

Oct. 20, 1953

S. C. MOON

2,656,152

TRUCK FOR DRILL AND MINING MACHINES

Filed Jan. 3, 1949

5 Sheets-Sheet 1

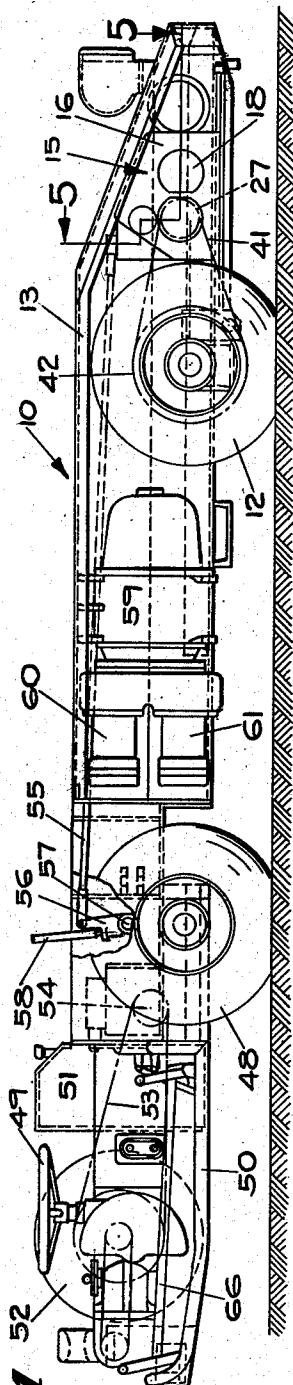


Fig. 1

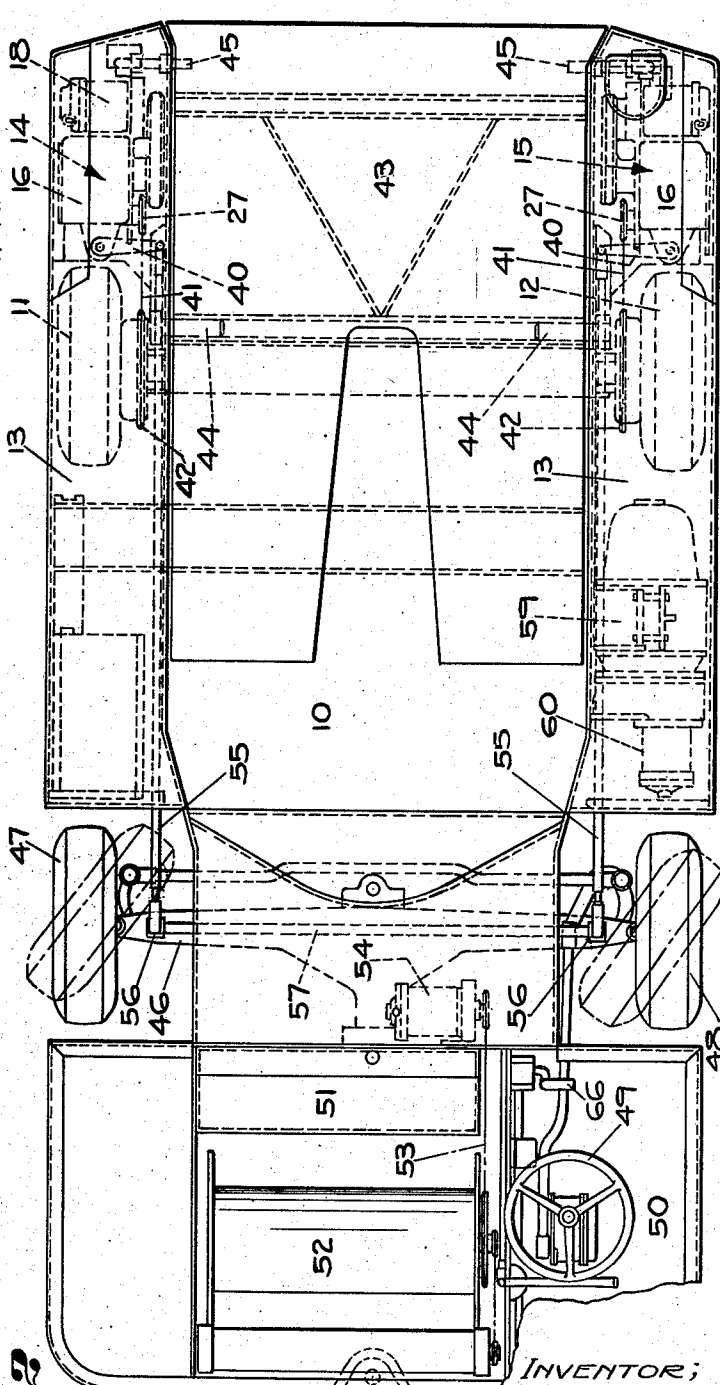


Fig. 2

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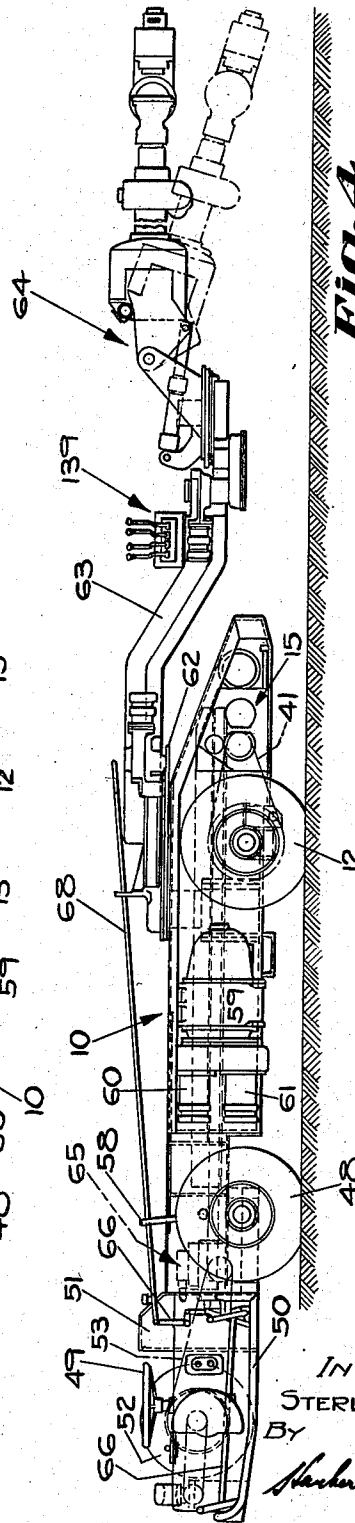
