

[54] MINING MACHINE HAVING
ADJUSTABLE LENGTH CUTTING
DRUM

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[58] Field of Search.....299/64, 67, 73, 75, 76, 80,
299/89

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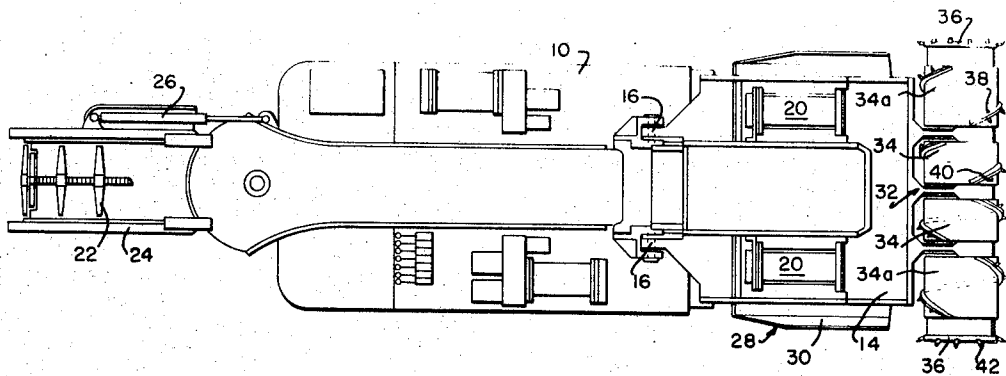
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[57] ABSTRACT

A mining machine having a rotary mining head which comprises an elongated support carrying a plurality of laterally spaced, rotatable cutter support drums fixed against lateral movement and rotatable end cutter support drums laterally movable to vary the length of the mining head by separate pistons in cylinder means contained in the support. The first mentioned drums carry cutter bits arranged to cut along the therebetween spaces thereby avoiding the necessity for cutter chains or other auxiliary cutting or breaking means therebetween; and the drums are rotatably driven by a pair of drive motors through clutchless interconnecting means including intermeshing gears in the mining head on non-parallel axes.

