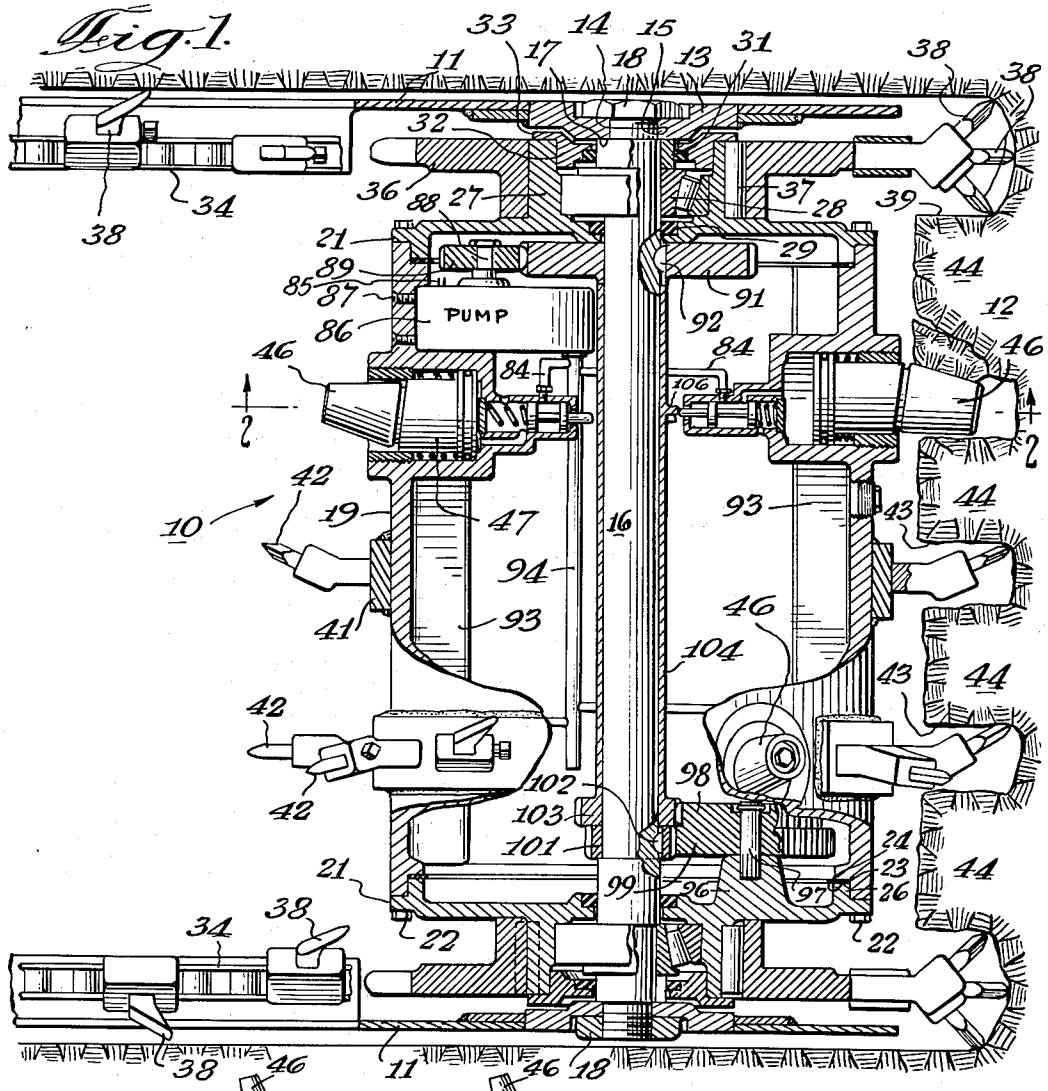
June 12, 1956 R. C. LINDBERG 2,750,177

DRUM CUTTER HEAD FOR CONTINUOUS MINER

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Fig. 1.



