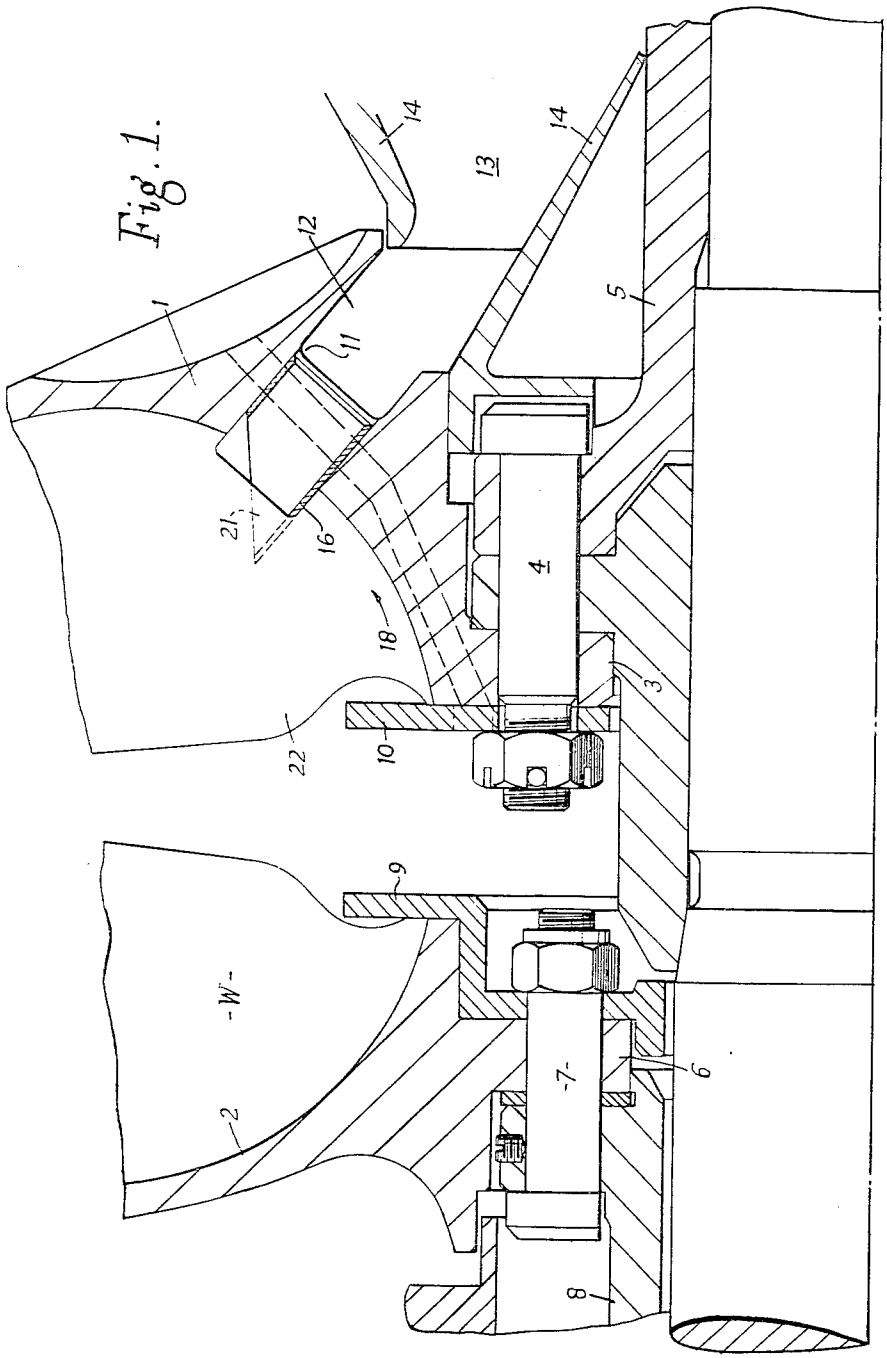
Dec. 30, 1969 J. BILTON 3,486,336

HYDRAULIC TURBO-COUPLINGS

Filed April 15, 1968 3 Sheets-Sheet 1

Fig. 1.



