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R. L. SMITH ET AL

2,934,014

IGNITER ASSEMBLIES

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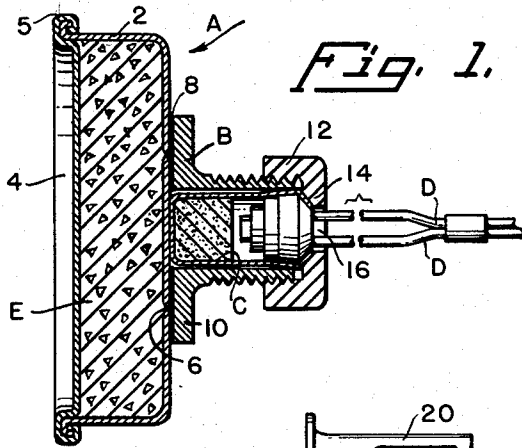


Fig. 1.

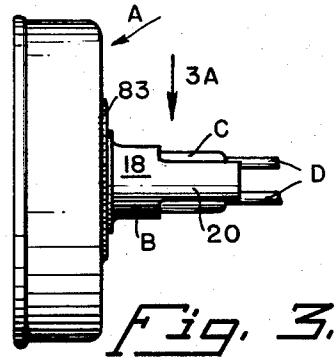


Fig. 3.

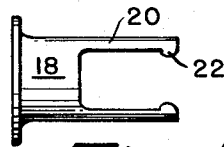


Fig. 3A.

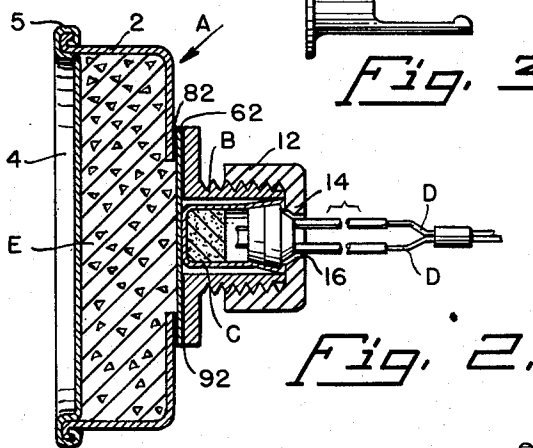


Fig. 2.

Fig. 4.

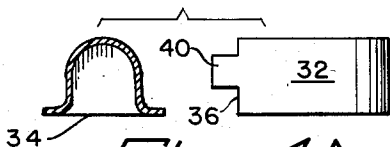
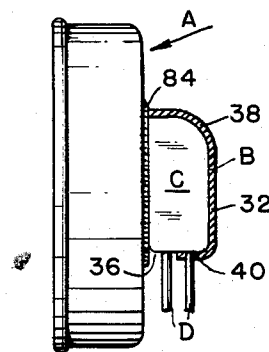


Fig. 4A.

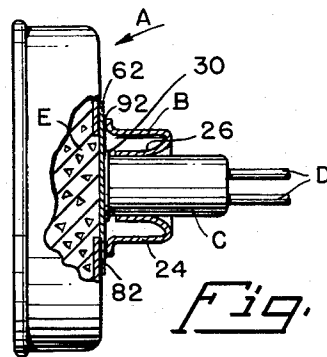


Fig. 5.

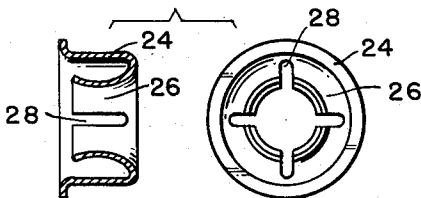


Fig. 5A.

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IGNITER ASSEMBLIES

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Application December 6, 1956, Serial No. 626,786

4 Claims. (Cl. 102—70)

This invention relates to igniter assemblies of the type in which a squib is ignited in proximity to a charge of igniter material to initiate burning of said charge to form heat and flame and gases for igniting an associated combustible. More particularly the invention relates to such igniters as applied to ordnance of various types, as for example, solid propellant type rockets, wherein the storage characteristics and the force of the shock wave, heat, flame and gases resulting from operation of such igniters may be critical.

