

Oct. 16, 1945.

A. L. LEE

2,387,159

MINING MACHINE

Filed Nov. 4, 1943

4 Sheets-Sheet 1

Fig. 1

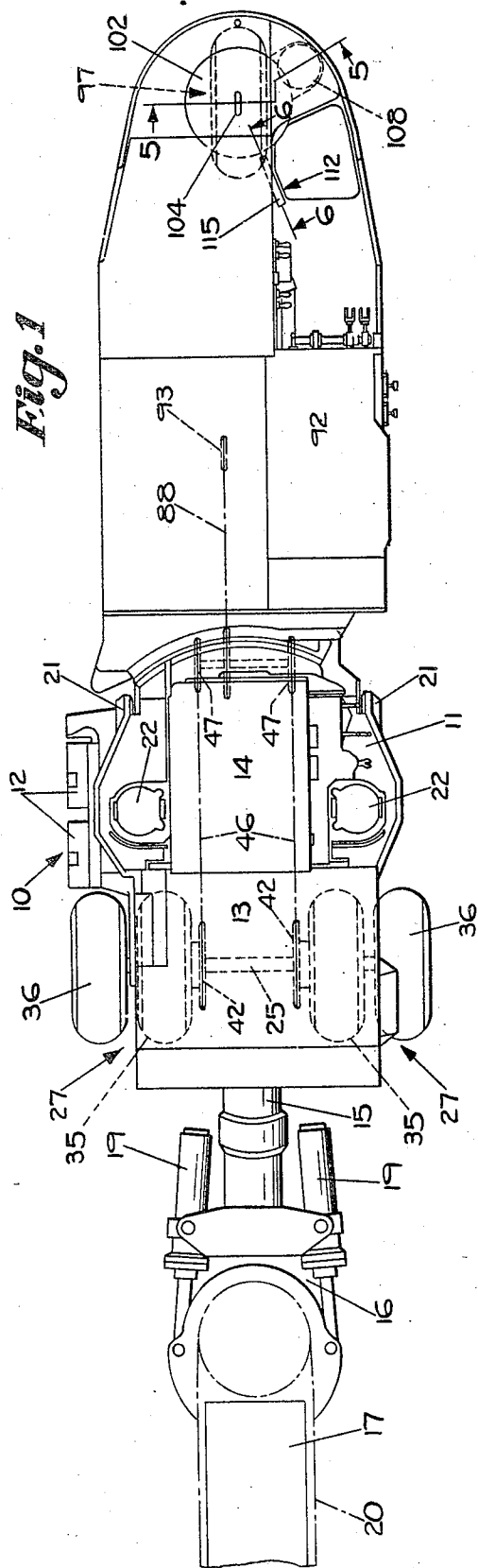
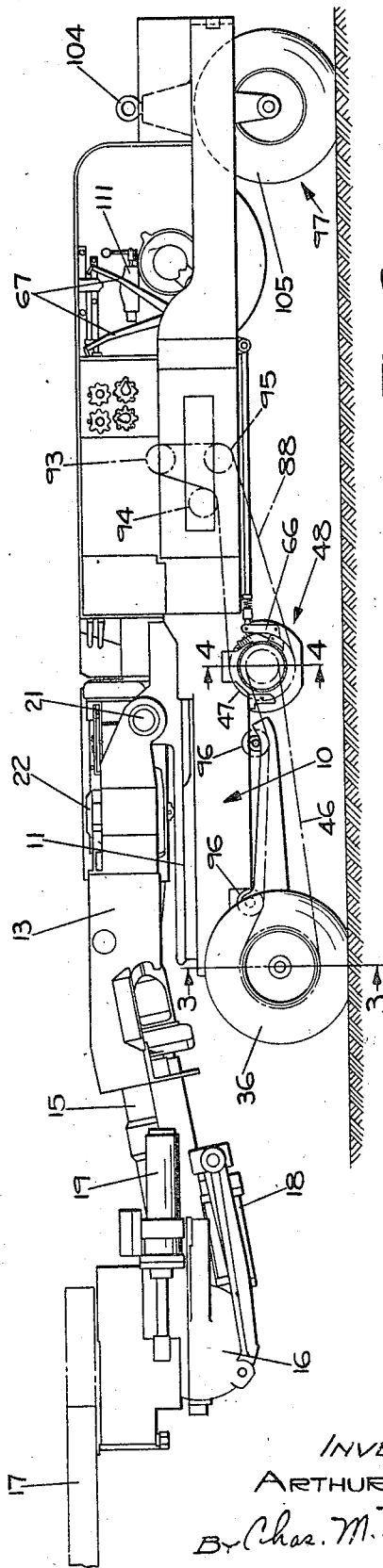