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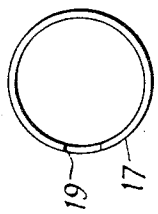


Fig. 4.

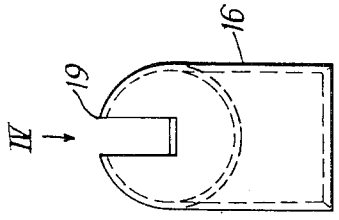


Fig. 3.

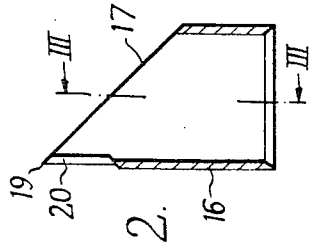


Fig. 2.

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HYDRAULIC TURBO-COUPLINGS

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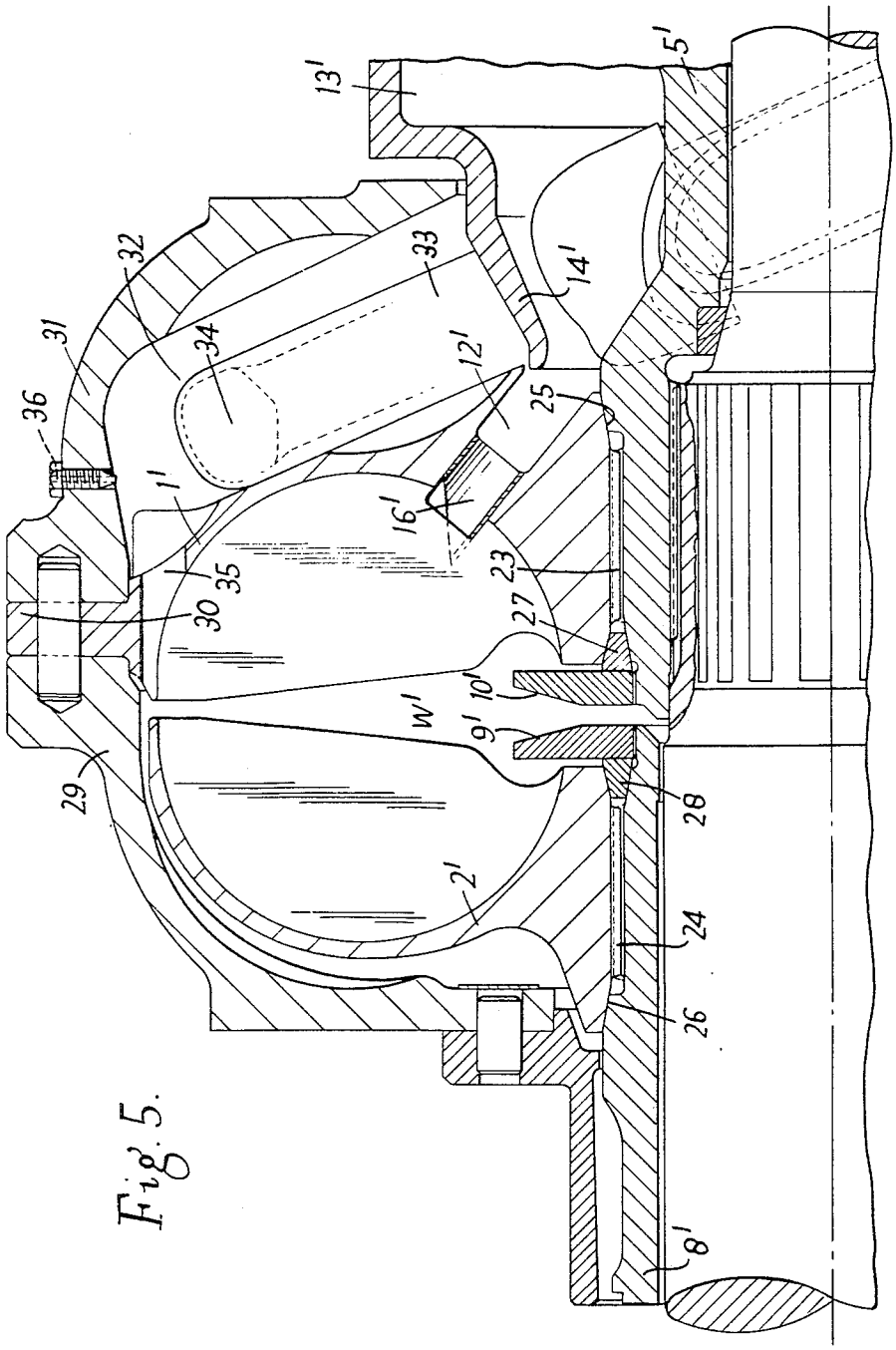


