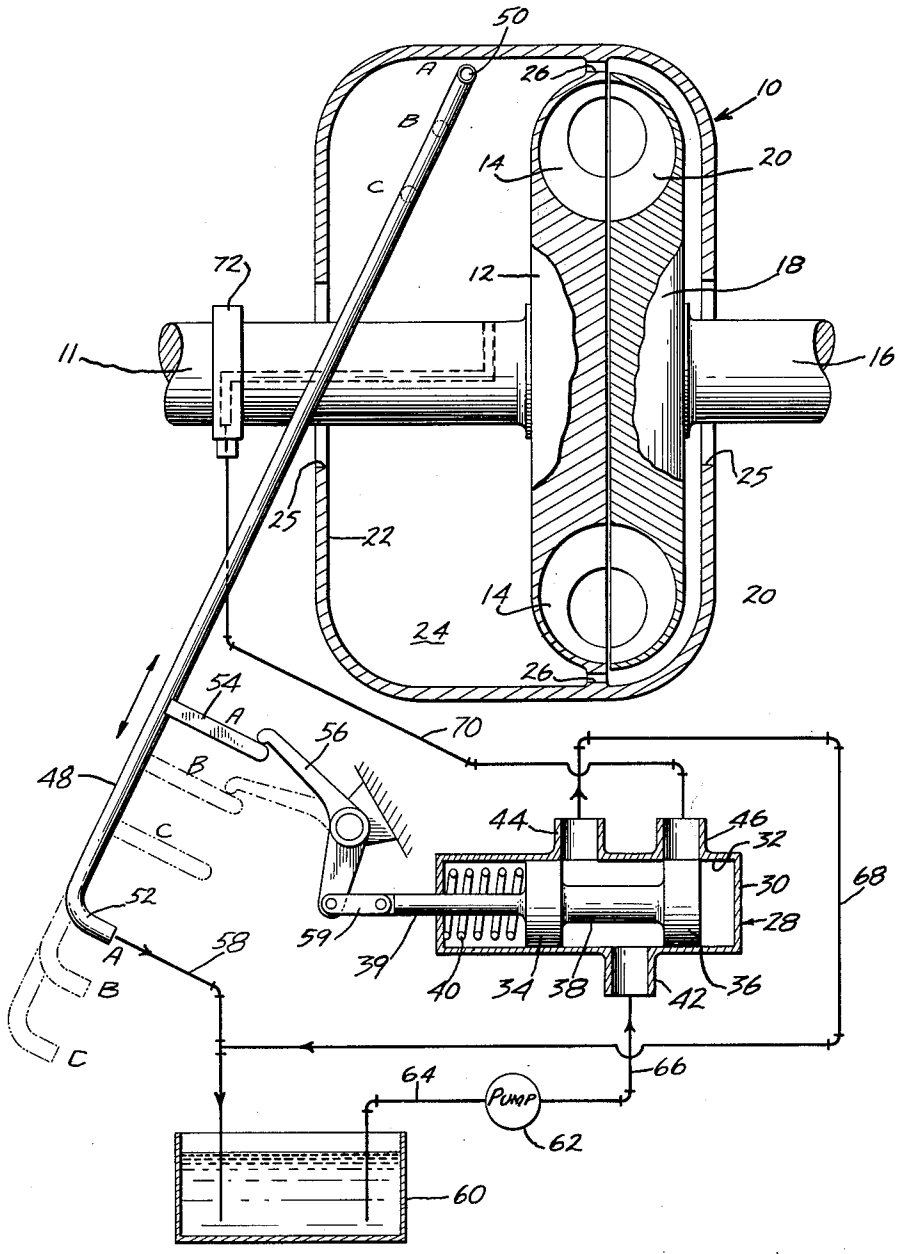
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HYDRAULIC TRANSMISSIONS

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INVENTOR.
PETER O. TAUSON

BY Arnold and Royalance
ATTORNEYS

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HYDRAULIC TRANSMISSIONS

Peter O. Tauson, Bradfordwoods, Pa., assignor to Armco Steel Corporation, Middletown, Ohio, a corporation of Ohio

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This invention relates to hydraulic transmissions and, more particularly, to control devices for regulating the amount of power transmitted in a hydraulic transmission of the type wherein power is transmitted by the kinetic energy of a liquid discharged from a driving impeller against the vanes of a turbine runner mounted on an output shaft.

The amount of power transmitted in a hydraulic transmission depends upon many factors such as the coupling diameter, the speed of rotation, the density of the circulating fluid, the amount of slip and the amount of fluid circulated. In some installations, many of these factors are fixed so that the amount of power transmitted can be conveniently regulated by controlling the amount of fluid circulating through the working chamber. Accordingly, one of the objects of the invention is to provide new and improved means for controlling the amount of power transmitted in a hydraulic coupling.

