May 7, 1957 N. J. THOMPSON 2,791,178

INCENDIARY DEVICE

Filed Nov. 14, 1944

Fig. 1

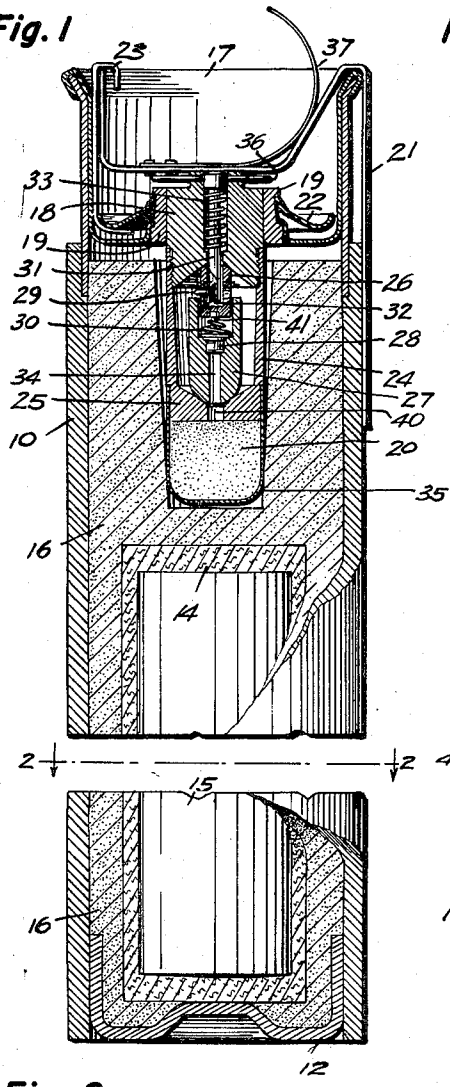


Fig. 3

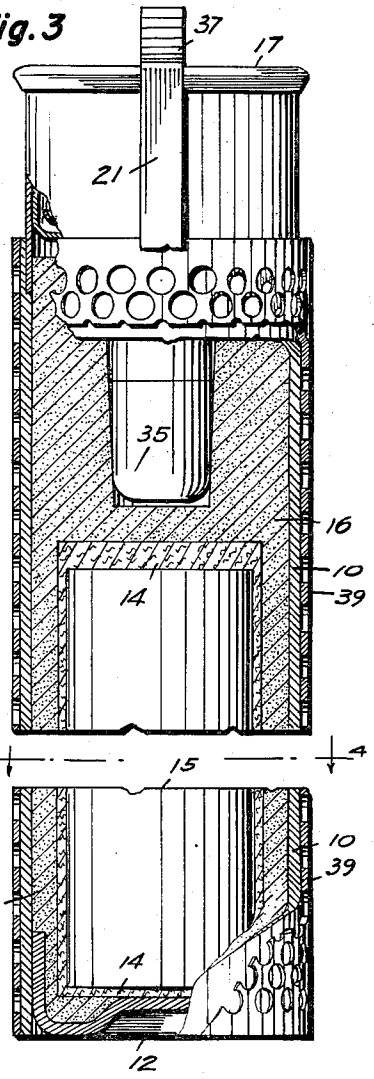


Fig. 2

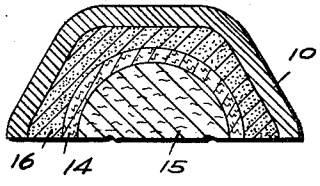
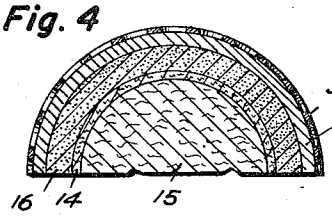


Fig. 4



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2,791,178

INCENDIARY DEVICE

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1 Claim. (Cl. 102—6)

The invention described herein may be manufactured and used by or for the Government, for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to an incendiary device and a heater mixture therefor, and more particularly to an incendiary device and heater mixture which are particularly adaptable for use in the construction of an incendiary bomb.

One object of this invention is the provision of an incendiary device which is unusually safe in storage and in transport.

Another object of this invention is the provision of an incendiary device which is not subject to evaporation or leakage.

A further object of this invention is the provision of an incendiary which is extremely difficult to extinguish with ordinary agents since it will burn in the absence of oxygen from the surrounding atmosphere.

A still further object of this invention is the provision of an incendiary which is particularly effective since it combines the high temperature and radiation characteristics of the common magnesium bomb and the long "reaching" flames of the oil bomb.

A still further object of this invention is the provision of a heater mixture which is particularly adapted for use in the above indicated incendiary.