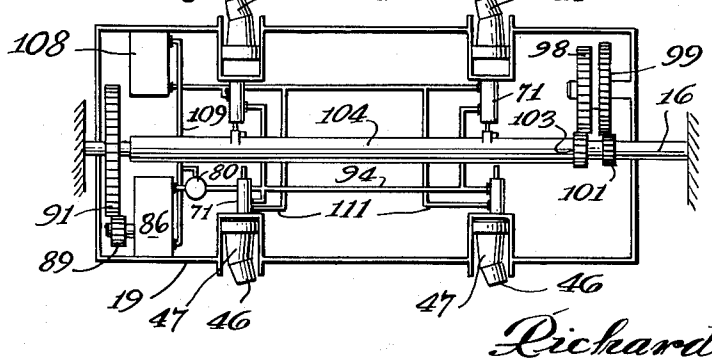


Fig. 3A.

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DRUM CUTTER HEAD FOR CONTINUOUS MINER

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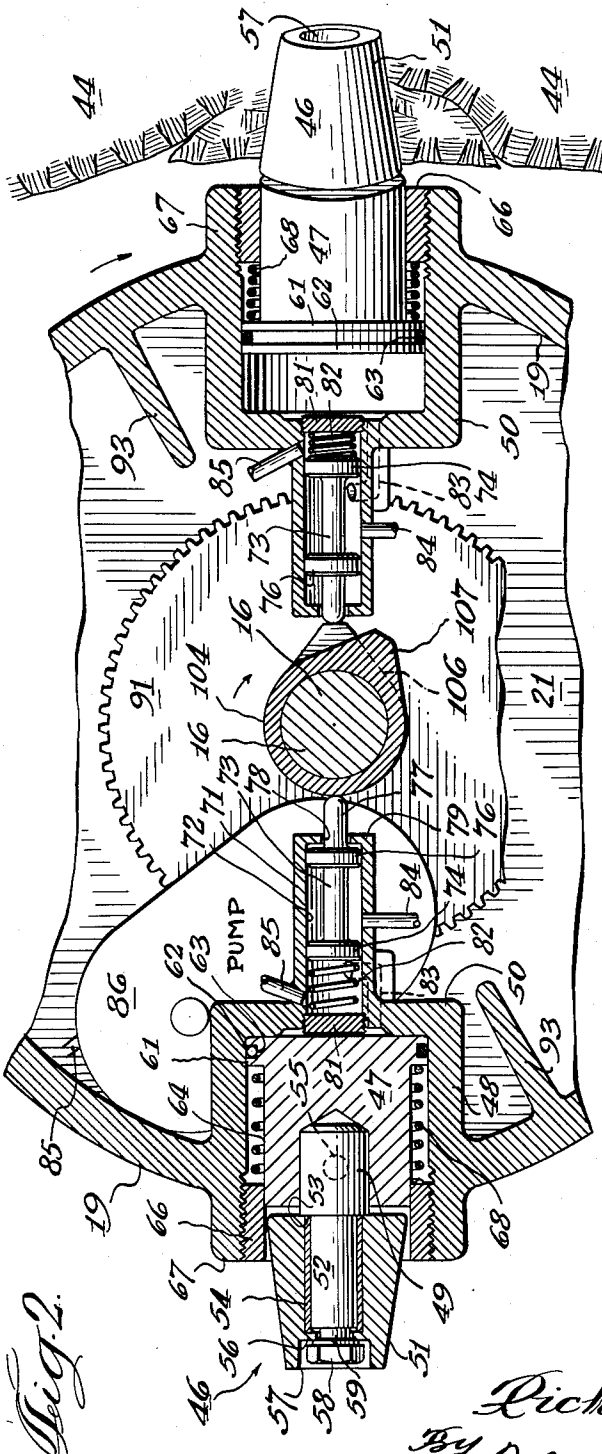


Fig. 2.

