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The Office of a Mine Foreman, 500 Feet Underground.


Anthracite Cual Mine Heading. The Roof is Higher than that of a Bituminuus Mine Because of the Thickness of the Vein.


Thousands of Boys are Employed in the Screen-Rooms of the Breakers.


Exterior of Breaker in the Anthracite District


A Breaker Head.


The Great Coal-Loading Machine Lifting a Car from the Railroad Tracks Before Discharging its Contents.

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## The editor is always glad 10 reeeive for examination illustrated articles on subjects of timely interest. it the photographs are 

the artistic element in bridge design.
At a time like the present, when we are constructing in this country, and notably at New York, so many important municipal long-span bridges, it is of interest to turn to similar work which is being designed and executed by foreign engineers and contractors. We present in the current issue of the Stpplenent a series of views of some recent notable bridges constructed in Germany and Switzerland, which are characterized by that strict regard for the wsthetic and architectural side of bridge construction, which is such a marked feature in the best Continental work.
Thanks to the Municipal Art Commission, in the city of New York strict attention is being paid, and we hope will continue to be paid, to the artistic side of all bridges, great and small, that are erected in the metropolis. Of course, the architectural embellishment of an engineering structure is something that requires to be undertaken by the architect or artist in direct collaboration with the engineer who designs the structure. This collaboration is now being carried out; but it is quite a question whether the bridge engineer, particularly if he intends to devote himself to city or county work, would not do well to round out his professional course by including instruction in at least the elements of architectural design, or some kindred study. Hitherto, American bridge engineers have been governed in their work too much by the strictest considerations of utility; and in the endeavor to design bridges that can be built with the least expenditure of time and material for the maximum amount of strength, they have produced structures that are a literal translation into steel of the straight lines and angles of the strain-sheet diagram. For economy of material and speed of erection, these bridges stand unsurpassed in the world; but it must be confessed trat, with a few notable and praiseworthy exceptions, sur bridges do not compare in beauty and harmony with their surroundings with the work of the Continental engineers. Among the exceptions may be mentioned the noble Washington Arch Bridge, over the Harlem River, and the design by the present Bridge Commissioner for the new Manhattan Bridge across the East River, New York; while it need scarcely be added that the famous Brooklyn Suspension ly be added that the famous Brooklyn Suspension
Bridge will be always a thing of beauty, in spite of Bridge will be always a thing of beauty, in spite of
the fact that the details of its construction, judged the fact that the details of its construction, judged
from the modern engineering standpoint, must be confrom the modern engi
sidered rather crude.

## american rapid transit in london.

The managing director of the Anglo-American Company which is building and equipping a large section of the London Underground Railways, states that the vast system of rapid transit which is being built beneath the city of London is progressing with far less disturbance to the streets and discomfort to the public than is our own in New York city. The difference is due to the depth at which the "tubes" are being built and to the fact that the material is soft and easy to tunnel. The most remarkable feature of the London system, according to Mr. Yerkes, is the great power station on the bank of the Thames, from which power for the entire system will be furnished. The building will contain ten 7,500 -horse power engines, and when the plant is. all in, there will: still be room in the building to increase the power capacitv by fifty per cent. An interesting detail of the entorprise is that a portion of the system is being equipped with four rails, of which two are the main rails for the cars, while of the other two one is the foeder. and the other the return rail for the current. The placing of the fourth rail is due to one of those government regulations-so common in Great Britain-that are inserted for the protection of the general publi? when
important franchises are granted to public corporations. In the present case the Board of Trade stipulated that there must not be a drop oi more than three or four volts in the pressure of the return current as received at the power house. The object of this restriction is to prevent leakage with its wellknown disastrous electrolytic effects on gas and water mains. Now, it would be impossible to prevent leakage, if the common system of return by way of the track rails were adopted; since the ordinary vitrified earthenware insulators could not be used between rail and track. Hence the necessity for a separate properly-insulated return rail.

## THE NEW CUNARDERS.

Some interesting light was thrown upon the subject of the two new express steamers for the Cunard Line at the recent annual meeting of the shareholders, when the president of the company stated that there was no truth in the report that the objections of the shipbuilders are due to their inability to construct two ships of the huge proportions and high speed called for by the government requirements. It seems that the shipbuilding firms consulted are fully prepared to build these vessels, which are to be of the same beam as the "Cedric," 75 feet, and are to be about 150 feet longer than the "Kaiser Wilhelm II." Moreover, they are prepared to guarantee that they shall show an average sea speed of 25 knots an hour, which is a knot and a half better than the highest speed for a single voyage ever made by a transatlantic steamer, and is over two knots higher than the average sea speed for a whole season of any existing ship. The government requirements, however, demand that the average sea speed. voyage by voyage, shall be 25 knots, and to insure this result the vessels would have to be capable of making an average speed for a single voyage under the best conditions of wind and sea of not less than $261 / 2$ to 27 knots an hour. As matters now stand, the British government expects the company to put these two ships in service with the stipulation that if they dc not maintain an average throughout the season of 25 knots, they will be thrown back upon the shipbuilders' hands. As the two vessels will cost about $\$ 10,000,000$, it can readily be understood that private firms are reluctant to undertake the contract subject to such onerous conditions.
The obligations imposed upon the builders of German express steamers are that the ship must give satisfaction on the trial trip, and that the builders must be prepared to remedy any defects that may show themselves during a specified period of their service; and these requirements would seem to be sufficiently exacting to protect the interests woth of the government and of the steamship companies. It begins to be pretty evident that unless the government makes a considerable modification of its demands, the 25 -knot steamers will never get beyond the paper stage.

## FLIES AS CARRIERS OF BACTERIA

There is, of course, nothing new in the theory that flies may be active agents in the spread of bacteria, but a forceful demonstration made under the auspices of Johns Hopkins University, which has been recently brought to our notice by a member of the nedical staff of that institution, is well worthy of record in these columns. The experiments were conducted with a box that was divided into two compartments, in the first of which was exposed some food material infected with an easily-recognizable species of bacteriaharmless bacteria, of course, being used-while in the second compartment was placed an open dish containing a sterile nutrient such as is used as a culture medium for bacteria. Flies were placed in the first compartment, and, as soon as a number of them had been seen to walk upon, or eat of, the infected material, they were allowed to pass through a small door into the second compartment, where they had a chanceto come in contact with the culture medium in the dish. The result was that bacteria deposited upon the surface of the sterile nutrient, multiplied there, and formed characteristic colonies. In these experiments molasses mixed with a growth of yellow bacteria was soread on a plate in the first compartment, and a dozen flies were nut into the apparatus, Half an hour later, the door between the two compartments was opened, and as soon as several of the flies had been seen to come in contact with the sterile nutrient, the dish that contained it was covered and put away to develop. A few days later there had grown on the nutrient over a hundred colonies of yellow bacteria. The experiment was repeated with red and violet rulture, and colonies of corresponding color were obtained. To prove that the germs from which these colonies grew came from the infected material in the first compartment, and not from accidental sources, further experiments were made with other groups of flies, but with no infected material in the first compartment. In this case. hnwever. none of the dishes used in the second compartment developed yellow, red, or violet
colonies. To prove further that the flies were the only means of transmitting the bacteria, experiments were made with infected material in the first compartment, but with no flies in the apparatus. The dishes containing the nutrient in these experiments also developed no colonies; and from these results it was considered to be absolutely demonstrated that flies are capable of carrying bacteria from one place to another, if they have an opportunity to come in contact with material containing these organisms.

BRITISH WORKMEN ON AMERICAN INDUSTRY.
The Mosely Industrial Commission to the United States, of which we have lately heard so much, was organized by the gentleman after whom it is named, who offered to pay the expenses of a certain number of secretaries of British trades unions for a visit to this country, in order that they might examine and report upon American industries. Not only did Mr. Mosely provide the necessary funds, but he accompanied the delegation himself; and the report of the findings of the various delegates is prefaced with one by himself, which is perhaps the most valuable, because of his broader point of view and his more philosophical treatment of the subject. There are in all twenty-two separate reports by the trades union delegates, representing as many different British industries. To insure that the field should be fully covered, a list of forty-one questions was proposed, which each delegate was requested to answer as far as he could. These questions related to the early training of the workmen in America; their general social condition; and the relations between employe and employer. The organizer of the commission reaches the conclusion that "The true-born American is better educated, better housed, better fed, better clothed, and more energetic than his British brother, and infinitely more sober. As a natural consequence, he is more capable of using his brains as well as his hands."
The commission as a whole agreed with Mr. Mosely The reports are practically unanimous on the question of sobriety, although one of the delegates considers that "while the American workman is sober during working hours, yet he is as much inclined to a spree as the ordinary Britisher." On the question of gambling, it is considered that the American working. man, as such, knows practically nothing about it, and in this connection we are surprised to learn that the wagering habit is increasing rapidly in the present day among British workmen. Mr. Mosely draws atten tion to the fact that many of the leading positions in industry in America are held by men who are either English or Scotch. The delegates agree with him in the statement that one of the chief reasons why the American workman has an advantage over his British brother is that he has received a more thorough and generally better education. There can be no question that one of the chief inducements to self-im provement in American education, is the reasonable hope of advancement that social conditions hold out to young men of all classes in America, if their abil ities fit them to fill higher positions. The delegates frequently allude to the great appearance of equality or absence of restraint in the intercourse between the masters and men. "But this," it is asserted, "is an effect and not, as seems to have been imagined, cause. The American employer has more sense of the value to himself of what may be comprehensibly described as talent among those who do the work of the establishment than his British confrìre." In this connection an instance is quoted of a young British mechanic whose ambition prompted him to come in America, and who was rapidly promoted until he became manager of one of the largest works in the United States, which under his vigorous direction forms one of the most successful in the country. It is urged that a little encouragement of the same sort would doubtless have kept the workman at home, with a benefit to English industry which it is difficult to estimate.
There is no doubt whatever that just here is to be found at once one of the greatest secrets of our in dustrial success in the United States, and of the comparative stagnation in many British industries. In Great Eritain a workman or subordinate who presents a new device or theory to a superior will more likely than not be coldly received for his trouble. Here a premium is placed upon ingenuity and useful sug gestions. Another most fatal hindrance to successful competition on the part of Great Britain with her Con tinental and American rivals is the fact, as pointed out by Mr. Mosely, that, "It has been the rule for generations past that as soon as a man earns beyond certain amount of wages, the price for his work is cut down, and he, finding that working harder or running his machine quicker (naturally a greater strain) brings in the long run no larger reward slackens his efforts accordingly." We are informed that this policy is rapidly passing away; and surely it is high time; for under such a system, there
can be no growth of that sense of community of interest, which is absolutely essential to secure the best results in the industrial world.
On the important question as to whether the Amer ican is on the whole better off than the English work man, the delegates point to the fact that while he receives higher wages, he has to work longer hours; and that though the wages are higher, the cost of living is greater. The general trend of opinion is that after income and expenditure have been balanced, the American is found to be better off than the British workman, to the extent of twenty per cent or so. This estimate, however, cannot be applied too broadly for the reason that conditions differ considerably in different parts of the United States.

## ELECTRIC POWER PLANT BELOW MOUNT RAINIER.

The glacier-capped mountains of the Pacific coast offer excellent facilities for the development of hydraulic-electric power. To utilize the glacier flow, a power plant, the largest on the coast, is now being constructed, which will deliver electrical energy to ihe principal cities of Washington for the street railroads, interurban lines, and lighting plants, and also tor mills, factories, and the principal commercial concerns.

The original source of the water power will be the great glacial cap of Mount Rainier, which towers 14,519 feet above sea level and is constantly reinforced by the warm mists and rain-clouds which are brought inland from the Japanese current which impinges on the neighboring coast. The moisture in the air, striking this great ice-cap, high above the limit of vegetation, is condensed, so that the glacial covering is con stantly growing from the top while it is being melted away from the bottom. The present undertaking ne cessitates the damming of the Puyallup River below its junction with the Mowich at an altitude of about 1,700 feet above sea level. Owing to the peculia formation of the mountain above this point, the Puyallup River drains not only the Mount Tacoma glacier, the Puyallup glacier, the South Mowich, North Mowich, and the Carbon glaciers, but also Crater Lake into which the Carbon glacier discharges. From be neath the glacial ice, whether it ends in a precipitous cliff or presents a confusion of broken ice, cold water flows throughout the whole year. The hidden streams which flow for several thousand feet between the ice cap and the granite surface of the mountain, burst from beneath the edges of the glaciers with a loud roaring, and sometimes the curtain of water which leaps out, although of slight depth, may have suffi cient force to carry a man off his feet.
Below the ice, in the almost impenetrable forests, the rainfall is perhaps greater than in any other part of the country. The wind which brings the mists ashore is always temperate, and the side of the mountain is sufficiently abrupt to catch the precipitation from clouds at varying elevations, while the dense woods tend to the preservation of all falling moisture. From experiments made in the neighbor hood it is estimated that the annual rainfall on the western slope of Mount Rainier aggregates 150 to 160 inches. The rainy season begins in October and continues into the early summer-nearly every day during this period showing some appreciable precipitation. During this season there is more water available than is needed, and it happens therefore that the flow from the glaciers, although it never fails, is diminished by the cold weather. During the dry sea son, including the months of Juiy, August, and September, when little or no rain is expected, the glacial flow is at its height and can be relied upon to provide an ample supply of water.
The water power which nature has stored in this cap of ice is regulated to the demands of man not only by its yearly variations, but also by the so-called glacial tides, which are manifest daily. The greates flow from the glacier, owing to the influence of the sun, occurs from perhaps eleven in the morning untii four or five o'clock in the afternoon. Owing to the distance that this water travels before being utilized for power, these high tides will reach the power station five or six hours later, and therefore the largest daily supply is available between five in the evening and eleven at night, when the city's illumination and street car travel make the greatest drain upon the piant. The glacial tides show a rise of perhaps two inches where the stream is broad, and of two feet where the water of the stream is crowded into a narrow channel, and they are the means of great economy, since, to a large extent, they regulate the power without artificial intervention.
At the point where the Puyallup River is being dammed, a series of rapids start, and extend to the comparatively level ground about 900 feet below. While the river normally travels down a cañon, it will be diverted by a flume and ditch along a bench or spur of the mountain, until it approaches a point above Lake Kapowsin, where there is an almost sheer decline to the foot of the rapids. The flume will be built with
a section of eight feet wide by seven feet high, and will carry $2,000,000$ tons of water daily. Here the canal, which will be ten and a half miles long, will discharge into a forebay or reservoir, which will hold sufficient reserve supply to operate the plant during any necessary repairs to the flume or ditch.
From the forebay, four steel pipes 1,700 feet long will carry the stream down the declivity at an average anble of 45 degrees, to the power station, which will be situated at the beginning of the level country below. When the necessary reductions are made for friction, the pipes will hold columns of water with a net head of about 850 . feet. This is to say, although the pipes will descend diagonally, the water efficiency will be as great as if they descended vertically 850 feet. From these great steel pipes, which will be four feet in diameter at the top and taper to a five-inch nozzle, a compressed stream of water will be released with a spouting velocity of about 15,000 feet, or nearly three miles a minute. This stream will be released in the shape of a solid round bar which strikes the cups of an "impulse" or tangential water wheel, so that the greatest efficiency known to hydraulics may be attained. The four impulse wheels will be connected directly to the generators, which are now heing built by the General Electric Company, and which will be unequaled by any now employed west of the Rocky Mountains, having a capacity of 3,500 kilowatts, or 5,000 horse power each. An alternating current of 2,500 volts will be generated and stepped up to 45,000 or 55,000 volts, and then transmitted to Tacoma, which is about 30 miles, and to Seattle, which is about 45 miles distant.

