June 2, 1931. S. G. FRANTZ 1,808,162

MINING CARTRIDGE

Filed Aug. 31, 1927 4 Sheets-Sheet 1

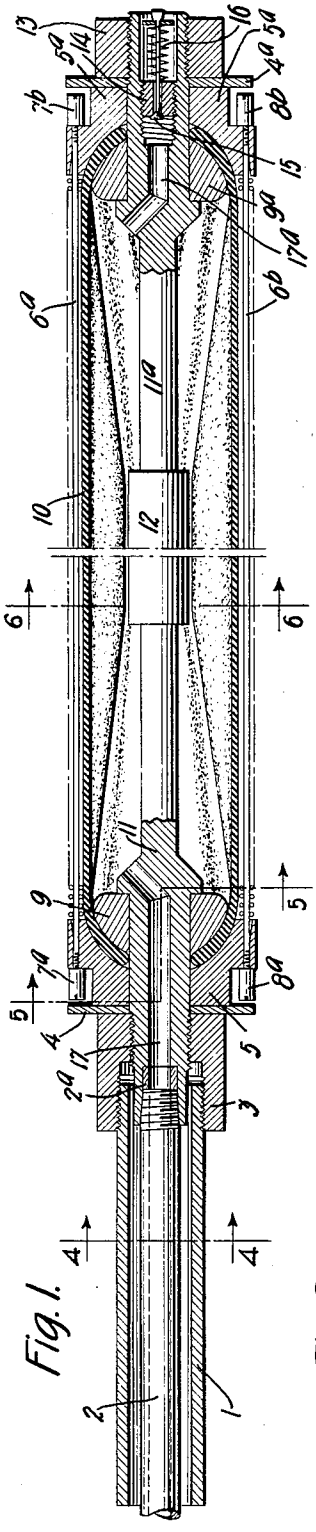

Fig. 1.

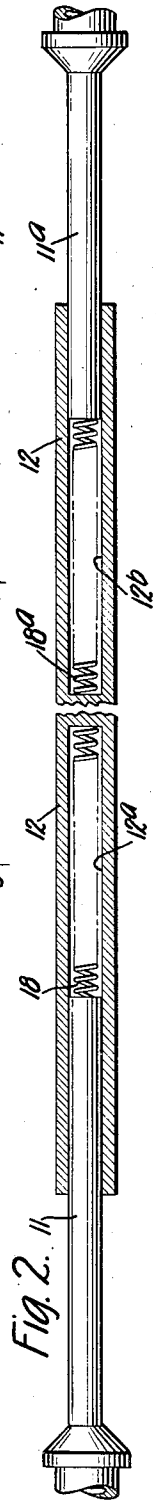

Fig. 2.

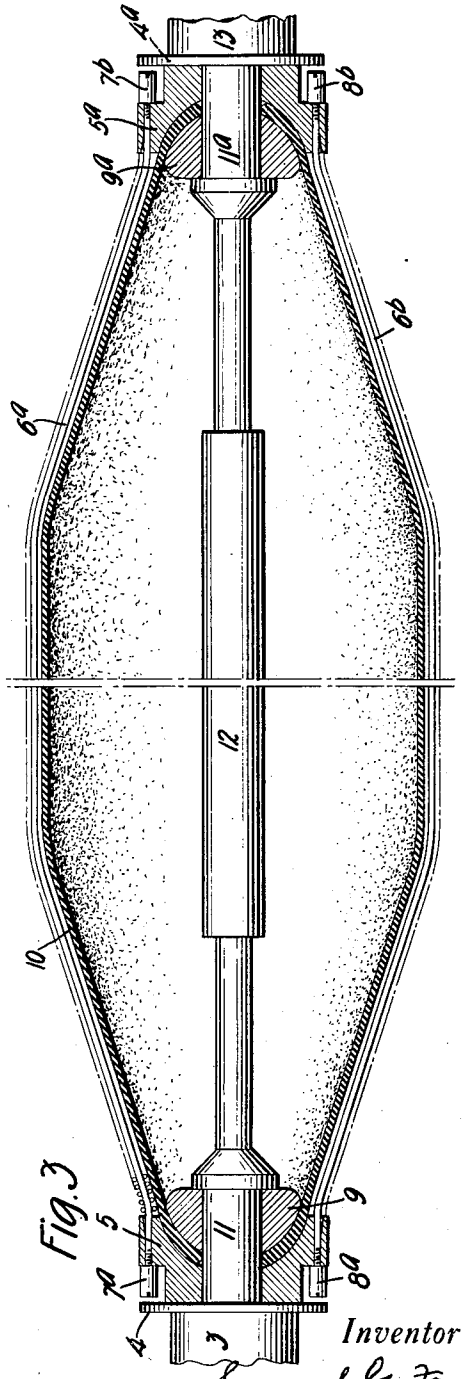

Fig. 3.