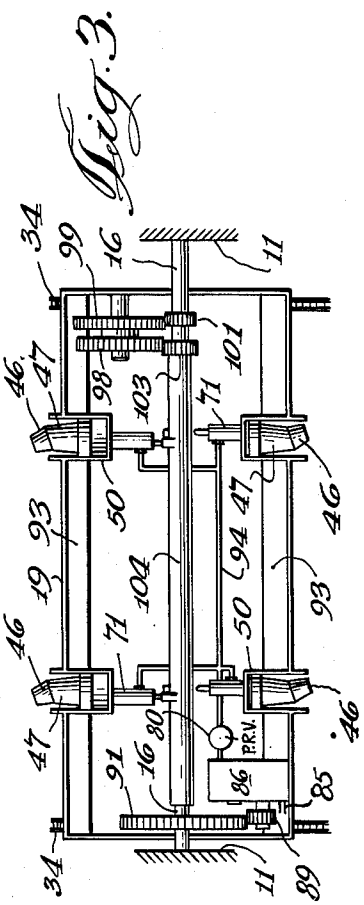


Fig. 3.

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2,750,177

Patented June 12, 1956

2,750,177

DRUM CUTTER HEAD FOR CONTINUOUS MINER

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Application March 7, 1952, Serial No. 275,309

7 Claims. (Cl. 262—9)

This invention relates generally to improvements in machines for mining coal or the like, and particularly to an improved cutting head for a continuous miner.

More recent developments in the field of continuous mining equipment have been characterized by drum cutter heads driven at each end by chains having staggered cutter bits mounted thereon. The drum cylinder affords a support for spaced rows of cutter bits, each row having the bits staggered so that a number of spaced kerfs are cut by the driving chains and the rows of cutter bits, each of the kerfs being spaced by annular cores which remain in the mine face.

Such devices produce an inordinate amount of fine material having a low commercial value, and in order to provide a larger amount of lump coal each row of staggered cutter bits has been provided with core breakers adapted to strike the edges of the cores formed by the action of the cutter bits.

In my copending applications, Serial Nos. 156,607 and 156,608, both filed April 18, 1950, now Patent Nos. 2,689,117 and 2,689,118 respectively, for Improvements in Cutting Heads for Continuous Miners, there is shown various forms of apparatus for imparting radial movement to such breakers in a desired timing sequence so that the cores may be broken off in the form of large lumps thereby to increase the percentage of lump coal having a greater commercial value.

According to the present invention radial movement is given to the core breakers in any desired sequence or timing, such movement being achieved by pressure fluid from a fluid pressure system. A pump for placing the fluid under pressure is mounted inside the hollow drum supporting the cutter bits, and power for driving the pump is derived from the rotation of the drum. Each of the breakers is part of a piston assembly movable within a cylinder, and the pump is arranged to rotate with the drum so that pressure lines connecting the pump to the separate cylinders will be characterized by the complete absence of any moving seals. In one form of the invention the hollow drum acts as a reservoir for the pressure fluid and vanes are arranged on the inside of the drum in such a fashion that the fluid is carried by the rotation of the vanes in the form of an annulus, and so that irrespective of the position of the pump in rotating the drum, the intake side of the pump will be supplied with fluid.

In another form of the system the pump and a closed reservoir are arranged to turn with the drum, such a form of the invention being also characterized by absence of any moving shaft seals.

The frequency with which the breakers move radially outward is determined by cams driven by the drum, each cam being arranged to actuate a control valve associated with each breaker to supply pressure fluid from the system to move the breaker.

It is a principal object of the invention to provide an improved rotating cutter head for a continuous mining machine and to derive power from the rotation thereof for operating an hydraulic pressure system for moving

core breakers outwardly in timed relationship to the rotation of the drum as desired.

Other objects and important features of the invention will be apparent from a study of the following description taken with the drawings which together illustrate some preferred embodiments of the invention and what is now considered to be the best modes of applying the principles thereof. Other embodiments may be suggested to those having the benefit of the teachings herein and it is therefore intended that the invention not be limited by the precise embodiments herein shown nor otherwise than by the scope and spirit of the claims subjoined.

In the drawings:

Fig. 1 is a longitudinal section through a drum cutter for a continuous miner having embodied therein the improvements according to the present invention, parts thereof being shown in plan elevation;

Fig. 2 is an enlarged transverse sectional view taken along the line 2—2 of Fig. 1 looking in the direction of the arrows, one of the breakers of this view being shown in elevation;

Fig. 3 is a schematic diagram illustrating the fluid pressure system for operating the core breakers shown in Figs. 1 and 2; and

Fig. 3A is a schematic diagram illustrating another form of fluid pressure system for operating the core breakers shown in Figs. 1 and 2.

