Dec. 17, 1968 W. D. BOONE 3,416,623

TRAM DRIVE UNIT FOR MINING MACHINE

Filed July 12, 1967 3 Sheets-Sheet 1

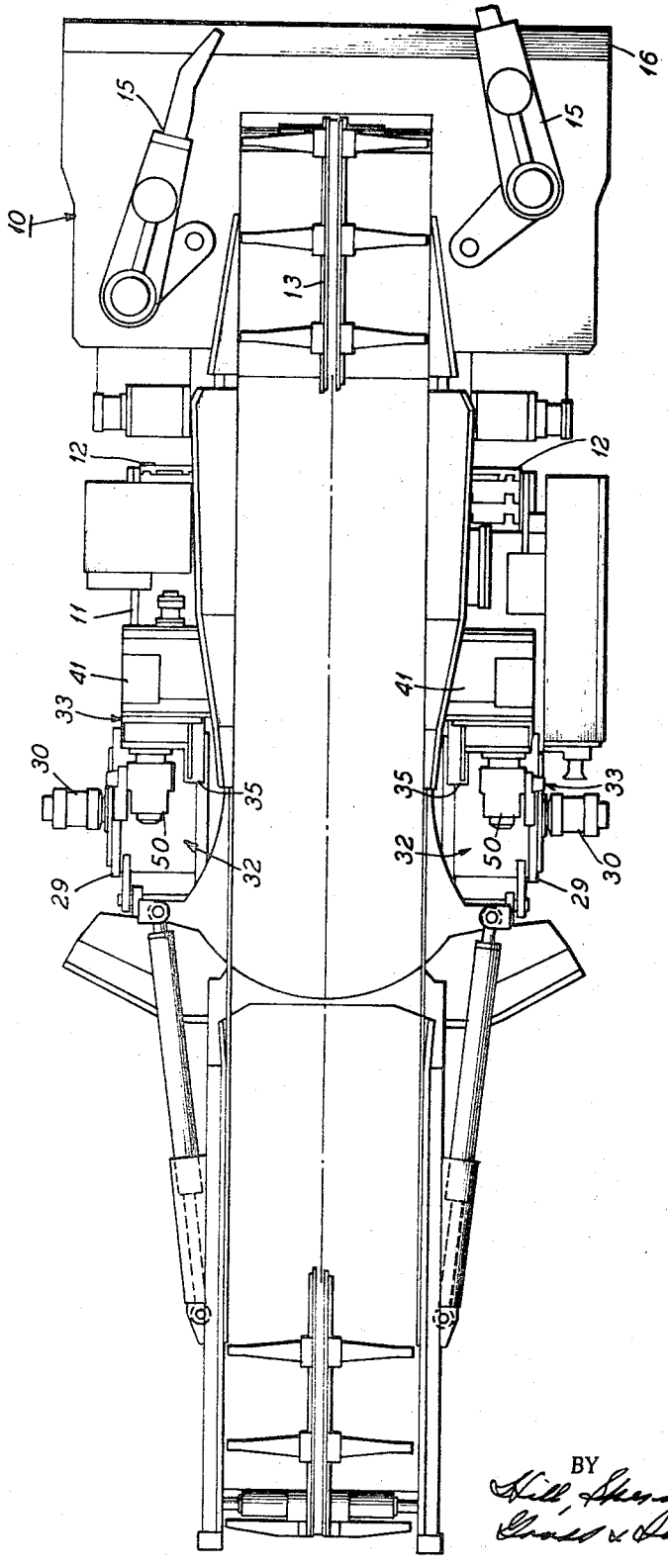


Fig. 1

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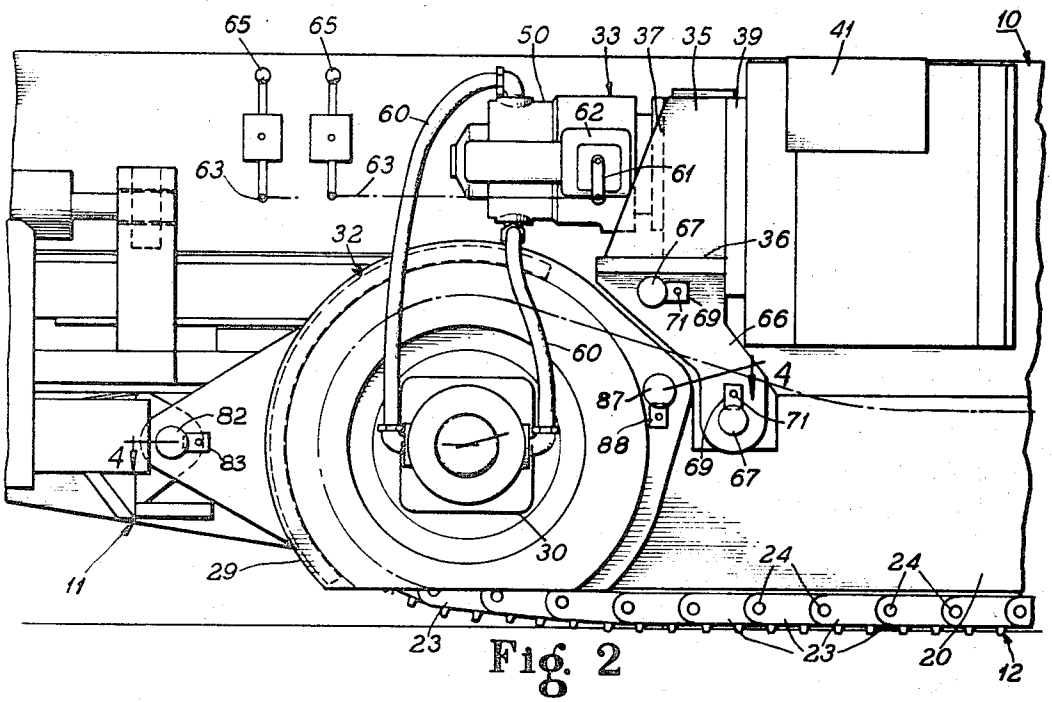


