Jan. 21, 1958 E. RUEGG 2,820,436

EFFECTING RELATIVE DISPLACEMENT BETWEEN PUSHER MEMBER AND SEPARATOR CAGE OF A PUSH-TYPE CENTRIFUGAL MACHINE

Filed Jan. 3, 1956 2 Sheets-Sheet 1

Fig.1

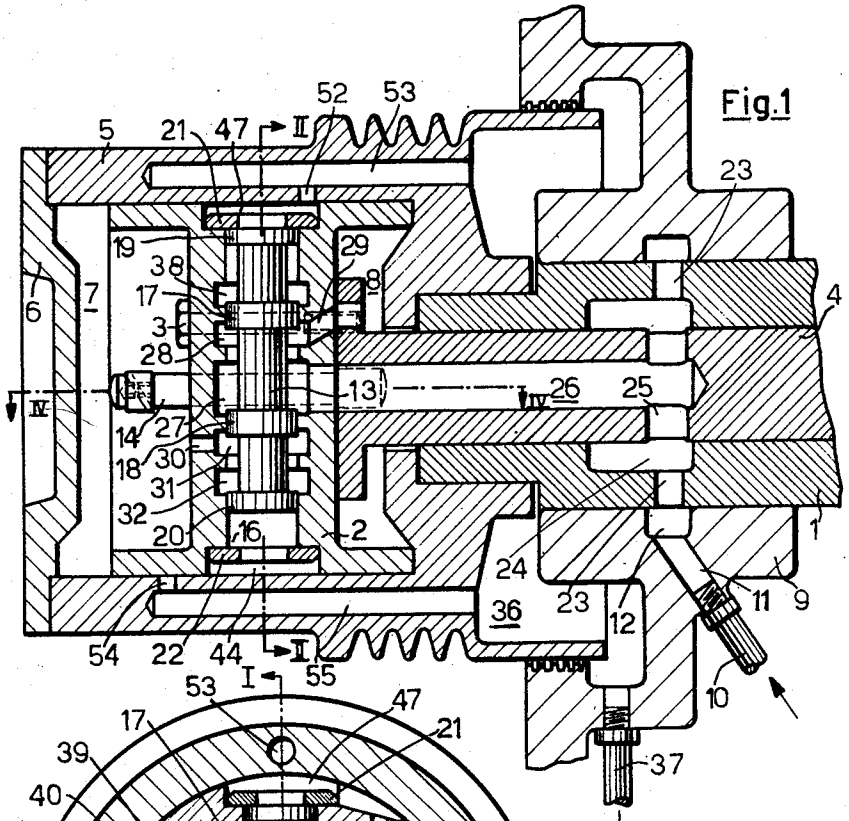


Fig.2

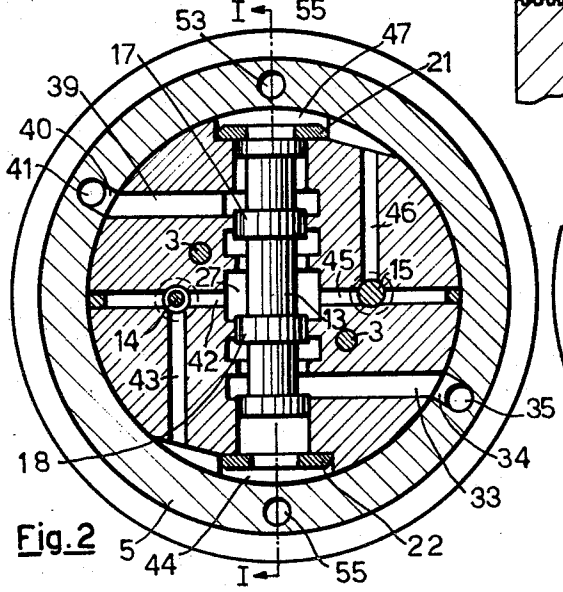
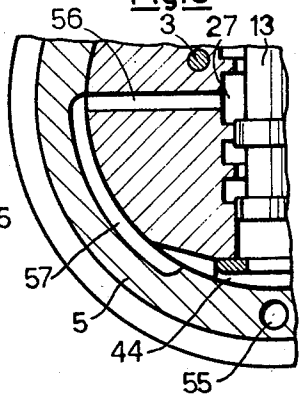


