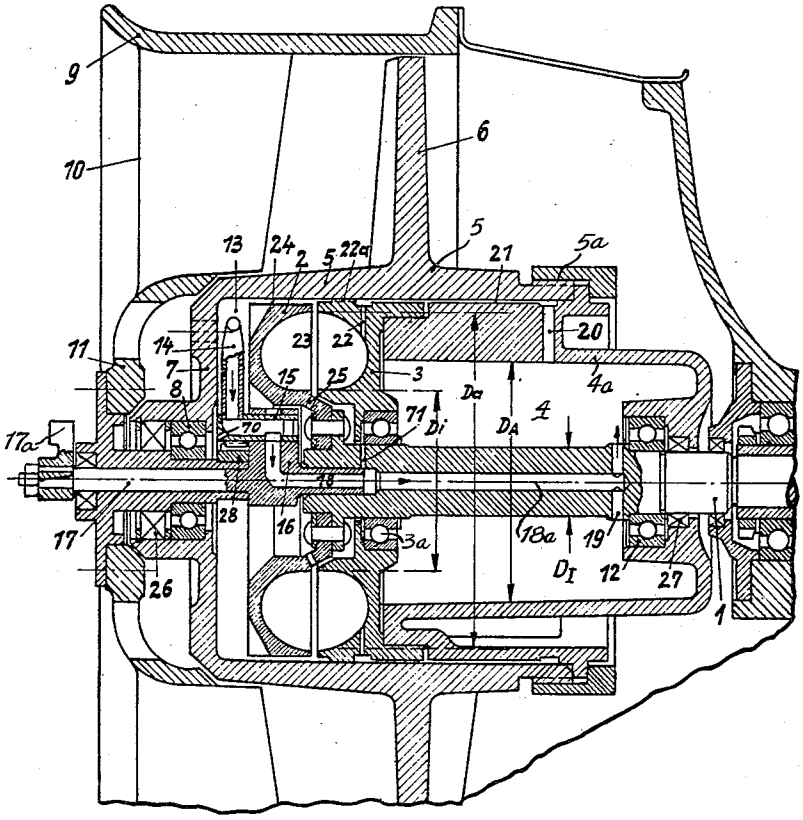
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FLUID COUPLINGS

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Inventors

FRITZ KUGEL

HELMUT MÜLLER

by Toulmin & Toulmin

Attorneys

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FLUID COUPLINGS

Fritz Kugel and Helmut Müller, Heidenheim, Germany, assignors to J. M. Voith G. m. b. H., Heidenheim, Germany, a corporation of Germany

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This invention relates to controllable hydraulic couplings provided with an adjustable scoop tube and a scoop tube reservoir in communication with the working chamber for circulating the coupling fluid therethrough.

It is an object of this invention to provide fluid circulating and cooling means in a hydraulic fluid coupling whereby the circulating quantity of fluid varies automatically with the quantity of heat developed in the various operating conditions.

It is a further object of this invention to provide fluid circulating and cooling means in a hydraulic fluid coupling, which make it possible to obtain a particularly strong cooling effect, if the coupling casing is connected with the runner, and the coupling, which serves, for example, for driving a rotary machine, is built directly into the hub of this driven machine.

It is a further object of this invention to provide fluid circulating and cooling means in a hydraulic fluid coupling, allowing a good heat elimination, thereby maintaining a greater density of the fluid, a higher inertia of the same and therewith a greater effectiveness of the coupling, and a prolonged service life of the fluid owing to less decomposition in consequence of heating.

These objects are attained in the coupling, according to the invention, wherein a reservoir, which is connected on the one hand with the scoop tube outlet and on the other hand with a working chamber formed by the impeller and the runner, is rotatable together with either said impeller or said runner.

The reservoir is so disposed relative to the working chamber and of such dimensions that it can take up the total volume of fluid from both the working chamber and the scoop tube chamber of the coupling, within a cylindrical space forming a portion of the interior of the reservoir, the radial diameter of which cylindrical space corresponds to the innermost position of the adjustable scoop tube, i. e. when the scoop tube is adjusted with its mouth nearest the central axis of the shaft on which the coupling is mounted.

