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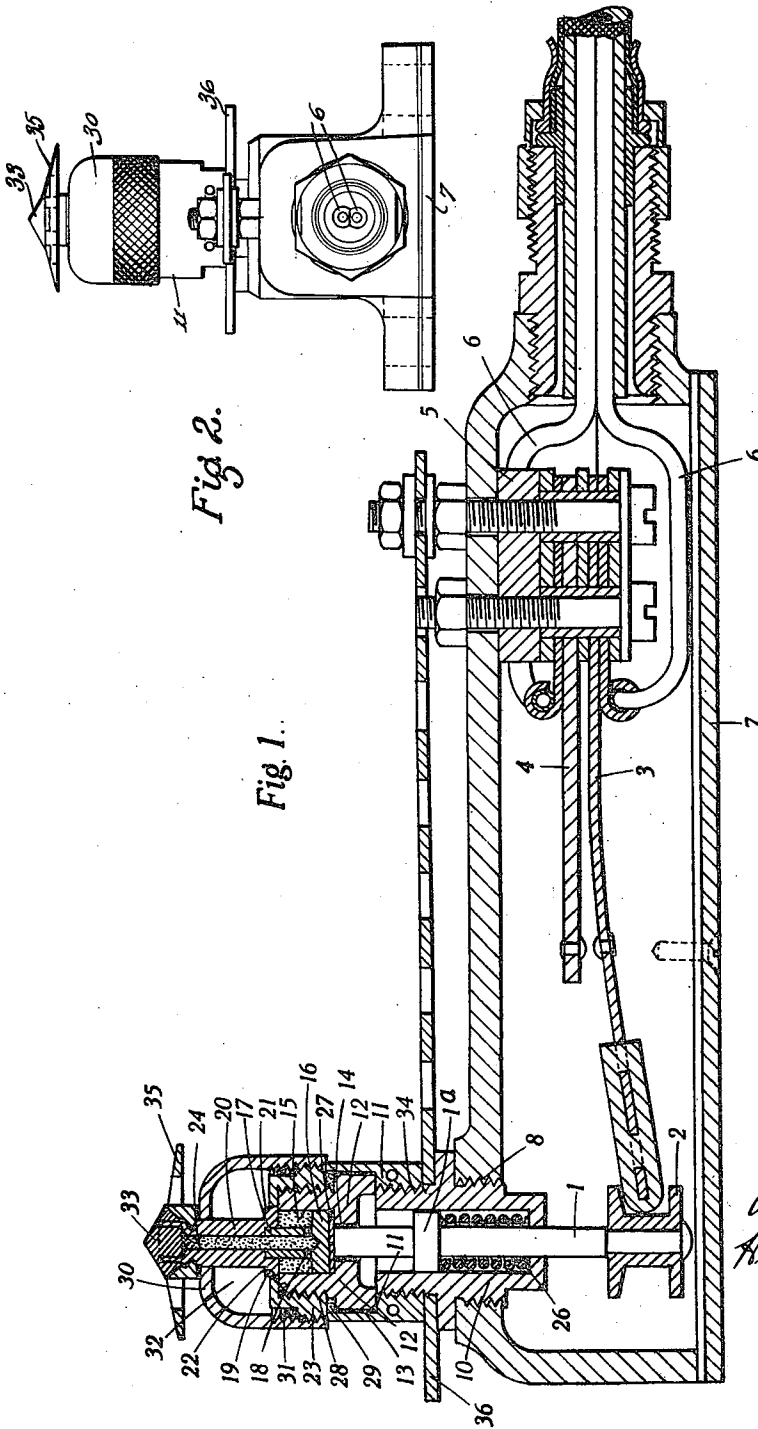
A. MATHISEN ET AL

