

Sept. 15, 1964

D. W. MOYER ET AL

3,148,506

HYDRAULIC SYSTEM

Filed Jan. 23, 1963

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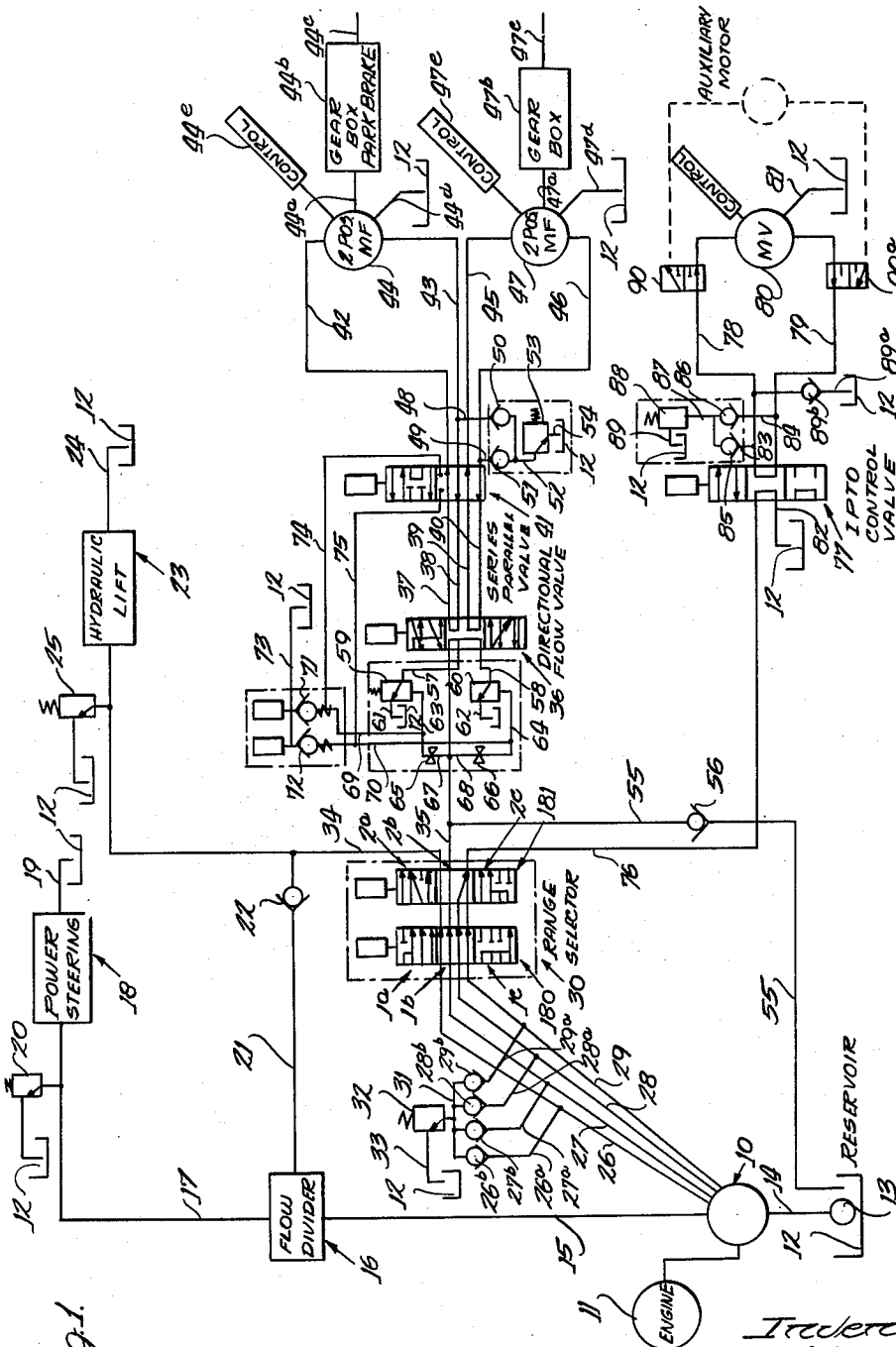


Fig. 1.

Inventors
Donald W. Moyer
David A. Harper
Harold A. Moyer
Attorneys

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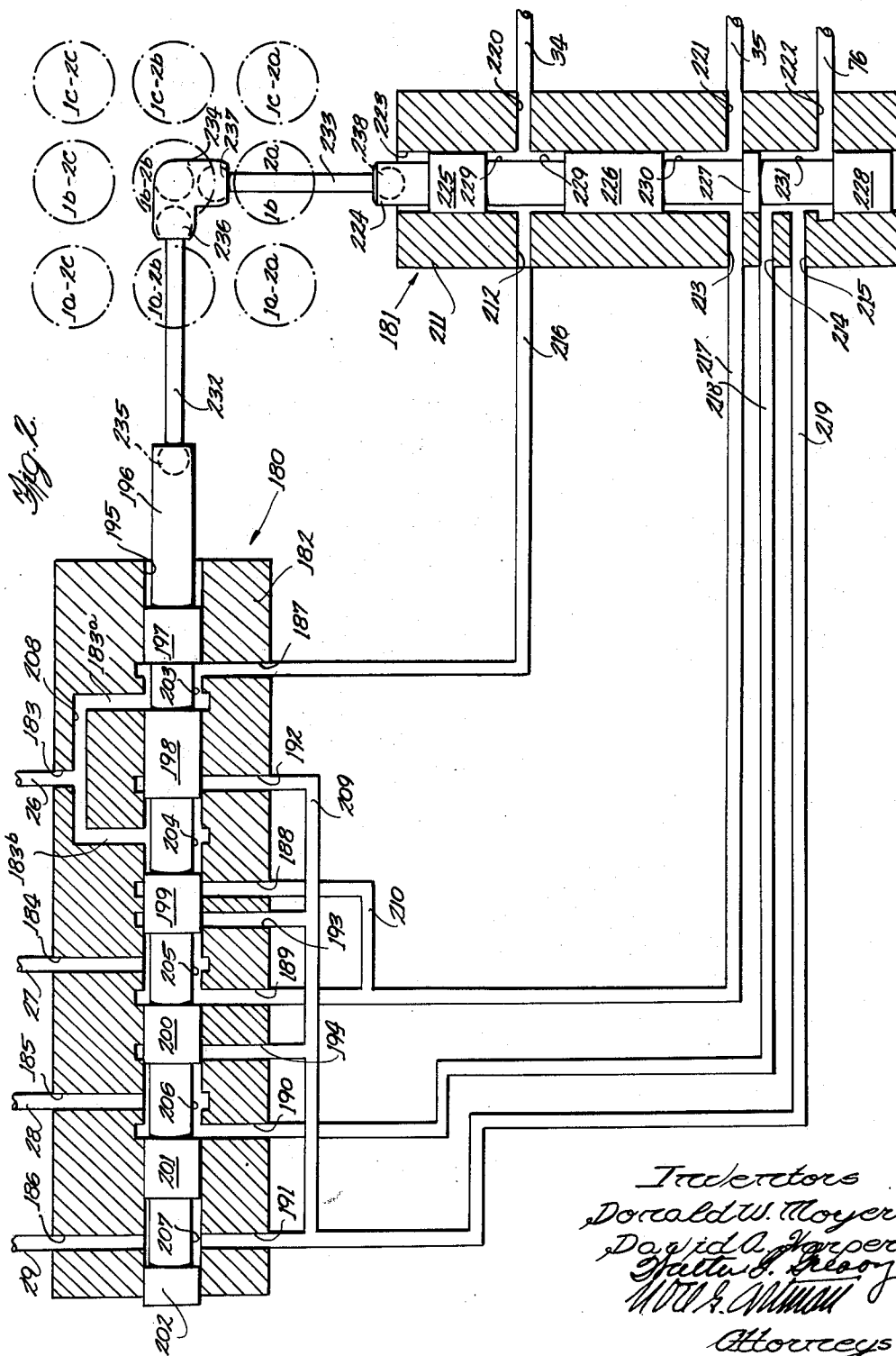
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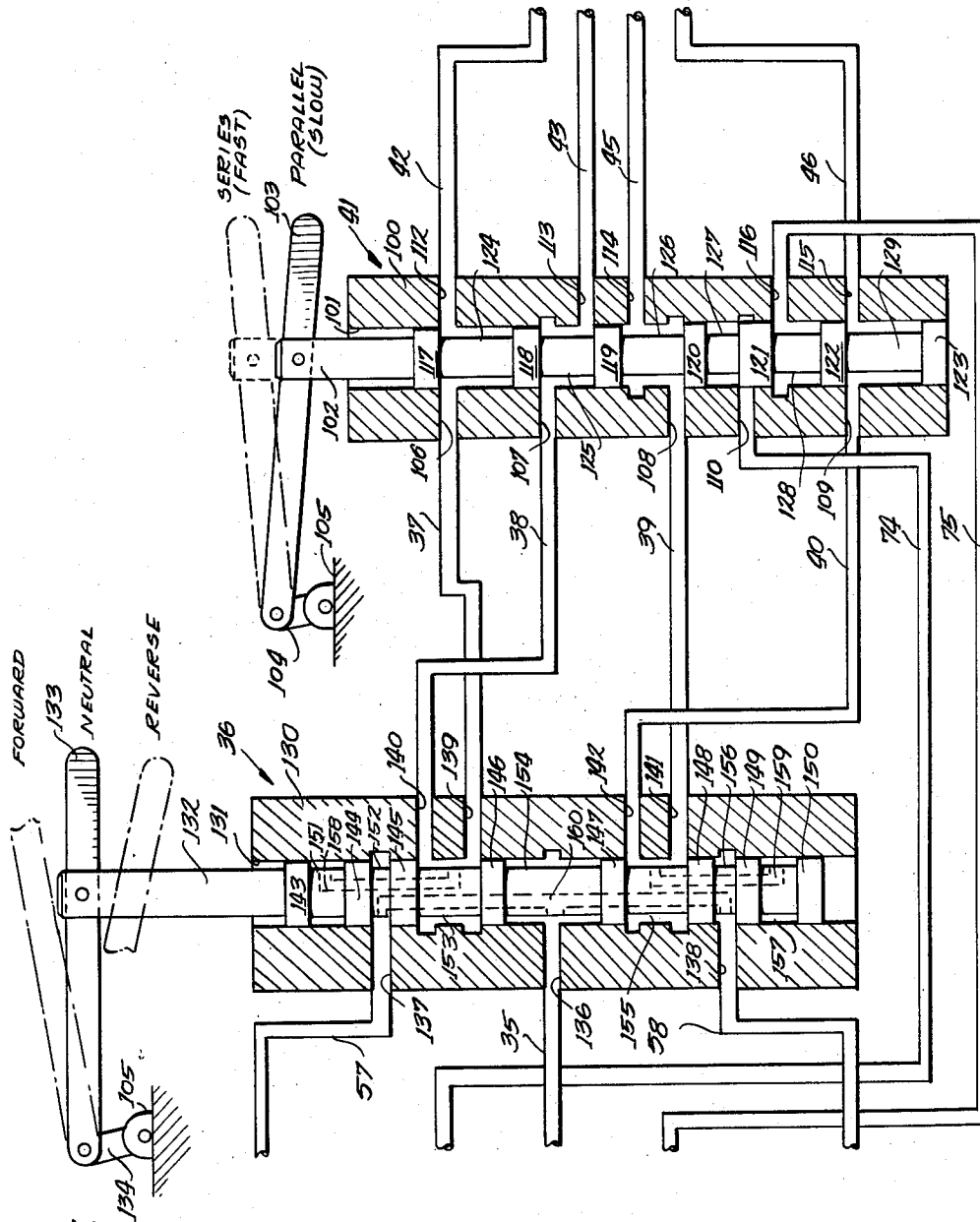


