March 7, 1933. J. F. JOY 1,900,446

DEVICE FOR BREAKING DOWN COAL

Filed Oct. 13, 1931 3 Sheets-Sheet 1

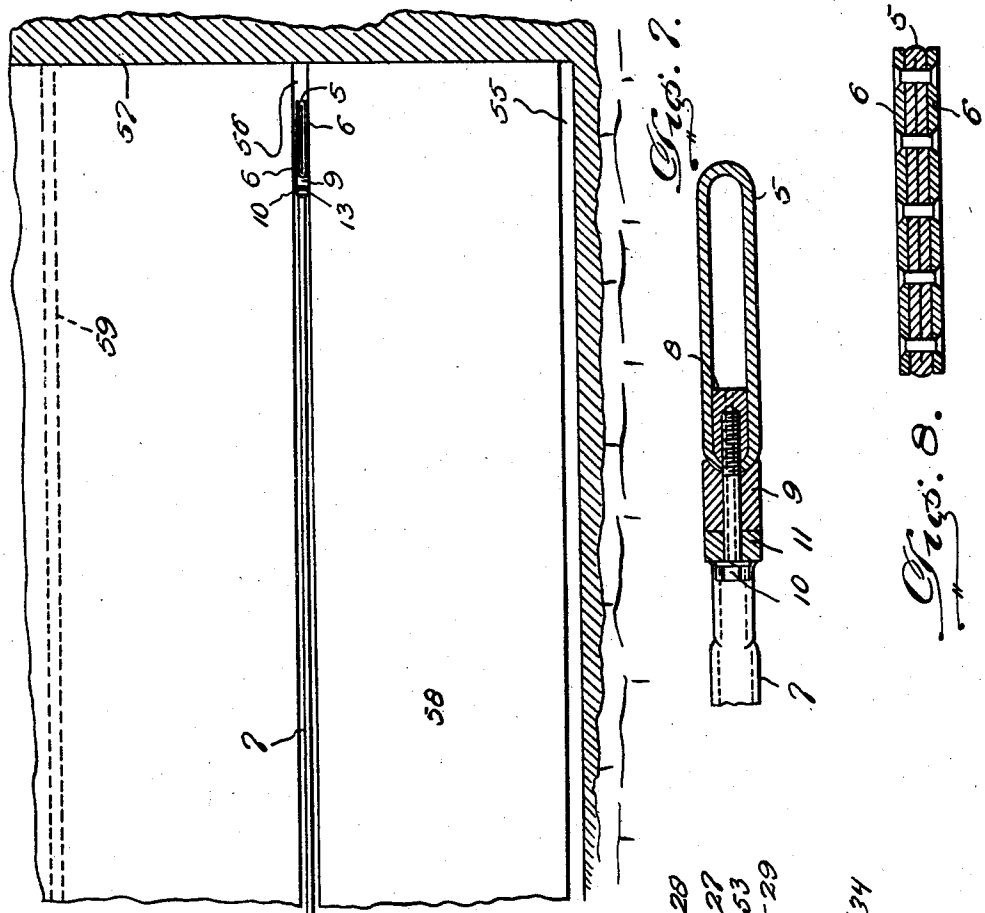


Fig. 1.

Fig. 2.

Fig. 8.

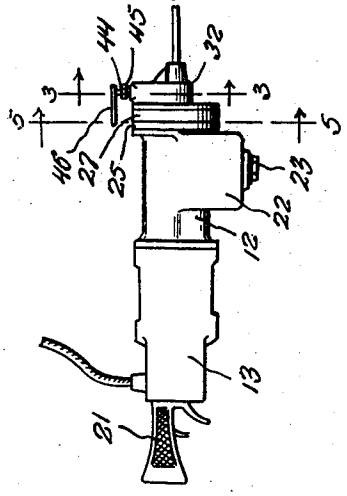


Fig. 4.

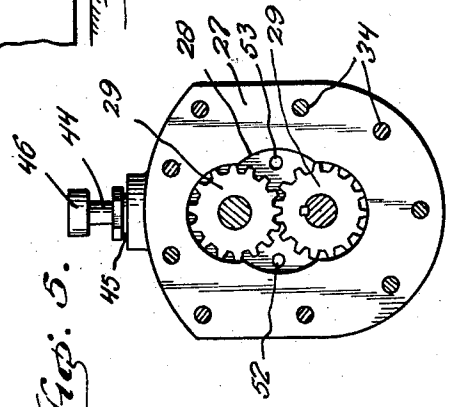


Fig. 5.

