

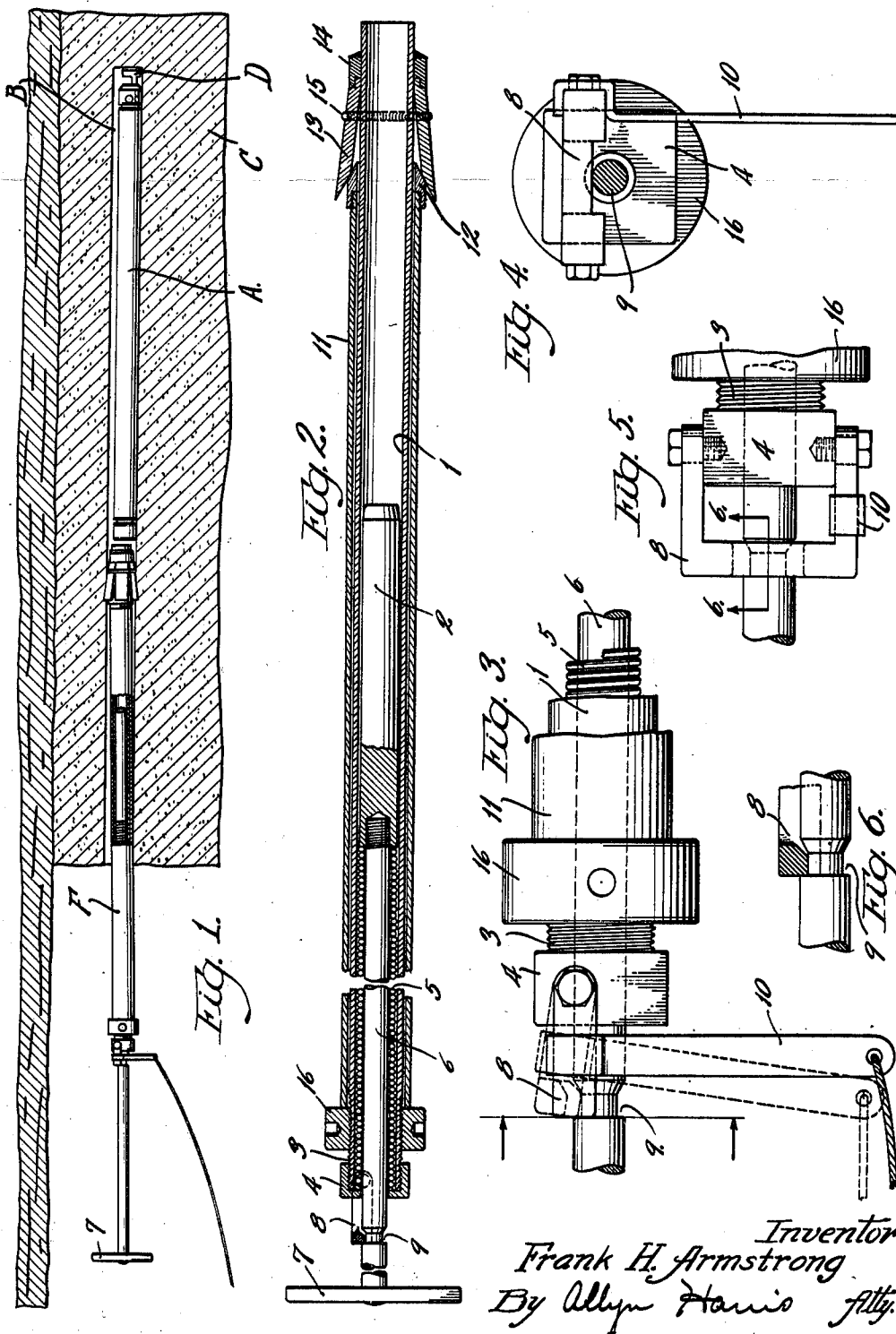
June 15, 1937.