Referring now to the drawings, the present invention is shown as embodied in a rotary cutting head 10 for a continuous mining machine or the like. The rotary cutting head 10 is supported for rotation between a pair of spaced frames 11 which are movable with respect to a coal seam 12 in a fashion as described in a combined cutting and loading machine as disclosed in Cartlidge application Serial No. 116,684, filed September 20, 1949. A gudgeon plate 13 is bored as at 15 to receive ends 14 of a stationary shaft 16 spanning the distance between the spaced frames 11. Each end of the shaft 16 has a shoulder 17 bearing against the inside faces of the gudgeon plate 13, and the shaft 16 is held in place by a nut 18 threaded to each end thereof.

The rotary cutting head 10 is mounted for rotation on the stationary shaft 16 and comprises a generally cylindrical drum 19 having end bells 21 held in place to the drum 19 by cap screws 22. The end bells 21 and drum 19 are sealed by a sealing gasket 23 bearing against a shoulder 24 on the end of the cylindrical drum 19 and held in place against a flange 26 on the end bell 21.

Each end bell 21 has a cylindrical hub 27 affording a support for a tapered roller bearing 28 which in turn is supported upon the stationary shaft 16. The interior of the drum 19 is sealed at all times by a seal 29 supported in the end bell 21 and between the bearing 28 and the interior of drum 19, and an outer seal 31 disposed on the other side of the bearing 28, the seal being supported in an annular ring 32 having a flange 33 which abuts the end of the hub 27.

Rotation is imparted to the rotary cutter head 10 by combined cutter and driving chains 34, each of which is trained around a drive sprocket 36 made fast to the outside of the hub 27 by a key 37. The cutter chains 34 have spaced and staggered bits 38 mounted thereon which cut a kerf 39 in the face of the coal seam 12.

The outer periphery of the cylindrical drum 19 is provided with supports 41 for cutter bits 42 which are spaced around the cylindrical shell thereby to cut additional spaced kerfs 43 in the face of the coal seam 12, said kerfs 39, 43, being alternate with core sections or core ribs 44.

As seen in Fig. 3, there are three such tiers or rows of cutter bits 42 spaced around the periphery of the drum 19. In each such row or tier of cutter bits are disposed

breakers 46 preferably spaced at 180° with respect to each other, and disposed angularly with respect to the breaker members 46 mounted in next adjacent or succeeding tiers. There being three tiers of breakers shown, the breakers of each tier are preferably disposed 120° apart.

According to the present invention the breakers 46 are adapted to move outward with respect to the periphery of the drum 19 to break the cores formed between the kerfs 43.

Each breaker 46 is thus moved radially by a fluid motor which includes a piston 47 slidable within a closed cylinder 48 having a cylinder head 50, both being formed integrally with the cylindrical wall of the drum 19, see particularly Fig. 2. Each piston 47 is bored at its skirt end to receive a pin 49 supporting a tapered breaker roller 51, the pin 49 having a reduced part as at 52 to provide a shoulder 53 against which the base of the tapered roller may at times bear. The pin 49 is secured in position in the piston 47 by a set secrew 55. The tapered roller 51 turns upon a bushing 54 held between the shoulder 53 and a turned in annular flange 56, the end of the roller 51 being countersunk as at 57. A nut 58 is threaded to a reduced diameter portion of the pin 52 to hold the tapered roller 51 in place upon the pin 52.

As seen particularly in Figs. 1 and 2, a surface element of the tapered roller 51 is parallel to a side wall of the kerf 43 and is adapted upon outward movement thereof to enter into the kerf 43 so that a diametrically opposite surface element will contact the corner of the core 44 and fragment same from the seam.

