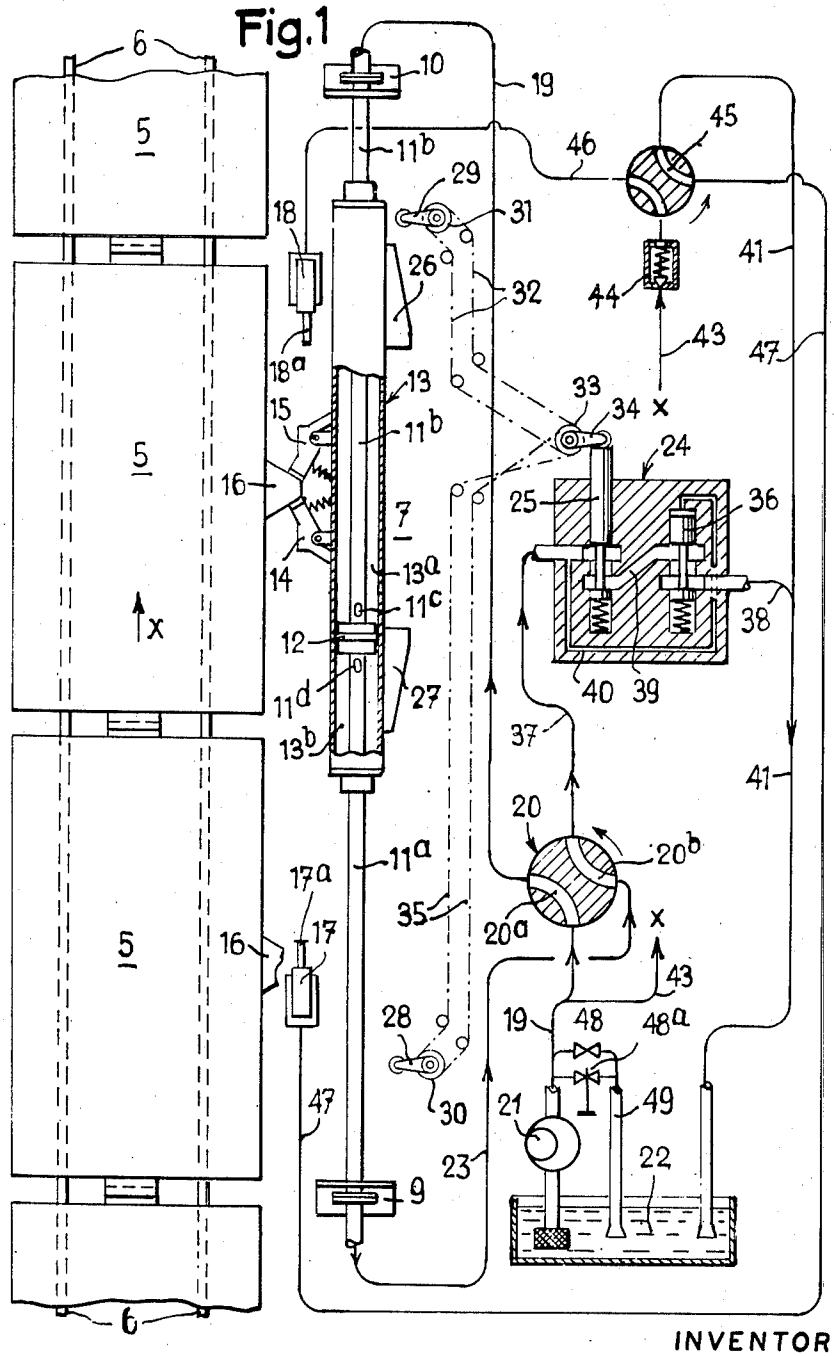
March 12, 1957 M. STRAUSS ET AL 2,784,852

