

Sept. 24, 1963

J. D. JACOBS

3,104,584

HOLE PACKING DEVICE

Filed March 14, 1961

4 Sheets-Sheet 1

Fig. 1.

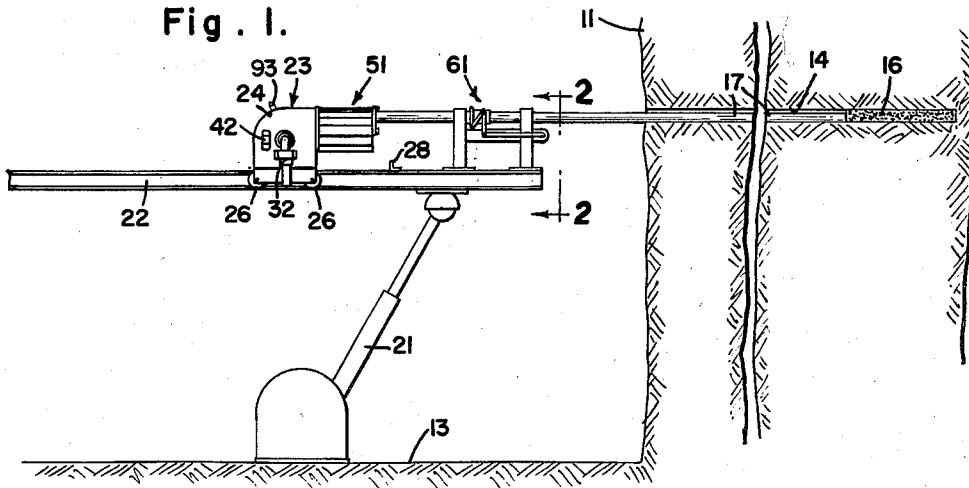
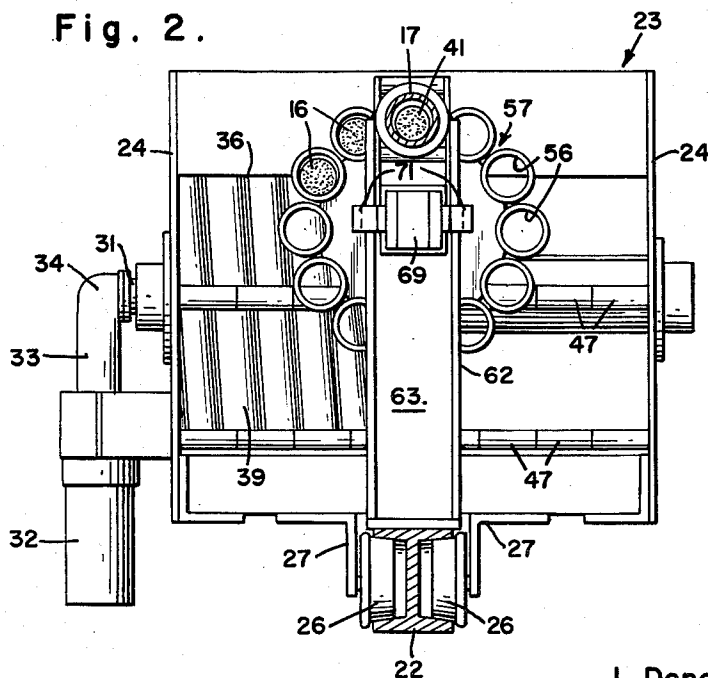


Fig. 2.



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Fig. 3.

