

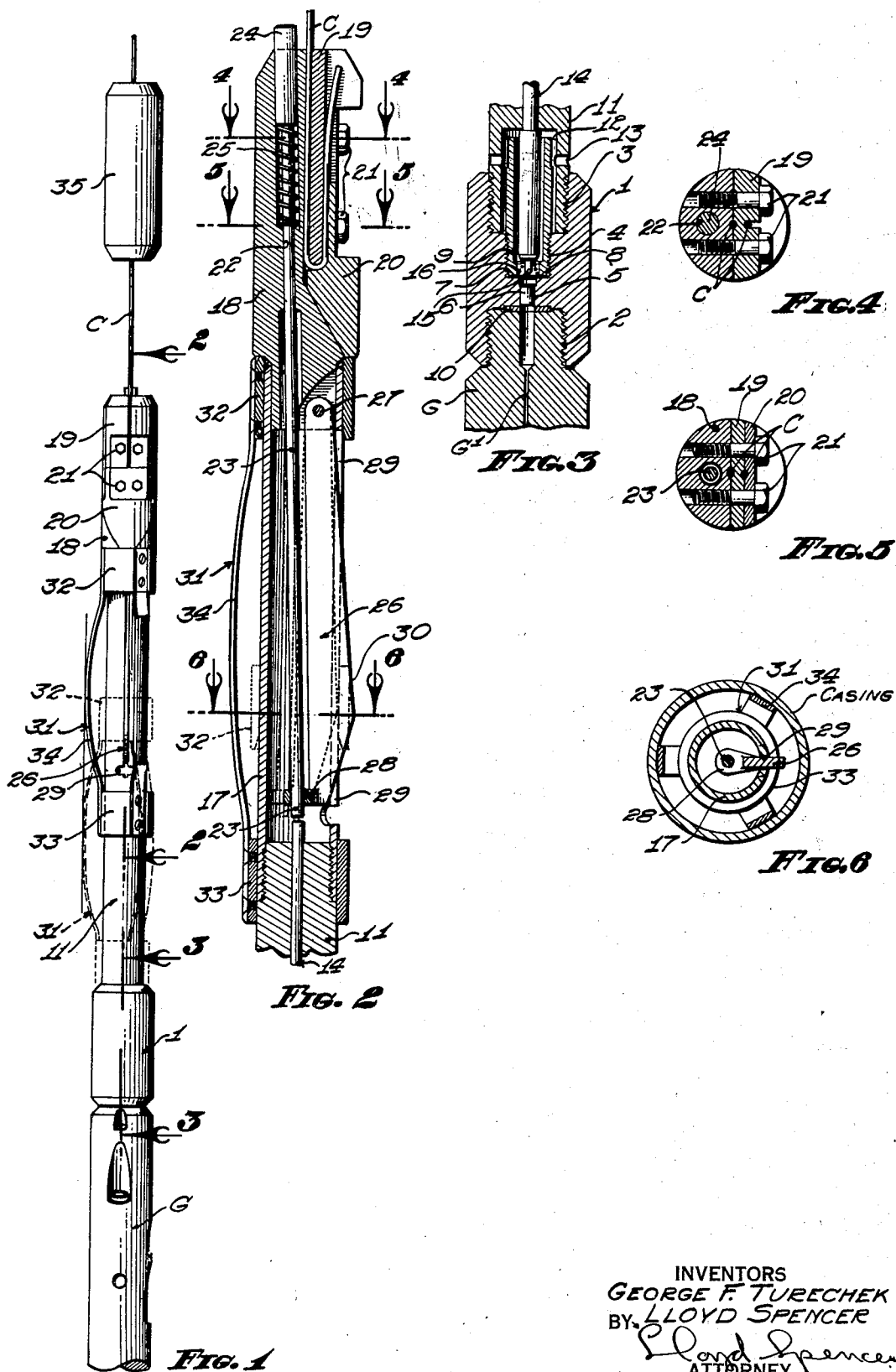
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FIRING HEAD FOR GUN PERFORATORS.

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FIRING HEAD FOR GUN PERFORATORS

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Our invention relates to firing heads for gun perforators, and among the objects of my invention are:

First, to provide a firing head adapted to be interposed between a gun perforator and supporting cable and carrying a firing arrangement adapted to be actuated by a tubular go-devil which is caused to slide along the supporting cable;

Second, to provide a firing head which incorporates means whereby the gun perforator can be fired only when the last preceding movement of the gun perforator has been a downward movement, said means being arranged to render the firing head inoperative whenever the firing head is raised in the casing, thereby rendering the gun perforator on which it is used relatively safe and foolproof;

Third, to provide a firing head which is simple of construction, comprising a minimum number of parts; and

Fourth, to provide a firing head which is particularly adapted for initiating the discharge of a mechanically fired gun perforator such as the type disclosed in the copending application of one of the inventors herein, namely, Serial No. 455,259, filed August 18, 1942.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawing, in which:

Figure 1 is an elevational view of our firing head shown connected to a gun perforator, the latter being shown fragmentarily, the safety cage being shown by solid lines in its arming position and shown by dotted lines in its disarming position;

Figure 2 is a longitudinal fragmentary sectional view taken through 2—2 of Figure 1;

Figure 3 is another longitudinal fragmentary sectional view taken through 3—3 of Figure 1, being in effect a continuation of Figure 2; and

Figures 4, 5 and 6 are transverse sectional views taken through 4—4, 5—5 and 6—6 of Figure 2.

