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DROPPABLE BACK-OFF TOOL

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2 Sheets-Sheet 1

Fig. 1

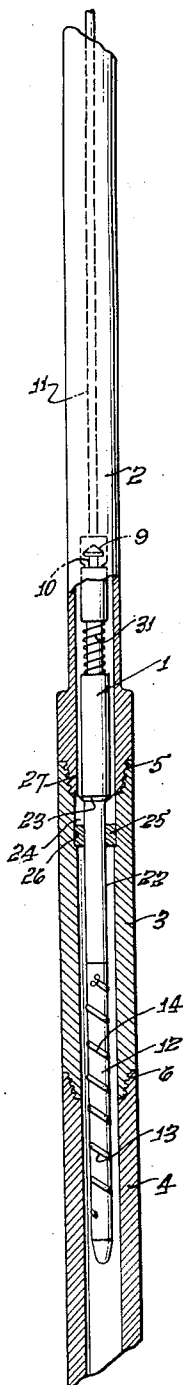
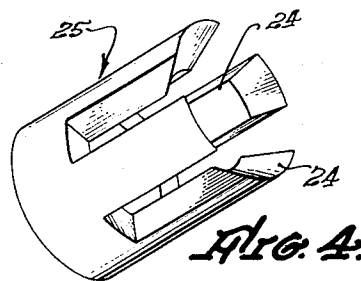
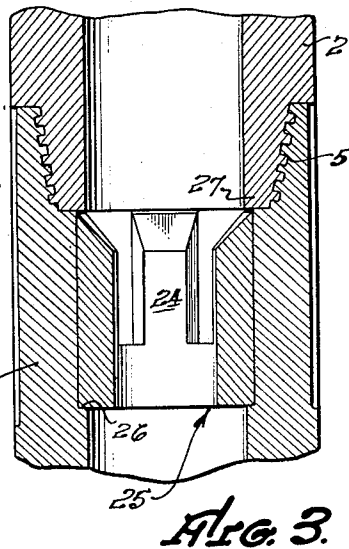
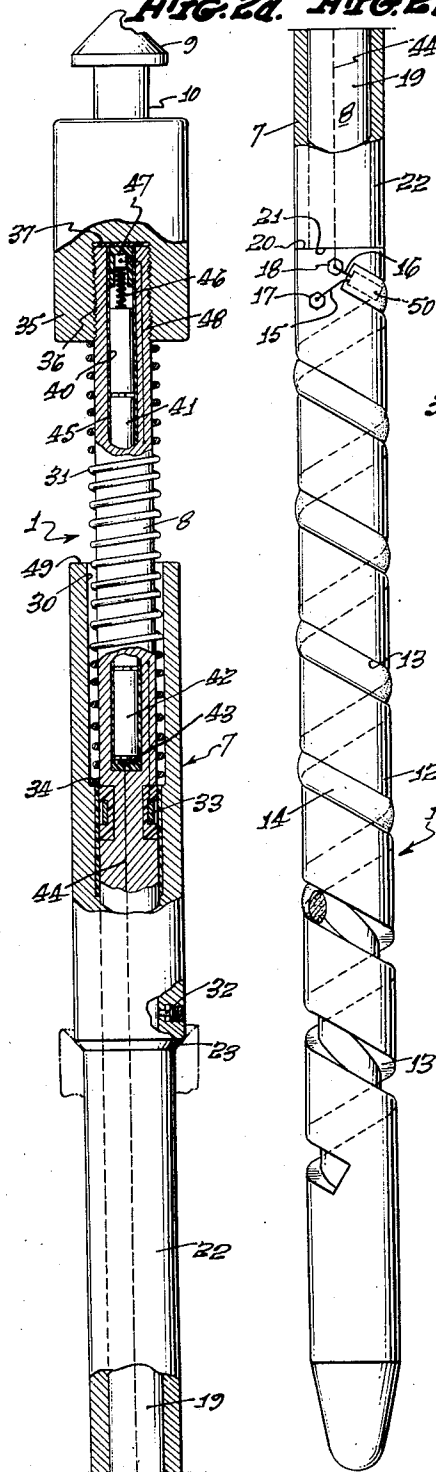


Fig. 2a. Fig. 2b.



