June 1, 1943. K. R. HERMAN ET AL 2,320,727

HYDRAULIC SPEED CONTROL APPARATUS

Filed Jan. 22, 1940

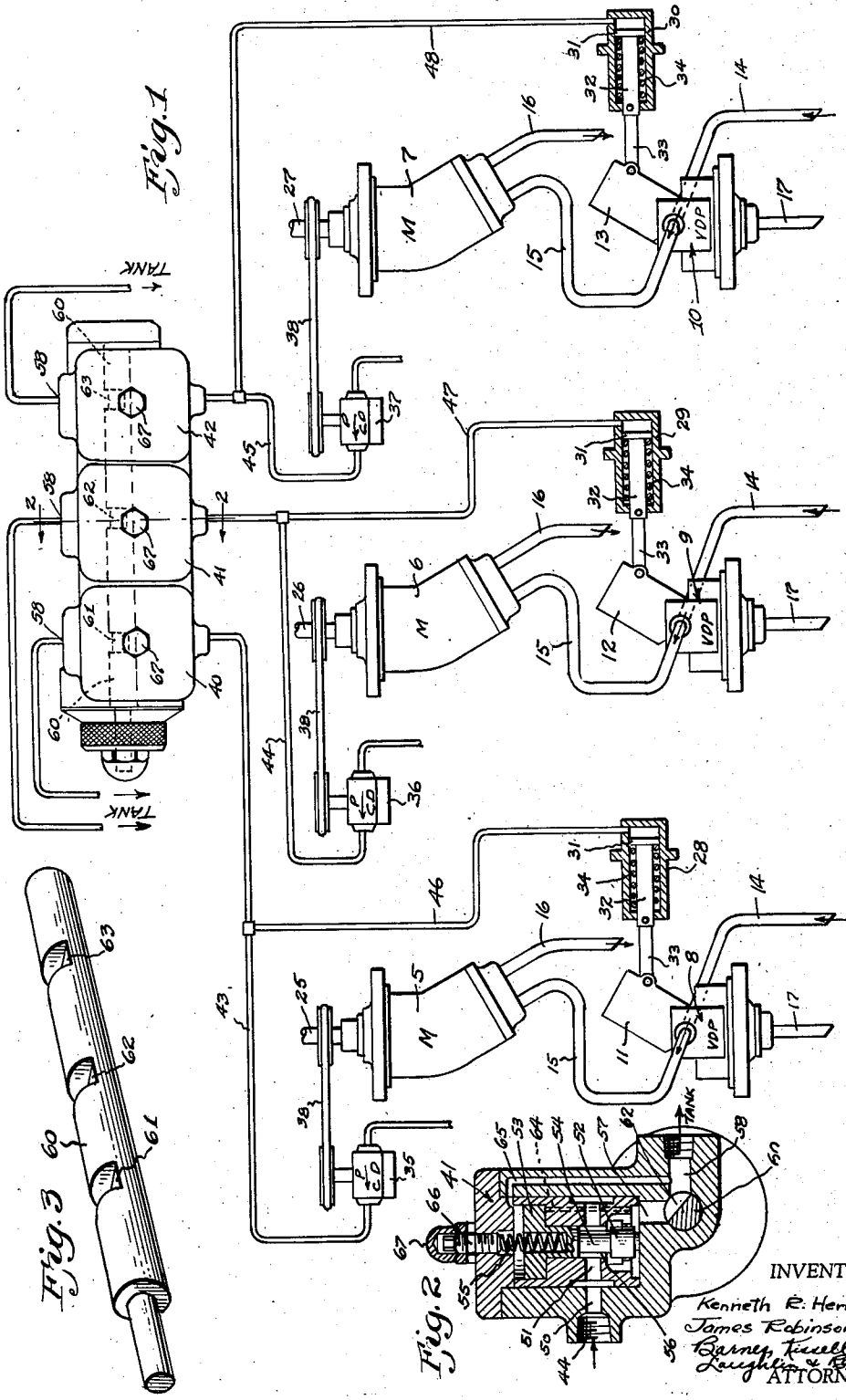


Fig. 1

Fig. 3

Fig. 2

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Patented June 1, 1943

2,320,727

UNITED STATES PATENT OFFICE

2,320,727

HYDRAULIC SPEED CONTROL APPARATUS

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Application January 22, 1940, Serial No. 315,000

2 Claims. (Cl. 60—97)

This invention relates to a hydraulic speed control apparatus.

