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AUXILIARY HYDRAULIC STEERING MECHANISM

Original Filed April 30, 1934 3 Sheets-Sheet 1

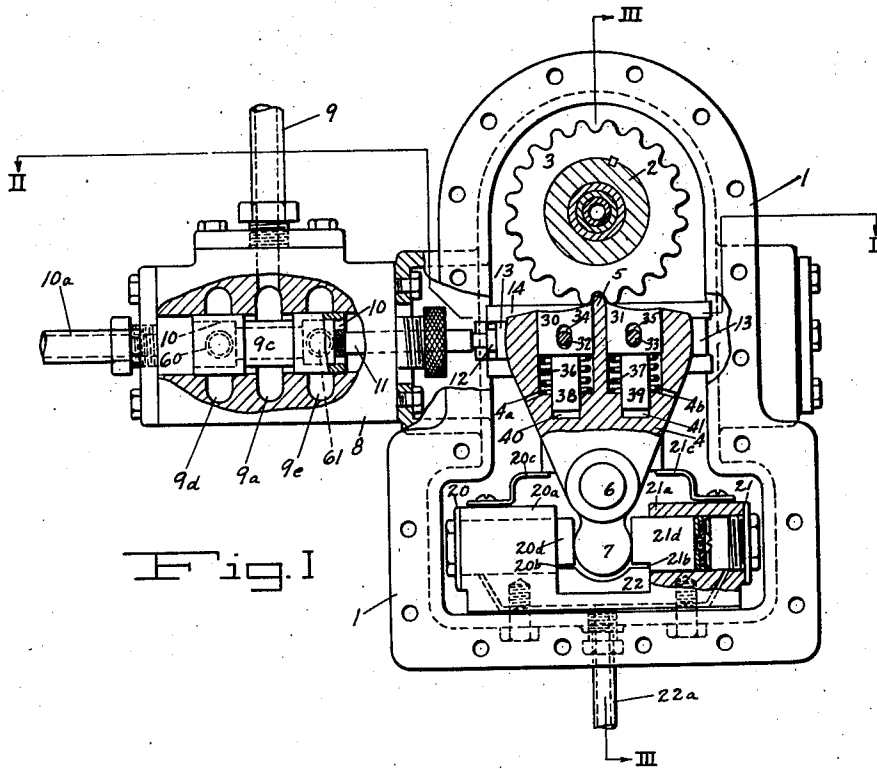


Fig. 1

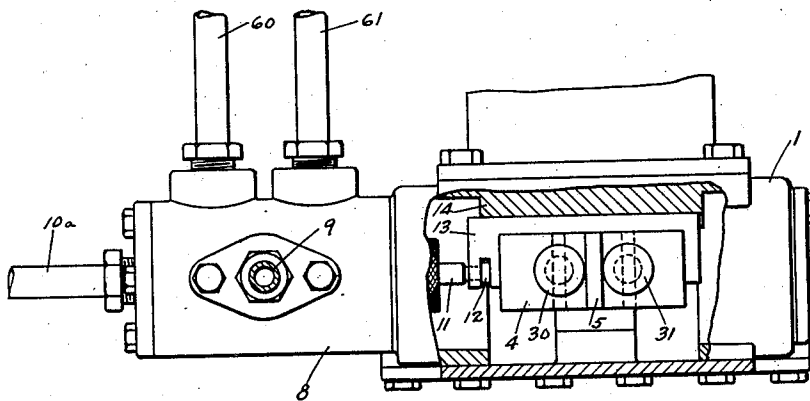


Fig. 2

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