Fig. 5.

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HYDRAULIC TURBO-COUPLINGS

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Claims priority, application Great Britain, Apr. 21, 1967, 18,571/67
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U.S. Cl. 60—54 8 Claims

ABSTRACT OF THE DISCLOSURE

In a hydraulic turbo-coupling comprising vaned impeller and runner elements which together define a toroidal working circuit, working liquid being supplied to the working circuit through ports in the impeller or runner. The liquid emerging from these ports is protected by shields against the strong flow along the boundary wall of the working circuit which is particularly strong when the coupling is in the stalled condition with the runner substantially stationary. By this means, the resistance offered to the incoming liquid is reduced, for example to one quarter of the normal resistance. This greatly assists the maintenance of a cooling flow through the coupling in the stalled condition particularly where the liquid cannot be directly pressure-fed to the ports.

The present invention relates to improvements in hydraulic turbo-couplings of the kind in which working liquid is fed into the working circuit through one or more ports in the impeller or runner element.

An object of the present invention is to increase the rate of filling of such a hydraulic coupling or to reduce the back pressure presented to the filling flow particularly during the time that the coupling is stalled, that is to say when the runner of the coupling is stationary while the impeller is being rotated at a normal working speed.

According to the present invention there is provided a hydraulic turbo-coupling comprising vaned impeller and runner elements together defining a toroidal working circuit for liquid, at least one of the elements being formed with one or more inlet ports for supplying liquid to fill the coupling during operation, wherein a shield for the inlet port or each inlet port projects from the wall of the working circuit into the path of the working liquid to protect liquid emerging into the working circuit from the port from the high speed flow of liquid around the periphery of the working circuit in the direction from the radially inner portion of the runner to the radially inner portion of the impeller when the coupling is operating in the stalled condition.

Advantageously each such shield is formed by a short length of tube the discharge end of which may be angled to face in the direction of fluid flow in the working circuit.

In the stalled condition of the coupling, the velocity of vortex flow is highest in a layer which lies close to the boundary of the working circuit. The inlet tubes may be dimensioned to project through this layer into the inside of the vortex where the flow velocity under the stalled condition is lower than in the said layer.

Preferably the inlet port or ports are formed in the impeller element of the coupling. This ensures that the inflowing working liquid is subjected to less variation in the centrifugal head since the variation in the angular speed of the impeller is usually much less than that of the runner. Furthermore the flow of working liquid around the working circuit is consequently more uniform and therefore the resulting cooling flow through the coupling is more steady thereby helping to ensure the reliable removal

of the considerable amount of heat generated in the coupling in the stalled condition.