The engineers have completed the laying out of the flume and ditch line, and while the great generators and water wheels are being constructed, sev eral hundred workmen are employed in clearing away the giant trees and rocky ledges that stand in the way of the free passage of the water between the diverting dam and the forebay. Meanwhile, also, preparations have been made for laying the great steel pipes down the face of the headland, and concrete anchors will be set into the hill to sustain the enormous weight of 1,700 feet of water, and prevent the pipes from forcing their way into the power house. Each tangential wheel receiving its impulse from this weight of water will revolve with a speed that would send its periphery 7,000 feet a minute, and the four wheels will develop 20,000 horse power

## CARRIER PIGEONS FOR THE GERMAN NAVY.

For some time past severe experiments have been conducted by the German naval authorities to ascer tain the suitability of the carrier pigeor for intelligence service in the navy; and so successful have these trials proved, that permanent pigeon stations are to be erected. The chief of these will be at Wil helmshaven and Helgoland for the North Sea, and at Friedrichsort for the Baltic. To assist the Admir alty in its scheme, sixty-one carrier pigeon clubs have placed their services at the disposal of the authorities. Six of these clubs have stations on the east coast-two at Kiel, two at Rendsburg, one at Nortof and one at Lubeck-while there are no less than fortytwo stations on the North Sea coast-sixteen at Ham burg, four at Bremen, the others being distributed over the country of the Lower Rhine, between Crefeld and Düsseldorf. The Naval Department will thus have sufficient birds and conveniences at their disposal and will defray the cost of conveying the baskets containing the birds to the various warships, and the return of the baskets to the respective clubs to which they belong.
From the results of the experiments it is estimated that the birds have sufficient endurance to fly home from a point 300 kilometers from land; and to insure the rapid delivery of a message to the desired quar ters from a war vessel at sea, a system of duplicating the messages is to be adopted, varying with the atmospheric conditions prevailing at the time of dispatch, the distance to be covered, etc. For instance up to 80 kilometers two birds will be released bearing the same message, and from 80 to 300 kilometers from three to five birds will be dispatched. Naturally, the time occupied by the birds in flying over the distance to be traversed depends upon the capabilities of the messenger, and the weather, but it is estimated that one kilometer per minute is the minimum speed likely to be attained.
The general practice of sending the message in a quill attached to a tail feather will not be adopted, as this has been proven to be generally unsatisfact ory. Instead, the message will be inscribed upon thin vegetable paper, which will be slipped into an India-rubber case and secured to the bird's foot by means of a ring of the same material. As the birds arrive at their respective homes on land the mes sages will be detached and forwarded unopened to the news-collecting office and there dealt with. At the pigeon stations on the North Sea coast, there are wire-
less telegraph stations, and the messages will there-
fore be retransmitted thence to the head office. For this service special regulations have been prepared. In future every warship, except torpedo boats, leaving Kiel or Wilhelmshaven will be compelled to carry a consignment of carrier pigeons to be released at varying distances from the land stations. The utilization of carrier pigeons for intelligence purposes has long been in vogue in the German army, with conspicuous success, and this latest development will mark a new departure in naval warfare.

## SCIENCE NOTES

Dispatches from the Bourges observatory show that the sun after a long period of quiescence has again entered into a state of activity. On March 27, there was visible on the solar disk a large spot measuring 1,864 miles in diameter. Again, on March 30, four sun spots, two of them extensive, were observed.
C. Hartwich and W. Uhlmann state that the fat of gentian root is not a saponifiable ofl, but a cholesterinlike body. The chloroformic solution, when treated by Hesse's test with concentrated $\mathrm{H}_{2} \mathrm{SO}_{i}$, colors the acid a bright red with a green fluorescence, and the chloroformic layer passes from yellow to red, and finally, after standing for twenty-four hours, to violet. By Liebermann's test, treating a solution in acetic anhydride with concentrated $\mathrm{H}_{2} \mathrm{SO}_{4}$, a red color, passing, on shaking, to bluish-green, and finally olive green was obtained. A similar cholesterin reaction also re sulted with Salowski's test. The fat was extracted from the root by means of ether. It occurs to the extent of 5.67 per cent, and forms a dark yellow, viscous substance, having the characteristic odor and taste of the drug. By shaking out the petroleum ether solution with water and alcohol, 50 per cent, the odorous and bitter principle is removed.
That there are bacteria, some large fungi, and rotten woods which give phospherescence or shine in the dark, has long been known, but it is a question whether there are shrubs or flowering plants that have the same property. Dr. H. Beckurts has recently, however, discovered a notice printed in 1845, stating that at the session of the Royal Asiatic Society, held April 5 of that year, the dry roots of an Indian plant were exhibited which pcssessed the property of shining or phosphorescing in the dark. An Indian officer, so goes the story, who took shelter from the rain under some projecting rocks, observed that the neighboring grass phosphoresced, and he gathered several specimens of the grass and brought them to General Cullen. The latter stated that the plant was long known to the Brahmins under the name of "diotishmati," belonged to the family of the vegetable Sapindaceæ, and was identified as the Cardiospermum halicacabum. This, however, cannot be, since Lindley, who presented the root to the association, stated that it was a rhizome of a monocotylic plant of the Orchidaceæ or Iridaceæ. According to Watson the Indian plant "diotishmati" belengs to the grasses. It is, however, believed that the fact in the case was that the plant was probably covered with one of the phosphorescing fungi, which caused the error of observation in the young officer.

Mr. F. W. Very, of the Allegheny observatory, re cently published a series of measurements on the radiations received from different portions of the solar disk. The measured amounts of radiation were found to diminish outwardly from the center, contrary to the assumption of a uniformly absorbing atmosphere. Taking Mr. Very's figures as a basis, Prof. Ar thur Schuster, of Manchester, publishes in the Astro physical Journal an examination which shows that the difficulty of explaining the law of variation of in tensity across the sun's disk is readily removed by placing the absorbing layer sufficiently near the photosphere and by taking accounts of the radiation which this layer, owing to its high temperature, must itself emit. There is no reason to look to a different region in the sun's atmosphere for the cause of the observed diminution of radiation than that which gives the Fraunhofer lines. The simplest supposition to make at present, and one consistent with our knowledge of spectra, is that the layer which gives the line-absorp tion absorbs also to some extent all wave lengths extending from infra-red to violet, and that the diminution in the observed intensity of the solar radiation to ward the edges of the disk is due simply to this absorption. The principles developed in this paper may find a wider application. Some observers have been puzzled by the fact that the radiation of the umbra of sun spots does not diminish as it nears the edge of the sun in the same way as that of the luminous disk itself, but, on the contrary, remains nearly constant. This investigation shows that in the case of the solar disk only about half of the radiation comes from the photosphere and that the rest is made up by the radiation of the absorbing layer itself. If that absorption, either by increased density or by greater thíckness, is increased four or five times, practically the whole of the radiation would come from the absorbing layer and would be nearly constant for different portions of the solar disk.

## A NEW SODA-WATER MACHINE.

In the manufacture of soda and mineral waters, it is important that the water to be charged should come into contact with carbonic acid in the form of a fine spray or a thin film, in order that it may be thoroughly saturated. In the machine herewith illustrated, the water is spread out into a thin film by being forced through the unglazed porcelain walls of the chamber, and it there comes into contact with the carbonic acid which is held under a pressure of a few atmospheres. The water of a city supply system does not usually have sufficient pressure to force through the pores in the porcelain, and it is, therefore, necessary to raise the pressure by means of a transformer. The machine is, therefore, equipped with a water motor driven by the city water supply which multiplies the which multiplies the
pressure several times. pressure several times.
In one of our illustrations the supply pipe is indicated at $A$ and leads from a faucet to the transformer at the bottom of the machine. From this point at a greatly increased pressure it is conducted up the pipe, $B$, to the top of the machine, where it passes through the porcelain walls of the carbonic-acid chamber. Within the chamber the water oozes out in tiny globules which trickle down the sides trickle down the sides
of the wall and are of the wall and are
thoroughly saturateo with carbonic acid, which is supplied from the tank, $C$. The saturated water then passes down into the reservoir, $D$, whence it may be drawn off into bottles as illustrated. The capacity of the machine depends largely upon the pressure employed. If local circumstances permit of artificially cooling the water, this, also, may add a great deal to the productive power of the apparatus; for it is a well-known fact that water of a low temperature absorbs a greater quantity of carbonic acid in the same space of time and under the same circumstances than it does at a higher one; for example, one quart of water at 0 degrees Cent., under a pressure of 5 atmospheres, will absorb 8.65 gallons of carbonic acid, and at 12 degrees Cent. will absorb only 5.15 gallons. The soda water obtained from this machine will be very pure; for on being passed through the unglazed portion the water deposits there not only all floating particles, but at the same time any disease germs it may contain. Where no water pressure is available for driving the water motor, a special form of machine is provided, in which the pressure of the carbonic acid is utilized to force the water into the saturating chamber. This form of machine will be especially useful at country resorts, on board ship or for army use, to afford an economical yet very efficient means for producing pure carbonic drinking pure carbonic drinking water. The machine is
the invention of Mr. Jan the invention of Mr. Jan
Frederik Beins, and is being introduced by B. F. Hagan, of Wijnstraat 116, Rotterdam, Netherlands.

## Cost of Warship Construction.

Owing to the general understanding between the various shipyards of Germany, whereby prices can me conveniently arranged, and inter-competition thereby averted, the Reichstag has passed a remarkable resolution to create competition between the various shipbuilding firms various shipbuilding firms undertaking the construc-
tion of German war vestion of German war ves-
sels, by which it is hoped the cost of building may be reduced. The gist of
this resolution is that foreign firms be allowed to compete for the construction of vessels for the imperial navy, and the Reichstag emphasized its determination to force prices down by countermanding orders for two new boats, and reducing the sum of $\$ 500,000$ for altering a cruiser to $\$ 125,000$. An interesting comparison of the construction of German and British war vessels has been drawn up, whereby it is shown, although absolute relative costs, owing to slight variations in the sizes of the equipments of the vessels of the respective powers, are unavailable, that

filling a bottle from the soda-water machine.
the English war vessels are built much cheaper than corresponding warships in the imperial navy. For instance, the German third-class type of cruisers of 2,665 tons, 8,000 horse power, and $211 / 2$ knots cost $\$ 837,500$, while similar vessels in the British navy are built for $\$ 675,000$-a difference of $\$ 162,500$ in favor of the English builders. In connection with gunboats the difference is much more marked, the British vessels costing $\$ 200,000$ less than the German gunboats, notwithstanding that the former, though 85 tons lighter, develop 2,300 more horse power and have a greater speed of $53 / 4$ knots.

AN ELECTRIC ORE-REDUCING APPARATUS.
In order to facilitate the reduction of finely comminuted iron ore, it is necessary to agglomerate the ore into lumps of convenient size to be subsequently manipulated in the reducing furnace. Heretofore this has usually been done by mixing in some cementing medium and pressing this mixture into briquettes.


THE RUTHENBURG APPARATUS FOR AGGLOMERATING AND REDUCING IRON ORE

However, this method is objectionable because the cement forms an additional impurity which must be subsequently eliminated. We illustrate herewith an apparatus invented by Mr. Marcus Ruthenburg, of Philadelphia, Pa ., and which is calculated to accomplish the desired results without the use of any cementing material. The apparatus, which is mounted to swing over a series of soaking pits arranged in a circle about the supporting post, consists of a pair of carbon-faced bronze rolls slowly revolved by an electric motor through the intermediary of worm gearing. The frame on which the rolls are mounted consists of a heavy horseshoe mag net divided at the rear by an insulated hinge through which the sup porting post passes. The magnet coils are wound on that portion of the magnet arms lying just back of the carbonfaced rolls. The poles, however, project within the rolls and are so shaped as to maintain an intense magnetic field between them at their line of nearest approach. The space be tween the rolls may be increased or decreased by operating the turn buckle at the rear of the apparatus.

In operation the rolls are rotated toward each other at a rate of from one to four rotations per minute. The ore to be agglomerated is fed onto the rolls from an automatic feeder above, which is not shown in our illustra tion. The magnetic field serves to hold the ore from dropping off the rolls as they rotate, and in this position the ore forms an electric bridge of high resistance for a heavy current passed between the rolls. This serves to melt the ore and form it into lumps which drop into a soaking pit below. Four hundred and fifty kilowatt hours will melt one ton of product, or the continuous expenditure of 19 kilowatts will melt a ton in 24 hours. The rolls are water-cooled, so that the carbon-faces never become heated to a higher temperature than can be borne by the hand Since the heat is engendered within the bridges, there is but little loss by radiation. Coal dust is usually mixed with the ore before it is introduced into the furnace so that a partial reduction takes place, and a further portion of oxygen is removed in the soaking pit, so that the product is then ready for melting in the open-hearth furnace as steel.

All the trolley lines entering Cleveland, Ohio, have entered into an arrangement to engage in the freight and express business on a very extensive scale as direct competitors to the railroads of that vicinity A large depot for the classification and handling of freight is being erected at a point in the city convenient to all the lines and it is expected that they will gather in a great deal of business. This method of handling the freight and express business has grown in such favor in some localities, particularly in the Middle West, that its merits are forcing them selves in those sections selves in those sections tofore protected the railroads. In Pennsylvania for instance, there is talk of the introduction of a measure in the next legislature permitting electric transportation companies to engage in express or freight business, and although it will be bitterly fought by the railroad companies, the probabili ties are the measure will become a law.

## A simple rerosene engine.

Considerable improvement has been made in the past few years in the utilization of kerosene oil as a motive power for combustion engines. Kerosene oil can be had almost anywhere, and on this account the prob-


## a valveless rerosene engine.

lem of supplying a cheap small power is greatly simplified. Our illustrations show a new type of kerosene engine recently introduced, which has the merit of simplicity in a remarkable degree. It is of the twocycle type, in which an explosion occurs in the cylinder at every revolution of the crankshaft; but its two most important features are that it operates without valves, and that the oil is forced by means of a small pump into the cylinder in the form of a spray through a suitable nozzle at the instant the piston begins to descend on its downward stroke, thereby avoiding premature explosions. Referring to the diagram, it will be noticed that the ignition is accomplished by the usual ignition hot tube or dome $D$ at the upper end of the cylinder, the dome being protected by a damper cap to prevent heat radiation after the engine is started. A concentric cap fits over the inner cap. When both apertures coincide, the heating lamp for starting is placed inside; after starting, the outer cap is rotated till the apertures are covered.
The operation of the engine is as follows: the ignition dome $D$ is heated for five minutes or more by a Primus kerosene blue-flame torch, then the handle of then the handle of
a small oil pump a small oil pump (seen on the lefthand side in the larger engraving) is operated a few times, to force the oil up from the tank $T$ through the tank $T$ through tie nozzle $O$ into the cylinder $F$. One or two quick turns of the flywheel are given, then the engine starts.
On the up-stroke of the piston $P$, air is drawn in through is drawn in through
two holes $A$ in the two holes $A$ in the
base, and follows the piston through the port $B$ into the
crankcase $C$ as soon as the piston uncovers the port On its descent the piston slightly compresses this air in the crankcase until its upper end uncovers the exhaust $E$ and also the air inlet $I$, then the exhaust gases pass out of $E$, and by the curved top of the piston the air from the crankcase is projected upward at the same time into the cylinder and locked there upon


MOTOR COACH BUILT FOR THE LONDON AND SOUTH-WESTERN RAILWAY.
seriously considered. In Great Britain several attempts are being made to introduce the motor-pro pelled vehicle upon certain branches of the railroads. Although the North-Eastern Railway Company was the first to decide upon the innovation, the first actual coach built upon these principles for use has been constructed conjointly by the London and South-Western Railroad and the London, Brighton, and South Coast Railroad, two trunk lines operating in the south of England.

The self-propelled motor coach possesses many advantages over the existing system for some phases of railroad working, the most obvious of which is its


SECTIONAL ELEVATION OF KEROSENE ENGINE.
utilization as a feeder to the through lines. Some branch lines extending through sparsely-populated areas cannot be profitably operated, although a train service is absolutely necessary. It is for such exigencies that the self-propelled motor coach is peculiarly suitable, since the cost of maintenance is much less than that of a fully-equipped train.
The experimental coach constructed by the London and South-Western and the London, Brighton and South Coast Railroads, a photograph of which we are enabled to publish herewith through the courtesy of Mr. Drummond, the chief engineer to the former railroad, is intended for service between Fratton and Havant, a short line on the south coast joining the Havant, a short line on the south coast joining
main trunk systems of the respective companies.
This coach consists of practically an ordinary pas senger vehicle, with a small space allotted in the fore part for the accommodation of the motor. The latter in this instance is of the steam type. The coach is 56 feet in length over all, including the engine. It is carried upon two four-wheeled bogie trucks, the driving mechanism being attached to the two fore wheels of the front bogie. The passenger accommodation is divided into two compartments, one for first-class, and the other for third-class passengers. The compartment for the latter has a capacity for 32 passengers, the seats being arranged in the manner that prevails in American cars, on each side of the gangway, which extends through the center of the car. The first-class compartment is built to seat ten passengers, the seats in this instance be ing arranged longitudinally on either side of the car. Between the space reserved for the passengers and the motor is a small space for the con veyance of ten tons of baggage. The boiler, to economize space, is of the ver tical type. The front pair of wheels of the fore bogie truck, as already stated, are the driv ers, the cylinders being of 7 -inch diameter and 10 -inch stroke. A cab is provided for the engineer and his fire