This invention has particularly to do with that type of apparatus in which two or more rotary elements are to be controlled as to speed, the operation of the rotary elements being such that a certain relationship between the speeds of the two elements is necessary. For example, on machines for winding continuous material such as thread or paper, it is necessary to have a number of rollers, each of which will be rotated at the same speed. This material is usually such that a constant tension is required on the material being wound and any variation in the speed of the various rollers winding the same, results in either breakage of the continuous material or a considerable slackening as it is being wound. In previous hydraulic circuits adapted to control this type of winding machine, it has been customary to direct oil from one roller actuating motor into the next and so on so that theoretically there is a constant volume of oil passing through the motors and there will be a constant speed. It was expected, of course, that there would be an equal drop in pressure across each motor, if of equal size, and this drop was compensated for in the original setting of the motors. Experience has proved, however, that this type of device operated successfully only when new since as the wear on each motor increased, there would be a greater slippage and consequently, the motors would get out of synchronism. The drawback is that slippage errors are cumulative unless all motors have identical slip characteristics.

It is an object of the present invention to provide a hydraulic control in which the individual power shaft of each roller used in a winding machine, for example, will be rotated at a constant speed. It is a further object to provide a control device for a plurality of power motors which may be utilized to control the speed of each motor individually and to control simultaneously the speed of the motors so that a definite ratio or proportion may be maintained in the speeds of the motors.

Other objects and features of the invention having to do with details of construction and operation will be brought out in the following description and claims.

In the drawing:

Fig. 1 is a view of a hydraulic circuit which, for the most part, is presented diagrammatically for illustrating the features of the invention.

Fig. 2 is a section taken on the lines 2—2 of Fig. 1, showing the cross section of the speed control unit.

Fig. 3 is a perspective view of a throttle bar which is intended to be used for simultaneous control for the plurality of motors.

This invention is closely related to a copending application, Serial No. 175,075, filed November 17, 1937, issued July 28, 1942, as Patent No. 2,291,011, having to do with a speed governor. Referring to Fig. 1, three motors which are to have their speeds controlled, are indicated at 5, 6 and 7. These are constant displacement motors. Three variable displacement pumps 8, 9 and 10 are arranged to direct fluid under pressure respectively to the motors 5, 6 and 7. Each of these variable displacement pumps 8, 9 and 10 are provided with pump yokes or movable members 11, 12 and 13 respectively, these members being adapted to vary the displacement of the particular pump on which they are located. Each pump takes liquid from a tank pipe 14 and directs it to a pressure pipe 15 leading to a motor, each motor is also provided with a tank pipe 16. Each pump is provided with a drive shaft 17 which is driven by a suitable power source. The motors 5, 6 and 7 are provided, respectively, with operating shafts 25, 26 and 27.

Referring now to the apparatus which controls the speed of the operating shafts of the motors, it will be understood that the speed of each particular motor is dependent on the volume of liquid which is directed to the motor from the variable delivery pumps. The volume output of the variable delivery pumps 8, 9 and 10 is directly dependent on the position of the pump yokes 11, 12 and 13 which control the displacement of the pumps. This type of pump is well known. Cylinders 28, 29 and 30 are provided to control respectively the position of the pump yokes 11, 12 and 13. A piston 31 is disposed in each of the cylinders 28, 29 and 30, and each piston has a piston rod 32 extending through one end of the cylinder and connected to a respective pump yoke by a link 33. Springs 34 urge the piston 31 and the pump yokes 11, 12 and 13 to the right to the maximum volume position of the yokes as viewed in the drawing.

Constant delivery pumps 35, 36 and 37 are located to be driven respectively by motors 5, 6 and 7 through belts 38 and suitable pulleys attached to the output shafts 25, 26 and 27 and the drive shafts of the pumps 35, 36 and 37. Three flow control devices 40, 41 and 42 are arranged adjacently and connected respectively to output pipes 43, 44 and 45 of constant displacement pumps 35, 36 and 37. A conduit 46 connects the cylinder 28 with pipe 43 so that the piston 31 is subject to pressure from the pump 35. Similarly, pipe 44 is connected to cylinder 29 by a conduit 47 and pipe 45 is connected to cylinder 30 through a conduit 48.

A section through flow control valve 41 is shown in Fig. 2. Fluid from line 44 and pump 36 enters valve 41 at port 50 and passes into a chamber 51. In this chamber is a piston valve 52 which is