Fig. 3

Inventors
Donald W. Moyer
David A. Harper
Patricia A. Greany
ATTORNEYS

Sept. 15, 1964

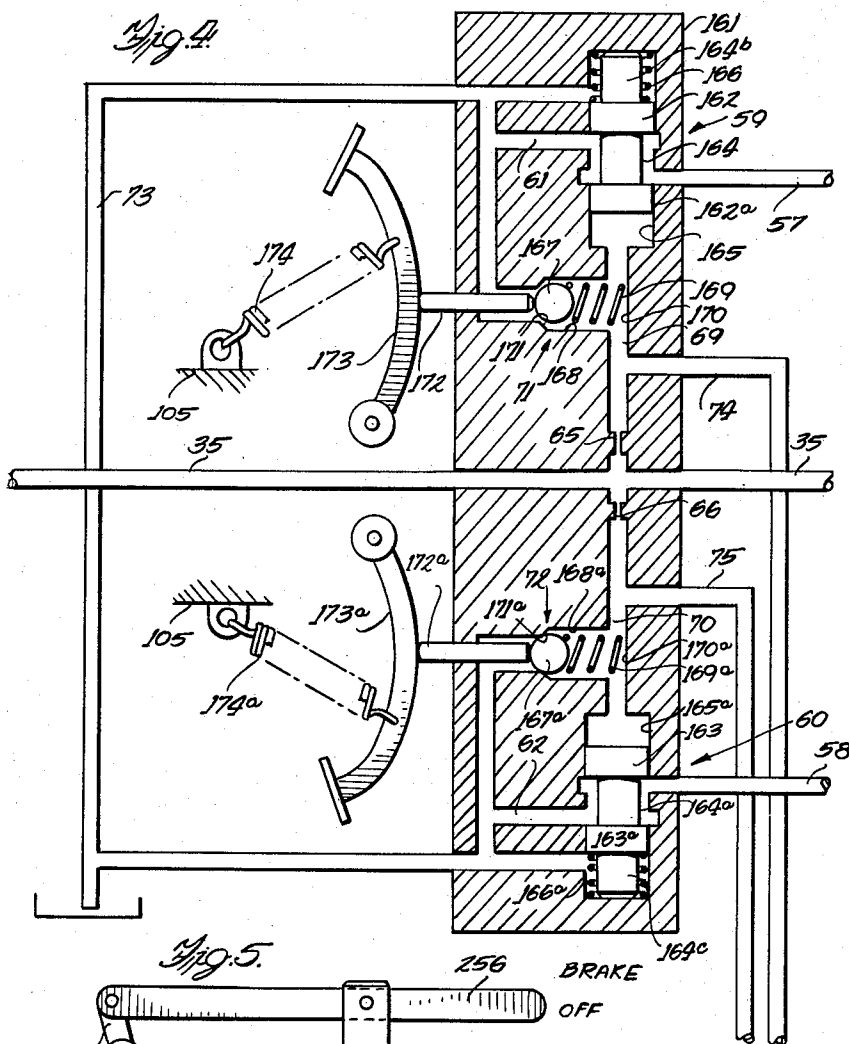
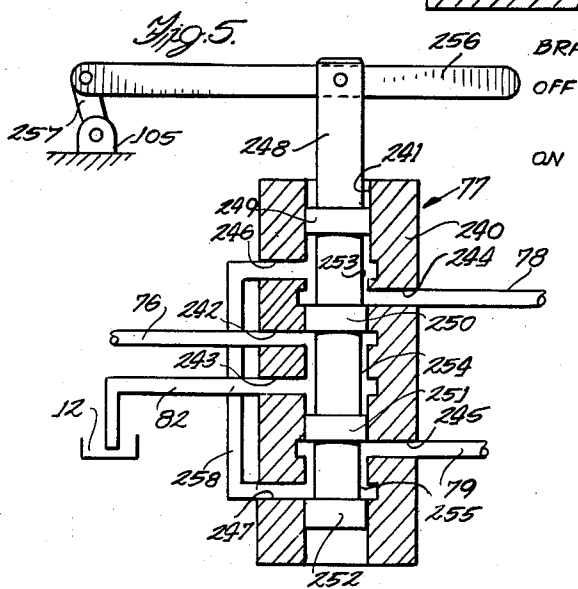
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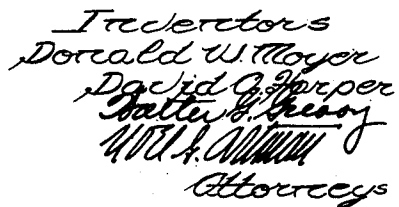
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Inventors
Donald W. Moyer
David A. Harper
Harold E. Benson
ATTORNEYS

3,148,506

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3,148,506

HYDRAULIC SYSTEM

Donald W. Moyer, Chicago, and David A. Harper, Bridgeview, Ill., assignors to International Harvester Company, Chicago, Ill., a corporation of New Jersey
Filed Jan. 23, 1963, Ser. No. 253,452
17 Claims. (Cl. 60—52)

This invention relates to hydraulic systems.

It is a primary object of this invention to provide an improved hydraulic system that is particularly adaptable to vehicles wherein there is a traction load and a plurality of auxiliary equipment mechanisms providing loads which frequently are powered only, although not limited to such operation, when the said traction load is at a minimum.

Another object is to provide a hydraulic system that utilizes both fixed volume and variable volume sources of fluid under pressure.

A further object is to provide a hydraulic system that allows for optimum division of power between accessory and propulsion loads therein while requiring a minimum of pump displacement.

A still further object is to provide, in a hydraulic system employing variable displacement circuits, means to allow for infinite variation of speed for the traction or propulsion motors in said system up to the maximum displacement of the variable circuits thereof at any one of a plurality of range settings of the flow control therefor.

An important object is to provide, in a hydraulic system utilizing a plurality of variable displacement circuits, a single or common relief valve with multiple entry through uni-directional check valves for providing overload protection to each of said circuits.

Another important object is to provide a hydraulic system wherein one of the auxiliary hydraulic motors operated therewithin receives fluid under pressure from a fixed volume source and which may be selectively supplemented by fluid under pressure from a variable volume source in order to increase the speed of said hydraulic motor with infinite variation.

A further important object is to provide for greatly increased flexibility in selectively splitting the load on a primary source of fluid pressure between demands of a traction load and the load produced by one or more auxiliary equipment mechanisms when both said types of loads are included in one hydraulic system.

Another primary object is to provide an improved hydraulic system wherein at least one fixed volume and a plurality of variable volume sources of fluid under pressure are utilized in the same system and wherein the variable volume sources are independently variable relative to one another.

The foregoing and other objects and advantages are attained by the present invention, various novel features of which will be apparent from the description herein and the accompanying drawings disclosing embodiments of the invention, and will be more particularly pointed out in the appended claims.

FIGURE 1 is a schematic diagram showing diagrammatically the components and their arrangement in the proposed hydraulic system;

FIGURE 2 is a generally schematic view, with portions thereof shown in section, of a range selector means provided for selectively controlling fluid flow and directing said flow to selected loads;

FIGURE 3 is a generally schematic view wherein the directional flow control and the series-parallel control valves have been shown in section;

FIGURE 4 is a generally schematic diagram, with

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portions thereof shown in section, of the retarder valve means;

FIGURE 5 is a sectional view of the three-position control valve employed for controlling one of the auxiliary equipment mechanisms;

FIGURE 6 is a diagrammatic representation that charts the various combinations of positions obtainable with the double-valve-type range selector means depicted in FIGURE 2;

FIGURE 7 is a sectional view of a modified form of the range selector control; and

FIGURE 8 is a diagrammatic representation, somewhat similar to FIGURE 6 showing the flow combinations selectable with the modified selector control valve shown in FIGURE 7.

