelf to the wall. The painting of the shelf, as well as the train board, is something you would do before attaching it to the wall. For convenience in working, hold off hinging the train board until your whole layout is completed.

Regular screen-door hooks and eyes added to the ends of pivoting 1x2 stops provide a simple way to hook the train board to the wall and to avoid crushing your mountain scenery. Here the length of the stops is governed by the depth you make the shelf. The train board should store vertically.

I painted both the shelf and the train-board with Plextone, a tough multicolored, water-base paint which you can blow on with a vacuum sweeper and sprayer attachment. You'll find it great for covering plywood, knots and end grain. The special self-locking leg brackets are available from Royal Oak Tile and Paint Co., 611 South Washington St., Royal Oak, Mich. and sell for \$2.75 per pair, postpaid.

Next month I plan to show you how to build the most realistic mountains you ever saw with paper bags, wallpaper paste and texture paint; make elevated roadbeds and tunnel portals; wire automatic switches, and set up your system. ★★

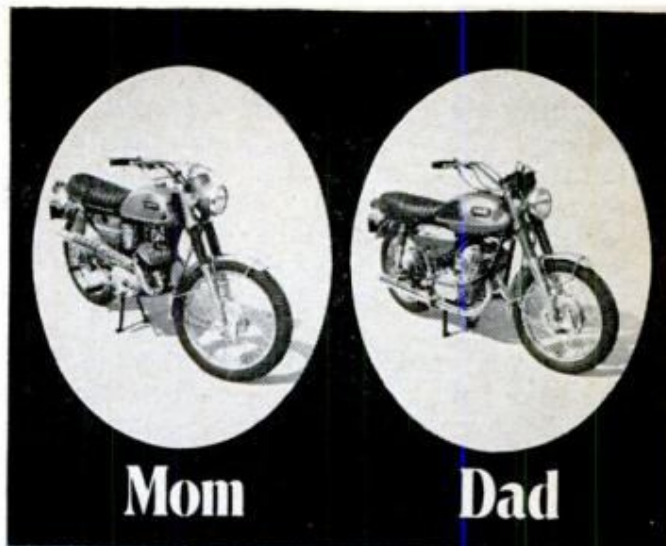
STUDED TIRES TAKE HOLD

(Continued from page 116)

give you the legal lowdown on studded skins. If not, check your local motor vehicle bureau.

There's no doubt that studs can be of great help under certain conditions. Such conditions prevail throughout most of the country, so if you've decided that you do need studded tires, you're among the majority.

Cornell Aeronautical Labs said, in passing, in one report that studs and studded tires could be made better, yet they didn't say how. Undoubtedly both stud and tire technology will improve. Meanwhile, sales will continue to spiral upward. And winter driving in the future will become less dangerous than it is today, thanks largely to studded tires. ★★



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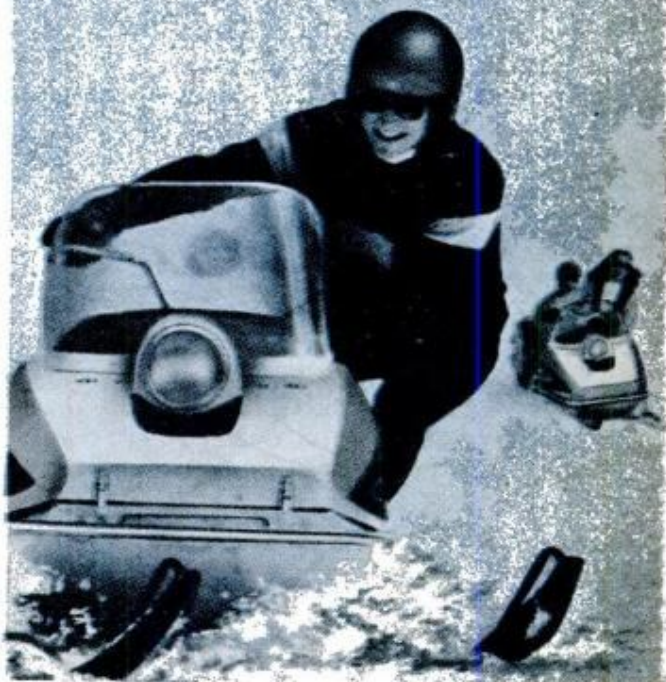
And he's no problem. Autolube blends the right amount of oil with just the right amount of gas. Automatically.

