

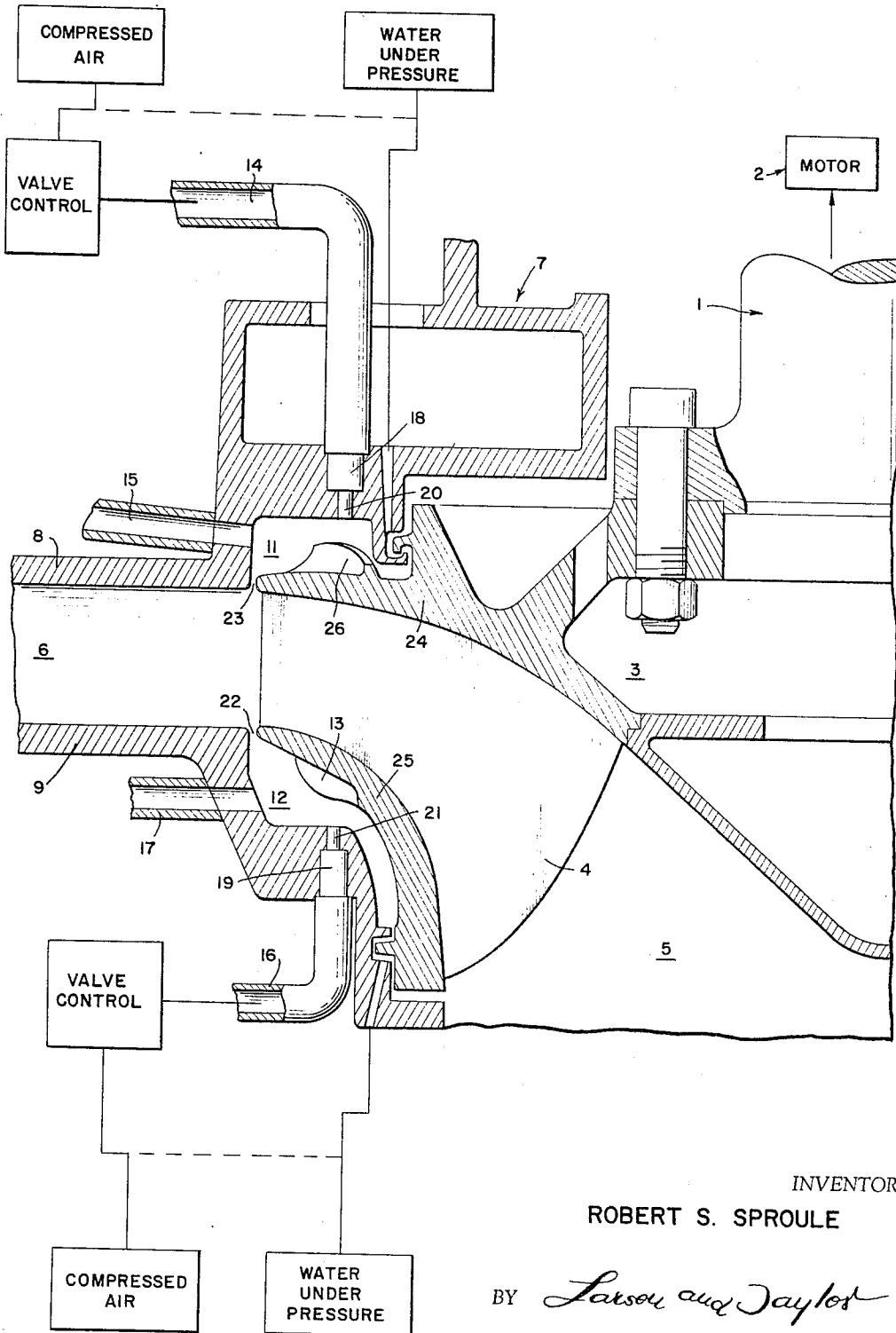
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STARTING MEANS FOR AN HYDRAULIC PUMP

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STARTING MEANS FOR AN HYDRAULIC PUMP
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This invention relates to large rotary pumps and pump-turbines while operating as pumps of the type used in water distribution or hydro-electric power generation in which there is incorporated a shrouded impeller with provision for reducing the fluid friction on the runner shrouds and in which there is provided improved means for starting the hydraulic machine.