Referring now to the drawings it will be noted the present invention has been illustrated generally diagrammatically in order to show the components of the hydraulic system and their relative relationship in such a system. A source of fluid pressure, shown generally by the numeral 10, may be motivated by suitable power means such as the vehicle engine 11, while a source of hydraulic fluid contained in reservoir 12 may be directed through filter 13 and conduit line 14 into said pressure source. A fixed volume outlet of the pressure source 10 is connected by conduit 15 to conventional flow divider means 16 and one outlet from said divider is connected by conduit 17 to a power steering unit indicated at 18, which, in turn, is connected by conduit 19 to reservoir 12. The power steering unit which may be of conventional design will, as is understood, include a hydraulic motor which upon actuation by hydraulic pressure operates suitable mechanism for turning the steerable wheels of a vehicle, none of which for purposes of this application need be illustrated. A relief valve 20 connects into conduit 17 and serves to drain the circuit thereof to reservoir when the pressure therein exceeds that for which the relief valve 20 is pre-set, as is well understood.

A conduit 21 connected into another outlet of flow-diverter 16 includes therein a uni-directional check valve 22 and, additionally, extends to and connects with a hydraulic lift accessory or auxiliary such as indicated at 23 and this, in turn, is connected by conduit 24 to reservoir 12. A relief valve 25 connects into conduit 21 and serves to drain the circuit thereof to reservoir 12, as is well understood. The hydraulic lift 23, it will be understood, may be of any suitable well-known type that includes a hydraulic motor which is actuable by hydraulic pressure for operating associated load handling equipment of a vehicle, none of which for the purposes of this application need be further illustrated.

Although relief valves 20 and 25 are depicted as the pilot-operated type of valve it will be appreciated that other type relief valves may be used without deviating from any of the teachings hereof.

The individual variable volume outlets of the pressure source 10 are connected by the respective pressure inlet conduits, 26, 27, 28 and 29 to a range selector control means, such as is indicated generally at 30, and each such conduit has connected thereto a conduit such as 26a, 27a, 28a and 29a which, in turn, includes therein a conventional uni-directional check valve such as shown at 26b, 27b, 28b and 29b respectively. Said check valves are connected by a common outlet or discharge conduit 31 to a single pilot-operated type relief valve 32 which, in turn, is connected by conduit 33 to reservoir 12. The relief valve 32 thus serves to drain the respective conduits 26, 27, 28 and 29, through their associated check valves, to reservoir 12 whenever the pressure in any one of said conduits exceeds that for which the valve 32 has been pre-set, thereby providing a single or common relief valve

to provide overload protection for a plurality of hydraulic circuits.

The range selector 30 has an outlet that connects by way of conduit 34 into the outlet or downstream side of check valve 22 thus a portion of the fluid flow through the range selector may be used to supplement fluid flow through said check valve for operating hydraulic lift 23 as the demands require such action.

A second outlet from range selector 30 is connected by conduit 35 into an inlet of directional flow valve 36, while the work port outlets of said valve are connected by conduits 37, 38, 39 and 40 with the series-parallel control valve 41. Two of the motor ports of the latter valve are connected by conduits 42 and 43 to a respective inlet and outlet of a propulsion motor 44, while two other motor ports thereof are connected by conduits 45 and 46 to a respective inlet and outlet of propulsion motor 47. The propulsion motors, which may be of any conventional type such as the two-position axial piston type suggested herein, are connected by drive transmitting shafts such as 44a and 47a to respective gearbox assemblies 44b and 47b which, in turn, may be drivingly connected by shafts 44c and 47c to the rear axle drive mechanism of a vehicle (not shown) as is well understood. Suitable conduits such as shown at 44d and 47d may be provided for draining leakage of the respective propulsion motors to reservoir 12. It will be understood that suitable controls, such as indicated diagrammatically at 44e and 47e, will be provided, but, since these are conventional and well-known, no further elaboration thereof will be presented herein.

Conduits 48 and 49 connect into conduits 43 and 46, respectively, and include therein conventional uni-directional check valves 50 and 51 which are connected by a common outlet or discharge conduit 52 to relief valve 53, in turn, connected by conduit 54 to reservoir 12. As thus arranged, the common or single relief valve 53 serves to drain to reservoir either or both of the circuits connected to the propulsion motors when the pressure in either circuit exceeds that for which said relief valve has been pre-set. This is particularly useful as a thermal relief device to accommodate increased pressures brought about by increased temperatures in the propulsion motor circuits, such, for instance, as might occur when the vehicle is parked exposed to high ambient temperatures.

A conduit 55 which has one end thereof opening into reservoir 12 includes therein a uni-directional check valve 56 while the opposite end thereof is connected into conduit 35 that supplies the propulsion motors 44 and 47. This connection serves as an anti-cavitation supply line in event of over-speeding of the propulsion motors, whereas the check valve 56 prevents flow from supply conduit 35 back to the reservoir while permitting flow from the reservoir to conduit 35.

The directional valve 36 is connected by conduits 57 and 58 with the respective pilot-operated retarders or relief valves 59 and 60 which, in turn, are connected by conduits 61 and 62 to reservoir 12. Conduits 63 and 64, respectively, connect relief valves 59 and 60 with the flow-restricting orifice devices 65 and 66 which, in turn, connect by conduits 67 and 68 into the main supply conduit line 35. Conduits 69 and 70 connect into conduits 63 and 64, respectively, and include therein uni-directional manually operable poppet check valves 71 and 72 the outlets of which are connected by a common outlet or discharge conduit 73 to reservoir 12. Conduits 74 and 75, respectively, connected into conduits 69 and 70 extend to and are connected into an inlet and outlet of the series-parallel control valve 41 for purposes which will subsequently be more fully explained.

Another outlet of range selector 30 connects by way of conduit 76 into a control valve 77 and the outlet or work ports of said control valve are connected by conduits 78 and 79 with a respective inlet and outlet of an auxiliary equipment hydraulic motor such as indicated dia-

grammatically at 80. A conduit 81 connected between motor 80 and reservoir 12 may be provided to drain leakage therefrom back to said reservoir. While the hydraulic motor 80 may be any suitable device provided for operation of the auxiliary equipment desired it is here indicated as a variable-type motor associated with a power take-off mechanism such as is frequently used with tractor vehicles and will, of course, be provided with conventional controls (not shown) therefor. The valve 77 is also connected by conduit 82 to reservoir 12 as will be further explained.

Conduits 83 and 84 connect into conduits 78 and 79, respectively, and include therein uni-directional check valves 85 and 86 which are connected by a common outlet or discharge conduit 87 to relief valve 88, in turn, connected by conduit 89 to reservoir 12. As thus arranged the single or common relief valve 88 serves to drain to reservoir either or both of the conduit lines connected to the auxiliary motor 80 when the pressure in either line exceeds that for which said valve has been pre-set. This relief valve also is useful as a thermal relief device to accommodate increased pressure built up by increased temperatures in the associated motor circuit.

A conduit 89a which has one end thereof opening into reservoir 12 includes therein a uni-directional check valve 89b while the opposite end thereof is connected into conduit 73 that connects with one side of auxiliary motor 80. This connection serves as an anti-cavitation siphon or supply line in event of over-speeding of the motor 80, whereas the check valve 89b prevents flow from supply conduit 73 back to reservoir while permitting flow from the reservoir to conduit 73.

Quick disconnect couplings, such as indicated diagrammatically at 90 and 90a, may be interposed in the respective conduit line connections 78 and 79 to the auxiliary motor 80 for purposes of providing means for interconnecting additional remote auxiliary or accessory equipment units into the system with a minimum of change or alteration in the components of the system. Preferably, these disconnect couplings will be any suitable type that blocks off flow to the auxiliary motor 80 and then bypasses such flow to the remote equipment with which such couplings are connected. A coupling of the type that is highly effective for accomplishing this objective is described in a co-pending application Serial No. 253,379, filed January 23, 1963, and assigned to the same assignee as this invention.

The fluid pressure source 10 illustrated herein suggests the utilization of a compound-type single pump unit to provide both the desired fixed volume and variable volume fluid flows with each being independently variable relative to the other. A commercial product that provides means for obtaining at least one fixed and one or more variable volume flow outlets from a unitary pump assembly is marketed by the Dynex Company of Pewaukee, Wisconsin, and is commonly referred to as the Dynex Split-Flow type pump. However, the present invention is not limited to the specific unitary pump arrangement noted because it also envisages that equally satisfactory results may be obtained by using a plurality of pumps, arranged in combinations calculated to provide at least one fixed volume flow and a plurality of variable volume flows wherein all the flows are independently variable relative to one another, without deviating from the teachings or inventive concepts hereof.

The series parallel control valve 41 which may be fashioned to assume any one of a variety of structural forms, preferably, is a two-position manually operative unit which in one position thereof serves to direct the fluid flow through the propulsion motors 44 and 47 in a parallel flow relationship, and in the other position thereof serves to communicatively interconnect the two motors and then to direct the fluid flow therethrough in a series flow relationship. The series flow arrangement is regarded as a high speed position and is particularly useful during transport of a vehicle. Furthermore, with the directional flow valve 36 in neutral and said series-parallel valve in

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its series-connected position the motors are communicatively interconnected on one side thereof while the opposite sides thereof are blocked and hence fluid flow in the propulsion circuit is blocked thereby providing a parking brake means for the vehicle.

As shown in FIGURE 3 the series-parallel valve may be fashioned to include a body 160 having a bore 101 therethrough that slidably receives a valve spool member 102 therein. An operating handle 103 is pivotally connected to an outwardly extending end of valve spool member 102 and to a link 104 that, in turn, pivotally mounts on a fixed support such as the vehicle body indicated fragmentarily at 105. The body 100 has inlet ports 106, 107, 108, 109, and 110 that connect respectively with conduits 37, 38, 39, 40 and 74, and motor or work ports 112, 113, 114, and 115 that communicate with motors 44 and 47 by way of the respective conduits 42, 43, 45 and 46, plus an outlet port 116 that connects with conduit 75. The valve spool 102 is fashioned to provide lands 117, 118, 119, 120, 121, 122 and 123 spaced therealong, and with grooves 124, 125, 126, 127, 128 and 129 disposed between said lands.