## MOTOR COACHES FOR BRITISH RAILROADS.

Now that the automobile has asserted its superiority over other systems of rapid locomotion upon the highroads, and the engines for propelling the vehicles have been developed to a high standard of efficiency, the adaptation of the motor car to railroads is being
man. As will be recognized from our illustration, the motor has been compressed in as small a space as possible, and the general arre agement of the vehicle is very ingenious. The coach has been designed with the idea of attaining a speed of 30 miles an hour in half a minute after starting. There is no doubt that this class of self-propelled motor coach
will prove profitable in its working, since it is of ample size to cope easily with the numbers of traveler requiring to journey over the few miles between Frat ton and Havant at any time of the day. Should the coach prove successful, further vehicles of the same kind will be constructed for service upon other similar short sections of the railroads, and will in al probability be requisitioned for suburban traffic.
While the southern trunk railroads have adopted the steam motor for these automotor coaches, the North Eastern Railroad has decided to utilize the petrol mo tor for the same purpose and is carrying out a series of experiments with various types of motors, to as certain which is the best suited to their require ments. Orders have been placed with the Wolseley Motor Company, of Birmingham, and the Napier Motor Car Company, of London. The former company is building two motors, each to develop 95 horse on the brake. They are of the horizontal type, while the Napier belong to the vertical category, though it is anticipated for this class of work that the former will prove more satisfactory. These engines have not yet been completed, so we are unable to publish a photograph of the petrol-propelled coach.
The cars measure 53 feet, 3 inches from buffer to buffer, and the greatest width is 9 feet, 6 inches over balks. It is carried on two four-wheeled bogie trucks, the distance between which from center to center is 34 feet. The wheels are of 3 feet, 6 inches diameter over treads, and are provided with the usual type of axle-boxes, springs, etc.
The third-class coach is designed to carry 48 passengers, while the first and second class composite ve hicle has accommodation for 14 and 24 passengers respectively. In the front of the coach is the compart ment for the petrol motor, which is direct-coupled to an elcectric generator mounted on one baseplate. This compartment also contains a small exciting dynamo for exciting the fields of the generator, and for charging a small battery of accumulators for lighting, etc. This battery is contained in a suitable box slung be neath the frame in the center of the coach. The en gine compartment also contains one complete set of control apparatus-controllers, regulating resistances, and switches-for driving the car, for driving the coach forward, while another set is installed at the other end of the coach for driving in the opposite direction. Each bogie is fitted with a powerful elec tric railroad motor.
The prime motor is a Wolseley 80 horse power four cylinder petrol engine of standard type. The four cylinders are each $81 / 2$-inch bore by 10 -inch stroke, giv ing 81 brake horse power at 420 revolutions, and with an acceleration up to 480 revolutions the engine gives 95 brake horse power. The cylinders work in pairs on two crankpins at 180 degrees from each other, thus obtaining two impulses at every revolution. The elec tric generator is of 60 -kilowatt capacity, 500 volts, at 450 revolutions per minute, with a 5 -kilowatt exciter An electric railway motor of 50 horse power is mounted on each of the two bogies. There is a battery of 40 accumulators carried beneath the coach, of about 90 amperes capacity, for lighting and starting the petrol engine through the exciter. The choking and acceler ating levers, and all controlling apparatus for the engine room and dynamo, are conveniently situated in the engine room. The necessary gear, such as brakes, controllers, etc., for driving the coach is installed in duplicate, one set at each end of the car, to enable the driver to occupy the front of the car when going either way.
The Westinghouse automatic air brake is installed, acting on all wheels, the air compressor being driven by a small electric motor. Powerful screw compen sated hand brakes are also provided, a brake whee being fixed at each end of the coach for its operation. A siren is fitted to each coach, operated by com pressed air from the Westinghouse brake reservoir Petrol and water tanks are provided of sufficient capacity to enable the car to run continuously for five hours at speeds up to 30 miles per hour. Ample si lencers and exhaust boxes are also provided.

## THE COAL INDUSTRY OF PENNSYLVANIA. <br> y w. frank m'Clure

Five years ago Great Britain produced more coal than America or any other country of the globe. Since that time the United States in one year has mined $25,000,000$ tons more than Great Britain and all her possessions. This is one of four important facts peculiar at this time to American coal mining. The other three are found in the development of the vast Southern resources, the combining of mining proper ties, and an evolution of the industry.
The development of the Southern fields gives some promise that the United States will yet become an important exporter of coal. The numerous consolidations of mining properties are believed to be the first steps toward another such giant combination as that represented by the United States Steel Cor poration in the world of iron and steel.
Since surpassing England, the United States has
not only maintained her prestige, but has increased it. The annual output has grown nearly one-half in five years, and is now figured at one-third that of the world While there is an end in sight to England's coal, in America there is no visible end except to Penasylvania anthracite. The annual American production now exceeds $293,000,000$ tons, of which more than $225,000,000$ tons are bituminous. To dig out this coal nearly a half million men are employed, of whom less than 150,000 are engaged in the famous hard-coal regions, which are located in Pennsylvania save very small beds in New Mexico and Colorado.

Five hundred or more feet beneath the surface of the ground of the anthracite or bituminous regions of Pennsylvania there exist many busy mining centers. So varied is the topography of the coal regions, and so different are the conditions and the necessities in the different localities, that no description of the construction of mines and methods of mining and transportation can be true of all mines, even though of the same type. The mines pictured on another page are of the shaft type, and are to be found in largest numbers in the hard-coal districts. The hard-coal mines are likewise the deepest. Occasionally an extreme depth of 1,500 feet is attained. The mine foreman's office, which is shown in the illustration, is 550 feet beneath the surface in the soft-coal fields of the Connellsville regions. The mine in which this view was taken is owned by the United States Steel Corporation, and is the deepest one in that section of the State.
Incidentally, there are two other styles of mines to be found in both anthracite and bituminous fields"drifts" and "slopes." The drift mine is dug straight into the mountain from one side. The passageway or heading may have an upward trend. The slope mine slants downvard to the extent of perhaps thirtyfive or forty degrees, the main heading often measuring a mile or more in length.
Occasionally coal is found in quantities near the surface of the ground. This is true to-day in parts of Missouri. At both Hazelton and Summit Hill, in Pennsylvania, coal has been extracted by an uncover ing operation known as "stripping," and which is re garded as apart from mining proper. An interesting process also is "pocket mining," but this is practised comparatively little to-day. An outcrop of coal a various points on the side of the mountain suggests the possibility of a rich mineral vein. Digging is begun directly into the bed of coal projecting at the surface. This form of mining is seldom highly profit able, for when the digging has progressed at considerable expense to a point where the mine should be expected to pay, all operations are suddenly cut short by the encountering of solid rock, which, owing to some upheaval of the past, has "faulted" the vein of coal from its natural course. These pockets a intervals in the mountains where pocket mining is done present an interesting sight. About Shickshinny, Pa., they are numerous.
Descending by means of an elevator into the depth of the soft-coal mine before mentioned, we find ourselves in front of a whitewashed haulageway which extends far into the distance. The mine is a strictly modern one. Nearby we find a door leading into the mine foreman's office, and this in turn con nects with the office of the fire boss. The foreman sits at his desk in the midst of mine reports and books of rules. Like the miners in the distant rooms, he is breathing fresh air, made possible at this depth by an air course which parallels the elevator shaft the bad air being drawn out by means of fans, while the pure air rushes down the shaft to take its place In close proximity to the foot of the elevator shaft are the stables of the mules, and these are likewise whitewashed. The mules in such a mine as this do not see daylight for months at a time. The haulageway, the offices, and the stables are lighted by elecway, tre
In shaft mines, and especially those of anthracite mules are used very extensively. Where mechanical power is employed to haul trains in the main haulage ways, these beasts bring the cars only from the side headings or the rooms. In bituminous drift mines the evolution has included the introduction of miniature trolley trains of forty or fifty cars, each train being in charge of a motorman and brakeman. In anthracite drifts steam locomotives of a small and peculiar type known as "hogs" haul the trains. In a slope mine cable trains transport the coal. One end of the cable is attached to the train, and the other winds upon a drum at the power house. When the cable turns a corner it passes around what is known as a "bull wheel." Twenty-five one-ton cars may comprise a cable train of soft coal. Anthracite cars often hold four and a half tons. In soft-coal mines the man in charge of the cable train is called a "rope ider." In bringing his cars out of the mine he sits upon the ring which connects the cable with the train. In the anthracite slopes a man stands upon the side of a car ready to "sprag" the wheels when a stop
is made. Spragging consists in throwing short but stout lengths of wood into the openings between the four spokes of the car wheel.
The differences in the modern soft-coal mine and the anthracite mine are very perceptible. It has been found impossible to employ electrical machinery and mechanical inventions in the actual mining opera tions in anthracite. Therefore picks and hand drills with blasting powder are still the mainstay of the anthracite miners, and the 4,000 machines in use in the United States are all at work in soft coal. More than fifty per cent of the big increase in bituminous coal production in the past few years is accounted for by the rapid introduction of machines. They are now in use in half the States and Territories. One third of the bituminous product of Pennsylvania is mined by their aid. These machines make the undercut that is to loosen the coal at the bottom. They cut as far back as the vein is high. The blade, which is four to six feet in length, severs the block of coa at the bottom and drills bore holes horizontally at the top. Powder is crowded into these holes and a fuse, or squib, is lighted. Blasting operations are similar in the anthracite regions. There, however the miner may break down enough coal at one blast to keep his helper busy loading for two days.
The photograph of the room in the hard-coal mine illustrates nicely the great height of the veins of coal in the anthracite districts. The height of the bit uminous vein is often not more than four or five feet, thus making the quarters of the miners rather cramped. In the mining of anthracite only two-thirds loosened from the vein is of value. The miner must use good judgment in loading only the paying coal. To handle and transport chunks in which slate predominates is unproficable. Even the better coal has more or less slate in it, while in bituminous coal the slate is principally at the top and bottom of the vein and not mixed with the product as mined.
Off from the main or side headings of a hard-coal mine "breasts" or "chambers" are opened. In bituminous fields these are known as "rooms." A tunnel or neck forty to sixty feet long may connect the room proper with the main passageway. Beyond the neck the chamber may broaden out to a width of thirty or more feet, continuing indefinitely. The coal between the rooms forms what is known as a "rib" or "pillar." As the rooms begin to broaden to their maximum widths, timber props are placed between the floors and ceilings to support the loose rock and earth. Apart from supporting the great mass of solid rock, they are of little service.
When all the coal that it is practical to mine in the chambers has been extracted, the work of drawing the ribs between the rooms is begun, eventually allow ing the rock above to cave in. In addition to secur ing the coal in the ribs, this process is necessary that the weight of the mountain bearing upon the entrance to the mine may be lightened. As mining progresses, the weight is thrown upon the main heading, until, were it not for the drawing of the ribs, this main passageway would close.

When drawing a rib, the soft-coal miner keeps but one car beside him. He can not tell how much of the rib he will be able to remove before the rock above his head will fall. The first warning of approaching danger is a drumming noise from the layer of stone overhead. Sometimes this noise may be heard hours before the final crash; in anthracite mines it may be perhaps weeks before. Again, it may come with marked suddenness.
The coal breaker, about which the public has heard not a little during the last big coal strike, is an anthracite institution. The breaker is mentioned per haps oftener than some other important plants chiefly because of the tender ages of the thousands of workers employed within them. The character of anthracite coal as mined makes it imperative that the breaking of it shall comprise a branch of the coal industry. The large chunks must be broken and the slate must be separated.
A modern coal breaker built on the side of a hill at Mocanaqua, Pa., will serve to illustrate the con struction and operations connected with this im portant branch of producing coal. This breaker is 300 feet in length and 180 feet in height. Ten tons of spikes and naiis were used in its construction It is capable of turning out 1,000 tons of clean coa per day. Some breakers have a capacity several hundred tons more. The Mocanaqua breaker was origin ally built at a cost of $\$ 50,000$, but with recent im provements and the installation of the latest machin ery its total cost reaches $\$ 100,000$. It is heated by steam.
Two $41 / 2$ ton cars of anthracite are brought to the head of the breaker at one time over a. little railway leading from the mine in the side of the mountain The coal when dumped from the cars passes over a screen thirty feet in length, through which the fine coal sifts. The big. chunks next pass to the breaker
product is larger than what is known as "steamboat size." It next runs into a screen which is cylindrical in shape, and not unlike a locomotive boiler in appear ance. As the coal is handled in this device, it falls through perforations of different sizes, each size dropping into a separate chute. On benches at inter vals on these chutes, sit the breaker boys, presided over by a boss. As the coal passes slowly down th chute at their feet, these lads pick the slate from it and throw the refuse into a paralle! chute. The inex perienced boys are always at the upper end of the chutes. They succeed in picking a part of the slate from the coal, and then it passes to the next workmen in line, who continue the operation until, by the time the product has reached the last boys in th.e rows-the ones at the bottom of the chutes--it is pretty well cleaned. From the chutes the various sized coal finds its way into bins, from which it is discharged into cars.

It is said to be difficult nowadays to find as many breaker boys as are needed, and, partly on this ac count, mechanical contrivances for sorting have recently been installed at great cost in modern breakers. These inventions are spiral in shape, and provide for ridding the coal of much of its slate by centrifugal force. But even with these machines the final operation must be performed by boys or men.
A large amount of the soft coal in Ohio and Pennsylvania is brought to the lower harbors of the Great Lakes, bound for the Northwest and Canada. The cars which carry this coal have a capacity of 100,000 pounds, whereas, in the early days of the coal industry in this country, coal cars scarce carried 1,800 pounds On reaching the lake ports, coal for Canada may b taken sixty miles across Lake Erie in car ferries But the bulk of the coal that comes to the lake ports is unloaded directly into the holds of lake vessels by means of most wonderful and massive machines, which pick up a 50 -ton car and dump its contents as quickly as a pail of coal could be emptied into the magazine of a stove. Some of these machines can be operated by three men, and yet have a capacity of 500 tons per hour. A large and modern coal vessel will carry a coal cargo of 6,000 tons. The cargo record is 7,800 tons. More than $2,500,000$ tons of coal have gone to the head of the Great Lakes in a single seasoz.

## Marconi's Recognition of Italy's Services.

The large rentals and heavy royalties demanded by the Marconi Company are said to be the thief reasons why the United States government has decided to adopt the Slaby-Arco or some other system. It is interesting, therefore, to note that Mr. Marconi is not quite as selfish as the reports which have been circulated would seem to indicate. He has ceded his apparatus to the Italian government, free of charge, giving permission to have it renroduced in military establishments, provided that his patents be not infringed. It is said that twelve wireless tele graph stations will be established on the coast and on the islands off the Italian coast, each station having an average range of about 200 rniles. Some of the stations are to be completed before the end of the present year, and the others within the first six months of 1904. The arrangement as to rates deserve some attention.
The receipts from telegrams sent from stations on the Italian coast will be paid into the government treasury; the receipts from mesages sent from ship equipped with the Marconi apparatus will go to the Marconi company, and finally, the Italian govern ment will receive a fixed tax of one lire per message above the ordinary cost of telegrams.

## The Use of Phosphorus Matches Prohibited in Germany

The Reichstag has passed a bill forbidding the use of white or yellow phosphorus in match-making after January 1, 1908. The Secretary of the Interior, sreaking in favor of the bill, said that phosphorus uot only caused necrosis three or four years after a workman had left a match factory, but that the disease thus contracted was hereditary, so that whole families were affected. So subtle were the effects, that the bones were fractured without the person being $f$ ven aware of the fracture at first. The government has reported favorably upon a match-manufacturing process said to be safe and harmless.

On May 9, the largest glass bottles even blown were made at the plant of the Illinois Glass Company for exhibition at the World's Fair. The capacity of each bottle is 45 gallons. It was not until after many unsuccessful attempts that the iottles were nade. Four perfect bottles were produced. Each stands nearly 6 feet high and measures about 16 inches across the bottom. The men who blew the bottles each supplied about 11,000 cubic inches of air.

It is likely that a system of power fans will be used to ventilate the New York subway when it is completed. The problem, however, of suitably venti lating the subway will not be formidable, for the reason that the stations are close to the surface of the ground. In this respect the New York system will differ widely from that of London, where the tubes are so far underground that the air quickly becomes vitiated.

A great pumping scheme is to be carried out in South Staffordshire, England, by means of which over $40,000,000$ tons of coal which are at present submerged will be released and rendered available for mining The district in which the scheme is to be carried out includes the important industrial centers of Tipton Wednesbury, and Bilston. The project has been con templated for many years past, but it is only recently that the scheme has been reduced to any practical form.

His Majesty's battleship "Hood" arrived at Devonport recently after steaming from Malta, a distance of 2,035 miles, without a rudder. On docking at Malta it was found that the rudder could not be satisfac torily repaired, and that it would be necessary to fit a new one, which must be cast in England. The disabled rudder, weighing fifteen tons, was accordingly hoisted on board and lashed fast on the deck, and on October 21 the "Hood" left Malta rudderless, ar riving at Gibraltar on October 24, having done 981 miles at an average speed of twelve and a half knots an hour. Leaving the Rock on the following day in a strong northeasterly gale she ran into a fog on the last day of her voyage (Tuesday), but ultimately reached Plymouth the same evening, having made the 2,035 miles in a little over six days, or at an average speed of nearly thirteen knots an hour. This would be a good performance for any battleship under normal circumstances, but for a vessel without a rudder in a heavy sea, continually being twisted round out of her course, it is a feat of seamanship reflecting the greatest credit on her officers. It should be added that the "Hood" was convoyed by cruisers.
In these days of high coal prices and strikes, it is interesting to know that peat gas has been employed as fuel at the Motala Steel Works, Sweden, for the past thirty years, originally for the puddling furnaces, and to a still greater extent, subsequently, for the open hearth furnaces. The peat is obtained from the further side of Lake Wetter, across which it is brought in sailing vessels and unloaded directly into large storehouses, whence it is trammed to the gas producers. The yearly consumption is from 13,000 to 16,000 cubic yards of dry kneaded peat, costing about 75 cents per cubic yard delivered at Motala. Two large gas producers are used, from which the gas is led to the open-hearth furnaces through oa condenser for rid ding it of some of its moisture. Although the pea gas, owing to the distance the peat has to be brought, is dearer than coal gas, it is used preferably in most Swedish steel works in consequence of the insignificant amount of sulphur and phosphorus it contains. In the rolling mill there is a smaller peat-gas producer for one of the plate furnaces, and thin steel plates especially scale less in rolling when the furnace is fired with peat gas.