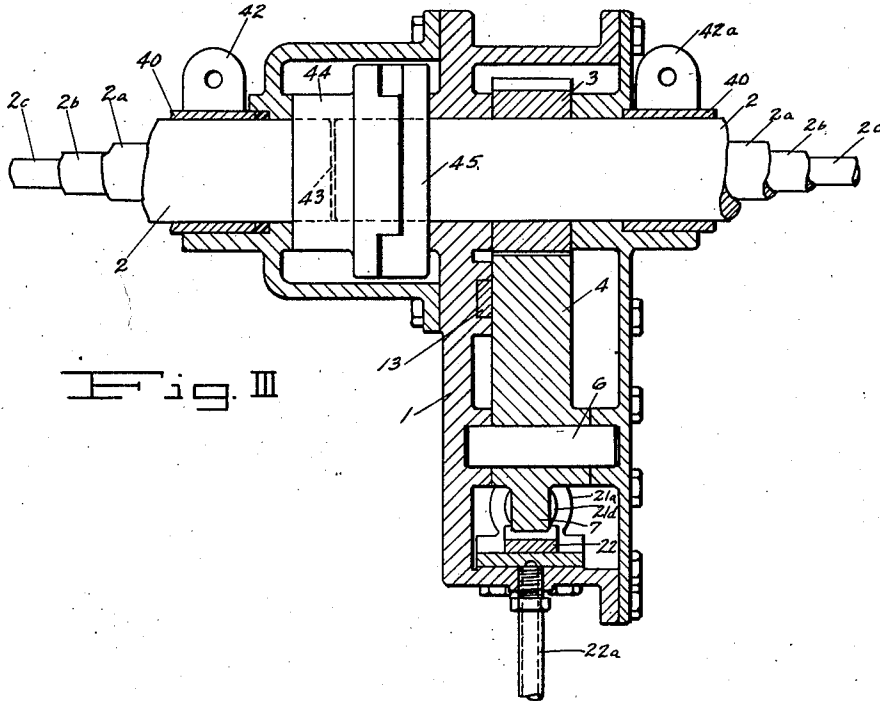


Fig. III

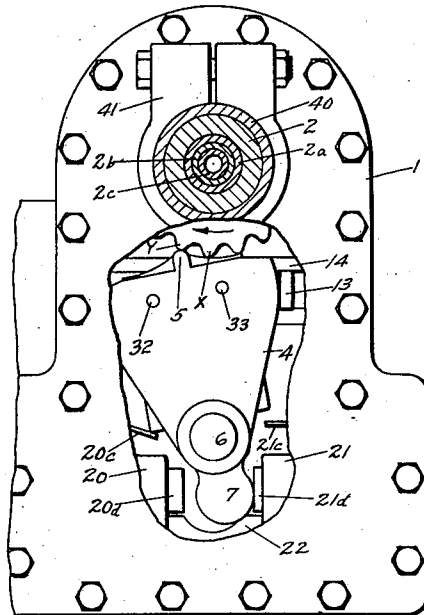


Fig. IV

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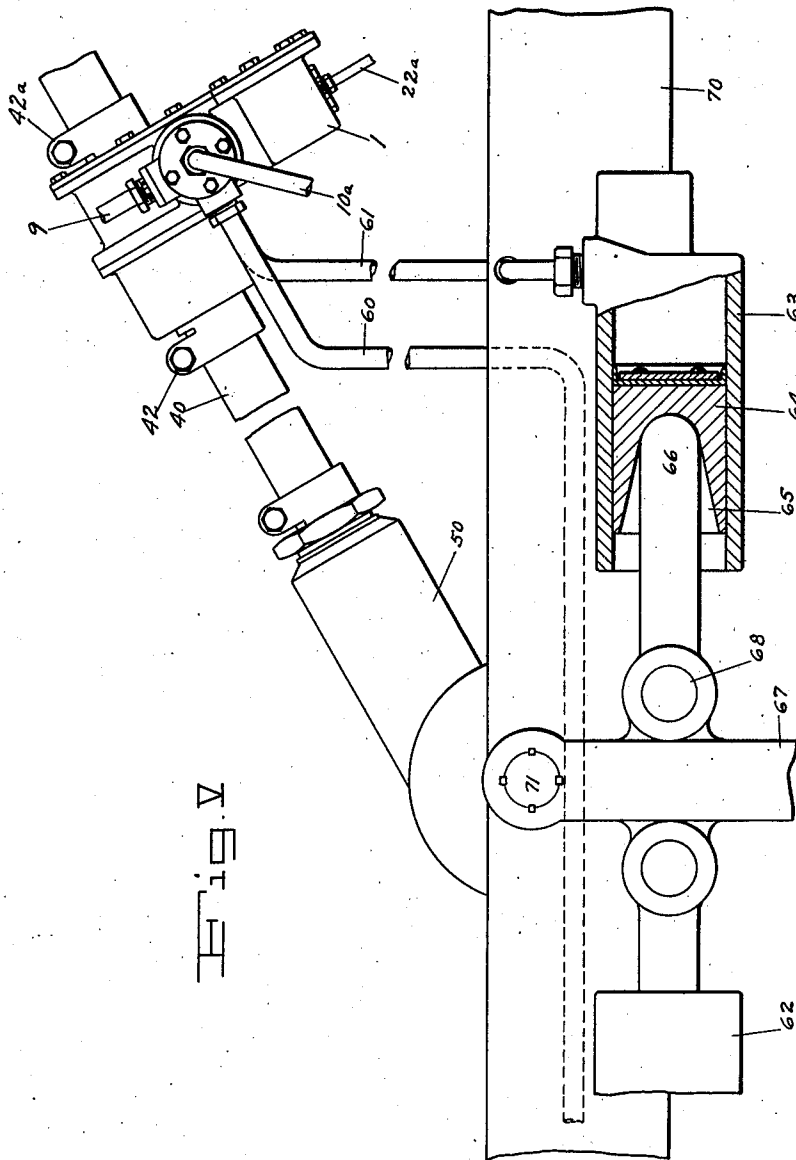
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AUXILIARY HYDRAULIC STEERING MECHANISM