There are described in the following co-pending applications, assigned to the present assignee, various methods of reducing the fluid friction by means of aeration:

Serial No. 201,881 filed June 12, 1962, now Patent No. 3,174,719.

Serial No. 286,646 filed June 10, 1963, now Patent No. 3,174,720.

Serial No. 326,608 filed November 27, 1963.

Serial No. 372,996 filed June 5, 1964.

The subject matter of the quoted applications, which cover the method of aeration, is noted only by way of illustration of the type of machine referred to herein and provides a system of controlled aeration which will result in the most efficient utilization of the present invention as will be fully described hereinafter. The present invention will operate equally well with other systems of aeration or other means of removing the working fluid from the shroud spaces, applied to the type of rotating pump described herein.

Where large pumps are motor-driven, the source of power supply is invariably A.C. current and economy of operating and electrical characteristics dictate a synchronous type motor. The motor for pump operation of a pump-turbine becomes the generator for turbine operation and is likewise designed for synchronous speed operation.

Even where the level of water in the machine is depressed by air pressure so that the impeller rotates in air a synchronous motor has difficulty overcoming the inertia of the rotating parts and in the past various means have been devised to overcome this difficulty, such as example, an extra starting motor, or starter windings in the synchronous motor and various types of hydraulic turbines attached to the pump shaft. All of these methods are expensive and in addition modifications of the electrical system to meet this problem impose very undesirable loads on the system.

The present invention overcomes the various disadvantages of prior art systems and provides a means for starting hydraulic pumps after depressing the level of the water below the pump impeller by means of compressed air without requiring extra electrical equipment or necessitating overloading the electrical system to provide the required starting torque. These objectives are achieved by incorporating in the impeller a series of starting blades or buckets and directing jets of water at these starting blades within the shrouds of the pump. When the inertia of the rotating assembly is overcome, the driving motor of synchronous type is energized and then maintains operation of the pump in the normal manner, while simultaneously the jets of water are cut off.

The structure of the starting blades is such that, if the shroud spaces surrounding the impeller were left flooded with water after the machine was operating normally, the resulting turbulence would produce undesirable fluid friction losses. Accordingly, during operation of the pump it is preferred that the shroud spaces be evacuated of

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water in order to most effectively use the present invention. Methods of achieving this evacuation of water are covered by the above referenced co-pending applications but it will be readily understood that other systems of producing shroud spaces free of water are included within the scope of this invention.

In the preferred embodiment of the present invention the starting blades are formed in both the band and crown faces of the impeller and adjacent to the outer periphery thereof. The casing structure which houses the impeller is provided with chambers into which the blades extend. Pipes or conduits extend through the casing structure to nozzles disposed in the chambers and jets of water are fed through one set of conduits to act against the starting blades to initiate rotation of the impeller. A return passageway or drain is provided to remove the water accumulated in the chamber. During the process of putting the pump into service air is injected in correct sequence to establish aerated shroud spaces.

The primary object of the present invention is to provide an economical starting means for rotary hydraulic pumps of the type described by utilizing water under pressure as the starting means.

Another object of the present invention is to provide economical starting means for a rotary hydraulic pump whereby the electric motor which drives the pump after start-up can be of the most economical type while not imposing undesirable loads on the power supply system.

Another object of the present invention is to provide a starting device for pumps of the type described wherein there is provided a plurality of starting blades on the impeller and jets of water are directed to these starting blades to initiate rotation of the impeller.

Still another object of the present invention is to provide a means for starting an hydraulic pump impeller and for reducing the resistance to rotation of the impeller after the impeller is brought to speed. This is achieved by directing water under pressure at the starting blades mounted on the impeller to initiate rotation of the impeller and thereafter aerating the shroud spaces of the pump.

Other objects, with their attendant advantages, will become more fully apparent upon consideration of the following detailed description of the preferred embodiment of the present invention in connection with the accompanying drawing wherein:

The single figure shows a partial sectional view of an hydraulic pump.

