

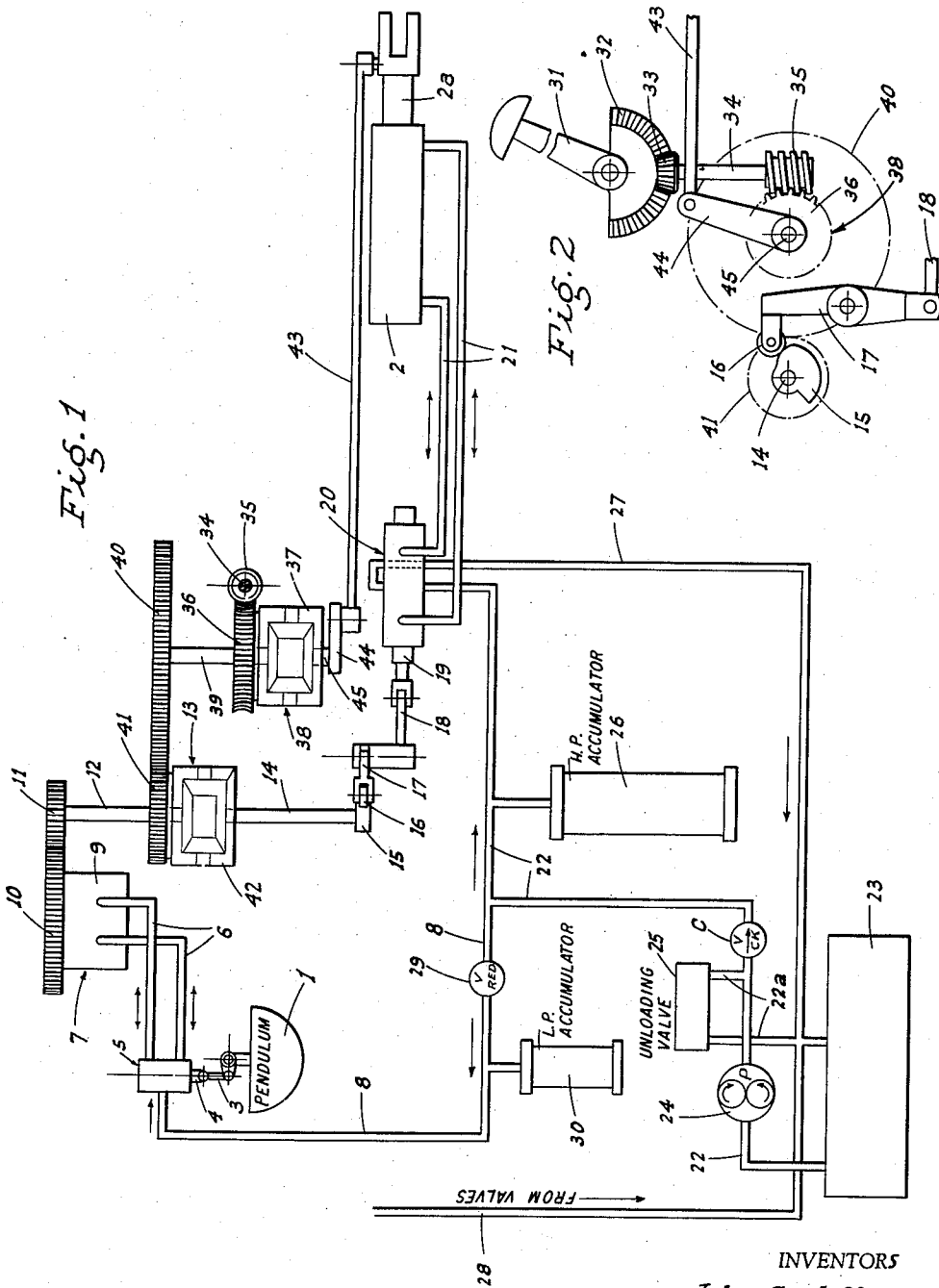
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HYDRAULIC POWER UNIT CONTROL SYSTEM

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HYDRAULIC POWER UNIT CONTROL SYSTEM

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5 Claims. (Cl. 121—41)

This invention relates to a hydraulic system for controlling the level of a bulldozer or grader blade or the like to compensate for variations in the level or contour of the ground being traversed by the implement; the system of the present invention particularly representing improvements over the system shown in our Patent No. 2,778,130, dated January 22, 1957.

The major object of this invention, and the main difference in the improved system over the previous one above identified, is the employment and incorporation into the system of a servo power boosted unit which gives unlimited power to the pendulum input and eliminates the problems arising from excessive friction. The new system and mechanism also allows the use of a standard type of full-flow high pressure control valve for the power unit instead of a pilot operated valve which is not smooth acting.