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UNITED STATES PATENT OFFICE

2,028,451

AUXILIARY HYDRAULIC STEERING
MECHANISM

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Original application April 30, 1934, Serial No. 723,218. Divided and this application October 20, 1934, Serial No. 749,245

13 Claims. (Cl. 180—79.2)

This is a divisional application of our joint application executed by us on April 25, 1934, for Auxiliary hydraulic steering mechanism, Serial No. 723,218, Filed April 30, 1934.

5 This invention relates to devices for controlling a reversible hydraulic valve such as one on an automotive vehicle which may influence motor devices connected to the steering gear thereof.

10 In a device of the character above indicated it is desirable that the control be and remain at all times under the direct influence of the operator, that is to say that hydraulic or other power when initiated must not assume nor continue a directing influence but should be capable of shutting itself off at any point where manual force is discontinued. It is also desirable to establish a hydraulic lock of the motor devices at the shut-off point.

20 An object of this invention is a device wherein the manual portion of the apparatus, such as a steering wheel, may turn as many as two or more complete revolutions in order to make maximum movement in one direction and is instantly reversible manually; and if the hydraulic apparatus is not operating will be free from mechanical or hydraulic drag.

25 Another object of the invention is a device which will immediately reverse an apparatus such as a valve for controlling expansible motors from any attained position of the manually operated control.

30 A further object of this invention is a valve control device applied to hand steering gear that permits the hand steering gear to be operated in the usual way, that is effective to discontinue or resume its function at any point within the range of the manual apparatus without inducing drag.

40 A further object of this invention is a valve control of the character described that will not be noisy due to clicking or ratcheting effect of the valve throwing device.

45 A further object of this invention is to provide a valve control of the character indicated in the preceding paragraph that will resume its work wherever it finds the steering gear in case for example the source of hydraulic power such as a pump, should stop and afterwards start up again, and all without the manipulation of any part by the user or any preparation for such resumption of the function of the power apparatus.

50 These and other objects that will be plain to those skilled in the hydraulic art are the pur-

poses of the present invention and explained in the subjoined specification and particularly pointed out in the claims appended thereto.

For a full understanding of the invention and its novel features reference is made to the accompanying drawings in which a preferred form is illustrated, to co-operate with the written description. The drawings are in considerable detail and for the most part properly proportioned but it must be understood that this is to the end that the description may be better understood and is in no wise intended to lay down a hard and fast plan of construction.

In the drawings:

Fig. I is a plan of the control device casing 15 and contents with the cover removed to show contained mechanisms and with the main control valve attached to same; being partly in section;

Fig. II is a view partly in section on the irregular line II—II of Fig. I;

Fig. III is a section on the line III—III of Fig. I and includes the cover which was omitted in Fig. I;

Fig. IV is a view showing part of the front of 25 the case broken away to show the intermittent gear in substantially the position it will occupy when the pinion is moving in the direction of the arrow shown in this view. A special explanation of this view will be found in the subjoined 30 specification;

Fig. V is a somewhat diagrammatic figure showing some parts in section and the relationship of the devices shown in Figs. I and II to the motors which they control and the relationship of the motors to the steering device as a whole.