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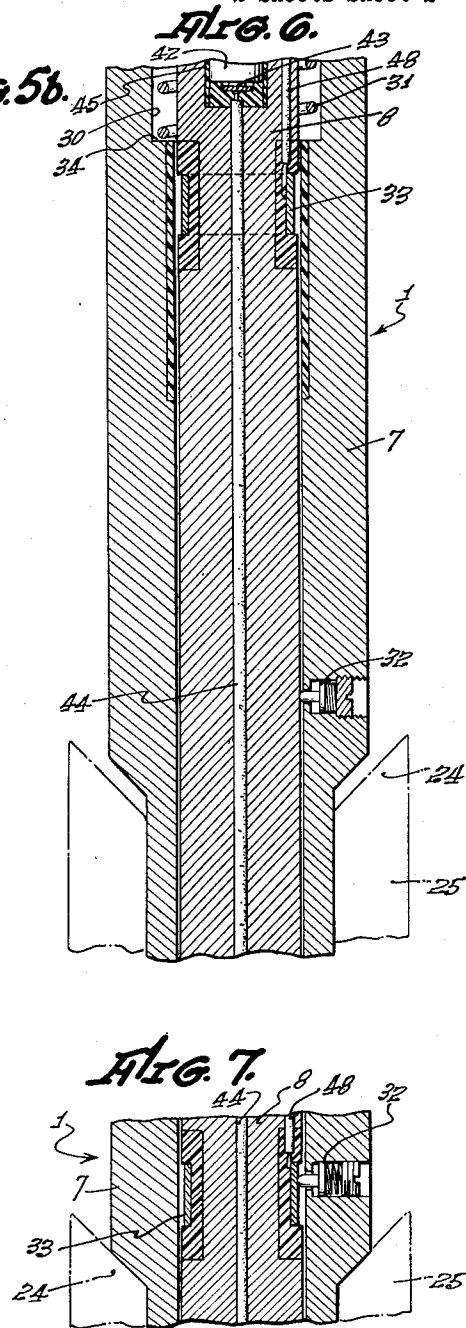
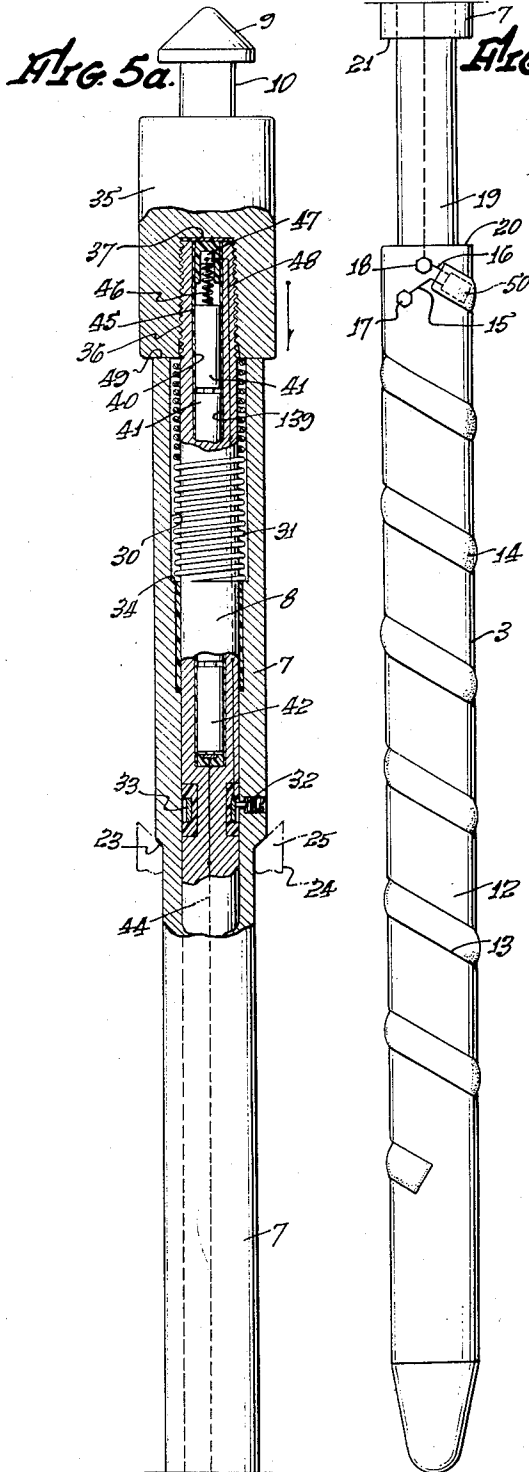
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## DROPPABLE BACK-OFF TOOL

