July 23, 1963 C. L. SCHWAB 3,098,550

DOUBLE ACTING CLUTCH

Filed Oct. 12, 1961 2 Sheets-Sheet 1

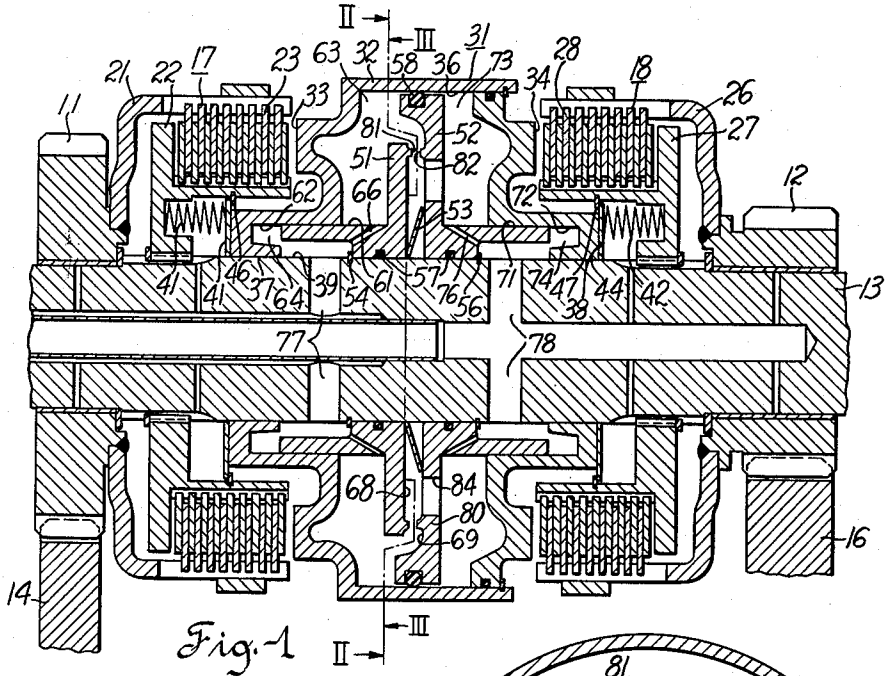


Fig. 1

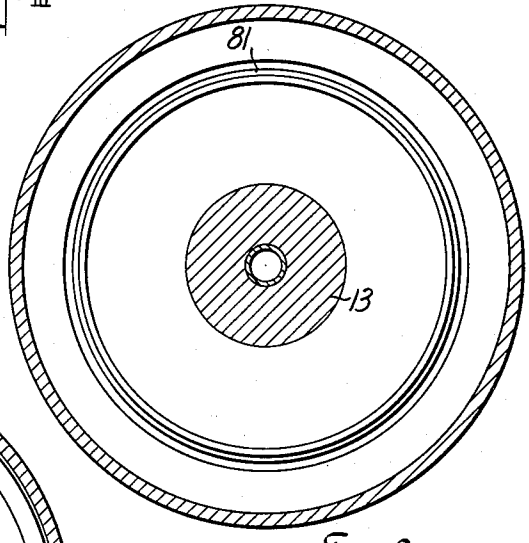


Fig. 3

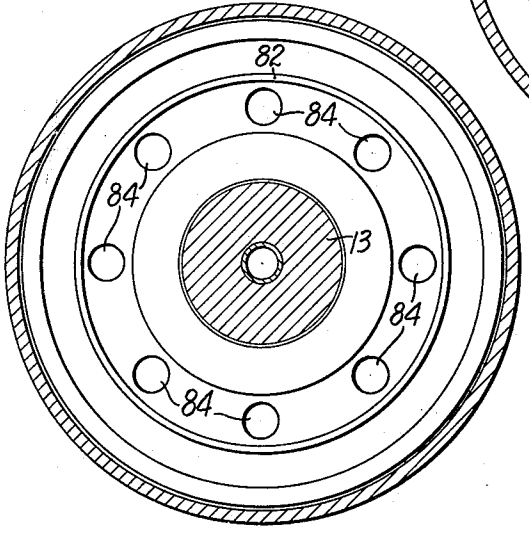


Fig. 2

Inventor

Charles L. Schwab

July 23, 1963 C. L. SCHWAB 3,098,550

DOUBLE ACTING CLUTCH

Filed Oct. 12, 1961 2 Sheets-Sheet 2

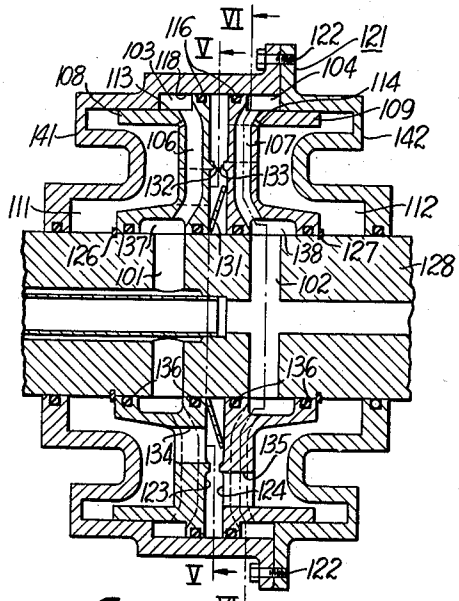


Fig. 4

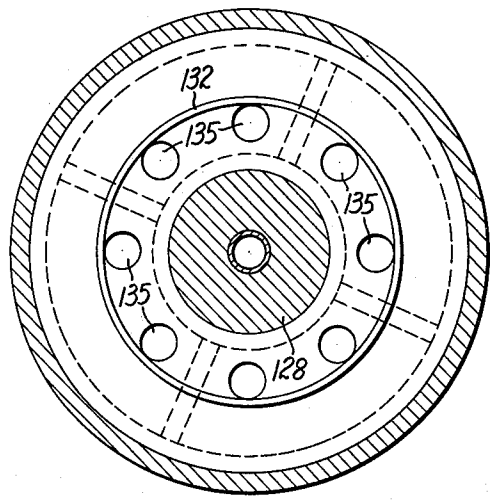


Fig. 5

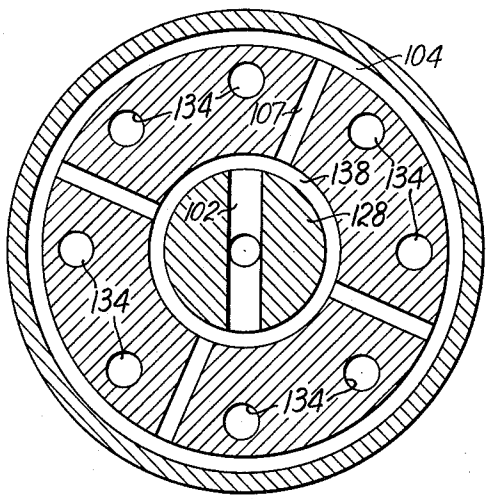


Fig. 6

Inventor

Charles L. Schwab

United States Patent Office 3,098,550 Patented July 23, 1963

3,098,550

DOUBLE ACTING CLUTCH

Charles L. Schwab, Wauwatosa, Wis., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Filed Oct. 12, 1961, Ser. No. 144,709
11 Claims. (Cl. 192—87)

This invention relates to a double acting hydraulic actuator for a pair of transmission clutches, and particularly to a double acting hydraulic actuator of the fluid transfer type.

Heretofore, various structures have been suggested for controlling the fluid transfer between pressure chambers of double acting hydraulic actuators. For instance, copending patent application of Frederick A. Schick and Charles L. Schwab, Serial No. 140,758, shows a double acting hydraulic actuator in which a movable reaction member is utilized as a valve member to control fluid transfer. Previously it has also been suggested that a double acting hydraulic actuator of the fluid transfer type be provided with an axially fixed reaction member and a pair of fluid pressure actuated chamber dividers for controlling fluid transfer through the reaction member.

