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GUN PERFORATOR DEVICE

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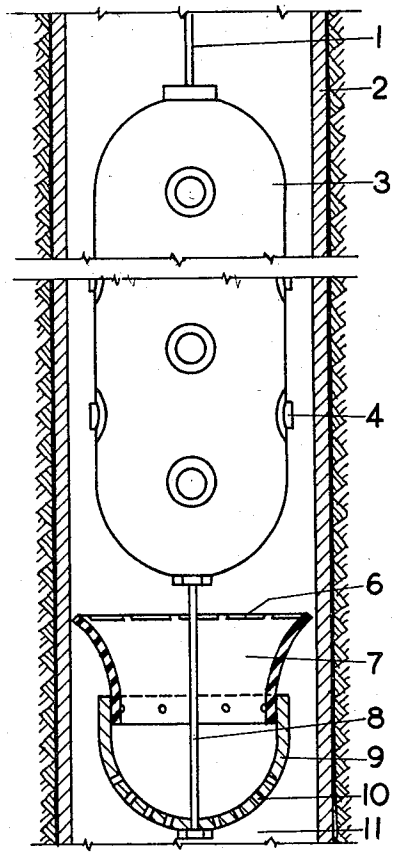

Fig. 1

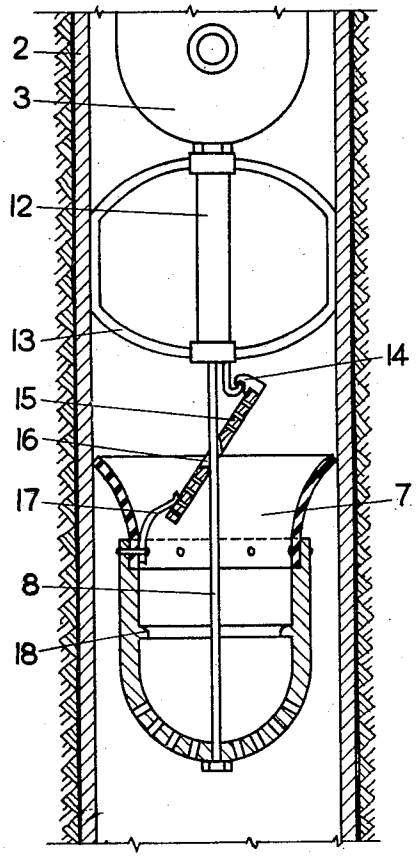

Fig. 2

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GUN PERFORATOR DEVICE

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5 Claims. (Cl. 164—0.5)

This invention pertains to the operation of gun perforators in oil and gas wells, and relates more particularly to a device for catching and retrieving gun perforator bullets or projectiles which fail to penetrate the casing, whereby the effectiveness of the shooting operations may be ascertained.

In perforating a casing by means of a gun perforator, a housing mounting a desired, usually fairly large, number of loaded barrels, is lowered into a well to a desired level, and the barrels are caused to discharge their projectiles into the casing for the purpose of establishing fluid communication between the interior of the well and the surrounding formations.

It sometimes happens, however, that, due to the high temperatures prevailing in wells, and to the jarring shocks to which the gun perforator is subjected while being moved in a well, one or several projectiles are prematurely discharged before the gun perforator is placed at the proper level.

It also sometimes happens that the bullets or projectiles fail, for various reasons, to penetrate the casing, but glance off said casing and fall to the bottom of the well. These bullets may sometimes be later accidentally retrieved at the surface, for example, during bailing operations.

It is, of course, of considerable importance to determine the effectiveness of a gun perforating operation, that is, the ratio of the number of bullets which actually penetrate the casing to the number of bullets which fail to do so.

Furthermore, during the process of completing or recompleting a well, several gun perforating operations may be carried out at different times and/or different levels in the well. In such cases, it is also of considerable importance to determine the effectiveness of each of said separate perforating operations.