It has been common in prior igniter constructions to incorporate the initiating means, or squib in the same casing in which the main igniter charge is contained, the assembly requiring means to pass electric wiring through the casing for initiation of the squib. Accordingly, the entire assembly is subject to the limitations of a seal (generally glass or porcelain) through which such wiring enters the casing. Such seal means must be of a high order of efficiency in order to effectively seal the contents of the casing against deterioration in storage. This caused the development of designs in which the flame and heat is released from walls of the casing other than that which supports the seal and the seal construction finally evolved into one which is capable of sealing combustion products pressures in the casing to insure casing rupture in a wall other than that supporting the seal. Thus, the old constructions had disadvantages in cost of assembly and in limitations in shelf-life characteristics by virtue of dependency on a seal through which wires must pass, to keep the moisture and impurities of the ambient air away from the igniter material in the casing.

Further disadvantages in the prior art igniter arrangements reside in the difficulties and danger involved in loading squib assemblies, with their wiring, etc., within the casings, and the fact that complex electrical conducting systems must sometimes be resorted to in order to bring initiating current to the igniter because of the necessity for facing the wall through which the igniter wires extend away from the material to be ignited. Referring to solid propellant rocket constructions, specifically, it has, in the past, been necessary either to provide complex and expensive means to lead electric current through the motor tube wall forward of the igniter, or to pass electrical wires through the propellant grain and around the igniter construction to a forwardly disposed seal.

Along with the above mentioned difficulties, an ever-present problem with igniters of the class described has been the tendency towards excessive pressures developing in the casing, causing either directionally uncontrolled blow-up of the igniter casing, or such violent shattering of the casing as to cause debris to crack the propellant grain, causing motor blow-up.

The igniter construction which is the subject matter of the instant invention obviates the difficulties mentioned hereinabove and has certain other advantages which will be brought out in the following discussion and description. The present invention has, as a basic construction, the

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provision of a permanently sealed container filled with a main charge of igniter material and an externally mounted squib supported relative to the container in such a manner that heat, gas and flame caused by ignition of the squib break through the container to ignite the main charge, the squib being blown out and the flame and hot gases formed by the main charge issuing from the opening left by the squib. Such a construction makes it possible to separately store squib and igniter charge components in a manner whereby the shelf-life (resistance to deterioration) by the igniter component particularly, is greatly enhanced. Moreover, the danger of accidental igniter explosion or ignition by virtue of the proximity of the squib component is obviated, and the use of high pressure seals in the means leading the electrical initiating wires into the squib is rendered unnecessary. A further and most important advantage of the present novel construction is that the brisance, or violence of ignition of the igniter charge is decreased for a given charge of igniter propellant material for the reason that the shock wave resulting from lighting of the igniter material is not a direct straight line wave bursting through the wall opposite the squib entry wall but is a reflected wave since it strikes the said opposite wall and is reflected back through the squib mounting opening. Other obvious advantages of the igniter assembly of this invention are that the expensive and dangerous loading and assembly procedures of the prior art do not need to be used, and that direct wiring lines through rocket motor nozzles to the after end of the igniter does away with the need for expensive and elaborate electrical systems in rockets.

It is therefore an object of the present invention to provide improved igniter assemblies wherein the squib and igniter charge components may be separately stored and assembled as desired

A further object of the present invention is to provide an igniter assembly in which the squib component thereof is mounted externally of the casing of a sealed container of igniter material.

A still further object is to provide an igniter utilizing externally mounted squib means whereby dangerous and expensive loading and assembly techniques are made unnecessary.

Another object of the invention is to provide an igniter assembly wherein the flame and gases developed are propagated in a shock wave which is rebounded from the ball wall of the igniter casing resulting in gentler igniter action and making it possible to use larger igniter charges without critically increasing the brisance of the igniter assembly.