The designs of the Quetta Nushki Railroad in Persia as a light road capable of being brought up to the standard of other frontier railways, when the circumstances so demand, have been completed and accepted by the government of India. The length of the line is $821 / 2$ miles, and the estimated cost is about $7,000,00$ rupees, or 85,000 rupees per mile. The route selected for the construction of the track involves passing through three mountain barriers, viz., the Chiltan, the Mashelak, and the southern tail of the Khwaja Amran range, which separates the Quetta plateau from the Nushki plain, by the intermediate steppes of the Mas tung and Sharud plains. The road leaves the existing Bolan section of the Northwestern Railway twelve miles from Quetta, and three from Spezand Station. Through the three mountain ridges the work is heavy, and good permanent foundation is provided for. Otherwise the country is comparatively easy, and a surface track only, capable of improvement later on, is at present in tended. The steepest grades are 1 in 50 , compensated for curvature, and the sharpest curve has a 573 -foot ra dius. A tunnel at Spezand is to be built, 2,600 feet long five miles from the commencement, and the heavy works in the Sheikh Wasil gorge, miles 27 to 32 , are to be put in hand at a cost of about $4,750,000$ rupees during the current financial year, and work on them will be commenced at once. These are the only heavy works in the first 50 miles; and as soon as they are negotiated there will be no further difficulty in at once carrying out the road to that distance. This will give immediate access to the Sharud plain, and will enable the entire line to be completed with speed and economy. This railroad will not only be an important one from a comruercial point of view $\mathrm{m}_{2}$ but is also of great political significance.

## Electrical Notes.

During a research into the electro-chemical behavior of sulphur Mr. F. W. Küster has observed that during the electrolysis of a solution of a polysulphide, both the current and the voltage undergo periodic variations, which are shown to be due to the deposition of sulphur on the anode. The periodicity of the phenomenon is, however, difficult to understand. In order to throw light on this, a number of measurements of the potential differences between electrodes of platinum or of silver and solutions of sodium polysulphides were made. The results show that such electrcdes may be regarded as sulphur electrodes, just as a platinum plate saturated with oxygen may be regarded as an oxygen electrode.

When we consider what an important adjunct the telegraph has become to the railroad, says The Electrical World and Engineer, it is hard to get one's self back to the time of the Baltimore \& Ohio experiments of 1844 , and to take seriously Prof. Morse's sugges tion that if a break were found in the telegraph wire the train should stop long enough to repair it. But this is what he said: "Very little interruption would take place if the train that discovered a break would stop not more than five minutes, and, being furnished with pieces of wire already prepared for the purpose, any one could simply unwrap and scrape the broken ends and unite them by twisting the ends of the piece of wire to them."
This country is rapidly becoming the center for the manufacture of cables for underground telephonic communication over long distances. The reason for this is not due to any economical or other aspects in the actual manufacture, but is entirely the result of at mospheric influences. One of the greatest difficulties that confronts the problem of telephone practice over long distances in England, is the provision of satis factory insulating material. All insulating substances at present utilized in the manufacture of cables absorb the electric current to a certain degree. The extent of this absorption depends upon two factors-the na ture of the dielectric employed and the potential of the current transmitted through the wire. In the cases of high-tension currents the leakage in this direction is so small as not to be worthy of notice, but in the case of a telephone cable, where the potential of the current is very low, this absorption is a matter of grave importance. So far the best dielectric yet discovered is anhydrous paper, which is extensively adopted in Eng land. This substance has the lowest specific inductive capacity of any known dielectric. In order that cables composed of anhydrous paper may be rendered abso lutely trustworthy and satisfactory, it is imperative that the process of manufacture should be carried out in a perfectly dry atmosphere. Should the paper cone into contact with moisture at any time during the making, its future good working will be absolutely nul lified. In Great Britain, owing to the natural humidity of the atmosphere, it is absolutely impossible to manufacture the material; while in this country, owing to much drier atmospheric conditions, we are enabled to turn out a perfect article. Consequently, the indus try has fallen into desuetude in Great Britain, while this country is becoming the center of the supply.
M. S. Leduc recently explained before the Academy of Sciences in Paris his method of inducing sleep and anæsthesia by electrical currents. He employs an in terrupted current in a low-resistance circuit, and sleep is induced by gradually augmenting the E. M. F. in the circuit. From further information we have re ceived it seems that the frequency of the current used is from 150 to 200 periods per second. Besides the interrupter, there is also placed in the circuit a mil iampere meter, the period of oscillation of which is much longer than the duration of the interruption of the current. Under these conditions, when the instru ment is traversed by an intermittent current the needle undergoes a permanent deviation, which enable the intensity of the currents having the same inter mittence and the same duration to be compared. Le duc has experimented with currents of varying degree of intensity, but those which gave the best results had from 150 to 200 intermittences in the second with tension of from 12 to 30 volts. The cathode is made of hydrophilous cotton impregnated with a solution of sodium chloride of the strength of 0.60 per cent and covering with a plate of metal. This is placed on the shaven head of the animal to be experimented on, while the anode is placed on the hinder part of the back, which is also shaved. The E. M. F. is in creased till convulsions take place, and the animal falls on its side and respiration ceases. The handle of the regulator is then brought backward till respira tion returns, and with a certain strength of current tranquil, ordinary sleep is induced. The duration of the sleep is variable, in many instances lasting for two hours or more without any ill effects upon the subject. The return of consciousness is effected by the removal of the current, and no injurious consequences are said to follow.

## WIRELESS TELEPHONIC COMMUNICATION BETWEEN

 MOVING FERRY BOATS.G FERRY BOATS
The electrical transmission of speech to a distance without the intervention of wires was given a com mercial test last week when Mr. A. Frederick Collins telephoned between two ferry boats which were moving in opposite directions on the North River between Jersey City and New York.

The test was the culmination of a long series of experiments begun three years ago at Narberth, Pa., and continued to the present time. During the past summer Congers and Rockland Lake, N. Y., served as a proving ground, but during the winter Mr. Collins transferred the scenes of his activity to this city. In April, he proposed to the officials of the Erie R. R. to apply his system to the boats of their ferry. Mr. Collins was given every facility to carry out his plans. He made a beginning by carefully studying the needs of the service in this regard and by thoroughly inspecting the conditions under which he would have to would have to work. He learned tha there were, as regards th h ferry boats at least, $\quad \mathrm{t}$ w o kinds of bot toms, iron and wooden; but wooden; bu the wooden bottoms, while rendering it easy to attach th h contact plates which are a part of the system were surrounded at the water line by a contin u ous sheathing of copper 36 inches wide. Deeming it possible that the lines of force might be carried around this conductor instead of being propagated as the successful working of the apparatus requires, he decided to us cided to us the iron bot toms, thoug this would in volve the use of other means of contact than the securing of the plates to the boats' hulls. There was also an uncertainty as to what effect this immense mass of metal would have in deflecting the current from the desired direction. Mr. Collins was working under absolutely new conditions. Experience proved that the iron bottoms held no inherent difficulties for wireless telephony; but an unexpected difficulty arose indirectly on their account. In Mr. Collins' system the contact with the water should be made by means of copper or zinc plates each having a surface of several square feet. It being impractical to have the boats laid up in drydock for the purpose of attaching such plates to the boats' bottoms, it was at first thought feasible to attach the plates to their wires and throw them overboard; but greatly to the surprise of everybody concerned, though the plates weighed ten pounds apiece, they were prevented from sinking by the rapid movement of the boat. In consequence, the contact pieces were finally replaced by a few inches of heavy

The Pillot-House Deck, Snowing the Flagstaff Used as a Mast for Antennae

copper tubing which was let down the rain pipes to the water. The tubes danced upon the surface of the water as the plates had done, the circuit was repeatedly broken, and at no time did they make a really satisfactory contact with the element.

In general it may be said that the system consists in antennæ as in wireless telegraphy, earth platesi. e., water contacts-the transmitting apparatus and the receiving instruments, all of which have been carefully written up by Mr. Collins himself and published in the Scientific American of July 18, 1902. The flagstaffs at the vessels' prows served admirabiy as masts for the antennæ and the steam radiators in the pilot houses answered for tables upon which to place the sending and receiving instruments. A battery of fifty cells, placed just outside the pilot house, furnished the current.
was neither sufficient nor constant and the current used was inadequate. In permanent installations there will be no difficulty in attaching the plates to the hulls. Where a strip of copper surrounds the boat a vertical slit would be made through the copper on either side and then each half would serve as a contact plate, it being necessary in such case only to make the proper connection.
For current, the cells would be discarded. Either a transformer employed in connection with the boat's dynamo or a motor generator set will be used.
Two or three questions suggested themselves to those who witnessed the performance. "How far can you telephone by this system?" "Why isn't the wireless telegraph better for this purpose?'
When the experiments were being conducted at Congers the writer heard articulate speech distinctly over a distance of 6,000 feet. In the harbor, where the conditions are all different, Mr. Collins will only state at present that he can cover 1,000 feet. But as he a n d others have pointed out, for harbor and river purposes it is not great distances which are called for. Boats do not ram each other at great distances. In the uncertainties of a blinding snowstorm or during a dense fog when the pilot cannot see the prow of his own boat, if he could telephone the vessel nearest to him, thougn he could on 1 y learn her name and the direction in which she was going he would be greatly assisted; but when he might learn also where she stood by the compass, the one could steer a few points to the right, the other a few points to the left, and the sickening dis. asters with their losses of human life which oicur time and again in every harbor would be largely avoided. The wire less telegraph has its place but it is not on harbor $a n d$

On Friday, May 8, everything was in readiness Mr. Collins took his stand in the pilot house of the "John G. McCullah," where the transmitting instruments were installed. The writer and several other gentlemen were in the corresponding location on the "Ridgewood" with the receiving device. As the boats approached within five hundred feet of each other the voice of Mr. Collins was distinctly heard. "Hello, hello. This is the Collins wireless telephone. Do you hear what I say? One, two, three, four, five. That's all. Good-bye." The following day-the 9th-the first public demonstration was given and amid the usual harbor and river sounds-the tug and other whistles, the swish of waters, etc.-the articulations of Mr . CoIlins' voice came over distinctly from the "McCullah" to the "Ridgewood."

The contact with the water, as before mentioned
river craft. Like any other telegraph, the wireless needs an operator. That means that an extra man would have to be employed and placed in the pilot house, which, with what it already contains, is none too large. Moreover, in the terrible uncertainties of thick weather there is no time to wait for the translation of messages-the pilot has no time for secondhand communications.
As yet, the instruments of the wireless telephone are not synchronized, but neither are they in wireless telegraphy. Besides, the telephone for ferries and other harbor craft is not for social purposes; it is for exigencies. Secrecy is of no importance here. The steam whistle is not synchronized, but its sounds have been of incalculable service, notwithstanding.
Captains of tug, ferry and other boats point out many uses for the wireless telephone which one un
familiar with the river and harbor service would never think of, and all are enthusiastic over its advent as a time saver, a money maker and a relief of the terrible responsibility for the precious lives entrusted to them in heavy weather.

## A LAND BOAT FOR ARMORY USE

In the exhibition drill given at the Armory of the Thirteenth Regiment, N. G. N. Y., following the review by Lt.-Col. Spicer, U. S. M. C., of a battalion composed of a battery from the Second Battalion, Naval Militia, New York, and Company D of the regiment, a novel form of boat was used. A fort had been constructed around the 8 -inch disappearing gun used by the regiment, and a range station was built on the parapet. In the opposite corner of the armory, the bow of a battleship projected out onto the floor. The armory being darkened, a boat appeared from behind the ship and dashed across the floor, containing a landing party, who were to attack and destroy the range station. Being discovered by an alert sentry, a searchlight was turned on and the alarm given. The long roll called the artillerymen to their posts, but before they could locate the attack, the boat had landed its party, the wall had been scaled, and a bomb placed in the station and the boat regained, the dead and wounded being carried off on the shoulders of the survivors. The fire of the sentries during the attack was answered by a one-pounder mounted in the bow of the cutter. After the boat disappeared in the darkness, the battleship was discovered by the searchlight, and its magazine reached by a well-directed shot from the 8 -inch gun. The boat, which is modeled on the lines of a regulation navy cutter, is 30 feet long and 6 feet beam, carrying a crew of ten men at the oars, a gun crew forward and a coxswain and commissioned officer aft. It is cut off at the waterline, and all mechanism being inside, the effect is that of a boat gliding through still water, and under the beam of the searchlight, is very realistic. A $21 / 2$-inch shaft under the forward thwart has an iron wheel, $A$, keyed to it on either end. In the center is keyed a drum, $C$, with ratchet teeth on its circumference, and engaging these teeth is a pawl carried by a sleeve which turns on the drum. Around the sleeve, and leading clear aft through a snatchblock back to the handles of the oars, is a manila line. When the men give way, the line turns the meene, the pawl engages the teeth on the drum, the shaft and with it the wheels turn, and the boat goes ahead. On recovering from the stroke, a line, $D$, leading from the oars forward returns the ratchet to position, and the operation is repeated indefinitely. As far aft as it could be placed without interfering with the lines of the boat, is placed a single wheel, and a rudder post rising from this controls the steering, the whole method of support and steering being similar to an iceboat. The weight of the gun, boat, and crew, amounting to about two tons, is carried by four wooden trusses running fore and aft, two close together and two as near the sides as they could be placed. The thwarts, gunwale, Sides as they could be pla
rowlocks, etc., are standrowlocks, etc., are stand-
ard. The hauling line is ard. The hauling line is
equipped with snaphooks equipped with snaphooks
and the oars with screwand the oars with screw-
eyes, so the line can be quickly detached from the oars. The men toss, boat the oars, up oars, let fall, give way, etc. just as they would afloat, and the Secwould afloat, and the Sec-
ond Naval Battalion will ond Naval Battalion will
use the boat for winter use the boat for winter
indoor instruction in their new armory, foot of 52 d Street, Brooklyn. The boat was designed by Lieut. Kingsley L. Martin, commanding the second division of the battalion, and was built under his direction by Chief Gunner's Mate William $H$. Free.

The Irish course for the Gordon Bennett motor car Gordon Bennett motor car race measures 368 miles
765 yards, of which 221 765 yards, of which 221
miles are straight road, miles are straight road, which will compare favorably with the course of last year in France.

## Origin of the Word "Barometer."

The instrument familiar to us all as the barometer, says Henry Carrington Bolton in Science, was first universally known by the name of its inventor as "Torricelli's tube;" de Guericke, the inventor of the air-pump, called his huge water barometer "Semper Vivum," also "Weather Mannikin," with the Latin form "Anemoscopium."

Soon after the year 1665 the words "baroscope" and "barometer" came into general use in England, but the person to whom the credit belongs for originating
barometer do not occur; he uses the common term, "tube," and often writes of the "mercurial cylinder." Nor are these words used by him in his "Defense of the Doctrine touching the Spring and the Weight of the Air . . . against the objections of Franciscus Linus," a paper published in 1662.
Their use by the anonymous writer to the Philosophical Transactions in 1665 has been shown, and the question arises, who was this person who modestly concealed his name? Mr. Bolton believes it was Boyle himself. This eminent man, who was so devoid of per sonal ambition that he declined a peerage, had a habit of writing about himself and his scientific labors in the third person, and often spoke of himself by fanciful, fictitious names, such as "Philaretus" (in his fragmentary autobiography) and "Carneades" (in the "Sceptical Chymist"). That he should send an unsigned communication to a journal was not surprising, particularly as he had occasion to mention himself.
Be this as it may, my claim that Boyre originated the word barometer does not rest on such slender conjectures as these. One year later than the communication in the Philosophical Transactions, Boyle wrote to this journal (dated April 2, 1666) and said, "barometrical observations" (as for brevity's sake Mr. Bolton calls them), using the per sonal pronoun this time. Elsewhere in the same paper are found the terms barometer baroscope, and baroscopical observations.

