Aug. 10, 1965 J. C. KINLEY 3,199,287

EXPLOSIVE MEANS FOR TUBING PERFORATOR AND THE LIKE

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Fig. 1

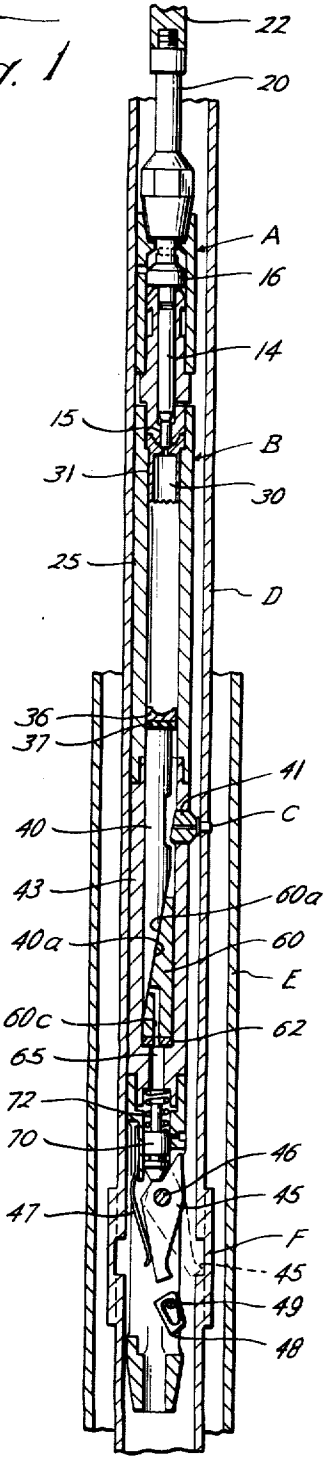
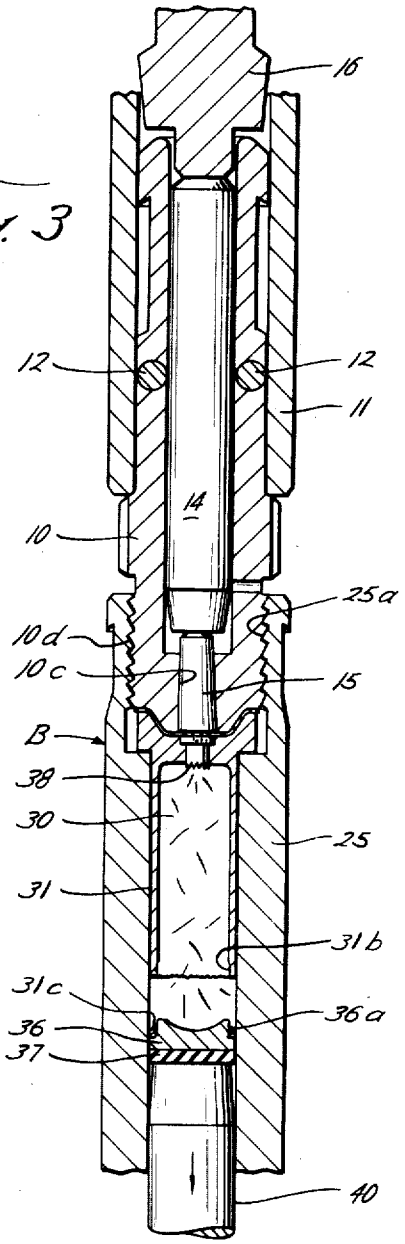