In order to provide sufficient space for the reservoir in the direction towards the aforesaid axis, it is preferred to construct the coupling with a large ratio of the inner diameter of the blading to the outer diameter thereof. This ratio should be greater than 0.4, and preferably greater than 0.5.

In the standard type of known controllable hydraulic couplings, the oil circulation is greatest with the smallest slip and becomes smaller with increasing slip.

Too little heat is removed when the coupling operates with the smallest filling, and, therefore, with the greatest slip and the greatest heating effect.

According to another known construction, the quantity of circulating oil is independent of the degree of filling. However, once the quantity of oil being circulated has been adjusted to a determined amount, it can be altered during operation only by means of additional regulating devices.

In the coupling according to the invention, the scoop tube, which is angularly movable or displaceable so as to adjust the degree of filling of the working chamber, leads to a rotatable reservoir from which the fluid is returned to the working chamber of the hydraulic coupling by centrifugal force. In this way the necessity of a separate filling pump or gravity tank is eliminated.

Even when the fluid in the coupling is in balanced condition during operation, that is after the desired degree of filling of the working chamber has been attained, a certain quantity of the working fluid is still to circulate out of the working chamber of the coupling through the scoop tube into the reservoir and thence back into the working chamber of the coupling, thereby carrying off the heat developed in the working chamber of the coupling. In the coupling according to the invention the quantity of circulating oil has been found to vary within certain limits in accordance with the degree of filling, and in about the same manner as the quantity of heat developed in the various stages of operation of the coupling. This variation in the amount of circulating oil takes place automatically, i. e. without the provision of a special control device. The degree of fluid circulation which serves for cooling the oil, also depends on whether the casing of the coupling and the reservoir are connected with the impeller or with the runner. If the casing is connected with the runner there is provided a circulating quantity and an automatic variation of the circulating quantity which is particularly suitable to meet the requirements of rotary machines, having varying torque while a construction in which the casing is connected with the impeller is particularly suitable for the effects on removal of heat, in drives opened normally at constant torque.

While it is always possible to lead the connecting conduit between the scoop tube and the reservoir inlet via a special cooler, it is also possible, in many cases, so to construct the coupling that sufficient heat is removed by surface cooling. The coupling can for this purpose be provided, in a manner known per se, with a suitably large rotating surface, which surface can be further increased for example by cooling ribs. During its circulation from the working chamber of the coupling into the reservoir and in particular from the latter back into the working chamber of the coupling, the coupling fluid is so guided that it spreads over a large surface adjacent the outer wall of the casing. In the connecting conduit between the reservoir and the working chamber of the coupling a throttle point should also be provided which limits the circulation when the coupling operates under balanced condition.

A particularly strong cooling effect is obtained by one embodiment of the invention wherein the coupling casing is connected with the runner, and the coupling, which serves for example for driving a rotary machine, is built directly into the hub of this driven machine. Such a construction of hydraulic coupling according to the invention is also particularly suitable for driving cooling blowers or fans wherein the coupling casing rotating with the secondary element carries the blower vanes. In this case the angular speed of the blower is preferably controlled by a thermostat which acts, for example, directly on an adjusting shaft carrying the scoop tube.

In order that the invention may be clearly understood and readily carried into effect it will now be described in more detail with reference to the accompanying drawing, in which the figure shows in section a hydraulic coupling having a container connected with the runner, the coupling forming the hub of a blower.

Referring to the drawing more in detail, the coupling comprises a driving shaft 1 on which there is mounted the

impeller 2 which is connected by a flange to the driving shaft 1, the latter is in turn coupled to the motor (not shown). The runner 3 and a reservoir 4 of substantially annular cross-section connected with the runner, are disposed in the hub 5 of an axial blower wheel having blades 6 and are firmly screwed to this hub by threaded connection 5*a*. The hub 5 also projects over the impeller 2 and its lateral closing wall 7 is supported by a bearing 8 on the bearing cover 11 which is connected with the casing 9 via the reinforcing vanes 10. At the opposite end of the coupling the reservoir 4 is supported by means of a bearing 12 on the driving shaft 1.