It is, therefore, an object of this invention to provide a device for catching and retrieving gun perforator bullets which fail to penetrate the casing, from which, knowing the total number of bullets discharged, the effectiveness of the perforating operations may be determined or estimated.

It is also an object of this invention to provide for the above purpose a device that is readily adapted to be mounted upon the bottom of the gun perforator, and that will travel along together therewith without creating undue stresses on the hoisting cable due to friction either with the walls of the well or the fluid standing in said well.

It is also an object of this invention to provide for the above purpose a device adapted to retrieve all bullets failing to penetrate the casing of a well, either prematurely fired, or fired at one or more desired levels, and to differentiate between said bullets.

These and other objects of this invention will be understood from the following description, taken with reference to the attached drawing, wherein:

Fig. 1 is a diagrammatic sketch, partly in cross-section, of the gun perforator bullet catcher device of the present invention; and

Fig. 2 is a diagrammatic sketch of a somewhat modified embodiment of the device of Fig. 1.

Referring to Fig. 1, a gun perforator housing 3, mounting any desired number of gun barrels 4, is lowered on a cable 1 into a well 11 having a casing 2.

Attached to the bottom of the housing 3 by any suitable means is a metallic stem 8, supporting a container 9, which may be made of a metallic or plastic material. The container 9 is constructed with circular or cylindrical walls fitting reasonably closely within the walls of the well, and has preferably a spherical bottom portion provided with perforations 10 to eliminate swabbing effects when the apparatus is moved through the well fluid.

An apron 7, made of rubber, rubberized canvas, or of any other desired resilient material, is affixed to the upper rim of the container 9, and flares upwardly so as to have its upper edge substantially in contact with the well casing. Metallic plates 6, which may be, for example, bent over the upper edge of the apron 7 and affixed thereto, may be used to reinforce said edge.

When the gun perforator, together with present bullet catcher, is being lowered into the well, the fluid passes easily upwards through the perforations 10 and around the edges of the resilient apron 7.

Upon reaching the desired level in the well, the barrels 4 are discharged, and any bullets which fail to penetrate the casing 2, rebound therefrom and fall into the container 9 where they are retained, the perforations 10 being of sufficiently small size to prevent the bullets from passing therethrough.

After the completion of the gun perforating operations, the whole apparatus is pulled to the surface by means of the cable 1. The bullets which neither perforated the casing, nor rebounded therefrom, but remained embedded in said casing, partially sticking out into the well bore, do not serve as an obstacle to the raising operation, since the apron 7 is sufficiently flexible to give way upon meeting such obstruction (as well as obstructions of other types which may be encountered in the wall), whereby the danger of the apparatus becoming stuck or lost in the well is eliminated. The metallic plates 6 reinforcing the edge of the apron 7 exert a scraping action on the casing, whereby any bullets which are not embedded too firmly in the casing, are

scraped out and caused to fall into the bullet catcher.

In cases where it is desired to ascertain whether any bullets which had failed to penetrate the casing had been fired prematurely, a somewhat modified embodiment of the present catcher, shown in Fig. 2, may be used. This embodiment can also be advantageously used in cases when two different zones are to be perforated consecutively without raising the perforator to the surface, and the effectiveness of each separate perforating job is to be determined from the number of bullets failing to penetrate the formation in each case.

The bullet catcher of Fig. 2 is similar to that of Fig. 1, except that the stem 8, supporting the receptacle 7 is slidably surrounded by a sleeve 12, which carries guide spring members 13 in frictional engagement with the casing 2.

A perforated cover plate 15, adapted to fit within the receptacle 7, wherein it may rest, for example, against an annular or segmental stop member 18, has a central elliptical or elongated opening 16, which permits said plate to be carried in a slanted position around the stem 8.

This cover plate may be supported from the sleeve 12 by means of a trip catch 14, while a leaf spring 17 may be used to maintain it in the desired slanting position and to guide it within the receptacle 7.