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11 Claims. (Cl. 102—20)

The invention relates to a back-off tool and more particularly to a tool carrying an explosive and adapted to be lowered in a drilling string of pipe, viz., drill pipe, crossover sub, and drill collars, in order to apply an explosive shock at a threaded coupling between such members, to jar the coupling so that torque can be applied to uncouple the parts. This operation is well known and is usually accomplished by lowering an explosive, usually a flexible explosive string known as a string shot, into the drill pipe and firing the explosive by a circuit including an electrical cable connected to the explosive and extending from it to a truck at the ground level. This requires an electrical cable as long as the distance from the truck to the remote threaded coupling to be jarred loose.

An object of the invention is to avoid the requirement for an electrical or other cable comparable in length to the depth, below the earth's surface, of the coupling to be loosened, and to provide a droppable back-off tool which can be freely dropped in the drilling string without any electrical or other cable attached to it. Hence, the speed of dropping is determined by the force of gravity and not by the speed of lowering a cable.

A further object of the invention is to automatically fire an explosive when it has reached a desired location determined by a stop located in the drilling string.

These objects are accomplished by providing a firing circuit which is local to the back-off tool, and by controlling this circuit by contacts which are operated by a stop device which completes the circuit when the explosive reaches a desired position in the drilling string of pipe. The stop device is arranged beforehand in the drilling string so that the explosive will be automatically fired when it reaches the break-away point.

For further details of the invention reference may be made to the drawings wherein, Fig. 1 is a view in elevation, partly in section, showing the droppable tool of this invention in position in a typical drilling string, with a cable used, not for lowering, but only for retrieving the tool.

Fig. 2a and Fig. 2b are enlarged views in elevation, partly in section, of the upper and lower portions respectively of the tool of Fig. 1, with the contacts in open position.

Fig. 3 is an enlarged view in cross section showing the stop sleeve in position in the drilling string.

Fig. 4 is a perspective view of the stop sleeve removed from the drilling string.

Figs. 5a and 5b correspond to Figs. 2a and 2b respectively, showing the tool in firing position with the contacts closed.

Fig. 6 is a further enlarged sectional view of the tool, with parts broken away, showing the contacts open.

Fig. 7 is a sectional view showing a portion of Fig. 6 with the contacts in firing position.

Referring in detail to the drawings, Fig. 1 shows the back-off tool 1 in position in a drilling string represented by the drill pipe 2, sub 3, and drill collar 4, con-

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nected by the usual box thread coupling like 5 and 6. The tool 1 comprises an outer hollow cylindrical casing 7 and an inner plunger 8. The plunger 8 at its upper end has a knob 9 having an annular groove 10 to receive a latch, not shown, on a sinker-bar 11, the latter having a cable, not shown, to retrieve said tool from the drilling string, if desired, after the shot has been fired.