Yet another object of this invention is to provide igniter assemblies for solid propellant rockets which make it possible to house an igniter internally within the rocket motor casing without resorting either to complex modification of the rocket motor casing to lead electric current into the igniter section, or to the passage of wiring through the igniter casing.

These and other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

Fig. 1 is a sectional view through an igniter assembly construction according to the present invention;

Fig. 2 is a sectional view similar to Fig. 1, illustrating a modified construction according to this invention, illustrating alternative igniter casing sealing means;

Fig. 3 is a side elevation of another modification of the present invention, wherein spring clip means are utilized to externally house a squib in position on an igniter casing;

Fig. 3A is a fragmentary elevational view (in the direc-

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tion of the arrow 3A of Fig. 3) showing the spring clip squib housing means of Fig. 3;

Fig. 4 is a side elevation of another modification of the present invention, showing an arrangement wherein the squib and its lead wires may be laterally disposed relative to the igniter casing;

Fig. 4A shows side elevation and cross-sectional views of the squib housing Fig. 4;

Fig. 5 is a further modification of igniter assembly utilizing spring clip means for positioning a squib assembly and adapted for use with modified squib means which has an outstanding flange at the outer end thereof; and

Fig. 5A shows side elevation and cross-sectional views of the spring clip utilized in the modification of Fig. 5.

Attention is now directed to the drawings wherein like reference numerals have been appended to like parts throughout. Fig. 1 illustrates one modification wherein the construction comprises a casing A of two parts, namely a cupped portion 2 and a closure portion 4. The casing contains a charge E of igniter material and the cupped portion and closure portion are crimped together, as at 5. The cupped portion 2 is formed with a weakened area, as by scoring 6, on the bottom wall thereof. A squib holder B, which may be made of a plastic material or of metal, is bonded, as by plastic cement 8, to the bottom wall over the said weakened area thereof, the holder comprising an open ended tubular member of metal or plastic material and having an attachment flange 10, the tubular portion being of a size and extent to hold an electrically actuatable squib member C therein. Many types of such squibs are available and may be used, it being preferable to utilize one which expends and directs its forces directionally away from the electric lead wires, and one such squib is specifically disclosed and claimed in United States Patent 2,801,585. The tubular squib holder member is provided with a retainer cap 12 having an intumed end flange 14 defining central opening 16 whereby a squib member inserted into the housing B may be retained therein by the flange 14 with the lead wires D thereof extending through the opening 16, the cap and tubular member having interengaging fastening means of any kind, as for example, screw threads.

In use, the loaded casing A with the squib holder attached thereto, may be stored separately from the squib. When assembly is desired the squib lead wires are extended through the opening 16 of the retainer cap 12, the squib being then inserted in the housing and the cap tightened down. Upon firing of the squib the flame and gases developed break through the extreme end of the squib member (to the left of Fig. 1) and rupture the weakened wall of the cupped container 2 to ignite the charge E. The flame and gases developed blow the squib remains out of the squib holder B and, moving in the other direction burn through the booster charge E in a wave motion (of pressure gas and flame) which strikes the wall 4 and rebounds through the squib holder B to send a directional flame against an article to be ignited. The wires D and the squib debris are, for the most part, destroyed in this process, and, when squib holder B and cap 12 are of thermoplastic material these elements are also melted and burned. When a grain of solid propellant material is to be ignited by such a construction the wires D are led from the squib in holder B through the grain to electrical voltage applying means.

Various modifications of detail are possible. Thus, in Fig. 2 there is shown an alternative structure for providing a weakened forward wall in the cupped portion 2 of the igniter. In this construction the cupped portion 2 of the casing has a circular opening (as distinguished from the scored weakened portion 6 of Fig. 1) and a thin frangible diaphragm 62 (as of .002" aluminum sheet) is bonded to the portion 2, as by plastic cement 82 as shown, or it may be sweat soldered thereon. The squib holder B (which may be of thermoplastic material

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or of metal) is then bonded to the diaphragm as by plastic cement 92, as shown or by a sweating procedure. The characteristics and operation of the Fig. 2 device as well as those of the modifications of Figs. 3, 4 and 5 are exactly the same as described in conjunction with the description of Fig. 1.