HYDRAULIC CONTROL GEARS FOR THE STORAGE OF GOODS, PARTICULARLY FOR THE PARKING OF AUTOMOBILES

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Fig.1




INVENTORS
M. STRAUSS &
P. TRUNINGER

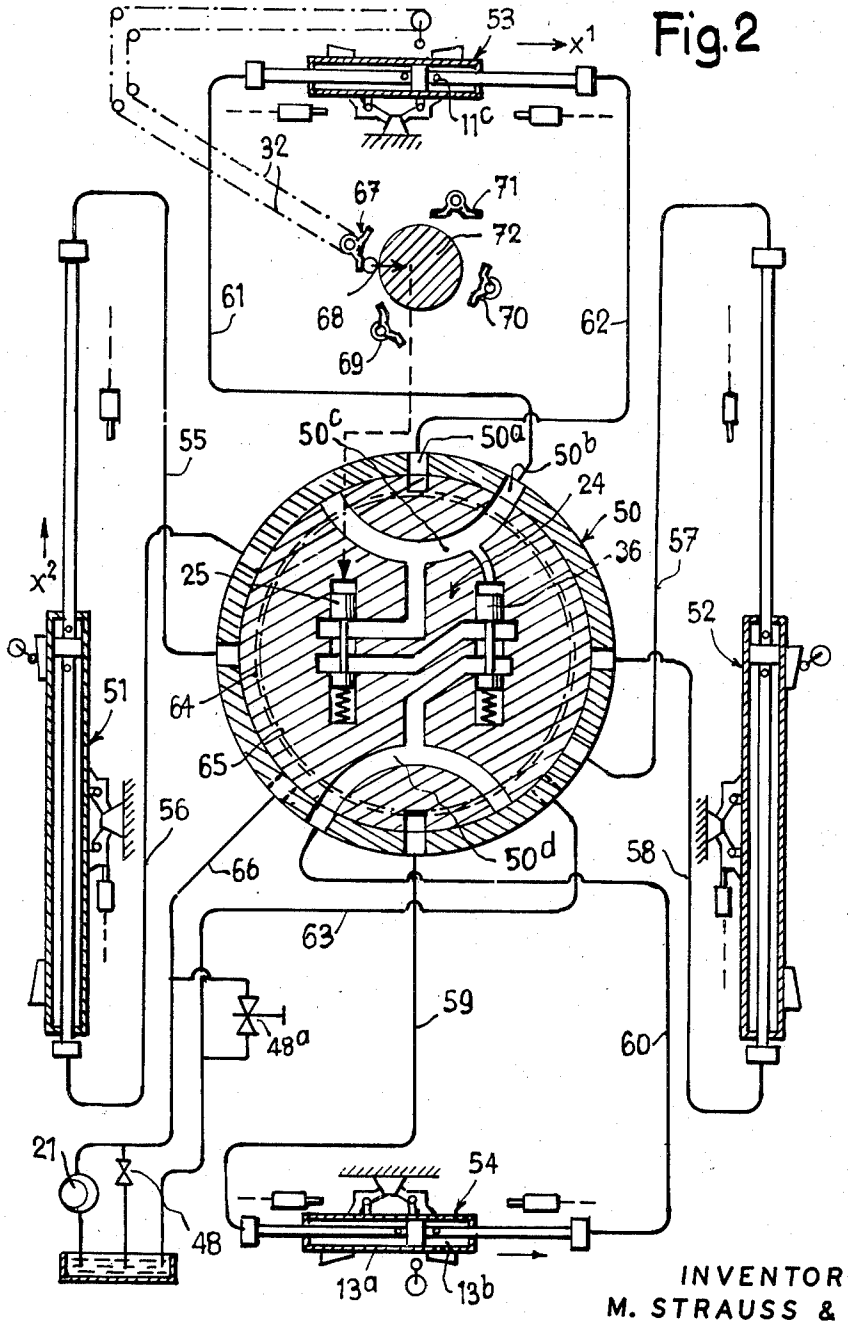
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Fig.2




INVENTORS
M. STRAUSS &
P. TRUNINGER

BY Wenderoth, Lind & Ponack
ATTYS.