It is an object of this invention to provide an improved double acting hydraulic actuator which has fewer parts, is less costly to manufacture, is less complicated and gives better service than actuators heretofore suggested.

It is a further object of this invention to provide a double acting hydraulic actuator of the fluid transfer type wherein fluid transfer is controlled by axial movement of a pair of reaction members which are mounted for limited axial movement.

It is a further object of this invention to provide a pair of reaction members in place of the usual single reaction member which are resiliently biased away from one another and which move into contact to interrupt fluid transfer when one of a pair of chambers of the actuator are subjected to a predetermined pressure.

It is a further object of this invention to provide a double acting hydraulic actuator of the fluid transfer type wherein a pair of radially inner chambers and a pair of radially outer chambers are provided and fluid transfer occurs between one of the pair of chambers through a passageway defined in part by the axially confronting walls of a pair of axially spaced and axially shiftable reaction members.

These and other objects and advantages of this invention will be apparent to those familiar with the art when the following description is read in conjunction with the drawings in which:

FIG. 1 is a section through a constant mesh transmission showing an actuator of this invention;

FIG. 2 is a section taken along the line II—II of FIG. 1;

FIG. 3 is a section taken along the line III—III of FIG. 1;

FIG. 4 is a section view of a second embodiment of this invention;

FIG. 5 is a section taken along the line V—V of FIG. 4; and

FIG. 6 is a section view taken along the line VI—VI of FIG. 4.

Referring to FIGS. 1, 2 and 3, a pair of axially spaced spur gears **11**, **12** are rotatably mounted on a transmission shaft **13** and are in mesh with gears **14**, **16** carried by another shaft of the transmission not shown. A pair of axially spaced transmission clutches **17**, **18** are employed to selectively connect gears **11** and **12** to the transmission shaft **13**. Clutch **17** includes an outer drum **21** which is welded to gear **11**, an inner drum **22** which is splined to the shaft **13**, and a clutch pack **23** made up of

a plurality of clutch disks of conventional construction. Transmission clutch **18** likewise includes an outer drum **26** welded to gear **12**, an inner drum **27** splined to the shaft **13** and a clutch pack **28**.

A double acting hydraulic actuator **31** is operatively interposed between the transmission clutches **17** and **18**. The actuator **31** includes a cylindrical piston **32** which has axially opposite ends **33**, **34** in confronting relation to the clutch packs **23**, **28**, respectively. The cylindrical piston **32** has a radially inward facing cylindrical surface **36** and a pair of cylindrical surfaces **37**, **38** of smaller diameter at its opposite ends in fluid sealing engagement with the outer cylindrical surface **39** of shaft **13**. Centering means are provided for maintaining the cylindrical piston **32** in an intermediate position in which it is illustrated in FIG. 1. As shown, the centering means includes springs **41**, **42**, washers **43**, **44** and snap rings **46**, **47**.

In place of the usual axially fixed reaction member, I provide two axially movable reaction members **51**, **52** which are resiliently urged by biasing means in the form of a Belleville washer **53** against stop means in the form of stops or snap rings **54**, **56** carried by the shaft **13**. Conventional O-ring seals **57** are carried by internal recesses in the inner bore of the reaction members **51**, **52** to seal the latter relative to the shaft **13**. An O-ring seal **58** is interposed between the radially outer portion of reaction member **52** and the cylindrical surface **36** of piston **32**.

Reaction member **51** has a cylindrical surface **61** which cooperates with cylindrical surface **62** on the cylindrical piston **32** to divide the left end of the hydraulic actuator into a radially outer chamber **63** and a radially inner chamber **64**. Bleed passages **66** restrict the flow of fluid from chamber **64** to chamber **63**.

Reaction member **52** has a cylindrical surface **71** which cooperates with a cylindrical surface **72** on the cylindrical piston **32** to divide the right end of the hydraulic actuator **31** into a large radially outer chamber **73** and a small radially inner chamber **74**. Bleed passages **76** restrict fluid flow between inner chamber **74** and outer chamber **73**. Fluid supply passages **77**, **78** which are in constant fluid communication with inner chambers **64** and **74**, respectively, are connected to a source of fluid, not shown, in a conventional manner.