Fig. 2

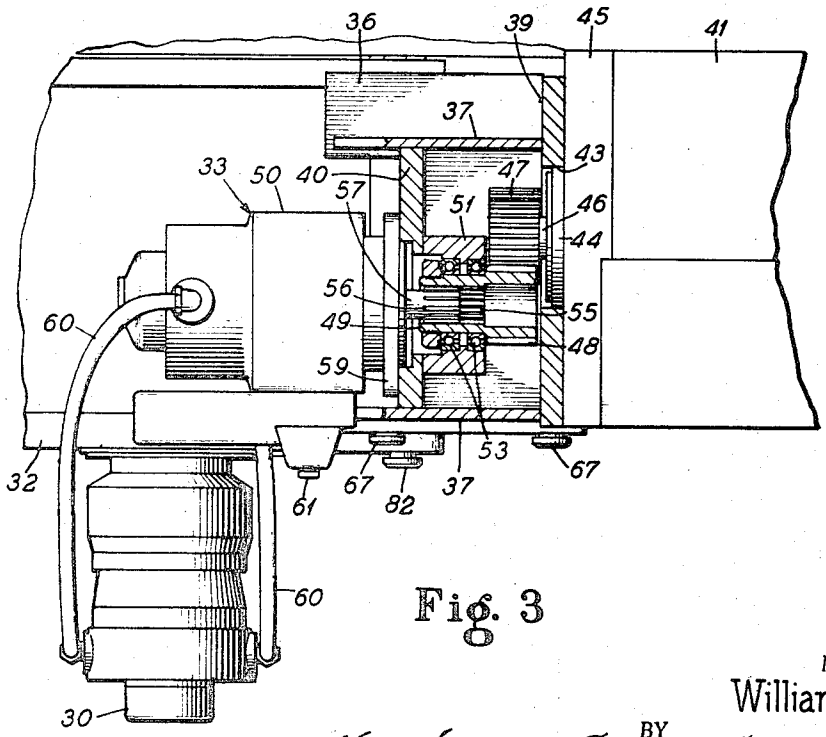


Fig. 3

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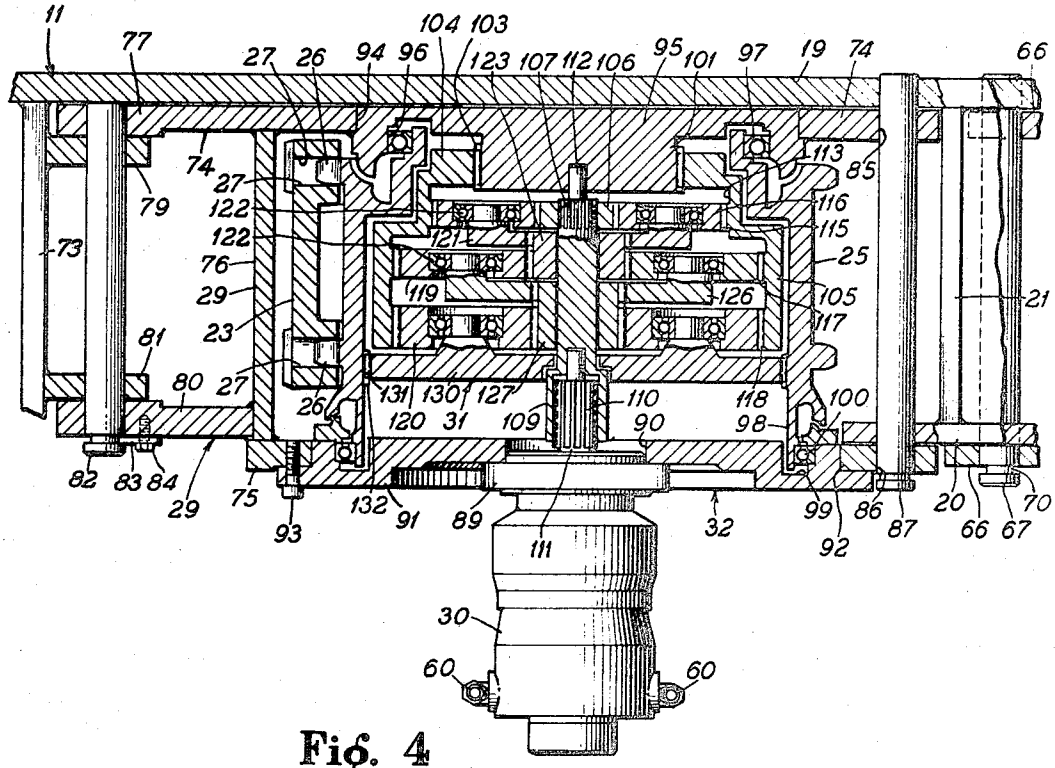


Fig. 4

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TRAM DRIVE UNIT FOR MINING MACHINE

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9 Claims. (Cl. 180—6.48)

ABSTRACT OF THE DISCLOSURE

Tram drive for mining machines of the loading and mining and loading type having an individual drive unit for each tram unit. The drive comprises a power pack including a pump and an electric motor for driving the pump and a drive pack including a hydraulic motor located within the extended confines of the drive element for an associated tram unit, and planetary reduction gearing within the confines of the drive element and driven by the hydraulic motor. The speed and direction of tramming is controlled by the control for the pump. The power pack and the drive pack are mounted on individual frames detachably mounted on the main frame of the machine by coupling pin and apertured mounting connections, enabling ready removal of the power pack and the drive pack for inspection and repair.

Background of the invention

Heretofore tram drives for mining machines of the loading and mining and loading type have been a frequent source of trouble, due to the rugged conditions and high power required to crowd the machine into the material being loaded or mined and loaded. When it becomes necessary to repair the drive, it is usually necessary to lay up the entire machine to disassemble, repair or replace the drive parts. This requires a relatively long down time of the machine, and many times makes it necessary to discontinue mining in the area where the machine is laid up during this down time.

Summary of the invention and objects

The present invention remedies the foregoing deficiencies by providing an individual power pack and a separate individual drive pack for each tram unit of the machine, and by separately mounting the power pack and the drive pack on the main frame of the machine, so the drive pack and the power pack may readily be removed as units for repair or replacement, with a resultant marked saving in time and cost for maintenance of the machine.

A principal object of the present invention is to provide a more compact and accessible drive for the tram units of mining machines, so arranged that the drives may be removed and replaced as units in a minimum time period.

Another object of the invention is to facilitate the maintenance of the drives to the tram units of continuous mining machines, by utilizing an individual electric motor and pump as the source of power for driving each tram unit, by connecting the pump to a hydraulic motor driving an associated tram unit, in which the hydraulic motor and drive gearing driven therefrom are within the confines of the tram unit and are mounted as units for ready removal from the main frame of the machine.