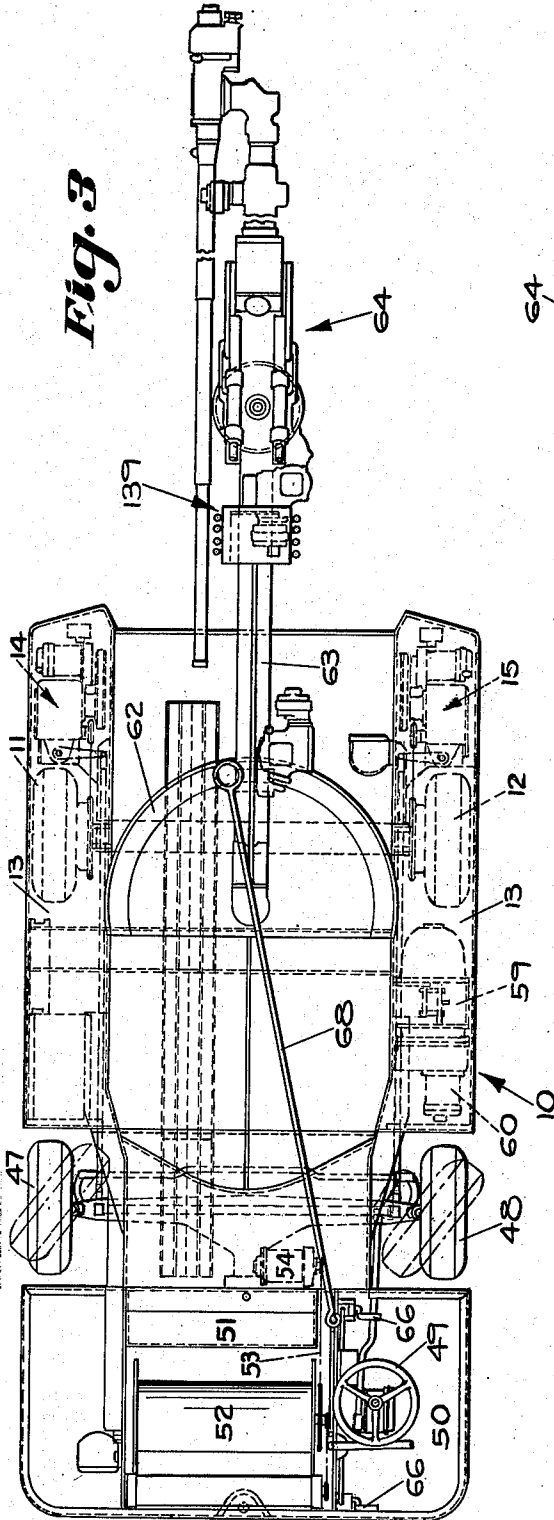
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5 Sheets-Sheet 2



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5 Sheets-Sheet 3

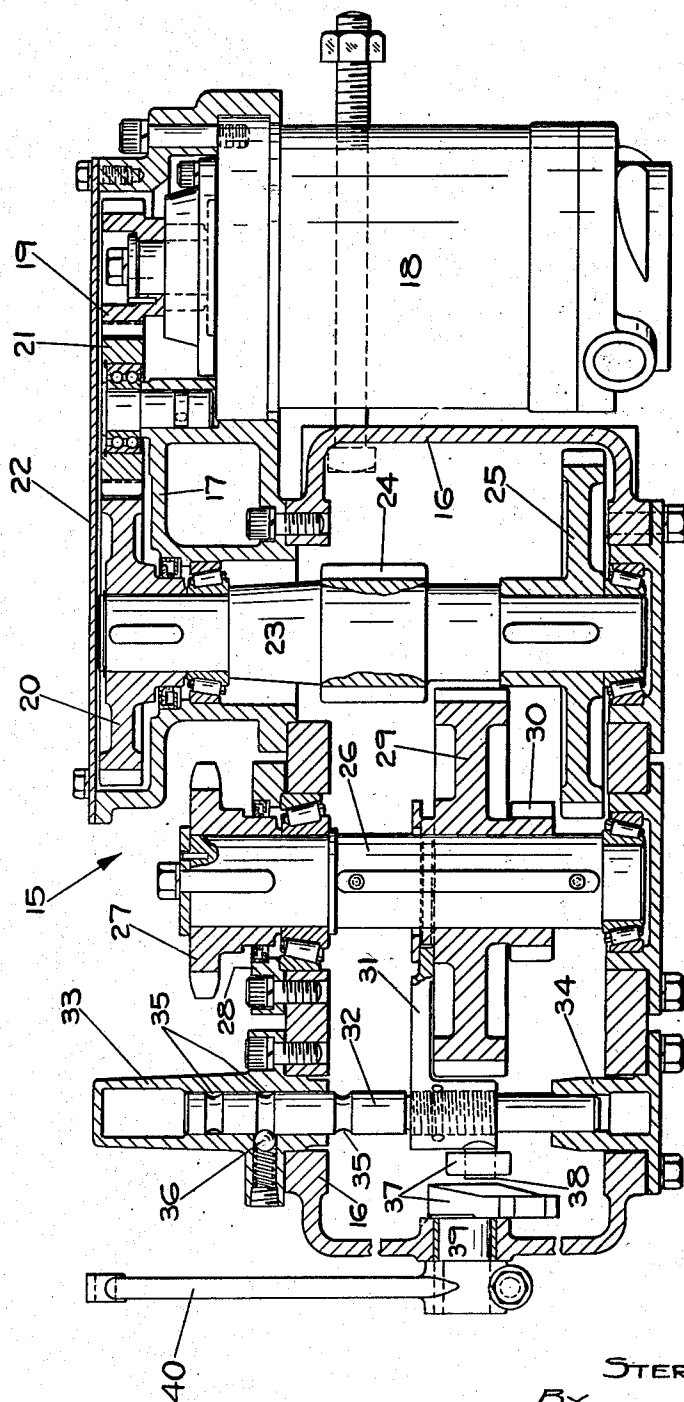


Fig. 5

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TRUCK FOR DRILL AND MINING MACHINES