When supply passage **77** is connected to a high pressure fluid source for instance at 150 p.s.i., the pressure build-up in small chambers **64** will be immediate and will cause the cylindrical piston **32** to move rapidly to the left. During this initial movement there is little resistance to the movement of the cylindrical piston and fluid will transfer from chamber **63** to chamber **73** between annular sealing surfaces **81**, **82** formed on the axially inner walls of the reaction members **51**, **52** in complementary engageable relation to one another. Flow from chamber **63** to chamber **73** occurs through passage means or a passageway including the spaced confronting walls **68**, **69** of the reaction members **51**, **52** and walls **80** defining a plurality of axial openings or holes **84** in reaction member **52**. It will be noted that the holes **84** are spaced radially inward from the annular sealing surfaces **81**, **82** and that the flat sealing surfaces **81**, **82** are on the confronting walls **68**, **69**. When the end **33** of cylindrical piston **32** engages the clutch stack **23** movement of the cylindrical piston is retarded and pressure will immediately build up in chamber **64** sufficiently to overcome the biasing effect of the spring or Belleville washer **53** thereby moving reaction member **51** to the right until sealing surface **81** contacts sealing surface **82** to prevent further fluid transfer between the large radially outer chambers **63**, **73**. After engagement of the sealing surfaces **81**, **82**, the bleed pas-

sages 66 convey high pressure fluid to the radially outer chamber 63 and thereby subject the clutch pack 23 to the full axial force produced by the high pressure fluid in chambers 63, 64. It should be noted that the reaction member 51 moves axially a distance which is substantially less than the predetermined axial movement of the piston 32. In fact it should be less than one-half of the axial movement of piston 32.

Referring to FIGS. 4, 5 and 6, a second embodiment of this invention is illustrated. Fluid is delivered through a pair of supply passages 101, 102 to a pair of small radially outer pressure chambers 103, 104 by way of passages 106, 107 formed in reaction members 108, 109. Large pressure chambers 111, 112 are connected to the small pressure chambers 103, 104, respectively, by bleed passages 113, 114. O-ring seals 116 are provided between each of the reaction members and the cylindrical surface 118 on the inside of a two piece piston cylinder 121 which is held together by cap screws 122. Stop means or stops in the form of snap rings 126, 127 are carried by shaft 128 to limit axial movement of the axially shiftable reaction members 108, 109 axially away from one another. The reaction members 108, 109 are biased away from one another by biasing means in the form of Belleville washer 131 which acts as a spring.

Annular sealing surfaces 132, 133 are formed on the axially facing sides or walls 123, 124 of the reaction members 108, 109. A plurality of circumferentially spaced openings 134 are formed in reaction member 108, radially between sealing surface 132 and the shaft 128 on which the reaction members are slidably mounted. O-rings 136 seal the reaction members relative to shaft 128. Annular recesses 137, 138 keep the fluid supply passages 101 and 102 in full flow delivery relation to the passages 106, 107 within the reaction members throughout the range of axial shifting of the reaction members. A plurality of circumferentially spaced openings 135 are provided in reaction member 109 intermediate the sealing surface 133 and the cylindrical sealing surface 118 of the cylindrical piston 121.

When high pressure fluid is delivered to passage 101 and passage 102 is connected to a low pressure fluid source, the volume of fluid delivered to chamber 103 will quickly build-up pressure sufficient to shift the cylindrical piston 121 to the left. Upon the pressure fluid being initially delivered to chamber 103, fluid transfer will occur between chambers 111 and 112 through openings 134, 135, this fluid transfer flows between the sealing passages 132, 133 which are in axially spaced relation to one another during initial movement of the cylindrical piston. When the end 141 of the cylindrical piston makes contact with a clutch disk pack, the pressure in chamber 103 will build up and sufficient axial force will be created against the reaction member 108 to compress the spring 131 and bring sealing surface 132 into fluid sealing engagement with complementary sealing surface 133, and thus the fluid transfer between chambers 111 and 112 will be stopped. Chamber 111 will thereafter be pressurized to the pressure of the fluid being delivered through passage 101 to chamber 103 through bleed passage 113.

