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PUMP AND METHOD OF MAKING THE SAME

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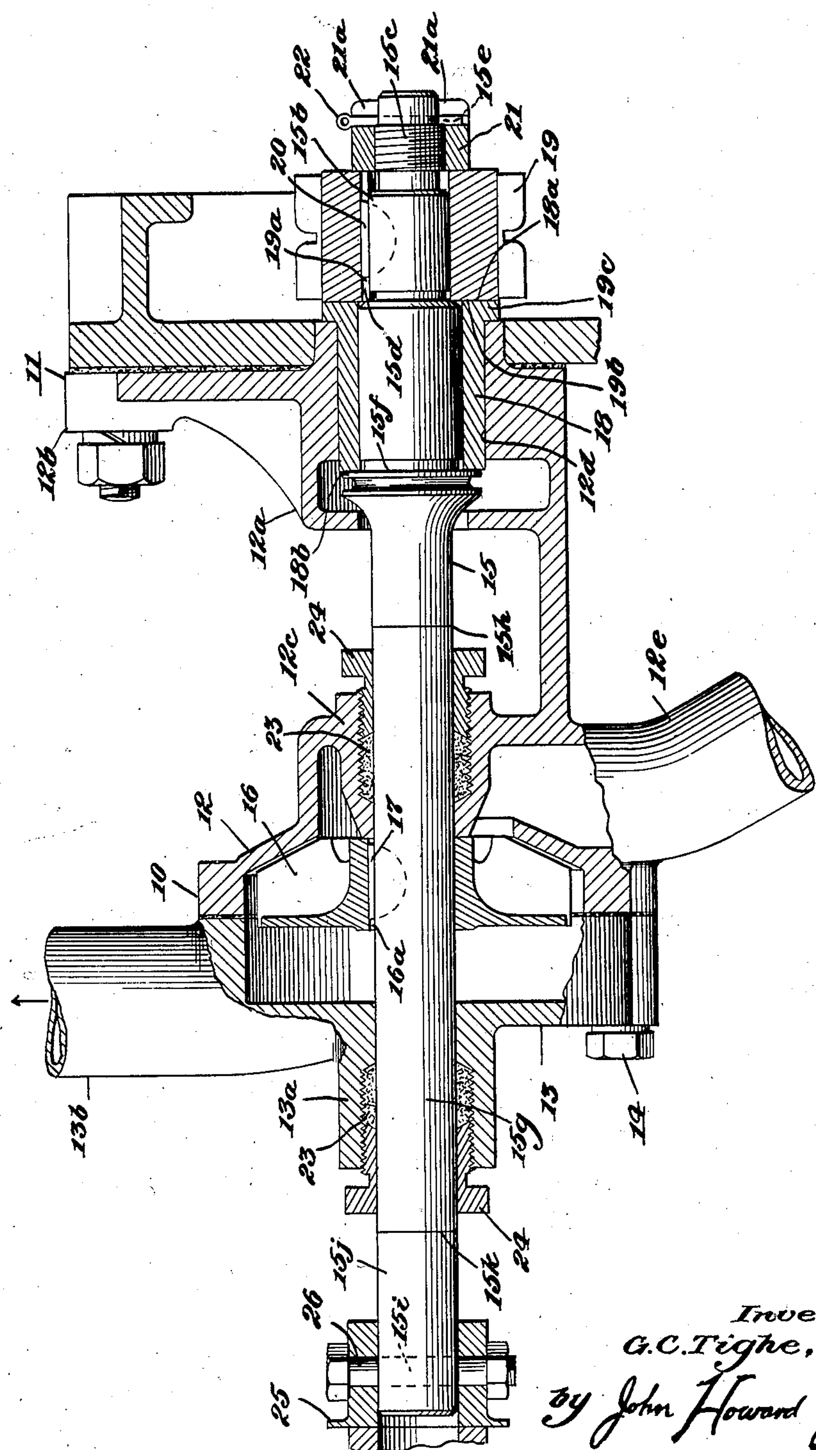

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PUMP AND METHOD OF MAKING THE SAME

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This invention relates to fluid pumps and more particularly to hydraulic pumps, especially of the centrifugal type.