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Fig. 8

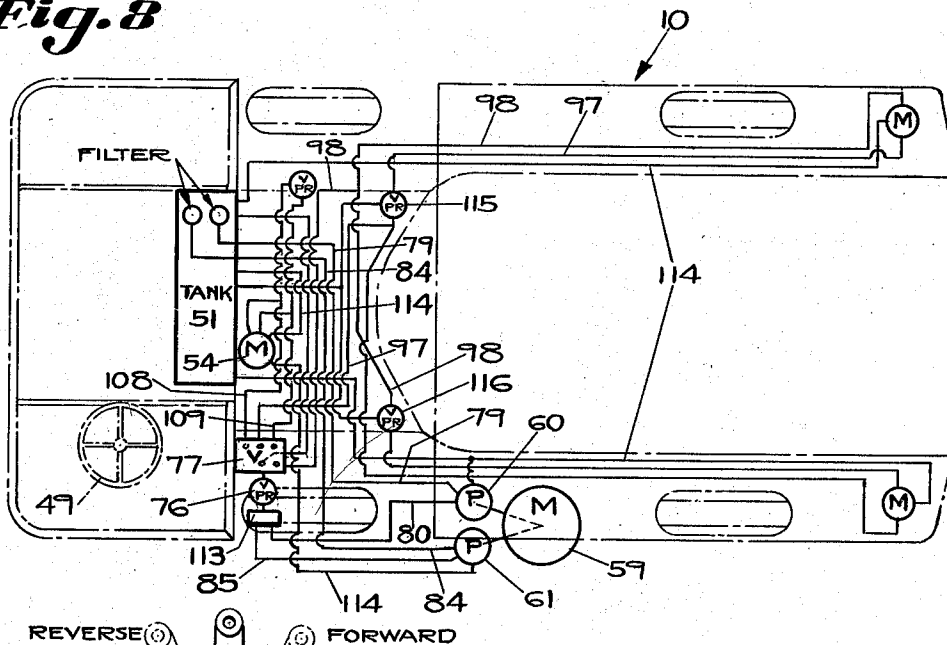
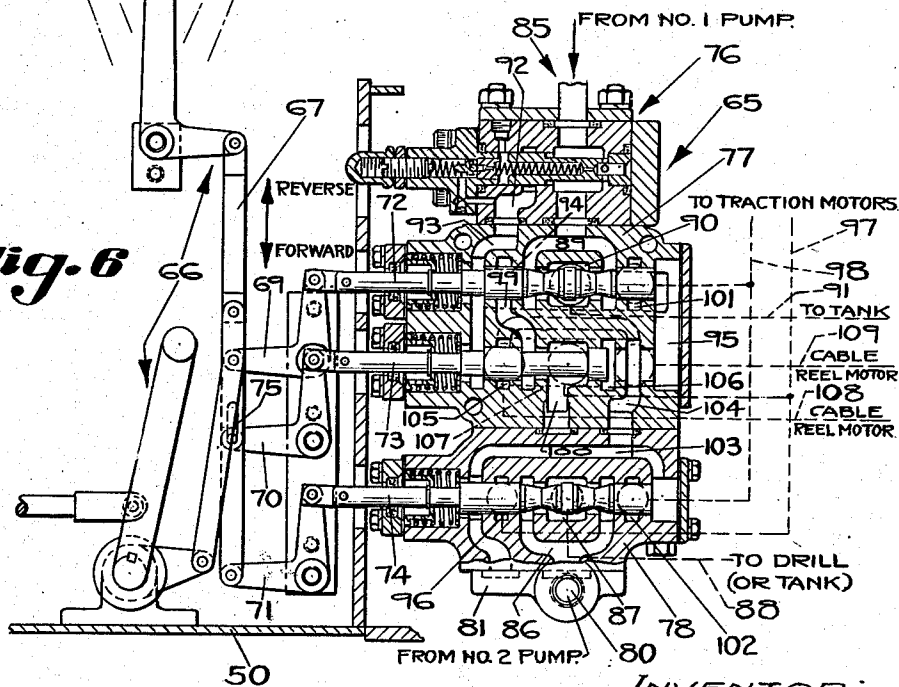


Fig. 6



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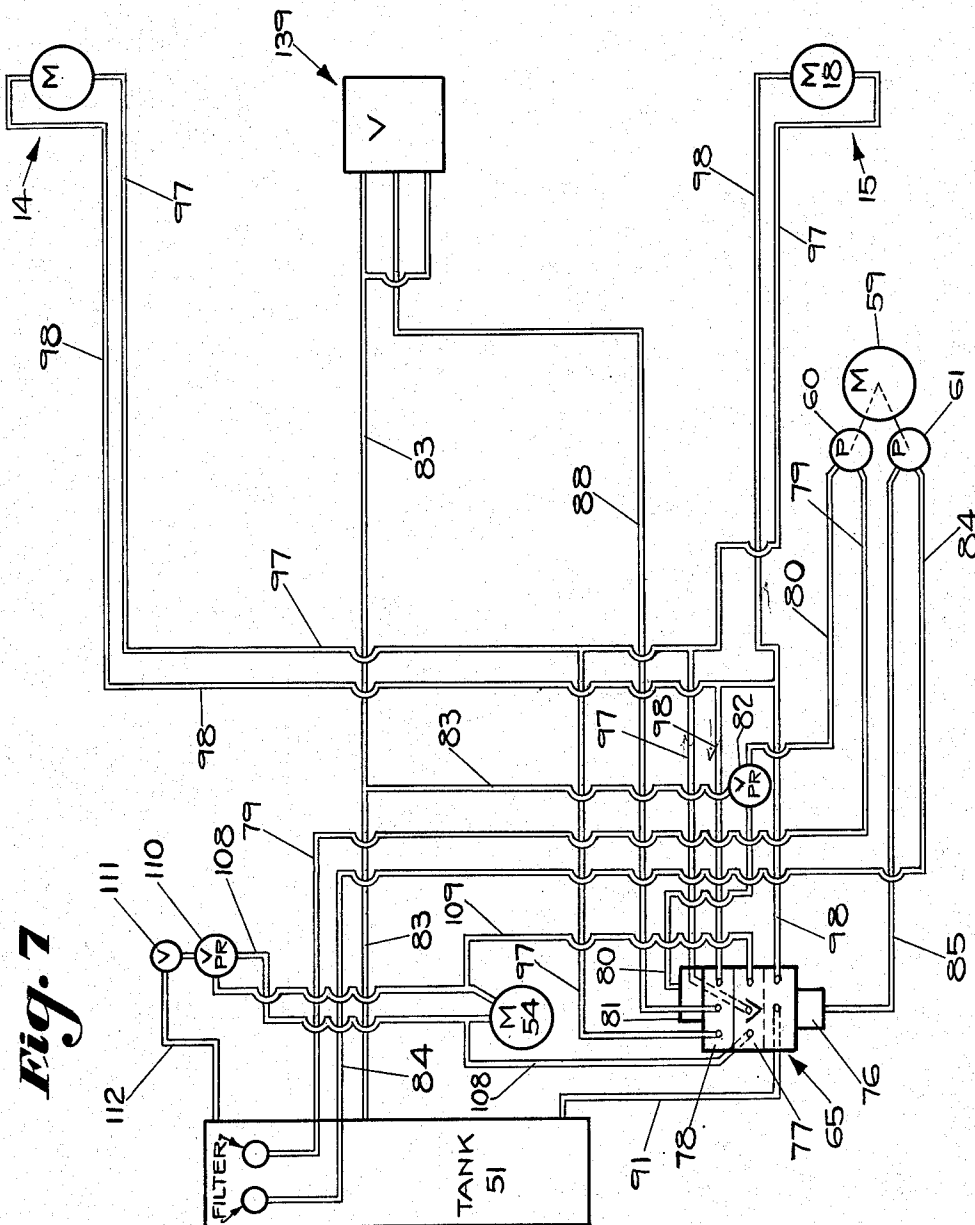
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TRUCK FOR DRILL AND MINING MACHINES