F. H. ARMSTRONG
MATERIAL BREAKING DEVICE

2,083,975

Filed Dec. 17, 1932

6 Sheets-Sheet 1



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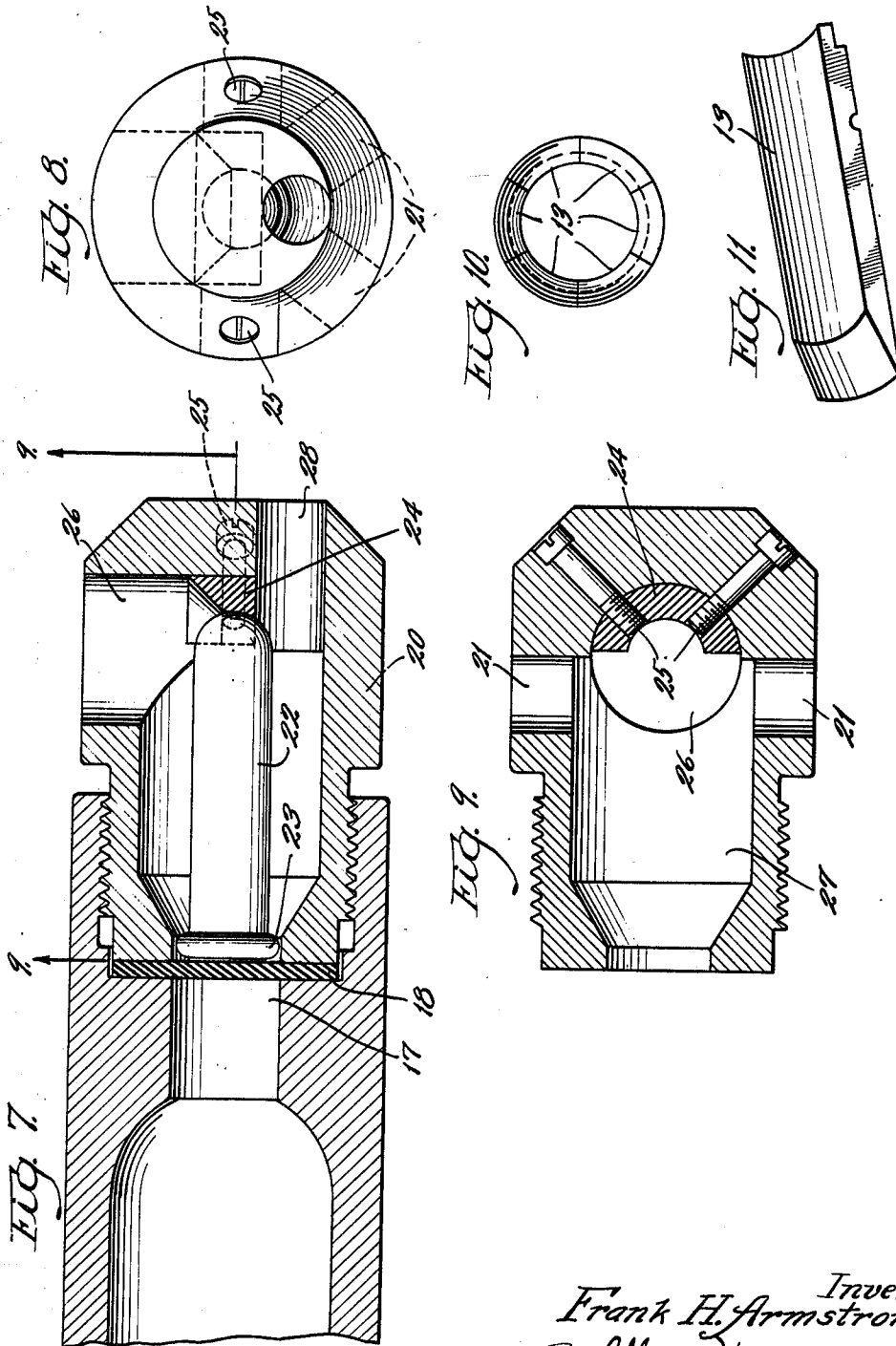
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6 Sheets-Sheet 2