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DEVICE FOR BREAKING DOWN COAL

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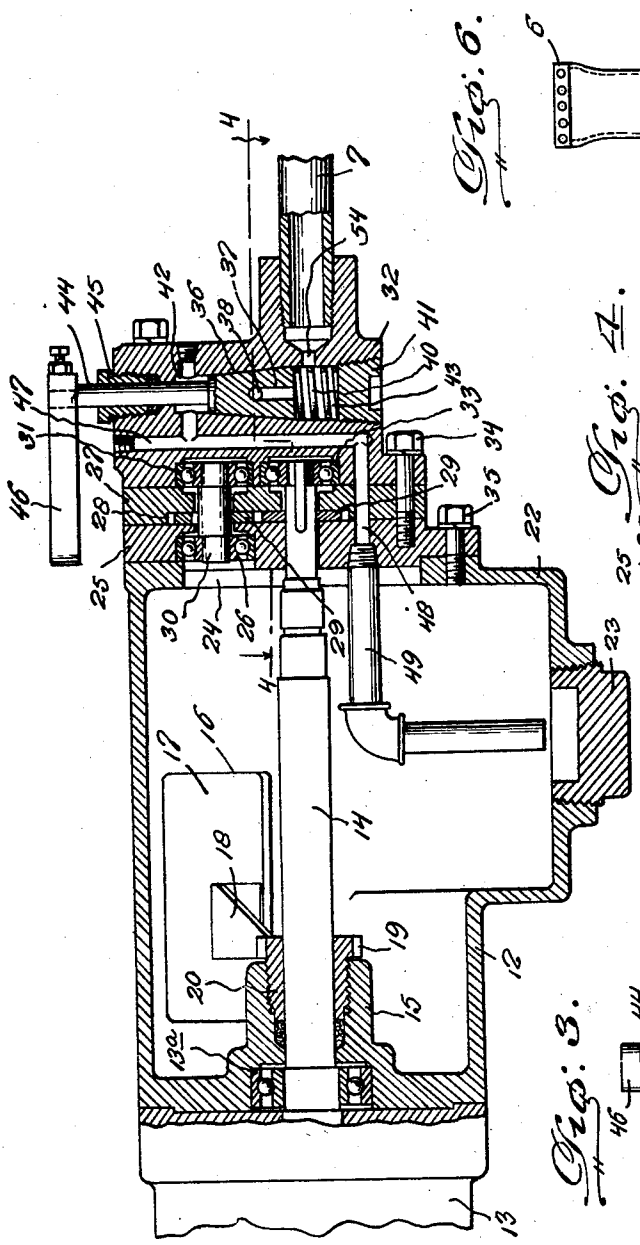


Fig. 2.

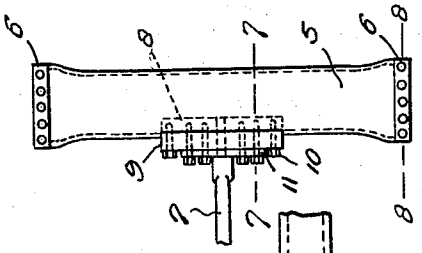


Fig. 6.

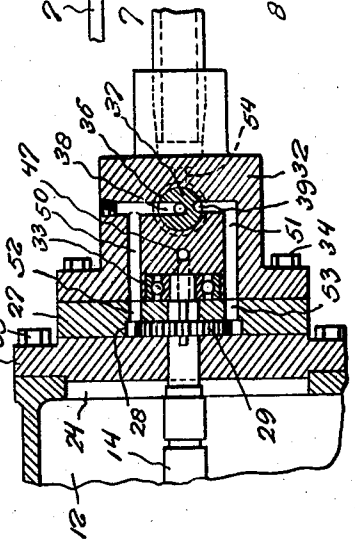


Fig. 4.