With the valve spool 102 positioned as indicated, in FIGURE 3, the valve 41 is conditioned for slow or parallel operation of the propelling motors 44 and 47, whereupon fluid flow from the incoming supply conduits 38 and 40 or 37 and 39 is directed through the motors ports 113 and 115 and conduits 43, 46, or through motor ports 112 and 114 and conduits 42 and 45, depending upon whether directional flow valve 36 is conditioned for reverse or forward operation. When, for instance, the incoming flow is through conduits 38 and 40, such as when valve 36 is conditioned for reverse operation, the return flow from said motors will be through conduits 42 and 45, ports 112, 106 and 114, 108 of valve 41 to conduits 37 and 39, then through valve 36 to conduits 57 and 58 and the respective retarder valves 59 and 60 to drain in reservoir 12. When the incoming flow is through conduits 37 and 39 the motors will operate in an opposite direction of rotation and the return flow will be through conduits 43 and 46, ports 113, 107 and 115, 109 of valve 41 to conduits 38 and 40, thence through valve 36 to conduits 57 and 58 and retarder valves 59 and 60 to drain in reservoir 12.

With the valve spool 102 positioned for fast or series operation and the directional valve 36 conditioned for reverse operation the incoming supply of fluid will be through conduit 40, since conduit 38 is blocked in valve 41, thence through ports 109 and 115 to conduit 46 and to one side of motor 47. In this position of valve 41 the other side of motor 47 is interconnected through conduits 45 and 43 and port 114, groove 126 and port 113 thereof, with one side of motor 44 while the other side of said latter motor connects through conduit 42, ports 112 and 106 with conduit 37 which, in turn, connects through valve 36, with conduit 57 and retarder valve 59 which drains to reservoir 12.

When the incoming supply of fluid is through conduit 37 and ports 106 and 112 of valve 41 to conduit 42 and thence to one side of motor 44, thus producing an opposite direction of rotation for the motors, the return flow from motor 47 will be through conduit 46, ports 115 and 109 of said valve to conduit 40, thence through valve 36 to conduit 58 and retarder valve 60 to drain in reservoir 12. Whenever valve 41 is conditioned for series operation of the propelling motors the return flow from said motors will be directed either through retarder valve 59 or retarder valve 60, depending upon the position of valve 36, but not through both said retarder valves. However, in the series-operating position of valve 41, retarder valves 59 and 60 are communicatively interconnected through conduits 74 and 75, and the ports 110 and 116 of said valve, hence operation will be simultaneous for both retarder valves accomplishing the appropriate retarding action against the propelling motors regardless of direction of operation as will subsequently be further discussed.

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The directional flow valve 36 which may be fashioned to assume any one of many structural forms preferably, is a three-position manually operative assembly which when positioned in neutral blocks the flow of fluid to the propulsion motors 44 and 47 and, which, when positioned in the other of its two positions directs the fluid flow into said motors in a direction such as to produce either forward or reverse operation thereof. As shown in FIGURE 3, this valve includes a body 130 having a bore 131 therethrough that slidably receives a valve spool member 132 therein. An operating handle 133 is pivotally connected to an outwardly extending end of the spool 132 and to a link 134 which, in turn, is pivotally mounted on a fixed support such as the vehicle body indicated fragmentarily at 105. The body 130 has an inlet port 136 therein that connects with the main supply conduit 35, retarder valve ports 137 and 138 that connect respectively with conduits 57 and 58 which in turn connect with retarder valves 59 and 60, and work ports 139, 140, 141 and 142 that communicate with the propulsion motors by way of the respective conduits 37, 38, 39 and 40.

The valve spool member 132 is fashioned to provide lands 143, 144, 145, 146, 147, 148, 149 and 150 spaced therealong, and with grooves 151, 152, 153, 154, 155, 156 and 157 disposed between said lands, and further having axially extending passages 158, 159 and 160 with passage 158 interconnecting grooves 151 and 153, passage 159 interconnecting grooves 155 and 157 and passage 160 interconnecting grooves 152, 154 and 156.

With valve spool 132 positioned as indicated, in FIGURE 3, said directional valve is conditioned for neutral operation. Now assume that valve 41 is conditioned for parallel operation of the motors whereupon fluid flow from the main supply conduit 35 enters valve 36 through inlet port 136 and is communicatively directed in one path by way of axial passage 160, groove 156 and valve port 138 to retarder valve 60 and thereafter to drain in reservoir 12, and in another path by way of axial passage 160, groove 152, and valve port 137 to conduit 57 and the respective retarder valve 59, and concurrent therewith the work ports 139 and 140 are interconnected through groove 153 while work ports 141 and 142 are interconnected through groove 155 thereby fashioning a separate closed or continuous loop for each propelling motor circuit and thus providing a free wheeling condition for the propulsion motors which permits towing or pushing of the vehicle as desired.

Movement of the handle 133 upwardly as viewed in FIGURE 3, to condition valve 36 for forward operation, carries with it the spool 132 and repositions said spool within the bore 131 whereupon communication is established for fluid flow from the incoming supply conduit 35 through the inlet port 136 and by way of groove 154 and work port 139 to conduit 37 and motor 44, and, by way of groove 154, passage 160, groove 156 and work port 141 to conduit 39 and motor 47, and concurrent therewith return conduit 38 from motor 44 communicates by way of work port 140, groove 153, valve port 137 and conduit 57 with retarder valve 59 which drains to reservoir 12, while return conduit 40 from motor 47 communicates by way of work port 142, groove 155, axial passage 159, groove 157, valve port 138, and conduit 58 with retarder valve 60 which, in turn, drains to reservoir 12.

Movement of the handle 133 (downwardly as viewed in FIGURE 3), to condition valve 36 for reverse operation, moves the spool 132 within bore 131 so that communication is established for fluid flow from the incoming supply conduit 35 through the inlet port 136 and by way of groove 154, axial passage 160, groove 152, work port 140 and conduit 38 to an opposite side of motor 44, and by way of groove 154, work port 142 and conduit 40 to an opposite side of motor 47, and concurrent therewith return conduit 37 from motor 44 communicates by way of work port 139, groove 153, axial passage 158, groove 151, valve port 137 and conduit 57 with retarder valve

59, while, return conduit 39 from motor 47 communicates by way of work port 141, groove 155, valve port 133 and conduit 58 with retarder valve 60.

In the foregoing movements of directional flow valve 36 it was assumed that series-parallel valve 41 was conditioned for parallel operation of the motors. Previously, the operation of valve 41 was described in greater detail whereupon both positions of the latter valve were reviewed relative to each of the various positions of said directional flow valve.

In FIGURE 4 there is fragmentarily illustrated, partially in section, one preferred form of a brake retarder means that applies the teachings of the present invention, but it will be appreciated other forms of such an assembly may be provided without deviating from the inventive concepts thereof. A body or casing member such as shown at 161 may, if desired, be provided to incorporate therein the retarder or relief valves 59 and 60, the check valves 71 and 72 and the flow restricting orifice devices 65 and 66 together with appropriate conduits or passageways interconnecting these various components. Said retarder valves may be fashioned as double-piston units with spaced pistons, such as 162-162a and 163-163a, connected by associated members 164-164a with extensions 164b-164c on the outboard side of said pistons, and the units are slidable in the respective bores 165-165a of said body. Springs 166-166a abuttingly positioned over extensions 164b-164c and between one end of a piston unit and a respective end wall of the bores 165-165a are reactive against pressure imposed on the piston surfaces as will be further explained. The check valves 71 and 72 may include ball members, such as 167-167a, slidable in the bores 168-168a and disposed to engage springs 169-169a that abut respective wall surfaces 170 and 170a and in turn react to urge said balls to seat against valve surfaces 171-171a formed at one end of the bores 168-168a. Plungers 172-172a slidably mounted in body 161 have one end thereof disposed to engage the respective balls 167-167a and at their opposite ends are engaged by pedals 173-173a suitably pivotally anchored on the vehicle in conventional manner, while springs 174-174a connected to said pedals and anchored on a suitable support such as the vehicle body 105 are stressed to prevent accidental unseating of the balls 168-168a off the valve seats 171-171a.

Normally the fluid pressure in conduit line 35, acting through the orifices 65-66, is effective in aiding springs 169 and 169a to seat the balls 167 and 167a against their respective valve seats, and in opposing the reaction of springs 166 and 166a against the respective piston units 162-162a and 163-163a. Such pressure thus is effective for maintaining retarder valves 59 and 60 open so that fluid flow returning by way of conduits 57 and 58 may pass through these retarder valves into return conduits 61-62 and thence to reservoir 12.

Assume now the series-parallel control valve 41 is conditioned for parallel-operation of the motors 44 and 47, whereupon return fluid flow will be by way of conduits 57 and 58 to drain. In this case when the brake pedal 173 is depressed plunger 172 unseats ball check valve 167 thus permitting discharge of fluid from behind this check valve into common return conduit 73 thence to drain. This drop in pressure against one face of associated piston unit 162-162a permits spring 166 to slide this piston unit in bore 165 sufficiently to restrict or block off the return conduit 57 from communication with discharge conduit 61 and by so doing provides a retarding or braking action for the associated propulsion motor 44. A similar retarding action for motor 47 may be accomplished independently when the brake pedal 173a is actuated by depressing.

