Feb. 4, 1930. F. LAWACZECK 1,745,854

ROTARY HYDRAULIC MACHINE, ESPECIALLY CENTRIFUGAL PUMP.

Filed Dec. 18, 1926 2 Sheets-Sheet 1

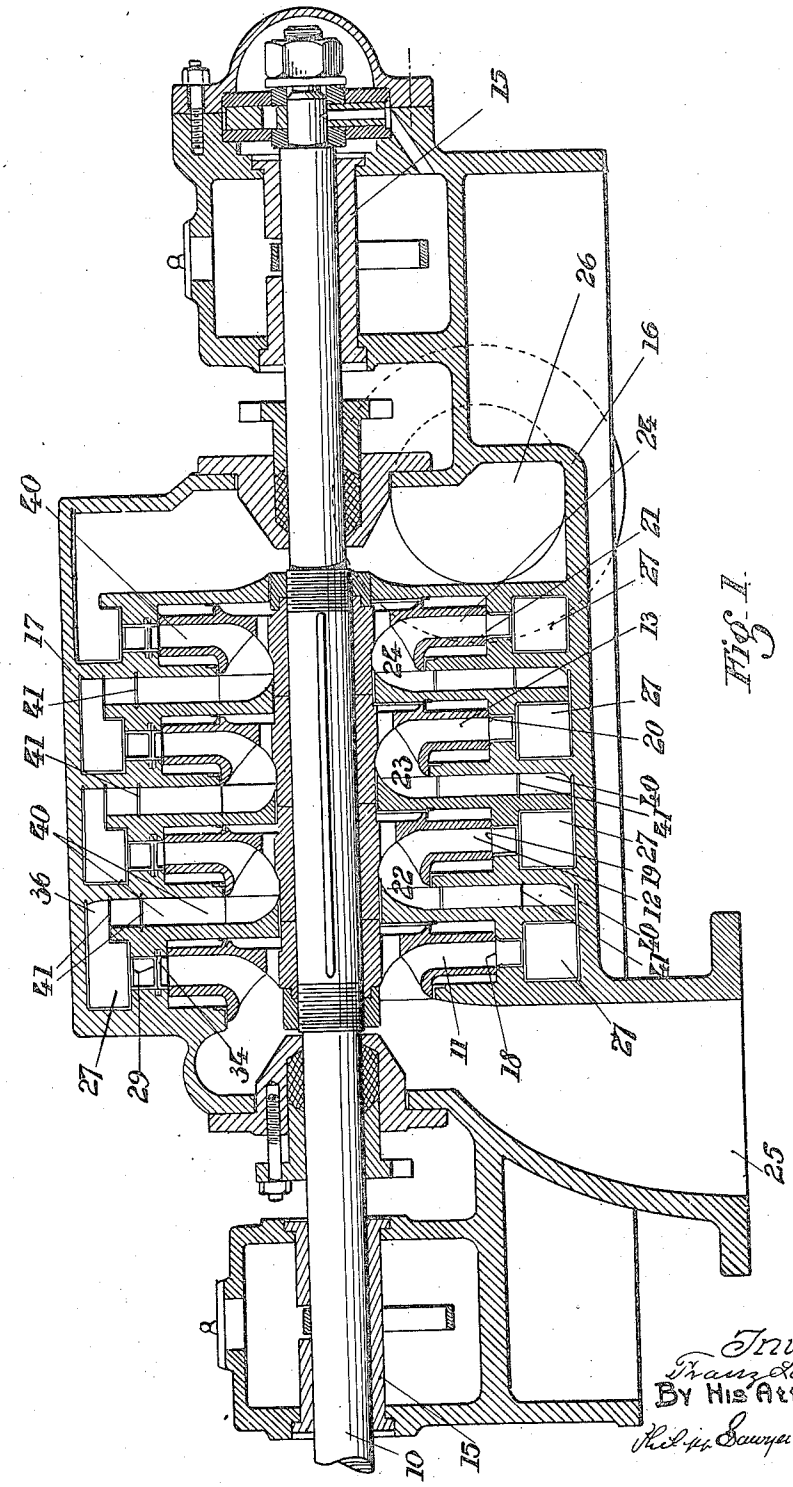


Fig. 1.

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Fig 3.