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He's pretty hard to keep up with.

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SL 396 and SL 338. Special SS 396 racing model also available. Yamaha International Corporation, Box 54540, L.A., Calif. 90054.

A LASER 'KNIFE' FOR SURGERY

(Continued from page 127)

vised. Originally of aluminum, but now of magnesium, it consists of a series of six hollow tubular sections, each no thicker than an infant's forearm, and six hollow connecting blocks to each of which two sections attach at right angles to each other.

Each section has an inner and outer tube, the inner connected to the block at one end and the outer to the block at the other end. Ball bearings between the tubes allow rotation about a common axis, permitting swiveling despite the fixed corner blocks. Prisms in the blocks bend the laser beam at right angles so that it zigzags from the laser source at the beginning through to the end probe, the size of a fountain pen, which can be handled like a scalpel. A lens on the probe focuses the light to a pinpoint just a few inches away.

The Laser Laboratory of the Children's Hospital Research Foundation, University of Cincinnati, is one of the first and largest laser research centers. Its director, Dr. Leon Goldman, is a pioneer in the field. He has become involved in juvenile delinquency rehabilitation programs because he can remove certain types of youngsters' tattoos with his lasers: "Although we can only remove small tattoos with our primitive instruments." He has worked with a range of lasers—ruby, YAG (yttrium aluminum garnet), carbon dioxide, neodymium and argon-ion. He is also experimenting with the laser in cancer diagnosis by transillumination, which would be much safer than X-rays. One area is mammography (examining technique for breast cancer) but "so far it's much inferior to X-rays."

However, the laser is valuable for fighting cancer in the laboratory where it can be used through a microscope to focus down to a point 1 micron (1/25,000 of an inch) in diameter. Tiny holes can be punched in red blood corpuscles, the contents of cells can be destroyed without damaging the surrounding membranes, the chromosomes and nucleus can be operated on. Even molecules in the cell can be destroyed, and closed-circuit television makes it possible to fire a laser at active moving cells while watching them. Latest is the adaptation of laser holography to microscopy so that cellular development can be observed in three dimensions.

Goldman predicted, "You will have an optical knife in the future and it will open the way to higher development of surgical techniques." He has already used laser knives to perform bloodless spleen

and liver surgery on experimental animals. He points out the Hartford Foundation "has singlehandedly made possible most of the advances in the biomedical applications of the laser, by its financial support."

Goldman's enthusiasm for the laser's future as a surgical tool is not shared by Dr. A. S. Ketchman, chief of the surgery branch of the National Cancer Institute, who told me bluntly: "We have curtailed our active ongoing studies relative to the role of the laser in the potential treatment of cancer. I would still be actively participating in the laser, but you've got to draw the line somewhere and do what you think shows the greatest potential."

Speaking of ophthalmology, Dr. L'Esperance concluded that "this [the argon laser and its effects] may solve those problems which have us so helpless today, particularly those caused by vascular disorders in the retina."

Dr. Zweng foresees a laser photograph, a hologram, of the inside of the eye to provide a three-dimensional image for careful study. As to the laser in ophthalmology he concludes "Much of its early promise has been fulfilled . . . The future of the laser in ophthalmology is as bright as the beam itself." ★★★

HI-FI TORTURE TRACKS

(Continued from page 134)

tone is heard before each bass and treble test tone. In effect, this pilot tone calibrates your ears so you can judge the test tone correctly. You compare the loudness of the test tone with the loudness of the pilot tone immediately preceding it. If the two seem equally loud to your ears, your system is okay. The net effect is to make the ear check almost as accurate as an instrument check of frequency response.

The frequency checks on these two discs are not straight test tones but warbling notes. That's another neat trick. It gets around the problem of room resonance. Every room has a resonance of its own. If this resonance happens to match a test tone, it reinforces the sound—like talking into a barrel. Naturally this throws off your judgment. But if the test tone is a fast warble instead of a steady pitch, the resonance never gets a chance to build up and the whole problem is sidestepped.

Separation and tracking. Separation checks usually consist of a test signal recorded in one channel and a reference tone in the other. You throw the balance control on your amplifier all the way left, then all the way right. By comparing the loudness of the signals, you get a good

idea of how much "left" signal sneaks over into the right channel and vice versa.