24 Claims, 7 Drawing Figures



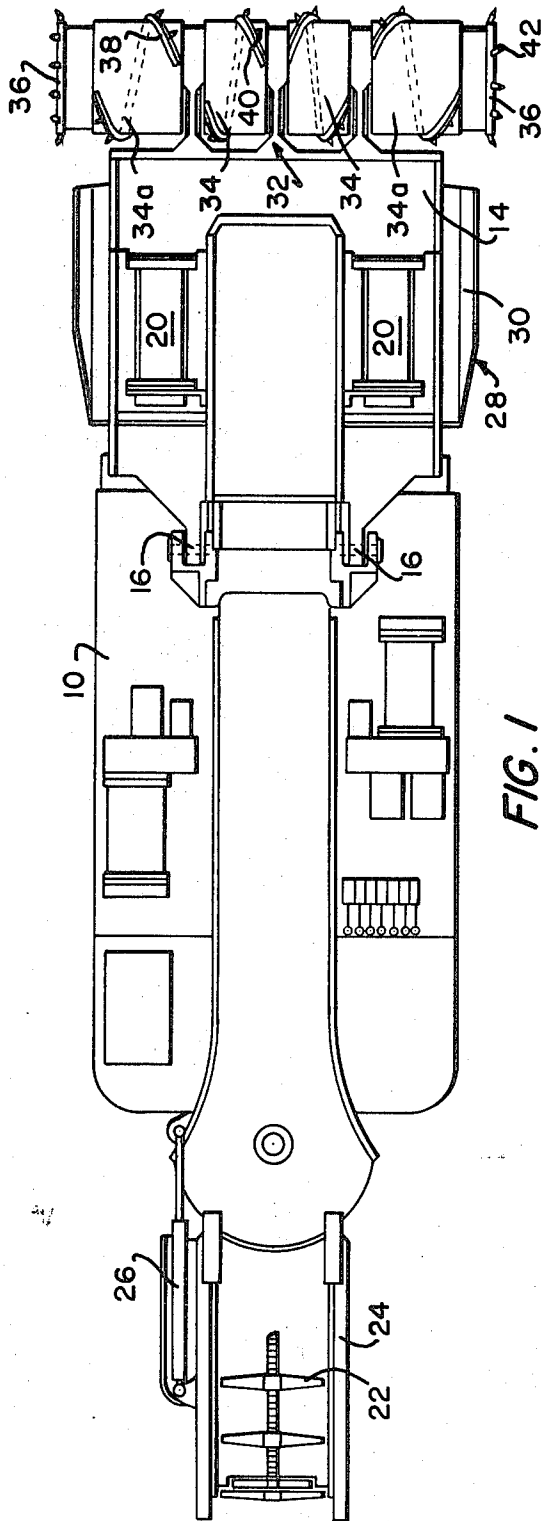


FIG. 1

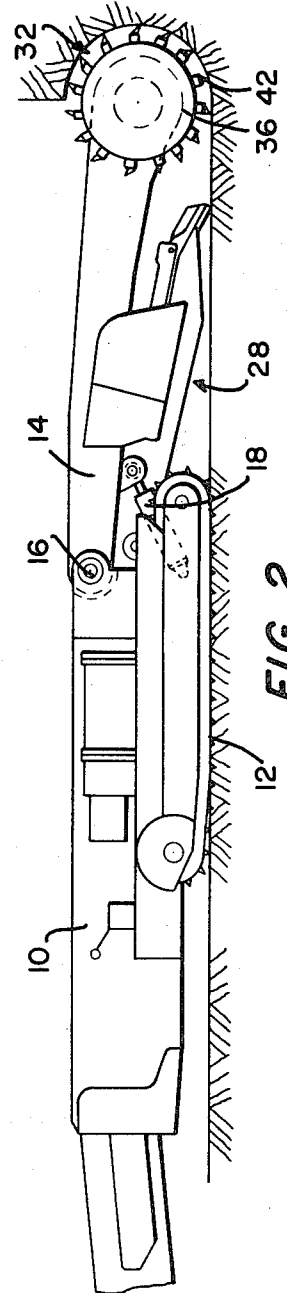
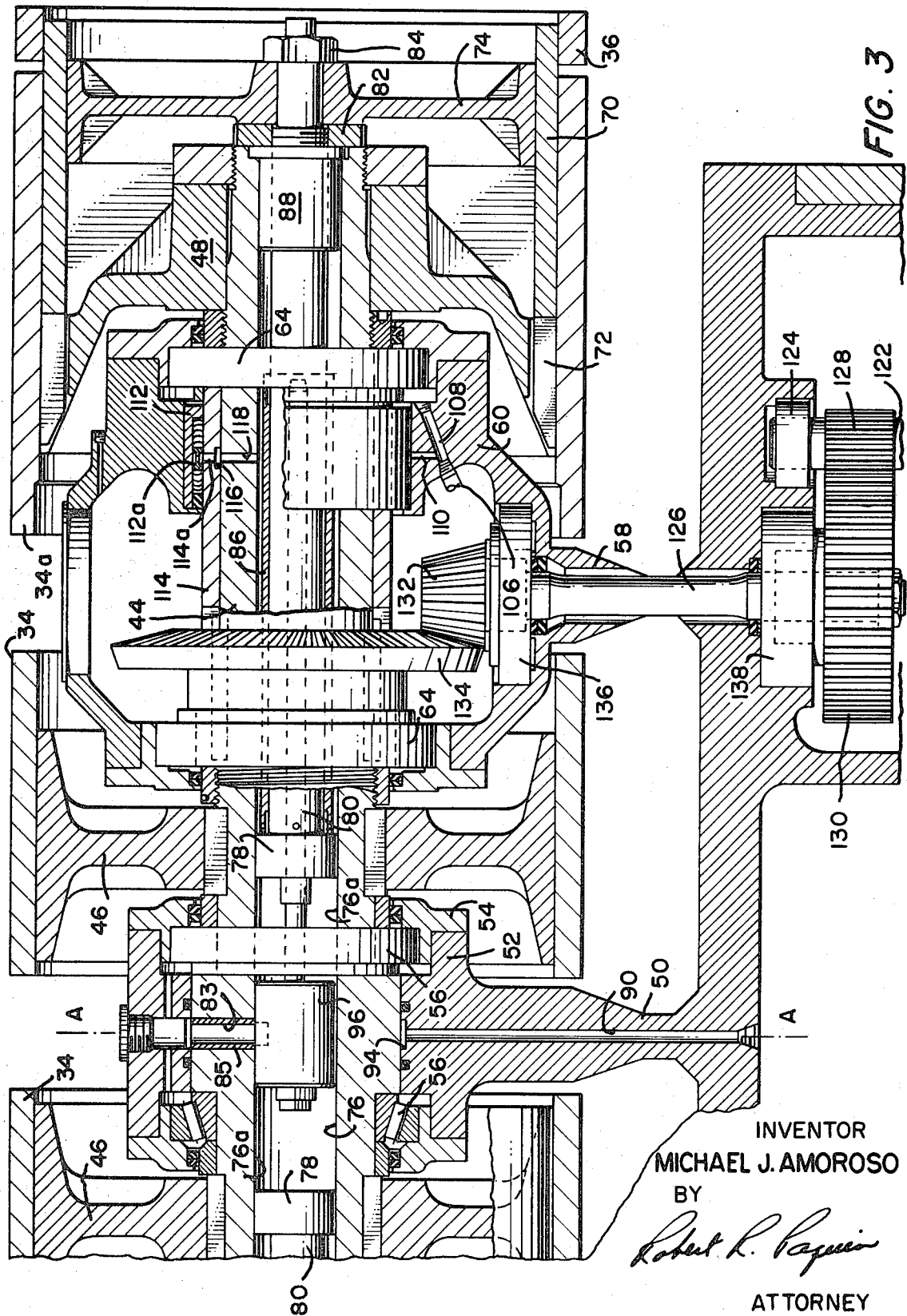