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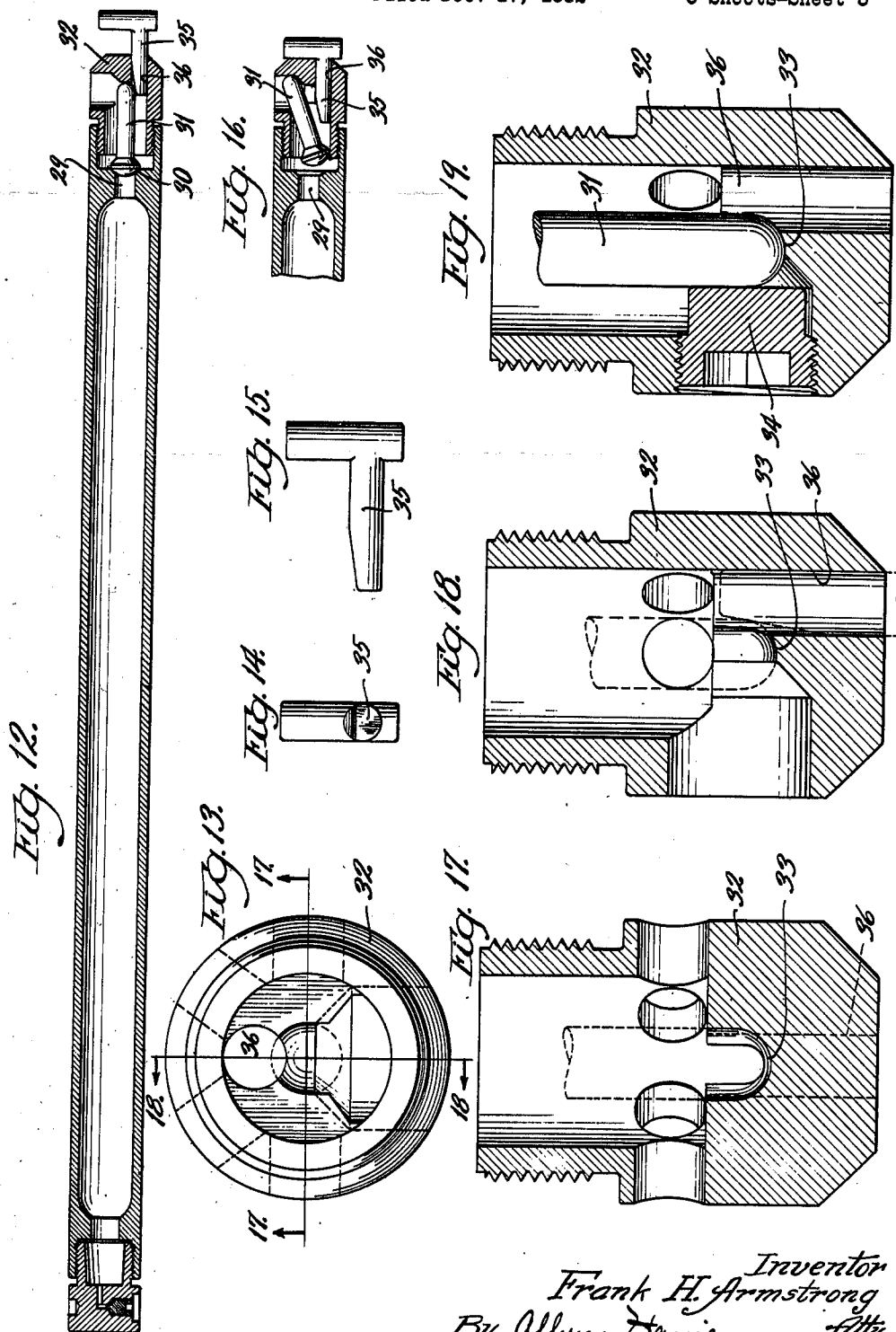
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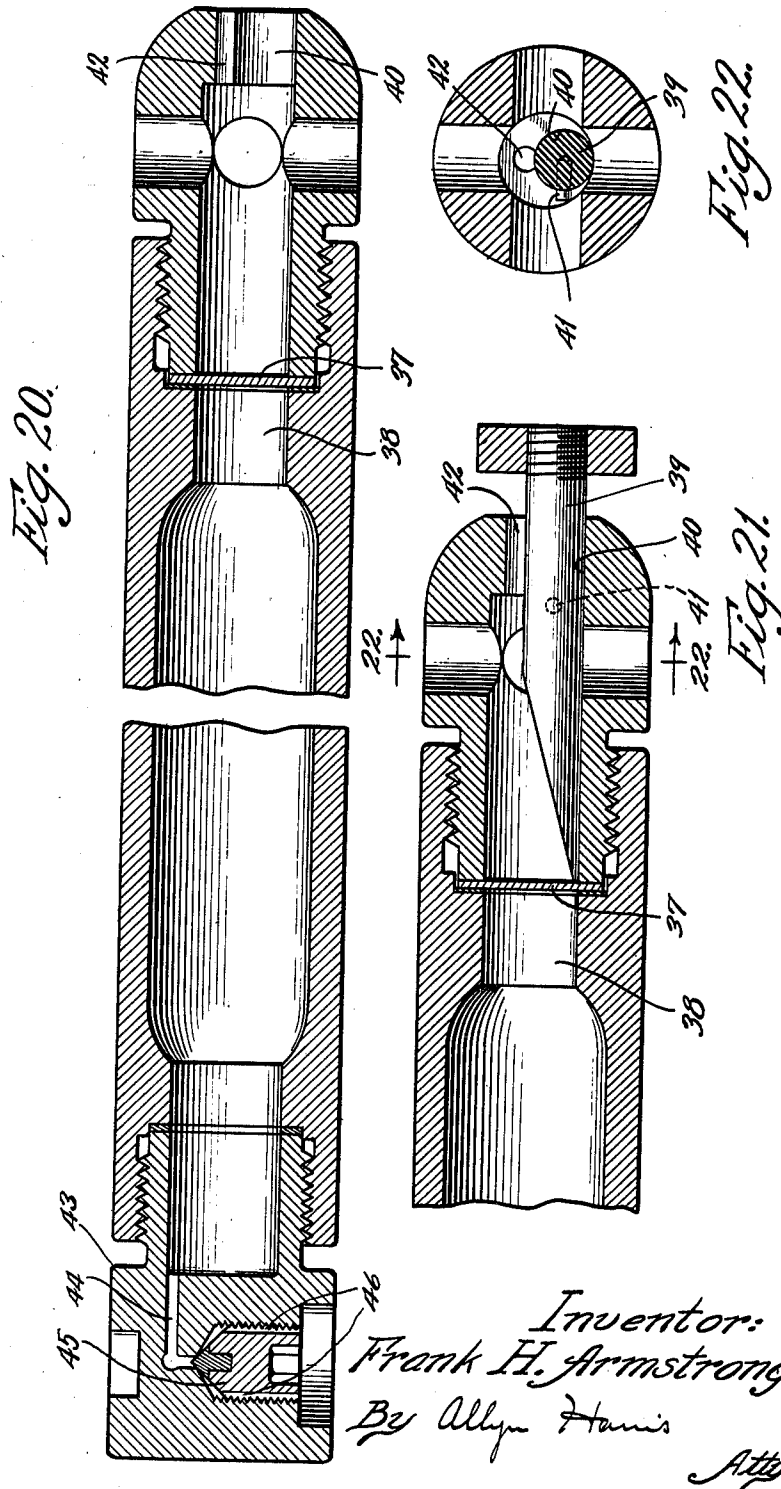
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6 Sheets-Sheet 4



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6 Sheets-Sheet 5

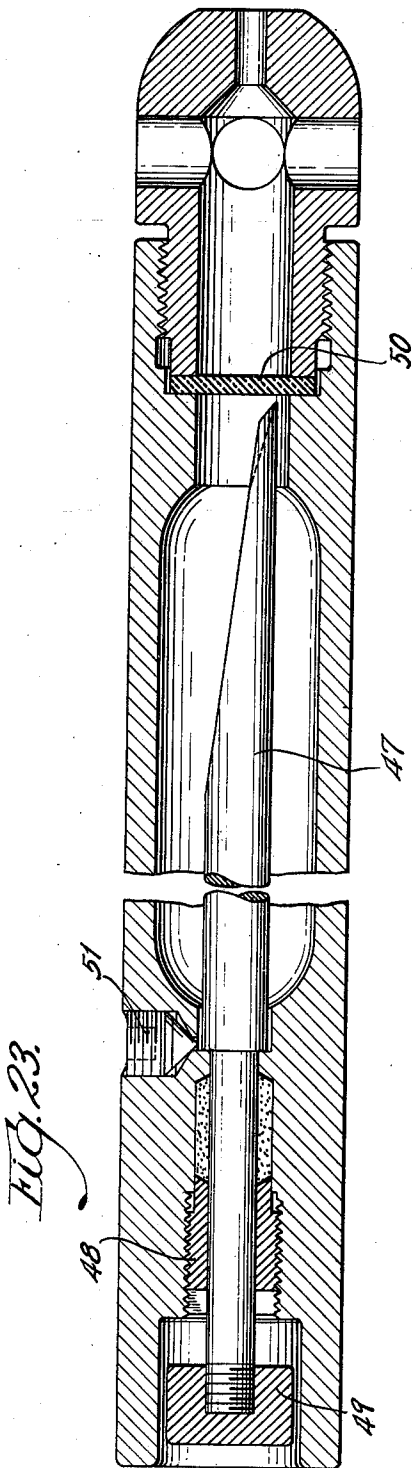
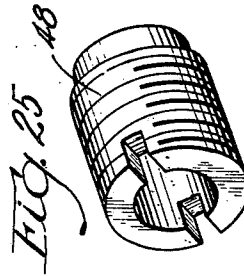
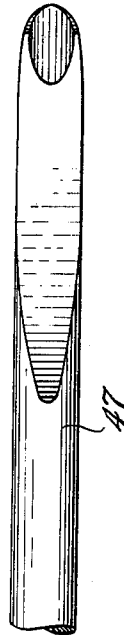


FIG. 24.