Assume now that the series-parallel control valve 41 is conditioned for series-operation of the motors 44 and 47, in which case return fluid flow will be by way of conduit 57 or conduit 58 depending upon whether the motors

are being operated in a forward or a reverse direction. With the motors operating in a reverse direction return flow will be through conduits 37, 57 and retarder valve 59 to drain, and with said motors operating in a forward direction the return flow will be by way of conduits 40, 58 and retarder valve 60. As previously noted, when the series-parallel valve 41 is conditioned for series-operation of the propelling motors the conduits 74 and 75 are communicatively interconnected through this valve hence the actuation of either check valve 71 or 72 will be effective for actuating both retarder valves 59 and 60 and thereby providing equalized braking for the motors. This is brought about by the fact that a reduction in pressure in either check valve 71 or 72 is reflected, by way of the interconnecting conduits 74 and 75, in the other one of said check valves thereby causing also the actuation of the retarder valve associated with the latter check valve.

In the event of overrunning or overspeeding of the motors 44 and 47 such action would produce a drop in pressure in the main conduit supply line 35, and this, in turn, would be reflected by a drop in pressure in the conduits 69 and 70 which forms portions of the pilot control circuit interconnected with orifices 65 and 66, hence, as previously noted, since a drop in pressure behind the ball check valves 71 and 72 is effective for causing actuation and closing of the associated retarder valves 59 and 60 there will be a retarding or braking action applied to the propulsion motors 44 and 47.

It will be noted there may appear at first glance to be some discrepancies or inconsistencies between the arrangement of the retarder means, including the passageways and conduits associated therewith, shown in FIGURE 1 and the detailed structural arrangement shown in FIGURE 5, but this may be accounted for by the fact that FIGURE 1 is only a schematic representation of the system and its components in simplified form whereas FIGURE 5 more closely resembles an actual structural form. The principles of the invention and the operations thereof, are equally applicable to both illustrations.

The range selector means 30, shown diagrammatically in FIGURE 1, contemplates means for directing or distributing the flow of fluid under pressure from incoming circuits selectively into one or more of several outlets, or into selected combinations of the distribution thereof. As shown herein the flow from pressure conduit 26 into an associated pressure inlet of said selector means may be directed to the outlet thereof that connects with conduit 34 so as to supplement the flow to the hydraulic lift 23 that is receivable through conduit 21 thereby permitting said lift to be increased in speed with infinite variation by the fluid flow thus added. In another combination the flow into the selector inlet from pressure conduit 26 may be selectively combined with the flow from one or more of the other pressure conduits 27, 28 and 29 by way of their respective inlets before being directed to the propulsion motors 44 and 47, or to another auxiliary mechanism such as the power take-off motor indicated at 80. Other combinations for selectively distributing or directing the fluid flow from the pressure source will be readily discernible from close study of the description herein.

As shown in FIGURE 1 it will be seen that range selector 30 may be fashioned as two three-position valves communicatively interconnected and mechanically coupled together for coordinated operation thereof. For instance, a first selector valve, designated by the numeral 180, may be selectively positionable as indicated by the references 1a, 1b and 1c while a second selector valve, designated by the numeral 181, may be selectively arranged in positions designated by the references 2a, 2b and 2c. Accordingly, it will be appreciated that nine different combinations of the selectable positions of these two range selector valves may be attained and such combinations are more fully illustrated by the fluid flow charts diagrammed in FIGURE 6.

In FIGURE 2 there is illustrated, partly in section, one preferred form of a range-selector device fashioned to incorporate therein the inventive concepts of the present invention. As shown, selector valve 180 includes a body or casing member 182 having inlet ports 183, 184, 185 and 186 disposed to connect respectively with pressure conduits 26, 27, 28 and 29, outlet ports 187, 188, 189, 190 and 191 disposed for communicative connection with selector valve 181, interconnecting ports 192, 193, and 194, and fashioned with a bore 195 extending through the body thereof. A spool valve member 196 slidably disposed in bore 195 is fashioned with lands 197, 198, 199, 200, 201 and 202 spaced therealong, and with grooves 203, 204, 205, 206 and 207 disposed between these lands. Inlet port 183 connects into a fluid passage 208 that may be formed, as shown, in the body 182 to provide branches or extensions 183a and 183b of said port that communicate with bore 195 at axially spaced positions. An interconnecting passage 209 is provided to interconnect the ports 191, 192, 193 and 194. An additional passage 210 is provided for interconnecting outlet ports 188 and 189. Passages 208, 209 and interconnecting passage 210 may, of course, be fashioned external of the body 182 or internal thereof, as desired, without deviating from any of the teachings thereof.

Selector valve 181 includes a body member 211 having inlet ports 212, 213, 214, and 215 communicatively connected by way of fluid passages or conduits 216, 217, 218 and 219 with the outlet ports of selector valve 180, outlet ports 220, 221 and 222 connected respectively with conduits 34, 35 and 76 and fashioned with a bore 223 extending through the body thereof. A spool valve member 224 slidably disposed in the bore 223 is fashioned with lands 225, 226, 227 and 228 spaced therealong, and with grooves 229, 230, and 231 disposed between these lands.

Operating members 232 and 233 are pivotally interconnected by a handle member such as 234 and additionally, are pivotally connected to the respective valve spool members 232 and 233 by suitable ball and socket means such as indicated at 235, 236, 237 and 238. The positions pattern described or traced by the handle member 234 for each of the various combinations of the positions of the two valves is approximated by the broken circles shown in the vicinity of said handle. In order to better illustrate the relative positions of the valves in various combinations the dimensions of some of the elements are somewhat exaggerated, since the actual valve spool axial movements would be considerably less than that shown by the broken circles herein, and furthermore the handle member would describe a generally arcuate pattern rather than the square form approximated by the broken circles herein.

By way of further explanation it will be seen that in the position combination 1b-2b of the valves 180 and 181, and as depicted herein, incoming conduit 26 establishes communication with outlet conduit 34, conduit 27 would conduit 35 and conduits 28 and 29 with conduit 76. In another position, such for instance as the combination 1b-2a, incoming conduit 26 establishes communication with outlet conduit 34, conduits 27 and 28 with conduit 35 and conduit 29 with conduit 76. Other position combinations follow corresponding patterns as will be readily understood from further study of the above-detailed description and of the positions flow diagrams.

It will now be evident that merely by moving the handle of the range selector means 30 the output from the variable volume source of fluid pressure may be utilized in a variety of combinations and directed or distributed to various using motors as desired. Furthermore, such variation of combinations may be accomplished with considerable flexibility.

In FIGURE 5 there is illustrated, partly in section, one preferred form of an auxiliary equipment control valve 77 fashioned to incorporate therein concepts of the present invention. As shown, this power take-off valve includes

a body or casing member 240 having a bore 241 there-through, an inlet port 242, a drain port 243, a pair of work ports 244 and 245, and interconnected ports 246 and 247. A valve spool member 248 slidably disposed in the bore 241 is fashioned with lands 249, 250, 251, and 252 spaced therealong, and with grooves 253, 254 and 255 disposed between these lands. An operating handle 256 is pivotally connected to an outwardly extending end of the spool 248 and to a link 257 which, in turn, is pivotally mounted on a fixed support such as the vehicle body indicated fragmentarily at 105. The ports 246 and 247 are interconnected by a fluid passage conduit such as 258 which may be extended externally of the body 240 or fashioned internally there within without deviating from any teachings hereof. The input conduit 76 connects into inlet port 242 and drain conduit 82 connects into drain port 243, while conduits 78 and 79 connect into the respective work ports 244 and 245.

With the handle 256 in the position indicated, in FIGURE 5, the valve 77 is conditioned for its OFF position, whereupon fluid flow incoming through conduit 76 is directed by way of port 242, groove 254, port 243 and conduit 82 to drain in reservoir 12, while concurrent therewith conduit 78 is interconnected by way of port 244, groove 253, port 246, passage 258, port 247, groove 255, and port 245 with conduit 79 thus providing a closed or continuous circuit for the auxiliary motor 80. In this freewheeling position the shaft of the motor 80 may be manually rotated for purposes of alignment of said shaft with associated equipment or for similar purposes without having to direct fluid under pressure from said source through said motor.

Movement of the handle 256 downwardly or to the ON position of valve 77 establishes communication between the incoming fluid pressure in conduit 76 and the outlet of port 244 into conduit 78, and concurrent therewith communication is established from conduit 79 by way of port 245, groove 254, port 243 and conduit 82 to the reservoir 12 so as to provide for working flow of fluid through auxiliary motor 80. Movement of handle 256 upwardly to the brake position of said valve establishes communication between conduit 76 and reservoir 12 by way of port 242, groove 254, port 243 and conduit 82, while concurrent therewith conduits 78 and 79 are blocked respectively by the lands 250 and 251-252 so that fluid is locked within the motor circuit thus providing a retarding or braking action for said auxiliary motor.

In FIGURE 7 there is shown one preferred modification of a range selector means wherein a single selector control valve 260 is provided to accomplish the desired range settings and combinations of flow distribution into the various hydraulic motors in the system. In this simplified form the range selector valve includes a body or casing member 261 having a bore 262 extending there-through, and said body is further provided with a plurality of inlet ports 263, 264, 265 and 266 connected with the respective inlet conduits 26, 27, 28 and 29, and outlet ports 267, 268 and 269 connected to the respective outlet conduits 34, 35 and 76. Inlet port 263 is further connected into bore 262 by way of a branch passage 263a which opens into said bore at a point axially displaced from port 263, while outlet port 267 is also connected into the bore 262 by way of a branch passage 267a which opens into said bore at a point axially displaced from the port 267. A spool valve member 270 slidably disposed within the bore 262 is fashioned with lands 271, 272, 273, 274, 275, 276, 277, 278 and 279 spaced therealong, and with grooves 280, 281, 282, 283, 284, 285, 286 and 287 disposed between these lands, and has an axially extending passage 288 communicatively interconnecting grooves 286 and 284 and an axial passage 289 that communicatively interconnects grooves 282, 283 and 285. An operating handle such as 290 is pivotally connected to an outwardly extending end portion of valve spool 270 and to a link member 291 that, in turn, pivotally mounts on a fixed support such as the vehicle body indicated at 105.