Fig. 2



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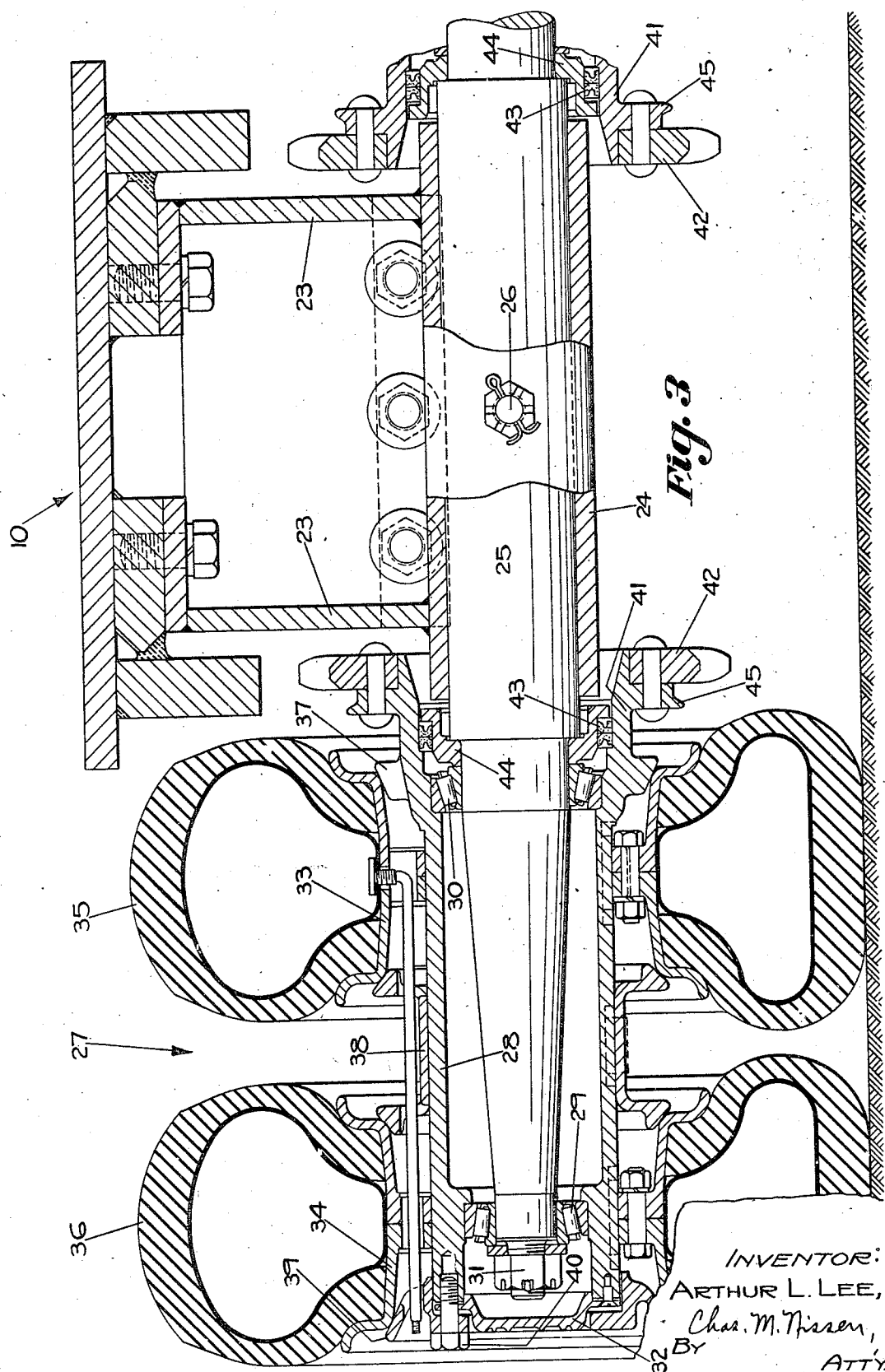
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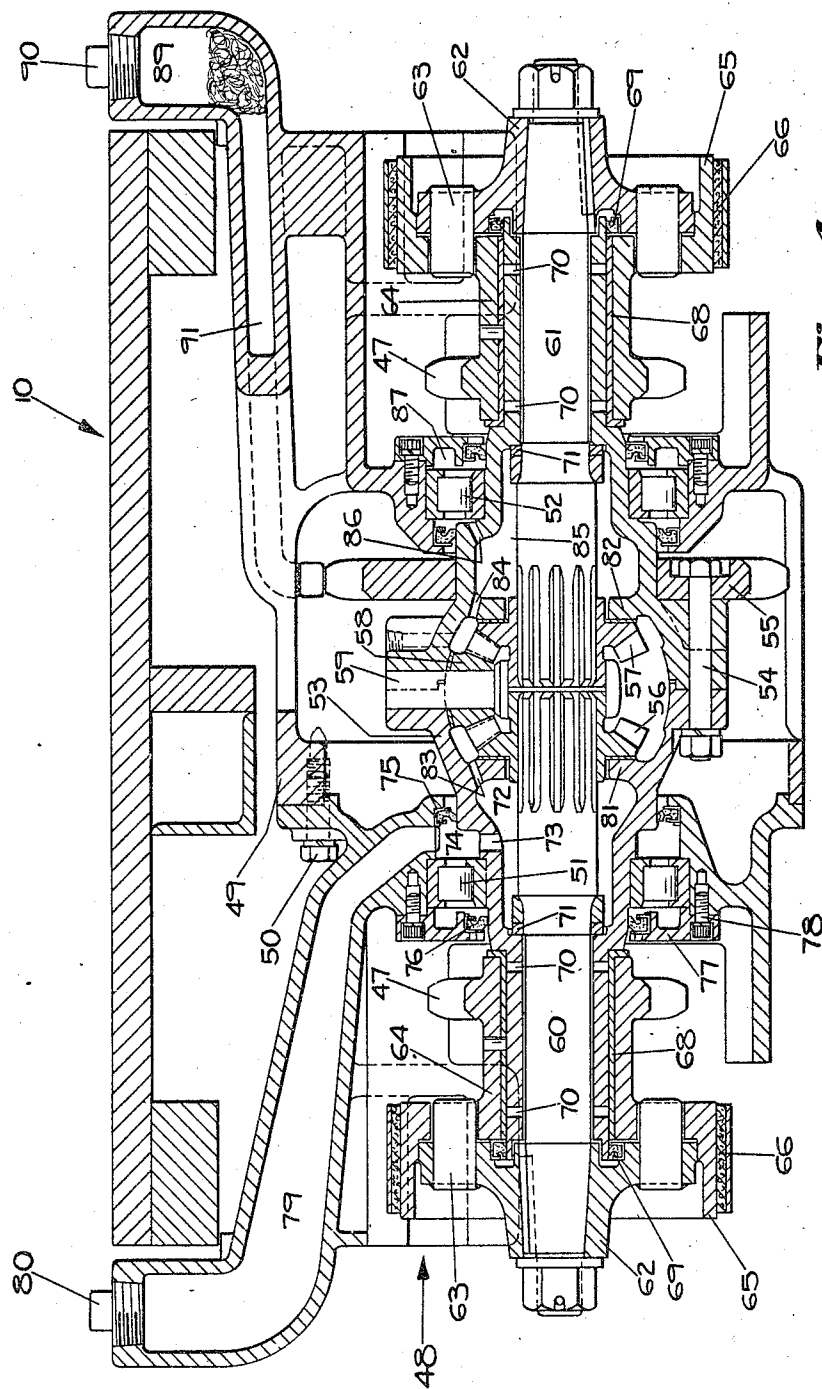