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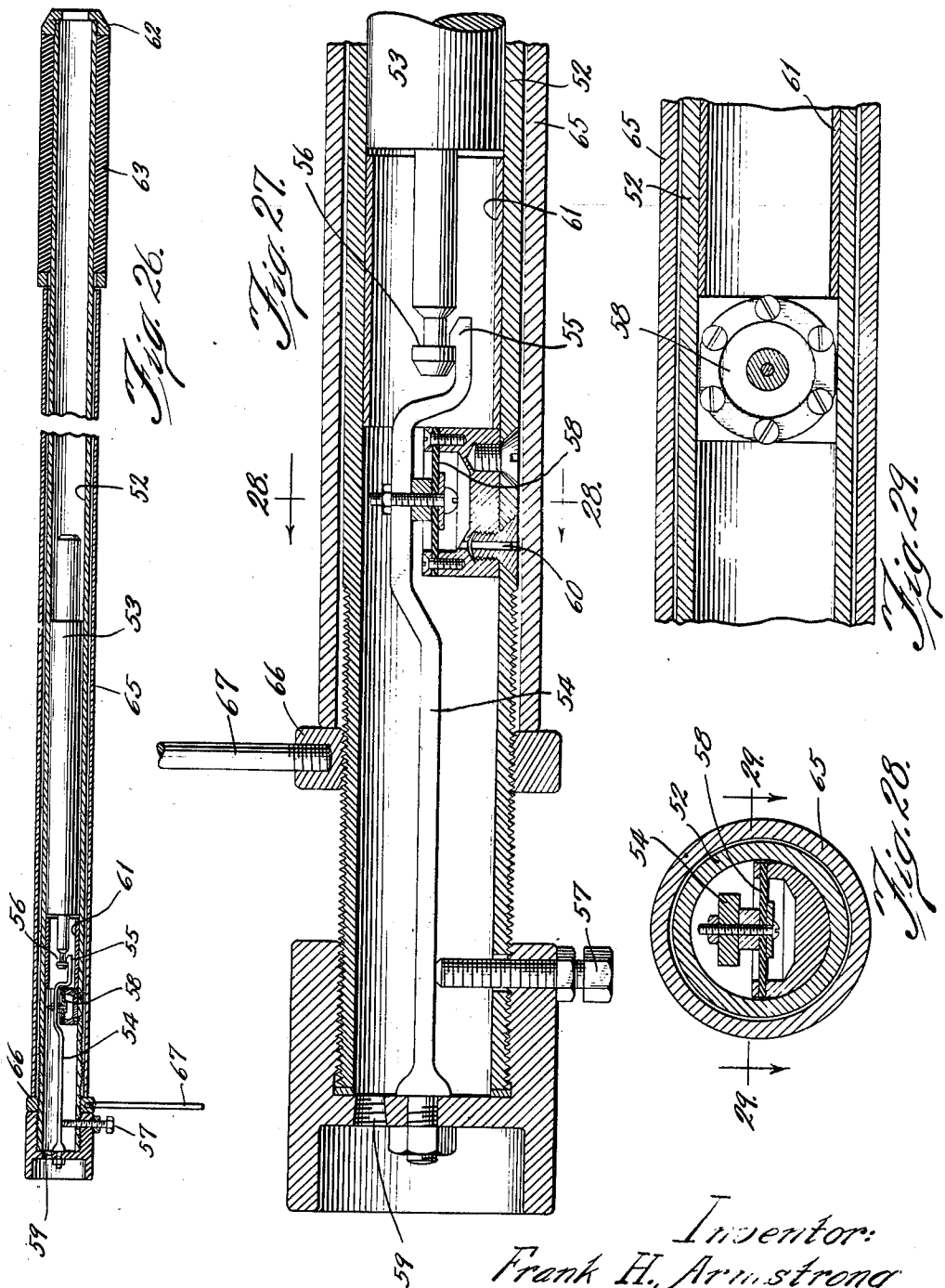
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F. H. ARMSTRONG
MATERIAL BREAKING DEVICE

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6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,083,975

MATERIAL BREAKING DEVICE

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Application December 17, 1932, Serial No. 647,785

29 Claims. (Cl. 102-6)

This invention relates to a blasting cartridge of the general type disclosed in my co-pending application filed September 16th, 1932 Serial No. 633,406, now matured into Patent No. 1,895,563, granted Jan. 31, 1923. It relates particularly, however, to improved mechanisms for releasing the work performing charge contained in such cartridges and the means for actuating and controlling such mechanisms.

The principal objection of the invention is to provide a discharge mechanism for cartridges containing charges of energy in work performing condition together with means for actuating and controlling the discharge all in a manner which will be extremely simple and absolutely safe and reliable. Another object is to provide an improved discharge mechanism of the above character having associated therewith improved hole tamping and sealing means. Yet another object is to provide an improved discharge mechanism having means controllable from a point remote from the blasting mechanism, for releasing the charge of blasting pressure. A still further object is to provide an improved discharge mechanism operated by an impact mechanism anchored within the blasting hole for delivering an impact blow to the cartridge to effect release of the blasting charge. A still further object is to provide an improved discharge mechanism having embodied therein a re-usable valve element, the latter being releasable to effect discharge of blasting pressure by means controllable from a point remote from the blasting mechanism. Yet another object is to provide an improved valve mechanism arranged within one end of the charge container and having means operable from the opposite end of the container and including valve actuating means extending through the container into operative relation with respect to the valve means, to effect release of the blasting charge. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there are shown for purposes of illustration several forms which the invention may assume in practice.