Further and additional objects will appear from the following description, the accompanying drawing and the appended claim.

In accordance with this invention, an incendiary device is provided which comprises preferably a fusible or combustible case (which may be reinforced with a strong non-combustible case material such as steel), a body of substantially non-volatile combustible organic material of high calorific value within said case and a second body of heater mixture, also within said case, capable of self-sustained burning at a reaction temperature sufficient to melt or burn said case and to vaporize and crack said organic material. Organic materials having suitable physical and thermal properties are exemplified by fatty acids, fats, oils, and fatty esters, such as, stearic acid, oleic and tallow, and lard oil, but hydrocarbons and other mineral carbonaceous materials which are readily available are preferred. The properties of high calorific value, high melting point, and high boiling point are important factors in the selection of these materials. For obtaining proper cracking, the heater mixture should give a localized heat of adequate intensity but should not burn too rapidly.

In accordance with one preferred embodiment of this invention, a non-volatile hydrocarbon mass is present in the form of a central core surrounded by the heater mixture and the whole is contained in a combustible or fusible case provided with suitable means for igniting the heater mixture. The heater mixture, during burning, fuses or ignites the case and at the same time volatilizes and cracks the hydrocarbon material to form vapors which

are ignited. Thus the device possesses a high degree of effectiveness as an incendiary.

In accordance with one preferred embodiment of this invention, the heater mixture is placed in an annular space between the combustible or fusible case and the central hydrocarbon core. However, under certain conditions, it may be desired that the heater mixture be centrally located along the longitudinal axis of the device and surrounded by the non-volatile hydrocarbon material.

The hydrocarbon core may comprise a heavy hydrocarbon oil disposed within an inner readily combustible receptacle, and to minimize the possibility of leakage, the oil may be practically solidified. This has been done effectively by providing a hydrocarbon-containing mass comprising cotton waste saturated with a heavy hydrocarbon oil and also by converting a heavy hydrocarbon oil to a solid mass by the use of suitable emulsifying agents. If desired, the hydrocarbon material may be a solid resinous or wax-like mass. In this event a separate receptacle will not be required for it.

The heater mixture for the device of this invention may comprise any mixture that is capable of self-sustained burning and that upon burning will fuse or burn the outer case and will volatilize and crack the hydrocarbon oil or organic material. If desired, thermite or thermate may be used as the heater mixture. However, in accordance with one embodiment of this invention, a heater mixture has been provided which may be used alone or in admixture with standard heater mixtures such as thermite or thermate. Such a mixture comprises a heavy hydrocarbon oil, fine flake aluminum and sodium nitrate to which finely divided sulphur may be added to insure evenness of burning. The ingredients of the mixture may be proportioned to control the rate of burning and the total amount of heat liberated. The surface of the fine flake aluminum permits the adsorption of large proportions of the hydrocarbon oil (having a high calorific value) without destroying the burning properties of the mixture. The larger proportion of oil at the same time provides a mixture insensitive to impact.

For a more complete understanding of this invention, reference is now made to the accompanying drawing wherein:

Fig. 1 is a broken sectional elevational view of an incendiary device constructed in accordance with one embodiment of this invention;

Fig. 2 is a fragmentary sectional view of the device shown in Fig. 1 taken along the line 2—2 thereof;

Fig. 3 is a broken sectional elevational view of a modified form of the incendiary device; and

Fig. 4 is a fragmentary sectional view of the device shown in Fig. 3 taken along the line 4—4 thereof.

Referring now more particularly to Fig. 1, the device there shown comprises an outer case 10 which may be constructed of a fusible or combustible material such as magnesium, aluminum, paper, nitrocellulose or other similar substance. This case is secured by suitable means to a base 12. A second case 14 is disposed within and spaced from the side walls of case 10. The case 14 is constructed of a readily combustible material such as paper, nitrocellulose or other readily combustible plastic. A non-volatile hydrocarbon core 15 is positioned within the inner case 14. This mass of material may comprise cellulose cotton waste saturated with a heavy hydrocarbon oil. However, it will be apparent that the heavy hydrocarbon may be present in other physical forms if desired. The hydrocarbon material may be a solid, self-supporting wax-like or resinous mass, in which case the inner receptacle 14 may be dispensed with. One advantage of such a construction is that the device is more readily assembled Gilsonite or other hydrocarbon resin,

wax, or emulsion has been found to be useful for this purpose. One solid emulsion that has been found to be satisfactory for this purpose was prepared by cooking 87% by weight of #2 fuel oil and 13% by weight of aluminum soaps of cocoanut fatty acids together for about 30 minutes at 212° F.