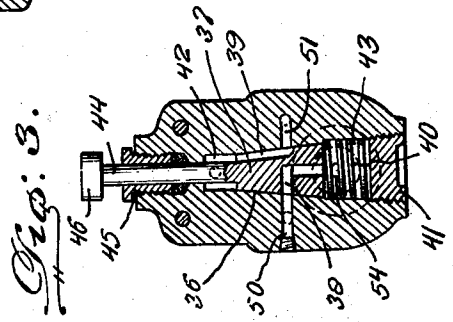


Fig. 3.

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DEVICE FOR BREAKING DOWN COAL

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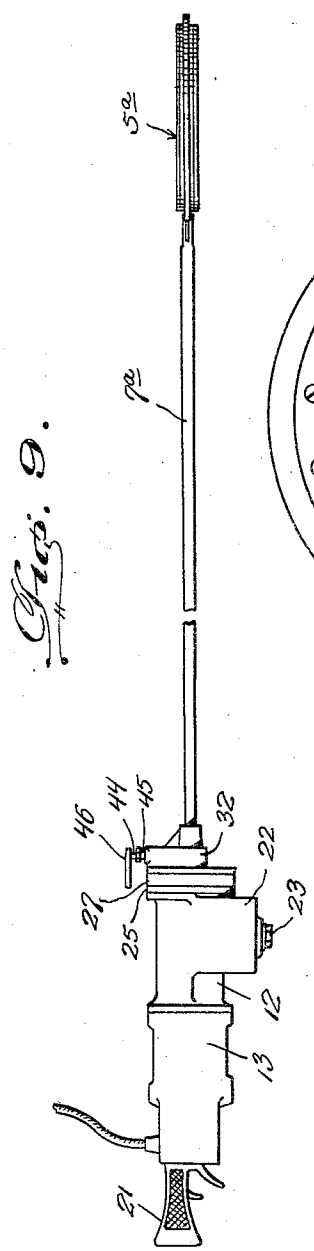


Fig. 9.

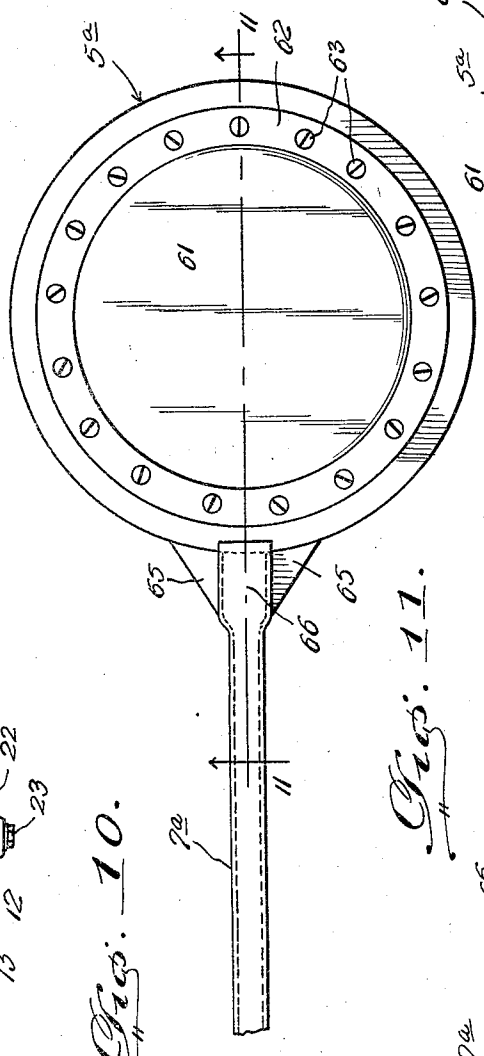


Fig. 10.

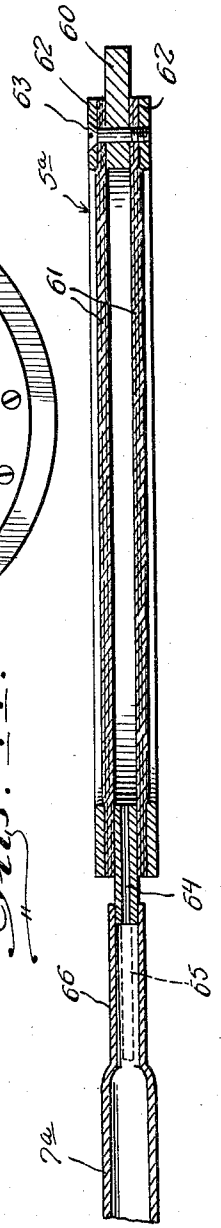


Fig. 11.