The lower end 12 of the plunger 8 is a string-shot holder and has a spiral groove 13 to receive the flexible explosive or string-shot 14 having wires 15 and 16 connected to terminals 17 and 18 respectively. The portion 19 of plunger 8 above the string-shot holder 12 is of reduced diameter providing a shoulder 20 which abuts the lower end 21 of casing 7 when plunger 8 is in its uppermost position as shown in Figs. 1, 2a, and 2b. The lower end 22 of the casing 7 is of reduced diameter providing at its upper end a shoulder 23 having a downwardly facing bevel, cooperating with the upwardly facing bevel on the upper inner portion of the four fingers like 24 on a stop sleeve 25. It is known beforehand where the coupling to be shocked is located, and while the shoulder 23 may be located anywhere in the pipe string, by way of example, it is assumed that the coupling 6 at the lower end of the sub 3 where it joins the upper end of the drill collar 4 is to be shocked. Hence, the stop sleeve 25 is arranged in a counterbore 26 at the upper end of the sub 3, being suitably held in position, e.g., between shoulder 26 and the end 27 of pipe 2. A stop serving the same purpose as sleeve 25 can be milled as a stop. This locates the string-shot holder 12 opposite coupling 6 when stop collar 23 is on stop sleeve 25, as casing length from collar 23 to its end 21 is of the length thus required and in the average case may be about 30 in. long. The tool length is thus determined by the sub length to be backed off.

The upper end of the casing 7 has a spring barrel 30 for a spring 31 which urges the plunger 8 upwardly as shown in Fig. 2a, to separate the contact 32 on the casing, from the contact 33 on the plunger until the weight of the sinker bar 11 and/or the weight of the plunger 8, overcomes the spring 31 to urge the plunger 8 downwardly to the position shown in Fig. 5a, and close the above-mentioned contacts and fire the shot string 14, this relative movement of plunger 8 and casing 7 being obtained at the desired location by reason of the fact that the stop sleeve 25 cooperates with the stop collar 23 to determine the point in the downward travel of the tool 1 through the drilling string where such relative movement and hence closure of contacts 32 and 33 shall take place.

Spring barrel 30 is in the form of a counter-bore at the end of casing 7 and it provides a shoulder 34 for the lower end of this spring. The upper end of plunger 8 bears against the head 35 having a threaded coupling 36 with the upper end of plunger 8, and sealed off with a gasket 37.

The upper end of plunger 8 is hollow, providing a battery chamber 40 for a plurality of dry batteries indicated at 41, arranged end to end, the bottom battery 42 having a bottom terminal connected with a contact 43 connected by wire 44 to terminal 18, terminal 17 being grounded on the metal plunger 8. The battery chamber 40 has insulation 45 on its wall. The upper contact of the top battery 41 is connected by a spring 46 to a suitable terminal 47 connected by wire 48 to contact 33, contact 32 being grounded on the casing 7. Wires 15 and 16 are connected to a fuse 50 which detonates the shot-string 14, which may be cordite.

The head 35 can be removed to replace the batteries 41. The bottom of head 35 strikes the top edge 49 of the casing 7 to serve as a stop and limit the downward movement of the plunger 8 when the casing 7 is stopped

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by the stop sleeve 25. The contact 33 is elongated so as to provide a wiping connection with contact 32, both when the plunger 8 is going downwardly and on its rebound, if any. It is understood that the back-off tool is dropped in the drilling string free from attachment to anything. After this tool has been used, a new string-shot explosive may be mounted in the groove 13, and the tool may be used again.

Various modifications may be made in the invention without departing from the spirit of the following claims. 10

I claim:

1. Back-off apparatus for use in a hollow drilling string including: a droppable back-off tool adapted to be dropped into the hollow drilling string, said droppable tool including a pair of relatively vertically movable members, means for carrying an explosive charge on one of said members, a battery circuit in said tool operatively connectable to said explosive charge carrying means to detonate said charge upon actuation of said circuit, a pair of normally vertically spaced circuit actuating members, one of which is mounted on each of said relatively movable members, at least one of said circuit actuating members being operatively connected to said circuit to actuate said circuit when said circuit actuating members are operatively engaged, said circuit actuating members being operatively engageable to actuate said circuit upon relative vertical movement of said relatively movable members, and a downwardly directed external shoulder on one of said relatively movable members; and an upwardly directed shoulder in said hollow drilling string; whereby said external shoulder carrying member will be stopped upon engagement of said shoulders as said droppable tool drops through said string, the weight and momentum of the other relatively movable member causing relative vertical movement between the said relatively movable members for actuating said circuit and detonating said charge.

