Oct. 5, 1943. F. T. HARRINGTON 2,331,026

POWER TRANSMISSION

Filed July 5, 1940

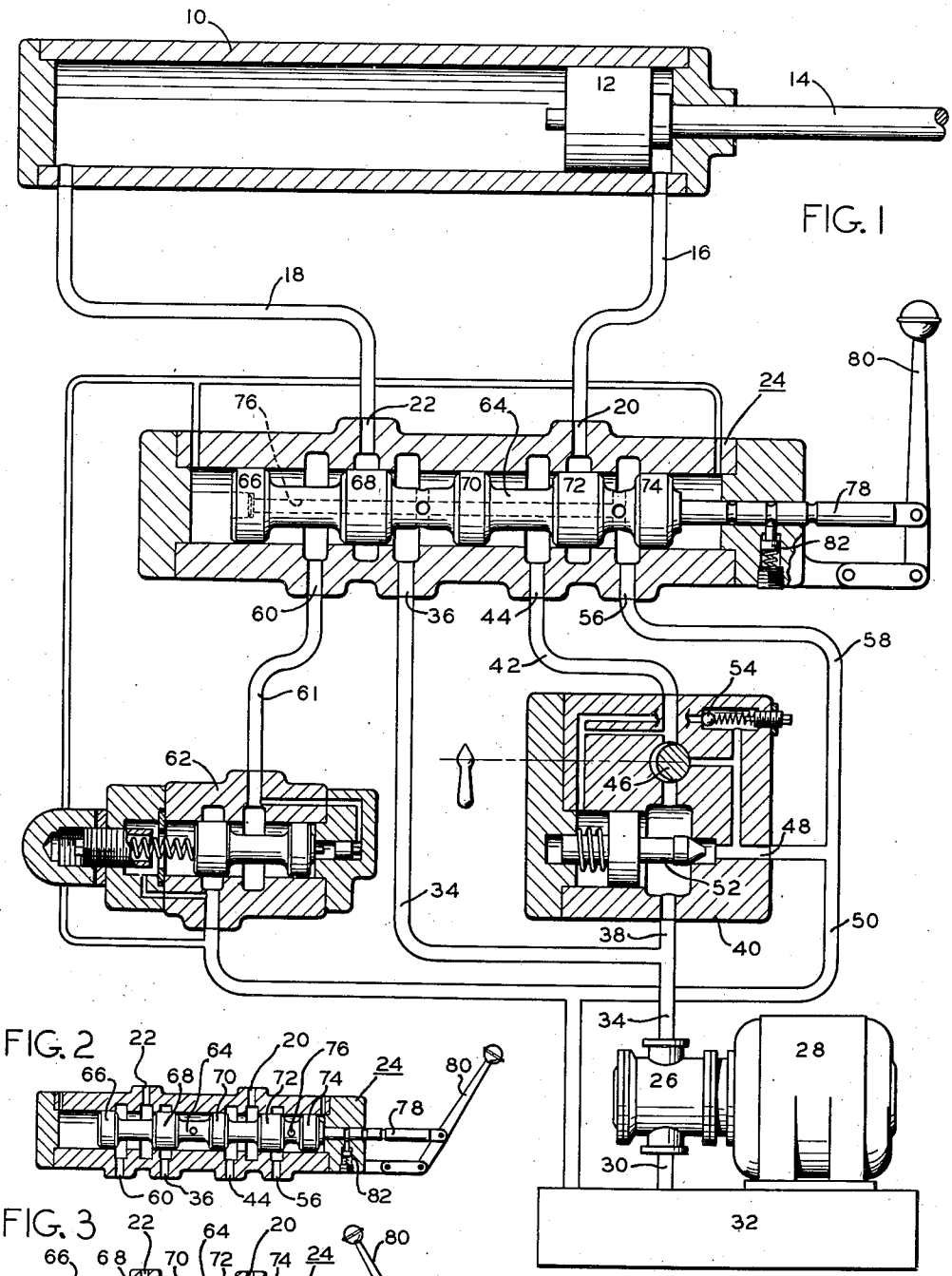


FIG. 1

FIG. 2

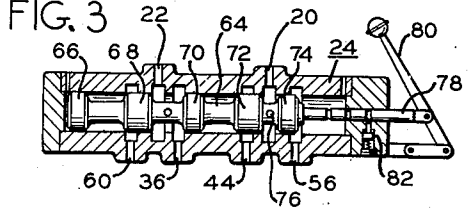


FIG. 3

INVENTOR
FERRIS T. HARRINGTON

BY Ralph L. Tweedale

ATTORNEY

Patented Oct. 5, 1943

2,331,026

UNITED STATES PATENT OFFICE

2,331,026

POWER TRANSMISSION

Ferris T. Harrington, Detroit, Mich., assignor to Vickers Incorporated, Detroit, Mich., a corporation of Michigan

Application July 5, 1940, Serial No. 343,969

2 Claims. (Cl. 60—52)

This invention relates to power transmissions, particularly to those of the type comprising two or more fluid pressure energy translating devices one of which may function as a pump and another as a fluid motor.