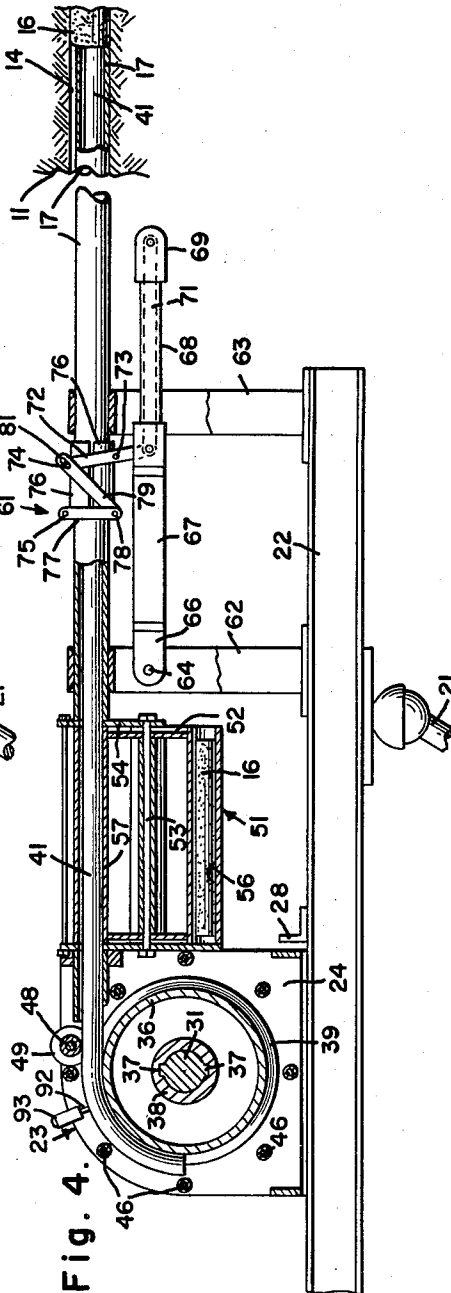
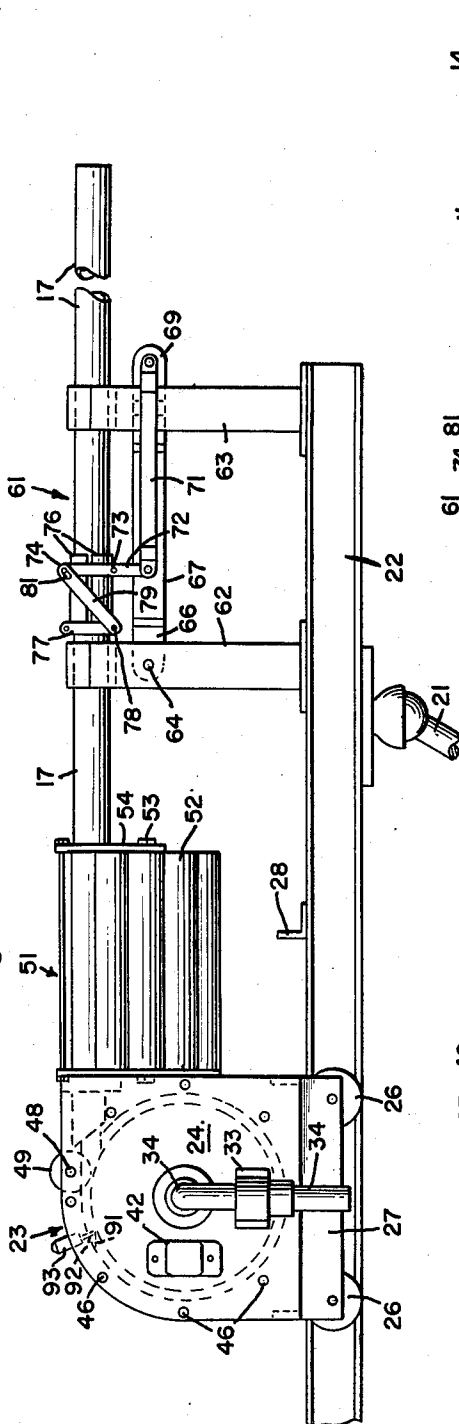


Fig. 4.