In the annular space between the side walls of the case **10** and the case **14** is provided a heater mixture **16** which is capable of self-sustained burning and which will liberate sufficient heat to burn or fuse the combustible case **10** and to volatilize and crack the hydrocarbon core. The heater mixture may comprise thermite, which is a mixture of iron oxide and aluminum powder in the ratio of about 3 to 1. Other thermite-like mixtures, such as thermate, may also be employed. A typical thermate composition comprises 80% thermite and 20% of a flare mixture comprising:

	Percent
Barium nitrate	75
Aluminum flake	19
Sulphur	4.5
Castor oil	1.5

However, in accordance with one embodiment of this invention, a mixture comprising suitable proportions of heavy hydrocarbon oil, fine flake aluminum and sodium nitrate may be used as the heater mixture. It has been found that the use of fine flake aluminum in mixtures of this character imparts properties to the resulting mixture that have been heretofore unobtainable. The tremendous surface area of the flaked aluminum will absorb a large amount of the heavy hydrocarbon oil (having a high calorific value) and will thus permit relatively large amounts of oil in the mixture without interfering with the burning characteristics. Moreover, the mixture is insensitive to impact when a larger proportion of hydrocarbon oil is used. Sulphur may be added to the mixture to insure evenness of burning if desired. A suitable mixture has been found to have the following composition:

	Percent
Motor oil (SAE–40)	15
Aluminum flake (through 200 M.)	35
Sulphur (through 100 M.)	2
Sodium nitrate (through 100 M.)	48

The relative proportions of the above indicated ingredients may be varied depending upon the desired burning rate and total heat output. This in turn may depend upon the characteristics of the fusible or combustible case. Lesser amounts of oil increases the burning rate and decreases the total heat output and vice versa. Also thermite or thermate may be incorporated into the above indicated mixture in order to control the burning properties thereof. Higher percentages of thermite or thermate tend to increase the local heat produced. In the event that the fusible or combustible outer case **10** comprises magnesium then a suitable mixture has been found to be 50% standard thermate and 50% of the above indicated composition. In the event that nitrocellulose or other readily combustible material is used in the construction of the case **10**, then the heater mixture may comprise smaller proportions of thermite or thermate and higher percentages of oil may be used.

In a completed form of the bomb the top of the case **10** may be provided with a suitable cover **17** and means for igniting the heater mixture. Such igniter means may comprise black powder whose burning may be initiated by a suitable firing mechanism.

Although the general design of the body, the closure, and fuze in the device may be varied, the drawing illustrates forms of bomb bodies provided with a standardized tail cup closure assembly and a standardized all-ways fuze assembly. The tail cup closure **17** is given a press fit into a tail end extension of the bomb body and is crimped to the edge of this extension to make the tail cup more secure in place, also, to which it may be welded. The all-ways fuze is secured at its head plug **18** to an apertured hub **19** disposed centrally in the bottom of the tail cup **17** so that a first fire charge **20** at the base of the fuze assembly is surrounded by the heater mixture **16**. Arming of the fuze is subject to a release band **21**, which held in place as shown prevents the fuze from being armed so long as an adjacent bomb in a cluster holds the band **21** in place. The tail cup hub **19** is encircled by a retaining ring **22** which may be used to secure the ends of cloth streamers (not shown) for stabilizing the bomb and regulating its speed in flight. Ring **22** also holds clip **23** in place as a catch for band **21**.

The all-ways fuze assembly comprises a tubular fuze body **24** secured to head plug **18** and a base plug **25**, with which the body **18** forms a hollow chamber having conical end surfaces. The firing mechanism inclosed in this hollow chamber is made up of a striker body **26** slidably coupled with a primer holder **27** and kept normally separated from a primer cap **28** in the primer holder by a safety pin **29** and by a coil spring **30**. An arming pin **31** is passed through a central bore in the head plug **18** so that it projects into the striker **26**, wherein the arming pin positions the safety pin **29** outwardly against a small coil spring **32** surrounding the safety pin to thereby lock the striker against movement. Ejection of the arming pin from the head plug **18** by spring **33**, when the release band **21** no longer presses on the head of the arming pin, allows the safety pin **29** to become recessed within the striker **26** by the coil spring **32** so that the coupled striker and primer holder are no longer fixed in position, and the striker **26** is free to move against coil spring **30** in the direction of a primer cap **28** within the primer holder **27**. The firing mechanism assembly thus armed is free to gyrate in the hollow chamber with the outer ends of the striker and the primer holder sliding on the cam-like conical end surfaces of the chamber. When the firing mechanism assembly is free to make such a movement, the striker **26** and primer holder **27** are forced together and upon impact of the bomb carrying the fuze, with sufficient set-back force, the striker **26** overcomes the resistance of coil spring **30** to drive firing pin **41** into primer cap **28** seated in the primer holder **27**. The armed firing mechanism is capable of functioning regardless of the position of the bomb on impact. The primer cap **28** is seated above a bore **34** extending through a primer holder **27**. A flash back from the fired primer cap **28** passes through this bore and through an aperture **40** in base plug **25** to ignite a first fire charge **20** attached to the base plug **25** by a combustible plastic cup **35**.