In his "Continuation of New Experiments Physico-Mechanical," . . . of which the preface is dated 1667 , occurs the following phrase: "But though about the barometer
these terms has not been certainly known; the assertion made by a contributor to the Edinburgh Review for 1812 that "baroscope" was first used by Prof. George Sinclair, of Scotland, in 1668, is an error, for both words occur in the Philosophical Transactions four years earlier. The passage is unsigned and reads thus:
"Modern Philosophers, to avoid Circumlocutions call that Instrument, wherein a Cylinder of Quicksilver, of between 28 and 31 inches in Altitude, is kept suspended after the manner of the Torricellian Experi-


## PROPELLING MECHANISM OF DRILL BOAT.

ment, a Barometer or Baroscope, first made publick by that Noble Searcher of Nature, Mr. Boyle, and imployed by him and others to detect all the minut variations in the Pressure and Weight of the Air."
The mention of the words in connection with the name of Robert Boyle has led Mr. Bolton to make a close examination of his voluminous and prolix writings. In Boyle's first publication, "New Experiments Physico-Mechanical touching the Spring and Weight of the Air," dated 1660 , the words baroscope and


A LAND BOAT FOR ARMORY DRILL.
(as others have by their imitation allowed me to call the instrument mentioned)." (Boyle's Works, Birch's edition, Vol. III., p. 219, London, 1744.)
This sentence is virtually an admission by Boyle that he had coined the word, since others imitating him had allowed and encouraged him to use the term to designate the tube of Torricelli.
Mr. Bolton concludes, therefore, that the word "barometer" was introduced into our language by the English philosopher, the Hon. Robert Boyle, about the year 1665. Boyle, by the way, was a scholar, and able to use Greek in forming an English word. Examination of Murray's, Skeat's and other standard English dictionaries throws no light on the origin of the word; they merely refep to the Philosophical Transactions and give its obvious etymology.

New York City as a "Spa."
There are, undoubtedly, thousands of residents of upper New York who do not know that there is a water cure or "Spa" conducted within the limits of Central Park. Yet, if the visitor passes through the Seventysecond Street gate on the west side, he will find a number of people walking toward a pavilion not far from the entrance. He will also doubtless be surprised to learn that the majority of these people are acting on the advice of their physicians. Between the hours of five and ten A. M., from five hundred to eight hundred people are served with mineral waters, the greater number visiting the pavilion about half past six. The busiest season is from the first of May until the fifteenth of June. The pavilion was erected in 1867 at the request of numerous physicians who felt that here was an op portunity of combining a mineral water cure with exercise in the open air The doctors prescribe the kind, strength, tempera ture and quantity of wa ter, and the amount of exercise to be taken. The attendants follow these in structions with the greatest care. The waters are of two kinds; first the natural mineral waters from all the famous springs at home and abroad, and second mineral waters prepared artificially and scientifically, thus ensuring a deflnite chemical composition at all times. The double and quadruple C a $\dot{\mathrm{r}} \mathrm{l} \mathrm{s} \mathrm{b}$ a d seems to be the ravorite, and it is mixed with varying proportions of distilled water, and the nat-
ural mineral waters can be heated in silver eup which are placed in racks in small steam kettles. The little tables are very suggestive of Wiesbaden, Homburg or Carlsbad, and the weighing scale is in con stant requisition. By a systematic course of the waters, coupled with proper exercise, it is not unusua to decrease the weight in six weeks by thirty-six pounds, in cases of obesity. The pavilion is patron ized by some of the best known people in New York who appreciate the privilege of having mineral water served under proper conditions.

## An Electrically Operated Curtain Hoist.

 by frank c. perkins.In every college lecture room, as well as many high schools and institutes, the electric stereopticon is frequently employed in connection with the regular day courses of work. It is then necessary to darken the windows by means of shades, as well as to draw down a prepared white screen for illustrative purposes.
A very ingenious electrical hoisting apparatus, for drawing down the shades and the stereopticon screen at the same time by simply pressing a button or turning a switeh, has been devised by Charles W. Carman of Chicago, formerly the professor of physics at the Lewis Institute.

This automatic electrical device makes it possible for the operator at the lantern to open all the opaqu shades of the lecture room or laboratory in an in stant by a special switch close at hand. The same device raises the screen out of the way, while another daylight demonstration or lecture is taking up a por tion of the time. The curtains are all raised or lowered in less than half a minute from the time the switch is closed, and when fully opened or closed the mechanism is automatically cut out of circuit. The operator after manipulating the switch may therefore immediately give his attention to other work.
The drum is connected to the motor through a worm gear and a magnetic clutch. It is a reversible motor, and by means of a double-throw switch is operated in one direction or the other, depending upon whether the curtains are to be raised or lowered. The limit stop provided breaks the circuit through the motor armature and the magnetic clutch, and changes the connections when the curtains are in their extreme position. The magnetic clutch ceases to act and the curtains are held in position while the armature comes to rest after its momentum is overcome.

The stereopticon screen is connected to the drum by a rope, and the various shades about the room are connected by cords through pulleys to the rope, which extends around the room below the windows. A weight is arranged at the end of the rope, which keeps it taut regardless of the action of the curtain rollers. There are two portions on the drum, one of greater diameter than the other, and the curtain roller cords are connected to one and the stereopticon screen rope to the other, so as to provide for the different ranges of travel. The motor used is of the multipolar direct-current type.

Street Railroads for Conveying Freight
In the busiest centers of Lancashire, especially so far as the cities of Liverpool, Manchester, and Darwen are concerned, an important development in connection with the electric street railroads is to be undertaken. Hitherto, the surface tramways have been exclusively devoted to the carriage of passengers, but they are now to be employed for the conveyance of frelght from one point to another. In Lancashire some 400 miles of these street railroads, all operated by electricity, are rapidly approaching completion, and are to be connected, so that freight can be discharged from, and embarked upon, the cars at any point upon the route. It is intended that the merchandise shall be carried only during the night. Throughout the day the passenger service in these centers is so busy, that to handle freight at the same time would only interrupt and disorganize the passenger traffic, whereas at night, although there is still a demand for passenger transit, necessarily it is limited, so that freight cars will be able to run quickly and without causing any inconvenience
The first step toward the inauguration of such a service has been taken by the corporation of the city of Liverpool with its street tramways, by an agreement to connect its system with the docks' surface railroads, thus securing direct access to the quays, warehouse, and vessels, picking up the freight and distributing it without further handling in the various parts of Lancashire where an electric tramway is in operation.
Such a system will considerably facilitate and cheapen the cost of transit of freight from the vessel's side at Liverpool docks to the Lancashire towns, especially Manchester. By the present system of handling the merchandise pon the trunk railroads, in the majority of instances, there are no less than six transshipments of the goods, from the moment they are discharged from the ship to their delivery at their destination. By the surface tramways all this extra labor will
be obviated. The trolleys laden with goods will run straight from the docks into the factories, or vice versa The saving in time and labor alone by this system will be enormous, while it will also be fifty per cent cheaper to convey goods by this means than by the ordinary railroads.

## GUILLEMINOT HIGH-TENSION AND HIGH-FREQUENCY coILs.

Dr. Guilleminot recently published the results which he had succeeded in obtaining with an arrangemen for the purpose of analyzing the effects of high frequen cy obtained with ordinary resonators. He prepared a coil or spiral of copper wire of constant pitch. Through the outermost convolution (Fig. 1) the oscillatory current of two Leyden jars was passed. At the center of the spiral, currents of exceedingly feeble intensity were received.

By modifying the pitch of the spiral and rendering


Fig. 1.


Fig. 2.
it progressively increasing from the center to the periphery, the effects obtained were more marked. The increase of pitch was based on the difference of the length of the spark which passes between the two adjacent points. This increase was 0.003 mm . between convolutions, an induction coil having a spark of 0.35 mm . being employed at 6 amperes to charge the Leyden jars.
Dr. Guilleminot studied the effects obtained with two spirals. The results were remarkable. An enormous field of action was given to the neighboring resonator. Experiments conducted in conjunction with MM. Radiguet and Massiot proved that if a passive spiral be submitted to the influence of an active spiral, entirely different effects, dependent upon the direction in which the convolutions run, are obtained; if two spirals be connected in multiple (Fig. 2) or in tension, the effects are again entirely different, dependent on the direction of the oscillating discharge in the first spiral. From these experiments it follows that in two spirals the same charging effect can be obtained, either by influence due to winding in the same direction, or by proper connection due to symmetrical mounting; and that it is possible to


Fig. 3.


Fig. 4.
obtain a counter-discharge effect either by influence or by proper connection.
Dr. Guilleminot has also ascertained the effect of combined inverse connection and inverse winding. The results obtained are striking. Superb interpolar effects were secured. A body interposed between the two spirals glowed at two sides.
By homologous connection and winding feeble current effects were obtained; a body interposed between these spirals emitted flaming streams.
It will be observed that Dr. Guilleminot's spirals enabled him to obtain two entirely different effects, one monopolar and the other bipolar. The therapeutical value of these coils should not be underestimated. Electric shower baths can be taken, which will doubtless have no slight beneficial effect upon the nerves.

## American Gunnery : New Record.

The report that American gunnery is not what it was during the Spanish-American war is tellingly refuted by the accounts which have been received of target practice in the Gulf of Mexico. During the Spanish-American war it was estimated that only three per cent of the shots fired by American gunners hit the enemy's ships. Still, that was considered very good shooting. Tables have been prepared of the recent work done by seven battleships of the North Atlantic fleet. These tables are complete for all ships except the "Kearsarge." The score made by the other six vessels foots up a fine average of 51.5 per cent. The record of prize firing by the British fleet on the Asiatic station shows that the average percentage of hits was 49. Of these English vessels the best per formance was that of the "Oceanic" whose record was 68 per cent of hits with a 12 -inch gun. The "Alabama" with her 13 -inch guns, striking the target 22 times out of 32 times, shows that her record is 67.12 per cent. The "Illinois," a sister ship of the "Alabama," made a record of 53.1. The performance of the older ships was not so creditable. With her 13 -inch rifles the "Massachusetts" hit the target only 6 times out of 15 ; the "Indiana," however, a sister ship of the "Massachusetts," missed the target only 6 times out of 24 shots. What target practice means is strikingly shown by the case of the "Texas." This vessel was only recently placed in commission, so that her men only recently placed in commission, so that her men
had no experience with target work. Her record was had no experience with target work. Her record was
only 39.3 per cent. The records which have been made are remarkable when it is considered that a 1,600 yards a target, viewed through the peephole of a turret, looks no larger than a visiting card held 100 feet from the eye.

## Using Aluminium Condensers to Produce "Singing"

In an article communicated to the Russian Physico Chemical Society, W. Mitkiewicz suggests replacing the ordinary high-capacity condensers necessary to produc Duddell's "singing arc" by the much less costly alumi nium condenser made up of an aluminium electrode connected with the positive pole immersed in a 7 to 8 per cent sodium bicarbonate solution, and thereby becoming coated with a thin layer of oxide or hydrox ide. Two plates of sheet iron of the same dimensions are placed upon the faces of the condenser, from which they are separated by means of thin caoutchouc, so that the distance between the aluminium and each of the iron plates does not exceed 3 millimeters. The whole system is provided with caoutchouc rings, and placed in the vessel containing the solution. The iron plates are, of course, connected with one another by means of a metal wire. The capacity of such a condenser with a working surface of about 5 square dm. was of the order of 100 microfarads. The magnitude of this capacity is due to the extreme thinness of the insulating layer. In order to produce with this device the phenomenon known as a "singing arc," Duddell's arrangement is made use of. After each experimen the electrodes must be taken out of the solution and carefully dried. This condenser may be advantageously used for many other experiments as well, e. g., for all "speaking" arc devices. Full particulars are given of the apparatus employed.

## The Current Supplement

The current Supplement, No. 1429, opens with an article on some modern types of Swiss and German bridges, editorially referred to in another part of this issue. The article discusses these bridges both from an engineering and architectural standpoint. The text is illustrated by pictures of several types. The investigation of a garbage crematory is concluded. Some new lightships on the coast of France are described and illustrated. Sir Oliver Lodge's paper on Electrons is continued. An article by Prof. Goodyear on the "Architectural Refinements of St. Mark's, Venice," will be found to contain many a striking bit of information on the architectural beauties of Italy's most famous cathedral. Perhaps the most important subject which is discussed in the current Supplement is that of radium and other radio-active substances. The article comes from the pen of William J. Hammer, and is probably the most exhaustive account which has so far been published. Numerous illustrations are given of the marvelous activity of these newly-discovered substances. Serpollet's steam automobile is described in the second installment of the article begun in the last issue.

Ruchomowski, who has achieved no little notoriety by reason of his skill in the fabrication of the tiara of Saitaphernes, seems also to have been the author of other curios which their owners have fondly imagined to be genuine antiques. M. Reitlinger, who thought he owned four valuable antiques, now receives the unpleasant news from Ruchomowski himself that they came from the hand of the Russian craftsman.

##  <br> Patent Department

## adjustable cultivator.

A patent has recently been granted to Mr. Arthur A. Thogersen, of Brookings, South Dakota, for an improved cultivator of a type used in gardens and nurseries for the cultivation and weeding of small plants. The improvement lies in the provision of means for adjusting the cultivator disks relative to the main frame, or to the rows of plants, so that the soil may be thrown toward or away from them, as occasion may require. The ground wheels and beams


## adjustable cultivator.

may also be shifted laterally to a sufficient degree to permit passage of large plants or bushes. The construction of the cultivator will be readily understood by a glance at the accompanying illustration. The frame comprises the usual arch 1, which connects the angle plates 2 , and the handles 9 , secured to the vertical portions 3 of the plates. The plates are provided with lateral slots 10 , through which the pivot bolts of the bearing sleeves for the cultivator disks 8 project. The bars or beams 5 and 6, supporting the ground wheels 7 , are similarly secured to the frame by bolts projecting through slots in the plates. Now, according as the rows of plants to be cultivated are close together or far apart, by loosening the nuts on the pivot bolts, the pairs of disks may be shifted to a corresponding distance from each other. By swinging the bearing sleeves about on their pivots, the amount of soil broken up by the disks, and the direction in which it is thrown, may be governed at will. The scrapers 4, which swing with the bearing sleeves, serve to remove any soil that may collect on the disks. It will be observed that the beams 6 are extended and curved downward to the ground. These serve to stir up the soil adjacent to the rows of plants, thus rendering them more susceptible to the disintegrating action of the disks.

USEFUL ATTACHMENT FOR RAIN-WATER LEADERS. in many localities rain-water when pure is preferably used for drinking purposes, being collected from the roofs of houses and kept in cisterns. One serious objection to rain-water thus collected lies in the fact that during dry weather impurities of many sorts gather upon the roof, and these when washed into the cisterns, often contaminate the watrr thus collected, and render it unfit for use in cooking or on the table. Mr. John Keller, of Ottoville, Putnam County, Ohio, overcomes this objection in the following manner. Located at any desired point on the rain-pipe is a box-like section containing in its front


USEFUL ATTACHMENT FOR RAIN-WATER LEADERS.
wall an opening closed by a two-part gate valve. This valve consists of two gates joined at the bottom, preferably at an angle of 45 degrees. The valve is rigidly secured to a shaft which has bearings in the sides of the box section. To the projecting ends of this shaft, the ends of a U-shaped rocker arm are secured, and from this rocker arm a water pail is hung, being adapted to slide between guide bars on the box section. Normally the parts assume the position shown at the right in our engraving, being thus held by a weight on an extension of the rocker arm. In this position it will be observed that the inner gate closes the passage through the box section, while the outer gate closes the opening in the front wall. The only outlet for the rain-water therefore is through a spout in the outer gate and thence into the water pail. The water will continue to flow into the pail until the increased weight of the latter overbalances that of the weight on the rocker arm, when the pail will drop, and the gates swing out to the position shown in our sectional view. By this time the impurities on the roof will have been washed off, and the pure water will flow down through the rain-pipe into the cistern. By adjusting the weight on the rocker arm, the amount of water allowed for washing off the roof may be varied at will. The water pail is provided with an opening at the bottom, through which this impure water may escape; the opening may be normally closed, or if it be exceedingly small, so that it would require several hours for the pail to empty, the opening may remain open continuously.

## HEATER ATTACHMENT FOR LAMPS AND GAS BURNERS.

The problem involved in the effort to utilize the waste heat of a lamp or a gas jet, for the purpose of warming a room is no small one. The natural tendency of heated air, on account of its expansion, is to travel upward; consequently, the lower parts of a room may be very cool while the ceiling is lined with a layer of bot air. Some systems make use of mechanical means for casting the heat down where it is needed, but obviously, such mechantsms could not be economically applied to a small heater adapted to be used on a kerosene lamp, a gas jet or the like. However, a very simple solution of the difficulty has been found. Heretofore inventors have apparently been experimenting with heat only as carried by a draft of air. Heat may be easily absorbed by an air current and again radiated out at some other place, but this is evidently an indirect method of distribution; for like light, heat is a vibration of the ether and may therefore be transmitted without the aid of any other medium. The heating of any material substance is merely the gradual communication of this vibration to the particles of the substance. With this brief review of high-school physics, we can readily see that the rays of heat may be made to travel in any desired direction, regardless of air currents; that the heat rays of a lamp may be reflected down to the floor in exactly the same way as light rays can.
A simple device used to accomplish this result is pictured in the accompanying illustration. It consists of a parabolic reflector surrounded by a drum and supported on a bracket. Two forms of bracket are provided-one adapted to be attached to a gas burner, Fig. 3; and the other applicable to a lamp chimney, as shown best in Fig. 1. The heat rays on striking the walls of the parabolic reflector are cast downward in parallel beams. In the caso of the lamp bracket, a buffer plate lies under the draft opening in the top of the reflector. This is necessary because most of the heat passes up the chimney and must be spread out to come in contact with the reflecting wall. The drum serves to assist in the circulation and to prevent the reflector from injury under the intense heat. Part of the heat is of course taken up by the air and the products of combustion, and passes up through the draft opening; but a large percentage is reflected down despite the strong upward air current. This may be demonstrated by the use of a lighted cigar, the smoke of which will be seen to pour into the reflector and out through the draft opening, while in the meantime, heat can be strongly felt at a


GEATER ATTACHMENT FOK LAMPS AND GAS BURNERS.
handles thereon. The central gage-rod resting on the surface of the axle will point to zero on the scale plate provided the axle is true. If, however, the axle be bent or sprung, the bar will be raised as the wheels rotate and the amount of deflection indicated on the scale plate. At the same time the gage-scresws resting on the peripheries of the wheels should be watched to detect any flattening in the treads. Any misplacement of the car wheels on their axie will be immedately observed by noting their relation to these gagescrews.