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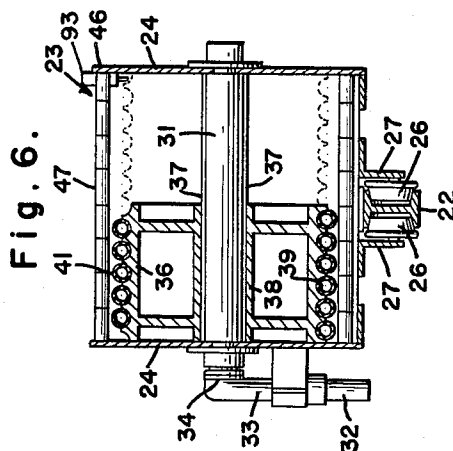
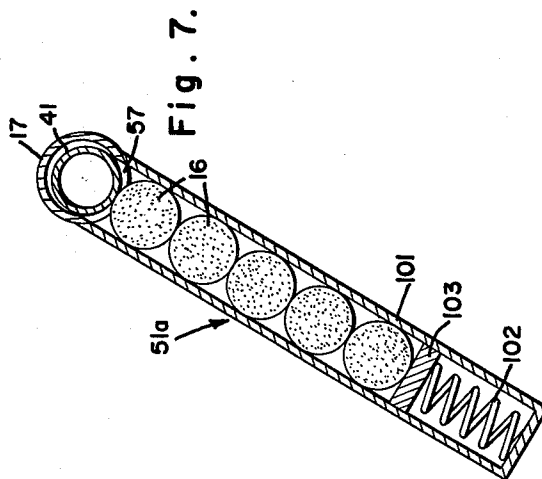
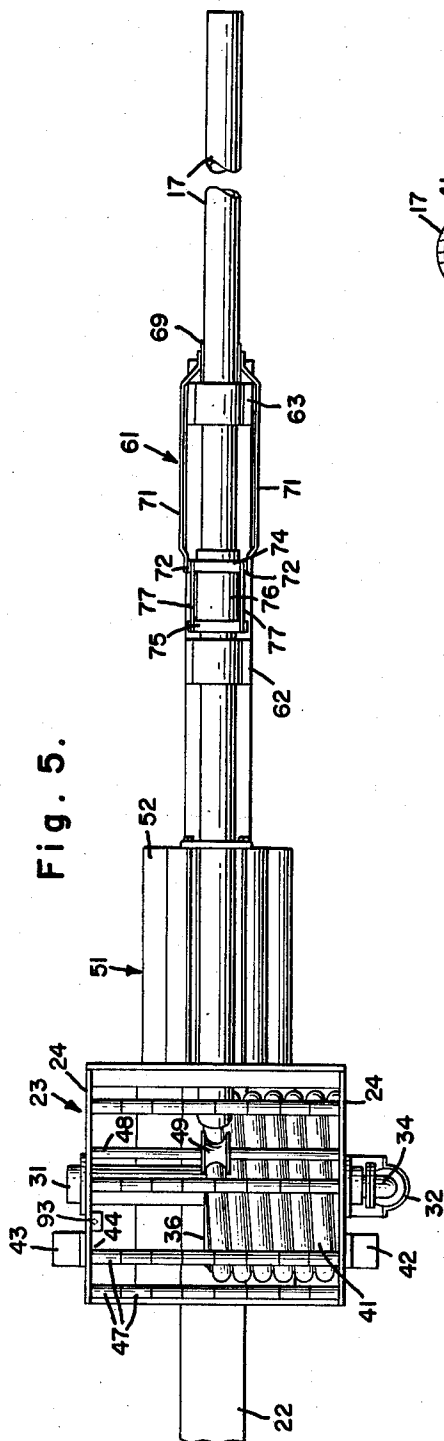