The system includes a low pressure sensitive pendulum operated valve for controlling the operation of the servo unit, and a high pressure valve for controlling the operation of the heavy-duty power unit, and another object of this invention is to provide a hydraulic system so arranged that with the use of a single pump, both high and low pressure valves will be supplied with the requisite and uniform pressures at all times. As a result, jerkiness in operation of the valve controlled units, as would be the case if the pressures fluctuated, is eliminated, and a smooth operation and accurate control is assured.

The system includes manually controlled means to operate the high pressure valve independently of the actuation thereof by the servo unit, and a further object of this invention is to improve and simplify the connecting mechanism between the power or pendulum operated means and the manually controlled means over what was employed in the previous above identified system.

It is also an object of the invention to provide a practical, reliable, and durable hydraulic power unit control system, and one which will be exceedingly effective for the purpose for which it is designed.

These objects are accomplished by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings:

Fig. 1 is a diagram of the improved system.

Fig. 2 is a fragmentary side elevation of the preferred form of the manual control mechanism of the system.

Referring now more particularly to the drawings, and to the characters of reference marked thereon, the system includes a pendulum 1 mounted on the tractor on which the bulldozer blade or other member is mounted whose level is to be maintained constant, and which is controlled by a hydraulic ram 2 also mounted on the tractor.

The pendulum is connected by linkage 3 to the plunger 4 of a piston-type valve 5 of conventional form. Com-

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bined feed and return conduits 6 lead from this valve to a servo unit which comprises a hydraulic rotary actuator of conventional or standard form, and indicated generally at 7. The feed conduit 8 to valve 5 is connected to a source of pressure, as will be seen later. This pendulum, valve, and actuator assembly is preferably the same as that shown and described in the copending application of John Curlett, Serial No. 818,923, filed June 8, 1959.

The rotating member 9 of the actuator 7 is fitted with a spur gear 10 which meshes with a pinion 11 fixed on one shaft 12 of a standard or conventional form of differential 13. The other shaft 14 of the differential 13 is fitted on its outer end with a cam 15 engaged by a roller 16 on one end of a lever 17 pivoted intermediate its ends in a fixed position. The other end of the lever is connected by a link 18 to the spring-retracted plunger 19 of a conventional four-way piston-type valve 20. Combined feed and return conduits 21 lead to and from the valve to the ends of the cylinder of ram 2.

High pressure is fed to valve 20 through a main conduit 22 leading from a supply tank 23 to said valve. A pump 24 is interposed in said conduit 22, and a check valve C is interposed in the main conduit between the pump and valve 20, and opens toward the latter. A secondary conduit 22a connects the tank 23 and conduit 22 at a point in the latter between the pump and check valve; an unloading valve 25 being interposed in said secondary conduit. This unloading valve is preferably the same as that shown in United States Patent No. 2,779,346, dated January 29, 1957.

An accumulator 26 is also included in the conduit system 22, being disposed between the unloading valve 25 and the valve 20. The return conduit 27 leads back from valve 20 to the tank 23, while another conduit 28 drains back to said tank from the housing (not shown) in which the valve 5 and actuator 7 are mounted, as shown in the previously mentioned copending application.

The feed conduit 8 leading to valve 5 is connected to the conduit system 22 at a point between the unloading valve 25 and the accumulator 26, and a pressure reducing valve 29 is interposed in said conduit 8. An accumulator 30 is connected to conduit 8 between the reducing valve 29 and the valve 5.

By reason of the above arrangement, the one pump supplies both the high and low pressure for the operation of the two halves 5 and 20, and because of the interposition of the accumulators in the related conduits, the two separate pressures retain their proper proportions under all conditions of operation.

The mechanical features of the improved system above described include a hand control means for operating the valve 20 irrespective of the pendulum control thereof, just as in the structure shown in Patent No. 2,778,130, noted in the preamble of this specification.

In the present system, such hand control means comprises a hand lever 31 connected to a bevel gear 32 to oscillate the same; said gear meshing with a pinion 33. This pinion is mounted on a shaft 34 on which an irreversible worm 35 is fixed; the worm engaging a worm wheel 36 secured on the body or carrier 37 of a differential 38. One shaft 39 of this differential has a spur gear 40 fixed thereon which meshes with a spur pinion 41 fixed on the body or carrier 42 of the differential 13.

A follow-up rod or link 43 connects the moving piston 2a of ram 2 with a radial arm 44 on the other shaft 45 of differential 38; this follow-up unit functioning to the same end as the corresponding device in said Patent No. 2,778,130.