The invention is more particularly concerned with a power transmission system incorporating a differential-area cylinder-and-piston motor together with control means for directing fluid to the opposite ends of the motor to produce feed and rapid-traverse movement with highest efficiency. In many classes of machine tools, for examples, shapers, planers, and broaching machines, it is desirable to utilize a feed movement in one direction and a rapid-traverse movement in the other direction. At the same time it is likewise desirable to have the feeding movement take place in that direction in which the piston rod is in tension. This means that during the feeding movement, when the work to be done is usually the heaviest, the oil is fed into the small end of the cylinder where a given volume of fluid will produce a greater piston movement than in the large end. This drawback has heretofore been overcome by connecting both ends of the cylinder together during the return stroke so that the fluid discharged from the small end is added to the volume supplied to the large end. Such a system, however, does not provide independent control of the speed of movement in one direction as compared to that in the other direction where a fixed displacement pump is utilized as the source of supply.

Another method of providing for rapid-traverse and feed rates with a fixed displacement pump utilizes a flow-rate controlling mechanism for providing a reduced rate of fluid supply during the feeding movement, the excess volume delivered by the pump being by-passed without doing effective work. Systems of this character permit of ready control of the feeding speed without affecting the rapid return speed but have not heretofore utilized a differential cylinder action.

It is an object of the present invention to provide an improved power transmission system for operating a differential piston-and-cylinder motor in which the advantages of both methods of obtaining feed and rapid-traverse movement are utilized.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred form of the present invention is clearly shown.

In the drawing:

Figure 1 is a diagrammatic view of a power transmission system incorporating a preferred form of the present invention.

Figure 2 is a sectional view of the valve mechanism shown in Figure 1 illustrating the parts in a different position.

Figure 3 is a view corresponding to Figure 2 showing the parts in a third position.

Referring now to Figure 1, there is illustrated a differential-area piston-and-cylinder motor comprising a cylinder 10 having a piston 12 therein provided with a rod 14 projecting from one end of the cylinder. Fluid conduits 16 and 18 connect between the small and large ends, respectively, of cylinder 10, and a pair of cylinder ports 20 and 22 provided in a directional control valve designated 24.

For the purpose of supplying fluid to operate the motor 10 a fixed displacement pump 26 is provided and is driven by a suitable prime mover such as an electric motor 28. A suction conduit 30 serves to supply oil from a tank 32 to the inlet of the pump 26. The pump 26 has its outlet connected with a supply conduit 34 which leads to one pressure port 36 in the valve 24.

A branch conduit 38 connects with the conduit 34 and extends to a combined flow-control and relief valve 40. The latter may be similar in construction to that illustrated in the patent to Harry F. Vickers, No. 2,102,865. This valve provides a through connection between conduit 38 and a conduit 42 which extends to a second inlet port 44 of the valve 24, this path being restricted, however, in varying degree, depending upon the adjustment of a manually controlled throttle 46. The valve 40 is provided with an overflow port 48 which connects to the tank 32 by a conduit 50.

A balanced piston valve 52 is automatically controlled to regulate the quantity overflowing through the port 48 to the amount necessary to maintain a predetermined pressure drop across the orifice 46. In addition, a pilot relief valve 54 provides for a maximum pressure limit on the oil in conduits 38 and 42.

The valve 24 is provided additionally with a return port 56 which is freely open to tank through the branch conduit 58 connected with the conduit 50. It is also provided with a second return port 60 which leads to the tank through a back-pressure valve 62. The latter may be similar in construction to that illustrated in the patent to Kenneth R. Herman, No. 2,200,824, and serves to maintain a predetermined back

pressure on oil returning from port 60 to the tank 32.

For the purpose of identifying the various ports in the valve 24 they are hereafter designated in the claims as follows: Port 36 is referred to as a first inlet port, while port 44 is referred to as a second inlet port. In a similar manner the port 56 is referred to as a first outlet port, and the port 60 is referred to as a second outlet port.