The piston 47 has a land 61 at the cylinder head end thereof adapted to receive an oil seal 62 in a slot 63 formed therein. The piston 47 has a portion of reduced diameter 64 which is slidable in a sleeve 66 threaded on the outside thereof to an internally threaded flange 67 extending from the outer periphery of the drum 19. A spring 68 for returning piston 47 and breaker 46 is bottomed at one end to the inside of the threaded sleeve 66, and is bottomed at the other end on the land 61.

The cylinder head 50 has extending integrally therefrom a cylindrical valve body 71 having an internal bore 72. A spool valve member 73 has a pair of spaced lands 74 and 76 and an actuating stem 77 extending through an opening 78 formed to an end wall 79 of the valve body 71 remote from the cylinder head 50. The other end of the bore has threaded thereto a closure member 81 which separates the cylinder 48 from the valve bore 72. A return spring 82 for the valve member 73 is positioned between the closure member 81 and the land 74 to bias the valve member 73 to the right as seen in Fig. 2. A pressure port 83 leads from the valve bore 72 to the interior of the cylinder 48, and a line 85 is connected to the valve bore 72 at a point adjacent the closure 81, said line freely communicating with the interior of the cylindrical drum 19 for a purpose as will appear as this specification proceeds. A pressure line 84 intersects the valve bore 82 at a point substantially midway of the lands 74 and 76 when the valve member 73 is in the position seen in Fig. 2.

When the parts just described are in the position shown in Fig. 2 the left hand piston 47 will be subjected to no back pressure, the pressure thereon being relieved by way of the port 83 and port 85. When the valve plunger 73 is moved to the left, under conditions as will be described as this specification proceeds, whereby the land 74 will be moved to a position to the left of the point where passage 83 communicates with the bore 72, fluid under pressure will be admitted to the cylinder 48 to move the piston 47 against the force of the spring 68 to move the breaker 46 radially outwardly into contact with the core 44.

Means are provided for supplying fluid under pressure to move the breakers 46 radially outwardly. To this end a pump 86, see Fig. 1, is arranged to rotate with the hollow drum 19 and is held on the inside thereof, for example, by means of countersunk screws 87 passing through the cylindrical wall of the drum 19. The pump 86 includes a drive shaft 88 having a driving gear 89 fast thereto which meshes with a stationary gear 91 held to the stationary shaft 16 by means of a key 92. It will be seen that as the pump rotates with the hollow drum 19 about the shaft 16 the drive shaft 88 thereof will be driven through the medium of the stationary gear 91 and the drive gear 89.

It should be noted that in one form of the invention the inside of the hollow drum 19 is caused to be the reservoir for a supply of hydraulic fluid pumped by the pump 86. The pump 86 is so arranged as to have an intake port 85, located near the inside face of the hollow drum 19. In order to insure that the intake port of the pump 86 will be submerged under the supply of hydraulic fluid contained within the reservoir 19, the inside of the cylindrical shell 19 has a plurality of inward extending vanes or ribs 93 which act in the nature of paddle wheels to insure that a moving annulus of hydraulic fluid is carried along the interior of the cylindrical shell 19 as the cutter head 10 rotates about the stationary shaft 16.

The output of the pump 86 is connected through a pressure relief valve 80 to a pressure manifold 94, the manifold having branching therefrom pressure lines 84 to supply pressure fluid to each of the breakers 46, the fluid being under the control of the valves 71.

Means are provided for causing the breakers 46 to move outward radially in timed relationship to the rotation of the drum. To this end there is provided a boss 96 extending inwardly from one of the end bells 21. Said boss has extending therefrom a stub shaft 97 upon which is mounted a pair of cluster gears 98, 99. Cluster gear 99 meshes with a gear 101 fast upon the stationary shaft 16 by means of a key 102. Cluster gear 98 meshes with a gear 103 which may be formed integrally with a long tubular sleeve 104 surrounding the stationary shaft 16.

The hollow tubular sleeve 104 is provided with cam members 106 which are disposed along the length thereof in alignment with the actuator stems 77 of the valves 71, said cam members 106 each having a lobe 107, see also Fig. 2, which when in alignment with its respective actuator 77 will cause the valve member 73 to move to a position to admit fluid from pressure line 84 past spool member 73 and out pressure port 83 to the cylinder 48 to move the piston 47 against the force of spring 68 and thereby move the breaker member 46 into contact with the core 44.