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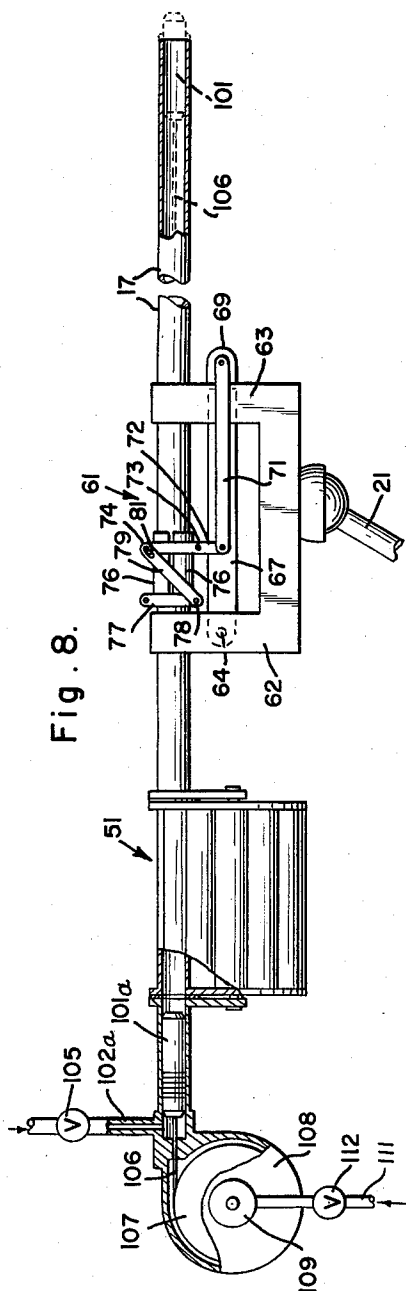
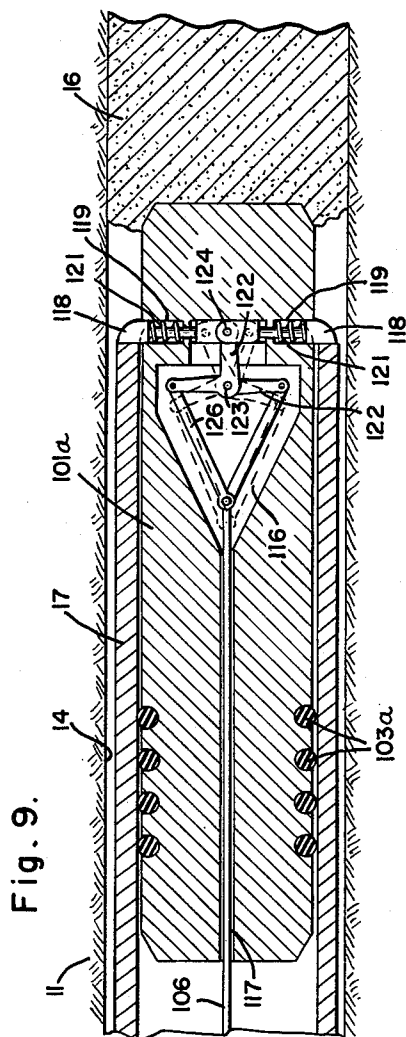