In operation, it will be seen that by reason of the dual

interconnected differential arrangement employed, the following action is obtained:

When the rotary member 9 of the servo unit or hydraulic actuator 7 is turned by pendulum actuation of valve 5, the pinion 11 connected to the shaft 12 of differential 13 is likewise turned. At this time, both the shaft 39 and the carrier 37 of differential 38 are prevented from rotating because of the then stationary link 43 and the irreversible manually controlled worm 35. The carrier 42 of differential 13 is thus likewise held against rotation because of the interconnected meshing gears 40 and 41. As a result, such rotation of the shaft imparts rotation to shaft 14. This turns the cam 15 to swing lever 17 and thus opens the normally closed valve 20 so as to admit fluid to one end or the other of ram 2.

If a manually controlled actuation of valve 20 is desired, such actuation is effected as follows:

Rotation of worm 35, by reason of its connection with the hand lever, rotates the carrier 37 of differential 38. Since the shaft of such differential is at that time held against movement by link 43, shaft 39 will be turned, and by reason of the interconnected gears 40 and 41 the carrier 42 of differential 13 will be turned. The shaft 12 of said differential 13 cannot then turn, however, because of its geared connection with the stationary and inactive member 9 of the actuator 7. As a result, turning of carrier 42 effects the turning of shaft 14 of said differential 13 with the accompanying opening of valve 20, as previously described.

In either case, movement of the follow-up link 43 which accompanies the movement of the ram piston 2a, acts to then close valve 20 in the following manner:

Shaft 45 of differential 38 is turned by the pull or push of link 43 on the radial arm 44 as the ram piston 2a moves. Since carrier 37 of said differential 38 and shaft 12 of differential 13 cannot then turn, shaft 39 of differential 38 and the gear 40 on said shaft are turned. This in turn imparts rotation to gear 41 and carrier 42 of differential 13, thus causing shaft 14 of differential 13—with the cam 15 thereon—to be turned in the direction opposite that originally imparted thereto, to effect closing of valve 20.

The use of a double set of differentials in the control mechanism of the control system thus maintains desired relationships in the system, which are: (1) the hand control setting; (2) the bulldozer or similar blade motion and position; (3) the pendulum position; and (4) the operating valve position.

From the foregoing description it will be readily seen that there has been produced such a system as will substantially fulfill the objects of the invention, as set forth herein.

While this specification sets forth the present and preferred construction of such system, still in practice such deviations therefrom may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described the invention, the following is claimed as new and useful, and upon which Letters Patent are desired:

1. In a hydraulic system, a pendulum, a normally closed valve mounted adjacent the pendulum and having a fluid pressure conduit connected thereto, means between the pendulum and valve to open the latter upon relative swinging of the pendulum from a normal position, a hydraulic rotary actuator including a rotary member, a

conduit connected to the valve and actuator to impart rotation to said member upon opening of the valve with a resultant flow of fluid through said conduit, another normally closed valve, and a mechanism connecting the member and said other valve to open the latter upon rotation of the member; said mechanism comprising a gear fixed on and concentric with said member, another gear meshing with the first named gear, a shaft unit on which said other gear is fixed, and connection means between the shaft unit and said other valve to actuate the latter upon rotation of the shaft unit.

2. In a hydraulic power-unit control system, a differential structure which includes alined gear-connected shafts and a gear carrier, a pendulum controlled means to rotate one of the shafts, a hydraulic valve to control the operation of the power unit of the system, means between the valve and the other shaft of the differential structure to actuate the valve upon such rotation of the one shaft and the accompanying functioning of the differential structure and rotation of the other shaft thereof, and manually controlled means to actuate said differential structure to cause rotation of said other shaft irrespective of the rotation of the one shaft of said structure by the pendulum controlled means.

3. A system, as in claim 2, in which said manually controlled means includes gear connections to rotate the carrier of the differential structure.

4. In a hydraulic power-unit control system, a differential structure which includes alined gear-connected shafts and a gear carrier, a pendulum controlled means to rotate one of the shafts, a hydraulic valve to control the operation of the power unit of the system, means between the valve and the other shaft of the differential structure to actuate the valve upon such rotation of the one shaft and the accompanying functioning of the differential structure and rotation of the other shaft thereof, and manually controlled means to actuate said differential structure to cause rotation of said other shaft irrespective of the rotation of the one shaft of said structure by the pendulum controlled means; said manually controlled means comprising another differential structure which includes alined gear-connected shafts and a gear carrier, manually operated means to rotate the last named carrier, a gear connection between one shaft of said other differential structure and the carrier of the first named differential structure, the power unit of the system including a movable member moved upon opening of said valve, and a follow-up connection between the movable member and the other shaft of said other differential structure to rotate such other shaft upon movement of said movable member.

5. A system, as in claim 4, in which said manually operated means comprises a worm gear fixed on said last named carrier, and an irreversible manually rotated worm engaging the worm gear.

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