In Fig. I, numeral 1 represents a box-like casing with the cover removed, 2 represents a steering shaft, 3 represents a pinion made rigid 40 with a part of the steering shaft 2, and 4 represents an intermittent gear shown partially in section and having one tooth, 5, adapted to engage any tooth of the pinion 3 that may be adjacent, in either direction; "intermittent gear" 45 being here defined as a partial gear designed to go into and out of mesh with a mating gear element.

The intermittent gear 4 is pivoted on the spindle 6 and has an arm 7 extending beyond 50 the pivot to engage the motors 20 and 21.

The intermittent gear 4 is shown in its neutral position. At the left hand side of Fig. I is a valve casing 8 having an inlet pipe 9 and an exhaust pipe 10a. The inlet pipe 9 will be 55

considered to represent a source of hydraulic power not requiring by-passing; that is to say, hydraulic power which may be arranged with a relief valve or may be so constructed in the known manner as not to require one, and 9 will be considered to be a source of hydraulic energy at all times when the pump is running. The pump, not being a part of this invention, has not been shown.

Within the valve casing 8 is a piston valve 9c in the form of a shell and is provided with an internal exhaust passage 10 as shown in dotted outline. It is operated by the valve stem 11 which is jointed at 12 to the slide 13 reciprocally movable in the guide 14 and movable by intermittent gear 4. On opposite sides of the arm 7 are positioned two single acting hydraulic motors 20 and 21 supplied with hydraulic energy through the connection 22a which will be presumed to be connected to the same source as the pipe 9 and therefore under the influence of hydraulic force at all times when the source of hydraulic energy is operating.

The hydraulic motors 20 and 21 consist of cylinders 20a and 21a within which the plungers 20d and 21d operate. The plungers 20d and 21d have a limited stroke fixed by the stop 22 which engages with notches 20b and 21b; hence they always tend to keep the arm 7 in the position shown in Fig. 1 and when the tooth 5 is in the position shown in Fig. IV or in its completely reversed position not shown but which will be the reverse of that shown in Fig. IV, the tooth 5 is under the influence of one or the other of the plungers 20d and 21d and always urged to the position shown in Fig. 1. In Fig. IV it is the motor 21 that is urging the arm 7 back to its central or neutral position and in that figure the plunger 20d is not operating, being held at its extreme stroke by the stop 22.

Abutting the tooth 5 on each side are plungers 30 and 31, held by the pins 32 and 33, working in the slots 34 and 35, and urged upwardly toward the teeth of the pinion 3 by the springs 36 and 37. Positioned below the plungers 30 and 31 are spindles 38 and 39 working in dash pots 40 and 41 (see Fig. 1).

The spindles 38 and 39 will have a clearance of several thousandths of an inch within the bores forming the dash pots 40 and 41, according to the designer's calculations, so that they may function efficiently as hydraulic dash pots, it being understood that the entire casing up to a line well above the top of the tooth 5 will at all times be kept filled with a light oil. Vents 4a and 4b confine the dash pot action to that part designated to act as such.

It will be observed from Fig. IV that the top of the plungers are curved to as near as may be, conform to the arc of the tooth ends of the pinion 3 and thus while the pinion 3 is turning in the direction of the arrow shown in Fig. IV the point of the tooth 5 will be cushioned to a very large extent and when it reaches the point shown in Fig. IV it will not snap back abruptly and strike the next tooth indicated in this view by x, but the movement backward will be cushioned, and if the pinion turns rapidly, almost imperceptible.

This particular view of Fig. IV is purposely made so that the center line of the tooth 5 intersects with the center line of the tooth y on the pinion in the position that these teeth will occupy at the instant they reach this point but they can never remain there so that reversal

at this point would cause locking of the gear and pinion upon reaching this point as shown in Fig. IV.

The motor 21 will instantly cause a slight movement reversely of the tooth 5 so that the center lines can never intersect and therefore the teeth can never lock if the hydraulic source of pressure represented by 9 is functioning. The function of the motors 20 and 21 will be taken up by the springs 20c and 21c which are auxiliary to the motors 20 and 21 and serve to accomplish this function if at any time the steering device is operated when the source of hydraulic energy is inoperative.