When high pressure fluid is delivered by passage 102 to small pressure chamber 104 and fluid supply passage 101 is connected to a low pressure fluid, the pressure will build up in chamber 104 as the end 142 angages a second disk stack and reaction member 109 will be moved to the left compressing the biasing means 131 and thus closing off fluid transfer from chamber 112 to chamber 111 by engagement of complementary annular sealing surfaces 132, 133. It will be noted that reaction members 108, 109 are of the same construction except for the drilling of holes 134 and 135. Thus this design lends itself to economical manufacture.

From the foregoing description it is obvious that an improved fluid transfer type hydraulic actuator has been provided for a pair of axially spaced clutches. By providing a pair of reaction members which are axially movable toward each other against biasing influence of a biasing means interposed therebetween, it is possible to provide a flow transfer type hydraulic actuator which has fewer parts and is less expensive to manufacture. Also, in view of the reduction of total number of parts, the hydraulic actuators using this invention will be more reliable in service and be less expensive to keep in service.

Various modifications and improvements of the invention illustrated and described herein may occur to those familiar with the art, however, it is intended that such modifications and improvements shall be within the scope of this invention as are embraced by the appended claims.

What is claimed is:

1. A double acting hydraulic actuator for actuating a pair of axially spaced clutch packs interposed between a shaft and gearing mounted thereon, comprising: a cylindrical piston mounted coaxially on said shaft for predetermined axial movement relative thereto from an intermediate position to a position of engagement with one of said clutch packs; a pair of axially spaced reaction members slidably mounted on said shaft within said piston and having relatively engageable annular sealing surfaces, respectively, disposed radially between said shaft and piston; stop means for limiting axial movement of said reaction members to a distance substantially less than said predetermined axial movement of said piston; biasing means for resiliently urging said reaction members axially away from one another thereby urging said sealing surfaces out of engagement; walls on said reaction members and piston defining a pair of radially outer chambers and a pair of radially inner chambers; and a passageway between one of said pairs of chambers including an opening extending axially through one of said reaction members radially inward from said sealing surface thereon, fluid transfer through said opening between said one pair of chambers being prevented upon engagement of said sealing surfaces.

2. The structure set forth in claim 1, wherein said one pair of chambers is said inner pair of chambers.

3. The structure set forth in claim 1, wherein said one pair of chambers is said outer pair of chambers.

4. A double acting hydraulic actuator for actuating a pair of axially spaced clutch packs interposed between a shaft and gearing mounted thereon, comprising: a cylindrical piston mounted coaxially on said shaft for predetermined axial movement relative thereto from an intermediate position to a position of engagement with one of said clutch packs; a radially inward facing cylindrical surface on the interior of said piston; a pair of axially spaced reaction members slidably mounted on said shaft within said piston and having relatively engageable annular sealing surfaces, respectively, disposed radially between said shaft and piston; an annular fluid seal between the radially outer periphery of one of said reaction members and said cylindrical surface of said piston, the other of said reaction members being spaced radially inwardly from said cylindrical surface; stop means for limiting axial movement of said reaction members to a distance substantially less than said predetermined axial movement of said piston; biasing means resiliently urging said reaction members axially away from one another thereby urging said sealing surfaces out of engagement; walls on said reaction members and piston defining a pair of radially outer chambers and a pair of radially inner chambers; and a fluid transfer passageway between said radially outer chambers including walls in said one reaction member defining an opening extending axially therethrough connecting one of said radially outer chambers to the space between said reaction members radially inward from said sealing surfaces, fluid transfer through said passageway being prevented upon engagement of said sealing surfaces.

