March 19, 1957 A. BLANCHARD 2,785,631

SHAPED EXPLOSIVE-CHARGE PERFORATING APPARATUS

Filed Oct. 5, 1950

FIG.1.

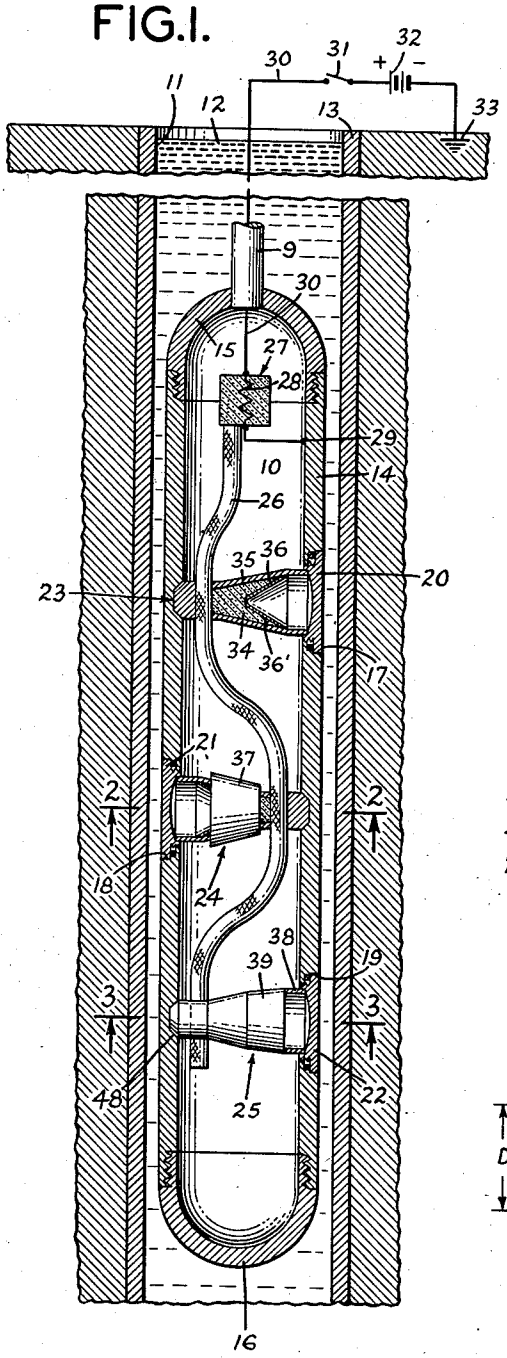


FIG.2.

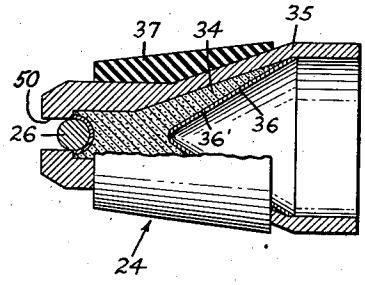


FIG.3.

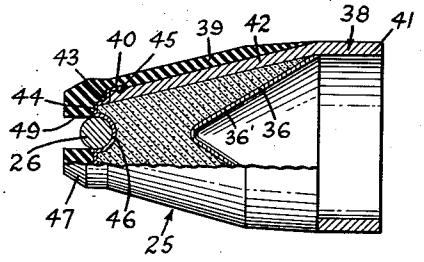
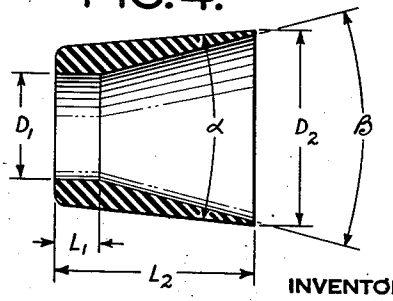


FIG.4.



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SHAPED EXPLOSIVE-CHARGE PERFORATING APPARATUS

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4 Claims. (Cl. 102—20)

The present invention relates to perforating apparatus utilizing one or more shaped explosive charges mounted in a reusable enclosed housing which may serve as an expansion chamber for absorbing part of the concussion produced when the charges are exploded. More specifically, it has to do with novel means for minimizing damage to the housing from effects accompanying the detonation of the charges.