2,236,958

HEAT RESPONSIVE CONTROL SYSTEM

Filed April 20, 1939

4 Sheets-Sheet 1



Anders Mathisen
Hubert Mackenzie
Inventors

by *B. J. Cahony*
their Attorney

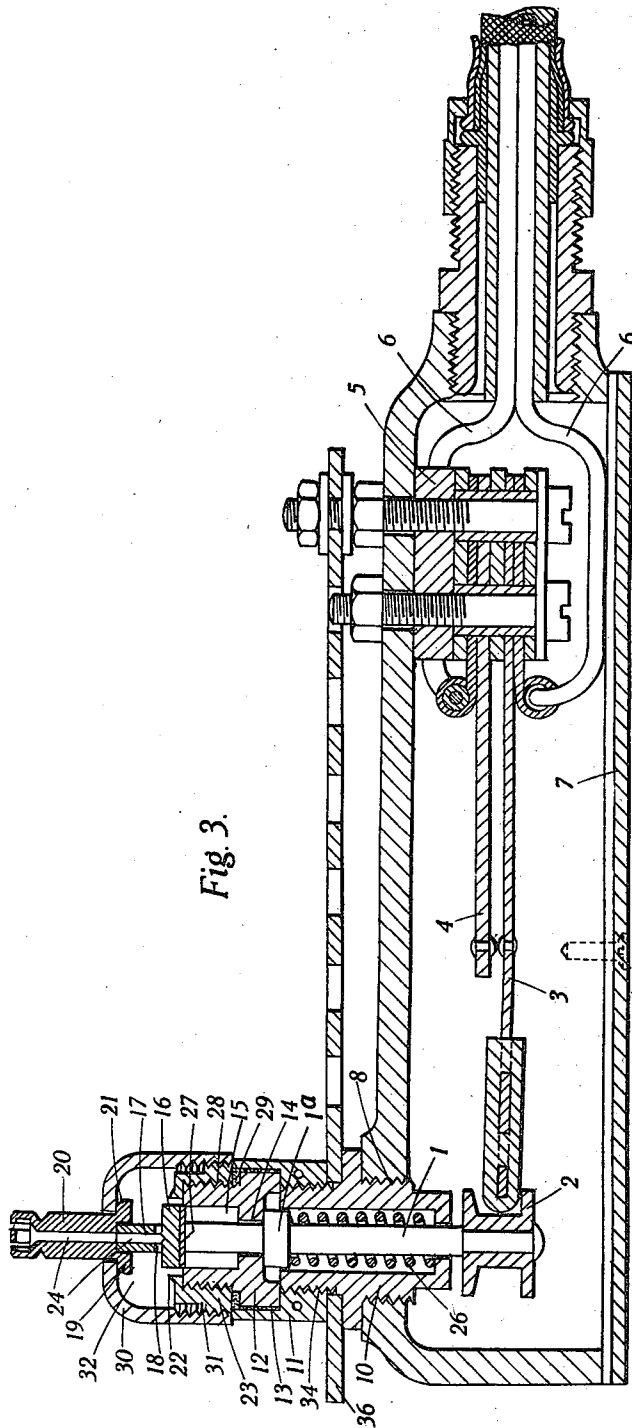
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4 Sheets-Sheet 2



Anders Mathisen
Hubert Mackenzie
Salmond
Inventors

by *Wm. J. Bohannon*
their Attorney

April 1, 1941.

A. MATHISEN ET AL

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Fig. 4.