5. A double acting hydraulic actuator for actuating a pair of axially spaced clutch packs interposed between a shaft and gearing mounted thereon, comprising: a cylin-

drical piston slidably mounted coaxially on said shaft for axial movement relative thereto between positions of engagement with said clutch packs, respectively; a radially inward facing cylindrical surface on the interior of said piston; a pair of axially spaced reaction members slidably mounted on said shaft within said piston, one of said reaction members being in fluid sealing relation with said cylindrical surface; stop means for limiting axial movement of said reaction members away from one another; biasing means resiliently urging said reaction members axially away from one another into engagement with said stop means; walls on said reaction members and piston dividing said interior of said piston into a pair of radially outer chambers and a pair of radially inner chambers; a fluid transfer passageway between said radially outer chambers including walls in said one reaction member defining a passageway extending axially therethrough and connecting one of said radially outer chambers to the space between said reaction members; and a pair of annular sealing surfaces formed on said reaction members, respectively, in said fluid transfer passageway, said sealing surfaces being brought into fluid sealing engagement to prevent fluid transfer between said one pair of chambers upon axial movement of either of said reaction members toward the other a predetermined distance, said predetermined distance being less than one-half of said axial movement of said cylindrical piston.

6. A double acting hydraulic actuator for actuating a pair of axially spaced clutch packs interposed between a shaft and gearing mounted thereon, comprising: a cylindrical piston mounted coaxially on said shaft for axial movement relative thereto and having axially opposite ends in confronting relation to said clutch packs; a pair of axially spaced reaction members within said piston having complementary fluid sealing surfaces spaced axially from one another and disposed radially between said shaft and piston; means for mounting said reaction members on said shaft in coaxial and axially shiftable relation thereto; stop means for limiting axial movement of said reaction members away from one another; biasing means for resiliently urging said reaction members axially away from one another; walls on said reaction members and piston defining a pair of radially outer chambers and a pair of radially inner chambers; and a fluid pasageway between one of said pair of chambers including an opening extending axially through one of said reaction members, said opening being in free flow fluid communication with one of said one pair of chambers, said sealing surfaces being brought into engagement to cut off fluid transfer between said one pair of chambers through said opening when

one of the other pair of chambers is connected to a source of high pressure fluid.

7. The structure set forth in claim 6 wherein said one pair of chambers is said radially outer pair of chambers.

8. The structure set forth in claim 6 wherein said one pair of chambers is said radially inner pair of chambers.

9. A double acting hydraulic actuator for actuating a pair of axially spaced clutch packs interposed between a shaft and gearing mounted thereon, comprising: a cylindrical piston mounted coaxially on said shaft for axial movement relative thereto and having axially opposite ends in confronting relation to said clutch packs; a first reaction member within said piston mounted on said shaft in coaxial and axially shiftable relation thereto; a second reaction member within said piston mounted on said shaft in coaxial and axially shiftable relation thereto and in axially spaced relation to said first reaction member; walls on said piston and reaction members cooperating to form a pair of radially outer chambers and a pair of radially inner chambers, one of said outer chambers and one of said inner chambers being intermediate one of said reaction members and one axial end of said piston and the other of said inner and outer chambers being at the other axial end of said piston; fluid passage means for connecting one of said pair of chambers in fluid communication including confronting walls on said reaction members, respectively, and an opening extending axially through one of said reaction members; complementary fluid sealing surfaces formed on said confronting walls of said reaction members, respectively; biasing means for urging said reaction members in opposite axial directions thereby biasing said sealing surfaces out of engagement; and stop means limiting axial movement of said reaction members axially away from one another, one of said reaction members moving axially against the biasing effect of said biasing means when the fluid in the associated chamber of the other of said pair of chambers is subjected to a predetermined pressure thereby effecting engagement of said sealing surfaces to stop fluid transfer between said one pair of chambers.

10. The structure set forth in claim 9 wherein said one pair of chambers is said outer pair of chambers.

11. The structure set forth in claim 9 wherein said one pair of chambers is said inner pair of chambers.

References Cited in the file of this patent

UNITED STATES PATENTS

2,868,341	Snoy	Jan. 13, 1959
2,920,732	Richards et al.	Jan. 12, 1960
2,979,176	Voth	Apr. 11, 1961
3,032,157	Richards	May 1, 1962