In FIGURE 8 there is presented a schematic layout of the flow diagrams corresponding to the various positions of the modified selector valve. These positions are indicated by the letters A-G inclusive, and the corresponding disposition of the spool 270 for each of these positions is indicated by the letters A-G in FIGURE 7. As shown, the valve is in its neutral or A position whereupon conduit 26 is placed in communication with conduit 34, conduit 27 with conduit 35 and conduits 28 and 29 with conduit 76. This position of valve 260 produces the same flow distribution as the 1b-2b position combination of the two-valve range selector designated generally by the reference numeral 30. Moving the handle 290 so as to condition the valve 260 for position D, for instance, establishes communication between incoming conduits 26, 27, 28 and 29 and outgoing conduit 35 so that all the incoming fluid flow may be directed or distributed to the propulsion motors 44 and 47. This position of the valve produces the same results as the position combinations 1a-2c and 1c-2c of range selector valve means 30. Position B produces the same result as 1b-2a; position C the same as 1b-2c; position E the same as 1c-2a and 1c-2b; position F the same as 1a-2b; and position G the same as 1a-2a of said range selector valve means.

It should now be apparent that a novel and improved hydraulic system adaptable for installations having a traction as well as an auxiliary equipment load has been shown and described, and it is to be understood that changes may be made in the construction without departing from the spirit of the invention or the scope thereof as defined in the appended claims.

What is claimed is:

1. In a hydraulic system:

means providing a source of fluid under pressure and including at least one fixed volume outlet and a plurality of variable volume outlets through which fixed and variable outputs respectively of operating fluid pressures are discharged;

a hydraulic motor adapted for connection with auxiliary equipment of a vehicle;

conduit means communicatively connecting said hydraulic motor with a fixed volume outlet of said source of fluid pressure;

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle; and

circuit conduit means communicatively connecting said propelling motors with the variable volume outlets of said source and including, interposed in the circuit in a fluid flow and series-connected relationship, a range selector having flow directing means provided therein operative for selectively communicatively directing therethrough for the propelling motors the fluid flow from one or more of the variable volume outlets of said source, a directional flow valve having means therein operative for controlling the flow therethrough so as to cause said propelling motors to operate forwardly or reversely or alternatively in neutral with fluid to said motors blocked, and a series-parallel control valve having means therein fashioned to provide interconnectible fluid flow passages therethrough and being manipulatively arrangeable so that in one position thereof the fluid flow will effect parallel operation of the propelling motors and in another position the fluid flow will effect series operation of said motors.

2. In a hydraulic system:

means providing a source of fluid under pressure and including at least one fixed volume outlet and a plurality of variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressure are discharged;

a hydraulic motor adapted for connection with auxiliary equipment of a vehicle;

conduit means communicatively connecting said hydraulic motor with a fixed volume outlet of said source of fluid pressure;

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle;

circuit conduit means communicatively connecting said propelling motors with the variable volume outlets of said source and including, interposed in the circuit in a fluid flow and series-connected relationship, a range selector having flow directing means provided therein operative for selectively communicatively directing therethrough for the propelling motors the fluid flow from one or more of the variable volume outlets of said source, a directional flow valve having means therein operative for controlling the flow therethrough so as to cause said motors to operate forwardly or reversely or alternatively in neutral with flow to said motors blocked, and a series-parallel control valve having means therein providing interconnectible fluid flow passages therethrough and being manipulatively arrangeable so that in one position thereof the fluid flow will effect parallel operation of the propelling motors and in another position the fluid flow will effect series operation of said motors; and

additional conduit means connected into said circuit conduit means intermediate said series-parallel control valve and said motors for conducting fluid from the propelling motors to drain when said directional valve is positioned in neutral with flow from said source to the motors blocked including relief valve means operable to effect release of fluid from either one or both of said motors attendant development of a pressure in either of said motors in excess of that for which said relief valve means is pre-set.

3. In a hydraulic system,

means providing a source of fluid under pressure and including a fixed volume outlet and a plurality of variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressure are discharged,

a hydraulic motor adapted for connection with auxiliary equipment of a vehicle,

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle;

conduit means including a first branch connecting said auxiliary equipment hydraulic motor to the fixed volume outlet of said source of fluid pressure, and a second branch communicatively connecting said pair of hydraulic motors with one or more of the variable volume outlets of said source,

a directional valve in said second branch conduit and having an inlet port communicating with one or more of the variable volume outlets of said source of fluid pressure, and two pairs of work ports communicating with respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports and two operative positions in opposite directions from neutral respectively for communicatively connecting either work port to the inlet port so that the propelling motors may be operated forwardly or reversely.

a series-parallel control valve interposed in said second branch conduit between the directional valve and the propelling motors and having a plurality of inlet ports connected to the work ports of said directional valve, and a plurality of motor ports connected to the respective inlets and outlets of the propelling motors, and a valve member having two operative positions in one of which positions the inlet and motor ports thereof are interconnected so as to effect parallel operation of the propelling motors and in the other

position the inlet and motor ports are so interconnected as to effect series operation of said motors, range selector means interposed in said second branch conduit between said directional valve and the variable volume outlets of said source of fluid pressure for controlling the flow from said source and including flow directing means therein operative for selectively communicatively directing the flow from one or more of said variable volume outlets to the propelling motors, and

additional conduit means connected into said second branch conduit at a point between said series-parallel control valve and the propelling motors for conducting fluid therefrom to drain including relief valve means operable to effect release of fluid from either one or both of said motors when said directional valve is positioned in neutral with communication between the inlet and work ports thereof blocked and attendant development of pressure in either of said motors in excess of that for which said relief valve means is pre-set.

4. In a hydraulic system,

means providing a source of fluid under pressure and including a fixed volume outlet and a plurality of variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressure are discharged,

a hydraulic motor adapted for connection with auxiliary equipment of a vehicle,

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle,

conduit means including a first branch connecting said auxiliary equipment hydraulic motor to the fixed volume outlet of said source of fluid pressure, and a second branch communicatively connecting said pair of hydraulic motors with one or more of the variable volume outlets of said source,

a directional valve in said second branch conduit and having an inlet port communicating with the variable volume outlets of said source of fluid pressure, and two pairs of work ports communicating with respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports and two operative positions in opposite directions from neutral respectively for communicatively connecting either work port to the inlet port so that the propelling motors may be operated forwardly or reversely,

a series-parallel control valve interposed in said second branch conduit between the directional valve and the propelling motors and having a plurality of inlet ports connected to the work ports of said directional valve, and a plurality of motor ports connected to the respective inlet and outlet of the propelling motors, and a valve member having two operative positions in one of which positions the inlet and motor ports thereof are interconnected so as to effect parallel operation of the propelling motors and in the other position the inlet and motor ports are so interconnected as to effect series operation of said motors,

range selector means interposed in said second branch conduit between said directional valve and the variable volume outlets of said source of fluid pressure for controlling the flow from said source and including flow directing means therein manually operative for selectively communicatively directing the flow from one or more of said variable volume outlets to the propelling motors according to the speed demands on said latter motors, and

additional conduit means connected into said second branch conduit at a point intermediate said variable volume outlets and said range selector means for conducting fluid therefrom to drain including relief valve means operable to effect release of fluid from

said second branch attendant development of a pressure in said branch conduit in excess of that for which relief valve means is pre-set.

5. In a hydraulic system:

means providing a source of fluid under pressure and including a fixed volume outlet and a plurality of variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressures are discharged,

a plurality of hydraulic motors adapted for connection respectively with different units of auxiliary equipment of a vehicle,

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle,

conduit means including a first branch connecting first and second ones of said auxiliary equipment hydraulic motors to the fixed volume outlet of said source of fluid pressure, and a second branch communicatively connecting said pair of hydraulic motors and a third one of said auxiliary equipment motors with the output from one or more of the variable volume outlets of said source, and further including a fluid transmitting interconnection between said second branch and said second of said auxiliary equipment motors,

a directional valve in said second branch conduit and having an inlet port communicating with the variable volume outlets of said source of fluid pressure, and two pairs of work ports communicating with the respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports and two operative positions in opposite directions from neutral respectively for communicatively connecting either work port to the inlet port so that the propelling motors may be operated forwardly or reversely,

a series-parallel control valve interposed in said second branch conduit between the directional valve and the propelling motors and having a plurality of inlet ports communicating with the work ports of said directional valve, and a plurality of motor ports communicating with the respective inlets and outlets of the propelling motors, and a valve member having two operative positions in one of which positions the inlet and motor ports of said control valve are interconnected so as to effect parallel operation of the propelling motors and in the other position the inlet and motor ports of said valve are so interconnected so as to effect series operation of said motors, and

range selector means interposed in said second branch conduit between said directional valve and the variable volume outlets of said source of fluid pressure for controlling the flow from said source and including flow directing means therein operative for selectively communicatively directing the flow from one or more of said variable volume outlets there-through to the propelling motors or to the third one of said auxiliary equipment motors, while additionally being selectively operative for directing the flow from one variable volume outlet through said fluid transmitting interconnection conduit to the second of said auxiliary equipment motors in order to supplement the flow to said latter motor from said fixed volume outlet of said source.