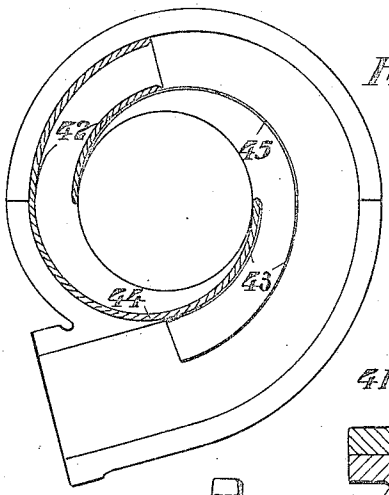
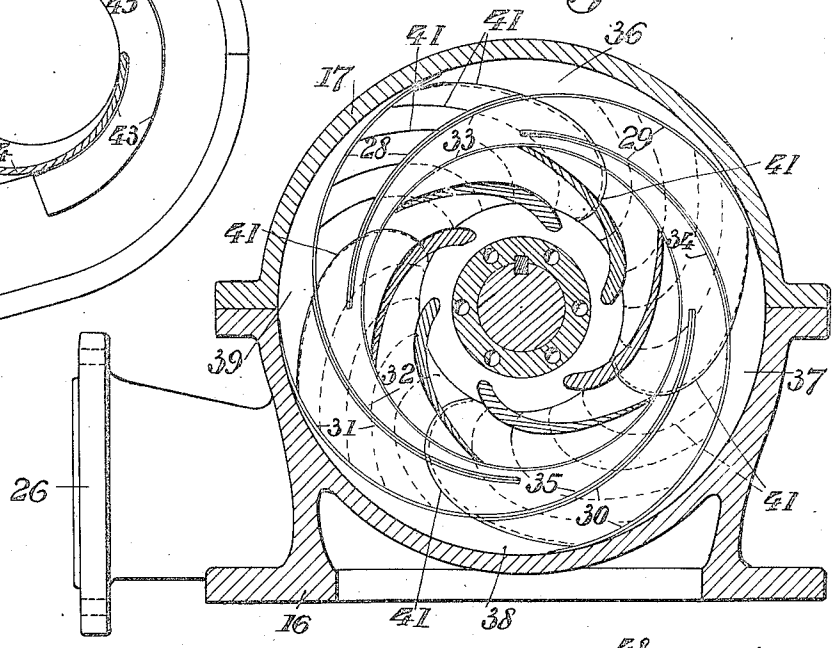


Fig 2.



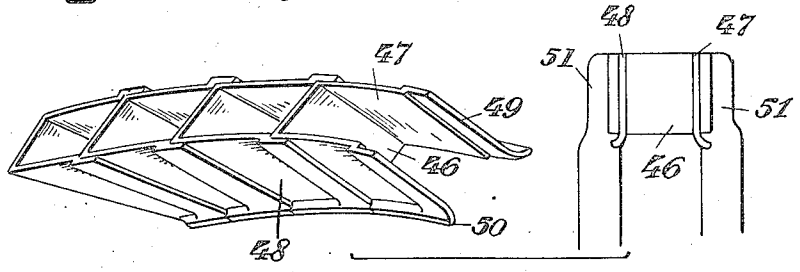
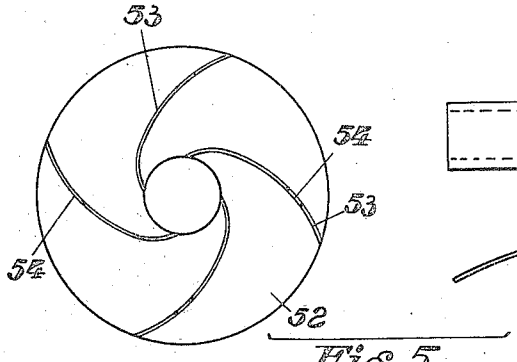


Fig 4.



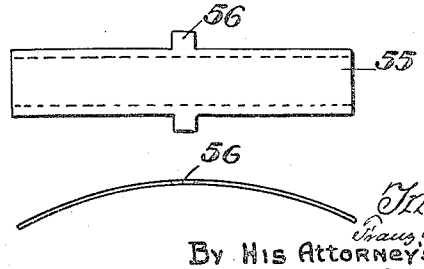


Fig 5.

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1,745,854

UNITED STATES PATENT OFFICE

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ROTARY HYDRAULIC MACHINE, ESPECIALLY CENTRIFUGAL PUMP

Application filed December 18, 1926. Serial No. 155,571.