Fig. 3



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EXPLOSIVE MEANS FOR TUBING PERFORATOR AND THE LIKE

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Fig. 2C

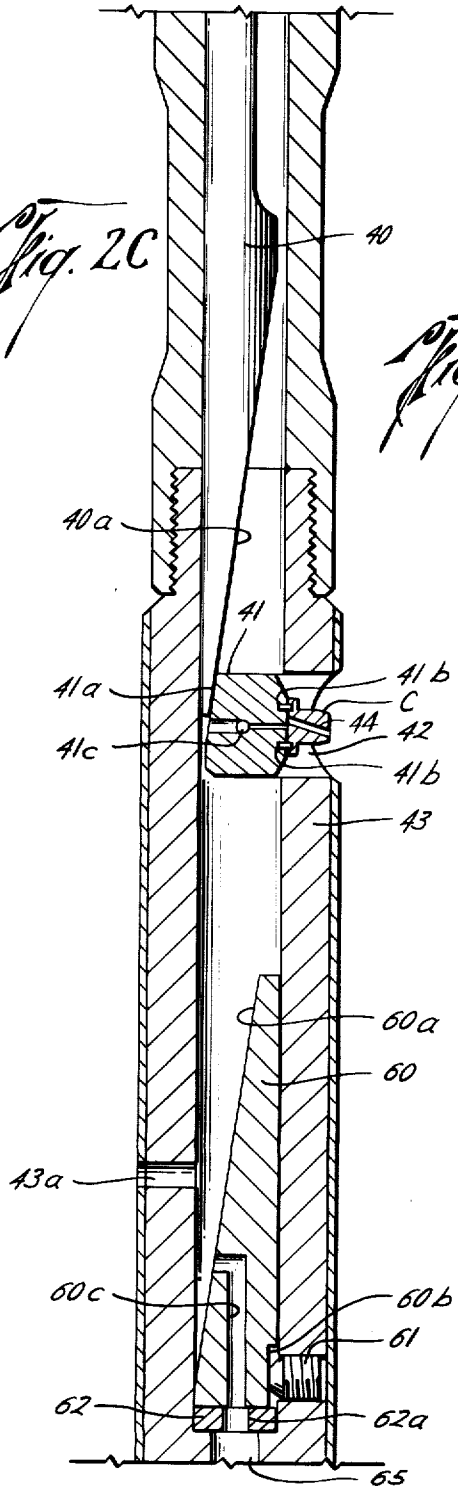
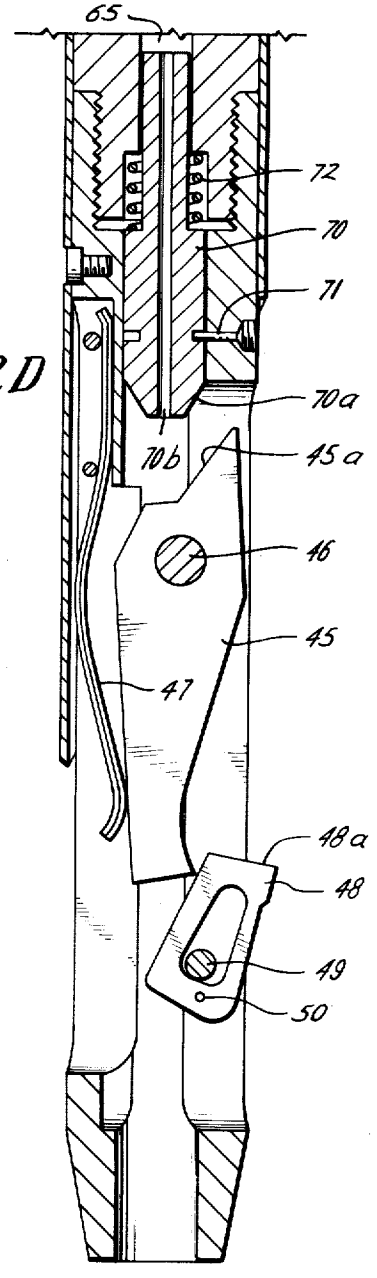