Thus, as described in connection with Figs. 1 and 2, the weakened blow-out area of the cupped portion 2 may be formed either by scoring the metal in the desired pattern or by covering a pre-prepared opening by a diaphragm cemented or sweat soldered to the casing around the opening.

Squib holder variations are also possible and some are illustrated in the drawing. Thus, in Fig. 3 a spring clip is utilized to grip the outer end of squib C to hold it in place, the spring clip comprising a circular main body 18 of a resilient material, and a pair of outwardly extending spring arms 20 having inwardly extending squib retaining lugs 22. Such a spring holder may be secured to either a scored or diaphragm-closed cupped portion by a sweat soldering technique as shown at 83 in Fig. 3. Obviously, insertion of a squib in the holder of Fig. 3 is accomplished by merely pushing a squib element past the lugs 22 which spread under pressure and which snap inwardly after insertion of the squib to resiliently retain the squib in assembled relation. It has been found that initiation of the squib develops forces sufficient to penetrate the weakened portion of the wall of the cupped portion 2 before, or as the squib is ejected from the spring clip.

Fig. 5 illustrates another variation of spring clip type squib holder for use with squibs having an end flange. In Fig. 5, the cupped portion 2 is shown as sealed by a thin aluminum diaphragm 62, secured to the wall by plastic cement 82 and to which squib holder B is secured by plastic cement 92. In this case the squib holder (as shown in detail in Fig. 5A) comprises a tubular element 24 of resilient material having a reduced portion 26 reentrantly disposed within the larger portion as by bending or other shaping methods. The reentrant portion 26 is provided with a plurality of resilient fingers formed by cutting notches 28 from the free end thereof inwardly, as shown best in Fig. 5A. Such a clip is particularly well adapted for use with a squib such as is shown in Fig. 5, which has an end flange 30. In use such a squib is pushed into the squib holder until the flange 30 slips under the ends of the resilient fingers formed in reduced portion 26, when the fingers snap inwardly to bear against the squib and the flange to securely position the squib within the housing.

Figs. 4 and 4A illustrate how the principles of the present invention may be applied to installations wherein it is desirable for the squib leads to be disposed laterally rather than longitudinally of the igniter assembly. For such an arrangement the squib housing is generally formed of metal and constitutes a generally cylindrical form 32 open at one side as at 34 and at one end as at 36. The housing is rounded at the closed end as at 38, for a reason to be later explained and has an integral tab 40 extending from the wall thereof at the open end 36. This metallic squib housing is sweat soldered to the casing portion 2, as shown at 84 in Fig. 4, and after insertion of a squib therein, the tab 40 is bent inwardly to retain and position the squib. In such an arrangement, the flame and hot gases formed by burning of the squib materials (which are usually directed out of the end of the squib) are deflected by the curved wall section 38 to the weakened wall portion of the igniter casing wall to rupture the wall and ignite the igniter material therein. The resultant shock wave of flame and gas burns off the squib housing and directs a flame in a direction perpendicular to the igniter casing (to the right in Fig. 4) to ignite an instrumentality to be burned, as a propellant grain. The Fig. 4 modification may be utilized in rocket designs wherein an igniter is as-

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sembled within the motor tube, without a squib, with a plugged opening in the motor side wall for squib insertion when desired. This renders the rocket motor substantially safer from inadvertent and accidental ignition than arrangements wherein the squib is included in the assembly. In such arrangements when it is desired to launch a rocket the plug is removed, a squib inserted into the housing 32 and retained therein, either by spring clip means such as described in conjunction with Figs. 3 and 5 or by inserting an instrument to bend down the retaining tab 40. After reinsertion of the plug, the rocket is ready for launching.