Our firing head includes a coupling body 1 having a lower internally threaded socket 2 adapted to be connected to the upper end of a gun perforator G. The coupling body 1 is provided with an upper internally threaded socket 3. Centered in the socket is a recess 4 of smaller diameter continuing into the body. The recess and lower socket are connected by a cartridge bore 5 adapted to receive a blank cartridge 6, the upper end of the cartridge bore 5 being slightly counterbored to receive the head of the cartridge. The recess 4 forms with the bore 5 a shoulder

7 which receives a seal disk 8 adapted to be clamped in place by a tubular nut member 9. A gasket 10 is interposed between the coupling body and the gun perforator, there being a passageway G1 in the gun perforator which registers with the cartridge bore 5.

The upper socket 3 of the coupling body is adapted to receive the lower end of a guide block 11 which is cylindrical and provided with a socket 12 in its lower end adapted to clear the tubular nut 9. The socket is provided with vent holes 13. In addition, the guide block 11 is provided with a longitudinal bore which slidably receives a lower firing stem 14. The firing stem is provided with a striker point 15 at its lower end positioned above the seal disk 8 and adapted to be driven through the seal disk or deform the shear disk to engage the blank cartridge 6. A small spring 16 may be interposed between the firing stem 14 and shear disk to hold the firing stem in a slightly raised position. The shear disk however is made strong enough to withstand the hydrostatic pressure of fluids in which the gun perforator is immersed and is therefore strong enough to carry the normal weight of the firing pin, so that the spring may be omitted. The position of the firing stem 14 within the socket 12 and sleeve 19 is enlarged to form a shoulder limiting upward movement of the stem.

The upper end of the guide block 11 is screw-threaded to a tube 17 which in turn is secured to a cable head 18. The cable head 18 is provided with a semi-cylindrical upper portion which receives complementary clamp plates 19 and 20 secured thereto by bolts 21 which engage and clamp a cable C, in this case shown as a single strand wire line. The cable clamping means per se is not a part of the present invention, but is a separate invention of one of the inventors herein.

The cable head 18 is provided with a longitudinal bore 22 which is eccentrically located and diverges downwardly toward the longitudinal axis of the cable head and tube. The axis of the bore 22 intersects the axis of the tube 17 and guide block 11 approximately at the upper end of the lower firing stem 14. The bore 22 receives an upper firing stem 23 which, by reason of the direction of the bore 22, registers at its lower end with the upper end of the lower firing stem 14. The upper end of the upper firing stem 23 is provided with a head 24 and the bore 22 is counter-bored accordingly. The head 24 protrudes above the cable head 18 and is held in an upper position by a spring 25.

A disarming lever 26 is hinged to the lower end

of the cable head 18 by means of a hinge pin 27. The disarming lever 26 extends downwardly along the side of the upper stem 23 and is provided at its lower end with a collar or ring 28 adapted to fit around the lower end of the upper stem 23. The disarming lever 26 protrudes through a longitudinal slot 29 formed in the tube 17 and its protruding portion forms a cam face 30.

The tube 17 and guide block 11 are preferably equal in diameter and slidably support a disarming cage 31 which comprises an upper collar 32 and a lower collar 33 connected by bow springs 34 which are adapted to bear against the walls of a surrounding casing in which the gun perforator and firing head are lowered. Normally the cage 31 occupies the upper or arming position shown by solid lines in Figures 1 and 2, this position being maintained when the gun perforator is lowered into a well bore. Upon raising the gun however the cage 31 moves to its lower or dotted line disarming position.

The upper end of the head 24 which protrudes above the cable head 18 is adapted to be engaged by a tubular go-devil 35 which slides downwardly on the cable C.

Operation of our firing head is as follows: The firing head, with the exception of the coupling body 1, remains attached to the cable. Just prior to lowering the gun perforator into the well the coupling body 1 containing the blank cartridge 69 is threaded to the firing head which is screw-threaded to the guide block. This is preferably done while the cage is in its lower or dotted disarming position. The coupling body has been previously attached to the gun perforator or the gun perforator is attached to the coupling body after it has been attached to the firing head. After assembly the firing head, coupling body and gun perforator are lowered into the well.