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June 2, 1931. S. G. FRANTZ 1,808,162

MINING CARTRIDGE

Filed Aug. 31, 1927 4 Sheets-Sheet 2

Fig. 4.

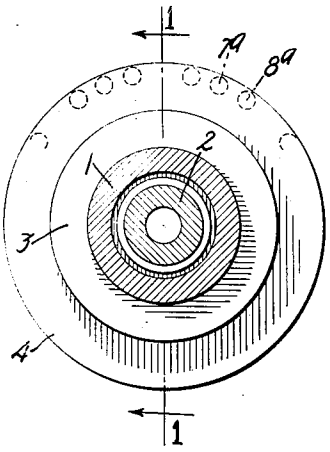


Fig. 5.

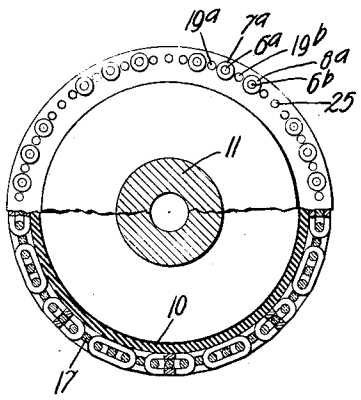


Fig. 6.

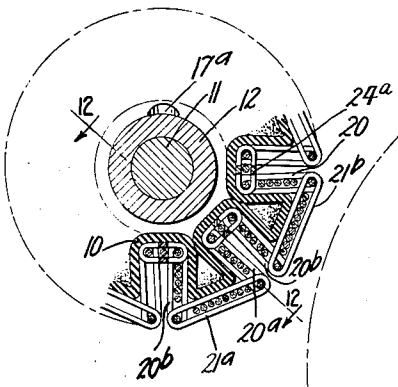
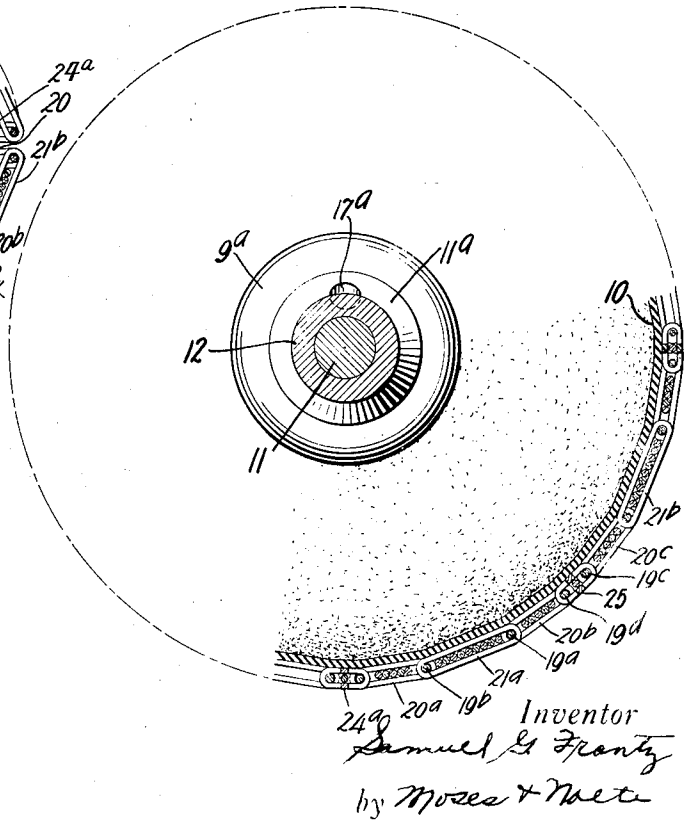


Fig. 7.



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June 2, 1931. S. G. FRANTZ 1,808,162

MINING CARTRIDGE

Filed Aug. 31, 1927 4 Sheets-Sheet 3

Fig. 8.