From the above it may be seen that the present invention provides new and improved igniter assemblies having advantages in economy and safety of construction and in increased length of shelf-life and safety in storage. Such constructions make possible simpler electrical systems in solid propellant type rockets and provide igniters of less brisance relative to the size of the charge of igniter material to provide igniting arrangements less apt to injure the instrumentalities to be ignited although capable of developing adequately projected and sustained igniting flames.

In all of the disclosed modifications the cupped portion 2 is formed, either with the scoring 6 (as in Fig. 1) or the diaphragm 62 (as in Fig. 2). The squib housing B is attached thereto, over the scored or diaphragm covered area, by means of plastic cement or a sweat soldering technique. The cupped portion is then loaded with the igniting composition charge E and the cover portion 4 is then crimped into closing position as at 5 to seal the casing A. The squib C and retaining cap 12 are separately made, and separately stored, and assembled as shown in the drawings when desired. It should be noted that, in contradistinction to prior art igniters, which use internally mounted squibs, the loading of the igniter material is a simple placing of the charge in the casing as distinguished from the positioning of squib support means, squibs and electrical lead wires within the relatively sensitive ignition mixture. This adds considerably to the ease and safety in loading.

Obviously, many variations and modifications, other than the few specifically illustrated herein, are possible in the light of the present disclosure. It is, accordingly, to be understood that the scope of the invention is not intended to be limited by the examples described, but rather by the scope and language of the appended claims.

What is claimed is:

1. An igniter assembly for propellants comprising unitary igniter charge and squib components adapted to be separately stored, and adapted to be assembled when desired; said igniter charge component comprising a circular cup-shaped member having an end wall and an integral circumferential outer wall, a circular plate-like member crimpingly secured at its outer edge to an edge of said circumferential wall to provide a second end wall parallel to the first named end wall, the three walls providing a closed casing sealed against entry of the atmosphere, an igniting composition filling the casing, one of said end walls having a circular central frangible portion adapted to be ruptured upon application of gas pressure to the outer face of same, a housing having an outward radially extending circular flange portion at one end thereof se-

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cured to the outer face of the last named wall, its interior communicating with said frangible portion, and having another portion extending laterally thereof and into which said unitary squib component may be inserted when desired; said unitary squib component comprising a closed tubular member having an electrical bridge wire and ignitable material disposed therein sealed against entry of atmosphere and having extending from one end thereof lead wires for energizing the bridge wire, the opposite end wall of said tubular member being disposed adjacent the outer face of said frangible portion when said tubular member is disposed within said housing; and retaining means carried by said housing and engageable with a portion of said tubular member for retaining it within said housing.

2. An igniter assembly in accordance with claim 1 wherein said retaining means comprises a nut threadedly engaging the outer free end of said housing having a portion engageable with one end of said squib component, and having an aperture therein through which said lead wires extend.

3. An igniter assembly in accordance with claim 1 wherein said retaining means comprises resilient means carried by said housing engageable with said squib component.

4. An igniter assembly for propellants comprising unitary igniter charge and squib components adapted to be separately stored, and adapted to be assembled when desired; said igniter charge component comprising a disc-shaped hermetically sealed casing filled with an igniting composition and having an end wall thereof provided with a circular central frangible portion adapted to be ruptured upon application of gas pressure to the outer face of same, an open-ended housing having an outward radially extending circular flange portion at one end thereof secured to the outer face of said wall, its interior communicating with said frangible portion, and having another portion extending laterally thereof and into which said unitary squib component may be inserted from its opposite end when desired; said unitary squib component comprising a closed tubular member having an electrical bridge wire and ignitable material disposed therein sealed against entry of atmosphere and having extending from one end thereof lead wires for energizing the bridge wire, the opposite end of said tubular member being disposed adjacent the outer face of said frangible portion when said tubular member is disposed within said housing; and retaining means carried by said housing and engageable with a portion of said tubular member for retaining it within said housing after it has been inserted through said opposite end.

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