The present invention relates to a rotary hydraulic machine, especially a centrifugal pump. The output of hydraulic machines of the usual construction is considerably impaired because the ducts of the machine traversed by the water have walls which are too rough and uneven owing to their being made of cast material. Attempts have been made, especially in machines of very high quality and those which propel to a great height, to diminish this drawback by polishing and touching up the cast walls of the ducts, but such touching up or subsequent work is not only very expensive and tedious but almost always accomplishes its object of obtaining duct-walls which are as smooth and frictionless as possible only very defectively because many and important portions of the walls of the very narrow curved ducts are inaccessible for such subsequent work. This applies not only to the runner-ducts, but to at least the same extent to the usually spiral ducts of the guide wheels. When the pump-casing is cast, the core of the single, double or even multiple guide-spirals is incompletely supported and frequently gets displaced. The core is supported through apertures in the walls which must afterwards be again closed. When doing so, it frequently happens that the closing plugs extend into the nozzle or spiral chamber the action of which is very sensibly prejudiced, during operation, by such hindrances to the flow. Moreover, after the cast the core-supports may project into the nozzle duct and there be seriously detrimental.

The object of the present invention accordingly is to provide smooth duct-walls for hydraulic machines without the manufacture of the machine being substantially more costly than heretofore.

According to the invention, the walls laved by the fluid are, at least in part, made of smooth material such as sheet metal the other portion of which material, that is, the side not wetted by the liquid, is embedded in and carried by the usual cast material. The sheet-metal walls therefore form, so to speak, an armouring of the hitherto usual cast walls, so that the liquid flows inside smooth sheet-metal walls throughout its entire course, or at least at those places at which the velocity of the flow is comparatively great, and where consequently the losses due to friction and eddies are liable to be considerable.

Some of the numerous possible embodiments of the invention are illustrated by way of example in the accompanying drawing, wherein

Figs. 1 and 2 are respectively longitudinal and transverse sections of a multiple-stage centrifugal pump having ducts in the casing which are armoured with sheet-metal.

Fig. 3 shows diagrammatically the cross-section of an armoured double-spiral casing of a single-stage rotary pump, and

Figs. 4 and 5 show how the runner-ducts either wholly or in part may be fitted with sheet-iron armouring.

Referring to the drawing, in the multiple-stage pump according to Figs. 1 and 2 the rotating part of the rotary pump, or the part which principally consists of the shaft 10 and runners 11, 12, 13, 14 secured thereon, is journalled in the two bearings 15 of the pump-casing, which is of two-part form, that is, consists of the foundation-part 16 and the cover-part 17. In these casing-parts 16, 17 are arranged, in a manner usual per se, ducts which are preferably of spiral form and which convert into pressure the velocity of the water issuing from each runner-periphery 18, 19, 20, or 21 and divert this water towards the shaft in order to conduct it to the suction-mouth 22, 23, or 24 of the runner following. Water enters the machine-casing through the suction pipe-connection 25, and the pressure-water is delivered from the pump through the pressure pipe-connection 26.

In order to make the walls of these spiral and diverting ducts in the casing-parts 16, 17 as smooth as possible and thereby to reduce fluid friction the largest portion of these duct-walls is made of sheet-metal which, at the time these casing-parts 16, 17 are cast, unites with the cast-walls. In the embodiment shown there are arranged in each annular chamber 27 into which water flows from the peripheral outlets 18, 19, 20, 21 of the

runners, four nozzles 28, 29, 30, 31 which are pressed out of sheet metal and have a spiral curvature and the outer walls 32, 33, 34, 35 of which extend spirally as inlet-tongues towards the runner. These nozzles open at 36, 37, 38, 39 towards the side of the runner 12, 13, 14 which follows, so that the pressure-water can flow in the radial ducts 40 towards the middle of the casing and is here preferably guided by sheet-metal tongues 41 which are set against the lateral nozzle-openings 36, 37, 38, 39 and which, acting as guide-blades conduct the pressure-water to suction-mouth 22, 23, 24 of the runner following. In this way the water in its entire course through the casing is enclosed by smooth sheet-metal walls, with the exception of the radial walls of the duct 40 in which, however, the water has such a small velocity that here no material losses due to friction and eddies can occur.

It will be understood from the drawing that the spiral nozzle-ducts are so formed and dimensioned that they may be pushed over and into one another and then mutually support one another so that they form an annular or disc-like whole which, being suitably filled with any mass readily subsequently removable, can be inserted into the mould for the casing in the manner of a core and of which the outer walls, which are preferably zinc-coated or prepared in other manner, are connected with the casing-walls 16, 17. The casing-parts 16, 17 therefore no longer contain cast ducts, but on the other hand, there serve for conducting the water the sheet-metal nozzle-members 28, 29, 30, 31 and their adjunct blades which are inserted into this cast casing and which are comparatively easily produced by pressing, bending or the like, and indeed have perfectly smooth walls, which are therefore approximately friction-less for the fluid means. By this mode of manufacture considerably more exactitude in the form of the nozzles 28, 29, 30, 31 and especially of their inwardly directed blades 32, 33, 34, 35, which are of great importance for transforming the pressure, is obtained than is the case with the hitherto usual cast ducts. In this way it may be attained that the most sensitive parts of the casing are perfectly homogeneous and clean without subsequent work. The increase of cost due to the manufacture of the pressed sheet-metal nozzles is more than balanced by the avoidance of the subsequent work on the hitherto usual cast casing. Moreover there is obtained with certainty a pump of high quality, the output of which remains exactly constant from the beginning of operation onwards. Especially when a series of pumps is manufactured there is a risk that each pump of the series may not turn out to be equally serviceable.