One of the objects of my invention is the provision of a fluid pump which has a minimum of wear, corrosion and erosion of moving parts and which requires a minimum of adjustment and/or shut-down and repair.

Another object is the provision of a pump adapted for use in circulating water in the cooling system associated with an internal combustion engine, such as the cooling systems associated with the engines of automotive vehicles, that is highly efficient and less given to leakage than heretofore known and/or used pumps of the character indicated throughout the long periods of alternate use and idleness, the various soft and hard waters employed as cooling fluids, and the dirt, grime, heat and vibration encountered in actual, practical use.

A still further object of my invention is the provision in a simple, direct, efficient, and thoroughly reliable manner of a pump shaft well adapted to withstand the varying conditions encountered in use.

Other objects of my invention in part will be obvious and in part pointed out hereinafter.

The invention, accordingly, consists in the combination of elements, features of construction and arrangement of parts and in the several method steps and the relation of each of the same to one or more of the others as described herein the scope of the application of which is indicated in the following claims.

In the accompanying drawing, illustrative of my invention, there is shown a pump, certain parts of which are broken away to more clearly disclose certain features of my invention, together with associated driving means and auxiliary mechanism.

As conducive to a clearer understanding of certain features of my invention it may be noted at this point that in many branches of industry, agriculture, mining and the like fluids are conveyed or handled which may be either acid, alkaline or salty in character or which may contain a considerable proportion of dirt, grit or other abrasive material. In these various branches of endeavor a variety of pumps are employed to handle these fluids. While the type, size and rating of these pumps are directly determined by the character of use to which they are to be put all of the pumps of necessity include certain moving parts either reciprocating or rotating where wear, abrasion, erosion and corrosion are experienced. The wear is particularly great in pumps handling these various fluids where both the corrosive and abrasive agents are encountered.

It may be further noted that in all of the pumps employed for handling fluids of the character indicated there are a number of intricate mechanical parts of special shape requiring considerable accurate machining. The pump shafts or members actuating the moving parts of the various pumps require an especially great amount of machining, as in the provision of precise bearing surfaces, grooves, slots, threaded end-sections and drilled portions, which greatly contribute to the expense of producing the pumps.

In heretofore known and/or used pumps of the general character indicated the use of corrosion-resistant and wear-resistant moving parts, and more particularly the use of corrosion-resistant and wear-resistant pump shafts, renders the pumps prohibitively expensive for use in general applications where mildly corrosive and/or erosive conditions are encountered because of the proportionately greater expense of these materials over the materials commonly used in general duty pumps and because of the increased cost of machining and finishing this wear-resistant metal. Where the general duty pump is employed in this class of service, as for example in circulating cooling water employed in the cooling systems associated with internal combustion engines, driving automotive vehicles, the grit and dirt present in these waters and especially the oxide scale coming from the cooling jackets of the engine, are all effective in causing considerable wear of the pump shaft by corrosion and erosion. This wear is especially great at the point where the pump shaft passes through the pump housing and where the pump is packed to avoid leakage at these points. Under the conditions encountered in actual, practical use where long periods of idleness are succeeded by long periods of operation the pump shaft is especially corroded at these sections.