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2,784,852

# HYDRAULIC CONTROL GEARS FOR THE STORAGE OF GOODS, PARTICULARLY FOR THE PARKING OF AUTOMOBILES

Manfred Strauss, Basel, and Paul Truninger, Solothurn, Switzerland, assignors to Buss A. G., Basel, Switzerland

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9 Claims. (Cl. 214—16.1)

This invention relates to a hydraulic control gear for installations for the storage of goods, particularly for the parking of automobiles.

Installations for the storage of goods, particularly for the parking of automobiles, are known, which comprise two juxtaposed parallel longitudinal tracks, two juxtaposed parallel transverse tracks disposed at both ends of and connecting said longitudinal tracks, and platforms movable on said tracks and adapted to carry said goods. In these known installations the platforms are moved rectangularly on said longitudinal and transverse tracks. Such a plant is described, e. g., in the U. S. Patent No, 2,718,317.

The present invention relates to a hydraulic control gear for moving said platforms. That control gear comprises a plurality of hydraulic motors each of which comprises a stationary element and a movable element, said elements consisting of a double-acting piston and a cylinder, said movable element carrying a pair of coupling members which are spring-loaded to cooperate with each other, said gear comprising further a countercoupling member carried by each of said platforms and adapted to be caught between said coupling members when the same cooperate with each other, a liquid pump arranged to operate said hydraulic motors, and auxiliary control means operable to move said coupling members individually into a position in which they do not cooperate with each other.

The hydraulic motor is suitably designed to have a stationary piston whereas the cylinder forms the said movable element carrying the pair of coupling members.

To ensure that the platforms are always started in a gentle manner, without a jerk, and are not suddenly stopped, regardless of the load thereof, it is recommendable to connect the hydraulic motor to the liquid pump by way of a rate control means.

An illustrative embodiment of the invention is shown in the accompanying drawing.

Fig. 1 is a diagrammatic view of part of the plant with only one of the hydraulic motors thereof and serves only for illustrating the invention.

Fig. 2 is a diagrammatic showing of a practical embodiment of the installation with all four hydraulic motors.

In Fig. 1, numerals 5 denote platforms which serve in a parking installation for receiving automobiles. According to the diagram in Fig. 1 of the said U. S. Patent No. 2,718,317 these platforms are moved rectangularly from one track (longitudinal track) on a track extending at right angles thereto (transverse track). These platforms 5 are assumed in Fig. 1 to be disposed on one of the two longitudinal tracks and are moved thereon every time by the distance from the center of a platform to the center of the next platform, until they reach the respective transverse track not shown here, on which they are moved at right angles onto the other longitudinal track in the course of the simultaneous movement of all platforms. The platforms 5 are moved on the longitudinal track 6 by a hydraulic motor 7, which is disposed beside the track 6 and whose axis extends in the direction of movement of the



platforms 5. That hydraulic motor has two elongated coaxial piston rods, which comprise tubular parts 11*a* and 11*b* affixed at their outer ends in beams 9 and 10 and connected at their mutually facing ends to a double-acting piston 12. An elongated cylinder 13 is guided on the two piston rods 11*a* and 11*b* and can be displaced over the piston 12 in a tight-fitting engagement therewith. The cylinder 13 carries on the side facing the longitudinal track two mutually associated latch-type coupling members 14 and 15, which are pivotally arranged and held by compression springs in their coupling position. Each platform 5 has attached thereto in its transverse center plane a laterally protruding countercoupling member 16. During the movement of the platforms 5 these countercoupling members 16 are caught between the two coupling members 14, 15, as is shown in Fig. 1. The two coupling members 14 and 15 have auxiliary control pistons 17 and 18 associated therewith, each of which has a piston rod 17*a* or 18*a* extending parrallel to the axis of the hydraulic motor 7 and forming an adjustable stop. The admission to these auxiliary control pistons 17, 18 causes the coupling members 14, 15 to be swung by the respective piston rods into their disengaged position.