Referring to the drawings, Figure 1 is a view in side elevation illustrating the cartridge of the type under consideration positioned in a drill hole in material to be broken, together with a device also positioned in the drill hole for actuating the discharge mechanism of the cartridge.

Figure 2 is a view in longitudinal section of one illustrative form of the actuating device shown in Fig. 1.

Figures 3, 4 and 5 are detailed views in side elevation, end elevation and top plan respectively illustrating the latch mechanism of the actuating device.

Figure 6 is a sectional detail view taken along line 6-6 of Figure 5.

Figure 7 is a view in longitudinal section illustrating the discharge end of a cartridge embodying one form of discharge mechanism designed in accordance with the present invention.

Figure 8 is a view in the end elevation of the structure shown in Figure 7.

Figure 9 is a sectional view of the discharge cap of the cartridge shown in Figure 7.

Figures 10 and 11 are detail views of the anchoring fingers used in connection with the actuating device illustrated particularly in Figure 2.

Figure 12 is a view in longitudinal section illustrating a complete cartridge embodying a modified form of the discharge device.

Figures 13 to 19 inclusive are detailed views illustrating the various parts of the discharge device shown in Figure 12.

Figures 20 and 21 are views in longitudinal section illustrating a further modified form of cartridge discharge mechanism.

Figure 22 is a sectional view taken along line 22-22 of Figure 21.

Figure 23 is a view in longitudinal section illustrating a cartridge embodying another modified form of discharge device.

Figures 24 and 25 are detailed views of elements shown in connection with Figure 23.

Figure 26 is a longitudinal sectional view, similar to Fig. 2, showing another form of an improved apparatus for actuating the various discharge devices illustrated in the drawings.

Figure 27 is an enlarged view in longitudinal section illustrating the mechanism of the device shown in Figure 26.

Figures 28 and 29 are detail views of parts of the mechanism shown in Figure 27.

Referring particularly to Figure 1 it will be seen that the cartridge A is adapted to be placed in a drill hole B formed in the material C to be broken and that the discharge of the cartridge is brought about by imparting to it a sudden and forceful longitudinal movement which causes the element D extending through the discharge end of the cartridge to come in contact with the end wall of the drill hole thereby projecting it into the end of the cartridge and effecting the release of the work performing charge of energy confined within the cartridge. This action is brought about by an energizing device F which

is also partly positioned in the drill hole outwardly of the cartridge, with its inner end positioned closely adjacent the outer end of the cartridge. This device is in the form of a gun or power hammer which serves to strike a sudden and forceful blow on the adjacent end of the cartridge, and also acts as a hole tamping and sealing means for preventing ejection of the cartridge from the blast hole and loss of blasting pressure from the hole.

Referring to Figure 2 it will be seen that this gun or power hammer consists of a long steel cylinder 1 in which is positioned a plunger or hammer member 2 designed to strike the desired blow on the end of the cartridge. One end of this cylinder is threaded as indicated at 3 and is provided with a cap member 4 which serves as an abutment for one end of a coil spring 5 whose opposite end engages a shoulder formed by the plunger. This plunger as will be seen is secured to an actuating rod 6 which has at its outer end a suitable handle 7 by means of which the rod and plunger may be drawn outwardly to store up the desired energy in the spring. A suitable latch 8 is pivotally mounted on the collar carried by the end of the cylinder and is designed to engage a notch 9 formed in the operating rod. This latch device more particularly shown in Figures 3 to 6 inclusive, is adapted to be operated from a remote point by means of a flexible or other form of connection extending to the arm 10 carried by the latch.

In order to firmly retain the power hammer or gun F in the drill hole B there is provided in connection therewith an anchoring device designed to be expanded into engagement with the wall of the drill hole. This device consists of a tubular member 11 surrounding the cylinder and carrying at one end a circular cam 12 designed to engage the tapered ends of a series of anchoring elements 13 whose opposite ends are secured by a suitable retaining ring 14. A circular coiled spring 15 positioned in a groove formed in the series of fingers 13 serves to normally retain the latter in collapsed position. This tubular member 11 carrying the cam 12 may be moved longitudinally for projecting the anchoring elements 13 into the coal or other material by means of a nut 16 engaging the end thereof remote from the cam 12 element. This nut 16 may be operated by any suitable form of wrench for causing the longitudinal movement of the tubular member 11.

Thus, it will be seen that after the cartridge has been positioned in the drill hole B as shown in Figure 1, the actuating device F may then be positioned in the outer end of the drill hole B with its end closely adjacent the outer end of the cartridge A after which the nut 16, above mentioned, may be operated for expanding the anchoring elements 13 into engagement with the wall of the drill hole. In this manner the actuating device F is firmly anchored in position and the operating rod 6 carrying the plunger 2 may then be pulled outwardly in order to store up the required energy in coil spring 5. The rod 6, of course, is retained in its operative position by means of a latch mechanism 8 above described until such time as the operator wishes to effect discharge of the cartridge from a suitably remote point by means of the cable or other connection extending to the latch operating lever.

It is, of course, essential in the form of actuating means described above that the device be firmly anchored in the drill hole in order that

it may be operated to create the desired energy. It is equally and perhaps more important, however, that some means be provided in the drill hole for preventing the forceful ejection of the cartridge therefrom due to the pressure released into the drill hole at time of discharge of the cartridge. This purpose is particularly well served by the actuating mechanism being firmly anchored in the drill hole adjacent the end of the cartridge. Thus, the drill hole is effectively blocked to prevent consequent wasting of a part of the energy released in the drill hole from the cartridge and also to retain the cartridge in the drill hole until it has had full opportunity to perform the intended work.