The steering shaft 2 is constructed after the well known manner and may be hollow and through the hollow of which may project control members such as the tubes 2a, 2b, and 2c which may control the throttle, spark lever and contain wiring, and the shaft 2 is mounted after the known manner in the steering tube 40 held to the casing 1 by clamps 42 and 42a. The tubes such as 2a, 2b and 2c are continuous through the shaft, while the shaft is cut at the point indicated by the dotted lines at 43 and rigidly mounted upon each half of the shaft beyond 43 is a half of the jaw coupling 44 and 45.

The jaw coupling 44 and 45 is made to have a degree of lost-motion, shown at 46, that will be sufficient to allow the pinion 3 to be manually reversed independently of the reducing gear 50 (see Fig. V) so that the intermittent gear 4 may be freely operated to throw the piston valve 9c from the position indicated in Fig. IV for example to the reverse position that it would occupy to steer in the opposite direction, or if manual force is released, from the shaft 2 the motor 21 may return the intermittent gear to the neutral position shown in Fig. 1 and the valve 9c to neutral as in Fig. 1. It is also shown in the same figure that returning to neutral effects a hydraulic lock of the pipes 60 and 61 and the connected motors 62 and 63.

Assuming the hydraulic pressure device diagrammatically indicated by the numeral 9 to be operating, then no hydraulic fluid can enter or leave the tubes 60 and 61, but if the intermittent gear has been moved to the position shown in Fig. IV then hydraulic energy will pass from 9 to the annular space 9a, thence past the shoulder of the valve to the annular space 9d and at the same time the annular space 9e will be in communication with the interior hollow of the valve 10 and thus in communication with the exhaust pipe 10a which will form an uninterrupted conduit to a reservoir, not shown, for the pumping device so that the fluid may be returned and used over again.

When energy is supplied to the annular passageway 9d it is effective through the tube 60 which connects to the hydraulic push motor 62 at the left hand side of Fig. V and when the intermittent gear is in reverse position to that shown in Fig. IV, then the other hydraulic push motor shown in section at 63 will be energized, while the first named motor 62 and its interior will be in direct communication with the exhaust pipe 10a and therefore with the reservoir and under a slight static pressure.

It will be noted that these push motors are single acting and the pistons such as 64 are of the trunk type and without wrist pins but have a socket 65 within which projects a piston rod 66 flexibly attached to the steering arm 67 by the pivot means 68; and it will be understood

that the other motor 62 is formed as a reverse duplicate. Movement of parts is less than the length of the socket 65.

Should the vehicle to which the steering gear as a whole is attached be steered solely by means of the steering shaft, to operate the reducing gear 50, (which may be of any type, kind or gear ratio) by hand, and which in turn influences the steering arm 67 backward or forward, to steer the vehicle, then if no hydraulic energy is available the piston 64, for example, will be easily forced back into its cylinder 63, the cylinder having a free communication with exhaust means to a reservoir and the piston 64 will remain where it is left by the piston rod 66 and the piston contained in the cylinder 62 under the same conditions will do the same thing, offering very slight parasitic drag to the movement of the steering arm 67 on one occasion and none thereafter.

It may also be noted that when the source of hydraulic energy is once more operative that either of the pistons such as 64 will immediately take up its position of contact with a piston rod such as 66 upon hydraulic energy being supplied through an appropriate conduit or pipe such as 60 or 61. 70 represents part of a vehicle frame and 71 is a shaft energized by the reducing gear 50. Reducing gears of most types, especially when made of sufficient ratio for a large heavy vehicle are practically irreversible, hence it will always be necessary for the steersman to furnish enough manual force to overcome the motors 20 and 21 and also enough additional force to move the reducing gear 50.

Returning now to Fig. 1 where the device is shown to be in neutral, it will be noted that the pinion 3 may be selectively moved by manual means in either direction and that upon being so moved it will move the valve 9c contained within the casing 9 to energize one or the other of the hydraulic motors 62 and 63 according to which direction the pinion is moved.

On the other hand if the driver releases his hold on the steering wheel or shaft the hydraulic mechanism will not reverse but will merely come to neutral owing to the virtues of the push motors 20 and 21 and their limited stroke.

It is of course clear that instead of the intermittent gear being pivoted it may be an intermittent rack with proper design of co-operating parts.