The piston rod 11*b* is connected through a conduit 19 and one duct 20*a* of a four-way cock 20 to a liquid pump 21, whose suction pipe is immersed in the liquid bath 22. The piston rod 11*a* is connected through a conduit 23 and the other duct 20*b* of the four-way cock 20 to a rate control means, which is generally indicated at 24 and whose function will be explained hereinafter. That rate control means comprises a spring-loaded main piston 25, which serves to reduce the rate of flow in the conduit 23 by a reduction of the cross-section of flow. That main piston 25 is mechanically controlled to effect that reduction in cross-section. To this end the cable system described hereinafter is provided.

The cylinder 13 is provided at each end, on the side opposite to the coupling members 14, 15, with a run-up ramp 26 or 27. These run-up ramps serve for swinging a lever 28 or 29 whereby a cable pulley 30 or 31 is turned through a corresponding angle. An endless cable 32 protected from slipping extends around the pulley 31 and has its other end loop in frictional engagement with a cable pulley 33, which is rotatably carried in a stationary bearing and on whose shaft a pivoted lever 34 is carried, which carries a pressure roller at its free end. In a similar manner an endless cable 35 extends with its two end loops frictionally around the two cable pulleys 30 and 33.

The rate control means 24 comprises also an auxiliary piston 36 which is not controlled mechanically, by means of cables, as the main piston 25, but hydraulically by admitting at one end. Both pistons 25 and 36 serve to throttle the rate of flow through the rate control means when the cylinder 13 has reached one or the other of its two end positions, as will be explained hereinafter. 37 is the inlet duct, 38 the outlet duct of the rate control means. These two ducts are interconnected by an intermediate duct 39. A bypass duct 40 branches from the inlet duct 37 and opens into the cylinder space disposed above the auxiliary piston 36. The outlet duct 38 has connected thereto a discharge line 41 opening onto the liquid bath 22.

The cylinders of the pistons 17 and 18 serving to actuate the two trip rods 17*a* and 18*a* are fed by the pump 21. To this end a line 43 is provided which branches from the conduit 19 in front of the four-way cock 20 and which is connected through a pressure holding valve 44 to a four-way cock 45. A conduit 46 extends from that four-way cock 45 to the cylinder of the piston 18, which serves to actuate the trip rod 18*a*. Another con-

duit 47 leads from the cock 45 to the cylinder of piston 17 and a third conduit 41 leads from the cock 45 to the liquid bath 22.

The mode of operation of the device described hereinbefore is as follows:

The cylinder 13 is shown in an intermediate position in Fig. 1. It is about to move from its end position adjacent to the support 9 to its other end position adjacent to the support 10 in order to move the series of coupled platforms through the desired distance in the sense of the arrow shown. The two four-way cocks 20 and 45 are shown in the position appropriate for this purpose. Thus the pump 21 feeds liquid through the conduit 19 and the hollow piston rod 11*b* through a hole 11*c* therein into the space 13*a* of cylinder 13, whereby the latter is moved in the direction of the arrow. Thereby the liquid is displaced out of the space 13*b*. To this end a hole 11*d* is provided in the piston rod 11*a*. The liquid flows off through the conduit 23 and passes through the four-way cock 20 to the rate control means 24. In the meantime the cylinder 13 has been displaced to such an extent as to swing the rocker lever 29 by means of the ramp 26, whereby the rocker lever 34 has been swung too. As a result the main piston 25 of the rate control means is moved in a sense whereby the flow therethrough is throttled. The auxiliary piston 36 acts in the same sense; it admits through the bypass duct 40 of the rate control means. The liquid flowing from the latter comes finally through the conduit 41 to the liquid bath 22. The cylinder 13 has reached its end position in the meantime. The flow through the rate control means 24 is checked by the pistons 25 and 36 thereof to such a degree that the liquid discharged by the pump 21 flows back to the liquid bath 22, except for a small residue, through a return conduit 49, provided with a relief valve 48.