Fig. 4

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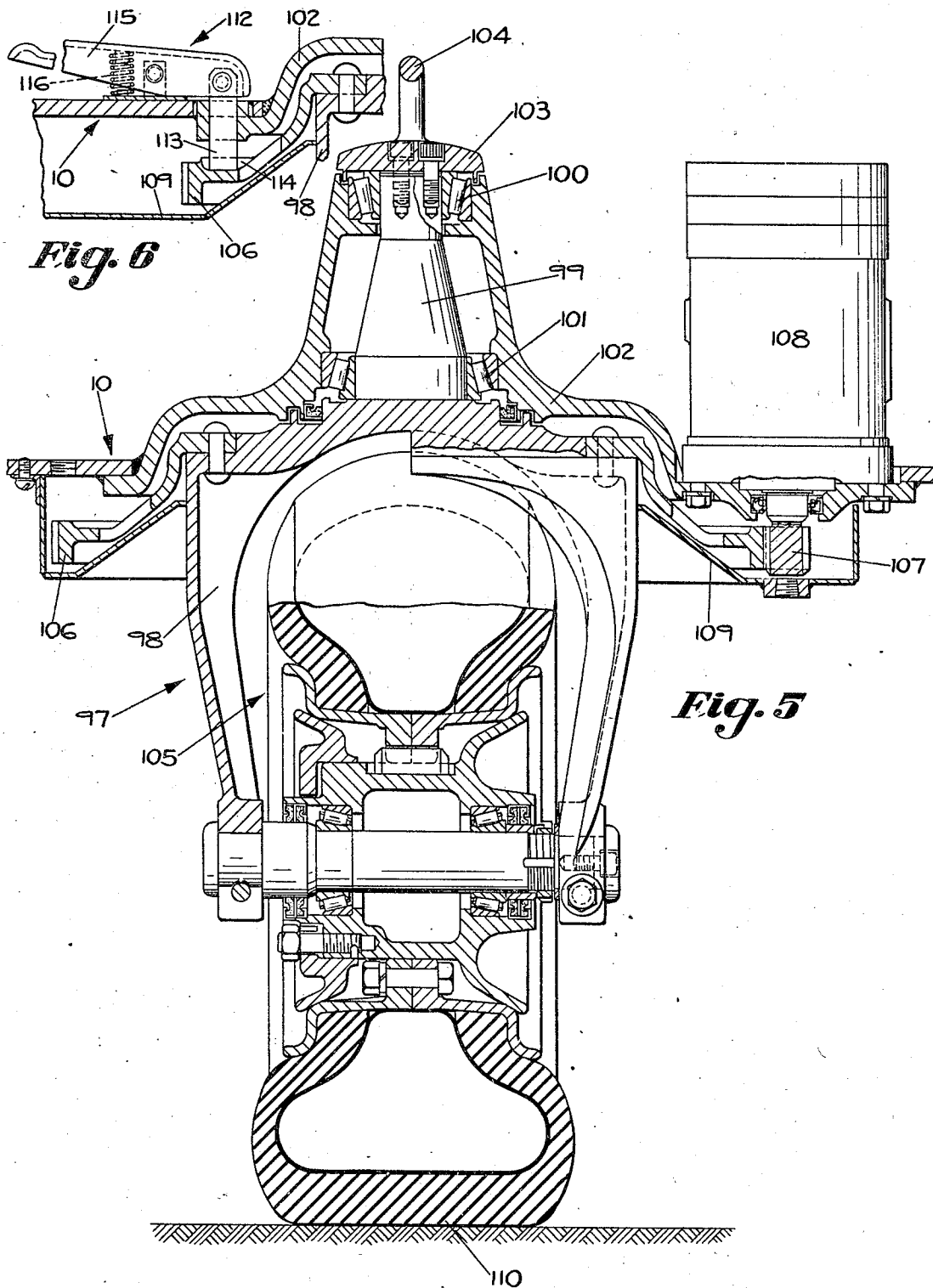
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MINING MACHINE