A still further object of the invention is to improve upon the maintenance of the tram drive for a mining machine and the like, by driving each tram unit by a hydraulic motor and planetary reduction gearing, within the confines of the tram unit, by mounting the hydraulic motor and planetary reduction gearing on a drive frame, readily removable from the main frame of the machine,

and by providing an individual power unit for each hydraulic motor in the form of an electric motor and pump mounted on a power frame mounted on the main frame of the machine for ready removal therefrom, in which the controls for the pump serve to vary the speed and change the direction of rotation of the hydraulic motor and the tramming speed of the machine.

These and other objects of the invention will more clearly appear as the following specification proceeds and with reference to the accompanying drawings.

Description of the drawings

FIGURE 1 is a fragmentary plan view of a mining machine of the loading type, showing tram drives constructed in accordance with the principles of the present invention on each side of the machine;

FIGURE 2 is an enlarged fragmentary view in side elevation of an intermediate portion of the machine, illustrating the tram drive and controls therefor;

FIGURE 3 is an enlarged fragmentary plan view of the tram drive, with certain parts shown in horizontal section, in order to illustrate the geared drive connection from the electric motor to the pump supplying power to the hydraulic tram motor; and

FIGURE 4 is a horizontal sectional view taken through the drive unit substantially along line 4—4 of FIGURE 2 and illustrating certain details in the geared reduction drive to the tram unit.

Description of preferred embodiment

In FIGURES 1 and 2 of the drawings I have generally shown a mining machine **10** of the type adapted to pick up and load mined coal from the ground, and transfer the mined coal to shuttle cars or other material transporting devices. While the mining machine **10** is shown as being a loading machine, it need not be a loading machine, but may be a mining machine or a continuous mining and loading machine of any conventional type.

The mining machine **10** generally includes a main frame **11** supported and trammed about the mine on tram units at each side of the machine, shown in FIGURE 1 as being laterally spaced continuous traction tread devices **12, 12**. A central conveyor **13** of the laterally flexible center strand chain and flight type extends along the main frame **11** from a position adjacent the ground in advance of the forward end of said main frame to a discharge position beyond the rear end of said main frame. Conventional orbitally driven gathering arms **15, 15**, extending along the top of an apron **16** on opposite sides of the conveyor **13** and beyond the forward end of said apron serve to progress the material onto said conveyor as the apron **16** is crowded into the loose material by the traction tread devices **12, 12**.

As shown in FIGURE 4, the main frame **11** includes a side plate **19** extending along each outer side thereof and a side plate **20** spaced outwardly therefrom by spacer plates **21**, spaced along said side plates and welded or otherwise secured thereto at their ends. The outer side plates **20** may form shoes along their bottom surfaces along which the continuous traction tread devices travel, or rollers (not shown) may be connected between said side plates **19** and **20** and form supports for the main frame **11** on said continuous traction tread devices, in a conventional manner.

Each continuous traction tread device includes a plurality of aligned tread shoes **23** interleaving at their adjacent ends and pivotally connected together by pivot pins **24**. The traction tread devices are trained about a drive element **25** disposed adjacent the rear end portion of the main frame **11** (FIGURE 4) and about an idler (not shown) disposed adjacent the forward end portion of said

main frame. The drive element **25** is shown in FIGURE 4 as having laterally spaced sprocket teeth **26** projecting from the periphery thereof for engagement within sprocket tooth receiving recesses **27**, **27** in the tread shoes **23**, for driving the continuous tread devices in a conventional manner. The drive element **25** is rotatably mounted in a drive pack frame **29** and is driven from a hydraulic motor **30**, shown as extending outwardly of the drive pack frame **29**, through driving reduction gearing **31** driven by said hydraulic motor and contained within the limits of the drive element **25**, as will hereinafter be more clearly described as this specification proceeds. The drive element **25**, drive pack frame **29**, reduction gearing **31** and hydraulic motor **30** form a drive pack **32**, removable from the main frame **11** as a unit.