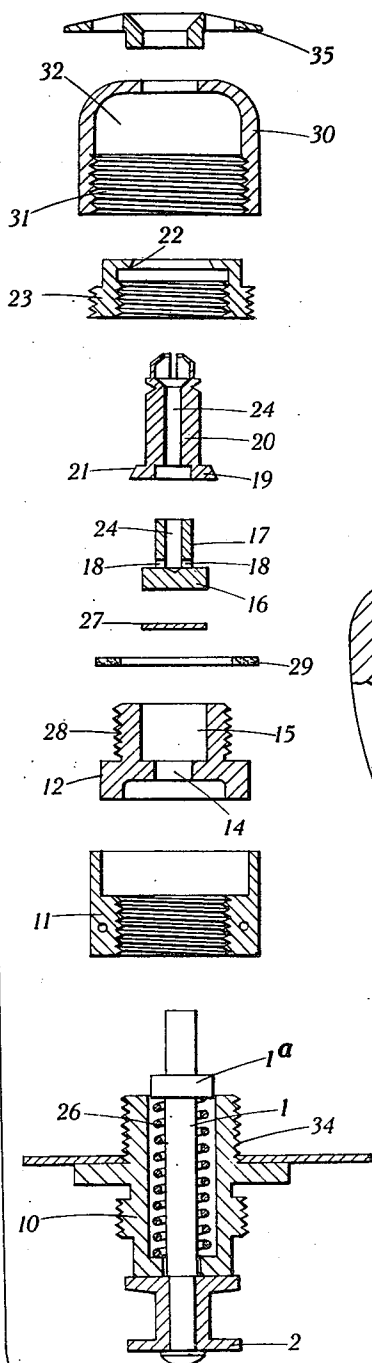
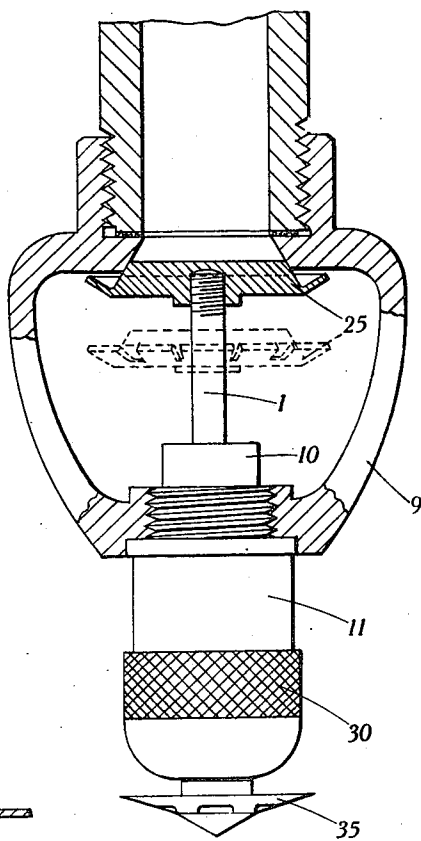


Fig. 5.



Anders Mathisen
Hubert Mackenzie Salmond
Inventors
by Ben J. Chorny
Attorney

April 1, 1941.

A. MATHISEN ET AL

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Fig. 6.

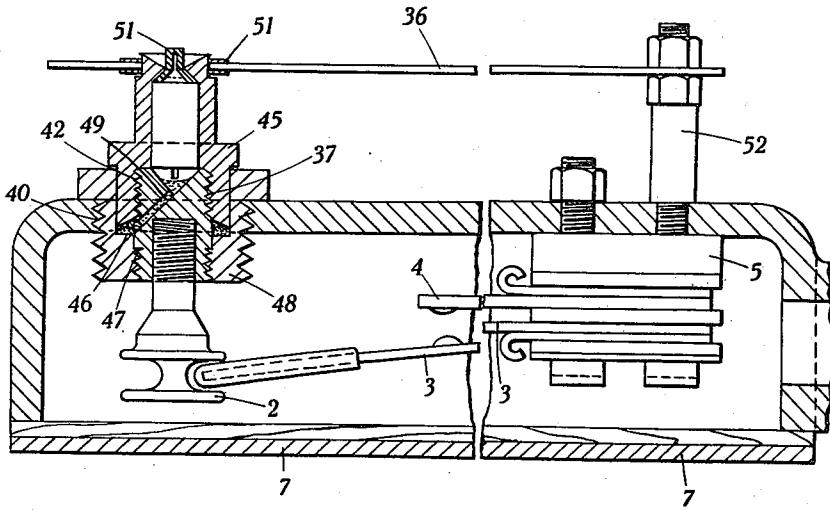
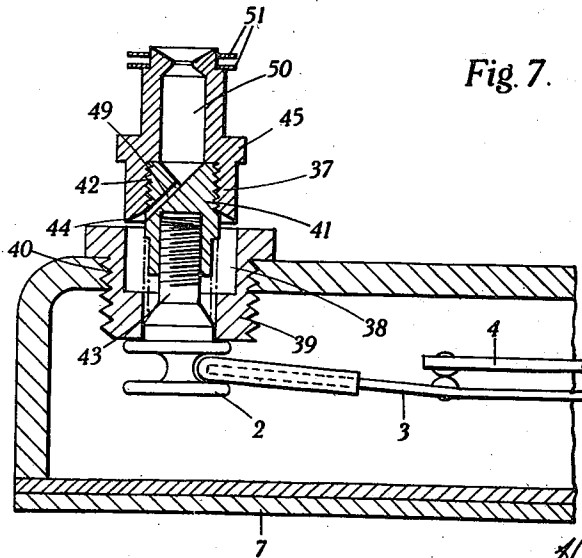


Fig. 7.