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,387,159

MINING MACHINE

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Application November 4, 1943, Serial No. 508,929

10 Claims. (Cl. 180—17)

This invention relates to a mining machine.

An object of the invention is to provide a kerf cutting type mining machine with improved mounting preferably involving pneumatic tired wheels for propelling and steering the mining machine.

Another object of the invention is to provide improved drive gearing for traction means of a mining machine.

A further object of the invention is to provide an improved relation of parts in a mining machine involving traction wheels in which the traction wheels, at least on one side, are within the lateral dimensions or confines of the mining machine main frame.

Another object of the invention is to provide an improved steering wheel construction for a mining machine.

Still another object of the invention is to provide an improved drive gearing involving particularly differential drive mechanism for a mining machine or like vehicle.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings,

Fig. 1 is a plan view of a mining machine incorporating the features of my invention;

Fig. 2 is a side elevational view of the machine of Fig. 1;

Fig. 3 is a sectional elevational view through the dual traction wheels and associated parts on one side of the mining machine, taken along line 3—3 of Fig. 2;

Fig. 4 is a sectional elevational view taken on the line 4—4 of Fig. 2 looking in the direction of the arrows;

Fig. 5 is a sectional elevational view taken on the line 5—5 of Fig. 1 looking in the direction of the arrows; and

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 1 looking in the direction of the arrows with certain parts shown in elevation rather than in section in the interest of clearness.

The mining machine herein disclosed is a modification of, and improvement on that disclosed in the patent to R. K. Jeffrey et al., 2,263,779, for a Mining machine, dated November 25, 1941.

Briefly described, the mining machine includes a main frame 10 adjacent the forward end of which there is a turntable 11 which is mounted for swinging movement about an upright axis and which is swung by a pair of hydraulic piston motors 12, the cylinders of which are formed as an integral part of the main frame 10.

Mounted on the turntable 11 and pivotally attached to the rear thereof on a horizontal axis is a supplemental frame 13 which carries an electric motor 14 for driving the chain of the cutter mechanism, as hereinafter described.

Formed as an integral part of the supplemental frame 13 is a downwardly extending elongated neck 15 upon which a turnover head 16 is mounted, said head 16 being adjustable about the axis of the neck 15 and also being pivotally mounted on said neck 15 for adjustment along a transverse axis which is parallel to the plane of a forwardly extending cutter bar 17 which is supported by the turnover head 16 for swinging movement about an axis which is at right angles to the plane of the said cutter bar 17.

The swinging movement of the cutter bar 17 about the two axes above described, which are at right angles to each other, is provided by virtue of hydraulic piston motors 18, as to the said parallel axis, and 19, 19 as to the said right angle axis. The cutter bar 17 carries an endless cutter chain 20 provided with appropriate cutter bits. Said chain 20 is driven through drive mechanism from the motor 14, as disclosed in detail in the above mentioned patent to R. K. Jeffrey, et al.

Swinging movement of the supplemental frame 13 about its rear pivotal axis provided by the pivots 21 is provided by a pair of spaced hydraulic piston motors 22, 22. All of the piston motors above described are preferably of the double acting type.

The above mentioned patent to R. K. Jeffrey et al. discloses a machine adapted to operate on the rails of a mine track. This machine has been modified in a number of important particulars and is so constructed as to be mounted on pneumatic tires and many of the features of my invention relate to construction which provides for this difference in operation.

Attention is directed now particularly to Figs. 1, 2 and 3 of the drawings and to the construction of the front dual traction wheels which support and propel the mining machine. Extending downwardly from the top plate of the main frame 10 and forming a part of the main frame is a central bracket 23 (see Fig. 3) which is attached by machine screws to integral portions of the main frame 10. The bottom of the bracket 23 is provided with an integrally formed shaft receiving pipe 24 which is welded to the vertical members of the said bracket 23. Extending through the pipe 24 is a shaft 25 which is held in the pipe 24 against longitudinal movement

by a bolt 26. Since the structure on each end of the shaft 25 is similar that on one end alone will be described in detail.