The device as illustrated, or its mechanical equivalent, is a strictly co-operative one to render assistance in the steering but not to carry it on when manual force, which it supplements, is withdrawn. The piping should be ample to eliminate any drag or obstruction to hand steering when the pump is not running.

Having thus fully disclosed the invention so that those skilled in the art to which it appertains may make and use it, what is claimed as new and desired to secure by Letters Patent, is,—

1. In an intermittent gear means for operation of a valve, a revoluble pinion, an intermittent gear adapted to mesh with said pinion and having a tooth thereon, movable plungers abutting said tooth to cushion ratcheting effect of the tooth and pinion and hydraulic motors adapted to remesh the intermittent gear with the pinion.

2. In an intermittent gear means for operation of a valve, a revoluble pinion, an intermittent gear adapted to mesh with said pinion and having a tooth thereon, movable plungers abutting said tooth to cushion ratcheting effect of the

tooth and pinion and spring means adapted to remesh the intermittent gear with the pinion.

3. In an intermittent gear device of the character described, a pinion, an intermeshing partial gear therefor, rounded teeth for both elements and hydraulic devices positioned to oppose movement of the partial gear and effective to prevent teeth on the partial gear and pinion from coming to rest with their center lines intersecting.

4. In an intermittent gear device of the character described, a pinion, an intermeshing partial gear therefor, rounded teeth for both elements and springs positioned to oppose movement of the partial gear and effective to prevent teeth on the partial gear and pinion from coming to rest with their center lines intersecting.

5. An intermittent gear device comprising in combination a revoluble pinion, an intermittent gear adapted to mesh with said pinion and having a tooth thereon, movable plungers abutting said tooth to cushion ratcheting effect of the tooth and pinion and hydraulic motors adapted to remesh the intermittent gear with the pinion.

6. An intermittent gear device comprising in combination a revoluble pinion, a partial gear adapted to mesh with said pinion and having a tooth thereon, movable plungers abutting said tooth to cushion ratcheting effect of the tooth and pinion and spring means adapted to remesh the partial gear with the pinion.

7. A valve control device comprising in combination a revoluble pinion, a partial gear adapted to mesh with said pinion and having a tooth thereon, movable plungers abutting said tooth, manual means for revolving the pinion in either direction and automatic means for remeshing the partial gear with the pinion upon cessation of manual force.

8. In a hydraulic control device, a hand wheel, a pinion movable with said hand wheel, a partial gear adapted to go into and out of mesh with said pinion, automatic means for remeshing the partial gear with the pinion at any tooth on the perimeter of said pinion and a valve controlled by said partial gear.

9. In a valve control device comprising manual means for rotating a shaft and a pinion made rigid therewith, intermittent gear valve control adapted to selectively move a valve by intermittent engagement with the pinion, a pair of hydraulic motors operatively connected to said intermittent gear and tending to restore the valve to an intermediate neutral position upon cessation of manual force to the shaft rotating means.

10. In a valve control device comprising a manually rotatable shaft, a pinion made rigid with said shaft, an intermittent gear adapted to engage the pinion during a fractional part of a revolution thereof, a valve selectively movable by the intermittent gear in either direction from an intermediate neutral position and the combination of a pair of hydraulic motors positioned to restore said valve to its neutral position upon cessation of manual force to said rotatable shaft.

11. A valve control for opposed hydraulic motors that is provided with an intermediate neutral position and working positions on both sides of said neutral position, manual means for selectively moving said valve from its neutral to either of its working positions and hydraulic motor means opposing said manual movement and tending to restore said valve to its neutral position upon cessation of manual force.

12. In a valve control device comprising a

manually rotatable shaft and a pinion rotatable
thereby, an intermittent gear adapted to be
moved in either direction by the pinion, valve
control means movable by the intermittent gear
5 from an intermediate neutral to an operative
position on either side of neutral and a pair of
hydraulic motors positioned to oppose movement
of the intermittent gear in either direction and
tending to restore the valve to neutral by a small
10 reverse movement of the intermittent gear, the

pinion and the manual device upon cessation of
manual force.

13. The combination according to claim 12 in
which the hydraulic motors are provided with
stroke limiting means restricting the automatic
5 return of the valve to its intermediate neutral
position.

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