FIG. 2

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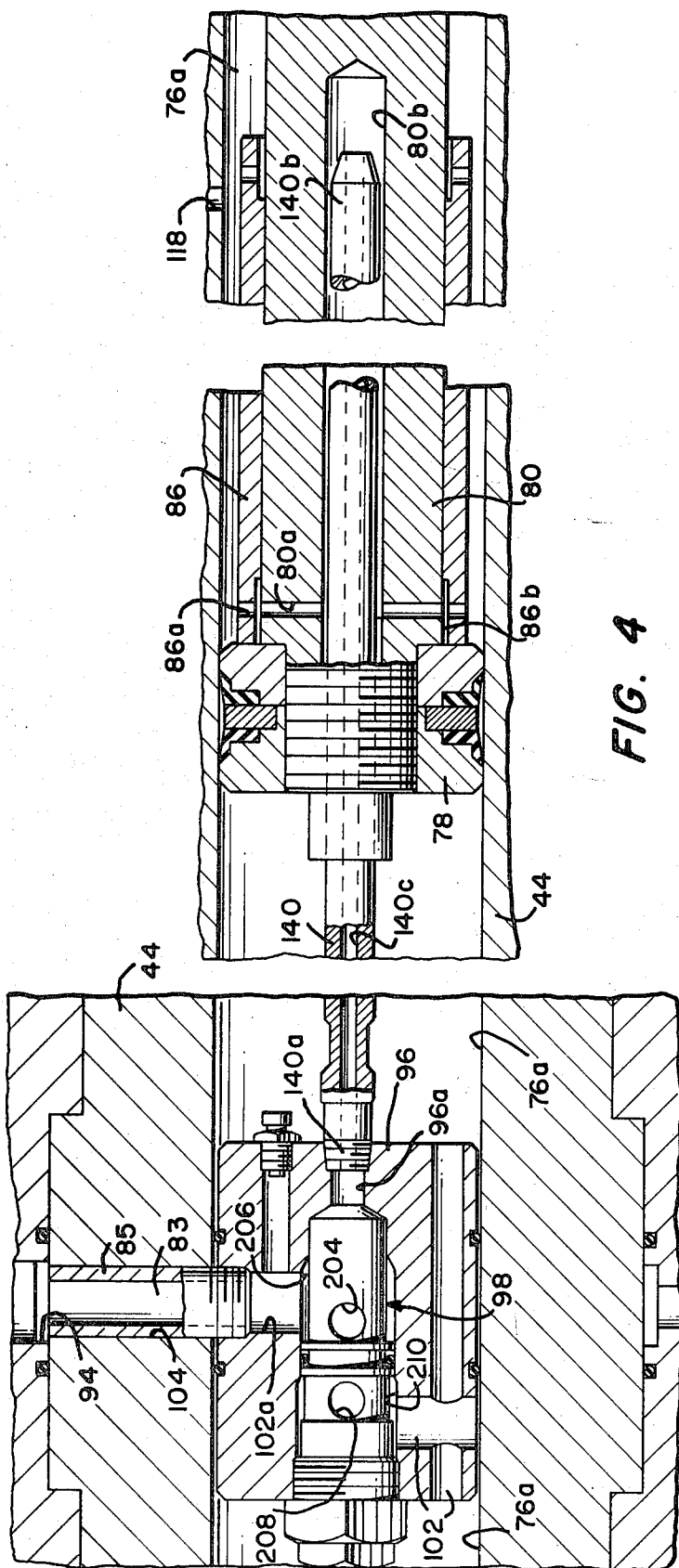
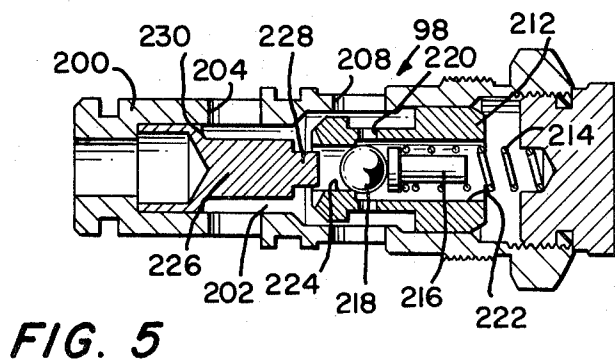
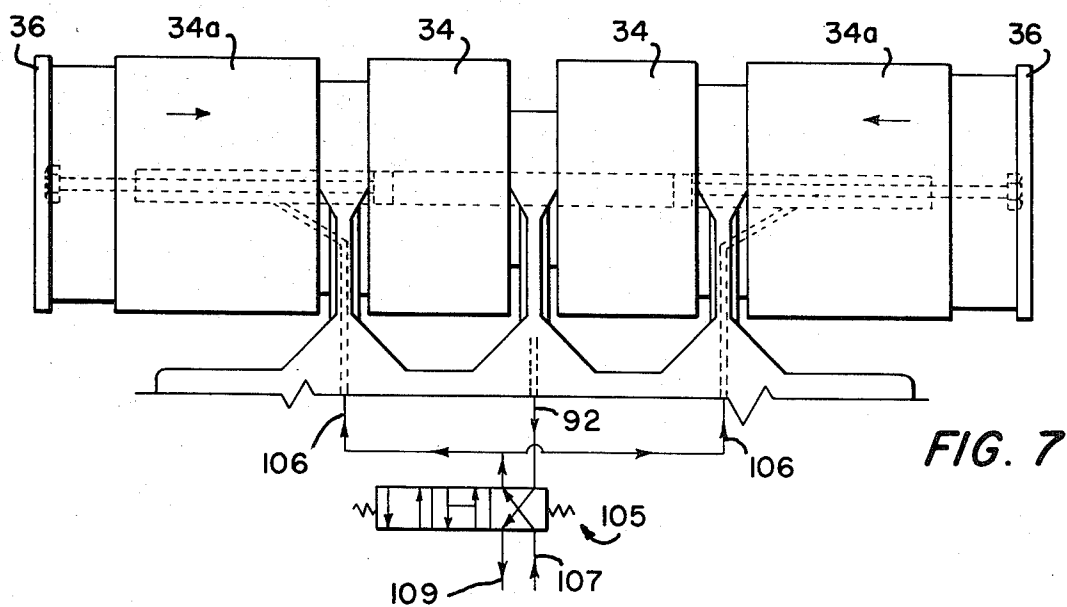
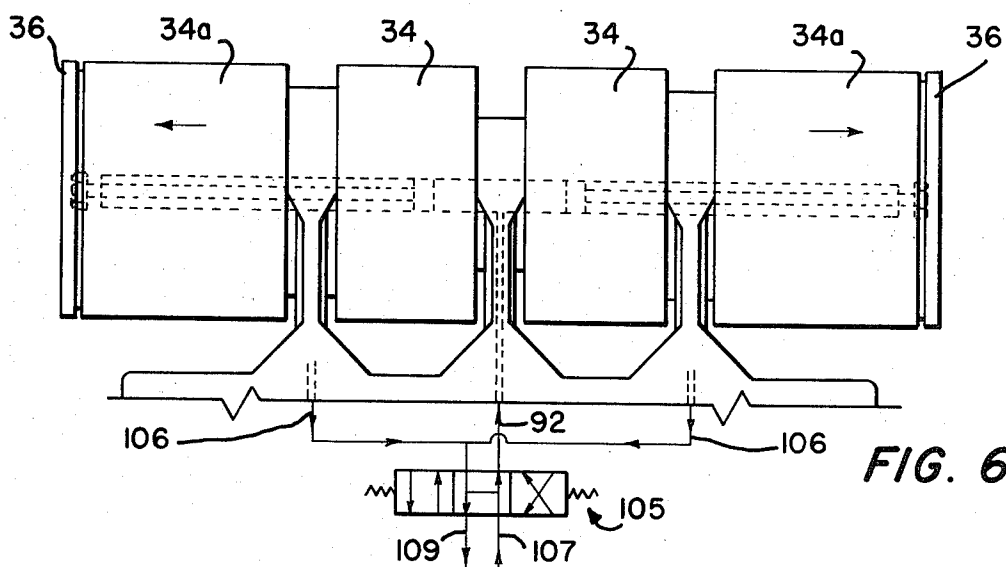