Hydraulic turbo-couplings normally include a baffle at the radially inner region of the runner. An additional baffle may be mounted on the impeller also in its radially inner region. The additional baffle is preferably not of greater outside diameter than the normal anti-surge baffle fitted to the runner. The additional baffle serves to assist the inlet port shields by deflecting the boundary vortex flow in the stalled condition away from the shielded inlet ports. It is desirable to retain the runner baffle in order to prevent liquid being deflected through the clearance between the impeller and runner at the inner profile diameter of the working circuit.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 shows part of a hydraulic turbo-coupling in axial section,

FIG. 2 shows an inlet port shield in longitudinal section,

FIG. 3 is a transverse section on the line III—III of FIG. 2,

FIG. 4 is an end view in the direction of the arrow IV of FIG. 3, and

FIG. 5 is a view corresponding to FIG. 1 of a scoop-trimmed turbo coupling.

The hydraulic turbo-coupling shown in FIG. 1 is basically of conventional design in that it comprises vaned impeller and runner elements **1** and **2** which together define a toroidal circuit W for liquid such as oil. The impeller **1** carries an inner radial flange **3** which is secured by bolts **4** to a driving sleeve **5** connected to a prime mover (not shown).

Similarly the runner **2** has a radially inner flange **6** which is bolted at **7** to an output sleeve **8**. An anti-surge baffle **9** is also bolted to the flange **6** by bolts **7**.

Correspondingly, an additional baffle **10** is bolted to the impeller flange **3** by the bolts **4**. The additional baffle **10** may be of the same outer diameter as the baffle **9**.

Oil is fed into the coupling through sixteen inlet ports **11** in the impeller. The ports **11** are fed from an annular collector channel **12** in the impeller **1** into which open one or more inlet passages **13** in the stationary part **14** of the coupling structure. Oil leaves the radially outer part of the working circuit at a controlled rate. This may be effected by conventional means (not shown).

Secured in each inlet **11** is a shield **16** formed by a short length of tube (FIGS. 2 to 4) the discharge end **17** of each tube **16** is angled at 45 degrees so as to face in the direction of the boundary flow of the working liquid along the walls of the working circuit. This direction extends, at the radially inner part of the working circuit, from the runner to the impeller and is indicated generally by the arrow **18**.

The point **19** of each shield **16** is formed with a slot **20** to accommodate the edge portions **21** of the vanes **22** of the impeller **1**.

In many cases it is possible to dispense with the additional baffle **10**. The arrangement described above may reduce the head to be overcome when filling the coupling in the stalled (and high slip) condition by a factor of four. The arrangement may be applied to any form of coupling requiring a filling flow. It has a further advantage in the case of a scoop control type of fluid coupling as shown for example in British patent specification No. 798,524.

In this type of coupling, when the prime mover is shut down, the working liquid is held in the lower regions of the reservoir casing, thereby avoiding the need for liquid seals where the working shafts protrude from the coupling. However in such couplings the working liquid in the shut down condition gradually leaks into the working circuit through leak-off nozzles, valves and like passages.

This may cause difficulties if the output of the coupling is connected to a load which may also be driven from another source for example a second prime mover in parallel with that connected to the coupling in question. under such circumstances, the output of the coupling may be rotated and the presence of liquid in the working circuit may result in the application of a considerable torque to the shutdown prime mover and exerting also an appreciable drag on the second prime mover in addition to generating heat in the shutdown coupling.

Under such conditions the inclined discharge ends **21** of the shield **16** will now face the vortex flow in the working circuit W which will be in the direction opposite to that of the arrow **18**. Consequently the working liquid will be scooped up by the shield **16** and removed from the working circuit W through the passages **13**.

FIG. 5 shows a scoop-trimmed coupling intended for transmitting relatively high powers at high rotational speeds. Parts correspondingly to parts in FIG. 1 are indicated by the same reference numerals primed. In view of the high speeds at which the coupling is intended to run, the inner profile diameter of the coupling is not much greater than the diameter of the hollow shafts **5'** and **8'** required for transmitting the input and output torque to the coupling. Accordingly the impeller and runner elements **1'** and **2'** are splined directly to their respective shafts **5'** and **8'** at **23** and **24**, concentricity being ensured by tapered surfaces **25** and **26** and annular wedge rings **27** and **28** which are tightened by means of annular nuts forming the baffles **9'** and **10'**.