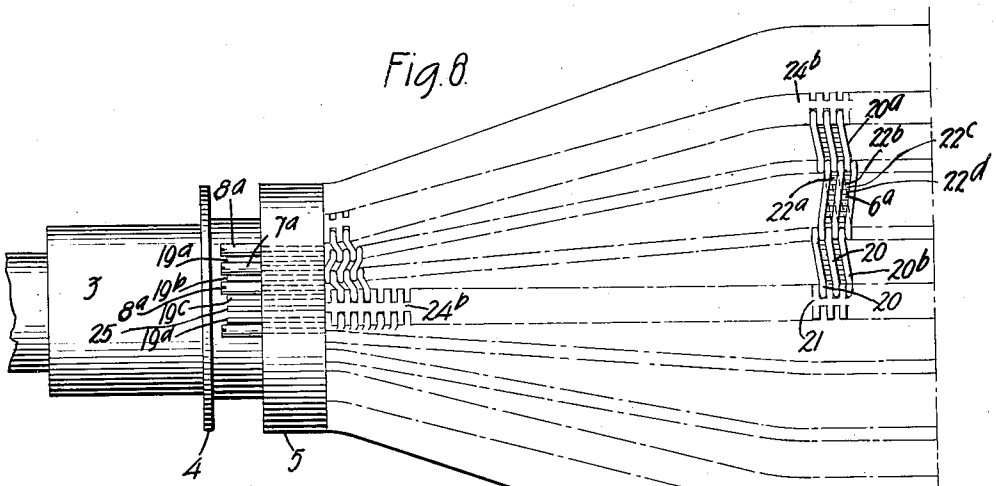


Fig. 9.

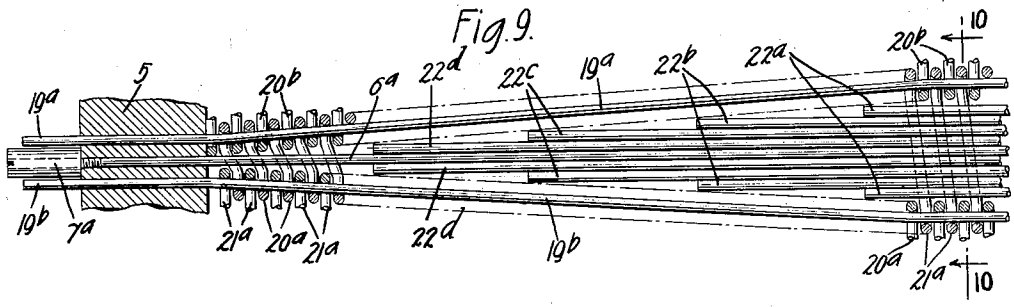


Fig. 10.

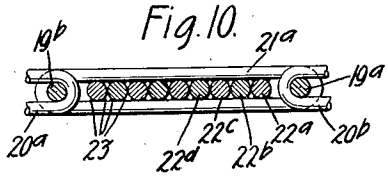


Fig. 11.

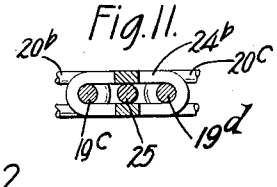
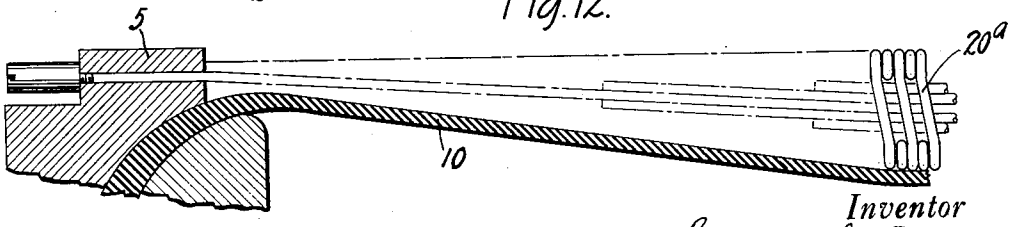


Fig. 12.



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June 2, 1931. S. G. FRANTZ 1,808,162

MINING CARTRIDGE

Filed Aug. 31, 1927 4 Sheets-Sheet 4

Fig. 13.