The entire oil ejected from the discharge side of the cylinder 13 must pass through the rate control means and is throttled therein to such a degree that the brake pressure appropriate for the intended length of brake path is obtained. That pressure may vary widely depending on the loading of the platforms. The effective brake pressure is the total of the pressure drops at both pistons 25 and 36, the former pressure drop constituting a constant component and the latter pressure drop constituting a variable component. The operation is automatic and independent on the loading of the platform. The piston 25 acts as a measuring member and the piston 36 as a control member.

The ideal braking operation is one with constant retardation, in which the speed declines gradually to reach the value zero exactly at the end point of the movement, independently of the magnitude of the load. This is achieved according to the invention by the rate control means 24 and its control in dependence on the cam 26. For this reason the cam 26 is designed so that the cross section of flow in the piston 25 is reduced in linear relation with the braking distance through which the cylinder has travelled. Constant retardation means constant brake pressure. This is the case for the piston 25 when the speed of the piston movement follows exactly the selected requirement that the flow rate should be proportional at any time to the passage opening of the valve 25. In that case the pressure drop between ducts 30 and 40 remains constant throughout the entire braking distance and the valve 36, which is controlled by said pressure drop, remains in a certain position of rest.

In practical operation that ideal case wil never be reached, if only because the loads will always be different. Larger or smaller loads tend to prolong or reduce the braking distance so that the instantaneous flow rate differs from the desired flow rate and for a certain point of the path. That deviation of the flow rate from the prescribed function causes a deviation of the pressure drop at the piston 25 from the prescribed value to be maintained. That deviation causes immediately a change of the pressure acting on the piston 36 and a different position of equilibrium thereof relating to the spring thereof. An increase of pressure causes a stronger throttling in the piston 36, i. e., an increase of the brake pressure and an automatic return to the prescribed function. The reverse occurs when the rate of flow decreases heavily in the case of a smaller load. Thus the pressure drop on the piston 25 is reduced, the piston 36 is opened to reduce the brake pressure unless the same has also returned to the prescribed value.

In the end position of the cylinder the valve 25 of the rate control is closed except for a very slight residual flow. Since the pump discharges at a constant rate, the surplus discharge obtained during the accelerating, braking, and standstill phases must escape through the pressure relief valve. Two valves are connected in parallel: The normal pressure relief valve 48, which responds to the admissible maximum pressure, and an electrically controlled valve 48*a*, which may be energized to open against a highly reduced excess pressure. The first valve 48 limits the accelerating pressure to the admissible maximum pressure and permits the surplus to flow back to the liquid bath 22. After the acceleration has been finished that valve wil be closed and the pressure will be reduced to a value which corresponds to the resistance against idling movement at constant velocity. This is only a fraction of the accelerating pressure. The response pressure of the second valve 48*a* is adjusted to that reduced pressure so that a pressure rise which would oppose the braking operation cannot occur on the pump side during braking. A lower pressure is desired to cause the end position to be reached in any case. The operation of that second valve is electrically initiated by an auxiliary contact at a point which lies between the end of the acceleration and the beginning of the braking operation.

During the operation described hereinbefore and while the four-way cock 45 is in the position shown in Fig. 1 the pump 21 has fed liquid also through the conduit 43. That liquid has entered the cylinder of the piston 18 of the trip rod 18*a* through the conduit 46. Thus the trip rod has been pushed ahead. When the cylinder 13 has then reached its end position the coupling member 15 is swung or tripped so that it can move past the countercoupling member 16 when the cylinder 13 has to perform an idle stroke in the opposite sense.

When the four-way cock 20 is then turned through 90 deg., in the sense of the arrows shown in the drawing, the cylinder 13 will perform an idle movement in the opposite direction because the space 13*b* is now fed through the conduit 23 from the pump 21 whereas the cylinder space 13*a* is emptied through the rate control means 24 in a similar manner as described hereinbefore. When the cylinder 13 moving in that direction while the platforms 5 are at rest has reached its corresponding end position, the coupling member 14 is swung and engaged by the countercoupling member 16 of the next following platform 5, which is at rest, so that the countercoupling member 16 remains caught between the two coupling members 14 and 15 and the row of platforms is again pushed ahead by a distance corresponding to the amount of feed of the cylinder 13 during the next cycle of operations. During that latter operation the piston 17, serving to push the trip rod 17*a* ahead, has remained ineffective, because the two-way cock 45 has not been adjusted. An adjustment of that cock will be effected only when the platforms 5 are to be moved in the direction opposite to that indicated by the arrow because in that case the coupling member 14 must be swung by the rod 17*a* so that the countercoupling members 16 attached to the platforms can move above the same.