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,656,152

TRUCK FOR DRILL AND MINING MACHINES

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Application January 3, 1949, Serial No. 68,963

6 Claims. (Cl. 255—51)

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This invention relates to a truck designed particularly for use in an underground coal mine and in one form adapted to support a removable mining machine and in another form adapted to support a drill mechanism.

An object of the invention is to provide a truck in which a pair of traction wheels are driven by hydraulic motors and in which there is an electric cable reel also driven by a hydraulic motor and a hydraulic circuit or system.

A further object of the invention is to provide a truck with an improved hydraulic circuit and to provide an improved hydraulic circuit, per se, in which two hydraulic pumps are provided, the output of which is delivered to a pair of traction hydraulic motors and a cable reel hydraulic motor and in which the output of only one of the pumps is delivered to a drill mechanism mounted on said truck.

Still another object of the invention is to provide an improved hydraulic circuit for controlling the operation of a pair of hydraulic traction motors and a cable reel motor.

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 side elevational view of a truck adapted to support a separate mining machine and involving certain features of my invention;

Fig. 2 is a plan view of the truck of Fig. 1;

Fig. 3 is a plan view of the truck of Figs. 1 and 2, modified, however, to support a drilling mechanism which is illustrated as carried thereby;

Fig. 4 is a side elevational view of the truck of Fig. 3;

Fig. 5 is a sectional view on the line 5—5 of Fig. 1 of the drawings, except as indicated hereinafter, and showing particularly the two speed drive gearing from a rotary hydraulic traction motor to a wheel driving sprocket;

Fig. 6 is an elevational view of a valve assembly and operating mechanism therefor, with the valves shown in section;

Fig. 7 is a piping diagram of the system, with the drilling mechanism; and

Fig. 8 is a diagrammatic plan view of the truck for supporting the mining machine, with the piping diagram also illustrated.

Referring particularly to Figs. 1 and 2 of the drawings, the truck includes a low generally horizontal elongated main frame or body 10, the front end of which is supported by a pair of laterally spaced aligned traction wheels 11 and

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12 which are mounted upon a cross axle rigid with the main frame 10, said traction wheels 11 and 12 being below protecting plate fenders 13 forming part of the main frame or body 10 and located on opposite sides thereof, said fenders extending laterally from the top edges of the forward portion of said body 10. These fenders 13 constitute protecting means for the wheels 11 and 12 as well as other apparatus hereinafter described.

Located forwardly of each wheel 11 and 12 and carried by the main frame 10 and also beneath and protected by a fender 13 is a two speed power unit. The power unit for driving the wheel 11 is designated 14 and the power unit for driving the wheel 12 is designated 15. These power units are essentially duplicate in design except one is a right hand unit, the other a left hand unit.

Power unit 15 is illustrated in detail in Fig. 5 of the drawings and is subsequently described completely. Power unit 15 includes a main casing or housing 16 which is adapted to be removably but rigidly attached to the main frame 10 in a position directly ahead of the wheel 12. Rigidly but removably attached to the main casing or housing 16 is a transfer casing or housing 17 which supports a reversible rotary hydraulic motor 18 which constitutes the traction motor for driving the wheel 12, said motor 18 being supplied with hydraulic fluid, as hereinafter described.

The rotor shaft of the reversible hydraulic motor 18 is provided with a pinion 19 which drives a gear 20 through a reach gear 21, all of said gears being within the transfer casing 17 and being accessible by virtue of a removable cover plate 22 provided for said transfer casing 17. Gear 20 is keyed to a shaft 23 mounted on spaced anti-friction bearings, one of which is in a neck of the transfer casing 17 which communicates with the main casing 16, the other being in a socket or recess in a removable cap of said main casing 16.

The shaft 23 is provided with an integral low speed gear 24 and has keyed thereto a large high speed gear 25. Spaced from the shaft 23 and parallel therewith is a driving shaft 26 which carries a drive sprocket 27 on its outer end which projects through a sealed opening in a cap 28 of the casing 16. Shaft 26 is mounted on spaced anti-friction bearings carried by caps on opposite sides of the main casing 16.

Splined to the shaft 26 for shifting movement along the axis thereof is a shiftable double gear

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having a large low speed gear 29 and a small high speed gear 30. As illustrated in the drawings, the two speed gearing provided by the gears 24 and 29 in the one instance and the gears 25 and 30 in the other instance, are in their neutral positions since the composite gear 29, 30 is positioned on the shaft 26 so that the gears thereof are out of mesh.