Power for driving the hydraulic motor **30** is attained from a power pack **33**, individual to the hydraulic motor **30**, and detachably mounted on the main frame **11** on a power pack frame **35**. The power pack frame **35** includes a base plate **36**, parallel spaced side walls **37** extending upwardly therefrom, a forward end wall **39** and a rear wall **40** extending between the side walls **37**. The forward wall **39** extends across the rear or drive end portion of a drive motor **41**, herein shown as being a conventional electric motor. Suitable securing means are provided for mounting said motor on said forward wall **39**. The wall **39** has a central opening **43** receiving a hub **44** of an end plate **45** for the motor. A motor shaft **46** having a motor pinion **47** on the end thereof extends through the opening **43** in the space between the plates **39** and **40**. The motor pinion **47** meshes with a pinion **48** of a lesser diameter than the diameter of the motor pinion **47**, to drive a hydraulic pump **50** at an increased rate of speed from the speed of the motor **41**. The pinion **48** is shown as being formed integrally of a sleeve **49** extending within a boss **51**, secured to the plate **40** as by welding. The boss **51** forms a bearing mounting for the sleeve **49** on anti-friction bearings **53**. The interior of the sleeve **49** is splined for a portion of the length thereof, as indicated by reference character **55**, and the splined portion of said sleeve is meshed with a spline **56** on a shaft **57**, for driving the pump **50**. The pump **50** has a radial flanged portion **59** abutting the back face of the wall **40**, and is suitably secured thereto as by machine screws (not shown), or other suitable securing means.

The pump **50** may be a conventional form of cam plate pump, such as the No. 45 pump manufactured by New York Air Brake Company. In this pump a series of pistons (not shown) are mounted in a rotatable block (not shown) rotatably driven from the shaft **57**. The pistons react against a cam plate (not shown) causing in and out movement of the pistons to supply high pressure fluid to the motor **30** through fluid pressure and return lines **60**, connected between said pump and motor.

The angular positions of the cam plate (not shown) are infinitely variable as the cam plate is positioned from a neutral position at a zero angle in which there is no piston stroke and no output from the pump, to extreme angular positions on either side of neutral, to reverse the flow of fluid from the pump through the pressure and return lines **60**, and to increase the flow of hydraulic fluid to rotate the motor **30** from a minimum to a maximum speed in either a forward or reverse direction.

Fluid under pressure is thus supplied to the motor **30** through one pressure line **60** and is returned to the pump **50** through the opposite pressure line **60**. Make up fluid may be supplied from a conventional tank (not shown) in a manner, which is no part of the present invention so need not be shown or described further herein.

The output of the pump **50** and the direction of flow of hydraulic fluid from the pump **50** to the hydraulic motor **30** is controlled by a control lever **61**, on the outside of a control casing **62** mounted on the outside of the pump. The lever **61** is pivotally mounted in the casing **62** and has operative connection with the cam plate (not shown) of the pump to effect movement of said cam plate to either side of neutral. A mechanical control for the lever **61** is diagrammatically shown in FIGURE 2. This control includes a rod or Bowden wire **63** connected with and operated by a hand lever **65** mounted on the outside of the main frame **11**. A second Bowden wire **63** and hand lever **65** is provided adjacent the first mentioned hand lever, to control the operation of the opposite continuous traction tread device and to enable tramming to be controlled from a convenient position at one side of the machine.

The means for detachably mounting the power pack frame **35** on the main frame **11** is shown in FIGURES 2 and 4 as comprising a pair of laterally spaced bracket legs **66** depending from the base **36**. One of said bracket legs extends along the outside of the plate **19** of the main frame **11** while the other of said bracket legs extends along the outside of the plate **20**. Vertically and longitudinally spaced coupling pins **67** are provided to detachably couple the power pack frame **35** to the main frame **11**. As shown in FIGURES 2 and 4 the coupling pins **67** extend through apertured portions of the bracket leg **66** and registering apertured portions of the plates **19** and **20** and are detachably retained thereto as by locking keys **69**. Said locking keys extend into annular grooves **70**, formed in the coupling pins **67**, adjacent the outer ends thereof (FIGURE 4) and retained to the outside of the outer bracket leg **66**, as by machine screws **71** or other suitable securing means. The entire power pack **33** may thus be readily removed for replacement or repair by the simple operation of removing the machine screws **71** from the locking keys **69**, and then removing the coupling pins from the bracket legs **66**.

The drive pack **32** includes the drive pack frame **29** having an inner plate **74** and a laterally outwardly spaced outer plate **75**, spaced therefrom by a spacer plate **76** (FIGURE 4). The inner plate **74** has an integrally formed coupling ear **77** extending therefrom along the outside of the plate **19** and the inside of a coupling lug **79** extending forwardly of a spacer plate **73** extending outwardly of the plate **19** and welded or otherwise secured thereto. A coupling ear **80** extends from the transverse spacer plate **76** along the outside of a similar mounting lug **81** extending from the spacer plate **73**. The ears **77** and **80** are mounted on the lugs **79** and **81** as by a coupling pin **82** extending through registered apertured positions of said ears and lugs and locked thereto as by a locking key **83** secured to the outside of the ear **80**, as by a machine screw **84**. The locking key **83** like the locking key **69** extends within a grooved portion of the coupling pin **82**. The forward end portions of the plates **74** and **75** have apertured portions **85** and **86** (FIGURE 4) for receiving a coupling pin **87** extending therethrough and through corrresponding apertured portions in the plates **19** and **20**, and locked thereto as by a locking key **88**. The drive pack frame including the hydraulic motor **30** and reduction gearing **31**, as well as the drive element **25**, may thus be readily removed from the main frame **11** as a unit, for repair or replacement, by merely removing the two coupling pins **82** and **87**.