When the gun perforator is being lowered into the well, the weight of the perforator casing, acting through the stem 8, forces the receptacle 7 downwards in rigid space relationship to said housing. At the same time, the friction of the guide springs 13 against the casing 2 causes the sleeve 12 to assume its uppermost position on the stem 8. The device is therefore in the condition shown in Fig. 2, and any bullets prematurely fired at this time, which fail to penetrate the casing, fall past the slanting cover plate 15 and are collected in the bottom of the receptacle 7, below the stop 18.

When the zone of the well which it is desired to perforate is reached, a pull is applied to the cable, slightly raising the housing 3, stem 8 and receptacle 7. The sleeve 12, however, tends to remain substantially stationary due to the friction of the guide springs 13 against the casing.

The sleeve 12, together with the cover plate 15 carried thereby, descends therefore with regard to the stem 8, until the lower end of said plate, guided by the spring 17, comes to rest within the container 7. This causes the trip catch 14 to release the cover plate 15, which falls within the receptacle 7 and assumes a horizontal position, being supported by the stop member 18. Any bullets fired subsequent to this and failing to penetrate the casing, fall, of course, on top of said plate, and are segregated from previously fired bullets.

The same procedure applies to the case when two zones are consecutively perforated by the same perforator without raising the latter to the surface. In such cases, the first zone is perforated without releasing the cover plate 15, while the second is perforated after releasing said plate, whereby the number of failures occurring during each operation can be easily ascertained.

It is obvious that the scheme described above for releasing the plate 15 can be modified in any desired mechanical details to secure the effect of the change of position of a cover plate for a bullet catcher from an inoperative to an operative position.

It is also understood that, although the present invention has been described with regard to operations in cased wells, it is equally applicable to uncased wells wherein the use of a gun perforator is desirable in connection with purposes such as acidizing, increase of production, securing of side-wall samples, etc.

I claim as my invention:

1. The combination of a gun perforator adapted to be lowered into a well on a cable and to discharge projectiles into the walls of the well, and a bullet catcher adapted to receive the bullets which fail to penetrate the walls of the well and fall down by gravity, said bullet catcher comprising a receptacle having an open upper face and a perforated bottom, said receptacle being positioned below said gun perforator and attached thereto.

2. The combination of a gun perforator adapted to be lowered into a well on a cable and to discharge projectiles into the walls of the well and a bullet catcher adapted to receive the bullets which fail to penetrate the walls of the well and fall down by gravity, said bullet catcher comprising a receptacle having cylindrical walls adapted to fit closely within the walls of the well, an open upper face and a perforated lower face, said receptacle being positioned below said gun perforator and attached thereto.

3. The combination of a gun perforator adapted to be lowered into a well on a cable and to discharge projectiles into the walls of the well, and a bullet catcher adapted to receive the bullets which fail to penetrate the walls of the well and fall down by gravity, said bullet catcher comprising a receptacle having cylindrical walls, a resilient annular member affixed thereto for close sliding contact with the walls of the well, an open upper face and a perforated lower face, said receptacle being positioned below said gun perforator and attached thereto.

4. The combination of a gun perforator adapted to be lowered into a well on a cable and to discharge projectiles into the walls of the well, and a bullet catcher adapted to receive the bullets which fail to penetrate the walls of the well and fall down by gravity, said bullet catcher comprising a receptacle having an open upper face, a perforated bottom, a perforated cover plate on said receptacle adapted to close said upper face, said cover plate being normally carried in an inoperative open position, and means operable through the cable supporting the gun perforator for shifting said plate to an operative closed position, said receptacle being positioned below said gun perforator and attached thereto.

5. The combination of a gun perforator adapted to be lowered into a well for discharging projectiles into the walls of the well from a plurality of gun barrels, and a bullet catcher attached to said perforator below said barrels, said bullet catcher comprising an upwardly opening receptacle adapted to retain the projectiles which fail to penetrate the walls of the well and fall down by gravity.

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