Cooperating with the composite gear 29, 30 is a shipper 31 which is rigidly attached to a shiftable guide rod 32 slidable axially in cylindrical guides 33 and 34 provided in removable caps forming part of the main casing 16. The guide rod 32 is provided with three spaced peripheral grooves 35 which selectively cooperate with a spring and ball detent 36 which indicates selectively three positions of the two speed gearing, namely, low speed, neutral, and high speed, the parts being illustrated in the neutral position in Fig. 5 of the drawings.

By shifting the guide rod 32 upwardly, as viewed in Fig. 5 of the drawings, the gears 24 and 29 will be brought into mesh, providing a low speed drive from the motor 18 to the sprocket 27. By shifting said guide rod downwardly from the position illustrated in Fig. 5 a high speed drive will be effected by meshing the gears 25 and 30. Shifting of the guide rod 32 is effected by a pivoted lever or arm 37 which cooperates with a pin 38 on the shipper 31, the lever or arm 37 being carried on a stub shaft 39 which is journaled in the end of the casing 16 and is operated by a horizontal inwardly extending operating lever 40.

In the interest of clearness, in Fig. 5 of the drawings the lever 37, shaft 39 and lever 40 have been rotated 90° with respect to the other parts illustrated, the actual physical relation of the lever 40 to the casing 16 being illustrated in Fig. 2 of the drawings.

Referring to Figs. 1 and 2 of the drawings, it will be seen that the sprocket 27 of power unit 15 is connected by a chain 41 to a sprocket 42 rigidly attached to the traction wheel 12. A similar chain and sprocket drive is provided between the sprocket 27 of the power unit 14 and the wheel 11.

From the above description it is evident that a very compact two speed drive is provided for each of the traction wheels 11 and 12 from an individual hydraulic motor. Furthermore, the power unit for each wheel, including the motor and speed reducing gearings, is located directly ahead of the wheel which it drives and is protected by the main frame, including the adjacent fender 13. This all contributes to a good distribution of weight, the location of the power units laterally of the main body carrying portion of the truck, and the close positioning of the power unit, including the driving motor, to the traction wheel which it drives. It also makes available considerable space rearwardly of the traction wheels for other apparatus, some of which is described hereinafter.

In the truck disclosed in Figs. 1 and 2 there is a pivoted platform 43 which is pivoted on a horizontal transverse axis, at substantially its middle, by means of aligned stub shafts 44 which are preferably carried in a hollow tube welded rigid with the platform 43. The stub shafts 44 are preferably welded to the tube and extend into bearing means in the adjacent side members of the main frame 10. The platform 43 is held in the position illustrated in Figs. 1 and 2 of the drawings by a pair of releasable latch-

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ing pins 45 carried by the main frame 10 adjacent the front end thereof, which pins 45 project beneath the upper end of the platform 43 adjacent opposite sides thereof. Latching pins 45 may be withdrawn to permit the front end of the platform 43 to drop down onto the mine floor so that a mining machine, such as a short-wall or longwall type of machine, may be dragged upon the platform 43 by operating its cable which may be hooked at one end to a portion of the main frame 10.

Toward the rear end of the frame 10 is a transversely extending steering wheel axle 46 having steerable wheels 47 and 48 on opposite sides thereof which are interconnected in a standard manner and operated by a steering wheel 49 adjacent an operator's platform 50 which is adjacent the rear right-hand side of the main frame 10. The axle 46 is pivotally attached to the main frame 10 at its center along a horizontal longitudinally extending axis to provide a three-point suspension for the main frame 10 in cooperation with the front wheels 11 and 12. The wheels 47 and 48 are received in open pockets and normally are within the lateral confines of the main frame 10.

Adjacent the operator's platform 50 and in the central rear portion of the main frame 10 there is a tank 51 for hydraulic fluid of the hydraulic system described hereinafter, to the rear of which there is an electric cable reel 52 which is driven through a chain and sprocket drive 53 from a reversible hydraulic motor 54.

Simultaneous control for the two speed reduction gearing mechanisms 14 and 15 is provided by means of a pair of longitudinally extending rods 55, one on each side of the upstanding members of the main frame 10, the forward ends of which rods are pivotally attached to the previously described levers 40, and the rearward ends of which are attached to crank arms 56 which are keyed to a horizontal transversely extending rock shaft 57 which has an operating lever 58 adjacent one side for rocking the shaft 57 and simultaneously and similarly shifting the gears of the power units 14 and 15.

On one side of the upstanding members of the main frame 10 and below one of the fenders 13 and between the front traction wheel 12 and the rear steering wheel 48, there is an electric motor 59 which drives a pair of hydraulic pumps 60 and 61.

From the above description it is evident that a compact flexible truck has been provided, in which there is a pair of front traction wheels, one adjacent each side of the body or main frame and near the front thereof. Each wheel is individually driven from a reversible rotary hydraulic motor through an individual two speed power transmission mechanism. The two power transmission mechanisms are simultaneously controlled from the rear of the unit by appropriate control mechanism. Near the rear end but forward of the operator's station, which is adjacent the rearmost portion thereof and at one side, there is a pair of steerable wheels which support the rear end of the body and provide for steering thereof. A hydraulically driven rotary electric cable reel is also provided adjacent the rear end of the body and substantially centrally thereof.

The above described drive mechanism for the truck is claimed in my divisional application, Serial No. 363,434, filed June 23, 1953, for a "Truck Including Improved Drive Means."

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Attention is now directed to Figs. 3 and 4 of the drawings where a modified form of truck is disclosed, it being understood that except for such differences as are obvious or specifically mentioned, it follows the disclosure of the truck in Figs. 1 and 2 above described.

In the truck disclosed in Figs. 3 and 4 the platform 43 has been entirely eliminated and the main frame or body 10 carries a rigid turntable 62 upon which the boom 63 of a coal drilling mechanism 64 is mounted for swinging movement about a vertical axis. The detailed construction of the drill mechanism 64, per se, is not a feature of the instant invention and may follow, for example, the construction of the drill mechanism disclosed and claimed in the application of John S. Beltz, Serial No. 769,358, and now abandoned, entitled "Power Driven and Controlled Coal Mine Drilling Machine," filed August 19, 1947.

As hereinafter pointed out, the principal significance, insofar as the present invention is concerned, is in the hydraulic circuit wherein the hydraulic circuit of the coal drilling mechanism is intimately involved in applicant's novel hydraulic circuit in one form thereof.