While the precise nature of this corrosive attack is not definitely known it is variously attributed to corrosion of the metal by air dissolved in the water or to a direct chemical attack of the metal by the acid or alkaline content of the water, such as carbonic acid resulting from the water dissolving carbon dioxide present in the gases exhausted from the engine, or to an electro-chemical action arising from inherent differences in the electro-potentials of the metals employed in the pump construction in and adjacent to the moving parts (the cast iron or cast steel of the pump housing, the mild steel of the pump shaft and the bronze or brass of the packing nuts employed to maintain the pump packing in proper position forming with the fluid handled by the pump an electrolytic cell effecting corrosion of the pump shaft). This corrosion, however produced, is effective in forming on the surface of the shaft a thin corrosion product which is subsequently worn away by the abrasion or erosion encountered in operation of the pump, permitting the formation of a new corrosion product which is subsequently worn away, an action which continues during the normal operation of the pump shortly causing an objectionable leakage of the pump at these points. The continual adjustment or tightening of the pump packing in an attempt to stop the leakage in many instances causes a binding of the pump and a scouring of the pump shaft resulting in further and greater leakage. The continual adjustment, repair and replacement of parts necessary to prevent leakage of the pump, and loss of cooling fluid in an internal combustion engine for example, is not only expensive in labor and materials but also causes many highly objectionable delays in the use and operation of the automotive vehicle driven by the engine.

One of the outstanding objects of my invention is the provision of a pump of general utility, and especially one which is designed for use with automotive vehicles, which is adapted to withstand the exacting conditions of actual, practical use employing a shaft which is particularly corrosion-resistant and wear-resistant formed of inexpensive stock which is readily machined and finished to desired specifications at minimum expense.

Referring now more particularly to the practice of my invention attention is directed to the drawing wherein a centrifugal pump generally indicated at **10** is suitably mounted adjacent an internal combustion engine (not shown) as by being bolted to the gear casing of the engine as generally indicated at **11** with a suitable gasket intervening. Illustratively, pump **10** comprises a section of pump housing **12**, conveniently of cast steel, shaped to include a bearing housing portion **12***a* and support bracket **12***b* which is conveniently bolted to the gear housing of the internal combustion engine. The pump housing is completed by a second portion **13**, conveniently of cast steel, which is conveniently fastened to the portion **12** by bolts **14**. To give a water-tight chamber the two parts of the pump housing are separated by a gasket in accordance with established practice.

Journaled within bearing housing **12***a* is pump shaft **15** which passes through drilled and threaded end-portions **12***c* and **13***a* of pump housing **12—13**. Mounted on shaft **15** and maintained properly spaced within pump housing **12—13** is the pump impeller **16** conveniently slotted as at **16***a* and fastened to shaft **15** by key **17** interfitting a suitable key-way provided in the shaft.

The shaft **15** is rotatably mounted and maintained in axial alignment with pump housing **12—13** by means of a Babbitt sleeve bearing **18** snugly interfitting the hole portion **12***d* provided in the bearing housing to which the sleeve bearing is secured in any suitable manner, as by a set screw (not shown). Power is supplied shaft **15** by way of gear **19** mounted on a constructed end-portion **15***b* of the shaft and conveniently fastened thereto by key **20** interfitting a slotted portion of the shaft and a slotted portion **19***a* of the gear. Movement along the length of the shaft is effectively precluded by the castellated nut **21** engaging a threaded portion **15***c* of the shaft forcing an inner shoulder **19***b* of the gear against shoulder **15***d* of the shaft. Loosening of the nut is prevented by the cotter key **22** passing through a hole **15***e* provided in the end of the shaft and resting snugly within the crenellated portion **21***a* of the nut.

End-play of shaft **15** is effectively precluded by the face **19***c* of driving gear **19** encountering an end-portion **18***a* of the sleeve bearing which prevents motion of the shaft from right to left, as seen in the drawing. Motion of the shaft in the direction from left to right is prevented by fashioning the shaft with an integral collar portion **15***f* which encounters the end-portion **18***b* of the sleeve bearing.

It may be noted at this point that because of the considerable amount of machining of the pump shaft necessary to provide a good bearing surface, grooves, key-ways, threaded end-portions and the like, a material which is strong and tough and yet which may be readily machined is desired. The well known cold rolled mild steel or special alloy steels containing small percentages of chromium, vanadium, copper, silicon and the like give good results.

