

Nov. 7, 1967

R. E. WILSON

3,351,012

EXPLOSIVE BRIDGEWIRE INITIATORS

Filed June 30, 1966

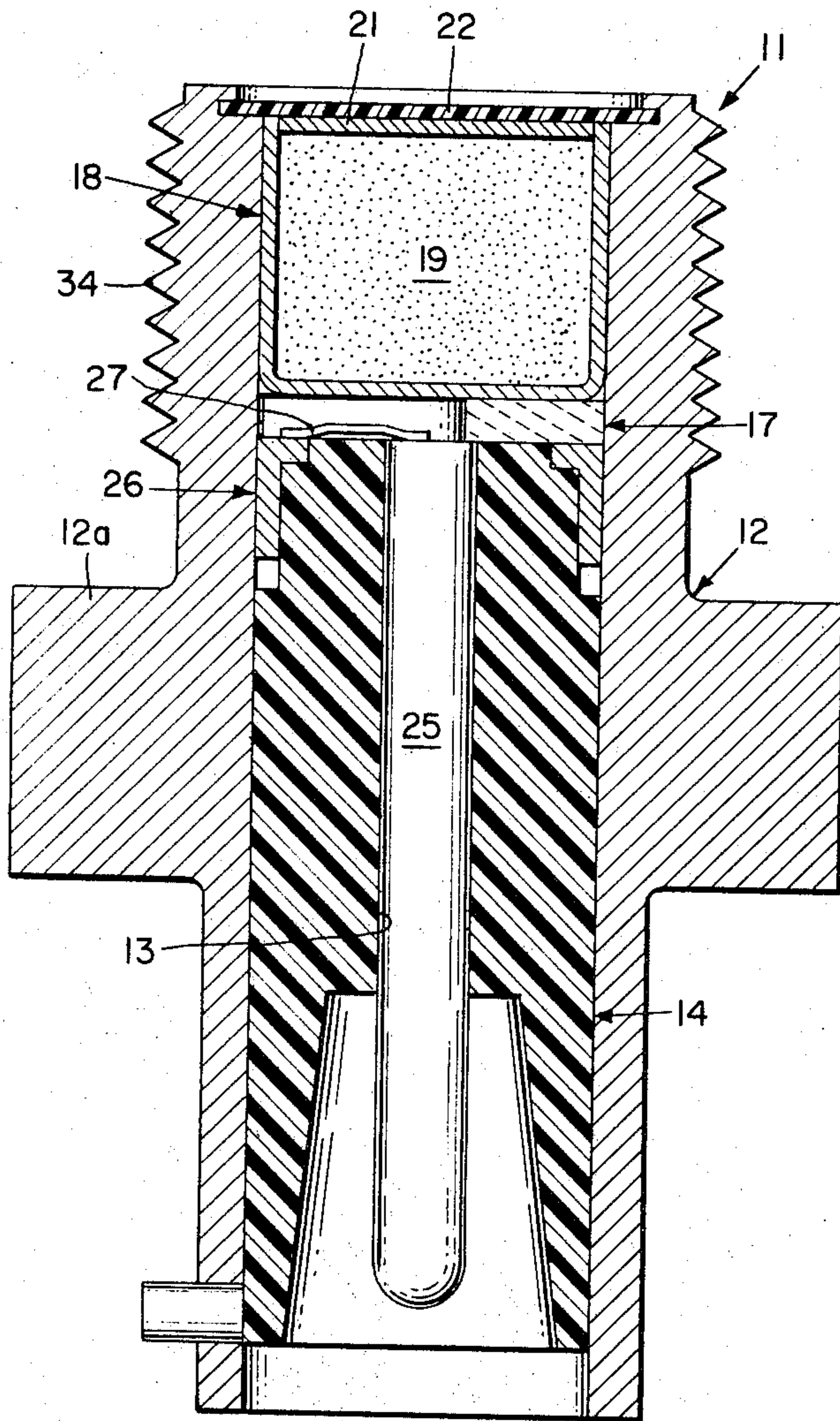


Fig. 1

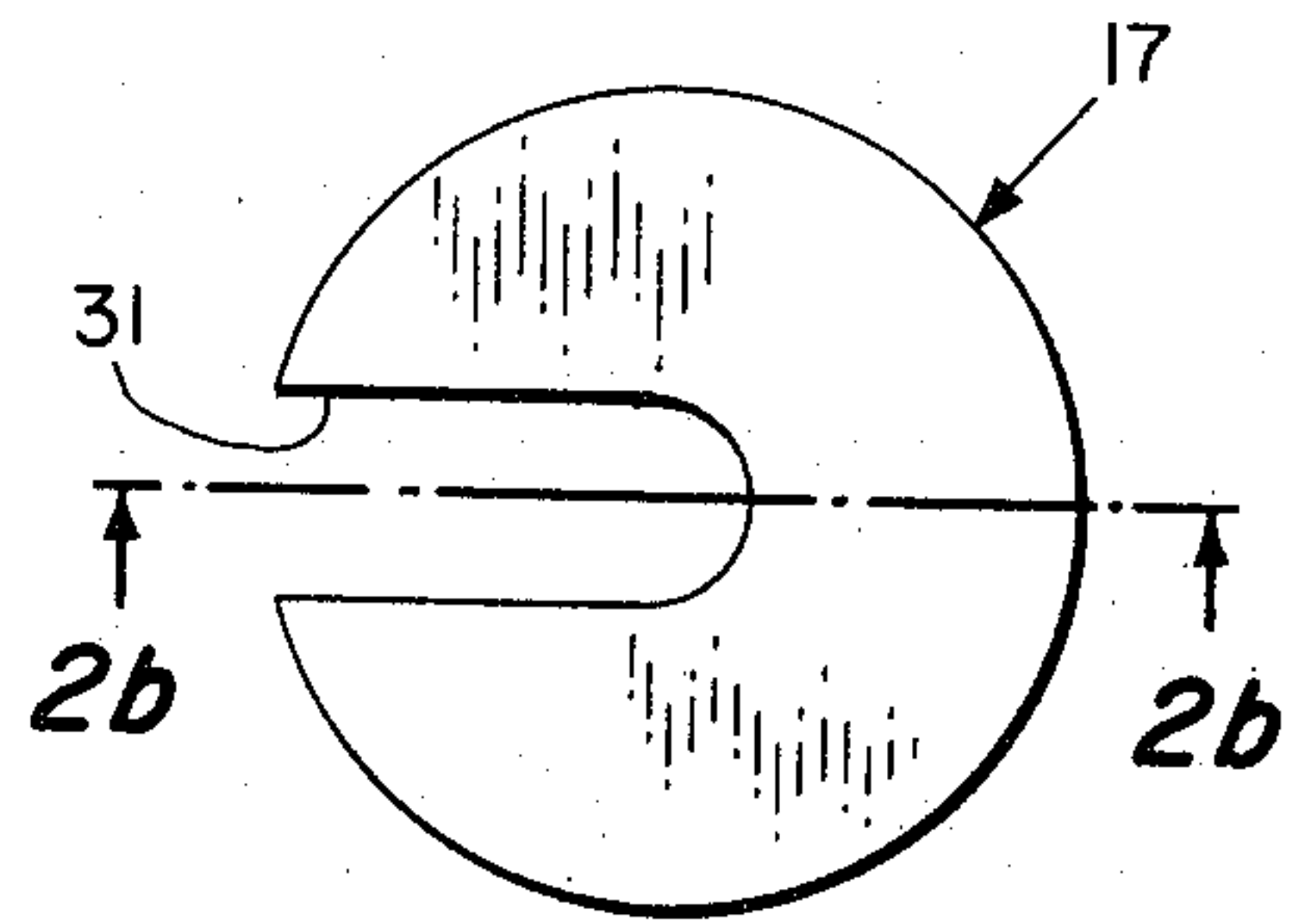


Fig. 2a



Fig. 2b

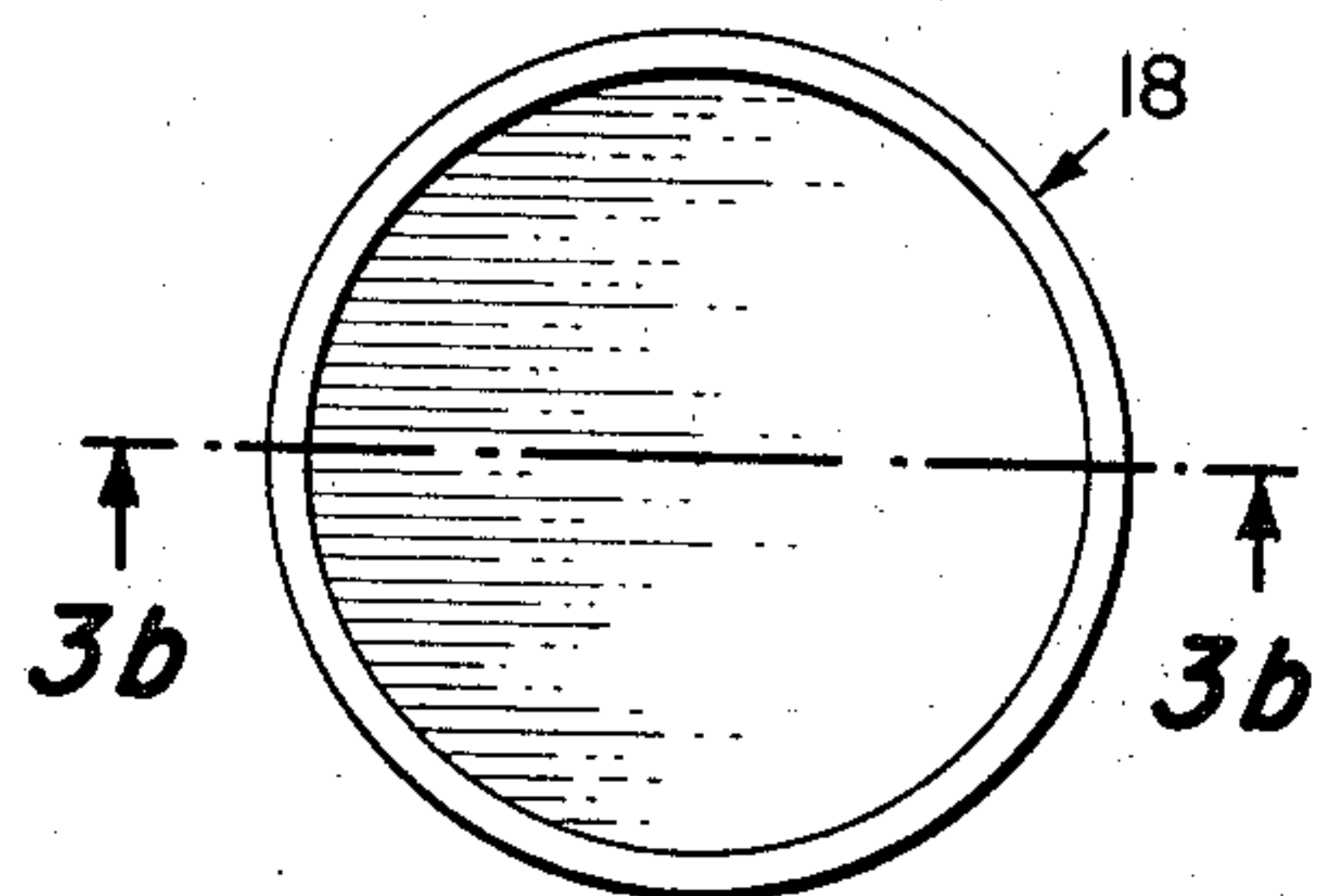


Fig. 3a

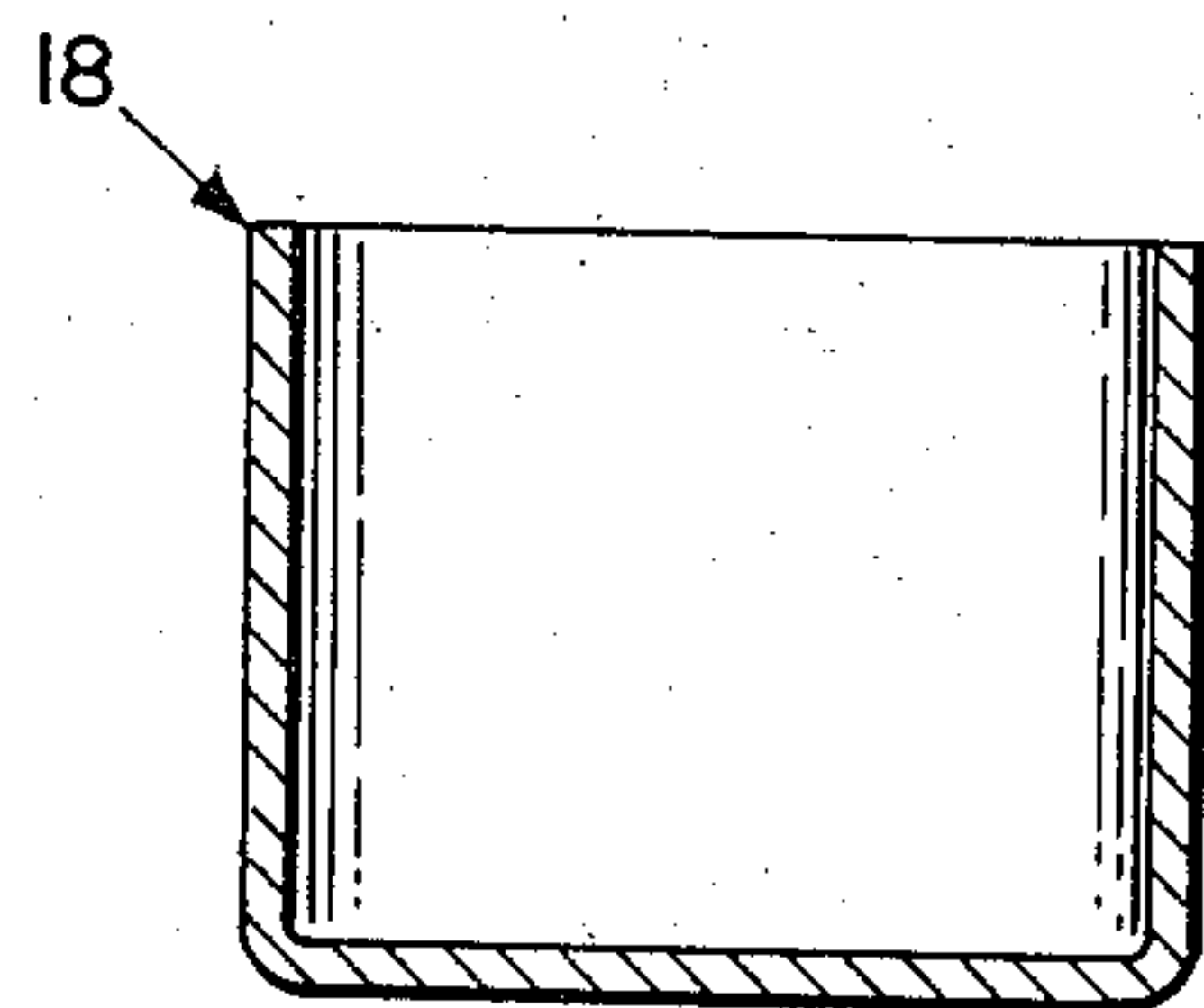


Fig. 3b

INVENTOR.
ROBERT E. WILSON
BY *C. E. Vautour*, AGENT
Q. Baxter Warner
ATTORNEY

1

3,351,012

EXPLOSIVE BRIDGEWIRE INITIATORS

Robert E. Wilson, Boulder Creek, Calif., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Filed June 30, 1966, Ser. No. 562,967

1 Claim. (Cl. 102-28)

ABSTRACT OF THE DISCLOSURE

An explosive bridgewire initiator is disclosed wherein the casing of the initiator is one contact and a coaxial terminal disposed in a dielectric plug is the other contact. The explosive charge is separated from the dielectric plug and coaxial terminal by a ceramic disc having a radial slot. An exploding bridgewire is disposed in the radial slot so as to be out of direct contact with the material of which the disc is composed and is connected at one end to the coaxial terminal and at the other end to a flanged metallic sleeve disposed between the casing and the dielectric plug.

This invention relates to explosive bridgewire pyrotechnic initiators and more particularly to such initiators which are protected from unintentional actuation by spurious electroenergy.