Each outer end of the shaft 25 supports a dual wheel designated generally by the reference character 27 and each dual wheel 27 includes an elongated hub 28 which is journaled on the spindle of the shaft 25 by spaced anti-friction roller bearings 29 and 30. The hub 28 is removably held on the spindle of the shaft 25 by nut and washer assembly 31. The hub 28 is provided with a removable hub cap 32. Mounted upon the hub 28 is a pair of spaced split rims 33 and 34, the former being the inner rim and the latter the outer rim. Rims 33 and 34 are provided with pneumatic tires 35 and 36, respectively. Rim 33 is removably supported on the hub 28 by an inner integral clamping ring 37 and one clamping surface of a double clamping ring 38 which is slidable over the hub 28 and is preferably split along one radial plane to permit it to contract under clamping pressure and have a tight fit on the hub 28. The outer rim 34 is clamped between the other clamping surface of the ring 38 and a removable outer clamping ring 39 which is removably attached to the hub 28 by a plurality of spaced lugs 40. The inner end of the hub 28 is provided with an integral extension 41 upon which a drive sprocket or gear 42 is attached as by rivets. A grease seal 43 is provided between extension 41 and a stationary grease seal ring 44 which has a tight fit with the shaft 25 and is adjacent the shoulder thereon and the inner race of the bearing 30. This provides a grease tight enclosure within the hollow portion of the hub 28 to provide a grease chamber, insuring proper lubrication of the bearings 29 and 30.

It is to be particularly noted that since the sprocket or gear 42 is on the inner end of the hub 28, each of the rims 33 and 34 and their associated tires may be readily removed by the simple expedient of removing the lugs 40.

It may be further pointed out that the extension 41 is provided with a drip ring 45 which is formed integral therewith and which provides a groove between it and the sprocket 42 which will catch oil from the chain associated with the sprocket 42 and drip it back onto the chain.

One of the problems which was encountered to provide the dual pneumatic tired wheels for the mining machine was that of providing adequate tire support for the mining machine, particularly at its forward end where the weight is largely concentrated, and still not extend the traction means appreciably beyond the lateral confines of the main frame. By reference to Fig. 1 of the drawings it will be noted that the outermost tire 36 does not extend laterally beyond the main frame as represented by the integral piston motors 12 and the other tire 35 on the opposite side of the machine will extend a like distance from the longitudinal center line of the forward part of said main frame 10. In other words, the two front traction dual wheel assemblies 27 are symmetrical with respect to the longitudinal axis of the main frame 10. It may be stated that the mounting of the sprocket or gear 42 on the inner end of the hub 28 contributes to this construction.

Each of the dual wheel assemblies 27 is separately driven in the sense that they may have individual independent movement and to this end each of the sprockets 42 is driven by a chain 46 from an individual sprocket 47 (see Fig. 4) of a differential drive mechanism, the structure of

which constitutes another feature of my invention.

Attention is particularly directed to Fig. 4 of the drawings and to the structure of this differential drive mechanism. The differential mechanism indicated at 48 is removably attached as a unit to the main frame 10 of the mining machine and it includes a stationary differential frame 49 formed of two parts which are removably attached by a plurality of spaced machine screws 50.

Mounted in spaced anti-friction roller bearings 51 and 52 carried by the frame 49 is a combination differential cage and housing 53 which is formed in two parts, which parts are connected together by elongated bolts 54 which also attach a ring gear or sprocket 55 to the differential cage or housing 53 which acts as a driving gear or sprocket therefor. In the central portion of the differential cage 53 is a pair of differential bevel gears 56 and 57 which mesh with opposite sides of a bevel gear 58 which is mounted on a pin 59 carried by the cage 53. This, of course, provides for the differential driving of individually splined drive shafts 60 and 61 which have a splined connection with the bevel gears 56 and 57, respectively. Each of the shafts 60 and 61 is provided with a rigidly attached hub 62. Welded to each hub 62 is a plurality of pins 63 which extend into and have a loose driving fit with a plurality of holes in a hub 64 of the previously mentioned sprocket or gear 47 which is the driven gear insofar as the differential mechanism 48 is concerned. This provides a flexible coupling between each shaft 60, 61 and associated hub 64.

Also formed as an integral part of each hub 64 is a brake drum 65 with which a brake mechanism 66 is associated. The brake mechanisms for the dual wheels 27 on opposite sides of the vehicle are independently operable by independent brake levers 67 (see Fig. 2) adjacent the operator's station at the rear end of the machine. It is to be noted that each of the hubs 64 is journaled on the outer end of the differential cage or housing 53 and as a consequence the pulling force of the chain 46 is not transmitted to the shaft 60 but is taken directly by this cage or housing 53. As a consequence, the shafts 60 and 61 are purely torque transmitting shafts.