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Patented Mar. 7, 1933

1,900,446

UNITED STATES PATENT OFFICE

JOSEPH F. JOY, OF MARION, OHIO, ASSIGNOR TO JOY BROS., INC., OF MARION, OHIO, A CORPORATION

DEVICE FOR BREAKING DOWN COAL

Application filed October 13, 1931. Serial No. 568,626.

My invention relates to improvements in devices for breaking down coal in mines, after suitable preparation. More specifically, the present device is especially serviceable for breaking down coal when prepared in the manner disclosed in my co-pending application for patent upon method of mining coal and apparatus therefor, Serial Number 568,596, filed October 13, 1931. As disclosed in said pending application, intersecting vertical and horizontal slots of relatively narrow form are sawed into the coal seam at right angles to the working face and for a depth approximating the thickness or height of the coal seam, whereby a "cut" of coal is divided into a number of horizontally elongated blocks attached only at their far ends to the coal seam. The present device embodies a normally flat and thin expansible coal breaking member adapted to be inserted in the aforementioned slots of relatively narrow form, whereby the blocks of coal will be effectively broken down upon expansion of the coal breaking member.

A general object of the present invention is to provide a device of the above kind which is extremely simple and durable in construction, economical to manufacture, and efficient in operation.

More specifically, the present invention aims to provide a device of the above kind including a fluid-tight hollow expansible coal breaking member, and means to supply said coal breaking member with fluid under pressure so as to expand the same.

More specific objects and features of the invention will become readily apparent from the following description when considered in connection with the accompanying drawings, in which:

Figure 1 is a side elevational view of a device for breaking down coal constructed in accordance with the present invention, and illustrating use of the device in a mine.

Figure 2 is an enlarged fragmentary view showing the liquid reservoir and adjacent parts of the device in central vertical longitudinal section.

Figure 3 is an enlarged vertical transverse section on line 3—3 of Figure 1.

Figure 4 is a horizontal section on line 4—4 of Figure 2.

Figure 5 is a vertical transverse section on line 5—5 of Figure 1.

Figure 6 is a plan view of the expansible coal breaking member and adjacent parts.

Figure 7 is an enlarged cross section taken on line 7—7 of Figure 6.

Figure 8 is a section on line 8—8 of Figure 6.

Figure 9 is a side elevation of the invention, employing a modified form of expansible coal breaking member.

Figure 10 is an enlarged plan view of the coal breaking member employed in the construction of Figure 9; and

Figure 11 is an enlarged section on line 11—11 of Figure 10.

Referring more in detail to the drawings, the present invention aims to provide a portable device of unitary construction, including an inflatable expansible coal breaking member, and power operated means for inflating or deflating said coal breaking member. As shown in Figures 1 to 8 inclusive, the coal breaking member preferably consists of an elongated flexible tube 5 formed of reinforced rubber or the like, and having its ends closed by tightly riveting the same between pairs of clamping plates 6 as shown in Figures 6 and 8. The expansible coal breaking member 5 is thus of fluid-tight construction and normally assumes a flat-like cross section as illustrated in Figure 7. The coal breaking member 5 is firmly attached to the outer end of a rigid fluid supply conduit 7 so as to extend transversely of the latter as shown clearly in Figure 6. For this purpose, a clamping bar 8 is arranged longitudinally within the member 5 and fitted within the fold of the latter at one longitudinal edge of the same, while a cooperating clamping bar 9 is placed against this longitudinal edge of the member 5 externally of the latter, the two clamping bars 8 and 9 being securely connected by cap screws 10 which freely pass through the clamping bar 9 and the adjacent folded edge of the member 5 and thread into suitable sockets in the clamping bar 8 as shown in Figure 6 and