Anders Matheson

Hubert Mackenzie Salmon
Inventors

by Ben J. Chromy
their Attorney

UNITED STATES PATENT OFFICE

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HEAT RESPONSIVE CONTROL SYSTEM

Anders Mathisen, Osterley, Isleworth, and Hubert Mackenzie Salmond, Fareham, England, assignors to Graviner Manufacturing Company Limited, High Holborn, London, England

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12 Claims. (Cl. 74—2)

This invention relates to devices for controlling flame or temperature operated devices such as electric switches, sprinkler heads and the like for use in fire protection systems and is applicable in general for actuating any member which is normally to be retained in one position and required to be released in an emergency to afford protection to structures, or persons associated therewith.

It has previously been proposed to use inflammable materials such as Celluloid strips, gun cotton strings and like materials for retaining electric switch contacts in open position, such materials being ignited by flame to permit closure of the switch contacts when a fire occurs, the closure being utilized to effect operation of fire extinguishing apparatus.

In sprinkler heads in fire protection systems it is common practice to utilize metal lever mechanism soldered together to form a strut capable of collapsing when subjected to temperature increase, such action effecting discharge of fire quenching liquid, generally water. The use of a liquid charged frangible glass capsule has also been proposed as a strut in such apparatus.

In connection with the use of automatic fire extinguishing apparatus upon aircraft it is found, on the one hand, to be of paramount importance to obtain as near as possible instantaneous discharge of the fire extinguishing liquid container as soon as a fire breaks out. On the other hand mechanical reliability is also important as continuous vibration, exposure to temperature changes of wide ranges and liability to corrosion due to moisture and acids such as may be present in an aero engine nacelle has extremely deleterious effects upon any form of mechanism such as flame and temperature operated devices of known types.

It is found that devices employing gun cotton string, Celluloid strips and the like are insufficiently reliable over long periods to permit their use in fire extinguishing systems upon aircraft. On the other hand it is found that operation within two seconds of a flame contacting with the flame sensitive control device on switches is required and this precludes the use of soldered metal struts or lever devices as well as of liquid charged frangible bulbs as heat absorption delays the operation of such devices to something exceeding 5 seconds at the best whereas 15 to 20 seconds is more usual.

It is the object of the present invention to provide a device suitable as a flame sensitive element in fire protection systems which shall oper-

ate within two or three seconds after contact with flame and yet be mechanically robust and capable of withstanding vibration and rough usage over long periods, being at the same time resistant to corrosion and other deleterious effects such as may be met with in aero engine compartments or nacelles.

According to this invention a device for actuating a controlled member such as a flame or temperature operated electric switch, sprinkler head or other actuating means, comprise a displaceable retaining element for the member to be controlled, locking means holding the retaining element against displacement, and means for confining an explosive charge in such a position adjacent the retaining element as to be capable of ignition by a flame to effect displacement of the retaining element against the action of the locking means.

Preferably, the locking means comprises an element which is adapted to be ruptured by the ignition of the explosive charge, for example, the locking means may be a screw thread which is adapted to be stripped when the explosion takes place, or it may be in the form of rigid flange, the strip or cap portion, or the whole, of which may be ruptured by the explosion. Alternatively, or in addition, the locking means may be capable of being displaced when the explosion occurs.

In carrying out the invention, the retaining element is in the form of a rigid slidable member, and a housing is recessed to accommodate the retaining element and to provide a chamber below or around the said retaining element in which the explosive charge can be confined. The retaining element is provided with an ignition channel which communicates with the charge confining chamber for effecting ignition of the charge.

For the purpose of illustrating the manner in which the invention can be carried out it will now be described with reference to the accompanying drawings which show two embodiments by way of example and in which:

Figure 1 is a vertical longitudinal section view of a preferred embodiment of the invention shown mounted in position on and controlling a flame operated electric switch, such as may be used in the fire protection system of an aeroplane, the figures showing the parts in the non-operated position of the controlled member with the switch contacts open.