The motor **30** has an end plate portion **89** extending within a cylindrical wall **90** of an end plate **91** for the drive pack frame **29**. The end plate **91** extends within a cylindrical opening **92** in the plate **75** and is secured to said plate **75**, as by machine screws **93**. The hydraulic motor **30** may be secured to the end plate **91** in a suitable manner, to attach said motor **30** to the power pack frame within the extended limits of the drive element **25**.

The inner plate **74** has a cylindrical open portion **94** closed by a closure plate **95**, welded or otherwise secured thereto. Said closure plate **95** has a shouldered portion **96**, extending inwardly within the space between the plates **74** and **75** and forming a mounting for an anti-friction bearing **97**. The bearing **97** forms a bearing support for the inner end of the drive element **25**. The opposite end

of the drive element **25** has a reduced annular portion **98** extending within an annular inwardly facing groove **99** formed in the closure plate **91**. An anti-friction bearing **100** recessed in the annular groove **99** forms a bearing support for said reduced annular portion and the outer end of said drive element.

The inner end closure **95** has a boss **101** extending inwardly therefrom. The boss **101** has external splines **103** formed integrally therewith meshed with corresponding internal splines formed in an end wall **104** of a casing **105** for the geared reduction device **31**, and holding said casing from rotation.

The geared reduction device **31** is herein shown as being a planetary geared reduction device, driven by a sun pinion **106** keyed or otherwise secured to the inner end of a coupling shaft **107**. The coupling shaft **107** has an internally splined coupling **109** at its outer end, meshing with and driven by splines **110** on the inner end portion of a drive shaft **111** of the hydraulic motor **30**. The coupling shaft **107** is abutted at its inner end by a thrust pin **112** recessed in the boss portion **101** of the end closure **95**.

The casing **105** is shown as having a stepped inner periphery, a small diameter portion **113** of which has an internal gear **115** formed integrally therewith, and meshing with planetary pinions **116** driven from the sun pinion **106**. The casing **105** also has an enlarged diameter portion having axially outwardly spaced internal gears **117** and **118** formed integrally therewith and meshed with planetary pinions **119** and **120** respectively. The planetary pinions **116** are carried on a cage **121** on antifriction bearings **122**, which may be self-aligning bearings. The cage **121** is shown as being splined to a gear **123** spaced from the coupling shaft **107** and freely rotatable with respect thereto. The gear **123** in turn meshes with the planetary pinions **119**, which are carried by a cage **126** on conventional self-aligning bearings. The cage **126** in turn is internally splined and is splined to a gear **127** spaced radially from the shaft **107**, for free rotation with respect thereto. The teeth of the gear **127** mesh with the planetary pinions **120**, which also mesh with the internal gear **118**. The planetary pinions **120** are carried on a drive cage **130** on the usual self-aligning bearings and form a drive member for said cage. The drive cage **130** has external gear teeth **131** formed integrally therewith, meshing with internal gear teeth **132**, formed integrally with the interior cylindrical wall portion of the drive element **25** for driving said drive element at a reduced rate of speed from the speed of rotation of the hydraulic motor **30**. A rugged compact geared reduction drive connection has thus been provided, within the limits of the drive element **25**, for rotatably driving said drive element **25** from the hydraulic motor **30**, in a simple and expeditious manner.

It may be seen from the foregoing that an economical drive has been provided for the tramming devices for a mining machine and the like, in which separate drive and power units are provided for each tramming device, which may readily be removed as units for inspection and repair by the simple operation of removing a series of coupling pins, and disconnecting the associated traction tread device, where the tramming device may be of the continuous traction tread type, and that this unit enables a simple control for the tramming devices to be attained, controlling the speed and direction of travel of the machine by the simple operation of controlling the pump and the direction of flow of fluid under pressure from the pump.

