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ALIGNING MEANS FOR SHAPED CHARGE PERFORATING APPARATUS

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FIG.1.

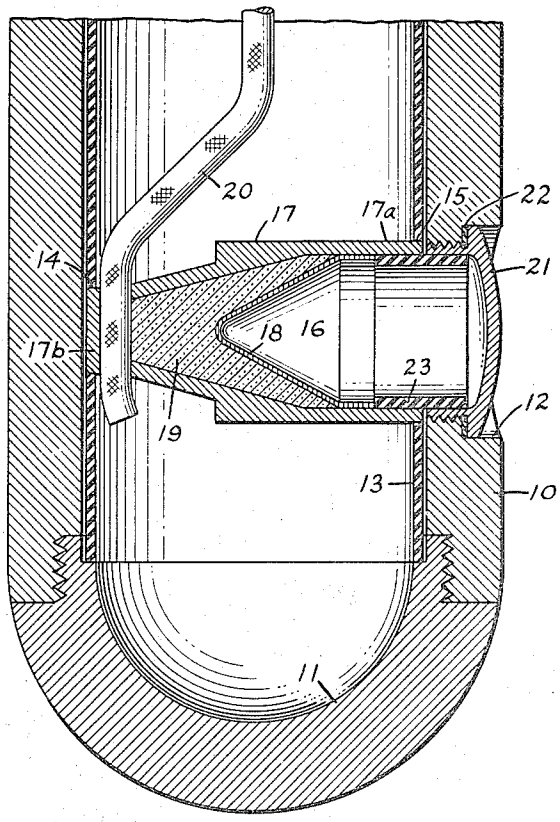
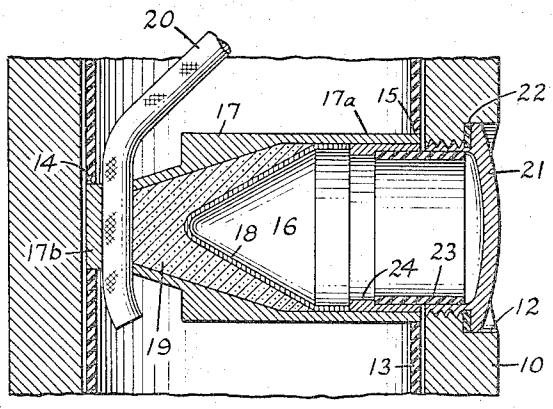


FIG.2.



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ALIGNING MEANS FOR SHAPED CHARGE PERFORATING APPARATUS

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2 Claims. (Cl. 102—20)

The present invention relates to shaped charge apparatus for perforating metallic casings placed in a bore hole. More particularly, it has to do with novel apparatus for maintaining proper alignment between shaped charges mounted in a housing adapted to be lowered into a bore hole and ports formed in the housing.

In the present practice, shaped charges are often employed to perforate well casings at a desired level in order to establish communication between the strata surrounding the bore hole and the interior of the casing. Generally a plurality of charges are placed in a plastic support which is positioned inside a steel housing in such fashion as to bring the shaped charges into alignment with ports in the housing. It has been found, however, that the support tends to twist or rotate relatively to the steel housing in handling so that, at the instant of perforation, the shaped charges may no longer be properly aligned with the ports. Also, the detonation of a charge may result in such deformation of the steel housing as to destroy the condition of perfect correspondence which may previously have existed between the ports and the charges. The detonation of shaped charges under these conditions may result in complete destruction of the expensive steel housing and may render the charges wholly ineffective for perforating purposes.

Accordingly, it is an object of the invention to provide means for insuring the proper alignment of shaped charges with the ports in a pressure resistant housing during the descent of the latter into a cased bore hole, and at all times prior to the detonation of the charges during perforating operations.

In accordance with the invention, sleeve means is provided which is adapted to be inserted into at least one port in the shaped charge housing and which cooperates with the charge and the port to maintain the two properly aligned. Preferably two or more sleeve means are employed in ports that are angularly spaced apart about the longitudinal axis of the housing. With this construction, the support in the housing on which the several charges are mounted is securely and permanently retained in the position at which proper alignment between the charges and the ports obtains.

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

Fig. 1 is a partial view in longitudinal section of the shaped charge perforating apparatus constructed according to the invention; and

Fig. 2 is a partial view also in longitudinal section, of another embodiment of the invention.

In Fig. 1 is shown the lowermost portion of a housing 10, made of steel or other suitable pressure-resistant material, the bottom end of which is enclosed by a cap 11. The housing 10 is preferably cylindrical in shape and is adapted to be lowered and raised in a bore hole by means (not shown) which is well known in the art. The housing

10 is provided with a plurality of ports 12 in the side wall thereof, there being one port for each shaped charge to be employed, and the ports preferably being angularly spaced about the longitudinal axis of the housing. Within the housing 10 is mounted a cylindrical support 13, preferably manufactured from a suitable plastic material or the like and having apertures 14 and 15 formed in opposite walls thereof within which a plurality of shaped charges 16 are adapted to be received. The apertures 14 and 15 are so located that they can be brought into accurate alignment with the ports 12 in the housing 10 by proper adjustment of the support 13.