To check tracking—the ability of your cartridge to follow the record groove accurately—test records have bands recorded at various frequencies with extreme loudness. The idea is, literally, to throw the stylus off the track by making it swing at wide amplitudes. This not only tests performance of your cartridge, but helps you adjust your tone arm so that it provides the optimum guidance for the cartridge.

Among the additional tests offered on most test records, turntable flutter is revealed by a steady note on the disc. If it refuses to stay steady in playback, it's a sign that your turntable has "flutter"—it is chugging instead of rotating evenly. Rumble—a low noise caused by turntable vibration—is usually revealed by playing a silent groove with no signal at all.

Instrument Checks. Every test mentioned so far is done by ear alone. Many experts feel that "ear testing" is the best method for a total system checkout. With instruments hooked to the amplifier, you bypass two of the most important factors in an audio setup: speakers and room acoustics.

Still, you may want to supplement your ear tests with instrument checks that measure the electrical performance of your system minus the acoustical factors—for this you need a different test routine and an output meter with a scale calibrated in decibels. A simple VOM (volt-ohmmeter) is fine for measuring output across the speaker terminals of your amplifier.

The procedure is simple. Most test records begin their frequency run with a reference tone. You adjust the gain of your amplifier so that the meter reads zero db for the reference tone. Ideally, the meter should remain at zero for all test tones. This means you have "flat" response. Most likely you don't. By plotting on a chart just how many decibels the meter rises or falls at various frequencies, you can plot the precise frequency response curve for your equipment.

Among the test records available for this type of checkout, Vanguard's *Stereolab Test Record* (VSD-100, \$2.98) offers a frequency run from 30 to 15,000 cycles, in addition to tests for channel balance, phasing, flutter, noise and distortion. Columbia's *Stereophonic Frequency Test Record* (STR-100, \$8.50) runs through 30 spot frequencies between 20 and 20,000 cycles. The disc also offers sweep frequencies for detecting rattles and resonances, channel separation tests, phasing, and cartridge-tracking tests. ★★★

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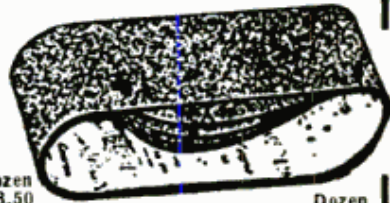


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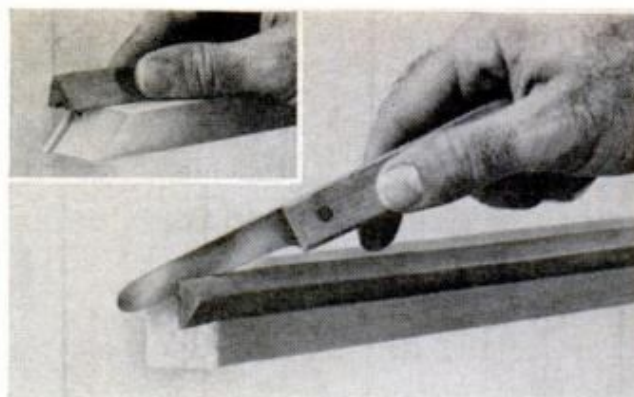


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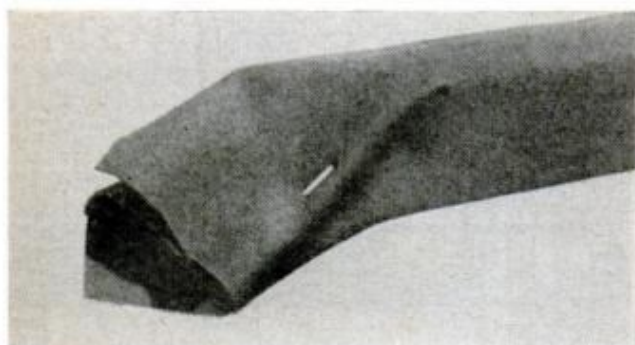
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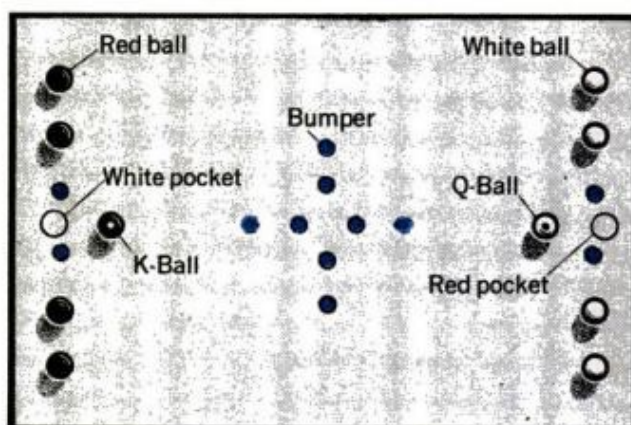
BED CLOTH IS STAPLED around perimeter every inch or so. Knife for trimming should be razor sharp