Fig. 3 is a diagrammatic radial section of the spiral casing, undivided if desired, of a single-stage rotary pump which contains two nozzles 42, 43 mutually supporting each other and pressed from sheet-metal to each of which is connected a long inwardly-directed blade 44, 45 which extends inwardly as far as the circumference of the runner. Here also accordingly the water is guided in the casing by smooth sheet-metal walls both at the places of high velocity of flow and where it takes the exact form of the wall owing to the transformation of the pressure.

This mode of producing smooth duct-walls in rotary hydraulic machines may be extended to the runners. Figs. 4 and 5 show as examples two constructions of this kind. In Fig. 4 it has been presumed that only the rim of the runner, wherein considerable velocity of the water prevails and a very large number of correctly and cleanly formed ducts is specially important, is made with pressed sheet-metal walls. The blades may be pressed separately from sheet metal so that they may be readily assembled into a closed rim. To this end each sheet-metal blade-wall 46 may be continuous with two walls 47, 48 arranged at right-angles to it and therefore in radial planes, so that the pressed sheet-metal element forms a passage of U-like section. The open ends of the sheet-metal limbs 47, 48 are formed, at 49, 50 preferably by being upset or the like, in such manner that the back of each blade, therefore the corners of the U-shaped element, engage in this upset portion of the adjacent blades and is securely guided thereby. In this way a closed annular rim of blades may be assembled and be positioned, as part of the core, in the mould for casting the runner and be cast in with the runner walls 51 to form an integral whole.

If all the walls of the blading passages of the runner are to be perfectly smooth, and are not therefore to consist of cast material, the runner may be constructed in the following manner: The two lateral walls 52 of the runner are pressed from thick sheet brass or the like and in those sides of these two discs which are to become passage-walls are cut curved grooves 53 which correspond to the thickness of the sheet-metal blading and in which small perforations 54 extend to the other side of the disc. The blades 55 are stamped from sheet-metal and bent into the desired form. At the lateral edges of the blades there are preferably left standing up pins 56 which fit into the perforations 54. The blades are now inserted into the grooves 53 of the lateral discs in such manner that their pins 56 extend through the perforations 54 and can be riveted on the outside. Hereupon the entire bladed wheel can be finished by turning and so on.

I claim:

1. A rotary hydraulic machine comprising a cast part and having duct-walls which are

laved by the fluid in said part made of pieces of sheet metal which interengage and support one another.

2. In a centrifugal hydraulic machine, a cast-metal casing, and sheet-metal liners for the passage walls of the casing which are laved by fluid, said sheet metal liners having portions thereof embedded in the cast-metal.

3. In a centrifugal hydraulic machine, a cast-metal casing, sheet-metal liners for the passage walls of the casing which are laved by fluid, said sheet metal liners having portions thereof embedded in the casing, said sheet-metal liners formed of sections inter-engaging to support one another prior to their embodyment in the casing.

4. In a centrifugal hydraulic machine, a cast-metal casing having a plurality of webs formed therein to provide a plurality of fluid passages in the casing, and sheet metal liners for the passage walls of the casing which are laved by fluid, said sheet-metal liners having portions thereof embedded in said webs.

5. In a centrifugal hydraulic machine, a cast-metal casing having a plurality of webs formed therein to provide a plurality of fluid passages in the casing, and sheet-metal liners for the passage walls of the casing which are laved by fluid, said sheet metal liners having portions thereof embedded in said webs and sheet-metal fluid guiding vanes in said passages and having portions thereof embedded in said webs.

6. In a centrifugal hydraulic machine, a cast-metal casing having a plurality of webs formed therein to provide a plurality of fluid passages in the casing, sheet-metal liners for the passage walls of the casing which are laved by fluid, said sheet-metal liners formed of sections inter-engaging to support one another and having portions thereon embedded in said webs, and sheet-metal fluid guiding vanes in said passages and having portions thereof embedded in said webs.

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