It is further to be noted that in the absence of any differential action or, in other words, when each of the dual wheels 27 is traveling at the same speed as when the machine is moving in a straight line, the hubs 64 and sprockets or drive gears 47 will not have any relative rotation with respect to the cage extensions or outer parts upon which they are journaled since the cage 53 will rotate as a unit with said sprockets or gears 47. However, where there is differential action involved and one of the dual wheels 27 rotates at a different rate than the other there will be some slight rotation of the hubs 64 on their journals and thus with respect to the outer portions or extensions of the cage or housing 53. These journals, which are seen at 68, may be free-floating or they may be keyed to the hubs 64 as illustrated. It is to be further noted that an oil ring or seal 69 is provided between each hub 62 and the outermost end of the cage 53 and this also effects a seal between each of the hubs 62 and 64. Lubricating oil reaches each of the journals 68 by means of radial bores 70 in the outer portions of the cage or housing 53 and oil is delivered to the interior of this cage or housing 53 to reach these bores 70 by virtue of the fact that

a thrust ring 71 on each of the drive shafts 60 and 61 does not have a tight fit with the adjacent shoulder on the cage 53 but permits oil to pass thereby from an oil receiving chamber 72 which is formed within the differential cage or housing 53 and which is supplied with oil in a manner now to be described.

The chamber 72 is provided with a feed port 73 which communicates with a chamber 74 formed as a part of the frame 49 of the differential mechanism 48. The chamber 74 is closed at its opposite ends by oil seals 75 and 76 which cooperate with adjacent cylindrical surfaces formed on the exterior of the housing or cage 53. It is, of course, evident that the anti-friction bearing 51 is within this chamber 74 and consequently it is lubricated by the oil therein. The seal 75 is contained in a groove formed within an integral portion of the frame 49 while the seal 76 is received in a groove formed in a removable plate 77 which is attached to the frame 49 by spaced screws 78. Said plate 77 provides for removal of the anti-friction bearing 51. Also formed as an integral part of the frame 49 is an oil feed pipe and chamber 79 provided with a removable plug 80. The chamber and feed pipe 79 is substantially filled with oil at all times. From the above description it is obvious how the bearing 61 and the journal bearing 68 are lubricated. The oil in the feed pipe and chamber 79 and in the chambers 72 and 74 also lubricates other gears, bearings and journals in a manner now to be described.

The aforedescribed bevel gears 56 and 57 are journaled on spaced integral webs 81 and 82 forming a part of the cage 53 and there is a plurality of bores or ports 83 which provide communication to the central compartment of the cage 53 formed by these webs 81 and 82 so that the oil in the chamber 72 is delivered to this compartment and thus lubricates the gears 56, 57 and 58 together with their bearing surfaces. From this central compartment the oil is free to flow by way of a plurality of bores or ports 84 in the web 82 to another chamber 85. In a manner similar to that above described in connection with the flow of oil from the chamber 72 to the bores 70, the oil in chamber 85 may flow to the bores 70 at the right hand end of the cage 53 as viewed in Fig. 4 of the drawings. Furthermore, there is another group of bores 86 leading from the chamber 85 to a chamber 87 within which the bearing 52 is housed and thus the bearing 52 is also lubricated. The housing 87 is provided with appropriate grease seals and ring construction similar to that above described at 75, 76 and 77. It is thus evident that the lubricating oil delivered to the feed pipe and chamber 79 lubricates all of the bearing surfaces within the cage and housing 53 and lubricates the anti-friction bearings 51 and 52 as well as the journals 69.

It is to be noted that in general the cage and housing 53 is an oil tight container except for those ports, bores or passageways which lead to other enclosing chambers or restricted areas which are to be lubricated. Furthermore, it is to be noted that the central portion of the housing or cage 53 is not enclosed but is exposed since the bottom portion of the differential frame 49 is open, as clearly illustrated in Fig. 4 of the drawings, to permit access thereto at all times and to the drive chain associated with the sprocket 55. Furthermore, the rear portion of this frame 49 is necessarily of open construction to permit the drive chain to extend thereinto and mesh with the sprocket 55. In this particular, it is evident

that the differential cage is of unusual construction because generally such a differential cage together with its associated ring gear is mounted in a totally enclosing differential housing which contains the oil or grease for lubricating the various gears, bearings and other frictional parts.

I also provide within the differential mechanism 48 a device for lubricating a drive chain 88 (see Figs. 1 and 2) associated with the drive sprocket or gear 47. This lubricating construction is in the form of an oil chamber 89 provided with a removable plug 90 which chamber communicates by way of an integrally formed feed pipe 91 which terminates just above the sprocket 55. The bottom of the oil chamber 89 is stuffed with wool waste or the like so that the lubricating oil which is preferably fairly heavy passes through it in very small quantities and thus merely drips at a very slow rate on the sprocket 55 and associated drive chain 88.

Referring particularly to Figs. 1 and 2 of the drawings, it may be pointed out that the complete drive gearing for the dual wheels 27 extends from an electric motor 92 carried on the main frame 10 by way of a speed reducing gearing which is disclosed in full detail in the above mentioned patent to R. K. Jeffrey, et al., and which ultimately leads to a sprocket 93 which is seen at 607 in said patent, which sprocket 93 drives the chain 88 which is guided over idler sprockets 94 and 95 and in turn drives the aforedescribed gear or sprocket 55. The sprocket 55 drives the cage 53 and in the absence of any differential action the sprocket 55, cage 53, shafts 60 and 61 and sprockets or gears 47 turn as a unit together. The sprockets 47 drive their associated chains 46 which, as illustrated in Fig. 2 of the drawings, have their upper runs guided by idler sprockets or rollers 96 carried by the main frame 10 and which drive the sprockets or gears 42 associated with the dual wheels 27. During turning movement of the mining machine when differential action is involved the shafts 60 and 61, and their associated driving mechanisms, will rotate at different speeds. It is evident that the individual brake mechanisms 66 assist not only in the stopping of the mining machine but also in the turning thereof, in that, while the vehicle is being turned, the brake on one side may be actuated to aid in this action.