## RAIL CONNECTION

The large number of patents on rail joints which are being issued each year indicates the importance of this part of a railway track, and also shows that the problem has not yet been satisfactorily solved. Mr. Alexis Hauptmann, of Beaumont, Tex., has attacked the problem from a new standpoint. Instead of providing devices for joining each rail to the next adjacent one, he proposes to weld together a large number of rails by electricity or any other suitable


## rail connection.

means, and then to join these long sections with a connection which allows for expansion and contraction. Moreover, the connection provided is of such a nature as to cause no break in the track, thus doing away with the objectionable pounding of car wheels in passing over the usual rail joints. The connection used is shown in our illustration. It will be observed that the track sections to be joined are bent outward at their ends and are connected by a rail which is tapered to fit these ends. This connecting rail is securely bolted to one of the track sections but has sliding connection with the other. This is necessary to allow for the extra large expansion and contraction of the track section due to the length of each section. A chair permitting this sliding connection is illustrated in our small detail view. Here the rail section $a$ and the connecting rail $b$ are supported on a bed plate. Formed on one end of this plate is a chair $c$ engaging the rail section, and at the other end a stud $d$ projecting into a casing $e$ and pressing the spring held therein against the rail $b$. This holds the parts with all the necessary rigidity, but at the same time permits slight longitudinal movement of the track section. To further prevent interference with this sliding movement the bedplates for the track sections are recessed to admit the base flanges of the rails, and the spike holes are so placed that the shank of the spike does not tnuch the rail, but only the head engages the top of the flange.
centrifugal separator.
The new type of separator for sugars and other sub-


CENTRIFUGAL SEPARATOR.
stances which is illustrated herewith, offers the advantage of permitting the material to be continuously fed and distributed while the parts are rotating at high speed, thus obviating the necessity of stopping the machine to place the material therein, and saving the time and power incidental thereto. The machine provides for the thorough separation and isolation of the liquid from solid matters, and for forcing the latter positively down through the separator. It comprises a drum rotated at high speed, within which a number of treatment cylinders are mounted which have a slow rotary movement on their axes. In our illus tration the drum may be seen in section at 1 , revealing the treatment cylinders 2 , mounted therein. The interior of the drum is provided with a number of plates or webs, two of which are secured to the shaft 3. The treatment cylinders are held loosely in openings in these webs, being supported by flanges at the top. Raceways 4 are formed along the edges of the web openings to receive rollers or balls, which bear against track-bands on the cylinders and serve to diminish the friction when the cylinders are in motion. The sheet-metal walls of the cylinders have a large number of perforations, through which the iquid is thrown by the centrifugal energy developed in the rapidly-rotating material, the solid matter being retained by the wire-screen lining of the cylinder Each cylinder is provided with a feeder consisting of a broad strip of metal bent in the form of a helix, as shown at 5 . In operation the drum is driven at a high rate of speed by any suitable motor acting on the shaft 3 , and the material is fed into the cylinders by centrifugal action from a hopper 6. Owing to the high speed of rotation of the drum, the material in each cylinder will hug that part of the circumference which is furthest removed from the center, the liquid part passing out through the perforations. By a system of gearing the cylinders are made to rotate slowly on their axes, so that the spiral feeders force he solid material downward until it passes into the stationary receptacle 7 . The liquid, in the meantime, s entirely drained out, and passing through perfora tions in the drum, is caught in a trough at the bot om of the stationary casing 8, whence it flows out through the discharge pipe. The gearing which pro vides for the independent rotation of the cylinders comprises the bevel gears 9 and spur gears 10 , mounted to revolve with the drum 1. These gears are caused to rotate on their own axes by means of worm gears meshing with the stationary screw or worm 11 The gears 10 engage an independent gear ring 12 which meshes with the gear on the bottom of each cylinder. It is evident that by this system of dif ferential gearing the cylinders are made to slowly rotate while revolving about the common axis of the drum. The universal joint 13 on a stationary shaft provides for any irregularity of rotation or oscilla tion of the gear casing 14 , which is rigidly secured to the drum and yet has bearing on the stationary shaft of the worm. The inventors of this machine are Messrs. W. G. Hall and W. A. Ramsay, of Honolulu, Hawaii.

## Brief Notes Concerning Iuventions

In the stockyards at Chicago, an electric goad has taken the place of a whip in urging the animals along through the various passages to their place of execu ion. This implement has been found to have many advantages, mainly in the fact that it is even mor effective than the whip, and does not in any way af fect the meat. The idea has been further improved upon in the invention of James A. Giles, of Elberton, Ga., a rural letter carrier, who has conceived the notion of using electricity to urge along his horse when attached to the carriage. The wagon made use of by Mr. Giles in the pursuit of his daily vocation must be entirely inclosed in order to protect the mail matter from the weather, and under the circumstances the use of a whip of the ordinary type is a very inconvenient matter. So the suggestion occurred to him to make use of an electric current as a substitute for the lash. His first experiments in this line were successful in the extreme, and he at once built a substantial device to be permanently made a part of his trav eling outfit. Now, when he wants to stir his steed up a little, he merely gives a few turns to the handle of a small generator, and the effect on the animal is like magic. Mr. Giles is of the opinion that these occasional shocks of electricity are decidedly beneficial to the animal instead of doing injury to it. The shock is administered to the horse through the means of two plates inconspicuously placed under parts of the harness.
George C. Hale, the former chief of the Kansas City Fire Department and the inventor of the swinging harness, the water tower, and an automatic alarm, has just completed another invention which will add greatly to the glory he has achieved in this line, if it proves to be entirely satisfactory. His invention is an improvement on the automatic sprinkler, and does away with one bad feature of that device, and that is the
great damage by water, which frequently takes place by the unnecessary flooding of a comparatively large area for the purpose of quenching a fire which may be confined to a few feet of floor space. It has frequently happened that where the fire has broken out and been extinguished without discovery, the sprink lers remain in action for hours afterward, and the water has done as much damage as a serious fire In the apparatus designed by ex-Chief Hale, he combines some of the features of the sprinkler system with that of the Babcock tank extinguisher. The pipes, instead of being flled with water, contain air under pressure. The unusual heat causes the breaking of a seal, as in the case of the sprinklers, and this re lease of air automatically performs the operations of generating the gas, which thereupon issues from the pipes and extinguishes the fire by smothering it There is a small amount of water in the tank, which is necessary to create the pressure of gas which is necessary, and some of this issues through the pipes, but it cannot under any circumstances be enough to cause any great damage. This system has been per fected and subjected to public trials, which are said to have proven entirely satisfactory. Application for a patent is pending.
The report of the Commissioner of Patents for the past fiscal year shows that the number of applications was greater than ever before, having exceeded the 50,000 mark. The total number of patents granted was 27,387 , including reissues and designs, 1,864 trade-marks, 750 labels, and 163 prints. The number of expiring patents, 20,335 , and the num ber of allowed applications which were forfeited by reason of the non-payment of the final fees was 4,123 . The total receipts of the office were $\$ 1,491,538.85$, and the total expenditures were $\$ 1,329$, 924.63, the surplus of the receipts over the expenditures being $\$ 161,614.63$. In his report the Commissioner notes a very gratifying decrease in the number of complaints of losses of money in the office. From September 1, 1900, to June 30, 1901, the amount of losses aggregated $\$ 686.13$, while for the corresponding ten months of the past year the amount had been de creased to $\$ 9.35$, and the Commissioner states that all of this can be charged to losses in the mail, and to claims erroneously made. The Commissioner urged the appropriation of a larger sum for the purchase of reference books for the library. The amount heretofore available for the purpose has been $\$ 2,000$, and a large part of that has been necessarily spent in sending the publications of the office to the offices of foreign countries. The Commissioner is of the opinion that the amount appropriated for this purpose should be doubled.

Propeller blades of cast iron are in general use, on account of the great cost of those of bronze. The life of a cast-iron blade is very uncertain, owing to the two facts that they are very easily broken and also that they are particularly subject to corrosion. Cor rosive action invariably attacks what is known as the "tip" of the blade, which is not the point particularly, but covers an area from twelve to eighteen inches from the point. It is a comparatively simple and inexpensive matter to replace the blade which has become broken or worn by corrosion, but the operation is one which requires several days' work, and it is this delay which is a serious matter to the ship's master. A pro cess has been recently devised and patented by Charles Fleming, of Sydney, New South Wales, by which the damaged portion of the blade can be replaced in a few hours with either cast iron or bronze and at a trifling expense. The corroded or damaged portion is broken away, and the remaining part is bedded in the foundry floor, and a cope rammed up over the part which is to be renewed. The mold is then parted, finished, dried, closed, and cast with the desired metal and it is here that the novelty of the process enter into the operation. The joint is then burned, care being taken that the metal from the ladle falls on the cast portion of the blade if the new part be of bronze. This mend is said to be thoroughly serviceable.

A machine for making railroad ties, whieh is re garded as a remarkable innovation, has been on exhi bition recently in New Orleans, La. It is the inven tion of Constantine Hege, a lumberman hailing from Salem, North Carolina. A company has been formed to exploit the patent. The president of this corporation is Thomas Gibbon, vice-president of the San Pedro, Salt Lake \& Los Angeles Railroad. By human labor, not more than ten or a dozen ties can be made per day per man, but by the aid of this machine it is claimed that four hundred ties can be made in the same time. These, too, are much more regularly formed than those made by the laboring man with his broadax. The machine is constructed somewhat on the principle of the lathe, augmented with a long steel roller set with about thirty blades, regulated with a system of projecting necks, so that they can cut only to the depth of a sixteenth of an inch at each stroke The log passes back and forth a few times, and is trimmed down to the desired size and shape.

Recently patented inventions. Agricultural Implements. machine for hulling oats.-s. e Hisid, Victoria, Canada. In operation this
machine receives the oats in a hopper and machine receives the oats in a hopper an
guides them to rollers in such manner that the guides them to rollers in such manner that the
rollers will nip the heads of the oats and will stulueze out the groats, the groats falling within the machine, while the hulls pass
throung to the outside. The oats and other through to the outside. The oats and other
grain may be hulled without goiug through grain may be hulled without going through
ilanter.-J. r. Caldwele, winnsboro, s. C. The present invention relates to an im-
provement upon a former patent granted to Mr. Cald well in 1900. The seed-planting whee or smaller seed as peas and corn, the dropping mechanism being automatically operated. Th sced-dropping mechanism may be rendere inactive, so that larger or smaller seed may be planted or the seed planted at intervals, thus avoiding chopping out the rows, after th plants have grown. The machine opens a
furrow, covers the seed and rolls the covering provides awituting devices for the bulk of the seed and the fertilizing material.
Thimesiling-machine.-N. E. Heieren, improved upon in this invention, by providin such pan with means, wherely sloould any grain be fed forward with the claaf from the
first series of chaffers such chaff containing ilist series of chaffers such chaff containing
grain will Jee compelled to pass over the second series ef chaffers before the chaff is thrown oit the grain-pan are adjustable and operate with any kind of grain so as to separate it from the chaff. The fan is located below the grain-pan so that the blast of air therefrom is diverted
into the pan and upward through the spaces between the chaffer-slats
grass-seled stritiere--hi. t. and w. it Mrcopsick, Winclester, Ky. This stripper 1 s
in the nature of an improvement in devices in the nature of an improvement in devices
employed for stripping orf grass-seed or the
heads of grain heads of grain. The invention gives ample the use of moderate sized wleepss; ; the shartss
are attached close to the centers of the wheels, making a lightit draft: and, as the seedlonx is rigid with the axle and is arrangel to oscillat of on the axle, the machine may be used on hillside as well as on level ground.

## Electrical Improvements.

ELECTRIC STOH-MOTION FOR KNIT TNG-MACHINERY.-A. L. Patreison, Albe marle, N. C. This device is of that class
known as "electric stop-motions" for knittingmachines. It is controlled ly electromagneti mechanism and circuits which automatically
stop the operation of the knitting-machine top the operation of the knitting-machin ccurs from a failure of the tension device to work properly.
COMBINEI RLECTROLYTIC AND MECIIANICAL INTERRUITER.-II. R. Smith Altoona, 1'enu. This improvement has refer ence to an interrupter suitable for the opera
tion of Ruhmkorff coils and the like, and comtion of Ruhmkorff coils and the like, and com-
prises both an electrolytic or Welnelt inter prises both an electrolytic or welinelt inter errupter connected the other.
plate for maletric accumilatons. -iels, Tomasis, 7 Rue des Immeubles Indus ator-plate is characterized ; first, by the em ployment of strips placed in close proximit to each other in the empty spaces of the lead
grid or frame of the plate, the strips serving the uniform distribution of the current through the unif iagonal conducting-strip upon one face of the plate, the strip extending from the angle co esponding to the point of entry of the curren and serving to insure a uniform distribution
of the current through all parts of the plate.

## Engineering Improvements.

 hicago, boiler.-M. K. Van Der Velde, the steam is generated on the several surfaces or levels of water, and the steam generatedin the bottom pan forces the water downward in the bottom pan forces the water downwar moving the float down and opening a valve, so
that the steam may pass into the middle pan, and the steam with the steam generated in the middle pan will cause the valve to open, permitting the steam to pass into the upper, space of the boiler or into the space in the top pan
and thence out through the steam-pipe. In.hector.-S. F. Sider. Address mail matter to Eli II. Goslin, Ietershurg, Indiana.
The adaptation of this injector is essentially for injecting air or other analogous gas into steam for the purpose of increasing the volume
of the steam. The invention also resides in of the steam. The invention also resides in
a novel combination of an injector with a source of steam and a motor driven there-

[^0]arly adapting the apparatus to the use of build-
rs in raising brick and other building material to the place of work, the object being to provid hoisting device that may be readily placed in osition and adjusted to height as the building progresses.
washing-machine.-D. S. Tyler and L. Drler, Indianapolis, Ind. The inventors rincipal object is to provide means whereby o thoroughly and easily cleanse and turn the
lothing during the washing operation, as well as means for securing the wringer so that the wringer can be quickly turned into and out o osition for use.
SELF-OILING JOURNAL BEARING.-G. A. Ensign, Defiance, Ohio. In the present cas ring-oiler type ; and their object is to provid new self-oiling journal-bearing which is posi ve in action, requiring little attention, an to all parts of the bearing and to permit em ployment on high-speed shafts.
MACHINE FOR PRODUCING APERTURED DISKS.-G. A. Evsign, Defiance, Ohio This invention relates to woodworking machinery and its object is to furnish a new and improved achine for producing apertured disks in
imple and quick manner, the disks produce being accurate in shape and the device readily wriked without the use of skilled labor. F rospondingly-sized cutter-heads and augers ar responding.
employed.
GRAPHOPhone - REPRODUCER. - w ments relasville, Mo. This is to improve the sounds made by the repro ducer, and also to provide certain adjustment or regulating the sounds reproduced. Doubl iaphragms are used, and the sounds produce y this device are louder, clearer and riche Gun bing and burvising GUN BORING AND BURNISHING MA mprovements in the present invention relat to machines for choke-boring a gun-barrel and eing to the interior of the barrel, the object ion to be made and sold at a low cost and that may be readily operated by any person eithe killed or a novice in the art of gun makin or repairing
Flying-machine.-O. A. Kaehler, De troit, Mich. In operating this machine, th the cranks by foot power or any other wellknown motor, and thereby revolves the wings. lifting effect is thus produced by the re action of the air upon the wings. The operato steers by means of hand-cranks, one of the
propellers at his right and the other at his left so that he can turn either at will in either di ection. These propellers drive the devic of the wings is slowed up, the machine gently descending, the buffers cushioning the force of the alighting frame.
FRICTION-COUPLING.-A. LeIKEm, Ch1 cago, Ill. Provided in this invention is a new designed to couple shafts together, and a anged to positively lock the $\alpha=i v i n g$-shaft to faces of shatup case thers sip on aces of the under a heavy load, and to insure proper friction contact of the faces in case the shaft move out of longitudinal alinement.
STOP-MOTION MECHANISM.-L. ment in this invention relates to stop-motion mechanisms for weaving-machines, looms and other devices used in operating textiles. It is hased upon the principle that the breaking or magnet, and thereby disconnects an electu the machinery.
Drier.-J. Wathrhouse, New York, N. Y chines for drying fruits, meats, sand, and mat the containing precious metals or gems, and haracter with which moisture and light dust may be quickly and effectually separated froi the material.