In the installation shown in Fig. 1 of the said U. S. Patent No. 2,718,317 a hydraulic gear according to the foregoing explanation could be provided for each of the two longitudinal tracks and of the two transverse tracks

in order to move the platforms in the sense indicated by arrows in that figure and in the opposite sense. In that case these four gears should be hydraulically interconnected in an appropriate manner and adapted to each other.

Fig. 2 shows a simplified practical arrangement of said four gears. The simplification resides in that all four gears have a common central control member consisting of a rotary valve 50, which has connected thereto the conduits leading to all control cylinders which serve to move the platform. The cylinders serving to move the platforms along the longitudinal tracks are indicated at 51 and 52, those for moving the platforms along the transverse tracks at 53 and 54. Since the latter cylinders are associated with shorter tracks, they are shorter than the cylinders 51 and 52. In other respects all four cylinders and the parts connected thereto are similar in structure and operation. It should be emphasized that two every two mutually opposite cylinders are moved in the same direction at a time. For the sake of convenience similar parts directly connected to said cylinders are provided with the same reference numerals as in Fig. 1.

The conduits connecting the four cylinders to the rotary valve 50 are indicated at 55 and 56 for cylinder 51, at 57 and 58 for cylinder 52, at 59 and 60 for the cylinder 54 and at 61 and 62 for the cylinder 53. The feed conduit leading from the pump 21 to the rotary valve 50 is indicated at 66 and the return conduit at 63. The rate control means indicated at 24 in Fig. 1 is incorporated in the rotary valve member of the rotary valve 50. That rotary valve member has two peripheral grooves which lie in dfferent planes and will be referred to hereinafter as an inlet channel 64 and an outlet channel 65. The feed conduit 66 is permanently connected to the inlet channel 64 and the return conduit 63 is permanently connected to the outlet channel 65.

In Fig. 2 it is assumed that the two cylinders 53 and 54 are in operation, the cylinder 53 performing a working stroke in the sense of the arrow $x^1$ and the cylinder 54 performing an idle stroke in the same sense. The liquid discharged by the pump 21 flows through the conduit 66, the inlet channel 64 of the rotary valve 50, the outlet opening 50*a* thereof, the conduit 62, the piston rod 11*b* and the passage opening 11*c* thereof. The liquid displaced on the other side of the respective piston 12 flows off through the piston rod 11*a*, the conduit 61, the opening 50*b* in the housing of the rotary valve, the channel 50*c* in the rotary member of the valve, the rate control means incorporated therein, the channel 50*d* and the conduit 60 to the same side of the opposite piston 54 so that the latter performs exactly the same movement under the action of the liquid expelled by the first cylinder. The same quantity of liquid is expelled from the latter on the opposite side. It flows off through the conduit 59 to the rotary valve and from there through the outlet channel 65 and the conduit 63 back to the collecting vessel. The two pistons 25 and 26 have again throttled the flow to almost complete interruption, as has been explained in connection with Fig. 1. As has been explained hereinbefore, the piston 25 has again been actuated by an endless cable 32, which has been indicated here only for the cylinder 53 by dash-and-dot lines. That endless cable 32 swings a double lever 67, which operates with one of its lever arms, a push member 68, whereby the piston 25 is displaced in a sense to throttle the flow. The other double levers 69, 70 and 71 are associated with the cylinders 51, 52 and 54.