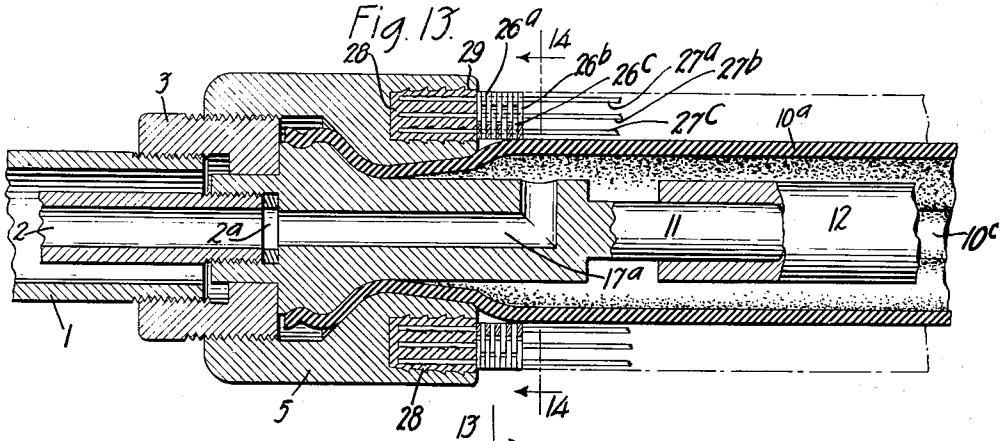


Fig. 14.

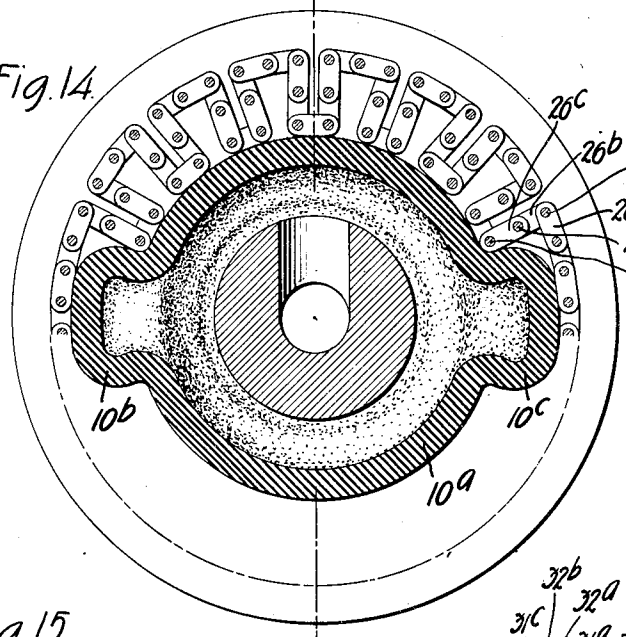


Fig. 15.

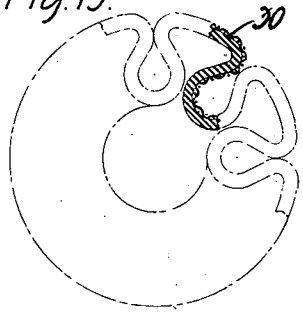
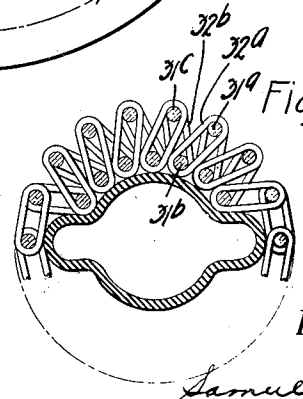


Fig. 16.



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UNITED STATES PATENT OFFICE

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MINING CARTRIDGE

Application filed August 31, 1927. Serial No. 216,698.

This invention relates to mining and quarrying, and has for one of its objects the provision of a device in the form of a cartridge which is expansible under the action of pressure applied therein to fracture and dislodge a body of mineral, such as coal or rock, while has previously been drilled in the customary manner.

Another object of the invention is to obviate the necessity for using explosives in such fracturing and dislodging processes, and to thereby greatly reduce the expense of mining and quarrying, as well as to avoid the dangers incident to the handling of high explosives, to their premature or delayed explosion, as well as the dangers incident to the ignition and explosion of fire-damp following the firing of a charge.

Other objects and advantages of the invention will be apparent from a consideration of the specification and the drawings.

The following is a description of a mining cartridge embodying the invention in its present preferred forms; but it will be understood that various modifications and changes may be made therein without departing from the spirit of the invention and without exceeding the scope of the claims.