## Metallurgical Apparatus.

apraratus for treating ores.-II bject in view in thisisco, Cal. The primary an improved apparatus for treating ores contain ing copper, zinc, nickel, silver, and gold, whic apparatus can be successfully employed whethe ae part ar of the abolione metal coin-
GOLD-DREDGER.-O. F. Barnes, Arcola, ill. The usual suction-dredgers are imprac river-bed or the like hecause of the preat spe cific gravity of gold as compared with sand and gravel-that is while sand and water are lifted by the suction the gold will sink into the sand-bed too deep to be lifted by the suction. The object, therefore, is to provide means for collecting gold with the sand at a point so
near the inlet of the suction-pipe that the gold nill be elevated by the suction-draft.

## Vehicles and Their Accessories.

VEHICLE-BRAKF.-C. Kepr, Xenia, Ill. brake mechanism so arranged that it may be
set to apply the brake to a team holding back
on the vehicle-tongue, to apply the brake by ither pulling or back pressure on the tongue to apply the brake by pulling strain alone, and
to so place the parts that the brake cannot b et by either forward or back strain on the

## Miscellaneous.

mhasuming instrument.-I. b. hagan North Lamoine, Me. In this measuring in
strument, the object is to provide a simple and inexpensive device that will be found useful to surveyors, engineers or others in layand plotting work generally. The wide rang of its measuring is shown in the capacity of nd distance of tor out rafters for building purposes.
SLICING-KNife--W. Kelley, Scammon, Kan. This invention relates to that class of
knives provided with a plurality of blades held in parallel planes on a single handle The object is to provide a knife adapted to cut by easy detachment of the two outer blades fom the handie enable the use of a central $f$ this blade and meat or more compact sub tances with the opposite edg
MO vable letters for advertising BOARDS.-T. Knoblich, 43 Pferdemark Iamburg, Germany. This Invention has refe poses, which either sirgly or connected, so form words and either in or not in ection with other immovable letters, shall be used for advertising words, for the purpose
of drawing the attention of the public through of drawing the attention of the public through wither movement, to such
UNDERWAIST.-E. H. Horwood, Hoboken, . J. In this case the inventor provides a co truction of undergarments in which gather yoke is so combined with the body as to take all the strain from the gathered-in fullness, thus preventing the gathers, etc., from bein drawn or wrenched from position at their edges. The yoke has integral shoulder-straps and the oody has stays at the top and bottom of the athered material, the upper stay reinforcing whe yoke and the
Wardrobe-Trunk.-N. Baruch, New York, N. Y. The construction invented by Mr. of general use, but particularly doside for actors, traveling salesmen, and others who have frequent need of carrying wearing-appare from place to place in journeying to any great extent, and who know the value of being able
to dress in becoming style where little time is $o$ dress in becoming style
vailable for the purpose.
TEMPORARY BINDER.-F. B. Towne, Holyoke, Mass. Means are provided in this invention for increasing the capacity or a
binder in storing or filing leaves or sieets. Extensible posts with adjus, ible ratchet members are provided, the members being attachable and enachable to allow increase or decrease in the members of the posts co-operate with locking devices on a shiftable locking-slat which may
be equipped with a waste leaf, and these atchet members are formed with teeth always on the slat.
BRUSH.-D. F. Mahfr, Watsonville, Cal While the application of this invention is
mainly to a tooth-brush, it may be embodied in other brushes. The object is to provide a brush which can be readily and thoroughly
cleansed by forming one of the sections movcleansed by forming one of the sections movslipped out of imediate relation with the fixed sections to facilitate the complete cleansing
the brush. EGG-PRESERVING COMPOUND.-J. M Brooks, Clifton, Texas. Mr. Brooks is the which is used for the preservation of eggs. It keeps eggs sweet and fresh for months at a very low cost. The operation of treating the eggs is very simple and can be quickly and
easily done when transferring the eggs from easily done when transferring the egg from bulk to the shipping cases.
SHIP'S TABLE.-W. J.
N. J. In carrying out this improvement, the inventor's particular point in view is to conuse by the motion of a vessel. The top of this table always rests in a horizontal plane irrespective of the pitch, roll, or motion of the vessel, and is so arranged that the use of the table is tot interfered with. The tahle-top for a large number of persons, such changes in size being readily made by lever-connecting means.
hinotype-Galley.-F. E. Milholland Rrooklyn, N. Y. In carrying out this inven
tion the object is to construct a linotype-galley so that it may be locked up-that is to say, so that the type may be locked firmly in the galley. The inventor accomplishes this by a movable barrier arranged in the galley and hav
ing a certain novel form of locking lever and spring.
Note.-Copies of any of these patents will be furnished by Munn \& Co. for ten cents each. Please state the name of the patente
the invention. and date of this paper.

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rounda, sbooting kalleries and hand orzanss
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ments, several suits already fled. New patents, adjustments, several
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## POPULAR STEAM TRAPS

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larity among steam fitters and engineers larity among steam ifters and engineers
throughout the country of the tried and
proved "Nason" and "Sidelug" Steam throughout the country of the tried and
proved "Nason" and "Sidelug" Steam
Traps, a cut of one of which is here shown. They are more extensively
 modern steam engineering for higher pressures. Consequently, while one "Nason" Trap is constructed for ordinary working
steam pressures of 70 lbs. or less, the other is for pressures of 71 lbs. and less than 150
lbs. Both the 'Nason" Traps areof a high stactured of construction and are manuCompany, by the Nason Manufacturing man Street, New York City.

hints to correspondents.

(9018) M. E. B. asks: I understand that the difference between the static and other
electric currents is its high voltage and exelectric currents is its high voltage and ex-
treme low amperage. Now, what is average treme low amperage. Now, what is average
voltage and amperage of an electric static cur-
rent from a common static machine of 16 plates rent from a common static machine of 16 plates
running at moderate speed? A. The voltage of the discharge of a static machine depends
upon the distance between the discharging rods. A spark of one inch in air under ordinary con-
ditions requires perhaps 28,000 volts. The matitions requires perhaps 28,000 volts. The mat-
er is treated in Thompson's "Elementary Lessons," quite fully. 2. Could a current similar to the static in voltage and amperage be procured from batteries (or lighting street cur-
ron rent) and coils? A. Any induction coil
the same kind of secondary discharge the same kiind of secondary discharge as a
static machine. 3. If cells to be used, how many would you need, say of the Laclede na-
tional No. 7 to generate such a current? tional No. 7 to generate such a current?
A coil giving a one-inch spark should be with two or three cells of battery; one giving potassium bicarbonate battery. 4. Describe making the coil or series of coils to produce the static current effect, procured from batteries, and from city lighting current of about 110
voltage. A. A coil giving a six-inch spark is described in S there such a machine made (in cents. 5. Is here such a machine made (in
the market) to give static current effect from batteries or city current? A. Induction coils
are for sale by all dealers in electric apparatus are for sale by all dealers in electric apparatus.
6. Give name ot book, brief and comprehenisive 6. Give name ot book, brief and comprehensive,
for making coils in general for medical batfor making coils in general for medical bat-
teries, etc. A. Norrie's "Induction Coils" is a good and recent book on coil making.
(9019) C. M. asks: What is the best way, for practical use, to cut down a
current of 220 volts to the strength of a Mesco dry battery? A. The Mesco dry cell has a
voltage of about 1.5. The current depends voltage of about 1.5 . The current depends
upon the resistance of the external circuit, but upon the resistance of the external circuit, but
on short circuit would scarcely exceed 1.5 to 3 amperes. To cut the current of a 220 -volt 150 obms. No. 24 iron wire is large enough
for this, and you will need about 1,000 feet 2. Does it matter what the amperage is? A. We
have shown you above that the amperes must have shown you above that the amperes must
be taken into account in your calculations just be taken into account in your calculations just
as much as the volts. 3. What would be the cost of material? A. We are not able to tell
you the cost of such an arrangement. That

16 c. p. 1 light costs $\$ 1$ per 100 hours, wh
would this current cost per 100 hours? A. 16 c . p. light on 220 volts consumes about ampere. In will cost $\$ 6$ for the same time.
amper
What What would two 110 -volt lamps connected in
series cost the two 110 -volt lamps are 16 c. p., they take
$1 / 2$ ampere, and the two in series will cost twice $1 / 2$ ampere, and the two in series will cost twice
as much as one 16 candle lamp on 220 volts. as much as one 16 candle lamp on 220
You will also have twice as much light.
(9020) P. T. P. writes: I have one of your SUPPLEMENTS giving directions for the making of an induction coil for sparking pur-
poses. I have as a condenser about 30 square poses. I have as a condenser about 30 square
feet of tinfoil, alternated with sheets of paraf fin paper. I use one sheet of paraffin between paper about like what I am writing upon,
soaked in parafifi. There is a paper about hake. There is a great noise like
soaked in parafin.
sparking or buzzing in the condenser when in operation. Does this indicate that the con denser leaks? That the insulating sheets are not what they ought to be? Your SUPplement
directed paper coated with shellac varnish to be directed paper coated with shellac varnish to be
used, but I substituted paraffin. Does the difsiculty lie here? Would the placing of two
fien
sheets overeme the dificulty? sheets overcome the difficulty? A. Paraffin is a suitable material for coating the sheets
of paper for a condenser of an induction coil of paper for a condenser of an induction coil.
The paper must be without pores or visible holes. Before coating each sheet must be amined by holairg between the eye and a
strong light to detect these holes. One sheet of good firm paper is enough to use between two sheets of tinfoil. As we do not know what coil you have built, nor how you built it,
we are not able to say what your difficulty may be. Norrie's "Induction Coils," price $\$ 1$, gives careful instructions for making a coil and the proper size of condenser for each length of
spark. One of the most frequent causes of failure in coil making is in getting the condenser too large or too small for the coill. It should
be very carefully adjusted to the current to be used. It is possible that the margin of the
paper beyond the foil is too small, around paper beyond the a discharge may take place
which
(9021) H. R. asks: 1. What is the "elastic limit," or limit of elasticity, of $\mathbf{a}$ body? A. The elastic limit of a body is the amount of deformation which a body will endure and
still return to its size and shape when the destill return to its size and shape when the de-
forming force is removed. When a permanent forming force is removed. When a permanent
change of shape is produced by force, the limit change of shape is produced by force, the limit
of elasticity is exceeded and the body is weakof elasticity is exceeded and the booy is weak
ene. The factor of the elasticity of a body is called its modulus of elasticity. 2. Is it
not a fact that a cannon-ball will sink to the
 ocean. 3. Will a non-magnetic body have any effect on the action of a magnet? A non-mag-
netic body has no effect whatever apon the netic body has no
action of a magnet.
(9022) T. A. K. asks how to anneal selenium so as to make it sensitive to light.
Also, what form of selenium is best to begin Also, what form of selenium is best to begin
with? I have some selenium in a precipitated or powdered form. Is this the best form to or powdered form. Is this the best form to
use? I wish to coat a metallic (copper) surface with a thin coat or film of sensitized sele-
num. Is it better to sensitize it before o nium. Is it better to sensitize it before or
after it is applied? What is the best shape to put it in to apply it, and how is the best
way to apply it ? Can it be dissolved and ap
plied while in solution and the made sensitive plied while in solution and then made sensitive
to ligit afterward? If so, what is the best to light afterward? If so, what is the best
chemical to dissolve it in? As stated above, the whole idea is to coat a copper or nickel surface with a, very thin coat of sensitive selenium, and what I want is the best way of do-
ing it. If the powdered or precipitated kind s not the best, where can I find the proper ind? A. The face of the plate is thinly covred with the selenium, which must then be
nelted on and allowed to cool slowly, so as to assume the crystalline form. In the "selenium cell" the coating of selenium is applied to a
strip of mica or other substance of high insulat ing power. Selenium will dissolve in selenium chloride, and will separate from this solution
in the metallic form. However, the selenium n the metallic form. However, the selenium
cell is always made by melting in the selenium, and we can find no accounts as to whether a coating obtained by using a solution in sele
nium chloride will be sufficiently adherent sufficiently sensitive. Your powdered selenium, if pure, should be all right.
(9023) A. C. asks: 1. What are the causes of color blindness? Can it be cured? the inability to see a difference between colors which to the normal eye appear quite distinct. it is a defect in the eye, born with it, and usually incurable. True color blindness is not
removable by education. The same mistakes emovable by education. The same mistakes
in matching colors are repated constantly by a person after they have been pointed out to
im. The only remedy for his mistakes is to avoid all occupations having to do with colors. 2. What is a good way to learn colors? A
One ignorant of the names of colors should learn them by having them pointed out to him. This has nothing to do with ocolor blindness. The test for color blindness is simply ${ }^{\circ}$ in select(9024) B. P. L. S. asks: 1. Is the econdary coil of an induction coll wound in an opposite direction to the primary coil? A.
It makes no difference which way the two coils are wound in reference to each other. All large
coils are furnished with a reversing switch in
the primarg circult and if the
as desired, the switch is thrown and the cur-
rent in th. primary is reversed. 2. Could rent in th. primary is reversed. 2. Could a
brass tube be used to cover the core of an inducbrass tube be used o cover the core of an induc
tion coil to regulate the amount of current? if not, what kind of metal or substance can be used? A. A brass tube cannot be used
as a regulator for a coil. It cannot cut off magnetism. An iron tube might be used
screen the primary from the secondary.
(9025) D. G. E. asks: 1. How much and what size wire would it require for a 20
ohm telegraph instrument? A. Almost any size wire from 24 to 30 can be employed for a
20 -ohm sounder. It is a matter of convenience 20 -ohm sounder. It is a matter of convenience
simply. 2 . How many square feet in a pound simply. 2. How many square feet in a pound
of tinfoil?
A. The number of square feet in of tinfoil? A. The number of square feet in
a pound of tinfoil varies with the thickness of a pound of tinfoil varies with the thickness of
the tinfoil. 3. What book is there giving size, esistance, and weight of copper wire Lessons in Practical
Electrictty."
4.
4. is the name of a maker of C. P. battery zinc
A. There is no book on zinc casting. ChemiC. There is no book on zinc casting. Chemi
cally pure zinc is not used for batteries. It price is prohibitory. Zine amalgamated with mercury is just as good. 5 . How may a
hole be made in the center of a glass plate?
ma be made in the center of a glass plate? A. To
make $\mathbf{a}$ hole through a glass plate, break the tip from a three-cornered or round file
Dissolve some camphor in turpentine. Dip the end of the file in the liquid, and by a twisting motion grind a hole into the glass plate, which must rest upon a level surface. Care should be
exercised when the hole is about to break through the glass. After an opening is made
through the glass, the hole is worked to its through the glass, the hole is worked to its
proper size by a round or balf-round file. Al ways keep the file wet with the fluid. Expe rience is better than any amount of written in-
struction on this subject. 6 . What is the exact diameter of a single cotton-ininulated No
36 copper wire, or how many wires to 36 copper wire, or how many wires to the
inch? A. No. 36 wire is five thousandths an inch in diameter. This does not Include the insulation. This may be thicker or thinner,
according to circumstances. 7. If a good
ar ground is made in the return circuit of a tele-
graph line, is the resistance of the earth greater
 taken to be zero. 8. Have you a book on
making batteries for amateurs? A. Bottone's making batteries for amateurs? A. Bottone's
"Galvanic Batteries" is the most recent work on this subject.
(9026) J. S. asks: If a bullet were shot from a .30 or .40 army rifle straight up
in the air, when it dropped to the earth would in the air, when it dropped the the earth would
it have the same force it had when it left the gun barrel, and would it penetrate the same
amount of pine as it would if it were shot di rect at it? A. A projectile shot vertically up into the air from any kind of gun does not have
the same velocity when in its fall it strikes the the same velocity when in its fall it strikes th ground as when it left the muzzle of the gun
on its ascent. The resistance of the air re on its ascent. The resistance of the air re-
tards it on its upward flight, and hence it does not attain the full height due to its initial air prevents it from attaining the full velocity of fall from the point where it ceased to rise.
It therefore does not rise to its full distance, nor in falling from its tower position does attain its full velocity due to that altitude it reaches the earth.
(9027) A. S. asks: 1. Has the socalled double strength sal-ammoniac battery
that has a carbon cylinder filled with granulated carbon and a zinc cylinder around that, and sal-ammoniac to the inc batteries for a telephone? A. The ordinary Le Clanché cell with a pencil zinc answers per-
fectly for a telephone, and there seems to be no sed to use any stronger one. 2. I want to put magnet on my telephone line similar to the wound with No. 20 wire? A. You can put an electro-magnet on a telephone line, and it can
pe wound with No. 20 wire. $\begin{aligned} & \text { 3. Would it inter }\end{aligned}$ fere with the talking qualitites of the line? It would lengthen the line by so much and
would make it so much more difficult to transwould make it so much more dificult to trans-
mit through the line. 4. How many cells of the above-mentioned double-strength sal-am magnets, if I had say twenty on a line forty miles long? A. Probably twenty cells would prove strong enough to work through twenty
magnets. If they were not, more could be added. No one can tell how many will be needed, since that depends on tne magnets, the connections, and the leakage, due to moisture
and other causes on the line. 5 . Could I use and other causes on the line. 5 . Could I use
a telephone over the same line, say with only two cells in each 'phone? Would there be an No. 20 wire than there is resistance on the magnets A. You can telephone through the magnets if you use power enough. You wil
find that out by trying. 6. What size wire is the ordinary telephone extension bell magnets wound with? A. We have not at hand
the size of the wire in the extension bell. There is no reason why it should not be about the
same as in the polarized calling bell attached to the magneto, since it is rung by the magneto 7. Which requires the greatest current to work working together, or the ordinary extension bell magnets, the wire being the same size A. The extension bell with polarized magnet is
more sensitive than the ordinary bell with electro-magnets simply. 8. How many turns
the horseshoe magnet to make it lift a leve weighing say one drachm, when the current is stops? A. We should suppose that you re cheaply than to mak the magnets by hand. These will lift a drachm with a small current, and would be exactly ike, if ordered to be made alike
(9028) J. F. P. asks: Can you tell me anything that will prevent the formation of chrome alum crystals in a battery using a bichromate of potash solution? A. There are
three ways of avoiding the troublesome crys tals in a bichromate battery. One is to us hromic acid in the cell. The second is $t$ sodium in place of the bichromat of potash No crystals form. The third is to make th solution after the formula which follows: Tak 1 part of potassium bichromate, $21 / 2$ parts of ater, and $31 / 2$ parts of sulphuric acid, all by weight. Dissolve the bromate in the wate by boiling, and allow the solution to cool
Then pour the sulphuric acid into the solu Then pour the sulphuric acid into the solu
tion slowly and with constant stirring. The mixture becomes very hot, and at a certain point changes its color in a marked manner This is the moment when decomposition takes place and chromic acid is formed. When all the acid is stiried in, let the solution stand form nigh. A harge crystals wil form. These are the alum crystals, and as they
are of no use in the liquid, they may be sepa are of no use in the liquid, they may be sepa
rated by decanting the liquid or by filtering through asbestos. If these crystals are fully gotten rid of, no others will form as the
lattery is used. This method is due, we unlattery is used. This method is due, we un-
derstand, to the veteran Prof. A. K. Eaton.
(9029) H. S. asks: 1. How much weight will a cubic foot of gas sustain in mid
ir? A. A cubic foot of air at 30 inche air? A. A cubic foot of air at 30 inches
of the barometer, and the freezing tempera ture, weighs 1.29 ounce. A cubic foot of coa
gas varies in weight from 0.56 ounce to 0.73 gas varies in weight from 0.56 ounce to 0.73
ounce. The sustaining power is the difference ounce. The sustaining power is the difference
of the weights of air and gas. This give of the weights of air and gas. This gives
from 0.73 ounce to 0.87 ounce. The lifting power is slightly less than these numbers. 2 What will be the entire weight of the lightest 6 horse power force that can be had, suitable
for an airship? A. The lightest 6 horse power motor will weigh about 250 pounds. 3. In ascending, will the attraction of gravity b greater than close to the earth? A. The at
traction of gravity decreases as you rise above traction of gravity cecreases as you rise above
the earth. This decrease in the force of gravity is so small that it would not be noticeable for any distances to which a balloon ascends. For five miles it amounts to nearly a quarter of a pound in a hundred pounds. As scales for weights as large as 100 pounds rarely mark less than quarter pounds, it is evident that so
small a change is not practically of any moment. The change in weight is calculated in the following manner: The mean diameter of the center to the surface is 3,959 miles. Five
miles above the surface is 3,964 miles from miles above the surface is 3,964 miles from
the center. According to Newton's Law of Gravitation, the weight of a body five miles at the surface of the earth as the squares these distances taken inversely; that is $\left(\frac{3959}{3964}\right) \times$ its surface weight. This somewhat large fraction reduced to a decimal gives 0.9975 nearly. Hence 100 pounds at the surface of a height of five miles above the carried to earth
(9030) J. W. O. says: 1. A weekly paper tells about a new and wonderful exa luminium filings and oxide of chromium, which when touched off with a match, using thich light powder for a primer, a heat of over 5,000 deg. is instantly produced, melting great bodies of iron or steel instantly. The paper says it is in use in Germany for welding steel rails, etc.
Can you tell anything about it, and give the details? A. Thermite, properly speaking, is a mixture of aluminium powder and iron oxide.
Barium peroxide is the primer most used. The heat generated is very intense ; the aluminium is burned to the oxide at the expense of the oxygen combined with the iron, and the iron is reduced to the metal and melted. It is being largely used in Germany for the purpose men-
tioned, and thousands of miles of rails are said tioned, and thousands of miles of rails are said It offers also an effective means of repairing shafts, gearing, broken lugs, etc., being thus a very great saving, as it obviates the necessity manufacture is patented, and is in the hands of a very strong company. The inventor of the chess is Hans Goldschmidt. There are a powder with different metallic oxides; all these re also called thermite compounds, but the specific name of "thermite" is applied to the
one above described. The other mixtures are useful for the preparation of metals and alloys as metallic titanium, manganese, etc. By mixing the
oxides, alloys can be directly produced. The commercial possibilities of these are very great. 2. I read in a book called "The Wonders of
the World" that one ounce of the fulminate of the World" that one ounce of the fulminate of
gold was enough to totally destroy the city of New York. Has this statement any truth for
its basis? What are the facts in the case?