FIG. 4

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MINING MACHINE HAVING ADJUSTABLE LENGTH CUTTING DRUM

The present invention relates to mining machines, such as for example employed for the mining of coal, having a mining head including cutter supporting drums rotatably driven during the mining operation.

An object of the invention is to provide a mining machine of this type with a new and improved mining head which is particularly constructed and arranged to avoid the necessity for cutter chains or other auxiliary cutting or breaking means between spaced drums of the mining head.

Another object of the invention is to provide a mining machine of this type with a new and improved mining head which is particularly constructed and arranged to be variable in length.

Another object is to provide a mining machine of this type with a new and improved mining head having driving means particularly constructed and arranged to rotatably drive the drums of the mining head without the employment of a clutch.

A mining machine constructed in accordance with the present invention may include a chassis, a boom mounted on the chassis for vertical movement thereto, an elongated mining head including supporting means and rotatable cutter support drums carried by the supporting means, such cutter support drums comprising drums at the opposite ends of the mining head movable for varying the length of the mining head and such cutter support drums also comprising therebetween drums mounted laterally spaced one from another along the length of the mining head to be retained in relatively fixed laterally spaced apart positions during operation of the machine, means mounting the mining head on the boom, actuating means connected to the end drums for moving the latter to vary the length of the mining head, cutter means carried by the drums for cutting along the mining head during rotation of the drums, such cutter means including cutters mounted on the laterally spaced apart drums for cutting along the therebetween space and such cutters being at least the primary means for cutting along such space, and driving means connected to the drums for rotatably driving the latter.

Referring to the drawings:

FIG. 1 is a top or plan view of a mining machine embodying the present invention;

FIG. 2 is an elevational side view of the mining machine shown in FIG. 1, illustrating the mining head in operation against a mine face;

FIG. 3 is an enlarged, fragmentary sectional view illustrating a portion of the mining head of the mining machine shown in FIGS. 1 and 2;

FIG. 4 is a further enlarged, fragmentary sectional view of such mining head;

FIG. 5 is an enlarged sectional view of a pilot operated valve in the mining head; and

FIGS. 6 and 7 are views of the mining head schematically depicting the head during its extension and its retraction, respectively.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, the illustrated mining machine comprises a mobile supporting base which includes a chassis 10 ground mounted at its opposite

sides by crawlers 12 and a boom 14 pivotally connected at 16 to the forward end of the chassis 10 for vertical movement relative to the latter by a pair of cylinder-and-piston motors 18. An endless conveying chain, shown fragmentarily as 22, extends longitudinally of the chassis 10 and at the rearward end thereof is supported by a swing support 24 which is horizontally movable by a cylinder-and-position motor 26 to provide angular adjustment of the direction in which mined material is discharged by the chain 22. Adjacent the forward end of the chassis 10, the chain 22 projects below the boom 14 and is operatively associated with a gathering head device, designated generally as 28, which in the conventional manner may include a gathering apron 30 provided with the usual gathering arms driven to direct material mined by the machine to the conveying chain 22.