7. The clamping bar 8 has a rounded outer longitudinal edge to fit the fold of the adjacent longitudinal edge of the member 5, while the clamping bar 9 has its adjacent longitudinal edge concaved to similarly fit the adjacent folded edge of the member 5, thus permitting clamping of the adjacent edge portion of said member 5 between the bars 8 and 9 without danger of cutting the latter. The adjacent outer end of the conduit 7 has a flange 11 secured tightly against the outer longitudinal edge of the outer clamping bar 9 by certain of the cap screws 10, and the clamping bars 8 and 9 have registered central transverse openings which register with an opening in the adjacent edge of the coal breaking member 5 and afford communication between the conduit 7 and the interior of said member 5. The expansible inflatable coal breaking member 5 is thus firmly attached to the outer end of the fluid supply conduit 7 so as to extend transversely of the latter in a plane parallel with the longitudinal axis of the conduit 7.

In the embodiments of the invention illustrated in the drawings, a suitable liquid, such as soluble oil, is pumped under pressure through the conduit 7 into the member 5 for expanding the latter. Accordingly, the present device is shown as including a liquid reservoir 12 adapted to contain a sufficient quantity of liquid to expand the member 5 to the required extent. This reservoir is rigidly secured to the front end of an electric motor 13 whose armature shaft 14 projects through the reservoir 12 and is journaled in a bearing 13*a* countersunk in the adjacent inner end wall of the reservoir 12 as shown in Figure 2. Said inner end wall of the reservoir 12 is further provided with a packing gland 15 through which the armature shaft of motor 13 extends and by means of which leakage of liquid from the reservoir about the armature shaft of motor 13 is prevented. A relatively large opening 16 is provided in one side of the reservoir 12 to permit access to the interior of the latter, and this opening is closed by a removable cover plate 17 having a rigid inwardly projecting blade 18 adapted to engage in peripheral notches 19 of a packing compressing bushing 20 of the gland 15 for maintaining said bushing in adjusted position, or against loosening. The motor 13 has a pistol grip control switch 21 rigid with its inner end for use in conveniently throwing the same into and out of operation and for use in facilitating manipulation of the entire device. Also, the reservoir 12 has a bottom sump 22 provided with a bottom drain opening closed by a removable plug 23.

The outer end of the reservoir 12 is provided with a relatively large opening 24 closed by a removable plate 25 through which the armature shaft of motor 13 extends, and in the upper portion of which is provided a countersunk bearing 26. A further plate 27 is secured to the plate 25 and has its inner side recessed as at 28. The recess 28 is closed at its inner end by the plate 25 so as to form a chamber for reception of the meshing gear pistons 29 of a pump assembly utilized for forcing the fluid into or out of the reservoir 12 from or into the expansible member 5, as will later become apparent. One gear piston 29 is keyed on the outer end of the armature shaft of motor 13, while the other gear piston 29 is secured to a counter shaft 30 journaled in the bearing 26 and a further bearing 31 countersunk within the inner face of a valve body 32 fastened to the outer side of the plate 27. A further bearing 33 is countersunk in the inner side of the valve body 32 in which the outer end of the armature shaft of motor 13 is journaled. As shown, the plates 25 and 27 and valve body 32 are rigidly fastened together by cap screws 34, while the plate 25 is fastened to the adjacent end of reservoir 12 by further cap screws 35.

The valve body 32 is provided with a vertical tapered bore 36 in which is revolubly fitted a tapered valve plug 37 having an angular port 38 and a longitudinal groove or passage 39. The valve plug 37 is yieldably held upwardly into snug contact with the walls of the bore 36 by means of a spring 40 interposed between the bottom end of the plug 37 and a closure plug 41 for the lower end of said bore 36. The valve plug 37 is shorter than the bore 36 so that when the plug 37 is operatively disposed, a chamber is left at the top of the bore 36 above the plug 37 as at 42, and a further chamber is left at the bottom of the bore 36 below the plug 37 as at 43. A stem 44 is rigid with the upper smaller end of the turn plug 37 and projects externally of the valve body 32 through a packing gland 45. A handle 46 is attached to the projecting outer end of the stem 44 for use in manipulating or turning the valve plug 37. The valve body 32 is formed with a vertical passage 47 rearwardly of the bore 36, and this passage 47 communicates with the chamber 42 above the valve plug 37, as shown in Figure 2. A further passage 48 extending through the plates 25 and 27 and the lower portion of the valve body 32 affords communication between the lower end of the passage 47 and a discharge pipe 49. The pipe 49 is of angular form and has one end threaded into the plate 25, while its other end turns downwardly to a point adjacent the bottom of the sump 22 of reservoir 12. Further horizontal passages 50 and 51 are provided in the valve body 32 on a plane intermediate the ends of the valve plug 37, and these passages communicate with the bore 36 at opposite sides of the valve plug 37 as shown clearly in Figure 4. The inner ends of the passages 50