6. In a hydraulic system:

means providing a source of fluid under pressure and including at least one fixed volume outlet and one or more variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressure are discharged;

a plurality of hydraulic motors adapted for connection respectively with individual units of auxiliary equipment of a vehicle;

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conduit means communicatively connecting a first one of said hydraulic motors to the fixed volume outlet of said pump;

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle;

circuit conduit means communicatively connecting said propelling motors and a second one of said auxiliary equipment hydraulic motors with the variable volume output of said pump and having a main branch and a secondary branch and including, interposed in the main branch of the circuit in a fluid flow relation, range selector means for controlling the flow from the variable volume outlets of said source and including means providing a plurality of inlets and a plurality of outlets and flow directing means therewithin fashioned to provide fluid flow passages therethrough and said latter means being movable to provide interconnections between the inlets and outlets thereof so that the flow from one or more of the variable volume outlets is selectively communicatively directible to the propelling motors or to the second one of said auxiliary equipment motors or to combinations of the propelling motors and said second motor, a directional flow valve having means therein operative for controlling the flow therethrough so as to cause said propelling motors to operate forwardly or reversely or alternatively in neutral with fluid flow from said source to said propelling motors blocked, and a series-parallel control valve having means therein fashioned to provide interconnectible fluid flow passages therethrough and being manipulatively arrangeable so that in one position thereof the fluid flow will effect parallel operation of the propelling motors and in another position the fluid flow will effect series operation of said propelling motors;

additional conduit means connected into said circuit conduit means intermediate the variable volume outlets of said source and said range selector means for conducting fluid therefrom to drain and including relief valve means comprising an individual check valve for each of said variable volume outlets of said source, and a relief valve common to all said check valves and said relief valve means being operable to effect release of fluid from said circuit conduit means attendant the development of a pressure in either of said variable volume outlets in excess of that for which said common relief valve is pre-set;

said secondary branch conduit means being connected at one end thereof to an outlet of said range selector means and including interposed in said second branch said second auxiliary equipment motor and control valve means conditionable in a first position thereof for directing fluid flow through said second motor to drain, in a second position for permitting recirculation of fluid through said second motor so as to permit manual rotation of an output shaft of said latter motor, and in a third position for blocking the inlet and outlet of said second motor thereby to lock said motor against rotation.

7. The system described in claim 5 and further characterized by providing flow dividing means in said first branch conduit means for directing a portion of the flow from said fixed volume outlet to each of said first and second auxiliary equipment motors and further having a uni-directional flow check valve in said first branch conduit at a point intermediate said flow divider and said second motor and operative to prevent fluid flow in an opposite direction through the portion of said first branch that includes said check valve.

8. In a hydraulic system;

means providing a source of fluid under pressure and including a fixed volume outlet and a plurality of variable volume outlets through which fixed and

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variable volume outputs respectively of operating fluid pressures are discharged,

a plurality of hydraulic motors adapted for connection respectively with different units of auxiliary equipment of a vehicle,

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle,

conduit means including a first branch connecting first and second ones of said auxiliary equipment hydraulic motors to the fixed volume outlet of said source of fluid pressure, and a second branch communicatively connecting said pair of hydraulic motors and a third one of said auxiliary equipment motors with the output from one or more of the variable volume outlets of said source, and further including a fluid transmitting interconnection between said second branch and said second one of said auxiliary equipment motors,

a directional valve in said second branch conduit and having an inlet port communicating with the variable volume outlets of said source of fluid pressure, and two pairs of work ports communicating with the respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports and two operative positions in opposite directions from neutral respectively for communicatively connecting either work port to the inlet port so that the propelling motors may be operated forwardly or reversely,

a series-parallel control valve interposed in said second branch conduit between the directional valve and the propelling motors and having a plurality of inlet ports communicating with the work ports of said directional valve, and a plurality of motor ports communicating with the respective inlets and outlets of the propelling motors, and a valve member having two operative positions in one of which positions the inlet and motor ports thereof are interconnected so as to effect parallel operation of the propelling motors and in the other position the inlet and motor ports are so interconnected so as to effect series operation of said motors, and

range selector means interposed in said second branch conduit between said directional valve and the variable volume outlets of said source of fluid pressure for controlling the flow from said source and including flow directing means therein operative for selectively communicatively directing the flow from one or more of said variable volume outlets therethrough to the propelling motors or to the third one of said auxiliary equipment motors, while additionally being selectively operative for directing the flow from one variable volume outlet through said fluid transmitting interconnection to the second of said auxiliary equipment motors in order to supplement the flow to said motor from said fixed volume outlet of said source, additional conduit means connected into said second branch conduit intermediate the variable volume outlets of said source and said range selector means for conducting fluid therefrom to drain including relief valve means operable to effect release of fluid from said second branch attendant development of a pressure in said branch conduit in excess of that for which said relief valve means is pre-set.

9. In a hydraulic system;

means providing a source of fluid under pressure and including a fixed volume outlet and a plurality of variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressures are discharged,

a plurality of hydraulic motors adapted for connection respectively with different units of auxiliary equipment of a vehicle,

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a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle,

conduit means including a first branch connecting first and second ones of said auxiliary equipment hydraulic motors to the fixed volume outlet of said source of fluid pressure, and a second branch communicatively connecting said pair of hydraulic motors and a third one of said auxiliary equipment motors with the output from one or more of the variable volume outlets of said source, and further including a fluid transmitting interconnection between said second branch and said second one of said auxiliary equipment motors,

a directional valve in said second branch conduit and having an inlet port communicating with the variable volume outlets of said source of fluid pressure, and two pairs of work ports communicating with the respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports and two operative positions in opposite directions from neutral respectively for communicatively connecting either motor port to the inlet port so that the propelling motors may be operated forwardly or reversely,

a series-parallel control valve interposed in said second branch conduit between the directional valve and the propelling motors and having a plurality of inlet ports communicating with the work ports of said directional valve, and a plurality of motor ports communicating with the respective inlets and outlets of the propelling motors, and a valve member having two operative positions in one of which positions the inlet and motor ports thereof are interconnected so as to effect parallel operation of the propelling motors and in the other position the inlet and motor ports are so interconnected so as to effect series operation of said motors, and

range selector means interposed in said second branch conduit between said directional valve and the variable volume outlets of said source of fluid pressure for controlling the flow from said source and including flow directing means therein operative for selectively communicatively directing the flow from one or more of said variable volume outlets therethrough to the propelling motors or to the third one of said auxiliary equipment motors, while additionally being selectively operative for directing the flow from one variable volume outlet through said fluid transmitting interconnection to the second of said auxiliary equipment motors in order to supplement the flow to said motor from said fixed volume outlet of said source,

said selector means having an individual inlet for each variable volume outlet of said source and being connected thereto by individual fluid carrying passages provided in the portion of said second branch conduit extending therebetween,

additional conduit means including an individual conduit connected into each of the said individual passages of said second branch conduit for conducting fluid therefrom to drain and further including a check valve in each such individual conduit connection, and a single relief valve common to all said individual conduit connections operable to effect release of fluid from any one of said passages individually or from all of said individual passages collectively attendant the development of a pressure in any one of said passages in excess of that for which the common relief valve is pre-set.

10. In a hydraulic system:

means providing a source of fluid under pressure and including at least one fixed volume outlet and one or more variable volume outlets through which fixed

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and variable volume outputs respectively of operating fluid pressure are discharged;

a hydraulic motor adapted for connection with auxiliary equipment of a vehicle;

conduit means communicatively connecting said hydraulic motor with a fixed volume outlet of said source of fluid pressure;

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle;

circuit conduit means communicatively connecting said propelling motors with one or more of the variable volume outlets of said source and including, interposed in the circuit in a fluid flow and a series sequence relation, range selector means for controlling the flow from the variable volume outlets of said source and including means providing a plurality of inlets and one or more outlets and flow directing means therewithin fashioned to provide fluid flow passages therethrough and said latter means being movable to provide interconnections between the inlets and outlets thereof so that the flow from one or more of the variable volume outlets is selectively communicatively directable to the propelling motors, a directional flow valve having an inlet port communicating with an outlet of said range selector, and two pairs of work ports communicating with respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports thereof and two operative positions in opposite directions from neutral respectively for communicatively connecting either work port to the inlet port so that the motors may be operated forwardly or reversely,

additional conduit means connected into said directional flow valve and communicative when the directional flow valve is in one of the said operative positions thereof with the outlets of said propelling motors for conducting fluid from said motors to drain and including retarder valve means communicatively connectable with the outlets of said propelling motors and to drain, and fluid restricting means communicatively connected on one side thereof to said retarder valve means and on the other side into said circuit conduit means intermediate said range selector means and said directional flow valve and normally operative to pass sufficient fluid flow to assist in maintaining said retarder valve means open, and said retarder valve being operable for restricting the flow of fluid from said motors to drain thereby to brake said motors.

11. In a hydraulic system:

means providing a source of fluid under pressure and including at least one fixed volume outlet and one or more variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressure are discharged;

a hydraulic motor adapted for connection with auxiliary equipment of a vehicle;

conduit means communicatively connecting said hydraulic motor with a fixed volume outlet of said source of fluid pressure;

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle;

circuit conduit means communicatively connecting said propelling motors with one or more of the variable volume outlets of said source and including, interposed in the circuit in a fluid flow and a series sequence relation, range selector means for controlling the flow from the variable volume outlets of said source and including means providing a plurality of inlets and one or more outlets and flow directing means therewithin fashioned to provide fluid flow passages therethrough and said latter means being

movable to provide interconnections between the inlets and outlets thereof so that the flow from one or more of the variable volume outlets is selectively communicatively directable to the propelling motors, a directional flow valve having an inlet port communicating with an outlet of said range selector, and two pairs of work ports communicating with respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports thereof and two operative positions in opposite directions from neutral respectively for communicatively connecting either work port to the inlet port so that the motors may be operated forwardly or reversely, additional conduit means connected into said directional flow valve and communicative when the directional flow valve is in one of the said operative positions thereof with the outlets of said propelling motors for conducting fluid from said motors to drain and including a plurality of retarder valve means communicatively connectible one means each with an outlet of a propelling motor and to drain, and a plurality of fluid restricting orifices one each of which is communicatively connected on one side of the orifice to a respective retarder valve means and on the other side thereof into said circuit conduit means and normally operative to pass sufficient fluid flow to assist in maintaining an associated retarder valve means open, and each such retarder valve means being operable to restrict the flow of fluid from a respective motor to drain thereby to brake the associated motor.