connected to a piston 53 through a rod 54. A spring 55 urges the piston 53 downward. The piston 52 is adapted to close a valve opening 56 when in its uppermost position. The valve opening 56 lies between the entrance chamber 51 and a chamber 57. Between the chamber 57 and an outlet port 58 to the tank is a throttle valve 60 shown in section. This valve 60 is shown in Fig. 3 and consists of a cylindrical bar adapted to pass through flow control units 40, 41 and 42. The bar is identically recessed at three points 61, 62 and 63 so that a passageway may be provided between chamber 57 and outlet port 58. A turning of the valve bar 60 will close the throttle opening between chamber 57 and port 58 as will be seen from Fig. 2. The underside of piston 53 is connected to chamber 57 through a passageway 64 shown in dotted lines in Fig. 2. The outlet port 58 is connected to the top of piston 53 through a passageway 65. The operation of this flow control device is identical with the valve described in copending application, Serial No. 543,908, filed June 12, 1931, now abandoned. The valve is so designed that there will be a constant pressure drop across the throttle valve 60, the amount of this drop being controlled by the adjustment of spring 55. An adjustment bolt 66 for spring 55 is locked in position by a cap 67. The throttle action which occurs at valve 60 causes a pressure in chamber 57 which acts on the bottom of pistons 52 and 53 to exert a lifting force on the valve piston. When this force becomes sufficient to overcome the spring 55, the valve opening 56 will be closed thus cutting down the pressure in chamber 57. In this way an equilibrium is reached which results in a constant pressure in chambers 51 and 57.

Referring to the circuit shown in Fig. 1, when pumps 8, 9 and 10 are operating to direct pressure to lines 15 and to motors 5, 6 and 7, respectively, there will be a discharge from pumps 35, 36 and 37. Since each of the flow control outlets 58 are connected to the tank, there will be a constant pressure maintained in pipes 43, 44 and 45, this pressure being dependent on the setting of spring 55 in each of the flow control units. Through conduits 46, 47 and 48 the pressure in pipes 43, 44 and 45 will be exerted on pistons 31 in cylinders 28, 29 and 30. Depending on the amount of this pressure, the pistons 31 will be shifted to the left against the springs 34 so that the volume output of the variable displacement pumps 8, 9 and 10 will be maintained at a definite point. If the speed of shafts 25, 26 and 27 is desired to be identical, the spring 55 in each flow control unit 40, 41 and 42 may be adjusted until the speed of these operating shafts is equal. From this point on, the speed of each of the shafts may be changed simultaneously by moving the bar 60. This will change the throttle opening between the chamber 57 and the outlet port 58 and consequently change the pressure which will exist in conduits 43 to 45 and conduits 46 to 48. Displacement of the pump yokes 11, 12 and 13 will thus be changed and the speed of the system will be increased or reduced depending on the movement of the bar 60.

In some cases in the winding of continuous material, it is desirable to stretch the material and this may be accomplished by increasing the speed of one of the last rollers on which the continuous material is being wound. In the present circuit this may be done by changing the setting of one of the springs 55 in the flow control unit. After this is done the operating shafts 25, 26 and 27 would not all be operating at the same speeds but their speeds can be proportionately changed by a shifting of the bar 60 as previously described. Similarly, each of the shafts 25, 26 and 27 could have a different speed and yet the speed of all three could be changed simultaneously, maintaining the ratio established, by a shifting of the bar 60.

We claim:

1. In a hydraulic power system, a plurality of fixed displacement motors, a work shaft on each of said motors, a plurality of variable delivery pumps respectively hydraulically connected with the motors, a movable part on each of said pumps for controlling the delivery of pressure fluid to said motors, a plurality of control pumps, each of said work shafts respectively driving a control pump, a group of metering valves respectively connected to the pressure outlets of the control pumps, each of said valves having a throttle valve opening and a pressure responsive member for controlling the pressure drop across said opening, means for regulating said pressure responsive member to control flow through said throttle valve opening, a member common to each of said metering valves located in said throttle valve opening for adjusting the size thereof and flow therethrough, a plurality of pressure responsive means respectively connected hydraulically to the control pump outlets and each operably connected respectively with the movable part of a variable delivery pump, and means urging each said movable part to a maximum volume position, whereby pressure liquid from the control pumps will tend to urge said movable parts to a lower volume position and the setting of said metering valves will control the pressure acting on the pressure responsive means.

2. In a variable speed power transmission system for driving a plurality of load devices at controlled relative speeds, a plurality of variable speed transmissions, each connected respectively to drive a load device, each transmission having a pressure responsive movable member for varying the output speed of the transmission, a group of metering valves, a plurality of control pumps, each transmission driving a respective control pump, each control pump delivering liquid to a respective metering valve at a volumetric rate proportional to the output speed of its respective transmission and also delivering liquid to a respective movable member, each of said valves having a throttle valve opening and a pressure responsive member for controlling the pressure drop across said opening, means for regulating said pressure responsive member to control flow through said throttle valve opening, a member common to each of said metering valves located in said throttle valve opening for adjusting the size thereof and flow therethrough, means urging each movable member to a maximum volume position, whereby pressure liquid from the control pumps will tend to urge its respective movable member to a lower volume position and the setting of said metering valves will determine the pressure acting on its respective movable member.

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