The teeth ratios of the clustered gears 98 and 99 and their respective mating gears 103 and 101 are desirably so chosen that the hollow shaft 104 will revolve one more revolution than any desired number of revolutions of the rotating drum. In the example shown in Fig. 1, the gears 98, 99, 101 and 103 are so chosen, for example, that the shaft 104 will rotate seven times for each six rotations of the rotating drum 19. The contour of the cams 106 and their lobes 107 are desirably chosen so that its corresponding breaker 46 will thus be moved radially outwardly once every six revolutions of the rotating drum 19 thereby enabling in the meanwhile the building up of a considerable depth of core 44 prior to the outward movement of breaker 46 to break same off.

As seen with respect to Fig. 2, the opposite breaker 46 in each tier shown has its cam advanced slightly with respect to the other cam, so that both breakers in each tier are out in their extended positions at substantially the same time. It will be remembered with respect to Fig. 1, that each pair of breakers 46 is adapted to strike the core on each side of the kerf 43 formed by each tier of cutter bits 42.

The cams 106 of each tier may also be disposed angularly with respect to the cams of the other tiers so that only one pair of breakers 46 are in the extended position at any one time, thereby eliminating the necessity of a

large volume pump which would be necessary if all the breakers were moved outwardly at the same time. Each pair of cams for moving its respective pair of breakers **46** may thus, in the case of where three such tiers of kerfs are cut, be spaced at 120° with respect to the other.

Obviously, any desired sequence of operations of the breakers **46** may be arrived at by suitably selecting the gears **98**, **99**, **101** and **103** and the arrangement and disposition of the cams **106** upon the shaft **104**. It may be desirable, for example, to have all the breakers moved outwardly substantially simultaneously. It may also be desirable, for example, to have the breakers moved outward for example once in each twenty revolutions of the drum cutter **10**.

Referring now to Fig. 3A of the drawings, there is shown another embodiment of the invention where the fluid pressure system described includes a closed reservoir **108** which is connected by a line **109** to the intake side of the pump **86**. The control valves **73** instead of exhausting the cylinders **48** directly to the interior of the drum **19** by means of the exhaust passages **85**, are connected by means of the exhaust passages **85** to a return manifold **111** connected to the tank **108**. The intake line **109** from the reservoir **108** is connected at a point on the reservoir **108** where the centrifugal force of the hydraulic fluid within the system will be normally thrown to a point therein closest to the cylindrical shell **19** of the cutter **10**, to insure at all times that the intake side of the pump **86** will be supplied with pressure fluid.

From the foregoing description it will be apparent that there has been provided a new and useful improvement in drum cutters for continuous mining machines. The apparatus of the present invention makes unnecessary the use of complicated mechanisms for providing outward movement of the breakers for removing the cores which have been built up by the action of the cutter bits **42**. By suitable selection of the timing mechanism for moving the cutters outwardly the size of the hydraulic system may be kept within any suitable or desirable range, and the breakers need only to be moved outwardly in accordance with the power available for such movement. The invention is further characterized by having the interior of the hollow drum supporting the cutter bits arranged as a reservoir for the pressure fluid. In the event that hydraulic fluid is used, the fluid also provides a means for lubricating all of the moving parts within the hollow drum.

While the invention has been described in terms of a number of preferred embodiments thereof, it is not intended that the invention be limited by the precise embodiment shown, nor otherwise than by the scope and spirit of the claims here appended.

I claim:

1. In a cutting head for a machine for mining coal or the like from a seam thereof, a frame defining a support for a shaft, a hollow rotating drum mounted upon said shaft, cutter bits mounted on the periphery of said drum for cutting spaced kerfs in said seam, breakers carried by said drum including fluid pressure motors for moving said breakers outwardly with respect to said drum for breaking the cores formed between said kerfs, a reservoir for fluid maintained within said drum, a pump supported within said drum and including means for driving said pump upon rotation of said drum for placing said fluid under pressure, and means for connecting said pump to a fluid pressure motor associated with each breaker for operating same.