Fig. 8.



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3,104,584

HOLE PACKING DEVICE

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9 Claims. (Cl. 86-20)

This invention relates to a new and improved hole packing device, and more particularly relates to an apparatus for loading and tamping plastic material such as explosives into confined spaces. A preferred embodiment of this invention is used to load and tamp explosives, such as dynamite, into holes which have been drilled in rock and finds particular application in tunnel construction, mining, open cut rock excavation, and the like.

Heretofore, insertion and tamping of sticks of dynamite and other explosives into drilled holes at the tunnel heading has customarily been performed by laborious manual procedure. The operation consists of inserting individual sticks of explosives into the hole opening and thereafter the workman uses a long wooden pole known as a tamping stick to pack the explosives within the hole.

In most underground excavation work this is an especially time consuming and costly operation since certain other work must cease and await the completion of the loading.

In tunnel excavation it is customary to use two men to load each hole. One man, such as the assistant to the driller, feeds sticks of powder into the hole at the face of the tunnel while the other workman, usually the driller, wields the long, ungainly tamping stick. On the other hand, drilling methods and apparatus have been improved so that fewer men are required for other operations carried on at the heading. The savings in labor and other savings resulting from improving drilling operations are reduced because of the hand operation required for loading explosives. It is, therefore, a principal object of the present invention to reduce the labor and time required to load and tamp the charge, thereby also facilitating the use of other labor saving devices and apparatus.

Still another object of the invention is to make more uniform the force with which the charge is tamped into the hole as compared with manual operation, which is subject to human factors.

Accordingly, the present invention provides an apparatus which is installed at the working head and which loads sticks of dynamite or the like into a tube installed in the drilled hole and which further comprises a flexible member which pushes the charge down the tube to the end of the hole and out of the tube and then rams the charge into the hole by pneumatic pressure. Means is provided for automatically feeding and retracting the flexible member which pushes the charge down the tube. Means is also provided for gripping and forcing inwardly the tube to ram the charge into the hole. It will thus be seen that apparatus is provided which automatically performs operations heretofore conducted by at least two men but requires the attendance of only one operator, it being understood that one operator can tend several machines.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. 1 is a schematic side elevation view partly broken away in section, showing the device installed at the working head.

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FIG. 2 is an enlarged transverse vertical sectional view taken substantially along the line 2—2 of FIG. 1.

FIG. 3 is a side elevational view showing the flexible tamping element retracted.

FIG. 4 is a view similar to FIG. 3, partly broken away in section and showing the flexible tamping element projected.

FIG. 5 is a top plan.

FIG. 6 is a transverse view through the reel for the extensible member, being partly broken away in section.

FIG. 7 is a vertical sectional view of the magazine of a modification.

FIG. 8 is a side elevation, partly broken away in section of another modification.

FIG. 9 is an enlarged fragmentary section of a portion of the modification of FIG. 8.

As shown in the accompanying drawings, particularly FIG. 1, the present invention is used at the heading 11 of a tunnel. Shown in the drawings is the working face 11 and floor 13. By a previous operation forming no part of the present invention, at least one hole 14 has been drilled in the working face, said hole being of extended length and intended to receive a plurality of charges of plastic material 16 such as dynamite or other explosives. Installed in the hole 14 is an elongated barrel 17 having a length to project entirely into the hole with an extended length outside the hole. Preferably the barrel 17 is formed of a light-weight material of a type which is not likely to cause sparks or otherwise create a hazard. Thus, the barrel may be formed of a plastic (e.g. polyvinyl), aluminum or other suitable material. The diameter of the barrel 17 is slightly less than that of the drill hole 14 and the inside diameter is slightly greater than that of the charge 16 or stick to be inserted.

Supported above the floor 13 of the tunnel, or a jumbo (not shown) used conventionally in drilling operations, by means of an extensible and adjustable leg 21, is a horizontally disposed track 22, here shown in the form of an I-beam. It will be understood the shape of the track is subject to wide modification as is the means whereby the same is supported, it being preferable that wide adjustability be afforded so that explosives may be inserted in drill holes in various locations including those which are difficult to service by manual operation. Supported by track 22 is a horizontally slidable carriage 23, here shown formed with side members 24 vertically disposed parallel to the direction of movement of the carriage and a pair of rollers 26 rotatably mounted on angles 27 on each side. Rollers 26 engage inside the flanges of the beam 22 so that the carriage is adequately supported for longitudinal movement along the beam. Stop 28 on the track limits forward movement of carriage 23. The outer end of the barrel 17 is connected to the carriage 23 so that the carriage and barrel move longitudinally together, and preferably a quick disconnect means (not shown) is provided to facilitate installation of the barrel. Transverse horizontal shaft 31 is rotatably mounted in the carriage between sides 24 and is rotated by means of a conventional compressed air motor 32, preferably of the well-known air turbine type, with a suitable gear reduction 33 and right-angle drive 34, all as is conventional in the pneumatic motor art. Mounted on shaft 31 within casing 23 is reel 36 which has a length approximately one-half the distance between the sides 24, and is free to move from side to side in an axial direction relative to shaft 31, but shaft 31 and reel 36 are so interconnected as to cause rotation of the reel when motor 32 is actuated. For such purpose, keys 37 may be formed on shaft 31 and suitable keyways in the hub 38 of reel 36, or other conventional