What is its explosive force compared with rifle it in a water bath, and heat slowly till the powder or nitro-glycerine, and why is it not used solution is complete. Next add the oil, previounce of gold fulminate could destroy New York
stirring all the while, after which closely cove City is alsurd. The fulminates are all New York only one has any commercial use, and that is the mercury fulminate. It is used as detonato
only. The fulminates are all far too pensive, and are also too unstable for any us as explosives. Mercury fulminate can be used for r .
(9031) A. M. Works asks: What should be the diameter and width of an under power when fixed in a current of six miles a hour. A. The area of each bucket should be 4 feet; the most suitable shape may be 4 feet wide, 1 foot deep, and have an immersion of $13 / 4$ feet above the periphery. The wheel should should run at from 9 to 12 revolutions per min te acording to its work
(9032) J. A. S. writes: Please inform me in regard to the elevation of the Mississippi River; as to whether it is higner
at its mouth than at its source, and please state how much, if possible. A. The Mississippi River, on the gravity plane, is about 426 feet higher at St. Louis than at its mouth in the
Gulf of Mexico. All levels on the globe are reGulf of Mexico. All levels on the globe are re-
ferred to the gravity plane, which is about $131 / 2$ miles nearer the earth's center at the poles than at the equator. This plane is the true basis upon which all level data are made.
Uphill and downhill always refer to the gravity plane. Its relation to a perfect sphere is the
cause of much misunderstanding and discussion among people, either from the desire for a catch of the facts. Water never runs uphill, althoug St. Louis is nearer the earth's center than th mouth of the Mississippi River
(9033) W. F. H. asks: 1. In a per manent steel ring $[0]$ magnet are there any
poles? If so, what determines their location? A. In a magnetized steel ring the poles ma those points the places from which making those points the places from which the mag
nets leave the ring when the ring is magnetized That is, pull the ring from the magnets, or the magnets from the ring, at the points where you desire poles to be located. Of course it is easie to place the poles at diametrically opposite points of the ring. 2. Are the magnetic lines of force the same in a permanent steel magnet as in an electro-magnet? If so, why could not the permanent magnetic field be made to re-
volve an armature as well as an electro-magnet field? A. Permanent magnets were first used for the fields of dynamos and motors. They
are not now used because they cannot be made as strong as electro-magnets, and they are
liable to lose their magnetism by jars, etc. 3 . liable to lose their magnetism by jars, etc.
Why is there a neutral point midway betwee Why is there a neutral point midway between
the poles of a magnet? A. The neutral point is just as much positive as negative force ther not the point or line of no force. Break a mag net on the neutral line and two poles are found on the ends of the two pieces. They were there before the bar was broken. The pole at the end of a magnet is due to the fact that there is no magnetism of the opposite sort to render it in together, either bar or horse shoe, and the poles at the point of contact disappear, not because hey are destroyed, but because their mutua escaping into the air at that place. If all line of force can find their way around the magnetic circuit without emerging into the air they are not discoverable from the outside and the cirmetal acts as if it were not magnetized. Only detected by any of our of the metal are to ber please inform me how the noise and vibration of a heavy printing press, on the second floor of a business block, can be prevented or measur
ably deadened, to prevent the annoyance auses to tenants on the first floor?
a difficult matter to so deaden a floor that the noise from a heavy printing press will not be
heard in the room below. A layer of deadening material could be put over the floor and a A deadening laid on that with or other material can be put into the space between the floor and ceiling below. A second ceiling can be put into the room below, enclosing an air space
and reducing the height of the lower room by and reducing the height of the lower room by have all been employed and all together will educe the annoyance as much as it can be re aced.
(9034) E. G. asks: Will you inform me how to prepare silk for making a small bal loon to hold gas for about two or three weeks?
Could I use paper instead of silk? The balloon must be about 3 feet long, 2 feet wide, and lift use anything besides above-mentioned materials? A. Silk is prepared for use in a balloon by varnishing it. It should be stretched tight, and the varnish applied in the usual way.
When dry it can be used. Good boiled linseed oil forms an excellent coating for balloons. An India rubber coating may be used. It is pre-
pared as follows: India rubber, 1 pound, cut pared as follows: India rubber, 1 pound, cut $\begin{array}{lll}\text { maseed } & \text { oil, } 1 \text { of turpentine, } 6 \text { pounds; bollon. Digest the India rub- }\end{array}$
ously warmed, simmer gently for five minutes,
stirring all the while, after which closely cover
it over, and when cold strain through flannel. it over, and when cold strain through flannel
You could probably make a balloon of such

## small size and for indoor use of

The Woman Who Toils. Being the Experience of Two Ladies as Factory Girls. By Mrs. John Van Vorst and Marie Van Vorst. New York: Double
day, Page \& Co. 1903. Pp. ix, 303. This book may well be considered as a de-
tailed study of one phase of the life which the other half" lives, as Jacob Riis has tol is. That the woman who toils is exposed misery than the man who toils, many of us have perhaps suspected. Just what this wo two authors of this book in a way that anything but cheerful. The picture is true;
and because it is true it is gloomy. Here and and because it is true it is gloomy. Here an he conditions that prevall in some of the better factories are described. On the whole, the conditions of the working girl as they are to say the least.
Racquets, Tennis, and Squash. By Eusphotographs and 16 diated with 5 photographs
Appleton \& Co. 1903.
This work at once demands recognition as an authority upon the games mentioned above
owing to the fact that the author is a past master in the art, and has made a deeper study of the theory of "games of the court"
than any other living player. The work is than any other living player. The work
divided into several parts; the first part be ing "Hints on Training," in which the author escribes preparatory exercises, the prop preliminary to putting one's self in fit condi tion for the strenuous side of these sports. The chapter on food and diet will probably Anglo- ved somewhat askance by the ordinary Anglo-Saxon, as the regime suggested by the most people. engaged in active forms of exer ise. The author describes and illustrates number of methods of developing the stroke a home, both for Tennis and Racquet, in which the ball is suspended by means of tackling in be practised in leisure moments when the uuch-sought-after court cannot be obtained shown, which will be of service to those ar propose to lay out private grounds. Anyone should certainly perfect himself in the game
have this book before him, as it will soon be considered a standard au thority. Lists of the winners of the cham pionships in both America and England are Mr. Miles the book. It will be noted that pionship in England in 1899, 1901, and 1902 and also the American amateur tennis cham pionship in 1900 .
norganic Chemistry. With the Ele
Chemistry. By J. I. D. Hinds,
New York: John Wiley \& Sons. Lon
don: Chapman \& Hall, Ltd. 1902 8vo. Pp. viii, 566. Price, $\$ 3$.
This volume is intended to supply a rather handy reference book for all studstry and handy reference-book for all students and
eachers of chemistry. The author has endeavored to present an orderly and systematic reatment of the subject without reference go from chapter to chapter as his own method requires. Part I. contains a good general inroduction to chemistry and a logical dive Part of the subject into its principal branches such an outline of chemistry as is necessary to the full under standing and appreciation of the descriptive portion of the work. Part III. discusses the chemical chemistry with more than usua
horoughness. It is the purpose of Part IV. o treat, with the fullness which it deserves, every known chemical element, and the compounds which are of commercial and theoretithe periodic system has been closely followed. We are pleased to nore that the author has adopted the modern spelling of chemical terms, recommended by the Chemical Section of the American Association for the Advancement of Science.
The Design of Simple Roof-trusses in
Wood and Steel. With an Introduc-
tion to the Elements of Graphic
Statics. By Malverd A. Howe, C.E. don: Chapman \& Hall, Ltd. 1902 don: Chapman \&
n his preface Prof. Howe modestly asserts in the pages of his book. Nevertheless, the book finds its justification in the fact that it has brought together in small compass all the essentials required in the proper designing of
roof-trusses. Although the roof-trusses. Although the timber roof-truss quated, Prof. Howe has deemed it worthy of His treassion, and not without reason, we think. in the sixth chapter of the book, in which he
says what he has to say in a terse, technical

Howe has adopted is both graphical and mathe matical.
Animals Before Man in North America
Their Lives and Times. By Frederi
A. Lucas. New York: D. Appleto
$\&$ Co. 1902.12 mo . Pp. vii, 291
Price, $\$ 1.20$.
This book pictures the early life of our This book pictures the early life of our
continent, tells something of the fishes that once swam about its shores, of the reptiles that splashed through the swamps, and of the great
mammals that once roamed over the western plains. All this Mr. Lucas has told with a cer tain charm that relieves his work of much of the monotony that would be expected of a sub-
ject of so scientific a character. His boo may be said to occupy a position midway between the technical manual and
description of historical animals.
The Thermodynamics of Heat-Engines. By Sidney A. Reeve. New York: The Macmillan Company London: Mac-
millan \& Co., Ltd. 1903 . 12mo. Pp. xi, 316. \& Price $\$ 2.60$.
The author his divided his book into two second to the application theory, and the tice. In the first part he discusses the genera principles of energetics, the cycle, the therma
properties of matter, the steam engine cycle and the laws of permanent gases, gas engine ycles, hot air engines, heat engine possibilities, nd refrigerating machines. In the second part discusses the simple steam engine, the comThe appendix is comprised of tables.
Hardening, Tempering, Annealing and Forging of Steel. By Joseph V. Co. 1903. 8vo. Pp. 288, 200 illustrations. Price $\$ 2.50$.
A new work from cover to cover, treating in clear, concise manner all modern processes
or the heating, annealing, forging, welding, hardening and tempering of steel, making it book of great practical value to metal-working for the successful hardening and tempering of all steel tools used in the arts, including milling cutters, taps, thread dies, reamers, both solid and shell, hollow mills, punches and dies, and ll kinds of sheet metal working tools, shear blades, saws, fine cutlery, and metal cutting all implements of steel both large and small. hardening and tempering processes are given. The uses to which the leading brands of steel may be adapted are concisely presented, and their treatment for working under different conditions explained, also the special methods or the hardening and tempering of special bands. In connection with the above numbers of "kinks," "ways" and "practical points" are
mbodied, making the volume a text book on mbodied, making the volume a text book on
the treatment of steel as modern demand the treatme
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Dies; Their Construction and Use for Modern Working of Sheet Metals. By Joseph V. Woodworth. Ner. Munn \& Co. 1903. 8vo. P
York: Munner
384, 505 engravings. $\quad$ Price $\$ 3$. a treatise upon the designing, constructing and use of tools, fixtures and devices, together
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Kalender für Elektrochemiker sowie Technische Chemiker und Physiker für das Jahr 1903. VII. Jahrgang. Mit einer Beilage. Berlin: Verlag von M. Krayn. Pp. xxx, 600
Report of the Minister of Agriculture for the Dominion of Canada for the Year Ended October
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Order of $\begin{array}{ll}\text { Printed } & \text { by Order of } \\ \text { Ottawa. } & \text { 1903. } \\ \text { Pp. } & \text { xiii, } \\ 284 .\end{array}$
Smithsonian Institution. Bureau of American Ethnology. J. W. Poweil Texts. By Franz Boas. Washington: Government Printing Office. 1902. Pp. 244.
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The Mental Status of Czolgosz, the AsSassin of President McKinley. By Walter Channing, M. D. Brookline, Mass. From the Am.
nal of Insanity. Pp. 46 .

## INDEX OF INVENTIONS

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