Attention is now directed particularly to Fig. 6 of the drawings and to the construction of a multiple valve unit, generally designated 65, which forms an important feature of my invention and provides novel hydraulic controls. Adjacent the operator's platform 50 there is a system of levers 66 which may be operated to shift an upstanding linkage 67. By reference to Figs. 1, 2, 3 and 4 it may be seen that the levers 66 are adapted to be operated from either end of the operator's platform and in the arrangement of Figs. 3 and 4 are also adapted to be operated by a forwardly extending rod 68, which may be grasped by an operator, adjacent the front of truck, who is operating the various control valves of the drill mechanism 64. Operation of any of these several levers of the mechanism 66 may be employed to shift the upstanding linkage 67 in either of reverse directions from its neutral position illustrated in Fig. 6 of the drawings.

When linkage 67 is moved upward, the associated truck is caused to travel rearwardly and when said linkage is moved down it is caused to travel forwardly. The linkage mechanism 67 is interconnected with three bell crank levers 69, 70 and 71 which are pivoted to the main frame and each of which is connected to an individual spool, or what may broadly be considered an individual valve of the valve unit 65; the spools or operating mechanisms associated with the levers 69, 70 and 71 being designated 72, 73 and 74, respectively. In effect, each of these spools 72, 73 and 74 represents an individual reversely operable control valve which while the essential characteristics are of standard design, nevertheless is designed particularly for the particular hydraulic circuit here involved.

Of particular importance is the fact that while the levers 69 and 71 are connected to partake of reverse movement with the linkage 67, there is a lost motion connection, provided by an elongated slot 75, between the lever 70 and the linkage 67 so that spool 73 is moved only in one direction from its normal position; that is, it is moved inwardly when the linkage 67 is moved upwardly. It does not move from its normal position when the linkage 67 moves downwardly. Stated another way, when linkage 67 moves upwardly, all three of the spools 72, 73 and 74 are moved inwardly or to the right, as viewed in

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Fig. 6 of the drawings. When the linkage 67 is moved downwardly, only spools 72 and 74 are actuated and they move out or to the left, as viewed in said Fig. 6. Each of these spools is provided with a self-centering spring of generally standard construction.

The valve unit 65, in the preferred and complete embodiment, is built up by combining three individual valve blocks or casings. The first valve is designated 76 and constitutes a standard form of pressure relief valve. Below the pressure relief valve 76 is the block 77 of a double valve which receives the spools 72 and 73, and for practical purposes this constitutes two individual control valves. Below the double block 77 is a block 78 which receives the aforementioned spool 74.

As hereinafter described, when the hydraulic drill is omitted the block 78 and the spool 74, together with the actuating mechanism therefor, may, if desired, be completely eliminated. However, it may, if desired, still be employed, as pointed out hereinafter. It may be stated at this time that in the hydraulic circuit illustrated in Fig. 8 the block 78 and spool 74 are completely eliminated. In the hydraulic circuit of Fig. 7 this block 78 and spool 74 are involved and they may be involved even though the hydraulic drill is eliminated.

The operation of the several valves of the valve unit 65 can best be explained in connection with the three operating conditions thereof in conjunction with the hydraulic circuit of Fig. 7. Assuming that the electric motor 59 is running and driving the two pumps 60 and 61, it will be seen that pump 60 derives hydraulic fluid from the tank 51 through a filter over a feed pipe or conduit 79 and delivers it over a pressure pipe or conduit 80 to a block 81 attached to the block 78. In this regard it may be noted that the relative positions of the valves are reversed in Fig. 7 as compared with Fig. 6; that is, block 78 is on top and block 77 is on the bottom in Fig. 7, while the reverse condition applies to Fig. 6. A pressure relief valve 82 is interposed in the conduit 80, the fluid normally flowing through it without effect. A high pressure condition, however, will cause the fluid to spill over to tank 51 by way of tank pipe or conduit 83.

Pump 61 derives fluid from the tank 51 through a filter by way of feed pipe or conduit 84 and delivers its output fluid under pressure to pipe or conduit 85 which leads to the pressure relief valve 76. The hydraulic fluid is preferably oil or the like.

With the valves or spools 72, 73 and 74 in their normal or neutral positions, as illustrated in Fig. 6 of the drawings, the truck will be standing still and be locked in position. This will be a normal condition under which the drill mechanism 64 will be operated whenever it is present on the truck. Under these conditions the output of the pump 60 flowing through the conduit 80 and block 81 will enter the bifurcated passageway 86 in the block 78 and will flow through the central cylindrical bore in said block to a central chamber 87 which is connected by a fitting to a pipe or conduit 88 which is the pressure line leading to the multiple control valve designated 139 which is the main control valve for the hydraulic drill mechanism 64, said valve 139 corresponding with the valve 139 of the Beltz application, Serial No. 769,358, above identified. In other words, under these conditions pump 60 supplies the hydraulic fluid for

operating one or more of the hydraulic control mechanisms of the drill 54, of which there are a number, as disclosed in detail in said Beltz application.

Tank conduit or pipe 83 also extends to valve 139, providing a return for the fluid from said hydraulic motors of the drill mechanism by way of valve 139 to tank 51. If the drill mechanism is eliminated, the valve of block 78 may be eliminated, together with all of its associated mechanism and this condition is illustrated in the diagrammatic piping diagram of Fig. 8 of the drawings which follows the piping diagram of Fig. 7, except for obvious differences or those pointed out hereinafter. On the other hand, even if the drill mechanism 54 is eliminated, the block 78 and associated mechanism may, if desired, be retained. If it is retained, the pipe or conduit 83 is merely connected to tank 51 and under such conditions the circuit above described would cause the pump 61 merely to by-pass freely to tank 51.

Under the assumed conditions, namely, with the valves in neutral, the output of pump 61 is delivered over conduit 85 to pressure relief valve 76, through which it freely flows, as evident by the provision of the through passageway seen in Fig. 6 of the drawings, the fluid being connected to a central bifurcated passageway 89 in the block 77. From this passageway 89 the hydraulic fluid will flow to a central chamber 99 in said block 77, which chamber 99 is permanently connected by pipe or conduit 91 to tank 51. This provides a no-load by-pass for the pump 61. Should a high pressure develop in the line 85, the standard pressure relief valve 76 will operate in a well known manner to interconnect the main central through passageway to a spillage passageway 92 which communicates with a passageway 93 in the block 77. Block 77 on the back side is provided with a passageway 94, indicated by dotted lines, which is in constant communication with the central chamber 99 and with a large end chamber 95.