Fig.3



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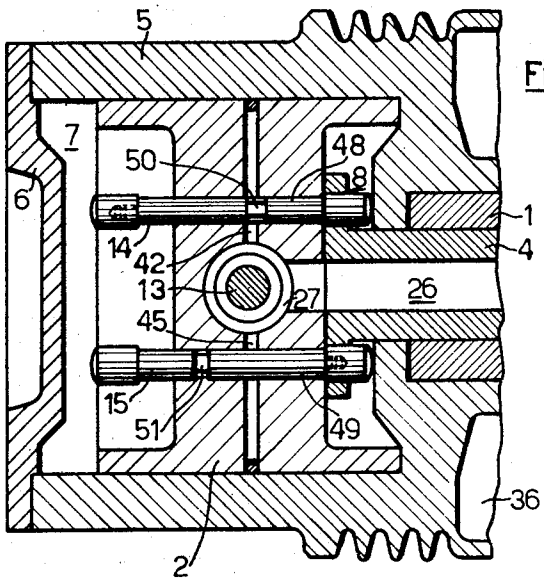

Fig. 4

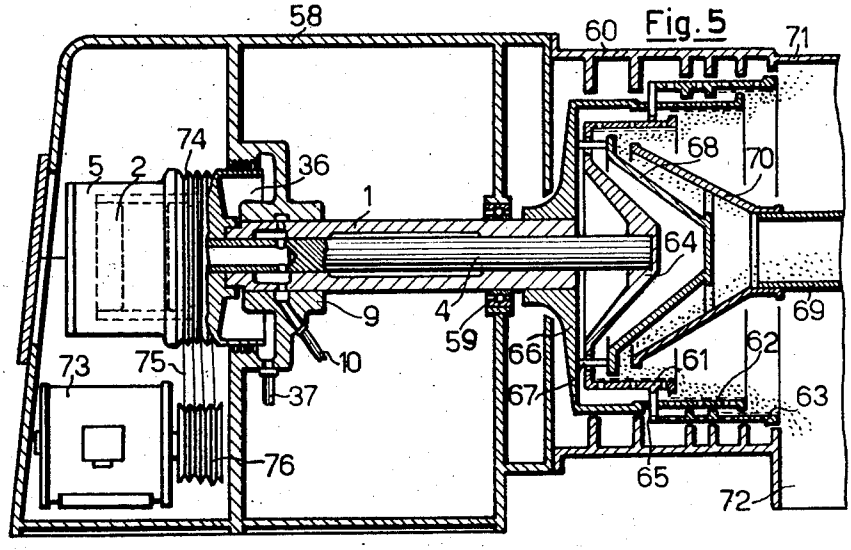

Fig. 5

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EFFECTING RELATIVE DISPLACEMENT BETWEEN PUSHER MEMBER AND SEPARATOR CAGE OF A PUSH-TYPE CENTRIFUCAL MACHINE

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3 Claims. (Cl. 121—123)

This invention relates to fluid pressure motor means, commonly hydraulic, for producing relative axial motion between two coaxial shafts, one encircling the other, the two shafts rotating together.

The claimed construction has the advantage that the controlling valve mechanism is in the main piston, so that fluid lines can be short, and packed joints can be reduced in number. This minimizes disturbing inertial effects and reduces the risks of leakage.

The distributing valve is mounted in the main piston of the motor and shifts along a diametric line in such a way that centrifugal force, developed by rotation of the shafts, assists in completing the valve shift and tends to hold the valve in its shifted position, so that valves which control its motion may be of the utmost simplicity.

The invention was developed for use in centrifuges of the pusher feed type, and will be described as so embodied.

Two constructions in accordance with the invention are illustrated in simplified form and by way of example in the drawings, in which:

Fig. 1 is an axial section on the line I—I of Fig. 2 through apparatus for producing a relative axial displacement between the pusher member and separator cage of a push-type centrifugal machine.

Fig. 2 is a section on the line II—II of Fig. 1.

Fig. 3 is a modification of the construction of the control apparatus, taken on the same section as in Fig. 2.

Fig. 4 is an axial longitudinal section on the line IV—IV of Fig. 1.

Fig. 5 is an axial longitudinal section through a push-type centrifugal machine with the apparatus according to Fig. 1.