Fig. 2D



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EXPLOSIVE MEANS FOR TUBING PERFORATOR AND THE LIKE

Filed May 9, 1962 3 Sheets-Sheet 3

Fig. 2A

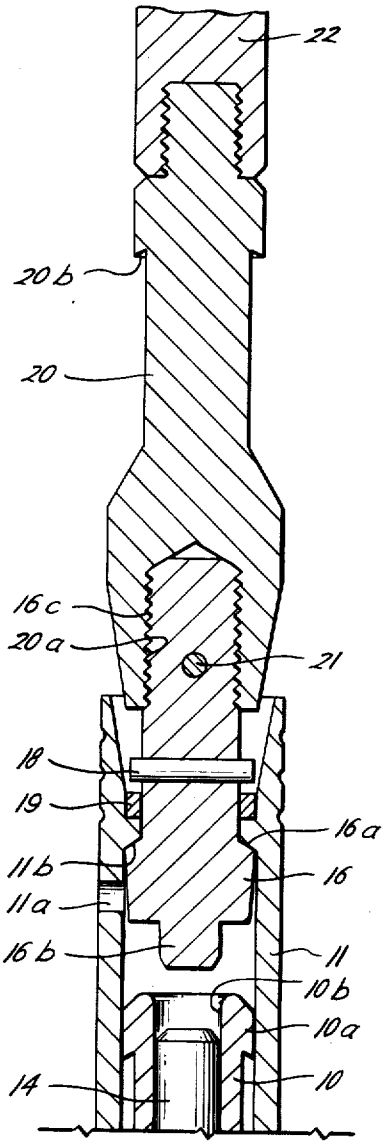
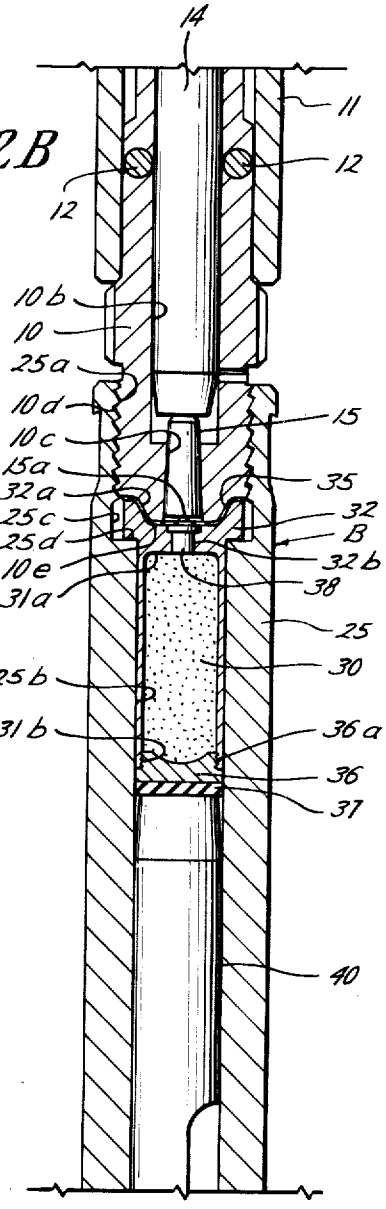


Fig. 2B



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EXPLOSIVE MEANS FOR TUBING PERFORATOR AND THE LIKE

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7 Claims. (Cl. 60—26.1)

This invention relates to new and useful improvements in explosive means for tubing perforators and the like.

In United States Patent No. 2,544,601, a tubing perforator of the general type of this invention is disclosed. Such perforator provides means for inserting an orifice insert into a tubing or pipe by explosive action.

An object of this invention is to provide a new and improved perforator tool, and particularly a new and improved explosive means therewith, which has all of the advantages of the tool of said Patent No. 2,544,601 as well as certain additional advantages.

An important object of this invention is to provide a new and improved explosive means which is especially suitable for use in a tool for inserting an orifice insert in a tubing or pipe but which is also suitable for use in other explosive-actuated tools and devices.

Another object of this invention is to provide a new and improved explosive means wherein a dish-shaped sealing disk is provided for sealing off one end of the explosive chamber to thereby prevent off-center travel of said disk whereby sealing of the explosive by the disk is assured.

A further object of this invention is to provide a new and improved explosive means wherein a dish-shaped sealing disk is provided for sealing off one end of the explosive chamber to locate the inside upper end of the chamber housing below a flange in the tool body supporting the chamber housing for thereby positioning the explosive within an increased thickness portion of the tool body so that an increased charge of the explosive can be safely used.

Still another object of this invention is to provide a new and improved perforator tool having a tool body which includes a firing pin body and an explosive chamber body; said firing pin body and said explosive chamber body being interconnected by buttress threads for increased strength, whereby increased explosive powder charges may be employed.

A particular object of this invention is to provide a new and improved explosive cartridge or chamber body having a lower closure plug which is threaded into the chamber body so that when the explosive powder is detonated, such threads are stripped or such cartridge is pulled apart where weakened by such threads to prevent re-use of the cartridge, whereby the dangers of re-use of a fired cartridge are prevented.

The preferred embodiment of this invention will be described hereinafter, together with other features thereof, and additional objects will become evident from such description.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

FIG. 1 is an elevation, partly in section, illustrating the tubing perforator, and the explosive means therewith, after it has been fired for the insertion of an insert orifice into a tubing or well pipe;

FIGS. 2A through 2D are longitudinal views, partly in elevation and partly in section, illustrating a tubing perforator tool from its upper end to its lower end, respectively, and incorporating therewith the explosive means of this invention; and

FIG. 3 is an enlarged view similar to FIG. 2B, but illustrating the explosive means of this invention after it has been fired.