In some hydraulic coupling systems, the coupling is provided with a reservoir which rotates with the driving impeller so that the working fluid hugs the inner wall of the reservoir due to centrifugal action. A scoop tube extends into the reservoir and is adjustable in position to vary the level of fluid in the reservoir and hence, the amount of power transmitted. The scoop tube picks up liquid in the reservoir and delivers it to a sump. A pump transmits fluid from the sump back to the hydraulic coupling for circulation through the working chamber. When such a coupling is designed to transmit large amounts of fluid, the pump has a relatively large capacity. It has been found that with a high capacity pump it is difficult, if not impossible, to control the transmission of small amounts of power at high slips, as required by certain types of driven apparatus such as fan drives, because with the scoop tube all the way in, there still remains sufficient liquid in the reservoir to transmit considerable amounts of power. Accordingly, another object of this invention is to provide means for controlling a hydraulic coupling of the above type with improved means for controlling the transmission of small amounts of power.

Another object is to provide means for bypassing fluid from the pump directly into the sump.

Still another object is to control a hydraulic coupling, operating at high slippage and low power transmission, by bypassing circulating fluid from the pump directly into the sump.

A further object is to provide a scoop tube which actuates a bypass valve to proportionately divide the fluid delivered by the pump to the sump and to the hydraulic coupling.

In order that the manner in which these and other objects are attained in accordance with the invention can be understood in detail, reference is had to the accompanying drawing, which forms a part of this specification, and which is a somewhat schematic view of a hydraulic coupling embodying the invention.

Referring now more particularly to the drawing, there is shown a hydraulic coupling, indicated generally by reference numeral 10, of the type comprising a rotatable input shaft 11 rigidly connected at its inner end to a driving impeller 12 provided with a plurality of radial vanes 14. An output shaft 16 is connected at its inner end to a driven turbine runner 18 provided with a plurality of radial vanes 20 disposed in operative position relative to

vanes 14 to form a working chamber through which working fluid is circulated to transmit power from input shaft 11 to output shaft 16.

An annular casing 22, having a somewhat U-shaped radial cross-section, is rigidly connected to the outer periphery of impeller 12 for rotation therewith and forms reservoir 24. Casing 22 is provided with a pair of apertures 25 through which shafts 11 and 16 pass. A plurality of leak orifices 26 are spaced about the periphery of impeller 12 so that fluid can leak, at a predetermined rate, from the working chamber into reservoir 24 where, due to centrifugal action, it clings to the inside of the casing 22.

A bypass valve 28 is provided with a cylindrical casing 30 having a bore 32 in which are disposed a pair of axially spaced cylindrical valve members 34 and 36. An axially extending rod 38 interconnects valve members 34 and has an extension 39 which passes through an aperture in the end of casing 30. A helical compression spring 40 is disposed between the end wall of casing 30 and valve member 34 for biasing valve members 34 and 36 to the right, as viewed in the drawing, the spring being coaxial with extension 39.

Valve casing 30 is provided with an inlet 42 and a pair of outlets 44 and 46. The thicknesses of valve members 34 and 36 are equal to the diameters of outlets 44 and 46 respectively, so that the valve members can shut off or prevent fluid from flowing through the outlets. Valve members 34 and 36 are axially spaced a distance greater than the spacing between outlets 44 and 46 so that only one outlet at a time can be completely closed. Thus, as shown in the drawing, valve members 34 and 36 are positioned so that fluid can flow into inlet 42 and out of outlet 44, outlet 46 being covered so that no fluid can pass therethrough. The valve members are movable to the right as viewed in the drawing, under the bias of spring 40 to a limiting position wherein valve member 36 engages the right end wall of casing 30 and unblocks outlet 46, and valve member 34 closes outlet 44 so that fluid can flow from inlet 42 only to outlet 46. Likewise, the valve members can be positioned at intermediate positions wherein fluid can flow into inlet 42 and out of both outlets 44 and 46 in amounts proportional to the position of the valve members.

A scoop tube 48 is provided at one end with a scoop 50 disposed in reservoir 24 for scooping fluid therefrom and delivering such fluid to outlet 52 of scoop tube 48. The scoop tube 48 is reciprocable along the axis thereof, in the direction shown by the arrows in the drawing. A projection 54 extends from scoop tube 48 and is adapted to engage the free end of a bell crank lever 56 having its other end connected to extension 39 via a link 59. Spring 40 is thereby effective to bias lever 56 in a counterclockwise direction, as viewed in the drawing, towards engagement with projection 54.

Outlet 52 is connected to conduit 58 which empties into a sump 60 so that fluid picked up by the scoop tube from reservoir 24 flows into the sump. The inlet of the pump 62 is connected by a conduit 64 to sump 60. The outlet of pump 62 is connected by a conduit 66 to inlet 42 of valve 28 so that the pump delivers fluid from sump 60 to the valve.

Outlet 44 of valve 28 is connected to one end of a conduit 68 having its other end connected to conduit 58 so that fluid flowing from outlet 44 passes through conduit 68 and flows into sump 60. If the pressure of fluid delivered from conduit 68 into conduit 58 is higher than the pressure of fluid delivered from the outlet 52, suitable check valve means can be provided to prevent fluid from flowing in the reverse direction through scoop tube 48.