Figure 2 is an end elevation of the mechanism shown in Figure 1,

Figure 3 is a view similar to Figure 1 with the parts in the position they take up after the ex-

plosive charge has been ignited, that is when the retaining element has been released to effect thereby operation of the controlled member and closure of the switch contacts.

Figure 4 is an exploded view of the parts comprising the flame sensitive control device as applied to the switch according to Figure 1.

Figure 5 is a view of the flame sensitive device shown in the preceding figure, with the controlled member connected for actuating the valve of a sprinkler head.

Figure 6 shows in longitudinal sectional elevation an alternative embodiment of a flame sensitive control device according to the invention applied to an electric switch, the parts being in the normal inoperative position, and,

Figure 7 is a detail view showing the parts of Figure 6 in the operated position with the switch contacts closed.

In the drawings, the controlled member which is operated by the retaining element, is a spring pressed plunger 1, which in Figures 1 to 4 and 6 and 7, is connected by an annularly recessed terminal collar 2 to one of a pair of springy electric switch contacts 3 and 4 which are supported in electrically insulated relation by a supporting block 5 and are connected by conductors 6 to the fire protective circuit. The block 5 is mounted in a rectangular elongated casing 7 which at one end has a tapped aperture 8 by which the flame sensitive control device may be mounted in position for controlling the switch contacts 3 and 4.

In the embodiment illustrated in Figures 1 to 5, the flame sensitive device is mounted in position on the casing 7 (or the sprinkler head casing 9 in Figure 5) by means of a hollow nut 10 having a ferrule 11 screwed thereon. The flame sensitive device consists of a housing in the form of a nipple 12 which is fitted into the ferrule 11 and is connected thereto preferably by a fusible sleeve 13 which may be obtained by soldering so as to permit the flame sensitive device to come off as a whole as a result of temperature rise causing melting of the fusible sleeve or layer. In this way the device may be adapted for operation otherwise than by a direct flame necessary to cause ignition of the explosive charge.

The nipple 12 has a hole 14 in its lower end into which the plunger 1 can pass. The other end of the nipple has a bore 15 larger than the said hole 14 into which the retaining element for the plunger slidably fits. This retaining element is made in two separate parts of which one, herein referred to for convenience as the upper part, consists of a flange 16 provided with a tubular projection 17. The tubular projection 17 of the flange 16 projects upwards and has a pair of fine ignition holes 18 bored transversely therein immediately above the flange 16. The upper end of the tubular member 17 projects into the bottom of the second part of the retaining element which is referred to as the lower part and which is in the form of a flange 19 provided with a tubular projection 20 which is co-axial with the tube 17. This upper flange 19 has its edge or rim tapered at 21, said tapered edge engaging wedge fashion with the inner edge or rim 22 of a cap 23 which screws on to the nipple 12. The space around the tubular projection 17 forms a chamber which is charged with a small quantity of explosive substance, preferably gun powder, the charge extending into the co-axial tubular members 17 and 20 which thus form a continuous ignition channel 24. When the cap 23

is screwed down tightly, the gun powder charge is confined below the upper flange 19, the latter being held from upward axial displacement by the edge 22 of the cap 23, which edge is capable of being ruptured or distorted by the force of explosion of the confined charge.

Thus upon ignition of the charge in channel 24 formed by the co-axial tubes 17 and 20 the confined charge is ignited, thereby blowing the upper flange 19 out and thus releasing the lower flange 16 and the plunger 1 which effects operation of the contacts 3 and 4 of the switch in Figures 1 to 3 or the valve 25 in Figure 5. The plunger 1 is pressed by a spring 26 housed in the nut 10 which bears upwardly onto flange 1 of plunger 1 so that upon release the required operation will take place. In the case of the switch, the action is facilitated, or it may be effected solely by the springiness of the contacts 3 and 4.