Metallic bore hole casings are currently being perforated by shaped explosive charges in containers lowered into the casing in a hollow cylindrical housing. The applicant's copending application Serial No. 123,003, filed October 22, 1949, discloses apparatus of this character embodying greatly improved charge containers which are designed so as to increase the depth of penetration by the explosive jets and to reduce the damaging effect of the exploding charges on the housing in which they are mounted. By virtue of the latter feature, the housing for the charges may be reused a number of times. Each perforating operation, however, causes some expansion of the housing, and the impact of the charge container fragments upon the interior wall thereof causes erosion so that eventually, after many operations, the housing becomes unserviceable.

It is an object of the invention, accordingly, to provide new and improved shaped charge perforating apparatus of the above character wherein the detonation of the charges results in negligible damage to the gun housing.

Another object of the invention is to provide new and improved shaped charge perforating apparatus of the above character in which the detonation of the charges in a hollow housing causes substantially no expansion of said housing.

A further object of the invention is to provide new and improved shaped charge perforating apparatus in which the detonation of the charges within a hollow housing causes substantially no erosion on the interior of said housing.

These and other objects of the invention are attained by placing about the containers for the individual shaped charges a flexible resilient material, such as rubber, for example. Preferably, a cover or sleeve of flexible resilient material is inserted over, or manufactured around, the metallic or plastic container in which a shaped charge is mounted. The flexible resilient material apparently cushions the impact of the container particles on the interior wall of the housing in which the charges are mounted. Hence, expansion and erosion of the housing are reduced to a minimum and the useful life of the housing is materially increased.

Additional objects and advantages of the invention will be apparent from the following detailed description of several typical embodiments thereof, taken in conjunction with the accompanying drawing, in which:

Fig. 1 is a view in longitudinal section of a shaped charge perforator showing several illustrative forms of

cushioning means constructed according to the present invention;

Fig. 2 is a view partly in transverse section taken along the line 2—2 of Fig. 1 showing one form of cushioning means according to the invention;

Fig. 3 is a view partly in transverse section taken along line 3—3 of Fig. 1 showing another form of the invention; and

Fig. 4 is a view in longitudinal section of the cushioning means used in Fig. 2.

In Fig. 1 the invention is shown as embodied in shaped charge casing perforating assembly of the type disclosed in the aforementioned copending patent application, comprising a hollow housing **10** adapted to be lowered on a cable **9** into a bore hole **11**, which may contain a conductive liquid **12**. The bore hole **11** is lined with a metallic casing **13** which is to be perforated by the perforating apparatus described herein.

The housing **10** may comprise, for example, a hollow cylindrical section **14** of strong material such as steel, for example, the ends of which are closed by pressure resistant cap members **15** and **16**, also of steel. Circumferentially and axially spaced along the wall of the cylindrical section **14** are a plurality of ports **17**, **18** and **19**, which may be sealed in any suitable manner as by threaded caps **20**, **21** and **22**, respectively.

A plurality of shaped explosive charge units **23**, **24** and **25** are mounted in the housing **10** with their hollowed portions opposite the caps **20**, **21** and **22**, respectively. The charges in the units **23**, **24** and **25** are adapted to be detonated from the rear by any suitable means such as a Primacord fuse **26**, for example. The fuse **26** may be detonated at one end by an electric blasting cap **27** having an electrical igniter **28**. One terminal of the igniter **28** may be grounded to the housing **10** at a junction **29**, the other terminal being connected in a circuit including an insulated conductor **30**, a switch **31**, and an electrical energy source **32** connected to a ground **33**, at the surface of the earth.

The shaped explosive charge unit **23** is preferably of the type disclosed in the aforementioned copending application and it comprises a container **35** made of lead or other suitable material in which is disposed the charge **34**, the cavity **36'** in the charge being lined with a conical liner **36** made of suitable material such as metal or a plastic, for example. An outwardly open longitudinally extending slot **50** (Fig. 2) is formed at the rear end of the container **35**, in which the Primacord fuse **26** is adapted to be received.

As indicated above, when the charge **23** is detonated, that portion of the housing **10** in the immediate vicinity thereof will experience some minute expansion and the fragments of the container **35** will be hurled against the interior of the housing **10** at an extremely high velocity. The impacts of these fragments against the housing causes erosion of the interior wall thereof, particularly on those portions lying on each side and somewhat to the rear of the charge unit **23**. The repeated detonation of like charges at the same location in the housing **10** in the subsequent reuse thereof eventually will damage the housing **10** and render it wholly unserviceable.