The invention will best be understood by reference to the accompanying drawings wherein it is illustrated in its present preferred embodiments, and in which Fig. 1 is a longitudinal section of a cartridge of one form, the device being shown as it appears when an expansible bag comprising a part thereof is deflated, and, for convenience in illustrating, being shown as separated into two parts with a portion near the longitudinal center omitted; Fig. 2 is a longitudinal view, partly in section and partly in elevation, of an axially-disposed assembly comprising a portion of the device and provided with relatively slidable conduit members, telescopic with reference to a common housing element; Fig. 3 is a longitudinal view of the device as it appears when inflated, the degree of inflation being represented as exaggerated for the purpose of clearer illustration; and the axially-disposed assembly of Fig. 2 being shown in elevation, while the remainder of the elements are, for the most part, shown in section; Fig. 4 is a section on the line 4—4 of Fig. 1, looking in the direction of the arrows; Fig. 5 is a section on the line 5—5 of Fig. 1, looking in the direction of the arrows—the upper portion of the device being shown in transverse section; Fig. 6 is a transverse section of Fig. 1 on the line 6—6, looking in the direction of the arrows; Fig. 7 is a transverse section corresponding to the section shown in Fig. 6, but illustrating the device as it appears when inflated; Fig. 8 is a fragmentary elevation, partly diagrammatic, of a portion of the device, illustrating certain structural details; Fig. 9 is a fragmentary view, partly in elevation and partly in section, showing an arrangement of longitudinal rods of varying lengths, with coacting helical members comprising part of the tapered portion of an outer armored covering for the expansible bag employed in the device; Fig. 10 is a section on line 10—10 of Fig. 9, looking in the direction of the arrows, and illustrating the manner in which certain of the longitudinal rods at the center of the assembly are attached to a helical element in order to constitute one type of a unitary composite section of said armored covering; Fig. 11 is a fragmentary detail showing a tubular linking element for connecting neighboring sections of the armored covering; Fig. 12 is a fragmentary longitudinal section on line 12—12 of Fig. 6, illustrating the expansible bag as it appears when deflated and the positions of the several parts of the armored covering as they appear when collapsed as a result of the deflation of the bag; Fig. 13 is a fragmentary longitudinal section of a portion of a modified form of the device; Fig. 14 is a transverse section, on an enlarged scale, on line 14—14 of Fig. 13, looking in the direction of the arrows; Fig. 15 is a fragmentary transverse view illustrating, partly in section and partly diagrammatically, a modified form of armored covering which may be employed in connection with the invention; and Fig. 16 is a fragmentary transverse section of a still further modified form

of the invention with another type of armored covering.

Like reference characters indicate like parts throughout the drawings.

Referring to the drawings (Fig. 1), 1 denotes a tubular handle by which the cartridge may be carried and held for insertion in a hole previously drilled in a mass of mineral. Axially disposed with reference to this handle is a metal pipe 2, the outer end of which may be attached in any well-known manner to a suitable connection (preferably flexible) leading to a source of fluid pressure, which fluid may be either in liquid form, such as water, or in gaseous form, such as air. Formed on the inner end of pipe 2 is an external screw thread adapted to coact with an internal screw thread formed in an inlet conduit member 11, a gasket 2*a* being interposed between the two elements to insure a leak-proof joint therebetween. Inlet conduit member 11 is also externally threaded for engagement with a nut, 3. This nut is also internally threaded to receive the handle 1. Threaded to the outer end of exhaust conduit member 11*a* is a nut 13. Mounted upon the unthreaded portion of inlet conduit member 11 is an annular head, 5. Similarly mounted upon the unthreaded portion of inlet conduit member 11 is an anchorage member 9, which, by the action of nut 3, is held in abutting relation to a shoulder formed on said conduit member. Exhaust conduit member 11*a* carries a similar annular head 5*a*, and a similar anchorage member, 9*a*. Also mounted upon inlet conduit member 11 and interposed between nut 3 and head 5 is a washer 4, the purpose of which will be hereinafter explained. A similar washer, 4*a*, is mounted on exhaust conduit 11*a* in a corresponding relation to nut 13 and head 5*a*.

An expansible bag, 10, formed of rubber or other suitable flexible material, is provided with apertures defined by arcuate end portions of the bag wall. Such a bag may be conveniently moulded from rubber. The arcuate wall portions, respectively, are securely clamped in position between head 5 and anchorage member 9, and between head 5*a* and anchorage member 9*a*, by the pressure which the nuts 3 and 13 exert upon said heads and anchorage washers. Inlet conduit member 11 is provided with an orifice 17 extending therethrough; and exhaust conduit 11*a* is provided with a similar orifice 17*a*.