Referring now more specifically to the drawing there is shown at 1 a central shaft which is driven by a motor shown diagrammatically at 2. Mounted on this shaft is an impeller 3 having a plurality of blades 4 mounted thereon. The impeller 3, and blades 4, are connected together by crown shroud 24 and band shroud 25. Under normal operation of the pump water is pumped from the inlet area 5 by the impeller blades up to the outlet passageway 6.

A casing structure generally indicated by the numeral 7 includes a head cover 8 and a bottom cover 9. This casing structure surrounds at least the peripheral portion of the impeller.

It can be seen that there are formed upper and lower shroud spaces 11 and 12 respectively and these shroud spaces are disposed immediately adjacent the outer peripheral portion of the impeller. There are formed in the upper and lower faces of the impeller a plurality of starting blades or buckets which are shown at 26 and 13 respectively. The blades or buckets are shown as formed in the outer faces of the impeller 3, however, if desired, separate blades could be attached to the outer face of the impeller.

Extending through the headcover 8 to the shroud area 11 is a supply pipe 14 and extending from the shroud area 11 is a drain pipe 15. Similar pipes 16 and 17 extend through the bottom cover 9 to the shroud area 12. Valve control means is provided to supply water under pressure to the supply pipes 14 and 16, which terminate in manifold areas 18 and 19 respectively. One or more nozzles 20 and 21 are formed at an oblique angle and lead from the manifolds into the upper and lower shroud spaces.

In operation, when it is desired to initiate rotation of the impeller 3, water from a source of high pressure is supplied through passageways 14 and 16 respectively. The nozzles 20 and 21 cause this water to be directed into the buckets or blades 26 and 13 so as to provide the starting torque necessary to rotate the impeller.

During this phase of the operation, the water after impinging on the blades 26 and 13 is forced out of the shroud spaces 11 and 12 by centrifugal action aided by the action of the shaped buckets 26 and 13 either through drain passages 15 and 17 or through the working clearances at 22 and 23 between the outer periphery of the runner and surrounding casing structure.

When the impeller has been brought up to a suitable speed the driving motor 2 is started and the supply of water to shroud spaces is shut off and drain passageways 15 and 17 are closed. During the starting process stable aeration is established as fully described in the above referenced co-pending applications.

While the invention has been shown as being applied to both the upper and lower shroud spaces, it is apparent that it is well within the scope and spirit of the invention to provide such a starting system for only one shroud area.

Obviously many modifications and variations of the present invention are possible in light of the above teachings.

What is claimed is new and is desired to be secured by Letters Patent is:

1. A hydraulic pump of the class described comprising, in combination, a central shaft, an impeller mounted on said shaft, motor means for driving said impeller, a casing surrounding at least the peripheral portion of said impeller, inlet and outlet passages in said casing communicating with the impeller, starter blades disposed on

the outer face of the impeller, said starter blades being unshrouded, means independent of the inlet and outlet passages for supplying jets of hydraulic fluid to the starter blades to initiate rotation of the impeller, means for withdrawing hydraulic fluid from the starter blades and means for supplying air to space between the impeller and casing when the motor means drives the impeller.

2. An hydraulic pump of the class describing comprising, in combination, a rotor, impeller blades on said rotor, a casing structure surrounding a portion of the rotor, said casing having inlet and outlet passages, the impeller blades adapted to pump hydraulic fluid from the inlet passage to the outlet passage, at least one chamber between the rotor and casing structure, a plurality of starting blades mounted on the rotor and disposed within said chamber, means independent of the inlet and outlet passages for directing jets of fluid to said starting blades to provide starting torque for the rotor, means for driving the rotor to force hydraulic fluid from the inlet passage to the outlet passage, and means for supplying a gas to said chamber to reduce the resistance to rotation of the rotor when said rotor is being driven by said driving means.

3. An hydraulic pump according to claim 2, wherein a chamber is disposed on both the upper and lower edges of the rotor.

4. A hydraulic pump according to claim 2, wherein said means for directing jets of fluid to the starting blades includes nozzles extending through the casing wall.

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