The elongated mining head of the mining machine is designated generally as 32 and is mounted on the forward end of the boom 14 with its longitudinal axis transverse to the boom 14 and the chassis 10. The mining head 32 comprises a central portion including pairs of laterally spaced, coaxial, rotatable inner and outer cutter support drums 34, 34a, respectively, which are fixedly held from lateral movement, and at its opposite ends has coaxial, rotatable end cutter support drums 36 which are laterally movable to extend and retract the length of the mining head 32. The support drums 34, 34a, as shown in FIG. 1, each circumferentially carry a single spiral cutter supporting plate 38 having cutters 40 at generally equally spaced locations therealong. The cutters 40 most adjacent to the sides of the drums 34, 34a angle outwardly towards the respective laterally adjacent drums; and such cutters 40 of laterally adjacent ones of the drums 34, 34a, are at their cutting tips spaced apart a distance generally the same as that between the cutting tips of the adjacent cutters 40 each of the drums 34, 34a. Thus, such outwardly angle cutters 40 cooperate to cut along the spaces between the drums; and no cutting chains or other auxiliary cutting or breaking means need be provided between laterally adjacent drums 34, 34a. The drums 36, as illustrated in FIG. 1, each circumferentially carry a plurality of cutters 42 arranged to cut both forwardly of the drums 36 and also adjacent the sides thereof. The cutters 40, 42, per se, may be of any suitable conventional construction and have not been shown in FIGS. 3, 6 and 7 to permit clearer illustration of the internal arrangement of the mining head 32.

The mining head 32 and its contained structure are generally symmetrical about a plane taken normal to the longitudinal axis of the mining head 32 at the longitudinal center of the latter, such plane being represented by the broken line A—A in FIG. 3. Hence, only the structure contained in one-half of the mining head 32 has been completely shown in detail in FIG. 3; and the structure contained in the portion of the mining head 32 not shown in detail in FIG. 3 is, as will be understood, similar to the corresponding portion of such illustrated half thereof.

The mining head 32 contains an elongated, horizontally extending, axial support or supporting means 44 which longitudinally extends through the inner drums 34 and has its opposite ends internally of the outer

drums 34a. The inner drums 34 are coaxially mounted on the support 44 for conjoined rotation therewith by annular drum mountings 46 which at their inner circumferences may be splined or otherwise suitably affixed to the support 44 and along their outer circumferences are welded or otherwise suitably affixed to the inner drums 34; and the outer drums 34a are similarly coaxially mounted on the support 44 for conjoined rotation therewith by annular drum mountings 48 which each are at their inner and outer circumferences affixed to the support 44 and an outer drum 34a, respectively. The drums 34, 34a are relatively arranged longitudinally of the support 44 such that the inner drums 34 are retained equally spaced on opposite sides of the plane A—A at the longitudinal center of the mining head 32 and the outer drums 34a are retained each spaced from the thereadjacent inner drum 34 a distance substantially the same as the spacing between the two inner drums 34.

The mining head 32 is mounted on the boom 14 by mounting means which rotatably support the mining head 32 adjacent its longitudinal center and also intermediate such location and each of the ends of the mining head 32. More particularly, adjacent the longitudinal center of the mining head 32, the boom 14 is provided with a mounting arm 50 which projects forwardly between the inner drums 34 and at its forward end carries an annular, open ended mounting housing 52 encircling the support 44. The mounting housing 52 at its ends is connected to mounting plates 54, each extending around the support 44, which support conventional roller bearings 56 rotatably mounting the support 44 adjacent the longitudinal center of the mining head 32. Similarly, the boom 14 is provided with a mounting arm 58 which projects forwardly between each inner drum 34 and the thereadjacent outer drum 34a, each mounting arm 58 at its forward end carrying an annular, open ended mounting housing 60 encircling the support 44. The mounting housings 60 are each at their ends closed by mounting plates 62 which extend around the support 44 and carry conventional roller bearings 64 rotatably mounting the support 44. The mounting housings 52, 60 and their respective mounting plates 54, 62, as best shown in FIG. 3, cooperate to enclose the support 44 in the spaces between laterally adjacent ones of the drums 34, 34a. The mounting arms 50, 58, as illustrated, are each constructed of relatively thin cross-section to facilitate the employment of the outwardly angled cutter bits 40 as the means for cutting along the spaces between the drums 34, 34a. The end drums 36 each are affixed to the outer circumference of an annular supporting drum 70 which is telescopingly received within the thereadjacent outer drum 34a and connected by elongated keys 72 to the latter. The supporting drums 70 each are welded or otherwise suitably affixed to the outer circumference of a supporting disc 74 by means of which the supporting drums 70 and the end drums 36 are selectively movable axially of the mining head 32 to extend and retract the length of the latter.