In the drawings, the letter A designates generally the tubing perforator which includes the explosive means B of this invention, as will be more fully explained. The perforator A is of the type which inserts an orifice insert C into a well pipe or tubing D for the purpose of controlling fluid flow into the tubing or pipe D. As shown in FIG. 1, the tubing D is normally located within a casing E. The perforator A is adapted to be located prior to the firing of the perforator A at a selected collar or joint F in the tubing or pipe string D. The perforator A is fired by the manipulation of a wire line on which the perforator tool A is lowered into the well pipe D, or a suitable weight may be dropped on the wire line for detonataing the explosive charge in the explosive means B of the tool A, as will be explained. Such explosion effects the insertion of the orifice insert C to the position shown in FIG. 1, and thereafter the tool A is removed from the particular location in the tubing D, leaving the insert C in position within the tubing or pipe D for flow control therethrough.

In the particular embodiment illustrated in the drawings, the perforator A includes a firing pin body **10** which is positioned within a sleeve **11** by means of suitable shear pins **12**, or other suitable connecting means. With the use of the shear pins **12**, the sleeve **11** may be separated from the firing pin body **10** by a manipulation of the wire line supporting the tool A, if such becomes desirable or necessary, so that the fishing neck **10***a* at the upper end of the body **10** is exposed for a fishing operation, as will be well understood by those skilled in the art.

The upper bore **10***b* of the firing pin body includes a firing pin rod **14** which is adapted to move downwardly and impart a movement to a tapered firing pin **15** which is located in a tapered lower bore **10***c* of the firing pin body **10**. The lower external end of the body **10** has external buttress threads **10***d*, the purpose of which will be explained hereinafter.

The sleeve **11** has one or more openings **11***a* to prevent a fluid lock within the housing or sleeve **11** as a punch **16** moves with respect to such sleeve **11**. The punch **16** is provided with an upper inclined annular shoulder **16***a* which engages a corresponding internal shoulder **11***b* in the sleeve **11** so that when the punch **16** is in the raised position (FIG. 2A), the entire tool A is supported from the wire line or other means extending to the surface of the well (not shown). In the preferred form of the invention, the punch **16** is suspended in an upper position by means of a shear pin **18** which is located above a shear ring **19** and is adapted to be sheared upon a downward movement of the punch **16**. In other words, the pin **18** is sheared by a downward impact or engagement with the shear ring **19** so as to permit a movement of the punch **16** downwardly to cause the lower reduced diameter portion **16***b* of the punch to enter the bore **10***b* of the firing pin body **10** and to strike the upper end of the firing pin rod **14** to cause it to move downwardly. The upper end of the punch **16** may be connected to the wire line (not shown) in any suitable manner, but as shown in FIG. 2A, an adapter **20** is threaded by the interengagement of threads **16***c* and **20***a* and by the locking of a pin **21** which extends from the punch **16** into the adapter **20** to prevent rotation thereof. The adapter **20** preferably has a fishing neck **20***b* at its upper end which may be used for a fishing operation in some instances. A partial showing of a rope socket **22** in FIG. 2A illustrates one manner of connecting a suitable wire line or cable to the upper end of the tool A. Wire line operated jars are usually connected above the adapter **20**.