and 51 communicate respectively with outlet and suction ports 52 and 53 provided in the plate 27 so as to communicate with the pump chamber or recess 28 at opposite sides of the gear pistons 29. It will be noted that the passage 38 in the valve plug 37 is in constant communication with the lower chamber 43, which is the outlet chamber, of the control valve, and such passage 38 may be selectively registered with the adjacent end of either passage 50 or 51 by properly turning the valve plug 37. It will also be noted that the passage 39 of valve plug 37 extends from the top of the latter to a point intermediate the ends of the same, whereby said passage 39 is in constant communication with the upper or inlet chamber 42 of the control valve, and whereby the passage 39 may be brought into communication with either passage 50 or 51 when the valve plug 37 is properly turned. It is thus apparent, that when the passage 38 is positioned as in Figure 3 to provide communication between passage 50 and outlet chamber 43, the passage 39 will be positioned to provide communication between the passage 51 and the inlet chamber 42. Thus, the motor 13 may be placed into operation for rotating the gear pistons 29 so that the liquid in reservoir 12 will be sucked through pipe 49, passages 48 and 47, inlet chamber 42, passages 39 and 51, and port 53 into pump chamber or recess 28. At the same time, the liquid will be forced from pump chamber or recess 28 through port 52, passages 50 and 38 into outlet chamber 43. The outlet chamber 43 has an outlet port 54 communicating with the conduit 7 so that the fluid under pressure may pass through the latter into the coal breaking member 5 for inflating the latter. Obviously, the member 5 may expand in a direction at right angles to its plane, thereby furnishing the necessary force in the proper direction for breaking down blocks of coal as shown in my co-pending application hereinbefore mentioned. When a desired block of coal has been broken down, removal of the coal breaking member from the slot in the coal seam may be facilitated by deflating said coal breaking member 5. This is accomplished by giving the valve plug 37 a half turn, in which position the passage 38 communicates with the passage 51 and the passage 39 communicates with the passage 50. When the valve plug is in this latter position, and the motor 12 is placed into operation, the liquid will be drawn from the inflatable member 5 through conduit 7 into chamber 43, through passage 38 and passage 51 into pump chamber or recess 28. At the same time, the liquid will be forced through port 52, passages 50 and 39, chamber 42, passages 47 and 48 and pipe 49 back into the reservoir 12. Obviously, by forming the reservoir 12 of proper capacity, overinflation of the expansible coal breaking member 5 will be impossible.

In Figure 1, the device is shown as it appears in use preparatory to expanding the coal breaking member 5. As shown, a horizontal slot 55 has been cut into the coal seam for a considerable distance at the floor line of the working place, and a further horizontal slot has been cut parallel with the slot 55 as at 56 a suitable distance above the floor line, the slots 55 and 56 intersecting spaced vertical slots, one of which is illustrated at 57. In this way, the cut of coal is divided into a number of horizontally elongated blocks attached only at their far ends to the seam of coal. The row of blocks adjacent the floor of the mine or working place are successively broken down by inserting the inflatable coal breaking member 5 successively above the respective blocks within the slot 56, expanding the member 5 at each positioning of the latter. Although the slots 55 and 56 are relatively narrow, the member 5 is readily inserted and sufficient clearance is provided beneath the blocks of coal indicated at 58 to permit them to readily break loose from the seam of coal at their far ends. These blocks may then be suitably transported to and loaded into cars for transportation from the mine. The same cycle of operation is repeated by cutting additional horizontal slots above the slots 55 and 56 as indicated by dotted lines at 59, the last horizontal cut being level with the ceiling of the working place. In this way, the entire cut of coal may be blocked and broken down without production of a great amount of fine coal or dust and without the dangerous use of explosives.