In order to cause the two other cylinders 51 and 52 to operate after the cylinders 53 and 54, the cylinder 51 performing a working stroke in the sense of arrow $x^2$ and the cylinder 52 performing an idle stroke in the same sense, the rotary valve member of the rotary valve is turned in the clockwise sense through 90 deg. Then the same cycle of operations begins as for the two other pistons 53 and 54. The rotation of the rotary valve causes also a rotation of the part 72 connected thereto so that the push member 68 enters the range of the corresponding double lever.



We claim:

1. A hydraulic control gear for operating an installation for the storage of goods, which installation comprises two juxtaposed parallel longitudinal tracks, two juxtaposed parallel transverse tracks disposed at both ends of and connecting said longitudinal tracks, and platforms movable on said tracks and adapted to carry said goods, said control gear comprising a plurality of hydraulic motors each of which comprises a stationary element and a movable element, said elements consisting of a double-acting piston and a cylinder, said movable element carrying a pair of coupling members which are spring-loaded to cooperate with each other, said gear comprising further a countercoupling member carried by each of said platforms and adapted to be caught between said coupling members when the same cooperate with each other, a liquid pump arranged to operate said hydraulic motors, and auxiliary control means operable to move said coupling members individually into a position in which they do not cooperate with each other.

2. A hydraulic control gear as set forth in claim 1, in which said movable element of each hydraulic motor consists of the cylinder thereof and each hydraulic motor comprises two stationary piston rods connected by said double-acting piston.

3. A hydraulic control gear as set forth in claim 2, which comprises conduit means connecting said pump to said hydraulic motors and in which said piston rods are hollow and apertured and form part of said conduit means.

4. A hydraulic control gear as set forth in claim 3, in which said conduit means include two conduits leading from the pump to each hydraulic motor and connected to the two piston rods thereof, and which comprises rate control means associated with said cylinders and a four-way cock for selectively connecting said rate control means into either of said conduits, said rate control means being adapted automatically to limit the flow therethrough to a given rate and adapted to be throttled to reduce said rate, and mechanical transmitting means operable by each hydraulic motor to throttle said rate control means for braking the movement of said cylinders.

5. A hydraulic control gear as set forth in claim 4, which comprises run-up ramps carried by each of said cylinders at both ends thereof and adapted to engage and operate said mechanical transmitting means for throttling said rate control means.

6. A hydraulic control gear as set forth in claim 4, which comprises four of said hydraulic motors, each of which is associated with one of said tracks, and a rotary valve forming a central control means having said cylinders of said hydraulic motors connected thereto, said rotary valve having a rotary valve member incorporating said rate control means.

7. A hydraulic control gear as set forth in claim 6, in which said rotary valve is movable between two effective positions and in one of said positions is adapted to cause the hydraulic motors associated with one of said longitudinal tracks to perform a working stroke and the hydraulic motor associated with the other of said longitudinal tracks to perform an idle stroke, while the two hydraulic motors associated with said transverse tracks remain at rest, whereas in the other of said two effective positions said rotary valve is adapted to cause the hydraulic motor associated with one of said transverse tracks to perform a working stroke and the hydraulic motor associated with the other of said transverse tracks to perform an idle stroke while the two hydraulic motors associated with said longitudinal tracks remain at rest.

8. A hydraulic control gear as set forth in claim 7, in which said rotary valve is designed to connect the

two cylinders moved at a time in series and to feed the discharge of said pump to the cylinder which is to perform a working stroke and to feed the discharge of said last-mentioned cylinder to the cylinder which is to perform an idle stroke.

9. A hydraulic control gear as set forth in claim 1, in which said auxiliary control means comprise two auxiliary cylinders associated with said coupling members, a four-way cock for selectively connecting either of said auxiliary cylinders to said liquid pump, two trip rods each of which is associated with one of said coupling



members and operable to move the same into a position in which it does not cooperate with the other coupling member of the same pair, and two auxiliary pistons each of which is movable in one of said auxiliary cylinders to operate one of said trip rods.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,431,248 | Norris | Oct. 10, 1922 |
| 2,009,579 | Ewend | July 30, 1935 |