The firing pin body 10 is connected to an explosive chamber body 25 by means of co-acting interengaging internal threads 25*a* and external threads 10*d*. Such threads are of the buttress type so that they serve to hold the firing pin body 10 and the explosive chamber body 25 securely together even with relatively large explosive charges 30. The chamber body 25 has an internal bore 25*b* which is substantially uniform throughout its length, but at its upper end it is enlarged at 25*c* to provide a lateral annular shoulder 25*d*. An explosive chamber housing or cartridge 31 for the explosive 30 is positioned within the body 25 (FIG. 2B). The chamber housing or cartridge 31 is formed with a laterally extending flange 32 at its upper end which rests upon the shoulder 25*d*. The flange 22 is provided with a dish-shaped depression or recess 32*a* for receiving a correspondingly dish-shaped sealing disk 35. When the firing pin body 10 is fully threaded into the body 25, the lower end 10*e* of the firing pin body 10 is in contact with the disk 35 to compress such disk 35 between the body 10 and the flange 32. It is to be noted that the lower end 10*e* of the body 10 is also shaped to fit within the dish-shaped recess 32*a*. Preferably, the disk 35 is formed of brass so that it provides a fluid-tight seal above the chamber housing 31. For detonating such charge 30, a detonator 38 such as the detonator of a shotgun shell or a blank cartridge is provided in a central opening 32*b* in the flange 32. Such detonator 38 is of conventional construction and is mounted so as to remain in position above the powder 30 and below the sealing disk 35. Preferably, the firing pin 15 has a firing pin projection 15*a* which is adapted to puncture the sealing disk 35 and strike the detonator 38 for the detonation of the detonator 38 and the subsequent explosion of the explosive powder or charge 30.

By reason of the provision of the dish-shaped recess 32*a*, and the corresponding dish-shaped disk 35, it is impossible for the disk 35 to shift off center from the flange 32. Therefore, the proper sealing is always obtained as compared to a flat disk which is not depressed or shaped as in the present invention. Furthermore, by the lowering of the upper surface of the flange 32 with such recess 32*a*, the upper inner end 31*a* of the housing 31 is located below the shoulder 25*d* so that the powder charge 30 is in a portion of the body 25 having a greater wall thickness than the area thereabove. By locating all of the powder 30 within the relatively thick wall of the body 25, a larger charge of powder 30 can be used in the cartridge or chamber housing 31. Also, the location of the powder within the increased wall thickness provides for further safety in the handling of the tool on the surface.

The lower end of the chamber housing 31 is closed by a plug 36 which has threads 36*a* in co-acting interengagement with threads 31*b* on the inner surface of the chamber housing 31. When the powder or charge 30 explodes, the force of such explosion is sufficient to strip, pull apart or sever the threads 31*b* (FIGS. 1 and 3) to pull a section 31*c* thereof with the plug 36 as it moves downwardly due to the explosive force (FIG. 3). The threads 36*a* may be stripped or severed instead of the threads 31*b*, or both threads 36*a* and 31*b* may be stripped or severed. The stripping or severing of the threads 31*b* and/or the threads 36*a* prevents a re-threading thereof and therefore, the cartridge or chamber housing 31 cannot be re-used by someone inexperienced in the loading of the powder or explosive 30. Therefore, the danger of a re-use of the cartridge 31 is eliminated by means of the threaded plug 36 shown in FIG. 2B.

A seal 37 of neoprene or similar material is positioned below the plug 36 and seals against the bore 25*b* to prevent any substantial loss of explosive pressure when the explosive is fired. A driving wedge 40 is below the seal 37. Such wedge 40 has an inclined surface 40*a* (FIG. 2C) which is behind and in engagement with an inclined surface 41*a* (FIG. 2C) of a carrier 41. The carrier 41 is adapted to slide laterally in a suitable slot or grooves 42 in the lower stop body 43. Normally, the carrier 41 is retained in its retracted position (FIG. 2C) by a shear pin 41*c* or other suitable means.

The carrier 41 is releasably attached to the insert C which has an opening or orifice 44 therethrough. One or more shear pins 41*b* releasably connect the carrier 41 and the insert C so that after the insert C is inserted into the tubing or pipe D, such pin or pins 41*b* may be sheared for releasing the carrier 41 from the insert C upon the longitudinal movement of the tool A. In order to position the tool A at a desired elevation in a well pipe D, a spring loaded latch 45 is mounted on a pivot pin 46 near the lower end of the tool A (FIG. 2D). The latch 45 is urged radially or laterally outwardly by a spring 47 or other resilient means so as to extend beyond the body 43 (dotted lines in FIG. 1). During the running in of the tool A, the latch 45 is held in a retracted position by a tripper 48 which is pivotally mounted on a pin 49. Such tripper 48 is held in an upwardly extending position during the running in of the tool A by a shear pin 50, which is adapted to be sheared by the engagement of the upper edge 48*a* of the tripper with the inside of a collar F (FIG. 1). Such tripping of the tripper 48 shears the pin 50 and allows it to swing or drop below the latch 45 (FIG. 1), whereby the latch 45 is moved by the resilient leaf spring 47 to its extended latching position for engagement within the collor F. Thus, the tool A is located within a particular collar F so as to properly position the tool A prior to the firing of the explosive charge 30.