One form of discharge device for cartridges such as shown in Figure 1 is illustrated in Figures 7 to 9 inclusive. As here shown the cartridge is provided with a discharge opening 17 adapted to be closed by a rupturable disc 18 of mild steel, fiber or any other suitable material. This disc is designed to be normally incapable of withstanding the pressure of the working charge confined within the cartridge. The disc is held in place and securely sealed against leakage by means of a discharge cap 20 screw threaded into the outer end of the cartridge. This cap is preferably provided with two lateral discharge ports 21. In order to reinforce or support the disc sufficiently to enable it to withstand the pressure of the confined charge until such time as it is desired to release the charge, there is provided a steel post member 22 having a substantial end surface area designed to engage the central portion of the disc. Adjacent the supporting end of the post there is provided a circular enlargement 23 which serves to centrally position the post with respect to the disc. The opposite end of the post is of substantially spherical form and is designed to rest upon a hardened steel seating member 24 secured in the end of the discharge cap by means of two screws 25. This seating member is tapered in one direction in order to facilitate lateral movement of the spherical end of the post into an enlarged lateral discharge port 26 thereby permitting the opposite end of the post to move out of supporting relation to the disc. When the supporting post is thus removed from engagement with the disc, the latter being substantially weaker than necessary to withstand the pressure of the confined charge within the cartridge, immediately gives way and releases the charge which then passes into the throat 27 of the discharge cap and radially outward therefrom through the three discharge ports. The supporting post may, and preferably is, designed to be moved laterally by means of a wedge D element extending through a bore 28 in the end of the discharge cap in the manner illustrated in Figure 1.

Referring now to Figures 12 to 19 inclusive, there is shown a slightly modified form of discharge arrangement wherein a re-usable valve is employed for sealing the container discharge opening. According to this form the discharge opening 29 formed in the cartridge is surrounded by a spherical sealing surface 30 designed for engagement by the spherical valve-like head of a post member 31 adapted to be positioned in a discharge cap 32 similar in form to that above described. Referring particularly to Figure 18 it will be noted that the end of the post remote from the sealing surface is adapted to be seated on a spherical surface 33 formed in the end wall of the discharge cap. In order to prevent acci-

dental or premature displacement of the post there may be provided a threaded plug 34 for insertion in the discharge port opposite the post 31 as indicated in Figure 19, for firmly retaining the post in central position until such time as it is desired to discharge the cartridge. Upon insertion of the cartridge into the drill hole the wedge member 35 is inserted in the bore 36 provided in the end of the discharge cap and the cartridge is then positioned in and pushed toward the rear end of the drill hole. Thus, when the actuating device described above strikes a blow on the opposite end of the cartridge the wedge device 35 is forced into the cartridge cap thereby displacing the post 31 laterally and permitting escape of the confined charge from within the cartridge. It will be understood, of course, that the threaded plug 34 must be removed from the discharge cap before the cartridge is placed in the drill hole.

A further modification of the discharge arrangement, as shown in Figures 20, 21 and 22, consists of a sealing disc 37 for the discharge opening 38 formed in the cartridge, such disc being of sufficient strength to withstand the pressure of the charge confined in the cartridge. Thus, the charged cartridge may be freely and safely transported without any possibility whatever of accidental release of the charge through the discharge mechanism. In order to provide for the release of the charge when it is desired there is provided in the discharge cap of the cartridge a chisel member 39 designed to puncture or at least weaken the disc 37 sufficiently to make it incapable of further withstanding the pressure of the confined charge. This chisel member extends through a bore 40 into the discharge cap and is provided with a lateral projection 41 which may be passed through a communicating bore 42 in the discharge cap and which serves to rotatively position the chisel 39 so that the point thereof is properly positioned in relation to the disc and also serves to prevent the chisel from being ejected out of the discharge cap and possibly become lost. The necessary force for driving the chisel against the disc is provided by some means of power hammer or gun, such, for example, as that described in Figures 1 to 6 inclusive. The disc in this case may be formed of any suitable material possessing the necessary strength for withstanding pressure ranging from 5,000 to 10,000 pounds per square inch.

In the several forms of cartridge thus far described there is provided some means for introducing a charge of compressed gas into the cartridge such, for example, as illustrated in Figure 20. The end of the cartridge opposite the discharge cap is also internally threaded for reception of a threaded cap member 43 which may be sealed against leakage by means of a suitable gasket. This cap member embodies a charging port 44 which may be suitably controlled by means of a conical valve 45 threaded in the body of the cap. In this type of valve the conical valve member is preferably provided with gas passages 46 extending from end to end thereof which permit the introduction of gas from a charging nozzle sealed on the surface surrounding the valve into the area controlled by the point of the conical valve member. Thus, when the valve is screwed outwardly gas is permitted to pass freely into the cartridge and when it is screwed inwardly the passage of gas from the cartridge is prevented. The charging nozzle designed to be

seated on the surface surrounding the valve may be provided with a packed wrench extending to the exterior of the nozzle for operating the valve member. This particular charging mechanism does not form an essential part of the present invention and hence, has been illustrated herein.

The principle of the modification shown in Figure 23 is the same as that of the design shown in Figures 20 and 21. The arrangement however, is somewhat different. In this form the chisel member 47 extends into the cartridge from the end opposite the discharge end of the cartridge and is designed to be actuated directly by the power hammer or gun. Thus, there is provided a chisel member 47 having a shank portion of reduced diameter extending outwardly of the cartridge through a suitable stuffing box 48 and carrying a head 49 adapted to be struck by the plunger of the actuating device. When so actuated the chisel serves to puncture or weaken the disc 50 to such an extent that it can no longer withstand the pressure of the charge confined within the cartridge. In this case a valve 51 is provided in the body of the cartridge itself instead of in a separate charging cap as in the preceding form.