CUSHION RUBBER is cut a bit oversize, attached with contact cement (see inset). Next, trim neatly



FELT IS FOLDED over ends, and tucked beneath undercut in liner. Finally, staple and trim with scissors



BUMPER-POOL TABLE

(Continued from page 149)

cloth is wrinkled, press it carefully on the *wrong* side with a steam iron set on low. Drape the cloth over the bed and tack with staples spaced 1 in. apart: first at the four corners, pulling the cloth taut before stapling; next along the ends, and finally along the long sides. After stapling completely around the perimeter of the bed, trim the excess cloth with a knife.

Slit the cloth over the holes with a sharp blade, stopping just short of the edges. Make eight slits in each hole area. Tap the pocket liner into place so that the edge is just a trifle below the surface. The bumpers are inserted into the holes with their projections aligned with notches of the holes and fastened with nuts.

Staple cushion covers along the back edge of the liner. Do the ends first; pull material taut, then staple at 1-in. intervals all along. Pull cloth around cushion and repeat the procedure on other edge of the cloth. Fold ends over as shown and staple gathered felt in the undercut section. Cut off excess cloth, and attach cushions to the table with roundhead screws driven from below.

Make and attach the ball boxes as shown. A plywood cover with attractive decals protects your table and completes the job. ★ ★ ★

HOW TO PLAY BUMPER POOL

Number of players: two to four. Each side has five balls: one side red, one white. In each set ball marked with spot is called the king (K) ball.

STRATEGY OF PLAY

Balls are spotted as shown above; white balls shoot toward white pocket and red toward red. To start play, both players shoot their K balls simultaneously toward their respective pockets. The player whose ball is closest to his pocket has the right to continue to shoot. After he "makes" (pockets) his K ball, he may shoot at *any* ball on the table. *Important:* Until a player makes his K ball, he may shoot only for his pocket; he may not try to hit his opponent's ball.

SKILLFUL PLAY

The strategy is to keep your opponent from having an open shot at his pocket while you leave yourself open to shoot at your pocket. This is usually done either by knocking your opponent's ball out of position, or by positioning your own ball in such a manner as to block his shot. The player who pockets his five balls first wins.

PENALTIES

If a player sinks one of his balls before the K ball, opponent pockets any two balls and shoots.

If a player causes a ball to jump the table, his opponent places the jumped ball wherever he chooses (including in the center of the eight-bumper cluster), pockets any two balls and shoots.

If a player pockets an opponent's ball, it is a scratch and he loses his turn. The pocketed ball stays in the pocket.

Specialty items are available from Armor Co., Box 290, Deer Park, N.Y. 11729. Write for free price list, with parcel-post rates and state taxes where applicable.

CATCH A HIPPOPOTAMUS

(Continued from page 106)

lapse. The herd stands around, trumpeting excitedly and throwing up clouds of dust while the mother tries to lift the calf bodily with her trunk or roll it to and fro with her foreleg to wake it up. If she notices the dart she may pull it out with her trunk and trample it.

Now the helicopter comes back and by buzzing the herd chases away all but the anguished mother. The latter stands over her fallen calf after the rest of the herd has gone, rearing up on her hind legs as if to snatch the helicopter out of the sky. Only repeated passes with the copter drive her away, and even then the copter has to remain on guard as the ground crew moves in with trucks and crates. A ranger ties a nylon rope around the calf's neck and passes the other end of the rope through the open door of the crate and out the back. Another warden gives the calf a shot of an antidote called M-285. In two or three minutes the calf gets up and can be guided gently into the crate. Dr. Pienaar and his aides captured 27 young elephants this way in a period of six weeks, five in a single day. Some were released for being too small or of the wrong sex. They trotted back unharmed to their mothers. Not one of the 27 was killed or permanently injured.