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means may be used for the same purpose. The exterior of reel 36 is formed with a helical groove 39 and carries a flexible extensible member 41 formed around the groove 39, said member 41 being preferably of a plastic resembling a plastic garden hose and dimensioned to slide freely inside barrel 71. Pneumatic valves 42, 43 are installed on either side 24 of the casing and have actuating levers 44 which are engaged by the reel 36 as it reaches one side or the other of the casing and are connected through a pneumatic system to reverse the direction of motor 32. Reel 36 is so located that the flexible member 41 feeds off the top of the reel 36 out of its groove 39 and directly into the barrel 17 and the reel moves from side to side so that the flexible member feeds directly into the barrel. Suitable means is provided to prevent the flexible member from being forced out of the groove and for such purpose a squirrel cage pattern of rods 46 carrying roller sections 47 may be disposed between sides 24 around the periphery of the reel 36. At the top of the casing is a transverse shaft 48 carrying a grooved roller 49 spaced above the reel 36 the diameter of the flexible member 41 and insuring proper feeding of the flexible member into the barrel 17. To prevent reversal of reel 36 when back pressure is applied to flexible member 41, a notch 91 is formed in the reel and engaged by pawl 92 reciprocable in air pressure cylinder 93 on carriage 23.

Immediately ahead of the carriage 23 is the magazine section 51. In the form of the magazine shown in FIGS. 1 to 6, inclusive, there is a multi-chamber cylinder 52 which revolves around a longitudinally extending horizontal shaft 53 fixed at one end to casing 23 and at its outer end to a support hung from barrel guide 54. Preferably, the number of chambers 56 in the revolving cylinder 52 is equal to the maximum number of charges 16 to be inserted in a drill hole, but this number is subject to wide modification. The barrel 17 is cut away at the magazine as indicated by reference numeral 57 so that the chambers communicate with the barrel 17 as each charge is moved into position. The cylinder 52 may be indexed manually, or various automatic means (not shown) may be used to bring each horizontal, longitudinal chamber 56 into registry with the barrel opening 57. Each chamber 56 is shaped to receive a single charge of a plastic material 16, such as a stick of dynamite.

Spaced forwardly of the magazine 51 is the barrel gripping and ramming station 61 which is supported above track 22 by rear and forward posts 62, 63, through which barrel 17 slides. Rear post 62 is attached by means of pin 64 to clevis 66 of double-acting pneumatic cylinder 67. The rod 68 of cylinder 67 at its forward end is provided with a fitting 69 to which, on either side, are pinned links 71. The rearward end of each link 71 is connected to lever 72 and the levers 72 are interconnected by horizontal pin 73 to the opposite lever. On the upper end of each lever 72 is another transverse pin 74. Between the two pins 73, 74 are semi-cylindrical split gripping shoes 76 having radii slightly greater than the radius of barrel 17. The linkage therefore described is such that when the cylinder 67 is energized, as the rod 68 is projected the levers 72 are moved from the vertical position shown in FIG. 3 (which is the relaxed position of the gripper) to the non-vertical position shown in FIG. 4. The pins 73, 74 bear against the top and bottom shoes 76 and bring them together to grip the barrel 17. On the return or retraction stroke of the rod 68 the movement is reversed. To prevent the levers 72 from moving beyond a vertical position on the return stroke of the rod, the shoes 76 are provided with vertical side members 77 pinned together at the top by pins 75 and at the bottom by means of pins 78 to diagonally dispose links 79 on either side which are formed with slots 81 at the upper end to receive top pin 74. It will thus be seen that levers 72 cannot swing in a clockwise

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direction beyond the position of FIG. 3, although they can swing in a counter-clockwise direction (FIG. 4) on the outer stroke of rod 68 to grip the barrel.