Figures 26 to 29 inclusive illustrate an improved form of actuating device which, as shown, is in the nature of a compressed air gun. As in the form first described this form includes a long steel cylinder 52 in which is positioned a plunger 53 designed to serve as a hammer. A pressure responsive latch member 54 is provided to retain the plunger in initial position until the pressure thereon is built up to a predetermined point whereupon the latch is automatically disengaged from the plunger and the latter rapidly moves toward the end of the cylinder under the force of the pressure imposed thereon. This latch member consists of a long spring arm having a hooked end 55 designed to engage a shoulder 56 formed on the reduced portion of the plunger. The tension of this spring arm may be adjusted by means of a bolt 57 extending through the cylinder. The spring latch normally tends to engage and retain the plunger in position but is adapted to be actuated to release the plunger by means of a diaphragm 58 which is responsive to the pressure introduced into the cylinder. Thus, the cylinder may be connected as at 59 to a source of compressed air or other gas at suitable pressure preferably in the neighborhood of 150 to 175 pounds per square inch and compressed air may be delivered into the chamber in order to build up therein the desired pressure for actuating the plunger. If this desired pressure is predetermined at say 150 pounds per square inch the diaphragm 58 will at this point be operated to move the latch 55 out of engagement with the shoulder or the plunger, and the latter, which will at this point be under an accumulated pressure of 150 pounds per square inch, will be forceably projected toward the end of the cylinder which lies adjacent to the cartridge to be discharged. The diaphragm chamber is suitably vented as indicated at 60 in order to prevent the trapping of air. Within the cylinder there is provided a spacing sleeve 60 which serves to limit the travel of the plunger in one direction. The travel of the plunger in the opposite direction is limited by the inwardly extending shoulder of the cap member 62 threaded on one end of the cylinder.

In order to firmly anchor this actuating device in the drill hole there is provided on one end of

the cylinder an expansible rubber sleeve 63 one end of which abuts against the cap member 62 above mentioned and the other end of which is engaged by a slidable ring 64. Surrounding the remaining portion of the cylinder 52 there is provided a tubular member 65 designed to be actuated in a longitudinal direction by means of a nut 66 threaded on the exterior of the cylinder 52. This nut may be rotated by any suitable means such, for example, as a rod 67 threaded therein. By sufficient movement of the tubular sleeve 65 in a longitudinal direction by means of the nut, the rubber sleeve 63 may be expanded, within limits, to any suitable diameter and thus cause it to forcefully engage the rough and irregular surface of the drill hole wall. This provides an exceptionally good seal against the escape of energy released by the cartridge and at the same time serves effectively to prevent ejection of the cartridge from the drill hole.

It should be clearly understood that cartridges of the types herein described are adapted to receive charges of energy in work performing condition and at work performing pressures which need only to be released in order to perform the desired work. For example, a cartridge to be used for mining coal may be charged with compressed air at the particular pressure best suited to the particular coal to be broken down, say from 5,000 to 10,000 pounds per square inch, and then transported to the point of use where it may be inserted in an ordinary drill hole, following which the energy may be conveniently and safely released at any time.

The invention resides primarily in the principles forming the basis for the various structures described, as it must be recognized that the structures themselves may be widely varied within the limits of these principles. Hence, the invention is not to be construed as being limited by the structures described, but as being merely illustrated thereby.

What I claim is:

1. A material breaking device comprising an indestructible container, an energy storing charge at working pressure in said container, means responsive to axial bodily movement of said container for effecting release of said charge, and power developing means distinct from said container but operable thereupon for effecting axial bodily movement of said container to effect charge release.

2. A material breaking apparatus adapted to be positioned in a drill hole formed in the material to be broken, said apparatus comprising an indestructible container, an energy storing charge at working pressure therein, means associated with said container for effecting release of said charge when axial movement is imparted to said container, having an actuating element engageable with the end wall of the drill hole, and means distinct from said container but operable thereupon for effecting axial bodily movement of the container to cause said element to engage said end wall.

3. A material breaking device comprising a container adapted to receive and hold an energy storing charge at working pressure in said container, said container having a discharge opening, a substantially indestructible member adapted to seal said opening and means effective at will while the charge pressure remains constant for bodily displacing said member in order to effect charge release.

4. A material breaking device comprising an

indestructible container having a discharge opening, a charge of compressed gas at a substantially predetermined working pressure in said container, means for sealing said opening, said means normally being of insufficient strength to withstand said pressure, means for supporting the aforesaid means to enable it to withstand said pressure, and means associated with said container and relative to which said container is moveable in an axial direction with respect thereto for displacing said supporting means.

5. A material breaking device comprising a container having a discharge opening, said container adapted to receive and hold a charge of compressed gas at a substantially predetermined pressure, means for sealing said opening, said means normally being of insufficient strength to withstand said pressure, means for supporting the aforesaid means to enable it to withstand said pressure, and means associated with said container and relative to which said container is moveable in an axial direction with respect thereto for displacing said supporting means.

6. A material breaking device comprising a container having a discharge opening, said container adapted to receive and hold an energy storing charge at a substantially predetermined pressure, a rupturable disk for sealing said opening normally having sufficient strength to withstand such pressure, and means operable at will for structurally weakening said disk to such extent that it will rupture and release said charge.

7. The combination with a material breaking device containing an energy storing charge at working pressure adapted to be positioned in a drill hole in the material to be broken and to be discharged by longitudinal movement within said drill hole, of a power actuated device also adapted to be positioned in said drill hole adjacent to said material breaking device for imparting longitudinal movement to the latter.

8. In a device of the character described, the combination with a cylinder, of a plunger therein, a latch for normally positioning said plunger, and means responsive to the pressure within said cylinder for releasing said latch and permitting said plunger to move under the force of said pressure, said latch automatically repositioning said plunger when the latter returns to aforesaid normal position.

9. A material breaking device comprising a container adapted to receive and hold an energy storing charge at working pressure, a rupturable element confining said charge, a single rigid strut supporting said element to prevent rupture thereof and means for displacing said strut at will.