Outlet 46 is connected to one end of a conduit 70 hav-

ing the other end connected to a suitable connector 72 for delivering fluid from outlet 46 to the working chamber of the hydraulic coupling 10.

When the hydraulic coupling is in operation, the amount of fluid flowing through the working chamber and the amount of power transmitted from input shaft 11 to output shaft 16 is proportional to the radial depth of fluid within reservoir 24. The radial depth is controlled by the position of scoop tube 48.

When it is desired to transmit a larger amount of power, scoop tube 48 is moved away from the inner wall of casing 22 to increase the radial depths of fluid within reservoir 24. When the scoop tube 48 is moved in this direction, spring 40 moves valve members 34 and 36 to the right and rotates lever 56 in a clockwise direction to maintain it in engagement with projection 54 until such time as valve members 34 and 36 reach their limiting position wherein fluid flows only through outlet 46, whereafter projection 54 separates from lever 56. Thus, when scoop tube 48 is in position B, lever 56 still engages projection 54 and the valve members are in their limiting position wherein fluid flows only through outlet 46. When scoop tube 48 moves beyond position B to a position such as that indicated by C, projection 54 separates from lever 56.

When scoop tube 48 is positioned between positions A and B, valve members 34 and 36 partially close both of outlets 44 and 46 so that fluid flowing from pump 62 flows proportionately to both sump 60 and hydraulic coupling 10 in amounts depending upon the positions of the valve members.

Recapitulating, a movable scoop tube 48 actuates a bypass valve 28 to control the amount of fluid bypassed from a pump 62 to a sump 60 and thereby regulate the amount of power transmitted through hydraulic coupling 10 over a minimum range of values. When pump 62 is operated at minimum capacity and low power is being transmitted by hydraulic coupling 10, all the fluid from pump 62 is bypassed around the coupling.

While in the embodiment shown the bypass valve is actuated by the scoop tube, it will be apparent that the bypass valve can be actuated manually or otherwise to effect the desired power regulation. It will also be obvious to those skilled in the art that many changes can be made in the details and arrangement of parts without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. In a hydraulic coupling system having a fluid reservoir in which the level of fluid is proportional to the power being transmitted by the coupling, the combination of a sump, a scoop tube operatively disposed for scooping fluid within the reservoir and delivering such fluid to said sump, said scoop tube being movable from a first position to empty said coupling and to a second position in which said coupling is filled, via a plurality of intermediate positions in which said coupling is partially filled, a pump for delivering fluid from the sump to said coupling, a valve connected between said pump and said coupling, said valve having a bypass outlet operably connected for delivering fluid from said pump to said sump to bypass

said coupling and another outlet operably connected for delivering fluid from said pump to said coupling, said scoop tube being operably connected for actuating said valve to substantially open said bypass outlet and close said other outlet when said scoop tube is in said first position and to substantially close said bypass outlet and open said other outlet when said scoop tube is in said second position, and to partially open and partially close each of said outlets when said scoop tube is in any of said various intermediate positions, whereby said scoop tube and valve are effective to control the level of fluid in said coupling.

2. A hydraulic coupling in accordance with claim 1 in which said fluid reservoir is a cylindrical casing rotatable with said coupling; and said scoop tube, in said first position scoops fluid from adjacent an inner peripheral wall of said casing, and in said second position scoops fluid at a location spaced substantially radially inwardly of said peripheral wall, and said intermediate positions of said scoop tube are between said inner peripheral wall and said location spaced therefrom.

3. In a hydraulic coupling system including a fluid coupling, the combination comprising, a sump; a fluid reservoir associated with said coupling; the level of fluid in said coupling being proportional to the power transmitted by the coupling, a pump for delivering fluid from said sump to said coupling, the pump being subject to pumping relatively large quantities of fluid when relatively low amounts of power are being transmitted by the coupling; a scoop tube disposed for scooping fluid from said reservoir and delivering such fluid to said sump, said scoop tube being moveable from a first position to empty said coupling to a second position in which said coupling is filled, and to a plurality of intermediate positions in which said coupling is partially filled; a valve connected between said pump and said coupling, said valve having: an inlet to receive the output of said pump, a bypass outlet operably connected to deliver fluid from said pump to said sump, and another outlet to deliver fluid from said pump to said coupling; said scoop tube being operably connected to actuate said valve to substantially open said bypass outlet and close said other outlet when said scoop tube is in said first position and to substantially close said bypass outlet and open said other outlet when said scoop tube is in said second position, and to partially open and partially close each of said outlets when said scoop tube is in any of said intermediate positions to meter a predetermined amount of fluid to said coupling and to bypass directly to said sump the remaining fluid supplied to said valve by said pump, whereby said scoop tube and valve are effective to control the level of fluid in said coupling.

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