In operation, before installing the barrel 17, the first stick of dynamite containing the detonator and long blasting wires (not shown) is inserted in the front end of the barrel. The wires extend out the front end of the barrel and back over the outside of the barrel. Then with beam 22 installed in place the barrel 17 is inserted in the hole 14 to adjacent the end thereof and connected to the carriage 23, the magazine 51 is filled with sticks 16 of dynamite, or the like, the number in the cylinder being selected depending upon the total charge desired. At the commencement of operation the reel 36 is in retracted position—i.e., the flexible member 41 is totally wound on the reel. Motor 32 is started in projecting direction and this causes the flexible member 41 to unwind from the reel 36 and move the charge down through the barrel 17 to the end thereof. Upon reaching the end, the charge 16 is pushed out of the end of the barrel and this causes the barrel to move backwardly—i.e., to move slightly out of the hole. When this movement occurs motor 32 is manually stopped and cylinder 67 is manually energized. Projection of rod 68 twists the levers 72 out of vertical position, causing the shoes 76 to grip the barrel. Further projection of rod 68 moves the barrel 17 inward and rams the charge between the end of the barrel and the end of the hole, the presence of the flexible member 41 at the end of the barrel preventing the charge from backing up inside the barrel. A pawl 92 locks reel 36 to prevent member 41 from being shoved backward sufficiently hard to reverse motor 32. As soon as this operation is completed, the cylinder 67 is manually reversed causing the barrel 17 to retract and then causing the shoes 76 to relax their grip on the barrel. Meanwhile, the flexible member 41 is being rewound on reel 36. When it reaches the end of the rewinding movement the magazine 51 is indexed and the next charge moved into the barrel. The operation is then repeated until the required number of charges have been inserted and rammed.

An alternate magazine 51a is shown in FIG. 7. A clip 101, rectangular in cross-section and dimensioned to receive a plurality of charges 16 in side-by-side relation is connected to barrel 17 with the open upper end of clip 101 in registry with opening 57. Spring 102 in the bottom of clip 101 biases pusher member 103 upward against the downmost charge 16. This forces the top charge into barrel 17. After this charge has been rammed home and flexible member 41 retracted, the next charge is fed into barrel 17. In other respects, the packing device is similar to that shown in FIGS. 1 to 6.

In the modification of FIGS. 8-9 certain elements of the device are substantially the same as those of the preceding modifications and such elements are marked with the same reference numerals and not herein further described in detail.

A plug 101a is slidable inside barrel 17 and is forced toward the outer end by compressed air which may be introduced into barrel 17 through port 102a under the control of valve 105. Thus the plug 101a is initially in the solid line position shown in FIG. 8 and is driven outwardly forcing one stick from magazine 51 to the end of barrel 17. Sealing rings 103a in grooves on the exterior of plug 101a reduce escape of air.

Retraction of plug 101a is accomplished by wire 106 connected thereto as hereinafter appears. The inner end of wire 106 is wound around drum 107 rotatable in casing 108. Drum 107 is actuated to retract wire 106. For such purpose compressed air motor 109 may be used, driven through air inlet pipe 111 and controlled by valve 112. Alternatively wire 106 may be retracted by a spiral spring (not shown), as well understood in the retractable wire and cable art.