While the elongated expansible coal breaking member 5 may be very cheaply produced and will permit application of force substantially at the back ends of the slits 56 and 59 when necessary or desirable, a very economical and efficient coal breaking member may be constructed of circular or disk-like form as generally indicated at 5*a* in Figures 9 to 11 inclusive. In these figures, the coal breaking member consists of a rigid flat metal frame ring 60 having diaphragms or flexible disks 61 of reinforced rubber or the like applied to opposite faces thereof to form a normally flat hollow expansible member of circular form. The margins of the disks 61 are tightly secured between the frame ring 60 and thinner clamping rings 62, by means of screws 63 or the like, whereby the member 5*a* is made fluid-tight. The frame ring 60 has a radial passage 64, and is formed with external spaced bracing webs 65 at opposite sides of said passage. The fluid supply conduit 7*a* has its outer end partly flattened as at 66, and this flattened portion snugly fits between the webs 65 to be braced by the latter against lateral strains. The terminal of this flattened end portion 66 is slotted to fit

over the outer edge portion of frame ring 60, and the conduit is thus positioned to communicate with the interior of member 5*a* through passage 64. The parts 60, 65 and 66 are then welded together to render the joint fluid-tight and to rigidly secure the conduit 7*a* and member 5*a* together. Obviously, when fluid is pumped under pressure into member 5*a*, the disks 61 will be bulged outwardly, while such disks will return to flat form when the fluid is pumped out of the member 5*a*. Tremendous force may thus be applied at right angles to the slits or cuts 56 and 59 for breaking down the blocks of coal when the member 5*a* is expanded or inflated, and when the member 5*a* is deflated it may be readily inserted in or removed from said slits or cuts. Otherwise, the construction of both embodiments of the invention is the same.

What I claim as new is:

1. A device for breaking down coal comprising a flat hollow coal breaking member having opposed flexible walls, and means operable at will to expand or collapse said coal breaking member including power operated means for pumping fluid into or from said coal breaking member.

2. A device for breaking down coal including a motor, a liquid reservoir, and a liquid pump rigidly connected in end to end relation with the motor operatively connected to the pump, a rigid conduit rigidly connected with the pump, an expansible hollow member carried by said conduit, and means for placing the pressure side of the pump in communication with said conduit and simultaneously placing the suction side of said pump in communication with the reservoir, or for placing said conduit in communication with the suction side of said pump and the pressure side of said pump in communication with the reservoir for selectively inflating or deflating the expansible member, at will.

3. A device for breaking down coal comprising a liquid reservoir, a motor rigid with one end of the reservoir and having a power shaft extending through the latter, a pump rigid with the other end of the reservoir and having its drive shaft constituted by said power shaft of the motor, a rigid conduit rigidly connected with the pump and having an inflatable coal breaking member attached to its outer end, and means for selectively establishing communication between the reservoir and the coal breaking member through the pump whereby the coal breaking member may be inflated or deflated at will.

4. A device for breaking down coal comprising a flat hollow coal breaking member having opposed flexible walls, a rigid conduit having said coal breaking member attached to one end thereof and in communication with the same, and means rigid with the other end of said conduit for selectively supplying fluid under pressure therethrough to or from said coal breaking member for inflating or collapsing the latter.

5. A device for breaking down coal comprising a rigid fluid conduit, a hollow normally flat flexible coal breaking member attached to one end of and in communication with said conduit, and manually controlled power operated means for pumping fluid under pressure into said coal breaking member.

6. A device for breaking down coal comprising a motor, a liquid reservoir, a pump, and a control valve rigidly assembled in end to end relation, a rigid conduit rigidly connected with the control valve in communication with the outlet chamber of the latter, an expansible hollow coal breaking member carried by and in communication with said conduit, and means including said control valve for providing communication between the reservoir and said conduit through said pump whereby the coal breaking member may be selectively inflated or deflated at will, said motor being operatively connected with said pump.

7. In a device for breaking down coal, a normally flat hollow coal breaking member having opposed flexible walls, said coal breaking member having a port through an edge thereof to facilitate inflation of the same.

In testimony whereof I affix my signature.

JOSEPH F. JOY.