10. A material breaking device comprising a container adapted to receive and hold an energy storing charge at working pressure, a rupturable element confining said charge, a rigid post supporting said element to prevent rupture thereof, and means for displacing said post at will consisting of a cam element movable with respect to said post.

11. In a material breaking device comprising a container adapted to receive and hold an energy storing charge at working pressure, a rupturable element confining said charge, a rigid post supporting said element to prevent rupture thereof, and means for displacing said post at will consisting of a cam element movable axially with respect to said device and engageable with said post for displacing the latter.

12. A material breaking device comprising a

container adapted to receive and hold an energy storing charge at working pressure, a rupturable element confining said charge, and an axially movable chisel accessible to the exterior of said device for puncturing said element.

13. A material breaking device comprising a container adapted to receive and hold an energy storing charge at working pressure, a substantially indestructible valve member for confining said charge, and means for bodily displacing said valve member at will to liberate said charge and of such strength as to resist any normal working pressure in said container.

14. A device substantially as set forth in claim 13 wherein said valve member consists of a post having a valve head engageable with a suitable valve seat formed in said device.

15. A material breaking device comprising a container adapted to receive and hold an energy storing charge at working pressure, said container having a discharge opening, a substantially indestructible member having a closure portion adapted to seal said opening and of such strength as to resist any normal working pressure within said container, and means for bodily displacing said member at will to effect release of said working pressure charge.

16. A material breaking device comprising a container having a discharge opening, said container adapted to receive and hold a charge of compressed gas at a substantially predetermined pressure, means for sealing said opening, said means normally being of insufficient strength to withstand said pressure, means for supporting the aforesaid means to enable it to withstand said pressure, and means operable upon relative movement in an axial direction between the same and said container and engageable with the extraneous abutment, whereby movement of said container relative to said abutment may effect such relative axial movement, for effecting displacement of said supporting means.

17. In a material breaking mechanism, a blasting charge containing means containing a blasting charge at working pressure, and power storing and delivering means associated therewith for striking a sudden impact blow to said containing means for effecting sudden release of the blasting charge therein.

18. In a material breaking mechanism, a blasting charge containing means confining a gaseous charge at blasting pressure and receivable in a blast hole drilled in the material to be blasted, charge releasing means for said containing means operable to release the charge by bodily axial movement of the containing means, and means distinct from the containing means and controllable at a point remote from the working face for effecting sudden, bodily axial motion of said containing means within the blast hole for operating said releasing means to effect sudden discharge of the blasting charge at its previously subsisting pressure.

19. In a blasting mechanism, a blasting cartridge receivable within a blast hole drilled in the working face and containing a gaseous charge at working pressure, and power operated impact mechanism distinct from said cartridge anchored within the blast hole and controllable from a point remote from the working face for delivering a sudden impact blow to the cartridge thereby to effect sudden release of the blasting charge at such working pressure.

20. In a blasting mechanism, a blasting cartridge containing a charge at working pressure,

and an impact mechanism distinct from said cartridge and controllable from a point remote therefrom for delivering a sudden impact blow to said cartridge thereby to effect sudden release of the blasting charge at such working pressure.

21. In a blasting mechanism, a blasting cartridge receivable in a blast hole drilled in the working face, an element engageable with the inner end of the blast hole, and means embodied in said cartridge and operable by bodily inward movement of the cartridge with respect to said element and with which said element cooperates for effecting sudden release of the blasting charge at its preexisting pressure.

22. In a blasting mechanism, a blasting cartridge receivable in a blast hole drilled in the working face, an element engageable with the inner end of the blast hole, means embodied in said cartridge and operable by bodily inward movement of the cartridge with respect to said element and with which said element cooperates for effecting sudden release of the blasting charge at its preexisting pressure, and mechanism for imparting a sudden longitudinal bodily movement to said cartridge to effect relative movement between said cartridge and said element to effect such blasting charge release.

23. In a blasting mechanism, a blasting charge container, mechanism associated with said container for effecting sudden bodily axial movement of the container in the blast hole, and means actuated by such bodily axial movement for effecting sudden release of the blasting charge at its preexisting pressure.

24. In a blasting mechanism, a blasting charge container, mechanism associated with said container and controllable from a point remote from the working face for effecting sudden bodily axial movement of the container in the blast hole, and means actuated by such bodily axial movement for effecting sudden release of the blasting charge at its previously subsisting pressure.

25. A material breaking device comprising a container adapted to receive and hold an energy storing charge at working pressure, a rupturable element normally confining said charge at said working pressure, and a cutting tool movable relative to the container for puncturing said element to structurally weaken it to such an extent that the pressure of the charge will effect rupturing of the element to release the charge.

26. A material breaking device comprising a container having a discharge opening, said container adapted to receive and hold an energy storing charge at a working pressure, a rupturable element for sealing said opening and normally strong enough to withstand said pressure, and a cutting device for piercing said element to structurally weaken it to such an extent that the element will rupture to suddenly, completely release said charge.

27. In combination, a cylinder adapted to be positioned in a drill hole and having a connection at one end by means of which the cylinder may be charged with a compressed fluid, a member adapted to be moved axially of the cylinder by the charge of compressed fluid, means in the cylinder for holding said member against axial movement, and means operated by the pressure of the charge when the latter reaches a predetermined value for rendering said holding means inoperative to further hold said member.

28. In combination, a cylinder adapted to be positioned in a drill hole and to receive a charge

of compressed fluid, a member positioned in said cylinder and adapted to be moved axially thereof by said fluid charge, latch mechanism in the cylinder for holding said member against movement by said charge, and means under remote control for tripping said latch mechanism to release said member.

29. In combination, a cylinder adapted to be positioned in a drill hole and having a connection at one end by means of which the cylinder

may be charged with a compressed fluid, a member adapted to be moved axially of the cylinder by the charge of compressed fluid, latch mechanism for holding said member against movement by said charge, and a diaphragm in said cylinder and operated by the pressure of the charge for tripping said latch mechanism to release said member.

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