The principal steering action which may be aided by the braking action above described is accomplished by a single steering wheel mechanism 97, which is disclosed in detail in Fig. 5 of the drawings, and which is situated at the extreme rear end of the main frame 10. Referring particularly to Fig. 5 of the drawings it will be seen that the steering wheel mechanism 97 includes a yoke 98 which at its top is provided with an integral stub shaft 99 mounted on a vertical or upright axis which is preferably along the longitudinal axis of the main frame 10. The stub shaft 99 is supported in top and bottom anti-friction bearings 100 and 101 which are carried in a cap 102 which is welded to and formed as an integral part of the main frame 10. The upper end of the shaft 99 carries a removable cap 103 attached thereto by spaced screws and which has a ring 104 used as an indicating device to indicate the alignment of a wheel 105 carried by the yoke 98. Also attached to the upper part of the yoke 98 is a large ring gear 106 which meshes with an integral pinion 107 formed on the lower end of the rotor shaft of a rotary hydraulic motor 108. The gear 106 is enclosed within the housing

formed by a top plate on the main frame 10 and surrounding plate 109 which provides a heavy oil retaining compartment for lubricating the gears 106 and 107. The wheel 105 is provided with a pneumatic tire 110 and since the structure of said wheel 105 is generally conventional and is clearly illustrated in Fig. 5 of the drawings, no detailed description thereof is believed necessary.

The hydraulic motor 108 is controlled by the hydraulic system which is disclosed more completely in the above mentioned patent to R. K. Jeffrey, et al., and it may be operated in reverse directions under the control of a reversible valve 111 (see Fig. 2) which is adjacent the operator's station.

In the normal operation of the device it is desirable that the wheel 97 be rotated a maximum of 60° to each side of a straight ahead position or, in other words, a total of 120°, though under certain circumstances a larger range of adjustment may be desired. It may be pointed out that said wheel 105 may be continuously rotated by the motor 108 in the absence of some stop mechanism. To provide the desirable restriction above mentioned I provide a releasable stop mechanism 112 which is illustrated in Fig. 6 of the drawings. This stop mechanism includes a plunger 113 which extends through a vertical bore in the rim of the cap 102 and in its normal position, as illustrated in Fig. 6 of the drawings, extends downwardly between a pair of stops or lugs, one of which is seen at 114, which stops are formed integral with the rim of the gear 106 and are spaced 120° apart. The two stops 114 are so located that when one of them abuts the plunger 113 the wheel 105 will be 60° in a clockwise direction from straight ahead and when the other stop 114 abuts the plunger 113 the wheel 105 will be 60° in a counter-clockwise direction with respect to the straight ahead position. In other words, the plunger 113 cooperates with the two spaced stops 114 to permit free adjustment of the wheel 105 to 60° from the aligned straight ahead position to either side.

It is sometimes desirable, as above noted, to be able to adjust the wheel 105 in excess of 60° and consequently the stop mechanism 112 is provided with a releasing handle 115 which is pivoted to the frame 10 and at one end is pivotally attached to the plunger 113. A spring 116 biases the handle 115 so that the plunger 113 is normally in stopping position. It is obvious that by pushing down on the handle 115 the plunger 113 may be lifted to permit entirely free rotation of the wheel 105. It may further be stated that since the wheel 105 has no normal position, in other words, since it may be rotated 180° and in either of two positions 180° apart have exactly the same effect, I preferably provide two sets of stops 114 so that should the wheel 105 be rotated 180°, a new set of stops 114 functioning as above described will come into operation without requiring the wheel 105 to be reset to its initial position.

It is, of course, evident that the principal steering of the mining machine will be by virtue of the steering wheel mechanism 97 which is adjustable about the vertical or upright axis and which may be turned a full 360° though normally is restricted to 60° of turning movement in either direction from the straight ahead position unless released. This steering action may be supplemented, if desired, by operating one of the brake mechanisms 65 associated with the differential mechanism, as above described.

The operation of the mining machine while

cutting a kerf or while being transported is essentially that described in the above mentioned patent to R. K. Jeffrey, et al. It is, of course, obvious that since the mining machine is not mounted on tracks it is more flexible in that it may be positioned substantially anywhere in a mine room. For example, it may be positioned adjacent either rib or any place between either rib. Furthermore, the pneumatic tire mounting provides for the ready transportation of the mining machine under its own power from one position to another in a mine, as for example from one room to another without requiring the laying of any tracks.

It may also be mentioned that pneumatic tires increase slightly the overall height of the machine measured with respect to the tops of the mine rails and to compensate for this the head section 16 has been modified very slightly by extending its length to insure that the cutter bar 17 may cut at a position at least as low as the mine bottom upon which the tires 35, 36 and 110 are supported.