The valve 24 is provided with a shiftable spool 64 having five lands 66, 68, 70, 72 and 74. It is also provided with a central bore 76 which communicates from the space between lands 68 and 70 to the space between lands 72 and 74. The spool is provided with a stem 78 whereby the spool may be shifted to any one of three effective operating positions by means of any suitable operator such as the manual lever 80. A spring-pressed detent 82 may be provided for retaining the valve frictionally in either one of its three effective positions.

In operation, starting with the parts in the position illustrated in Figure 1, and with the pump 26 and motor 28 operating, it will be seen that oil will be withdrawn from the tank through suction conduit 30 and delivered through conduit 34 to port 36 of valve 24. Port 36 is in communication with port 56 through the central bore 76 so that the whole pump delivery is effectively bypassed back to the tank through conduits 58 and 50, this path imposing negligible resistance so that the pump is effectively unloaded. In this position of the spool 64, both of the cylinder ports 20 and 22 are blocked by the lands 72 and 68, respectively.

In order to start the piston 12 moving to the left on a feeding stroke, the valve spool 64 may be shifted to the right into the position illustrated in Figure 2. The land 68 now blocks the supply port 36, while the supply port 44 is connected to the cylinder port 20. Oil is accordingly delivered at a rate determined by the setting of throttle 46 to the cylinder conduit 16 and the small end of cylinder 10. Piston 12 accordingly moves to the left discharging oil from the large end of the cylinder through conduit 18, port 22, port 60, and conduit 61 and valve 62 to the tank. It will thus be seen that the piston 12 will accordingly move to the left at a predetermined rate, the back-pressure valve 62 preventing any jerky operation in case the load should rapidly fluctuate.

When it is desired to return the piston 12 to the right, the valve spool 64 may be shifted completely to its lefthand position as illustrated in Figure 3. In this position the second supply port 44 is blocked by the land 72. The first supply port 36 is opened to the cylinder port 22 so that the full pump delivery is freely delivered through conduit 18 to the large end of cylinder 10. The piston 12 accordingly moves to the right discharging oil from the small end through conduit 16 to port 20. The latter is in communication with ports 36 and 22 through the central bore 76 so that this volume of oil joins with the pump delivery in propelling the piston 12 to the right.

It will be seen that during this righthand stroke the speed is determined by the volumetric capacity of the pump 26 in relation to the difference in area between the large and small ends of the cylinder 10. This speed relationship is independent of adjustment at the throttle 46. This feature is particularly desirable with machine tools such as planers and shapers where varying requirements of the work necessitate widely different speeds on the feed part of the cycle. On the return stroke, however, which is always an idle stroke, the maximum possible speed is desirable. Thus, the present circuit provides for producing the rapid return stroke by utilizing the full volume of the pump 26 over the smallest net area at the motor which its pressure rating will permit.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A hydraulic power transmission system comprising in combination a differential-area piston-and-cylinder motor, a pump for supplying fluid to the motor, a three-position, six-port valve for controlling the flow of fluid between the pump and motor, a direct connection between the pump and a first inlet port of the valve, a connection including a flow-rate controller between the pump and a second inlet port of the valve, an open exhaust line from a first outlet port of the valve, a restricted exhaust line from a second outlet port of the valve, connections leading respectively from the ends of the cylinder to a pair of motor ports of the valve, a movable valve member having lands and recesses to selectively place said ports in communication with one another, said ports, lands and recesses being arranged to provide a rate-controlled forward motor stroke by connecting the second inlet port with the small-end motor port and the second outlet port with the large-end motor port, a differential rapid return by connecting the first inlet port with both motor ports and blocking the second inlet port, and a stop by connecting the first inlet port with the first outlet port.

2. A hydraulic power transmission system comprising in combination a differential-area piston-and-cylinder motor, a pump for supplying fluid to the motor, a three-position, six-port valve for controlling the flow of fluid between the pump and motor, a direct connection between the pump and a first inlet port of the valve, a connection including a flow-rate controller between the pump and a second inlet port of the valve, an open exhaust line from a first outlet port of the valve, a restricted exhaust line from a second outlet port of the valve, connections leading respectively from the ends of the cylinder to a pair of motor ports of the valve, a movable valve member having lands and recesses to selectively place said ports in communication with one another, said ports, lands and recesses being arranged to provide a rate-controlled forward motor stroke by connecting the second inlet port with the small-end motor port and the second outlet port with the large-end motor port, a differential rapid return by connecting the first inlet port with both motor ports and blocking the second inlet port, and a stop by connecting the first inlet port with the first outlet port, said movable member having an internal connection between two otherwise separated recesses and serving to conduct operating fluid in at least two positions of the valve.

FERRIS T. HARRINGTON.