Exploding wires have been used for many years as light sources and in the production of shock waves and high temperature plasmas. Of principal interest in recent years has been the use of explosive bridgewires for the direct initiation of relatively insensitive explosives. This employment is of prime importance particularly in weapons systems and space programs where explosive bridgewire devices have helped to eliminate very sensitive primary explosives requiring special safety and arming devices.

An explosive bridgewire device comprises basically a wire of relatively small diameter coupled to a source of electrical energy capable of delivering a short pulse of very high energy to the wire such that the wire melts, evaporates and explodes. This energy, on the order of 2×10^7 ergs, must be applied to the bridgewire in a very short time, on the order of 4 microseconds or less, to cause it to be transformed so as to produce the necessary explosion. The energy of such explosion is transmitted to an adjacent pyrotechnic charge causing it to ignite.

In construction, explosive bridgewire devices are similar to the more common hot and explosive wire initiating devices but have a distinct inherent advantage over the latter in that, among other things, safety and arming devices are simplified or eliminated and electro-magnetic radiation effects are reduced. Nevertheless, although recent prior art explosive bridgewire squibs are more resistant to accidental actuation than prior art ignition devices, there are a number of spurious energy sources which may produce accidental actuation and against which existing devices do not afford adequate protection. Such spurious electroenergy sources include any and all electric current, voltage and spark producing media that may occur at any energy level below the designated minimum applicable energy level required to initiate the primary charge of high explosive by means of body capacitance discharge, electrical induction, electrical radiation or that electroenergy induced or applied or produced through any known or unknown factor or phenomenon. The present invention appreciably increases the safety factor of explosive bridgewire devices against premature or unintentional function of the device and its associated pyrotechnic charge by electroenergy sources during both handling and operation thereof.

In accordance with the present invention, the bridgewire, or the terminal thereof, in an explosive bridgewire

2

device is precluded from prematurely initiating the high-explosive primary charge by the inclusion of a flow path to the metal case of the device for conducting away spurious electroenergy of lesser magnitude than that required to initiate the primary charge.

Accordingly, it is an object of the present invention to provide an improved explosive bridgewire pyrotechnic initiator which conducts away spurious electroenergy.

Another object of this invention is to provide an explosive bridgewire pyrotechnic initiator adapted to conduct away spurious electroenergy from the bridgewire itself or from the terminals thereof in the event the bridgewire has become detached.

A further object of the present invention is to provide explosive bridgewire means which although melted or volatilized by spurious electroenergy completing an electrical circuit therethrough will nevertheless not explode and thus will not inadvertently ignite the primary charge.

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 drawings in which like numerals designate like parts throughout and wherein:

FIG. 1 is a longitudinal sectional view of one embodiment of the invention;

FIG. 2a is a plan view of the protective insulator used in the embodiment of FIG. 1;

FIG. 2b is a longitudinal sectional view of the insulator of FIG. 2a taken along a line substantially corresponding to line 2b-2b in that figure;

FIG. 3a is top view of the primary charge container used in the embodiment of FIG. 1; and

FIG. 3b is a longitudinal sectional view of the container of FIG. 3a taken along a line substantially corresponding to line 3b-3b in that figure.

Referring to the drawing, there is shown in FIG. 1 a coaxial explosive bridgewire squib 11 in which the invention is advantageously employed. Squib 11 comprises a housing such as metallic body 12 which may have a hexagonal outer portion 12a and an axially extending internal chamber 13, preferably cylindrical and of uniform diameter, in which the components of the device are received. These components include a central plug 14, an insulator 17 and a container such as conductive cup 18 in which is placed a primary charge 19. Charge 19 preferably is enclosed by a metal foil cover 21 and the entire assembly of components is held in body 12 by a rupturable disc 22 which preferably is made of dielectric material.