The push-type centrifugal machine comprises a hollow rotary shaft 1. A piston 2 serves to actuate that part of the centrifugal machine which is to be displaced. It is fixed by screws 3 to one end of a central shaft 4 which extends axially through the central bore of the hollow shaft 1 and by which is produced the connection with the part to be displaced. The two shafts are axially shiftable in relation to one another. Fixed to the end of the hollow shaft 1 coaxially therewith is a cylinder 5 which revolves with the separator cage and which is closed at its outer end by a cover 6. The piston 2 is arranged in the cylinder 5 so as to be axially displaceable in relation thereto and also revolves with the cylinder. It divides the cylinder space axially into two chambers 7 and 8.

The hollow shaft 1 is supported in a bearing 9 at the end adjacent the cylinder 5. This bearing serves at the same time for the supply of pressure fluid, which is introduced through a pipe 10 and a connecting bore 11 into an annular duct 12 of the bearing.

The piston 2 is actuated by fluid, the said piston imparting a reciprocatory movement to the moving part of the centrifugal machine. A control device, which consists of a control valve 13 and two initial control members

14 and 15, controls the admission of pressure fluid alternately to the two sides of the piston. This control device is arranged in the piston 2 itself. The control valve 13 is arranged in the piston 2 in a bore 16 extending transversely of the axis of rotation. It comprises two control pistons 17 and 18 and also two valve-motor piston heads 19 and 20, and it is displaceable between two end positions which are symmetrical with respect to the rotational axis of the piston 2 and which are determined by two abutments consisting of annular washers 21 and 22. The control piston 17 controls the admission of pressure fluid to the cylinder chamber 8 and the control piston 18 controls the admission of pressure fluid to the cylinder chamber 7.

In Figs. 1 and 2, the control valve 13 is shown in its top end position. From the annular passage 12 of the bearing 9, the pressure fluid supplied by the pipe 10 passes through transverse bores 23 in the hollow shaft 1 into an annular passage 24 formed from inside in this hollow shaft. A transverse bore 25 and an axially extending longitudinal bore 26 in the central shaft 4 also produce a connection between the annular passage 24 and an annular space 27 provided in the piston 2 in the region of the axis so as to surround the control valve 13.

In the position of the control valve 13 as illustrated, the path of the control fluid from the annular space 27 into an annular space 28 disposed above it is open, the space 28 communicating through a passage 29 with the working space 8 in the cylinder 5. This causes piston 2 to move toward head 6. The fluid displaced from the working space 7 passes through a passage 30 successively into two annular spaces 31 and 32 surrounding the control valve 13 and from thence through a passage 33 in the piston 2 and an opening 34 of the cylinder 5 into a passage 35 extending axially in the cylinder. The passage 33 is shown in Fig. 2 and extends transversely of the axis of the control valve. From the passage 35, the fluid discharges into a space 36 in order to be returned from this space through a pipe 37 into a liquid container.

On the other hand, if the control valve 13 is in its bottom end position, the control pistons 17 and 18 are displaced to such an extent in the direction toward the end washer 22 that a connection is produced between the annular space 27 and the annular space 31, while the connection between the spaces 31 and 32 is closed. In this case, the pressure fluid passes from the longitudinal bore 26 of the central shaft 4 through the annular spaces 27 and 31 and the passage 30 into the working space 7. The connection between the annular spaces 27 and 28, on the other hand, is closed by the piston 17, while fluid can now pass over from the working space 8, through the bore 29 and the annular space 28, into an annular space 38 disposed symmetrically of the annular space 32. A bore 39 in the piston 2 and extending transversely of the axis of the control valve 13 then permits the discharge of fluid through an opening 40 of the cylinder 5 and a longitudinal duct 41 extending in the latter in a symmetrical position in relation to the passage 35, the said duct 41 in turn opening into the space 36.

In the one end position of the control valve 13, pressure fluid is thus supplied to the working space 8, and in the other end position of the control valve, to the working space 7. In the one end position, therefore, the control valve 13 frees the path to one side of the piston 2 for the pressure liquid from the longitudinal bore 26 of the central shaft 4 which produces the connection between the piston 2 and the part to be displaced and which travels in the central bore of the machine shaft 1, while in the other end position, it frees the path to the other side of the piston 2 for the supply of pressure fluid from this longitudinal bore 26.

The piston 2 is thus displaced axially in one direction

or the other. The arrangement of the control valve **13** in the piston itself has the advantage that it is only necessary to have a single pipe **10** for the supply of pressure fluid to the rotating parts. Consequently, it is only necessary for the annular passage **12** to be sealed off against high pressure at the transition points from the fixed part to the rotating part. The reversal of the flow of fluid is effected only in short connecting ducts in the piston itself, while the same direction of flow obtains in the supply line as far as the annular duct **27** of the piston **2** and also the discharge ducts **33**, **35** and **39**, **41** respectively, always have the liquid flowing therethrough in the same direction.