In order to stop the downward movement of the wedge 40, a stop-wedge 60 having an inclined surface 60*a* is positioned at the lower end of the body 43. Such stop-wedge 60 is maintained at the proper position for receiving the drive wedge 40 by a set screw 61 which projects into a recess 60*b*. It is to be noted that the recess 60*b* extends slightly above the set screw 61 to permit limited downward longitudinal movement of the stop-wedge 60 relative to the screw 61. The stop-wedge 60 is formed of brass in the preferred case and it is seated upon a washer 62 which is preferably made of hardened steel. The stop-wedge 60 has a fluid passage 60*c* near its lower end which is in communication with a central opening 62*a* in the washer 62 and also a central opening 65 in the body 43, the purpose of which will be hereinafter explained. The washer 62 is provided to prevent the jamming of the wedge 60 so tightly into the bottom of the body 43 that it cannot be removed. It is also to be noted that the body 43 preferably has a relief port 43*a* to prevent a fluid lock as the drive-wedge 40 moves downwardly to the stop-wedge 60.

When the drive-wedge 40 moves downwardly after having forced the carrier 41 and the orifice insert C outwardly, it reaches a position wherein the opening 43*a* is closed by the drive wedge 40 and grease or other fluid confined below the wedge 40 is then compressed and is forced down through the opening 60*c* and the opening 62*a* into the area 65. The area 65 is above a latch release piston 70 which is held in an upper retracted position by one or more shear pins 71 (FIG. 2D). While the piston 70 is in its upper retracted position, a spring 72 is confined under compression so that upon the shearing of the pin 71, such spring 72 urges the latch release member or piston 70 downwardly together with the action of the grease or fluid in the chamber 65 above the piston 70. Thus, when the compressed grease or fluid in the chamber 65 acts on the piston 70 to shear the pin 71, the spring 72 then acts to continue the downward movement of the piston 70 and cause the inclined tapered surface 70*a* to move into engagement with an inclined surface 45*a* on the latch 45 which in turn causes a pivoting or retraction of the latch 45 as shown by the solid lines in FIG. 1. The latch 45 is thus retracted and held in the retracted position by the piston 70. It is to be noted that the piston 70 preferably has a relief hole 70*b* therethrough to prevent an excessive downward force on the piston 70 by the fluid compressed within the cham-

ber or area **65**. If such opening **70***b* is not provided in the piston **70**, the piston **70** is apt to be forced downwardly with such force that it damages the pivot pin **46**. The particular size of the opening **70***b* may of course be varied to control such downward impact by the piston **70** on the latch **45**.

In the operation or use of the tool A of this invention with its explosive means B, the tool A is preferably lowered on a wire line or other suitable conventional support extending from the rope socket **22** or other suitable connecting means. While the tool A is being lowered in the tubing or pipe D, the tripper **48** is in the retracted position shown in FIG. 2D and is held in such position by the shear pin **50**. The tripper **48** thus serves to hold the latch **45** in the retracted position as the tool A is lowered. Also, the punch **16** is in its raised position as shown in FIG. 2A and is therefore spaced from the firing pin rod **14** to prevent premature firing as the tool A is lowered.

When the elevation in the tubing D has been reached at which it is desired to insert the orifice insert C, the tool is raised upwardly to engage the edge **48***a* of the tripper **48** with the collar or joint F to shear the pin **50**. Upon a shearing of the pin **50**, the tripper **48** drops to the position shown in FIG. 1 and the spring **47** urges the latch **45** to the extended dotted line position shown in FIG. 1. With the latch **45** in the extended position, the tool A is again lowered until such latch **45** catches in the tubing or collar F to stop the downward movement of the tool A.

Thereafter, the line supporting the tool A is jerked or manipulated, preferably with a conventional wire line jarring tool or weight (not shown) to impart a downward force to the punch **16** which causes a shearing or severing of the pin **18** and an impact blow by the punch on the top of the firing pin rod **14**. Such blow is transmitted from the rod **14** to the firing pin **15** and to the detonator or shell **38**. Upon the explosion of the detonator **38**, the entire explosive charge **30** is detonated or fired. The firing of the explosive powder or charge **30** causes the plug **36** to move downwardly and strip the threads **36***a* from the threads **31***b* or to pull apart the cartridge at such threads to prevent a re-use of the cartridge or chamber housing **31**. The explosive force of the charge or powder **30** transmits a downward movement to the wedge **40** which causes a co-action between its inclined surface **40***a* and the inner inclined surface **41***a* of the carrier **41** to move such carrier **41** laterally outwardly. The carrier **41** carries the insert C with it in the lateral movement to cause the orifice insert C to puncture through the pipe or tubing D and position it for permitting subsequent flow through the orifice **44**.