2. In a cutting head for a machine for mining coal or the like from a seam thereof, a frame defining a support for a shaft, a hollow rotating drum mounted upon said shaft, cutter bits mounted on the periphery of said drum for cutting spaced kerfs in said seam, breakers carried by said drum including fluid pressure motors for moving said breakers outwardly with respect to said drum for breaking the cores formed between said kerfs, a reservoir for fluid maintained within said drum, a pump supported within said drum and including means for driving said pump upon rotation of said drum for placing said fluid under pressure, valve means connecting said pump with each of said fluid pressure motors and controlling the operation of said fluid pressure motors, and means for actuating said valve means comprising a cam operable in timed relationship to the rotation of said drum.

3. In a cutting head for a machine for mining coal or the like from a seam thereof, a frame defining a support for a shaft, a hollow rotating drum mounted upon said shaft, cutter bits mounted on the periphery of said drum for cutting spaced kerfs in said seam, breakers carried by said drum including fluid pressure motors for moving said breakers outwardly with respect to said drum for breaking the cores formed between said kerfs, a reservoir for fluid maintained within said drum, a pump supported within said drum and including means for driving said pump upon rotation of said drum for placing said fluid under pressure, valve means connecting said pump with each of said fluid pressure motors and controlling the operation of said fluid pressure motors, and means for actuating said valve means and said fluid pressure motors in accordance with the rotation of said drum.

4. In a cutting head for a machine for mining coal or the like from a seam thereof, a frame defining a support for a shaft, a hollow rotating drum mounted upon said shaft, cutter bits mounted on the periphery of said drum for cutting spaced kerfs in said seam, breakers carried by said drum including fluid pressure motors for moving said breakers outwardly with respect to said drum for breaking the cores formed between said kerfs, a reservoir for fluid maintained within said drum, a pump supported within said drum and including means for driving said pump upon rotation of said drum for placing said fluid under pressure, and valve means for connecting each of said fluid pressure motors to the output of said pump.

5. In a cutting head for a machine for mining coal or the like from a seam thereof, a frame defining a support for a shaft, a hollow rotating drum mounted upon said shaft, cutter bits mounted on the periphery of said drum for cutting spaced kerfs in said seam, breakers carried by said drum including fluid pressure motors for moving said breakers outwardly with respect to said drum for breaking the cores formed between said kerfs, a reservoir for fluid maintained within said drum, a pump supported within said drum and including means for driving said pump upon rotation of said drum for placing said fluid under pressure, and means for connecting the output of said pump to each of said fluid pressure motors.

6. A cutting head for a machine for mining coal or the like from a seam thereof comprising: a rotating drum having cutting bits mounted thereon for cutting spaced kerfs in said seam, breakers mounted on said drum arranged to move outwardly with respect to said drum for breaking the cores formed between said kerfs, a fluid pressure motor for moving each breaker, a supply of pressure fluid retained with said drum, vane members extending inwardly from said drum and so arranged that upon rotation of said drum said fluid rotates with said drum substantially as an annular shaped body, a pump mounted within said drum and including means for driving said pump upon rotation of said drum, said pump having its intake in said annular shaped body of fluid, and valve means operable in timed relationship with the rotation of said drum and connecting said pump and said fluid pressure motor for controlling the operation of said fluid pressure motor.

7. A cutting head for a machine for mining coal or the like from a seam thereof comprising: a rotating drum having cutting bits mounted thereon for cutting spaced kerfs in said seam, breakers mounted on said drum arranged to move outwardly with respect to said drum for breaking the cores formed between said kerfs,

a fluid pressure motor for moving each breaker, a supply of pressure fluid retained within said drum, vane members extending inwardly from said drum and so arranged that upon rotation of said drum said fluid rotates with said drum substantially as an annular shaped body, a pump mounted within said drum and including means for driving said pump upon rotation of said drum, said pump having its intake in said annular shaped body of fluid, and means for connecting the output of said pump to said fluid motor to cause movement of its associated breaker.

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