The support 44 contains a uniform cross-section axial bore 76 having its ends closed at the ends of the support 44; and the bore 76 is divided into a pair of end-to-end cylinders 76a by a valve block 96 which is located at the longitudinal center of the mining head 32

and provided with a check valve designated generally as 98. A piston 78 is slidably disposed within each of the cylinders 76a, the pistons 78 each being affixed to one end of an extension or piston rod 80 which longitudinally projects from its respective connected piston 78 towards the thereadjacent end of the mining head 32 and at its other end is affixed by mounting nuts 82, 84 to the supporting disc 74 at such mining head end. The rods 80 carry surrounding sleeves 86 and adjacent their said other ends extend through packing and bushing assemblies 88.

The valve block 96 contains bores 102, 102a connecting the head ends of the cylinders 76a through the check valve 98 to a bore 83 contained in a tubular sleeve 85 extending inwardly through a bore 104 in the support 44; and the bore 83 is connected to source or reservoir of pressurized fluid through an annular chamber 94 surrounding the support 44, a communicating bore 90 formed through the mounting arm 50 and its carried mounting housing 52 and a hose shown schematically in FIGS. 6 and 7 as 92. The check valve 98 is of conventional construction and may, for example, be Racine Hydraulic Inc. Model No. 1609-6.

The check valve 98 includes a valve housing 200 which, as shown in FIG. 5, contains a valve chamber 202 and has a plurality of ports 204 communicating the chamber 202 with the bore 83 through an annular chamber 206 and the bore 102a in the valve block 96. The housing 200 also contains a plurality of outer ports 208 which communicate the valve chamber 202 with the inner ends of the cylinders 76a through an annular chamber 210 and the bores 102 in the valve block 96.

Fluid flow through the valve chamber 202 from the ports 204 to the ports 208 is controlled by a slidable hollow valving piston 212 biased to a closed position against such flow by a spring 214 which acts on the piston 212 through a rod 216 and a ball element 218. The force of the fluid supplied through the bore 83 is, as will be understood, sufficiently great to overcome the biasing spring 214 whereby the piston 212 is moved against the spring 214 to permit the fluid to flow from the ports 204 peripherally around the piston 212 to the ports 208. The piston contains a plurality of radial bores 220 communicating the ports 208 with the cavity 222 in the piston 212, the cavity 222 having an open end 224 adapted to permit flow of fluid from the ports 208 to the ports 204. The open end 224 is, during the aforescribed flow of fluid from the ports 204 to the ports 208 closed by the ball element 218 to prevent reverse flow of fluid at such time.

The valve 98 includes a slidable piston 226 having a neck portion 228 adapted to extend into the open end 224 to sufficiently displace the ball element 218 to permit fluid flow from the ports 208 to the ports 204 through the open end 224 peripherally around the neck portion 228. The piston 226 has an annular shoulder 230 in which fluid acts to maintain the piston 226 remote from the ball element 218 during the flow of fluid from the ports 204 to the ports 208; and the piston 226 is moved to displace the ball element 218 only upon supply of fluid to the outer ends of the cylinders 76a.

More particularly, outwardly of the outermost positions of each piston 78 the support 44 is provided with a plurality of radial bores 118 communicating with the

cylinders 76a. The bores 118 communicating with each cylinder 76a are connected to an annular chamber 116 in a sleeve 114 surrounding the support, such annular chambers 116, in turn, communicating through bores 114a with passages 112a internally of an outer sleeve 112 surrounding the sleeve 114. The passages 112a communicate through bores (not shown) through the sleeve 112 with a pair of intersecting bores 110, 108 in a mounting housing 60; and each bore 108 is connected to a fluid supply hose or tube 106.

The hoses 92, 106 communicate through a valve designated generally as 105 with fluid supply and discharge lines 107, 109, respectively, connected to the tank or reservoir (not shown) containing the fluid. The valve 105 is of conventional construction and manually controllable by the operator of the machine to alternatively supply fluid through the hose 92 or the hoses 106 while discharging fluid from the other.

One of the sleeves 86 contains a plurality of radial bores 86a communicating through an annular chamber 86b with radial bores 80a connected to a chamber 80b contained within one of the piston rods 80. A stationary tube 140 is threadedly connected at one end 140a to the valve block 96 and contains an axial passage 140c which communicates through a bore 96a in such block 96 with the valve chamber 202 to supply fluid thereto for moving the piston 226 to displace the ball element 218. The other end 140b of the tube 140 is slidably received in the chamber 80b whereby the passage 140c receives fluid in the chamber 80b during the supply of fluid through the hoses 106.

The mining head 32 is rotatably driven by a pair of conventional rotary motors 20 which are mounted on the boom 14 and individually drivingly connected to the mining head 32 on opposite sides of the longitudinal center of the latter by separate clutchless interconnecting means. Each of the interconnecting means comprises a drive shaft 122, rotatably mounted by conventional bearings 124 and directly coupled to one of the motors 20, and a driven shaft 126 which is rotatably driven by the drive shaft 122 through intermeshing gears 128, 130 carried by the shafts 122, 126, respectively. Each driven shaft 126 longitudinally projects through one of the mounting arms 58 to have an end within one of the mounting housings 60; and such ends of the driven shafts 126 carry bevel gears 132 drivingly intermeshing with larger bevel gears 134 fixedly mounted around the support 44. The driven shafts 126, as illustrated, are rotatably mounted on conventional bearings 136, 138.