A cotter pin **36** through aligned drill holes in the head plug **18** and the head of the arming pin **31** maintains the fuze unarmed until it is assembled to the bomb with the release band **21** in place on the clustered bomb. Spring band **37** is riveted to band **21** to assist in holding it in place.

After a bomb cluster is dropped from air craft, the release band **21** unhinges from a bomb separated from the cluster and thereupon the arming pin **31** is ejected from the fuze to arm the firing mechanism. When the bomb carrying the armed fuze receives adequate impact on hitting a target, the primer becomes ignited by percussion and flashes back into the first firing charge. If desired a powder train delay element may be inserted into the bore **34** of the primer holder **27** or into the aperture **40** of the fuze base plug **25**.

A suitable first fire charge which does not burn explosively comprises 25% magnesium and 75% barium chromate. To vent gases from the bomb when the heater mixture begins to burn, a small vent hole may be made in the upper part of the bomb body and a small blowout plug may be normally fitted in this hole.

In operation, the heater mixture burns downwardly from the upper regions of the case **10** causing the case

to fuse or burn as the mixture burns down. When the mixture has burned down as far as the hydrocarbon core, the latter is caused to vaporize and the hydrocarbon is cracked. The cracked vapors are ignited and a very intense burning is produced. The incendiary is almost impossible to extinguish by ordinary agents because of the presence of oxidizing agents (iron oxide and $NaNO_3$) in the heater mixture which provide the necessary oxygen for combustion.

A modified form of the incendiary device is shown in Figs. 3 and 4. This modified form comprises a hydrocarbon core **15** and a heater mixture **16** similar to the device shown in Figs. 1 and 2. The outer case, however, comprises a layer of nitrocellulose **10** reinforced with a perforated steel sleeve **39**. This sleeve serves to reinforce the case so that the device when used as a bomb will not be deformed on impact. Other non-combustible reinforcing agents such as expanded metal, wire screen, or other foraminous sheet material may be employed if desired. However, the use of a perforated steel sleeve is preferred for the reason that, as the contents of the case are being burned, jets of flame will be projected through the perforations thus setting fire to any combustible object that happens to be positioned near the burning incendiary. In actual production the nitrocellulose layer may be molded directly inside of and into the perforated steel case whereby the perforations are filled with the nitrocellulose.

It will thus be seen that an incendiary device has been disclosed herein which may be readily and cheaply prepared. By having its charge in a substantially solid and non-volatile condition, the device is not subject to evaporation or leakage, during storage or handling, yet when functioning, gives the effects of long flaming jets of gas. It is difficult to extinguish and the mixture contained therein is not sensitive to impact, thus rendering the device safe to transport. The ingredients of the heater mixture may be proportioned to provide any desired burning rate and heat liberation that may be required for effectiveness against any given target.

While in the foregoing several specific embodiments of this invention have been specifically disclosed it is not intended that the invention should be limited strictly thereto. It will be apparent to one skilled in the art that many modifications may be made and it is therefore intended that this invention be limited only by the scope of the appended claim.

I claim:

An incendiary bomb including means for cracking oil within said bomb and being charged with heavy hydrocarbon oil adapted to be cracked by said means in said bomb, said means comprising a bomb casing having a nitrocellulose wall portion and a surrounding, reinforcing steel sleeve provided with a plurality of perforated portions through which jets of flame are outwardly and forcibly directed through said sleeve for igniting combustibles in the vicinity of said bomb, said casing containing an inner core of cotton impregnated with heavy hydrocarbon oil, a heater composition in which said core is imbedded and held apart from said wall portion consisting essentially of an admixture of a volatile hydrocarbon oil, thermite, and a flare mixture, said flare mixture consisting by weight of from about 19% to about 35% of fine aluminum flakes providing, in aggregate, a surface area highly adapted to absorb a large quantity of heavy hydrocarbon oil, from about 48% to 75% of fine particles of a readily oxidizable nitrate selected from the group of nitrates consisting of sodium nitrate and barium nitrate and from about 1% to about 2% of sulfur in the form of fine particles adapted to make said composition burn more evenly.

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