An impeller casing **29** surrounds the runner **2'** and is secured to a flange **30** on the impeller **1'**. Also secured to the flange **30** is a scoop chamber casing **31** defining an annular scoop chamber **32** in which is mounted a scoop tube **33** having a scooping orifice **34**. The scoop tube **33** is movable axially of itself to determine the position of the radially inner surface of the ring of working liquid which collects in the scoop chamber **32** when the impeller is rotating. The scoop chamber **32** communicates with the radially outermost part of the working circuit W' through passages **35** in the impeller **1'**.

Working liquid is fed to the coupling through the passage **13'** in the stationary part of the housing. The passage **13'** discharges into an annular collecting channel **12'** in the back of the impeller **1'** and the channel **12'** discharges into the working circuit W' through tubes **16'** in FIGS. 1 to 4. In order to ensure a cooling flow of liquid through the working circuit W' in all positions of the scoop **33**, the scoop chamber casing **31** carries a number of restricted leak-off nozzles **36**.

The tubes **16'** protect the incoming flow into the working circuit from the direct action of the vortex flow around the boundary wall of the working circuit W' which can occur when the runner **2'** is stalled. They also serve to remove from the coupling any working liquid which may accidentally enter the working circuit W' when the coupling is shut down and the runner **2'** is rotated for any reason. In addition to their normal functions, the baffles **9'** and **10'** reduce the leakage flow through the clearances between the shafts **5'** and **8'** under all opearting conditions including cases where the runner **2'** is rotated while the impeller **1'** is stationary and the vortex flow is in the reverse direction to normal.

In the couplings described above, liquid cannot be fed directly under pressure to the working circuit along the axis of the coupling for design reasons, usually because the necessarily large bores required to transmit the maximum filling flow cannot be accommodated within the restricted shaft diameters without weakening the shafts. Instead, the working liquid is supplied to the annular channel **12** or **12'** in the back of the impeller so that for a given impeller speed there is a fixed and relatively small centrifugal head available for feeding the fresh liquid into the working circuit W'. Thus the rate at which liquid enters the working circuit is greatly dependent upon the effective resistance offered by the vortex within the working circuit. The shielded inlets **16**, **16'** serve to reduce this resistance to an acceptable value under the most adverse condition, that is to say when the runner is stalled. It is precisely under this condition that the cooling flow is most desired in view of the high rate of disipation of heat in the coupling.

What is claimed is:

1. A hydraulic turbo-coupling comprising vaned impeller and runner elements together defining a toroidal working circuit for liquid, at least one of the said elements being formed with one or more inlet ports for supplying liquid to fill the coupling during operation, wherein a shield for the inlet port or each inlet port projects from the wall of the working circuit into the path of the working liquid to protect liquid emerging into the working circuit from the port from the high speed flow of liquid around the periphery of the working circuit in the direction from the radially inner portion of the runner to the radially inner portion of the impeller when the coupling is operating in the stalled condition.

2. A coupling according to claim **1**, wherein each such shield is formed by a tubular extension surrounding the respective inlet port and projecting into the working circuit.

3. A coupling according to claim **2**, wherein the discharge end of each tubular extension is angled to face in the direction of normal fluid flow in the working circuit as seen in axial section.

4. A coupling according to claim **2**, wherein the tubular extensions project through the relatively rapid boundary layer of the vortex which occurs in the stalled condition of the coupling.

5. A coupling according to claim **1**, and including an annular impeller baffle on the impeller at the inner profile diameter.

6. A coupling according to claim **5**, wherein the runner carries an anti-surge baffle at its inner profile diameter, the anti-surge baffle being substantialy the same diameter as the impeller baffle.

7. A coupling according to claim **6**, wherein the said baffles form nuts for securing their respective elements to respective hollow driving and driven shafts.

8. A coupling according to claim **1**, wherein the said ports open into the working circuit from an annular channel in the element in which they are formed and the coupling includes means for delivering working liquid to the channel.

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