It is obvious that the mining machine produced is one which is not only universal in character but is extremely flexible and is easily adjusted or moved to various positions in a mine room at a transportation speed where it can be fed under its own power at a slow feeding or sumping speed for cutting a kerf. Other means of cutting kerfs by swinging the turntable 11, swinging the supplemental frame 13 or swinging the cutter bar 17 about the head 16 are believed obvious from a description of the mode of operation of the above mentioned patent to R. K. Jeffrey, et al., all of which are preserved in this machine.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

1. Drive mechanism including a frame, a differential cage, a pair of spaced bearings directly mounting said differential cage for rotation on said frame, means for driving said differential cage, a pair of driven gears on said cage mounted to rotate relative thereto said gears being removable while said cage is mounted on said frame as aforesaid, means including an individual drive shaft connected to drive each of said gears, and differential gearing connecting said shafts and driven by said cage, said driven gears normally rotating with said cage on which they are mounted but rotating relative thereto when controlled by differential action.

2. A differential drive mechanism including a frame, a differential cage, means including a bearing mounting said cage for rotation on said frame, means for rotating said differential cage, a driven gear mounted on said cage and independently rotatable relative thereto, means including an individual drive shaft extending into said cage and connected to drive said gear, and differential gearing connecting said shaft and driven by said cage, said driven gear normally rotating with said cage on which it is mounted but rotating relative thereto when controlled by differential action, said bearing mounting said differential cage on said frame independently of

said driven gear and providing for removal of said driven gear while said differential cage is mounted as aforesaid.

3. A differential including a cage having a laterally extending portion, a gear mounted for rotation on said laterally extending portion of said cage, means mounting said cage for rotation, differential gearing in said cage and connected thereto, and means including a shaft extending through said laterally extending portion and connected to said gear, said means also including a loose driving coupling between said shaft and gear.

4. A differential including a frame, a cage having a pair of laterally extending portions, a gear mounted for rotation on each laterally extending portion of said cage, means including a pair of bearings mounting said cage for rotation directly on said frame, differential gearing in said cage and connected thereto, and means including individual shafts extending through said laterally extending portions and connected to said gears, one shaft being individual to each gear, the mounting means for said cage being entirely independent of said gears mounted thereon.

5. A differential including a cage having a pair of laterally extending portions, a gear mounted for rotation on each laterally extending portion of said cage, means mounting said cage for rotation, differential gearing in said cage and connected thereto, and means including individual shafts extending through said laterally extending portions and connected to said gears, one shaft being individual to each gear, said means also including a loose driving coupling between each shaft and gear, each gear having a brake drum rigidly attached thereto.

6. A differential including a cage having a laterally extending portion, a gear mounted for rotation on said laterally extending portion of said cage, means mounting said cage for rotation, differential gearing in said cage and connected thereto, and means including a shaft extending through said laterally extending portion and connected to said gear, said means also including a loose driving coupling between said shaft and gear, said gear having an integrally formed brake drum.

7. Drive mechanism including a frame, a differential including a housing, differential gears in and connected to said housing, spaced bearings on said frame mounting said housing for rotation as a unit with the differential gears, said frame including an enclosure for one of said bearings, said differential housing having a portion extending through openings in said enclosure, seals between said housing and the walls of said enclosure openings through which said differential housing portion extends, means for feeding grease to said enclosure and lubricating the bearing therein, means providing an opening in said differential housing portion within said

enclosure whereby grease therein can flow into said differential housing, another enclosure for the other of said bearings having openings through which another part of said differential housing extends, seals for said openings cooperating with said housing, and means providing an opening in said differential housing to provide a path for grease in said housing to said other bearing.

8. Drive gearing including a frame, a differential housing mounted on a pair of spaced bearings in said frame, means providing an enclosure for one of said bearings through which said differential housing extends, differential gears within said differential housing, a drive gear journaled on one end of said differential housing, means for supplying grease to said enclosure to lubricate said one bearing, said differential housing having an opening therein within said enclosure whereby grease therein may flow into said housing and lubricate said differential gears, means providing a grease passageway through said housing to the other of said spaced bearings, and means providing a grease passageway through said housing to the journal of said drive gear on said housing.

9. Drive gearing including a frame, a differential housing mounted on a pair of spaced bearings in said frame, means providing an enclosure for one of said bearings through which said differential housing extends, differential gears within said differential housing, a drive gear journaled on one end of said differential housing, means for supplying grease to said enclosure to lubricate said one bearing, said differential housing having an opening therein within said enclosure whereby grease therein may flow into said housing and lubricate said differential gears, and means providing a grease passageway through said housing to the journal of said drive gear on said housing.

10. In a machine, a frame, a differential, said differential including a housing and cage, differential gearing in said housing and cage, means mounting said housing and cage for rotation as a unit with said gearing including a pair of bearings carried by said frame, one on each side of said housing and cage, a separate enclosure for each bearing and separate portions of said housing and cage, said housing and cage having opposite portions each extending through a sealed opening into an individual bearing enclosure, and means for supplying oil to one of said bearing enclosures, said differential housing and cage having means providing a lubricating path for the oil in said one bearing enclosure to the interior of the differential housing and cage and the gearing therein and to the interior of the other of said bearing enclosures to lubricate the bearing therein.

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