Each shaped charge 16 may comprise, for example, a container 17 of steel or other suitable material, a thin liner 18, preferably made of metal, and an explosive charge 19, as is well known in the art. The container 17 preferably comprises a cylindrical forward portion 17*a* which fits into the aperture 15 in the support 13 and a smaller rear portion 17*b* which fits into the aperture 14. The shaped charges 16 may be detonated from the rear in any suitable manner as by Primacord 20, the detonation of which may be controlled from the surface in the usual manner in order that all the charges may be fired substantially simultaneously. Into the port 12 is fitted a cap 21 which is preferably made fluid-resistant by means of a washer 22, for example.

As stated, even if the support 13 is initially positioned to bring the shaped charges 16 into accurate alignment with the ports 12 in the housing, the support 13 tends to rotate in use so that the charges 16 may get out of registry with the ports 12. This is prevented according to the invention, by fitting a sleeve member 23 snugly into the front end of the charge container 17, the front end of the sleeve member 23 also being adapted to fit snugly into the cap 21 as shown in Fig. 1. With this construction, the charge support is anchored to the housing 10 in the proper position to insure accurate alignment between the shaped charges 16 and the ports 12. Preferably, the sleeve member 23 is made of a suitable strong plastic material or of metal.

In preparation for a perforating operation, the cap 11 is unscrewed from the empty housing 10, and the plastic support 13 containing shaped charges 16, is inserted therein. The support is positioned so as to bring the charges 16 approximately in line with ports 12. One or more retaining sleeve members 23 are then inserted through the ports 12 in housing 10. Preferably, retaining sleeves are assembled to two charges disposed at right angles to one another near the center of the housing 10, or alternatively to charges located at opposite ends of the housing 10. It will be understood, of course, that any desired number of sleeve members 23 may be employed to align the charges 16 with the ports 12 in accordance with the invention.

The caps 21, with the washers 22 in place, are then fitted into the ports 12. The sleeve members 23, which fit snugly into the containers 17 and the caps 21 will restrain the support from any radial or longitudinal movement relative to the housing 10 and will therefore maintain the shaped charges 16 accurately in alignment with the ports 12 during handling and up to the instant of detonation.

In operation, the housing 10 is lowered into a bore hole (not shown) to the level at which perforation is desired and the Primacord 20 is then detonated. As is well known in the art, the detonation of the explosive charge 19 creates a high velocity jet of material from the tin liner 18 through the port 12 and perforates the well casing and any adjacent cement that may be present. This, of course, destroys the support 13 as well as the sealing caps 20 which are inexpensive pieces of apparatus, but the steel housing 10 is not materially damaged and may

be withdrawn from the bore hole for use in subsequent operations.

In some cases, it may be desirable to employ a shaped charge having an interior diameter which is larger than the interior diameter of the sealing cap employed to close off the housing ports **12**. For example, in the embodiment shown in Fig. 2, the diameter of the charge container **17** is substantially larger than that of the sealing cap **21**. In such case, a cylindrical adapter **24** may first be snugly fitted into the front end of container **17**, the cylindrical sleeve member then being snugly fitted within both the adapter **24** and the cap **21**.

The invention thus provides a novel and highly effective shaped charge apparatus for perforating metal well casings or the like. By providing sleeve members constructed as described above for maintaining shaped charges mounted in a pressure resistant housing in alignment with ports formed in the side wall of the housing, misalignment is prevented, thus avoiding possible damage to the housing accompanied by partly or wholly ineffective perforating operations.

Of course, it will be understood that the above described embodiments are presented as examples only and are capable of many modifications without departing from the spirit of the invention. The illustrative embodiments described above, therefore, are not to be regarded as limiting, in any way, the scope of the following claims.

I claim:

1. In well casing perforating apparatus, the combination of an enclosed, elongated cylindrical pressure resistant housing adapted to be lowered into a bore hole and having a plurality of ports formed in the side wall thereof, a plurality of closure means for said ports, each of said closure means having a cylindrical bore in the interior wall thereof, a cylindrical support in said housing having a plurality of opposed apertures therein at locations corresponding to said housing ports, a plurality of shaped charge containers mounted in the apertures in said support and having substantially cylindrical openings at the forward ends thereof of substantially the same diameter as the bores in said closure means, shaped charges in said containers each having a cavity therein facing a housing port and lined with an inert material, and hollow cylindrical sleeve means snugly fitted within the cylindrical opening in one of said charge containers and within the bore in the corresponding closure means for retaining said charge containers in accurate alignment with the corresponding ports in the housing.

2. In well casing perforating apparatus, the combination of an enclosed, elongated cylindrical pressure resistant housing adapted to be lowered into a bore hole and having a plurality of ports formed in the side wall thereof, a plurality of closure means for said ports, each of said closure means having a cylindrical bore in the interior wall thereof, a cylindrical support having a plurality of opposed apertures therein at locations corresponding to said housing ports, a plurality of shaped charge containers mounted in the apertures in said support and having substantially cylindrical openings at the forward ends thereof of substantially greater diameter than the bores in said closure means, shaped charges in said containers each having a cavity therein facing a housing port and lined with an inert material, hollow cylindrical adapter means snugly fitted in the forward end of one of said containers and having a cylindrical opening in the forward end thereof of substantially the same diameter as the bore in the corresponding closure means, and hollow cylindrical sleeve means snugly fitted within the cylindrical opening in said adapter means and within the bore in the corresponding closure means for retaining said charge containers in accurate alignment with the corresponding ports in the housing.

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