Thus if pressure relief valve 76 operates it connects the pressure line or conduit 85 to tank by way of passageways 92, 93 and 94 to chamber 99 which is directly connected by conduit 91 to tank.

When the truck is trammed forward it is, of course, evident that the cable reel will have to rotate to pay out cable, unless there is a reasonable amount of slack in it. In this operation the two traction motors of the power units 14 and 15 are supplied with hydraulic fluid in parallel and the cable reel operating hydraulic motor 54 is merely by-passed; that is, its input and output conduits are connected together, thus allowing it to float and allowing the pull on the cable to rotate the reel as required. This is effected by actuating any one of the control levers 65 to push the linkage 67 downward, which actuates valves or spools 72 and 74 by pulling them out or moving them to the left, without effecting any actuation of valve or spool 73.

Under these conditions, the hydraulic fluid from the pump 61 is delivered, as above described, over pressure conduit 80 to the bifurcated passageway 86, from which it is now connected to a chamber 96 by the lands on the spool 74, which chamber 96 is connected by conduit 97 (see Fig. 7) to the two reversible rotary hydraulic motors of the power units 14 and 15 connecting them in parallel; the return line from said traction motors being by way of pipe or conduit 98.

Under the conditions just described, the con-

duit 97 is, of course, the pressure conduit which delivers hydraulic fluid to the two traction motors of the power units 14 and 15 in parallel. This fluid is not only delivered to said conduit 97 from the pump 61, above described, but also simultaneously delivered thereto from the pump 61. This path is from pump 61 by way of pressure conduit 85 through relief valve 76 into the bifurcated passage 89 of valve 72, thence into passageway 99 which is now in communication therewith, since the spool 72 is moved to the left, as viewed in Fig. 6. Passageway 99 is connected with the central chamber 100 associated with the spool or valve 73 under these conditions, since it is in its neutral position. Chamber 100 is permanently and directly connected to a branch of conduit 97, as clearly illustrated in Fig. 6 of the drawings. Thus both of the pumps 60 and 61 are connected in parallel and the combined output is delivered to conduit 97, including all the branches thereof, which connects the two traction motors in parallel. Conduit 98, including all branches, provides the return path for the hydraulic fluid from the traction motors of power units 14 and 15. One of these branches of conduit 98 is connected to chamber 101 associated with spool 72 which with the spool moved to the left, as viewed in Fig. 6, as assumed, is now in communication with the end chamber 95 which, as above described, is permanently connected to tank by means of passageway 94, central chamber 99 and conduit 91.

At the same time the lower branch of return conduit 98 is also connected to tank through the blocks 77 and 78, since chamber 102, associated with spool 74, is now connected to passageway 103 which in turn communicates with passageway 104 in block 77, and said passageway 104 being now in communication with end chamber 95.

At the same time the reversible hydraulic motor 54 for controlling the cable reel 52 is by-passed. In other words, its two conduits are connected together to allow it to rotate freely. This is effected by spool 73 which is in its neutral position and in which position it accomplishes the above result.

To this end, there is a pair of spaced chambers 105 and 106 associated with the spool 73, which passageways are permanently interconnected by a passageway on the back of the block 77, said passageway being indicated by the dotted lines 107. Chamber 105 is permanently connected to a conduit 108, and chamber 106 is permanently connected to conduit 109. Conduits 108 and 109 are the output and input conduits respectively for the cable reel driving motor 54.

When the machine is reversed, or travels rearwardly, it is, of course, necessary to supply power to the reel motor 54 so as to reel in the cable. This is effected automatically and simultaneously with the actuation of the traction motors of the power units 14 and 15 to drive the truck rearwardly. To effect this operation the linkage mechanism 67 is lifted upward by any one of the operating mechanisms 66, under which conditions all three of the spools 72, 73 and 74 are actuated to the right, as viewed in Fig. 6 of the drawings.

Under these conditions, hydraulic fluid from the pump 61 delivered through the conduit 80 flows through the bifurcated passageway 86, and the chamber 102 which, as previously described, is connected to conduit 98. Conduit 98, as above described, connects the two motors of the power units 14 and 15 in parallel, this now being the pressure conduit instead of the return conduit.

Pump 61 delivers hydraulic fluid under pressure by way of conduit 95 to relief valve 76, then to bifurcated passage 89 which is now connected by spool 72 to chamber 101 which, as previously described, is connected to a branch of conduit 98. Thus again the output of both pumps 60 and 61 is delivered to the two traction motors of the power units 14 and 15 in parallel. Return lines from the motors of the power units 14 and 15 are now provided by conduit 97 and the various branches of it.

As above described, the conduit 97 leads to chamber 100 associated with spool 73 which is now in communication with chamber 106 under the control of said spool 73. Chamber 106, as above described, is connected with conduit 109 which leads to one side of the reel operating motor 54, delivering hydraulic fluid which is first passed through the two traction motors of power units 14 and 15 in parallel to said reel operating motor 54 at a reduced pressure, driving it in such a direction as to tend to reel in the cable associated therewith. The normal return line from the motor 54 is by way of conduit 108 which, as previously described, is permanently connected to chamber 105 which is now in communication with the passageway 93 which, as above mentioned, is in permanent communication with tank passageway 89 and tank chamber 90 by way of conduit 91.

The motor 54 is therefore connected in series with the two motors of units 14 and 15 which as a pair are connected in parallel. The quantity of hydraulic fluid delivered to the motor 54 is such as to tend to rotate the cable reel at a higher rate than is normally required to reel in the cable. This is desirable to insure that the cable will be adequately reeled in. However, to prevent breaking of the cable a pressure relief valve 110 interconnects the conduits 108 and 109, it being controlled by the pressure in said conduit 109. It is set at a relatively low pressure, such as one hundred and fifty pounds per square inch, so that whenever there is any appreciable tension on the cable associated with the reel 52, this pressure will be developed in line 109 and the excess fluid by-passed by valve 110 to the tank line 108.