Downward movement of the gun perforator holds the cage in an upper or arming position in which the upper firing stem is in registry with the lower firing stem 14. When the gun perforator has been lowered into position the go-devil 35 is dropped, causing the upper firing stem 23 to strike the lower firing stem 14 and driving the striker point through the seal disk 18 and against the cartridge 6, or causing the striker point to deform the disk so that the disk strikes the cartridge. Should the gun perforator fail to go off for any reason it can not subsequently be discharged during raising of the gun perforator for the reason that the cage moves to its lower or dotted line position, disarming the firing head by moving the lower end of the upper firing stem 23 out of registry with the lower firing stem.

The seal disk is capable of withstanding the hydrostatic pressure of the liquid in which the gun perforator may be immersed, which pressure may be as high as 2000 to 3000 pounds per square inch. When the gun perforator is under liquid the inertia of the liquid in the spaces above the cartridge is sufficient to confine the explosive pressures even though the seal disk itself would not withstand such pressure. If the gun perforator is to be fired above the liquid, grease or similar material may be placed in the tubular nut member 9 and socket 12. However, the pressure required to initiate operation of the gun perforator need not be high so that even though some force may be dissipated by backfire through the seal disk, operation is not impaired.

Various changes and alternate arrangements

may be made within the scope of the appended claims, in which it is our intention to claim all novelty inherent in the invention.

We claim:

1. A firing head for explosively operated well tools, comprising: a body member; an explosive cartridge supported therein; a firing pin positioned to strike said cartridge; a stem adapted to engage said firing pin, said stem having a laterally flexible portion; and means engageable with said flexible portion to move the end of said stem adjacent said firing pin clear thereof.

2. A firing head for explosively operated well tools, comprising: a body structure; spaced guide means for a firing stem and firing pin formed therein; a firing pin and a firing stem having coacting adjacent ends and guided by said means, said firing stem having an unsupported laterally displaceable portion adjacent said firing pin; means for moving the coacting end of said firing stem laterally clear of said firing pin; and an explosive cartridge adapted to be engaged by said firing pin when said firing pin is engaged by said firing stem.

3. The combination with a suspension cable and an explosively operated well tool, of a firing head attached to said cable and supporting said well tool, said firing head comprising: a body structure defining longitudinally extending guide means; a firing pin member and a firing stem member guided thereby and having adjacent coacting ends, the firing stem member protruding above said body structure for engagement by a go-devil dropped along said cable; one of said firing members including a flexible portion adjacent the other firing member; means for moving said end out of registry to prevent transmission of force from one member to the other; and an explosive cartridge engageable by said firing pin member when said firing stem member is engaged by said go-devil and said adjacent ends are in registry.

4. The combination with a suspension cable and an explosively operated well tool, of a firing head attached to said cable and supporting said well tool, said firing head comprising: a body structure including a pair of guide blocks and a tubular portion therebetween; firing stems guided in said blocks and having contiguous coacting ends for transmitting longitudinal movement from one stem to the other, the portion of one stem adjacent said coacting end being laterally flexible; and means slidable on said body structure and including a member engageable with said flexible portion to hold said portion laterally out of registry with the other of said firing stems.

5. A firing head for explosively operated well tools, comprising: a body structure including spaced upper and lower guide members; firing stems slidably mounted in said guide members and having confronting ends whereby longitudinal movement of one stem may be transmitted to the other, the confronting end of one stem being movable laterally to a position offset from the other stem; a cage slidably mounted on said body structure and engageable with a surrounding casing; means operatively connecting said cage with the laterally movable end of said stem to move said end clear of the other stem when said cage occupies a predetermined position on said body structure; and an explosive cartridge positioned for engagement by one of said stems when said stem is driven longitudinally.

6. A firing head for explosively operated well tools, comprising: a body structure including

spaced upper and lower guide members; firing stems slidably mounted in said guide members and having confronting ends whereby longitudinal movement of one stem may be transmitted to the other, the confronting end of one stem being movable laterally to a position offset from the other stem; means for moving the laterally movable end of said stem clear of the other stem, including a device engageable with a surrounding casing and slidable longitudinally on said body structure to one position when said body structure is moved downwardly with respect to said casing and to another position when said body structure is moved upwardly with respect to said casing; and an explosive cartridge positioned for engagement by one of said stems when said stem is driven longitudinally.

7. A firing head for explosively operated well tools, comprising: a pair of firing stems normally in substantial alignment whereby a blow in a longitudinal direction on one is transmitted to the other; an explosive cartridge including a

detonator positioned to receive a blow delivered through said firing stems; and disarming means for moving one of said stems out of alignment with the other.

8. A firing head for explosively operated well tools, comprising: a pair of firing stems normally in substantial alignment whereby a blow in a longitudinal direction on one is transmitted to the other; an explosive cartridge including a detonator positioned to receive a blow delivered through said firing stems; a body structure including guide means for said stems; a device engageable with a surrounding casing and longitudinally slidable on said body structure; and a disarming member operatively connecting said device to one of said stems for moving said stem out of alignment with the other stem when said device occupies a predetermined position on said body structure.

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