The downward movement of the drive-wedge **40** continues until it is stopped by the stop-wedge **60**. Also, as explained above, when the drive-wedge **40** reaches its lower limit, it forces the grease or other fluid under compression into the chamber **65** above the piston **70** and causes a shearing of the pin **71**. The coil spring **72** thereafter urges the piston **70** downwardly to cause a release of the latch **45** to the solid line position of FIG. 1 so that the tool A can therefore be raised or lowered as desired within the tubing D. With the orifice insert C in the tubing D as shown in FIG. 1, a longitudinal movement of the carrier **41** with the tool A severs the shear pins **41***b* and leaves the insert C in the pipe D after the tool A is moved.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A tool having an explosive means therewith, the improvement residing in said explosive means, including:
(a) an explosive chamber housing having an upper flange and a chamber therebelow for receiving explosive powder,
(b) said flange also having a dish-shaped depression in its upper lateral surface, and
(c) a dish-shaped sealing disk generally conforming in shape to said depression for forming a seal for the upper end of said chamber housing.

2. The structure set forth in claim **1**, including:
(a) a detonator disposed in said flange below said sealing disk and adapted to detonate said explosive powder.

3. A tool having an explosive therewith, the improvement residing in:
(a) an explosive chamber body having a tubular inner bore and an internal lateral shoulder,
(b) an explosive chamber housing having an inner chamber for receiving an explosive charge,
(c) said housing also having an external laterally extending flange forming the upper end of said chamber,
(d) a sealing disk on said flange,
(e) a firing pin body in said bore of said explosive chamber body above said shoulder and in contact with said sealing disk, and
(f) buttress threads on said explosive chamber body and said firing pin body for holding them together with said sealing disk in sealing contact between said firing pin body and said flange to prevent fluids from entering said inner chamber.

4. A tool having an explosive means therewith, the improvement residing in:
(a) an explosive chamber body having a tubular inner bore and an internal lateral shoulder,
(b) an explosive chamber housing having an inner chamber for receiving an explosive charge,
(c) said housing also having an external laterally extending flange forming the upper end of said chamber,
(d) said flange having a dish-shaped recess in its upper surface,
(e) a dish-shaped sealing disk seated in said recess of said flange, and
(f) a firing pin body connected to said explosive chamber body for holding said sealing disk in sealing contact with and between said flange and said firing pin body.

5. A tool having an explosive means therewith, the improvement residing in:
(a) an explosive chamber body having a tubular inner bore and an internal lateral shoulder,
(b) an explosive chamber housing having an inner chamber for receiving an explosive charge,
(c) said housing also having an external laterally extending flange forming the upper end of said chamber,
(d) said flange having a dish-shaped recess in its upper surface,
(e) a dish-shaped sealing disk seated in said recess of said flange,
(f) a firing pin body connected to said explosive chamber body for holding said sealing disk in sealing contact with and between said flange and said firing pin body, and
(g) buttress threads on said explosive chamber body and said firing pin body for holding them connected together with said sealing disk compressed therebetween to provide an efficient seal.

6. A tool having an explosive means therewith, the improvement residing in said explosive means, including:
(a) an explosive chamber housing having an upper

flange and a chamber therebelow for receiving explosive powder,

(b) a plug closing the lower end of said chamber housing, and

(c) severable co-acting threads on said plug and said housing for holding said plug in said housing until the powder explodes.

7. A tool having an explosive means therewith, the improvement residing in:

(a) an explosive chamber body having a tubular inner bore and an internal lateral shoulder,

(b) an explosive chamber housing having an inner chamber for receiving an explosive charge,

(c) said housing also having an external laterally extending flange forming the upper end of said chamber and resting on said internal lateral shoulder,

(d) the inner surface of said upper end of said chamber being disposed below said shoulder to surround

said charge in said chamber with a portion of said chamber body having a relatively thick wall.

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