Referring to Fig. 2, the inner ends, respectively, of conduit members 11 and 11*a* operatively enter axial recesses 12*a* and 12*b* formed in the ends of a cylindrical housing member, 12, the central portion of which housing member is solid to form an abutment for springs 18 and 18*a*. The pressure exerted by these springs, respectively, against the inner ends of conduit members 11 and 11*a* tends to keep bag 10 in a longitudinally extended condition when there is no pressure therein. When, however, the bag is inflated so that its diameter increases and its length correspondingly decreases, the telescoping of the conduit members in the housing member 12 compresses the springs, so that, upon release of the pressure, the conduit members move uniformly in an outward direction and restore the bag, together with its articulated armored covering (to be hereinafter described) to normal position.

Because of the rough usage to which the cartridge is necessarily subjected, and in order to prevent indefinite stretching longitudinally and circumferentially, and consequent rupture of the bag 10, it is desirable to protect said bag with an armored metallic covering. Obviously, this covering must be so constructed and arranged as to permit of its expanding and contracting in response to such expansion and contraction movements of the bag. In short, it must be not only flexible, but it must conform in general outline to whatever shape the bag may operatively assume. In Figs. 4 to 12, inclusive, is illustrated one embodiment of the invention wherein such armored covering is employed. Fig. 9 is a fragmentary view of a portion of a typical section of armored covering embodying the invention, which section is fabricated in the following manner: the armored covering comprises a plurality of series of flattened helices, preferably varying in their transverse dimensions, the helices being indicated by the reference characters 20^b, 21^a and 20^a, and further comprises a plurality of flattened tubes 24^b, said helices and tubes being so arranged and interlocked with each other by the aid of tie rods and other devices described in greater detail hereinafter as to form an articulated covering. When the cartridge is in its collapsed condition, as shown in Figure 6, the helices 21^a, 21^b, etc., are all disposed on the outer exposed surface of the cartridge while the helices 20, 20^a, 20^b, etc., form side walls for the longitudinal convolutions in the cartridge, and the tubular linking members, such as 24^a and 24^b, assume positions at the bottoms of such convolutions.

The helices preferably taper in their transverse dimensions towards the ends of the cartridge. Two fulcrum rods, 19*a* and 19*b*, extend throughout the entire length of the cartridge and adjacent the exterior of the bag 10. These fulcrum rods (which are preferably made of spring steel) are slidable at their ends respectively in longtiudinal apertures formed through heads 5 and 5*a*. Referring to Fig. 7, the fulcrum rods pass through a flattened metal helix, 21*a*, the ends of which helix are tapering in form, as illustrated in Fig. 9. In order to strengthen each of the sections of armored covering and to provide ample contact area with the bag 10, there are also inserted in the helix flexible filler rods (likewise preferably formed of

spring steel), and designated respectively in Fig. 9 as 22*a*, 22*b*, 22*c*, 22*d*, etc. It will be noted that these filler rods vary in length to conform generally to the tapering area defined by the end portions of fulcrum rods 19*a* and 19*b*. A tie-rod, such as 6*a*, is centrally disposed with reference to the series of filler rods of each section, this tie-rod also preferably being made of spring steel. Like the fulcrum rods 19*a* and 19*b*, the tie-rod extends throughout the entire length of the cartridge and adjacent the exterior wall of bag 10. Its outer ends pass through apertures formed through heads 5 and 5*a*, respectively; but, instead of being slidable with reference to said heads, as are the fulcrum rods, the tie-rod is held in position with reference to the heads by means of tie-rod nuts, such as 7*a* and 7*b*, coacting with screw threads formed on either end of the rod. The effect of these tie-rods is to hold the cartridge together longitudinally when under pressure and also to restrict, under the condition of deflation of bag 10, the outward movement of heads 5 and 5*a*, due to the urge of springs 18 and 18*a*. The filler rods, together with the tie-rods, are preferably firmly attached to the flattened and tapering helix 21*a* in any well-known manner, as by welding (indicated in Fig. 10 by the numeral 23). There is thus formed a flexible composite section of armored covering which is slidable with reference to fulcrum rods 19*a* and 19*b*, and which ties together the heads 5 and 5*a*, restricting their tendency toward separation.

As appears from Fig. 7, the composite section 21*a* is somewhat wider than the adjacent articulated composite sections 20*a* and 20*b*. Intermediate each of two neighboring short sections (as indicated in Fig. 7) is a still narrower tubular linking member, 24*b*, articulated with reference to said narrow composite sections 20*b* and 20*c* by reason of the passage therethrough of fulcrum rods such as 19*c* and 19*d* (Figs. 7, 8, and 11). Linking member 24*b* is preferably formed of flattened tubing, the edges of which are slotted as indicated in Fig. 8, to permit entrance therein of the ends of the coils of flattened helices such as 20*b* and 20*c*. Passing longitudinally through the center of tubular linking member 24*b* is a sliding fulcrum rod 25, similar to that hereinbefore described as being associated with the flattened helix 21*a*. Fig. 8 shows, in longitudinal detail, the manner of effecting the articulate connections between the several sections of armored covering, the dot-and-dash lines indicating generally the lines of articulation under the condition of an assumed distortion due to inflation of bag 10.