Plug 14 is made of any suitable dielectric material and is adapted centrally to receive coaxial terminal 25 and peripherally to receive flanged metallic sleeve 26. The plug 14, coaxial terminal 25 and conductive sleeve 26 preferably are assembled first after which explosive bridgewire 27 is connected across the terminal and sleeve. At this point plug 14 is inserted into body 12 and secured at the desired position therein by any suitable means. Insulator 17, which preferably is in the form of a disc as seen in FIGS. 2a and 2b, has a radial slot 31 of sufficient size to receive bridgewire 27 and is positioned in body 12 with bridgewire 27 disposed in slot 31. Thereafter conductive cup 18, shown in detail in FIGS. 3a and 3b, is positioned over insulator 17, cup 18 preferably having previously been filled with primary charge 19 and covered by foil 21. The final step in the squib assembly is the insertion in body 12 of disc 22 which may be crimped in place as shown. At this stage squib 11 is ready for insertion into the rocket motor or other device which it is to ignite and may be secured in place by threads 34 engaging mating threads.

Insulator 17 preferably is made of inert non-conduc-

tive material such as ceramic and serves as an insulation medium between conductive cup 18 and bridgewire 27. Cup 18 may be a commercially available electrically conductive cup known as a Curvark Deflector which, since it is in contact with metallic body 12, serves to conduct to body 12 spurious electroenergy which otherwise may explode bridgewire 27 and ignite primary charge 19. Insulator 17 is positioned in and occupies substantially all of the explosive cavity between the bottom of conductive cup 18 and the top of plug 14. Slot 31 is parallel to the bridgewire span, with bridgewire 27 centered in slot 31.

In operation, spurious electroenergy which may generate a current, voltage or spark through capacitive storage and discharge, induction, radiation, etc., is caused to flow to body 12 along the bottom of cup 18 whether bridgewire 27 is in coupling contact or has become detached from either coaxial terminal 25 or sleeve 26. This flow or diverting of energy is made possible by the exposure of the bridgewire and terminal to cup 18 and their proximity thereto. Such electroenergy thus is diverted in all cases where it is lesser in magnitude than that required to initiate melting, vaporization and explosion of bridgewire 27. Spurious electroenergy may cause bridgewire 27 to heat and perhaps melt or rupture but would not be in such a form as to provide in a matter of a few microseconds the magnitude of energy necessary to explode the bridgewire. In effect, the present invention duds the primary charge or pyrotechnic initiator thereby precluding unintentional ignition from occurring.

Intentional function of squib 11 is not affected by the invention since, during normal function, high voltage and high current are passed through the bridgewire which almost instantaneously melts, vaporizes and explodes. This explosive force ruptures the thin-walled conductive cup 18 containing primary charge 19 and the heat and flame from the explosion pass into the primary charge where ignition occurs.

It will be recognized that many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

I claim:
A squib of the exploding bridgewire type comprising:
an electrically conductive housing of generally tubular

form having an axial passage therein adapted to receive an electrically conductive container and a dielectric plug;
an electrically conducting container having pyrotechnic material therein disposed in one end of said housing and making electrical contact therewith;
said container being metalically sealed to shield said pyrotechnic material from spurious electroenergy;
a dielectric plug disposed in said housing and axially spaced from said container;
an elongated terminal axially disposed in said plug and extending from the end thereof adjacent said container to the end remote therefrom;
a bridgewire electrically connecting said terminal at the end adjacent said container to said housing;
electrically-conductive sleeve means disposed about the periphery of said plug and in contact with said housing, said bridgewire being connected between said terminal and said sleeve means; and
a non-explosive dielectric spacer composed of ceramic material disposed between said container and said plug;
said dielectric spacer being in the form of a disc having a radially-extending slot therein in which said bridgewire and the adjoining end of said terminal are disposed in such fashion that said bridgewire lies in a cavity of restricted volume and out of direct contact with the material of which said spacer is composed, said slot acting to permit closely-spaced exposure of said bridgewire and the adjoining end of said terminal to the adjacent conductive surface of said container;
whereby spurious electroenergy is caused to flow through the material of which said conductive container is composed to said housing thereby protecting said pyrotechnic material from unintentional ignition.

References Cited

UNITED STATES PATENTS

3,100,447	8/1963	Betts	102—28
3,169,482	2/1965	Noble	102—28
3,227,083	1/1966	Moses et al.	102—28

45 SAMUEL FEINBERG, *Primary Examiner*.
BENJAMIN A. BORCHELT, *Examiner*.
V. R. PENDEGRASS, *Assistant Examiner*.