Provision is also made for latching plug 101 at the

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outer end of barrel 17, particularly during the ramming operation. Thus a cavity 116 is formed in plug 101a communicating with axial bore 117 through which wire 106 extends. A pair of radially extending latch members 118 project out through diametrically opposed radial slots 119 likewise communicating with cavity 116. In projected position, latch members 118 project outside plug 101a and, as shown in FIG. 9, prevent plug 101a from being drawn inside barrel 17 during ramming. Springs 121 bias latch members 118 outwardly. Retraction of the latch members may be accomplished in several ways. As here illustrated, bell cranks 122 are mounted in cavity 116 by transverse pivot pin 123. Each crank 122 is connected to the inner end of one of the latch members, preferably by a slot and pin connection 124. The opposite arms of cranks 122 are connected to converging links 126 which are attached to the end of wire 106. Hence when wire 106 is pulled by turning drum 107 (or other means), latch members 118 are retracted and thereupon plug 101a may be returned from dotted line position in FIG. 8 to solid line position.

Although the foregoing invention has been described in some detail, by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be practiced within the spirit of the invention and scope of the appended claims.

What is claimed is:

1. A hole packing device comprising a track, means supporting said track edjacent a hole to be packed, a carriage movable along said track, a reel rotatably mounted in said carriage, power means for said reel, a sleeve mounted for movement with said carriage and dimensioned to fit inside said hole, said sleeve being formed with an opening ahead of said carriage, a flexible pushing element dimensioned to fit inside said sleeve and wound about said reel for projection into and withdrawal from said sleeve, a magazine adjacent said sleeve having a discharge port in registry with said opening for inserting charges into said opening ahead of the withdrawn position of said element, gripping means for gripping said sleeve, and pressure responsive means for moving said gripping means longitudinally of said track to ram said sleeve and carriage.

2. A device according to claim 1 in which said magazine comprises a multi-chambered cylinder and means rotatively mounting said cylinder to bring each chamber into position in registry with said opening, each said chamber being shaped to receive a charge.

3. A device according to claim 1, in which said magazine comprises a box shaped to receive a plurality of charges side by side and opening into said opening in said sleeve and resilient means for biasing charges from said box into said sleeve.

4. A device according to claim 1, in which said pres-

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sure responsive means comprises a fluid-actuated cylinder mounted on said track, and said gripping means comprises a clamp articulately connected to said cylinder to grip said sleeve, said cylinder being arranged to force said clamp for movement longitudinally of said track to ram said sleeve down said hole.

5. A device according to claim 1, which further comprises means cooperating with said reel to lock said reel against winding of said element, whereby tamping movement of said sleeve and of said element is performed simultaneously.

6. A hole packing device comprising a sleeve dimensioned to fit inside a hole to be packed with a plurality of charges, an elongated continuously flexible charge pushing element dimensioned to fit inside said sleeve, a reel positioned adjacent an end of said sleeve for winding and unwinding said pushing element for movement of said element within said sleeve between a withdrawn position and a projected position, support means for mounting said sleeve and reel for movement together longitudinally of the axis of said sleeve, power means for said reel, said sleeve being formed with an opening dimensioned to accept a charge, said opening located ahead of the withdrawn position of said pushing element, a magazine for a plurality of charges mounted adjacent said sleeve having a discharge port in registry with said opening and means fixed relative to said support means for moving said sleeve and said reel on said support means longitudinally of said sleeve to ram charges delivered ahead of said element.

7. A device according to claim 6, in which said last named means comprises gripping means for gripping said sleeve and pressure-actuated means for moving said gripping means longitudinally of said hole.

8. A device according to claim 6, in which said magazine comprises a multi-chambered cylinder and means rotatively mounting said cylinder to bring each chamber into position in registry with said opening, each said chamber being shaped to receive a charge.

9. A device according to claim 6, in which said magazine comprises a box shaped to receive a plurality of charges side by side and opening into said opening in said sleeve and resilient means for biasing charges from said box into said sleeve.

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