I claim as my invention:

1. A tram drive unit for a mining machine comprising:
a main frame and tramming devices propelling the machine along the ground,
an individual power pack for each tramming device, separate from said power pack,
each power pack comprising:
a power pack frame,
a pump mounted on said power pack frame and an electric motor mounted on said power pack frame for driving said pump,
means mounting said power pack frame on said main frame for removal as a unit,
each drive pack comprising:
a drive pack frame,
a hydraulic motor secured to said drive pack frame,
a drive element rotatably journalled in said drive pack frame and having driving engagement with said tramming device,
reduction gearing driven from said hydraulic motor for rotatably driving said drive element,
means removably mounting said drive pack frame on said main frame for removal from said main frame as a unit,
fluid pressure connections from said hydraulic pump to said hydraulic motor,
and control means for said pump, controlling the direction and speed of rotation of said hydraulic motor and the speed and direction of travel of the mining machine.

2. A train drive unit in accordance with claim **1**,
wherein the reduction gearing is planetary geared reduction gearing having an initial drive gear driven from said hydraulic motor and a final drive gear having driving engagement with said drive element.

3. The structure of claim **1**,
wherein each power pack frame has a pair of parallel spaced inner and outer apertured bracket legs, each having more than one apertured portion aligned with the apertured portion of a next adjacent bracket leg,
wherein a pair of coupling pins passing through the apertured portions of said mounting bracket legs and corresponding apertured portions in said main frame serve to detachably mount said power pack frame to said main frame,
wherein said drive pack frame has laterally spaced apertured mounting portions extending generally forwardly and rearwardly therefrom,
and wherein coupling pins are provided to pass through said apertured mounting portions and corresponding aligned apertures of said main frame, for detachably mounting said main frame to said power pack frame.

4. In a mining machine having a main frame and laterally spaced continuous traction tread devices guided for movement along opposite sides of said main frame for supporting and propelling the machine, drive means for said traction tread devices comprising:
an individual drive sprocket for each traction tread device,
a drive pack for driving said drive sprocket,
a power pack separate from and individual to said drive pack for supplying power to said drive pack,
said power pack comprising:
a power pack frame,
a pump mounted on said frame,
a motor mounted on said power pack frame and having driving connection with said pump,
said drive pack comprising:
a drive pack frame forming a bearing support for said sprocket,
reduction driving gearing within the confines of said sprocket and having driving connection therewith,
a hydraulic motor secured to said drive pack frame and extending outwardly therefrom,
a drive connection from said hydraulic motor to said reduction drive gearing,
fluid pressure connections from said pump to said motor,
and means individually mounting said power pack frame

and said drive pack frame on said main frame for ready removal and replacement as units.

5. The structure of claim 4,

wherein control means are provided for said pump, controlling the direction and speed of rotation of said hydraulic motor, by controlling the output from said pump.

6. The structure of claim 5,

wherein the reduction gearing is planetary reduction gearing contained wholly within the limits of said drive sprocket and having a sun pinion driven by said motor and a cage having driving connection with said drive sprocket and coaxial with the axis of said motor shaft.

7. The structure of claim 4,

wherein the individual mounting means for mounting said power pack frame and said drive pack frame on said main frame comprise:

laterally spaced apertured bracket legs extending from said power pack frame,

apertured portions on said main frame registrable with the apertured portions of said bracket legs,

coupling pins extending through the apertured portions of said bracket legs and the registered apertured portions of said main frame,

means locking said coupling pins in engagement with the apertured portions of said mounting lugs and said main frame,

apertured mounting portions on said drive pack frame, spaced laterally of each other and extending forwardly and rearwardly of said drive pack frame,

apertured portions on said main frame registrable with the apertured portions of said mounting portions of said drive pack frame,

coupling pins passing through the apertures of said mounting portions and the aligned apertures of the apertured portions of said main frame,

and means locking said coupling pins in position.

8. The structure of claim 7,

wherein the reduction gearing is planetary geared reduction gearing contained within the limits of said drive sprocket and having initial and terminal drive gears coaxial with the axis of said motor, the initial drive gear being directly driven by said motor and the terminal drive gear having driving connection with said drive sprocket.

9. The structure of claim 8,

wherein a control lever is provided for said pump manually controllable to vary the output of said pump and the direction of the flow of fluid from said pump to said hydraulic motor, for driving said hydraulic motor at varying speeds in forward and reverse directions.

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