When the cartridge is expanded as in Fig. 7 the bag 10 is held against further expansion and resultant rupture by the helices 20*b*, 21*a*, 20*a*, etc. and the link member 24*a* which in effect form a series of chain links extending around the bag. From the foregoing it will be understood that the rods 19*a*, 19*b*, 19*c* and 19*d* prevent longitudinal rupture of the bag, that they also serve to connect the helices and the members 24*a*, and that the helices and the members 24*a* limit the dilation of the bag or envelope to prevent rupture thereof circumferentially.

Referring to Fig. 6, it will be observed that when the bag 10 is deflated and the armored covering has collapsed, the wide composite sections such as 21*a* and 21*b* assume a peripheral position with reference to the bag; the narrow sections such as 20*a* and 20*b* assume side-wall positions with reference to longitudinal convolutions which are moulded in the bag; and the tubular linking members such as 24*a* and 24*b* assume positions at the bottoms of such convolutions, respectively.

Referring again to Fig. 1, the washers 4 and 4*a* serve to limit any possible movement of the fulcrum rods, such as 19*a* and 19*b*, which by reason of the fact that they are neither provided with nuts nor welded to the helices, might otherwise come partially or completely out of the casing.

In Figs. 13 and 14 there is illustrated a modification of the invention, wherein there is employed a bag 10*a* of slightly different form; also a different type of armored covering and bag-attaching means which renders somewhat easier the removal of the bag when ruptured or worn out, and the installation of a new bag in place thereof. As shown in Fig. 14, the bag is here moulded with longitudinal protuberances 10*b* and 10*c*, instead of with the longitudinal convolutions shown in Fig. 6. In this modification of the invention, the armored covering consists of a number of links, such as 26*a*, 26*b*, 26*c*, etc., maintained in articulated relation by means of a series of flexible longitudinally parallel fulcrum rods, such as 27*a*, 27*b*, 27*c*, etc., preferably made of spring steel, and extending throughout the length of the cartridge. The ends of these rods are permanently anchored in a mass of metal, 28, such as zinc, which, while in a molten state, is poured into an annular recess 29 formed in the head, such as 5, at each end of the cartridge. It will be apparent that, upon inflation of the bag 10*a*, the position of the links will change and the flexible rods will yield, permitting corresponding expansion of the composite armored structure formed by said links and rods. It will further be evident that, because of the fact that the ends of the rods are permanently anchored, these rods will be subjected to some twisting action; but this will not be objectionable where the rods are formed of material such as spring wire or music wire, having a high tensile strength.

In Fig. 15 is shown a further modified form of armored covering 30, consisting of intertwined wires, attached to the bag and suffi-

ciently flexible to follow its changes in conformation.

In Fig. 16 is illustrated a still further modification of the armored covering, adapted to be employed in connection with a bag of the form shown in Fig. 15. There are here provided a number of longitudinal rods, such as 31*a*, 31*b*, 31*c*, etc., embracing each of which rods in articulate relation are two flattened helices such as 32*a* and 32*b*, thus forming a composite flexible armored covering which will conform to the various shapes assumed by the bag 10*a*.

Following the usual practice in mining and quarrying, a series of holes is drilled to define the proposed line of cleavage of the mass. One of the cartridges is to be placed in each such drilled hole, and a fluid, such as air or water, under high pressure, is then admitted to pipe 2, passing through orifice 17 of inlet conduit member 11 to the bag 10, passing into said bag and causing it to expand—thereby applying to the mineral mass the pressure under which the fluid is delivered to the bag. When the mineral mass has been fractured and dislodged, the pressure in the cartridge bag may be released near its source. If water or other liquid is to be employed as a pressure medium, air is released from bag 10 by opening check-valve 15 (Fig. 1), which valve is normally maintained by spring 16 in leak-proof relation with its seat, 14.