To avoid loss of explosive gas and entry of moisture the lower flange 16 is placed upon a fibre or like disc 27 which may be shellacked to form a hermetical seal for the confined explosive charge at this point. Similarly, the inclined surfaces of the edge 22 and the threads 28 upon the cap 23 are shellacked to avoid loss of gas and entry of moisture, and a washer 29 is preferably inserted between the cap 23 and nipple 12 below the threads 28.

A secondary cap 30 is fitted over the above mentioned cap 23 being secured thereto by screw threads 31, said secondary cap serving to catch the blown-out flanged elements 16 and 19, since their projection by explosive violence is an objection. The space 32 between the top of upper flange 19 and top of the secondary cap 30 is sufficient to permit the movement necessary for permitting the contacts 3 and 4 to close or the valve 25 (Figure 5) to open.

Where gun powder is used as the explosive charge this might be lost through the outer end of the ignition channel 24 and to prevent this contingency the latter is fitted with a priming head 33 made of a substance such as constitutes the match head of the kind used in fireworks, or comprising gun powder in the proportion of 75% mixed with 25% Celluloid dissolved in acetone, the head being preferably covered with a thin coating of Celluloid dissolved in acetone to prevent it from becoming moist or from being attacked by fumes or acids as may be present in aero engine nacelles.

It will be appreciated that when the priming head is ignited by an applied flame, the charge in the ignition channel 24 is ignited which, in turn, results in the firing of the main charge in the explosion chamber, the ignition of this main charge occurring through the transverse ignition channel 18.

In the embodiment described above, the unit comprising the flame sensitive device 12 and associated parts and its mounting 11 and 10 are capable of being readily detached from the casing 7, by means of the screw threads 8. Similarly the flame sensitive device and the sleeve 11 can be readily detached from the nut 10 by means of the screw threaded connection 34. Thus by unscrewing the parts the contacts can be made to close for circuit test purposes, upon screwing the unit back the contacts are opened and the unit is locked in position to avoid accidental unscrewing.

In order to ensure that the flame sensitive device according to the invention shall be operated by a blast of flame blown over the device

such as by the slip stream of an aero engine propeller, inflammable discs 35 and strips 36 of substances such as Celluloid are secured to the device and adjacent the ignitable substance so as to act as flame traps which catch and concentrate flames upon the flame sensitive substances.

Thus in the embodiments of Figures 1 to 5, the priming head, when unignited, is surrounded by the perforated flame trapping discs 35, strip 36 also facilitating the catching of flames. In Figure 6, the flame trap element is the strip 36 only this being of inflammable Celluloid.

In the embodiment illustrated in Figures 6 and 7, the actuating element is in the form of a hollow plug 37 which is slidably fitted in an interior recess 38 (Fig. 7) formed in a nipple like housing 39 of which the exterior is screw threaded at 40 to screw into the switch casing or sprinkler head casing. The plug 37 has a downwardly projecting spigot 41 which is conveniently separate from the plug proper and secured thereto by a screw thread 42, and the controller member, in the form of a plunger 43, is directly screwed into this spigot. The annular flange portion 44 of the plug which surrounds the spigot 41 is bevelled inwardly as shown and a flange 45 on the plug is adapted to engage with the top of the nipple housing when the plug is seated therein, to provide a chamber 46 between the bevelled annular portion 44 of the plug and the base of the recess 38.

In this chamber 46 the explosive charge is confined by the plug and the latter is retained seated in position by screw threads 47 on the spigot portion which screws into a depending flange 48 of the housing. An ignition channel 49 leads from the charge confining chamber through the spigot to the main interior 50 of the plug which is adapted to contain a safety fuse and which terminates in a priming head 51. The latter and the fuse retain the charge confined within the ignition channel and the chamber 45, but, upon ignition they touch off the confined charge, the resulting explosion causing the retaining screw threads 47 to be stripped so that the whole plug can blow out of the seating, as illustrated in Figure 7. The switch contacts 3 and 4 will then close in the case of a switch, or the valve will operate in the case of a sprinkler head.

It will be observed that the flame trapping 36 is held in position on the head of the plug by a pair of washers 51 the opposite end of the strip being supported by an upstanding bracket 52 from the switch casing.