Tourists love to see elephants, but the breeding herds tend to stay away from the roads. Even so, the official park booklet carries this warning:

"BEWARE OF ELEPHANTS. When traveling through ELEPHANT COUNTRY visitors are warned to travel very slowly, especially round corners, and not to try to pass cow elephants with young ones but to turn back as soon as possible, or to remain perfectly quiet until the elephants have gone. When wishing to photograph bull elephants near the road, drive a little way past the animals before stopping the car and do not stop to take photographs while they are still ahead. Do not stop to photograph a herd of elephant cows and calves but make haste to get away."

Despite all this, Dirk Ackerman, who showed us a stack of old *Popular Mechanics* at his station at Tshokvane, told us about a family with two kids who had to walk back to camp when their car broke down. The road was blocked by several mama elephants and their off-spring.

"How did you get past?" Dirk asked.

"We threw rocks at them," the father replied.

Dirk broke out in a sweat, just telling about it. ★★★

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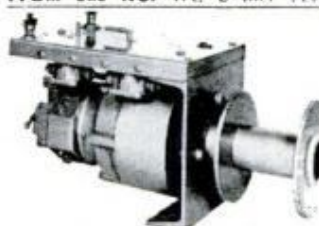
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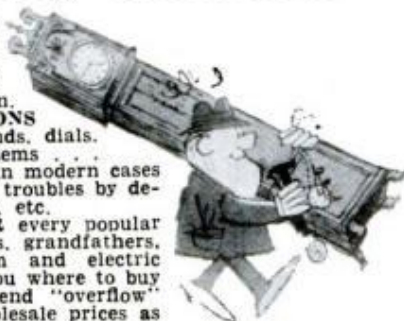
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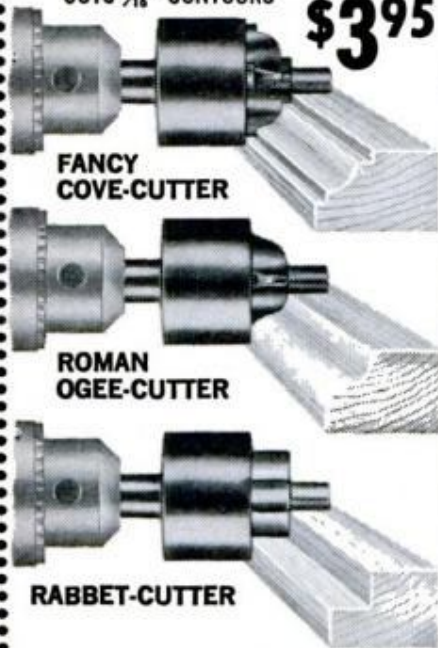
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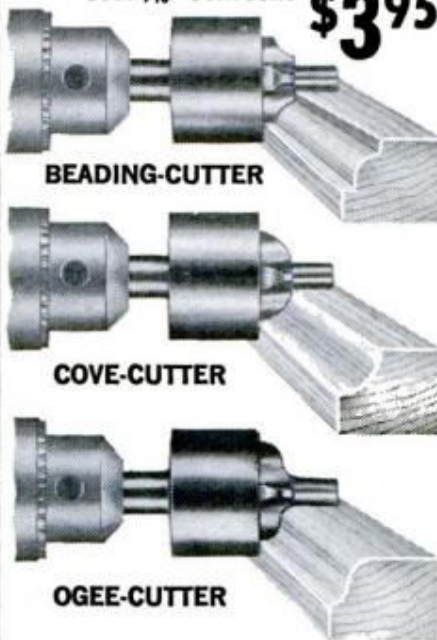
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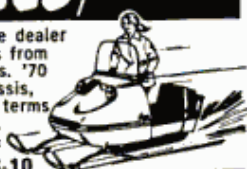
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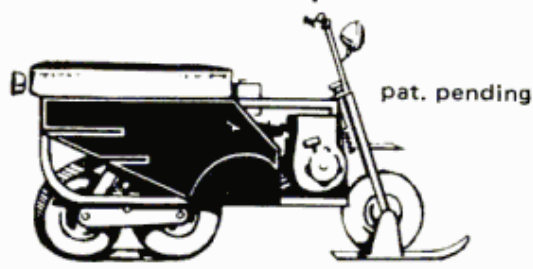
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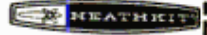
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