In order constantly to produce a reciprocatory movement of the piston **2** in the cylinder **5**, the control valve **13** is always to be changed over to its opposite end position upon the end position of the piston being reached. In the construction according to Figs. 1 and 2, this changeover is effected automatically by the initial control members **14** and **15**. The member **14** controls the supply of pressure fluid from the annular passage **27** through the bores **42** and **43** to one end of the transversely extending bore **16** of the piston **2**, i. e. to a space **44**, which is defined on one side by the valve-motor piston head **20** of the control valve **13**. On the other head, the initial control member **15** controls the flow of pressure fluid through bores **45** and **46** to the other end of the transversely extending bore **16**, i. e. to a space **47** which is defined on one side by the valve-motor piston head **19** of the control valve. The initial control members **14** and **15** are arranged in the piston **2** symmetrically of its axis of rotation and parallel thereto, and are fitted for longitudinal displacement in axial bores **48** and **49**, respectively. They are formed with recesses **50** and **51**, respectively, which are offset relatively to one another. The two control members **14** and **15** could, of course, also be replaced by a single control member for the control of the pressure fluid supply to both the spaces **44** and **47**.

At the end position of the piston **2**, as shown in Figures 1 and 4, the initial control members **14** and **15** are brought by abutment on the cylinder base into the position shown in Figure 4. The recess **50** of the member **14** is then at the place where the bores **42** and **43** meet. The pressure fluid can therefore pass from the annular space **27** through the ducts **42** and **43** into the space **44**, the control valve **13** being urged against the end washer **21** and therefore held in the position shown. From the space **47**, on the other hand, the fluid can flow out into the space **36** through an opening **52** and a duct extending longitudinally of the cylinder. Pressure fluid is supplied to the working space **8** and the piston **2** is moved toward the cylinder cover **6**. The control valve **13** remains in the position shown until as the piston approaches the cylinder cover **6**, the initial control members **14** and **15** strike against the cover **6** and are thus displaced toward the bearing end relatively to the piston **2**. As a result, the recess **50** of the iniital control member **14** is displaced away from that position in which the bores **42** and **43** meet, so that the throughflow of pressure fluid is shut off. On the other hand, the recess **51** of the initial control member **15** is displaced to the position where the bores **45** and **46** meet. Thus, the path of flow of pressure fluid from the annular space **27** into the space **47** is opened, the control valve **13** being urged against the end washer **22**. In the end position of the piston **2** at the cover end, a connection has been produced between the space **44** and the discharge space **36** through an opening **54** and a passage extending longitudinally of the cylinder **5**, so that the fluid displaced with the movement of the control valve **13** toward the washer **22** is able to escape.

The initial control members **14** and **15** thus control the flow to the ends of the transversely extending bore **16** of the piston **2**, i. e. to the spaces **44** and **47**, respectively, adjoining the end faces of the control valve **13** and in each case, when the piston **2** approaches one of its end positions and owing to abutment on the axial limits of the working space **7** or **8**, they are shifted into a position in which, due to the opening of the path for pressure fluid to the corresponding end face of the control valve, the latter is changed over to its opposite end position and thereby initiates a reversal of movement of the piston **2**.

This initial control device ensures that in all cases the control valve **13** is adjusted into the suitable end position when the piston **2** has to reverse its direction of travel. A changeover operation may, however, be obtained by more simple means, as represented in Figure 3. With this arrangement, the provision of separate initial control members is dispensed with. Provided as supply duct for the fluid under pressure, a bore **56** extends radially outwardly from the space **27** in a direction at right angles to the axis of the control valve in the piston. Formed in the cylinder **5** is a groove **57** which, in the end position of the piston **2** as shown in Figure 1, produces a connection between the bore **56** and the space **44** below the control valve. Axially of the piston, the groove **57** is of such limited space that the said connection is produced solely in and in the vicinity of the end position. Provision must then be made for the fact that such an amount of pressure fluid can flow through the bore **56** that the control valve is adjusted from the lower to the upper end position before the piston **2** has again left its end position tc such an extent that the connection has been broken.