Between the impeller and the end wall 7 is located the scoop tube chamber 13 into which the scoop tube 14 projects. This scoop tube 14 is journalled by means of a hollow pivot 15 in the arm 16 which is located on the adjusting shaft 17. The latter projects through a central bore in the bearing cover 11 into the interior of the latter. The bearing cover also carries, on the inner side of the bearing 8, a stationary sun gear segment 28 which cooperates with a gear segment provided on the hollow pivot 15 of the scoop tube.

In order to adjust the position of the scoop tube 14, the scoop tube adjusting shaft 17 is rotated, for instance, by turning the lever 17*a* which is rigidly connected to shaft 17 outside the cover 11. When rotating shaft 17, the arm 16 projecting laterally from shaft 17 rotates and takes along scoop pivot 15 which is freely rotatably mounted in arm 16. Since the gear segment on pivot 15 meshes with the stationary sun gear segment 28, scoop pivot 15 is caused to rotate about its own axis and thereby causes scoop tube 14 to rotate with pivot 15 about the central axis of the latter so that the scoop tube mouth varies its distance from the central axis of the casing.

The arm 16 of the scoop tube adjusting shaft 17 as well as the latter are provided with bores forming a passage 18 which communicates with the scoop tube via the hollow pivot 15. The passage 18 opens into a bore 18*a* in the driving shaft 1 and leads via a plurality of radial bores 19 into the reservoir 4. Openings 20 in the outer cylindrical wall 4*a* of the reservoir lead to an annular oil-cooling space 21 formed between the reservoir wall 4*a* and the hub 5. This space 21 is connected by bores 22 to the working chamber 23, the bores 22 serving as inlet passages to that chamber. Between the impeller 2 and the hub 5 there is formed an annular space 24, which serves as an outlet passage from the working chamber of the coupling to the scoop tube chamber 13. Furthermore, passages 25 are provided through the hub of the impeller. At both ends the coupling is tightly sealed against oil losses by means of packing rings 26 and 27 respectively. In the scoop tube pressure conduit in the interior of pivot 15 there is provided small lubricating passages 70 which communicate with the bearing 8. Lubricating passages 71 lead from passage 18*a* to bearing 3*a*.

According to a main feature of the invention, the outer diameter D_A of the internal space of the reservoir 4 is, as can readily be seen, somewhat greater than the inner diameter D_I of the working chamber of the hydraulic coupling, while the inner diameter D_I of the reservoir extends up to the ball-bearings. The outer diameter of the coupling working chamber is indicated by D_a.

When starting operation of the coupling from the stationary condition with the scoop tube withdrawn inwardly, the oil located in the lower half of the working chamber of the coupling is engaged by the impeller and set in rotation and thereby the runner is caused to gradually follow the rotation of the impeller. As soon as the runner begins to rotate, the liquid in the reservoir 4 is forced outwardly through the openings 20 by way of passage 21 into the working chamber of the coupling until the working chamber is completely filled and the coupling runs with only 2 to 3 per cent slip.

In order to reduce the speed of the secondary member, the scoop tube is adjusted automatically or deliberately, so that its mouth is at greater radial distance from the central axis of the coupling. Thereby the scoop tube is dipped deeper into the fluid ring in the scoop tube chamber 13, the level of which ring corresponds to the degree of filling of the coupling. Consequently the scoop tube scoops up a part of the liquid from said chamber 13, whereupon this part of the fluid is led off through the interior of scoop tube 14, through the hollow pivot 15, passages 18 and 18*a* and bores 19 into the reservoir 4, thus causing the oil level in the reservoir to become higher. This is due to the fact that the scoop tube is able to scoop up more fluid than can flow through the throttling bores 22 out of the reservoir back into the working chamber of the coupling. After a balanced condition is reached, a small oil circulation is reached which removes any heat generated in the working chamber of the coupling. Due to the oil stream being guided along the inside wall of the hub 5 of the blower, which is in contact with the air, the coupling oil is effectively cooled.