An important feature of each of the various modifications of the present invention resides in the function of a flexible, non-stretchable element in the form of a covering or reinforcement for the bag, whereby after the said bag has been expanded to its full extent the said element prevents all further expansion of the bag and thus prevents rupture thereof. This feature is of particular importance when the cartridge is used in mining and quarrying because at the time of fracture or dislodgment of the mineral mass the covering comes into play to take the stress due to the internal pressure and thus prevent rupture of the bag. It will be readily understood that if it were not for such positive check on the dilation of the bag, it might readily be ruptured, because of the sudden yield of the mineral mass, which, in such state, is frequently entirely incapable of resisting the pressure developed in the bag.

While the cartridge has been described and is illustrated as being protected by metallic armored coverings, the invention is not restricted to such construction, In some classes of work, such, for example, as the fracturing of large blocks of building stone, it is possible to employ a bag made of material such as that used in automobile tire casings which, while sufficiently expansible to transmit the required fracturing pressure to the mass, is, at the same time, tough and resistant enough to withstand the rough usage without the requirement of a metallic armored circumferential casing. Under such conditions the cartridge will require only longitudinal metallic reinforcing members to restrict the outward movement of the ends.

I have described what I believe to be the best embodiments of my invention. I do not wish, however, to be confined to the embodiments shown, but what I desire to cover by Letters Patent is set forth in the appended claims.

I claim:

1. In a mining cartridge, the combination of a resilient container and an articulated armored covering therefor.

2. In a mining cartridge, an expansible container and an armored covering therefor comprising a plurality of rods longitudinally disposed with reference to said container and a plurality of elements circumferentially disposed with reference to said container and in articulate relation to said rods.

3. In a mining cartridge, the combination of an expansible container, conduit members axially disposed with reference thereto and constructed and arranged to telescope in recesses formed in a common housing member.

4. In a mining cartridge, the combination of an expansible member constructed and arranged to be inserted in a recess formed in a mass of mineral, a plurality of conduits associated with said expansible member and constructed and arranged to approach each other under inflation of said expansible member, and springs adapted to be compressed by said conduits in their movement of approach.

5. In a mining cartridge, the combination of an expansible container provided with longitudinally-movable non-resilient heads and an armored covering for said container and co-operating with said heads comprising a plurality of rods longitudinally disposed with reference to said container and a plurality of flattened metallic helices in articulate relation with said rods.

6. In a mining cartridge, the combination of an expansible container and an armored covering therefor, comprising a plurality of flexible metallic rods longitudinally disposed with reference to said container and a plurality of flexible helical elements in articulate relation with said rods.

7. In a mining cartridge, the combination of a fluid-tight expansible container and a flexible metallic armored covering therefor.

8. In a mining cartridge, the combination of an expansible container provided with tapering ends and a metallic armored covering therefor constructed and arranged to conform to the shape of said container under varying conditions of pressure therein.

9. An expansible hydraulic cartridge, comprising an inner fluid-tight expansible cham-

ber surrounded by a flexible metallic casing capable of expanding under the influence of fluid pressure in the inner chamber, to limit the expansion and to resist the pressure when said inner chamber is fully expanded.

10. A mining cartridge comprising a fluid tight dilatable container and a flexible non-stretchable covering therefor and means for admitting fluid pressure into said container to dilate the same.

11. A mining cartridge comprising a dilatable container, a flexible, metallic covering therefor and means for conveying fluid pressure into said container.

12. A fluid pressure mining cartridge comprising a collapsible fluid tight envelope capable of dilation by fluid pressure, said cartridge having inelastic means for resisting said pressure after dilation of the envelope to a predetermined extent to prevent rupture thereof.

13. A fluid pressure mining cartridge comprising a collapsible fluid tight envelope capable of dilation by fluid pressure, said cartridge having inelastic means for limiting the delation of the envelope.

14. An expansible hydraulic mining cartridge, comprising an inner fluid tight expansible chamber surrounded by a flexible non-elastic casing capable of expanding under the influence of fluid pressure in the inner chamber to limit the expansion and to resist the pressure when said inner chamber is fully expanded, and capable of sustaining pressures sufficient to cause fracture or dislodgment of a mineral mass.

15. An expansible fluid pressure mining cartridge comprising an inner fluid tight expansible chamber surrounded by a flexible, expansible, non-elastic covering capable of sustaining pressures sufficient to cause fracture or dislodgment of the mineral mass to limit the expansion of the inner chamber, a headpiece carried by said chamber at one end thereof and means for guiding the movement of said headpiece upon the expansion and contraction of said chamber.

In testimony whereof I have affixed my signature to this specification.

SAMUEL G. FRANTZ.