2. The apparatus of claim 1 in which said relatively movable members are in telescoping relationship.

3. The apparatus of claim 1 in which spring means operatively engaged between said relatively movable members normally urges said relatively movable members toward a relative vertical position with said circuit actuating members vertically spaced and said circuit unactuated, and in which said weight and momentum overcome said spring means to cause relative vertical movement between said members for actuating said circuit and detonating said charge.

4. The apparatus of claim 1 in which a stop sleeve is mounted in said string to provide said shoulder in said string.

5. Back-off apparatus for use in a hollow drilling string including: a droppable back-off tool adapted to be dropped into the hollow drilling string, said droppable tool including a hollow casing member, a plunger member vertically slidably mounted in said hollow casing member, means for carrying an explosive charge on one of said members, a battery circuit in said tool operatively connectable to said explosive charge carrying means to detonate said charge upon actuation of said circuit, a pair of normally vertically spaced circuit actuating members, the upper one being mounted on said plunger member and the lower one being mounted on said casing member, at least one of said circuit actuating members being operatively connected to said circuit to actuate said circuit when said circuit actuating members are operatively engaged, said circuit actuating members being operatively engageable to actuate said circuit upon downward movement of said plunger member relative to said casing member, and a downwardly directed external shoulder on said casing member; and an upwardly directed shoulder in said hollow drilling string; whereby said casing member will be stopped upon engagement of said shoulders

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as said droppable tool drops through said string, the weight and momentum of said plunger member causing downward movement of said plunger member relative to said casing member for actuating said circuit and detonating said charge.

6. The apparatus of claim 5 in which spring means operatively engaged between said casing and plunger members normally urges said plunger member upwardly relative to said casing member to a position wherein said circuit actuating members are vertically spaced and said circuit is unactuated, and in which said weight and momentum of said plunger member overcome said spring means when said casing member is stopped by engagement of said shoulders to cause downward movement of said plunger member relative to said casing member for actuating said circuit and detonating said charge.

7. The apparatus of claim 5 in which said explosive charge carrying means is a string shot holder forming a part of said plunger member.

8. The apparatus of claim 5 in which said explosive charge carrying means is located on said plunger and in which battery containing means for said battery circuit is provided in said plunger, and in which a portion of said circuit is carried in each of said casing and plunger members with said circuit actuating members connecting together these circuit portions in their respective casing and plunger members when said circuit actuating members become operatively engaged upon said downward movement of said plunger member relative to said casing member.

9. Back-off apparatus for use in a hollow drilling string, including: a droppable back-off tool adapted to be dropped into the hollow drilling string, said droppable tool including: a hollow casing, a plunger slidably mounted in said casing and extending both above and below said casing, a string shot holder on said plunger below said casing, battery containing means mounted in said plunger above said casing, an electrical contact on said casing and a cooperating electrical contact on said plunger, a circuit between said battery containing means and said holder controlled by said contacts, and a downwardly directed external shoulder on said casing; and an upwardly directed shoulder in said string; whereby said casing will be stopped upon engagement of said shoulders as said tool drops through said string, the weight and momentum of said plunger causing downward movement of said plunger in said casing to bring said contacts into operative engagement with each other to electrically connect said battery containing means and said holder.

10. The apparatus of claim 9 in which spring means operatively engaged between said casing and said plunger normally urges said plunger upwardly relative to said casing to a position in said casing in which said contacts are out of operative engagement, and in which said weight and momentum of said plunger overcomes said spring means to cause downward movement of said plunger in said casing to bring said contacts into operative engagement with each other to electrically connect said battery containing means and said holder.

11. The apparatus of claim 9 in which a stop sleeve is mounted in said string to provide said shoulder in said string.

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