12. The system described in claim 11 and further characterized in that each said retarder valve means includes a retarder valve normally biased to a closed position but maintained open by fluid pressure from said fluid pressure source received through an associated one of said fluid restricting orifices to thereby permit fluid flow from the outlet of a respective motor to drain, and a unidirectional check valve communicatively connected to a respective retarder valve and to drain and normally biased closed but being manually operative to open so as to effect release of fluid pressure against the associated retarder valve to permit actuation thereof and thereby cause said latter valve to offer restriction to the flow of fluid from a respective propelling motor to drain thereby to brake said motor.

13. In a hydraulic system:

means providing a source of fluid under pressure and including at least one fixed volume outlet and one or more variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressure are discharged;

a hydraulic motor adapted for connection with auxiliary equipment of a vehicle;

conduit means communicatively connecting said hydraulic motor with a fixed volume outlet of said source of fluid pressure;

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle;

circuit conduit means communicatively connecting said propelling motors with one or more of the variable volume outlets of said source and including, interposed in the circuit in a fluid flow and a series sequence relation, range selector means for controlling the flow from the variable volume outlets of said source and including means providing a plurality of inlets and one or more outlets and flow directing means therewithin fashioned to provide fluid flow passages therethrough and said latter means being movable to provide interconnections between the inlets and outlets thereof so that the flow from one or more of the variable volume outlets is selectively communicatively directable to the propelling motors, a directional flow valve having an inlet port communi-

cating with an outlet of said range selector, and two pairs of work ports communicating with respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports thereof and two operative positions in opposite directions from neutral respectively for communicatively connecting either work port to the inlet port so that the motors may be operated forwardly or reversely,

additional conduit means connected into said directional flow valve for conducting fluid from the propelling motors to drain (when the directional flow valve is in one of the said operative positions thereof) and including retarder valve means comprising a pair of retarder valves communicatively connectible one each to an outlet of a propelling motor and to drain, and a pair of flow restricting devices one side of each of which communicatively connects with a respective retarder valve while the other side of each such device communicatively connects into said circuit conduit means, said retarder valves being fashioned so as to be normally biased to a closed position but being maintained open by fluid pressure from said fluid pressure source acting through said flow restricting devices to thereby permit fluid flow from the outlets of the propelling motors to drain and being operative when a drop in fluid pressure in said circuit conduit means becomes effective for permitting actuation of said retarder valves and causing at least one of said valves to offer restriction to the return flow of fluid from the propelling motors and thereby prevent overrunning of said motors.

14. In a hydraulic system:

means providing a source of fluid under pressure and including at least one fixed volume outlet and one or more variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressure are discharged;

a hydraulic motor adapted for connection with auxiliary equipment of a vehicle;

conduit means communicatively connecting said hydraulic motor with a fixed volume outlet of said source of fluid pressure;

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle;

circuit conduit means communicatively connecting said propelling motors with one or more of the variable volume outlets of said source and including, interposed in the circuit in a fluid flow and a series sequence relation, range selector means for controlling the flow from the variable volume outlets of said source and including means providing a plurality of inlets and one or more outlets and flow directing means therewithin fashioned to provide fluid flow passages therethrough and said latter means being movable to provide interconnections between the inlets and outlets thereof so that the flow from one or more of the variable volume outlets is selectively communicatively directable to the propelling motors, a directional flow valve having an inlet port communicating with an outlet of said range selector, and two pairs of work ports communicating with respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports thereof and two operative positions in opposite directions from neutral respectively for communicatively connecting either work port to the inlet port so that the motors may be operated forwardly or reversely, a series-parallel control valve interposed between the directional flow valve and the propelling motors and fashioned with a plurality of inlet ports certain of which com-

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communicate with the work ports of said directional valve, an outlet port, and a plurality of motor ports which communicate with respective inlets and outlets of the propelling motors, and a valve member having two operative positions in one of which said certain inlet ports and said motor ports are interconnected so as to effect parallel operation of the propelling motors while another of said inlet ports is blocked from communication with said outlet port and in the other position said certain inlet ports and said motor ports are so interconnected as to effect series operation of said motors while the said another inlet and said outlet port are communicatively interconnected,

additional conduit means connected into said directional flow valve and communicative with the outlets of said propelling motors for conducting fluid from said motors to drain when the directional flow valve is in one of the said operative positions thereof and including a plurality of retarder valve means communicatively connectible one means each to an outlet of a propelling motor and to drain, and a plurality of fluid restricting orifices one each of which is communicatively connected on one side of the orifice to a respective retarder valve means and on the other side into said circuit conduit means and normally operative to pass sufficient fluid flow to assist in maintaining an associated retarder valve means open, and each such retarder valve means being operable to restrict the flow of fluid from a respective motor to drain thereby to brake the associated motor,

additional fluid pressure transmitting connections communicatively connecting one of said retarder valve means with the said another inlet port and another of said retarder valve means with the said outlet port respectively of said series-parallel valve so that when said latter valve is in position to effect series operation of the propelling motors the separate retarder valve means are communicatively interconnected so that actuation of either one thereof is effective to actuate both thereby to brake both propelling motors in forward or reverse operation.

15. In a hydraulic system:

means providing a source of fluid under pressure and including at least one fixed volume outlet and one or more variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressure are discharged;

a plurality of hydraulic motors adapted for connection respectively with individual units of auxiliary equipment of a vehicle;

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle;

conduit means communicatively connecting first and second ones of said auxiliary equipment hydraulic motors to the fixed volume outlet of said source of fluid pressure;

circuit conduit means communicatively connecting said propelling motors and a third one of said auxiliary equipment hydraulic motors with the variable volume output of said source of fluid pressure, and having an additional branch connection communicatively connecting the second one of said auxiliary equipment hydraulic motors with said circuit conduit means, and including, interposed in said circuit conduit means, range selector means for controlling the flow from the variable outlets of said source and fashioned with means providing a plurality of inlets and one or more outlets and a movable member therebetween which latter member is fashioned to provide fluid flow passages therethrough and being movable for registration with and to provide interconnections between the inlets and outlets there-

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of so that the flow from one or more of the variable volume outlets is selectively communicatively directable therethrough to the propelling motors or to a third one of said auxiliary equipment motors while additionally being selectively operative for directing the flow from one variable volume outlet through said additional branch connection to the second one of said auxiliary equipment motors in order to supplement the flow thereto from the said fixed volume outlet of said source;

a directional flow valve having an inlet port communicating with an outlet of said range selector and two pairs of work ports communicating with respective inlets and outlets of the propelling motors, and a valve member having a neutral position blocking communication of the inlet port with the work ports and two operative positions in opposite directions from neutral respectively for communicatively connecting either work port to the inlet port so that the motors may be operated forwardly or reversely;

a series parallel control valve interposed in the circuit intermediate the directional valve and the propelling motors and having a plurality of inlet ports communicating with said work ports, and a plurality of motor ports communicating with respective inlet and outlets of the propelling motors, and a valve member movable therewithin and having two operative positions in one of which the inlet and motor ports thereof are interconnected so as to effect parallel operation of the propelling motors and in the other position the inlet and motor ports are so interconnected as to effect series operation of said motors; and

additional conduit means connected into said circuit conduit means intermediate said variable volume outlets and said range selector means for conducting fluid therefrom to drain and including relief valve means operable to effect release of fluid from said circuit conduit means attendant development of a pressure in said circuit conduit means in excess of that for which said relief valve means is pre-set.

16. In a hydraulic system:

a power driven pump providing a source of fluid under pressure and having at least one fixed volume outlet and one or more variable volume outlets through which fixed and variable volume outputs respectively of operating fluid pressure are discharged;

a plurality of hydraulic motors adapted for connection respectively with individual units of auxiliary equipment of a vehicle;

conduit means communicatively connecting a first one of said hydraulic motors to the fixed volume outlet of said pump;

a pair of hydraulic motors adapted for connection respectively with a pair of propelling wheels of a vehicle;

circuit conduit means communicatively connecting said propelling motors and a second one of said auxiliary equipment hydraulic motors with the variable volume output of said pump and including, interposed in the circuit conduit means, range selector means for controlling the flow from the variable volume outlets of said pump and including means providing a plurality of inlets and a plurality of outlets and flow directing means therewithin fashioned to provide fluid flow passages therethrough and said latter means being movable to provide interconnections between the inlets and outlets thereof so that the flow from one or more of the variable volume outlets is selectively communicatively directable to the propelling motors or to the second one of said auxiliary motors or alternatively to combinations of the propelling motors and said second motor, a directional flow valve having means therein operative for controlling the flow therethrough so as to

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cause said propelling motors to operate forwardly or reversely or alternatively in neutral with fluid to said propelling motors blocked, and a series-parallel control valve having means therein fashioned to provide interconnectible fluid flow passages there-through and being manipulatively arrangeable so that in one position thereof the fluid flow will effect parallel operation of the propelling motors and in another position the fluid flow will effect series operation of said propelling motors; and
 additional conduit means connected into said circuit conduit means intermediate the variable volume outlets of said pump and said range selector means for conducting fluid therefrom to drain and including relief valve means comprising an individual check

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valve for each of said variable volume outlets of said pump and a relief valve common to all said check valves and said relief valve means being operable to effect release of fluid from said circuit conduit means attendant development of a pressure in either one of said variable volume outlets in excess of that for which said common relief valve is pre-set.

17. The system described in claim 6 and further characterized by having included in said secondary branch remote connection means operative for communicatively connecting an additional auxiliary hydraulic motor into said secondary branch while concurrent therewith interrupting the flow of fluid pressure to said second auxiliary motor.

No references cited.