Associated with the relief valve 110 I also preferably provide a bleeder valve 111 which is connected to tank 51 by a conduit 112. In normal operation the bleeder valve 111 will be closed and pressure relief valve 110 will operate as above described. The function of this bleeder valve is to disable the motor 54 completely which sometimes is desirable when the truck is adjacent a working face and is carrying the drilling mechanism 64 and the operator wishes to jockey the truck back and forth to position the drill, during which time he does not desire to take up the slack in the cable but merely wishes it to lie on the floor. When the bleeder valve 111 is open, it effectively opens the by-pass valve 110 so that it will freely by-pass any fluid delivered to conduit 109, delivering said fluid through the valve 110 to tank conduit 108.

The hydraulic circuit of Fig. 8 differs only slightly from that above described. In the first place, of course, the hydraulically operated drill 64 has been eliminated. Consequently there are no conduits provided for such a device. In this system the block 78 and associated mechanism, including the spool 74 and bell crank 71, are also eliminated. This calls for the principal difference between this system and that of Fig.

7. In this system the output of each pump 60 and 61 is delivered over conduits 80 and 85 to a junction block 113 where the hydraulic fluid is combined and delivered to the previously described pressure relief valve 76. The block 77 is the same in the system of Fig. 8 as in the system of Fig. 7, as are the associated spools 72 and 73 and the actuating means therefor.

It may also be noted that in Fig. 8 leakage conduits 114 for the several motors have been illustrated, by which leakage is conducted to the tank 51. In addition, the pressure relief valve 82 has been eliminated, but a pressure relief valve 115 is interposed in conduit 97, and a pressure relief valve 116 is interposed in conduit 98. Spillage from these relief valves is, of course, connected to tank over an obvious line or conduit.

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 applicant therefore wishes not to be restricted to the precise construction herein disclosed.

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

1. A truck mounted drill including a frame, means for driving said truck including a pair of hydraulic traction motors, an electric cable reel driving motor, a drill on said frame having a hydraulic operating motor, a pair of power driven hydraulic pumps, a hydraulic circuit interconnecting said pumps and motors including three adjustable valve members, means biasing said valve members to neutral position wherein the output of both pumps is by-passed, and reversely operable lever mechanism connected to adjust all three of said valve members to one operating position when moved in one direction from neutral and to adjust only two of said valve members when moved in a reverse direction from neutral, said lever mechanism when moved in said one direction operating said three valves to connect the output of both said pumps to said two traction motors, and to connect the output of said two traction motors to said cable reel driving motor; said lever mechanism when moved in said reverse direction operating said two valves to connect the output of both pumps to said two traction motors, and to provide a by-pass for the cable reel driving motor, said valves operating when they and said lever mechanism are in their neutral positions to by-pass the output of one of said pumps and connect the output of the other pump to said drill operating motor.

2. A truck including a frame, means for driving said truck including a pair of hydraulic traction motors, an electric cable reel driving motor, a pair of power driven hydraulic pumps, a hydraulic circuit interconnecting said pumps and motors including three adjustable valve members, means biasing said valve members to neutral position wherein the output of both pumps is by-passed, and reversely operable lever mechanism connected to adjust all three of said valve members to one operating position when moved in one direction from neutral and to adjust only two of said valve members when moved in a reverse direction from neutral, said lever mechanism when moved in said one direction operating said three valves to connect the output of both said pumps to said two traction motors, and to connect the output of said two traction motors

to said cable reel driving motor; said lever mechanism when moved in said reverse direction operating said two valves to connect the output of both pumps to said two traction motors, and to provide a by-pass for the cable reel driving motor.

3. A hydraulic circuit including a pair of reversible rotary hydraulic motors, a third hydraulic motor, a fourth hydraulic motor, a pair of power driven pumps, a hydraulic circuit interconnecting said pumps and said motors including a plurality of control valves at least some of which have neutral and reverse operating positions, and operating means for said valves operable to adjust all of them when operated in one direction from neutral and operable to adjust less than all of them when operated in a reverse direction from neutral, said valves being operable in said one direction to connect the output of both said pumps to said pair of reversible rotary hydraulic motors, and to connect the output of said pair of rotary hydraulic motors to said third motor; said valves being operable in said reverse direction to connect the output of both said pumps reversely to said pair of reversible rotary hydraulic motors, and to provide a by-pass for the third motor; said valves operating when in neutral to by-pass the output of one of said pumps and connect the output of the other pump to said fourth hydraulic motor.

4. A hydraulic circuit including a first rotary hydraulic motor, a second rotary hydraulic motor, a pump, a hydraulic circuit interconnecting said pump and said motors, and a pair of control valves in said circuit, one of said valves having a neutral position and reverse operating positions, the other of said valves having a neutral position and one operating position, said one valve being constructed to provide a by-pass for said pump when it is in its neutral position, said two valves cooperating when said one valve is moved to one operating position and the other valve is in neutral to connect said first rotary hydraulic motor in series with said pump and to provide a by-pass for said second rotary hydraulic motor, said two valves also cooperating when said one valve is reversely operated and the other valve is operated from its neutral position to connect both said rotary hydraulic motors in series.

5. A hydraulic circuit including a pair of power driven pumps, a first hydraulic motor, a second hydraulic motor, a third hydraulic motor, and a hydraulic circuit interconnecting said pumps and said motors, said hydraulic circuit having three adjustable valves therein all of which have a normal position, two of which have reversely operating positions and one of which has one operating position, one of said reversely operable valves providing a by-pass for an individual one of said pair of pumps when in its neutral position, the other connecting the other pump to said third

hydraulic motor, said two reversely operable valves when operated in one operating position cooperating with the third valve to connect both of said pumps to said first hydraulic motor and to provide a by-pass for said second hydraulic motor, said two valves when operated in the reverse operating position together with the operation of said third valve to its operating position reversely connecting both of said pumps to said first hydraulic motor and with said second hydraulic motor.

6. A hydraulic circuit including a pair of power driven pumps, a first hydraulic motor, a second hydraulic motor, and a hydraulic circuit interconnecting said pumps and said motors, said hydraulic circuit having three adjustable valves therein all of which have a normal position, two of which have reversely operating positions and one of which has one operating position, each of said reversely operable valves providing a by-pass for an individual one of said pair of pumps when it is in its neutral position, said two reversely operable valves when operated in one operating position cooperating with the third valve to connect both of said pumps to said first hydraulic motor and to provide a by-pass for said second hydraulic motor, said two valves when operated in the reverse operating position together with the operation of said third valve to its operating position reversely connecting both of said pumps to said first hydraulic motor and with said second hydraulic motor.

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