In the end position of the piston **2** near the cylinder cover, with this method of reversal, a second groove extending symmetrically of the groove **57** in relation to the axis of the piston is to be arranged in the cylinder, which second groove has to produce the connection of the space **47** with the annular space **27** through a radial bore extending in the piston opposite to the bore **56**.

With this arrangement, therefore, by means of grooves arranged in the cylinder, a connection between a pressure fluid supply duct and the space adjoining the corresponding end face of the control valve is always produced in the end positions of the piston **2**, a reversal of the control valve into its opposite end position being effected by the fluid pressure from the said space, thereby initiating a reversal of the movement of the piston **2**.

Figure 5 shows the assembly of the arrangement with a threestage push-type centrifugal machine. The hollow shaft **1** is arranged in a housing **58**, which also encloses the cylinder **5** and is supported in a bearing **59** as well as in the bearing **9**. Arranged in a housing **60** adjoining the housing **58** are three separator cages **61**, **62** and **63** successively supplied with the material being centrifuged. The cage **61** is mounted by a boss **64** on that end of the central shaft **4** which projects from the shaft **1**. The cage **63** is connected fast to the cage **61** by means of struts or bars **65**. The cage **62**, on the other hand, is rigidly connected by means of a boss **66** to that end of the shaft **1** which projects beyond the bearing **59**. Bars **67** extending through the boss **64** also produce a rigid connection between the boss **66** and a pusher member **68** arranged in the cage **61**.

The material to be centrifuged is introduced through a pipe **69** and conveyed on to the cage **61** by means of a funnel **70** rigidly connected to the pusher member **68**. With the axial reciprocatory movement of the central shaft **4**, the cages **61** and **63** are concurrently moved. The cage **61** and the fixed pusher member **68** which cooperates with the cage **61**, are moved relatively to one another, and this movement displaces the material on the cage **61** toward the end of the latter, where it passes on to the cage **62**, which is fixed axially. For the layers of material forming on this cage, the end of the cage **61** serves as a pusher member and the reciprocatory movement thereof causes the material to travel forward on to the last cage **63**. Due to the axial reciprocatory movement thereof with the cage **61**, the end of the axially fixed cage **62** again serves as pusher member, whereby the

material is finally expelled from the cage 63 and is collected in a part 71 of the housing 60 serving as collecting device, in order then to drop downwardly through an opening 72.

The housing 58 also has arranged therein a motor 73 which serves for the drive of the centrifugal machine. The cylinder 5 is at the same time designed as a belt pulley formed with grooves 74, the machine being driven by V-belts which extend around the cylinder 5 and a driving pulley 76 arranged on the motor shaft. The part of the cylinder 5 which is not used for the belt drive may also be used in known manner as a brake drum.

Due to the fact that the control device 13 is arranged in the piston 2 itself, the machine is given a very compact construction. No control devices arranged externally of the machine are to be provided, which devices can render access to the machine difficult while it is running. With the constructional form described, the control piston can readily be removed with the control means after removing the cover 6, this being effected rearwardly and axially, so that also an inspection can easily be made.

What is claimed is:

1. The combination of two coaxial shafts, one encircled by the other and movable axially relatively thereto while rotating therewith; bearings in which the outer shaft is rotatable; an expansible chamber motor comprising a main cylinder closed at its ends and mounted coaxially on the encircling shaft and a double-acting main piston reciprocable in said main cylinder and connected with the encircled shaft to shift said shaft relatively to the encircling shaft; a combined distributing valve and valve-shifting piston means mounted in a combined ported valve seat and valve-motor cylinder extending diametrically within said main piston and substantially symmetrical with reference to the common axis of the shafts, there

being a supply passage leading through the inner shaft to a supply port substantially at mid-length of said valve seat, there being exhaust ports leading from opposite end portions of the valve seat to and thence through coacting passages in the main piston and cylinder, and there being two motor ports intermediate said supply and exhaust ports and each leading through the main piston to a different working space in said main cylinder, said ports being controlled by said distributing valve to cause the main piston to shift reversely in response to reverse shifts of said distributing valve; and valve means rendered effective by arrival of the main piston at its opposite limits of motion to energize reversely said valve-shifting piston means.

2. The combination defined in claim 1 in which the valve means last named is effective to energize the valve-shifting piston means past its mid-stroke and centrifugal force is effective to complete the terminal portion of such stroke.

3. The combination defined in claim 2 in which said last-named valve means comprises ports in the main cylinder controlled by the main piston.

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