In the operation of the mining machine, the mining head 32 is extended adjacent the face to be mined by fluid supplied to the inner ends of the cylinders 76a through the hose 92 and the aforescribed communicating passages and bores in the mounting arm 50, mounting housing 52, support 44 and the valve block 96. The flow of the fluid through the valve 98 proceeds in the beforedescribed manner and, after the mining head 32 has extended to the desired length, it is retained at such length by the valve 98. Thereafter, the drums 34, 34a 36 of the mining head 32 are normally continuously rotatably driven by the motors 20 through the aforescribed clutchless interconnecting means. During each cut, the drums 34, 34a, 36 may be first

raised to elevate the mining head 32 and then, after the drums 34, 34a, 36 have formed an elevated portion of the cut in depth of around one-half of the drum diameter, the boom 14 is progressively lowered to cause the mining head 32 to downwardly extend the cut towards the floor supporting the mining machine.

In the event that the length of the mining head 32 is to be retracted, such as for example for movement of the machine between locations to be mined, pressurized fluid is supplied to the cylinders 76a through the two outer passage means including the hoses 106 to drive the pistons 78 towards one another whereby the supporting discs 74 and their carried supporting drums 70 and cutter support drums 36 are driven towards the longitudinal center of the mining head 32. Simultaneously, of course, pressurized fluid in the cylinder 76 between the pistons 78 is exhausted through the valve 98 due to the aforescribed supply of a minor portion of the fluid through the passage 140c in the element 140 to cause the piston 226 to displace or open the ball element 218.

The extension of the mining head 32 is schematically depicted in FIG. 6; the retraction of the mining head is schematically depicted in FIG. 7.

From the foregoing it will be seen that the invention provides new and improved means for attaining all of the aforesaid objects. It will, however, be understood that, although only a single embodiment of the invention has been illustrated and hereinbefore specifically described, the invention is not limited merely to this single embodiment but rather contemplates other embodiments and variations within the scope of the following claims.

I claim:

1. In a mining machine, a chassis, a boom mounted on said chassis for vertical movement thereto, an elongated mining head including supporting means and rotatable cutter support drums carried by said supporting means, said cutter support drums comprising drums at the opposite ends of said mining head movable for varying the length of said mining head and said cutter support drums also comprising therebetween drums mounted laterally spaced one from another longitudinally of the mining head to be retained in relatively fixed laterally spaced apart positions during operation of the machine, means mounting said mining head on said boom, said supporting means containing a bore, means generally centrally of said bore dividing said bore into a cylinder adjacent each end of the bore, a piston movably in each of said cylinders of said bore, said pistons being connected to said end drums to be fluid actuable for moving said end drums to vary the length of said mining head, cutter means carried by said drums for cutting along said mining head during rotation of said drums, said cutter means including cutters mounted on said laterally spaced apart drums for cutting along the therebetween space and such cutters being at least the primary means for cutting along such space, and driving means connected to said drums for rotatably driving said drums.

2. A mining machine according to claim 1, wherein said bore dividing means comprises valve means for controlling the communication of said cylinders with a source of pressure fluid.

3. A mining machine according to claim 2, wherein said valve means comprises a valve for normally preventing exhausting of fluid from the ends of said cylinders most adjacent to said valve means.

4. A mining machine according to claim 3, further comprising means for causing said valve to be responsive upon supply of fluid to the other end of a said cylinder to permit fluid to be exhausted from said most adjacent ends of said cylinders.

5. A mining machine according to claim 1, wherein said driving means comprises motor means and clutchless interconnecting means drivingly interconnecting said motor means with said drums to cause said motor means to rotatably drive said drums.

6. A mining machine according to claim 5, wherein said motor means includes a plurality of motors and said clutchless interconnecting means for each motor comprises a plurality of intermeshing gears in said mining head on intersecting axes.

7. A mining machine according to claim 1, wherein said mounting means includes mounting arms extending between adjacent ones of the cutter support drums.

8. In a mining machine, a chassis, a boom mounted on said chassis for vertical movement thereto, an elongated mining head including axial supporting means and a plurality of rotatable cutter support drums carried by said supporting means, said cutter support drums comprising end drums at the opposite ends of said mining head and a plurality of therebetween drums laterally spaced apart along the length of the mining head, said end drums being laterally movable to extend and retract the length of said mining head and said laterally spaced apart drums being mounted to be retained in relatively fixed laterally spaced apart positions during operation of the machine, means mounting said mining head on said boom on an axis transverse to said boom, said mounting means including mounting arms projecting between adjacent ones of said laterally spaced apart drums, said supporting means containing an elongated bore, means within said supporting means containing an elongated bore, means within said bore generally centrally thereof dividing said bore into a cylinder adjacent each end of the bore, a piston movably in each of said cylinders of said bore, said pistons each being connected to the thereadjacent end drum to be fluid actuatable to laterally move such end drum for extending and retracting the length of said mining head, means for supplying pressurized fluid to said cylinders, cutter means carried by said end drums and said laterally spaced drums for cutting along said mining head during rotation of said drums, said cutter means including cutters carried by said laterally spaced apart drums for cutting along the therebetween spaces and such cutters being the sole means for cutting along such spaces, and driving means connected to said drums for rotatably driving said drums.