In accordance with the invention, expansion of the housing **10** and erosion of the interior wall thereof are reduced to a negligible minimum by disposing a flexible and resilient material such as soft rubber, for example, around the housing container **35**. Thus the charge **24** (Fig. 2) may be the same as the charge **23** except that a rubber sleeve **37** is snugly fitted around the container **35** essentially in the manner shown. If desired, longitudinal slots (not shown) may be formed in the sleeve **37** to facilitate its insertion over the container **35**. While

the reasons for these phenomena are not completely understood, tests have proved that the presence of the sleeve 37 will reduce appreciably the amount of erosion and expansion produced in the casing 10 when the charge is detonated.

In the modification shown in Fig. 3, the charge unit 25 may comprise a container 38 including a substantially cylindrical forward portion 41 and a portion 42 tapering rearwardly to an opening 43. A closure member 44 of relatively light material may be provided for the opening 43 and it may be provided with detent portions 40 adapted to be received in recesses 45 formed in the outer wall of the container 38 to retain the closure member 44 to the container 38. The closure member 44 may be provided with an arcuate wall 46 adjacent which the Primacord fuse 26 is adapted to be positioned.

Surrounding the container 38 is a sleeve-like member 39 made of rubber, or other suitable material, the rear portion 47 of which is shaped similarly to the rear portion of the container 35 in Fig. 2 so that it will fit into the retaining recesses 48 (Fig. 1) formed in the interior wall of the housing 10. The rear portion 47 of the sleeve member 39 is also provided with an outwardly open longitudinally extending slot 49 through which the Primacord fuse 26 may be inserted and positioned against the closure member 44.

It will be noted that the container 38 has less metal around the rear portion of the charge than does the container 35 in Fig. 2 and that the rear portion 47 of the flexible resilient sleeve member 39 completely surrounds the explosive charge in the container 38. This form of the invention, therefore, gives added protection to those portions of the housing which lie on each side and somewhat to the rear of the charge where erosion due to the impact of container fragments is likely to be greatest.

The dimensions of the sleeve-like member are not critical, although it should preferably be long enough to encompass a substantial portion of the explosive charge. The protection afforded by the sleeve-like member increases somewhat in proportion to its thickness, within practical ranges. In a typical example, the sleeve-like member might be made of molded synthetic rubber, 60–65 Durometer, oil and heat resistant, with dimensions (Fig. 4) as follows:

D_1= .8″	L_1=.36″	α=11°
D_2=1.5″	L_2=1.6″	β=30°

Thus, the invention provides a novel and highly effective shaped explosive charge assembly which can be detonated in a hollow housing as in well casing perforating apparatus, for example, with minimum damage to the housing. By disposing resilient flexible material

about the charges, preferably in the form of sleeve members over the charge containers, erosion and expansion of the housing are substantially reduced. As a result, the housing may be reused a considerable number of times before becoming so damaged as to be unserviceable.

It will be understood that the several illustrative embodiments disclosed herein are susceptible of numerous modifications in form and detail within the scope of the invention. Of course, the protective cover or coating may take many forms and shapes as will be obvious to those skilled in the art. The embodiments described and shown in the drawings, therefore, are not to be regarded as limiting the scope of the following claims.

I claim:

1. A shaped charge perforating apparatus for use in a borehole including, in combination, an elongated housing to be lowered repeatedly into a borehole and including pressure resistant walls defining a closed air filled chamber, at least one shaped explosive charge containing unit detachably mounted in the chamber transversely on the walls thereof to direct its explosive jet outwardly toward the wall of the borehole, said unit including a container having a relatively hard frangible shell portion encircling said charge, said charge being adapted to fracture the shell portion and to scatter its fragments forcefully against the inner walls of the chamber, a sleeve portion of relatively soft, resilient material attached to and surrounding the major portion of the shell of the container over the length of the charge therein to shield the inner walls of the chamber from the lateral effects of the explosion, and means to detonate the explosive charge.

2. A shaped charge assembly as set forth in claim 1 in which the sleeve is formed of soft rubber.

3. A shaped charge assembly as set forth in claim 1 in which the sleeve is formed of soft rubber and the container is formed of lead.

4. A shaped charge assembly as set forth in claim 1 in which the sleeve is formed of soft rubber and the container is formed of brass.

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