According to another embodiment of the invention the cylindrical annular space 21 is connected with space 24 and thereby with the scoop tube chamber 13 through the bores 22*a* shown dotted in the figure, instead of via the bores 22. These bores 22*a* form a bleed passage between the supply passage 21 and outlet passage 24. In this way the secondary side can be more quickly uncoupled in the following manner: When the mouth of the scoop tube 14 is adjusted to its greatest distance from the central axis of the coupling, the contents of the working chamber will be quickly scooped up by the scoop tube 14 and fed into the reservoir 4; since the angular speed of the latter decreases only gradually, fluid will continue to be forced into the annular oil-cooling space 21 by centrifugal force. This fluid can then return directly through the bores 22*a* into the scoop tube chamber 13, without first coming into contact with the blading of the working chamber of the coupling.

The bores 22*a* may be larger in cross-section than the bores 22, it is also possible to provide both the bores 22 as well as bores 22*a* in the same coupling.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

We claim:

1. A hydraulic fluid coupling having a casing, an impeller, a runner, and fluid circulating and cooling means within said casing comprising a work chamber between said impeller and said runner, a scoop tube chamber axially spaced from said working chamber, a first annular space next to the inside of said casing for connecting said working chamber with said scoop tube chamber to form a free communication with the latter, a scoop tube mounted for radial adjustment within said scoop tube chamber toward an innermost position at which the mouth of said scoop tube is nearer the central coupling axis than is said working chamber, a rotatable annular reservoir axially spaced from said communicating chambers, said reservoir having an inner and an outer annular wall, and being connected to said scoop tube at the level of said inner annular wall for circulating the fluid to be cooled from said working chamber to said reservoir, an annular oil-cooling space next to the inside of said casing wherein thin layers of fluid circulating from said reservoir toward said communicating chamber are being cooled, a plurality of openings connecting said reservoir with said oil-cooling space, and a plurality of passages connecting said reservoir with said communicating chambers for recirculating the fluid from said reservoir to said working chamber, said reservoir having an external diameter smaller than the external diameter of said working chamber, the volume of that portion of the interior of said reservoir which lies between a level corresponding to said innermost portion of said scoop tube and said inner annular reservoir wall being at least equal

to the sum of the volumes of said working chamber and said scoop tube chamber.

2. A hydraulic fluid coupling having a casing: an impeller, a runner and fluid circulating and cooling means within said casing comprising a working chamber between said impeller and said runner, a scoop tube chamber axially spaced from said working chamber and connected therewith to form a free communication with the latter, a scoop tube mounted for radial adjustment within said scoop tube chamber, toward an innermost position at which the mouth of said scoop tube is nearer the central coupling axis than is said working chamber, a rotatable annular reservoir axially spaced from said communicating chambers and connected with said runner to rotate together with the same, said reservoir having an inner and an outer annular wall, and being connected to said scoop tube substantially at the level of said inner annular wall for circulating the fluid to be cooled from said working chamber to said reservoir, and at least one passage connecting said reservoir with at least one of said communicating chambers for recirculating the fluid from said reservoir to said working chamber, said reservoir having an external diameter smaller than the external diameter of said working chamber, the volume of that portion of the interior of said reservoir which lies between a level corresponding to said innermost portion of said scoop tube and said inner annular reservoir wall being at least equal to the sum of the volumes of said working chamber and said scoop tube chamber.

3. A hydraulic fluid coupling having a casing; an impeller, a runner and fluid circulating and cooling means within said casing comprising a working chamber between said impeller and said runner, a scoop tube chamber axially spaced from said working chamber and connected therewith to form a free communication with the latter, a scoop tube mounted for radial adjustment within said scoop tube chamber, toward an innermost position at which the mouth of said scoop tube is nearer the central coupling axis than is said working chamber, a rotatable annular reservoir axially spaced from said communicating chambers, both said reservoir and said casing being connected to said runner to rotate together with the same, said reservoir having an inner and an outer annular wall, and being connected to said scoop tube substantially at the level of said inner annular wall for circulating the fluid to be cooled from said working chamber to said reservoir, and at least one passage connecting said reservoir with at least one of said communicating chambers for recirculating the fluid from said reservoir to said working chamber, said reservoir having an external diameter smaller than the external diameter of said working chamber, the volume of that portion of the interior of said reservoir which lies between a level corresponding to said innermost portion of said scoop tube and said inner annular reservoir wall being at least equal to the sum of the volumes of said working chamber and said scoop tube chamber.

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