9. A mining machine according to claim 8, wherein said bore dividing means comprises valve means for controlling the communication of said cylinders with a source of pressurized fluid.

10. A mining machine according to claim 9, wherein said driving means includes a plurality of drive motors and clutchless interconnecting means connecting said mining head adjacent each of its ends with one of said drive motors to cause said drive motors to rotatably drive the drums of said mining head.

11. A mining machine according to claim 10, wherein said clutchless interconnecting means for each drive motor includes a first gear around said supporting means and a second intermeshing gear in said mining head on an axis nonparallel with that of said first gear.

12. A mining machine according to claim 11, wherein said mounting arms include a mounting arm adjacent the longitudinal center of said mining head containing passage means which forms a portion of said pressurized fluid supply means.

13. A mining machine according to claim 11, wherein said clutchless interconnecting means includes portion projecting through said mounting arms.

14. A mining machine according to claim 9, wherein said valve means includes a valve for normally preventing exhausting of fluid from the ends of said cylinders most adjacent to said valve means.

15. In a mining head for a mining machine, supporting means, rotatable cutter support drum means carried by said supporting means and at opposite ends of the mining head comprising cutter drums laterally movable for extending and retracting the mining head, said supporting means containing a bore, means generally centrally of said bore dividing said bore into a plurality of cylinders, a piston movably in each of said cylinders of said bore, said pistons being connected to said support drums to be fluid actuatable for laterally moving said support drums to extend and retract the mining head, and means for supplying pressurized fluid to said cylinders.

16. A mining head according to claim 15, wherein said bore dividing means comprises valve means for controlling the communication of said cylinders with a source of pressurized fluid.

17. In a mining head for a mining machine, elongated supporting means, rotatable drum means carried by said supporting means, said drum means including end drums and a plurality of intermediate drums laterally spaced apart along the length of said supporting means intermediate said end drums, said end drums being laterally movable to extend and retract the length of the mining head and said laterally spaced apart drums being mounted to be retained in relatively fixed laterally spaced apart positions, said supporting means containing a bore, means within said bore generally centrally thereof dividing said bore into a cylinder adjacent each end of said bore, a piston movably in each of said cylinders of said bore, said pistons each being connected to the thereadjacent said end drum to be fluid actuatable for moving such end drum to extend and retract the length of the mining head, cutter means carried by said end and laterally spaced apart drums for cutting along the mining head during rotation of said drums, said cutter means including cutters carried by said laterally spaced apart drums for cutting along the therebetween spaces and such cutters being the sole means for cutting along such spaces, and means for supplying pressurized fluid to said cylinders.

18. A mining head according to claim 17, wherein said bore dividing means comprises valve means.

19. A mining head according to claim 18, wherein said valve means comprises a valve normally preventing exhausting of fluid from the ends of said cylinders most adjacent to said valve means and actuatable upon supply of fluid to the other end of one of said cylinders, to permit fluid to be exhausted from said most adjacent ends of said cylinders.

20. A mining head according to claim 19, further comprising individual piston rods connecting said pistons to their respective end drums, the piston rod for the piston in said one cylinder containing a chamber communicating with said other end of said one cylinder, and said valve means being provided with means received in said chamber and communicating with said valve for supplying fluid from said chamber to said valve to actuate the latter.

21. A mining machine according to claim 9, wherein said valve means comprises a valve normally preventing exhausting of fluid from the ends of said cylinders most adjacent to said valve means and actuatable, upon supply of fluid to the other end of one of said cylinders, to permit such exhausting.

22. A mining machine according to claim 21, further comprising individual piston rods connecting said pistons to their respective end drums, the piston rod for the piston in said one cylinder containing a chamber communicating with said other end of said one cylinder, and said valve means being provided with tubular means slidably extending into said chamber and communicating with said valve for supplying fluid from said chamber to said valve to actuate the latter.

23. In a mining machine, a chassis, a boom mounted on said chassis for vertical movement thereto, an elongated mining head including supporting means and rotatable cutter support drums carried by said support-

ing means, said cutter support drums comprising drums at the opposite ends of said mining head movable for varying the length of said mining head, said supporting means containing a bore, means generally centrally of said bore dividing said bore into a plurality of cylinders, a piston movable in each of said cylinders of said bore, said pistons being connected to said end drums to be fluid actuatable for moving said end drums to vary the length of said mining head, and driving means connected to said cutter support drums for rotatably driving said drums.

24. In a mining machine, a chassis, a boom mounted on said chassis for vertical movement thereto, an elongated mining head including supporting means and rotatable cutter support drum carried by said supporting means, said cutter support drums comprising drums at the opposite ends of said mining head movable for varying the length of said mining head, said supporting means containing a bore, valve means dividing said bore into a plurality of cylinders and controlling the communication of said cylinders with a source of pressure fluid, a piston movable in each of said cylinders of said bore, said pistons being connected to said end drums to be fluid actuatable for moving said end drums to vary the length of said mining head, and driving means connected to said cutter support drums for rotatably driving said drums.

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