Having thus fully described our invention, what we claim as new and desire to protect by Letters Patent is:

1. Flame or temperature operated apparatus comprising a displaceable controlled member, a housing, a slidable retaining member mounted for retaining said controlled member, mounted in a recess in said housing and comprising upper and lower co-axial tubular members, an explosive charge, flanges at the lower ends of said tubular members to provide an annular chamber around the lower tubular member in which said explosive charge is confined, said lower tubular member having an ignition channel extending transversely therethrough to connect said charge confining chamber with the bore formed by the co-axial tubular members, and a retaining cap engaging said flange of the upper tubular member to hold said retaining element against displacement, said cap being capable of deformation by ignition of

the explosive charge to release said retaining element for movement.

2. A device as set forth in claim 1, in which said retaining cap has a tapered edge portion which engages wedge fashion with a tapered edge portion on said flange of said upper tubular member, said tapered edge portions being capable of deformation under the action of the explosion to release the retaining element for movement.

3. A device as set forth in claim 1, in which a sealing member is interposed between said lower flange and said base of the housing recess in which said retaining element is mounted.

4. A device as set forth in claim 1, and comprising a secondary cap mounted on said housing above said upper flange and in a position to catch the latter when ejected by the explosion of the charge while permitting sufficient movement of said retaining element resulting from the explosion to enable the required movement of said controlled member to take place.

5. A device as set forth in claim 1, including an ignitable priming head which terminates said retaining element.

6. A device as set forth in claim 1 including flame trapping means which direct and concentrate a flame on to the terminal portion of the bore of said retaining element.

7. Flame or temperature operated apparatus comprising a displaceable controlled member, a housing, a slidable retaining element mounted for retaining said controlled member, mounted in the said housing, an explosive charge, a chamber in said housing and adjacent said retaining element for confining said explosive charge, said retaining element having an ignition channel which communicates with said chamber whereby said charge is ignitable by a flame, means on said retaining element which takes the force of the explosion for causing displacement of the retaining element, and locking means normally holding said actuating element against displacement, a priming head terminating said actuating element and retaining the explosive charge within the ignition channel, and flame trapping means which direct and concentrate a flame on to said priming head.

8. Flame or temperature operated apparatus comprising a displaceable controlled member, a housing, a slidable retaining member positioned for retaining said controlled member and mounted in a recess in said housing and comprising upper and lower co-axial tubular members, an explosive charge, flanges at the lower ends of said tubular members to provide an annular chamber around said lower tubular member in which an explosive charge is confined, an ignition channel extending transversely through said lower tubular member to connect the charge confining chamber with the bore formed by said co-axial tubular members, and a retaining cap engaging the flange of said upper tubular member to hold said retaining element against displacement, said cap being capable of deformation by ignition of said explosive charge to release said retaining element for movement, a secondary dome shape cap mounted on said housing to cover the flange of said upper tubular member, and having an opening through which the bore of said retaining element is accessible, and an ignitable priming head connected through said opening to the said upper tubular member to plug the end of the latter.

9. A device as set forth in claim 1, and comprising a fixed member connected to said actu-

ating element, and a fusible coupling between said fixed member and said housing whereby the latter is freed and thereby also the retaining member released upon a comparatively slow temperature rise.

10. In a flame or temperature operated device, a plunger member, a sleeve for slidably mounting said plunger member, resilient means normally urging said plunger member into a released position, slidable retaining means normally holding said plunger member in a restrained position, a cap member carried on said sleeve and provided with a base aperture adapted to receive said retaining means, said cap member and said retaining means comprising mutually engaging locking means for normally holding said retaining means in its restraining position, and explosive means adjacent said locking means and adapted to fracture the same when exploded.

11. A device according to claim 10, said locking means comprising a tapered conical flange formed on said retaining means and adapted to wedgingly engage the rim of said aperture in said cap member.

12. A device according to claim 10, said retaining means comprising a pair of co-axially mutually engageable sleeve members, a first one of said sleeve members having a flange engageable with the rim of the aperture of said cap, and a nipple mounted to surround the second one of said sleeve members and to form with said second sleeve member and said flange a space for containing said explosive means, said explosive means extending continuously from said space through the axial bores of said sleeves to the exterior of said retaining means.

ANDERS MATHISEN.
HUBERT MACKENZIE SALMOND.