As driving energy is supplied the shaft **15** the shaft revolves the pump and impeller **16** causing a flow of cooling fluid in through pump intake **12***e* where it is directed radially toward the shaft by the peculiar shaping of pump housing **12**. The cooling fluid is whirled by the revolving impeller **16** and thrown radially outward of the shaft where it is guided by the outermost portions of pump housing **12—13** to the pump outlet **13***b* from which it is taken to the cooling jackets of the internal combustion engine. Leakage from pump housing **12—13** along pump shaft **15** is prevented by pump packing **23** which is maintained snugly against the pump shaft at the sections where the shaft enters the housing by packing nuts **24** fitting about shaft **15** and threadedly engaging end-portions **12***c* and **13***a* of the pump housing.

As more particularly indicated above the various radiator fluids, dirt, grime, scale and the like encountered in cooling fluids employed in the cooling systems associated with internal combustion engines are effective in causing considerable wear by abrasion, corrosion and erosion of the pump shaft. This wear is particularly pronounced along the regions where the pump packing is maintained in intimate contact with the pump shaft in an attempt to avoid leakage of the cooling fluid.

In the practice of my invention excessive wear by abrasion, erosion and corrosion at these points is effectively prevented by including in the shaft **15** a section of rustless iron or steel **15***g*. This alloy iron or steel analyzes approximately, 10% to 30% chromium, 0% to 20% nickel with or without supplementary additions of copper, molybdenum, tungsten, aluminum, silicon and the like and the balance substantially iron. The corrosion-resistant and wear-resistant section of the shaft is preferably butt-welded, as shown at **15***h* to the mild steel section during an early stage of manufacture of the shaft.

As a matter of convenience in manufacture the mild steel section of the pump shaft is butt-welded to the corrosion-resistant iron or steel section of the shaft prior to machining the shaft to the desired specifications. Where the corrosion-resistant section of the shaft is of the well known austenitic 18—8 chromium-nickel iron analyzing approximately, 18% chromium, 8% nickel, .10% carbon and the balance substantially iron the high temperatures encountered in welding the two sections of pump shaft cause no objectionable hardening of the material. The shaft is then machined to desired specifications with grooved, slotted, threaded and drilled portions, as indicated above, and finished by grinding and polishing.

Where a less expensive corrosion-resistant iron or steel, such as a straight chromium iron analyzing, 12% chromium, .10% carbon and the balance substantially iron, is employed the sections of corrosion-resistant iron or steel and mild steel or special alloy steel are preferably machined to desired specifications prior to butt-welding the two sections together because of the hardening of the corrosion-resistant material as a result of the welding operation. The formed shaft is then ground and polished to the finished specification.

The resultant composite pump shaft comprises a corrosion-resistant, wear-resistant section requiring very little machining, which is particularly resistant to the formation of a corrosion product under the conditions encountered in actual, practical use. This section of the pump shaft is resistant to the direct chemical attack of the fluid handled by the pump either in a hot or cold condition. It is resistant to oxidation by the amount of dissolved air contained in the fluid and it is resistant to the electrolytic corrosion arising from differences in the electro-potentials of the various materials employed in the pump construction. This section of shaft is also highly resistant to wear or abrasion by dirt, grime, scale or the like contained in the fluid circulated by the pump and which finds its way into the pump packing.

The composite pump shaft comprises in addition to the corrosion-resistant, wear-resistant section which enters the pump proper a section which is readily machined giving the desired bearing surface, thrust collar and mounting for the driving element of the shaft.

Where desired, as where an auxiliary device such as an electric generator is driven by the pump a section of shaft is extended beyond the pump. This section may be of mild steel or special alloy steel rather than a corrosion-resistant iron or steel. For example, referring to the drawing, a generator (not shown) is coupled to the pump shaft 15 by way of a suitable coupling device 25 fastened to shaft 15 in any suitable manner, as by a bolt 26 passing through a hole portion 15i provided in shaft 15 and engaging coupling 25. Where the savings in the cost of the corrosion-resistant iron or steel is warranted the section 15j of shaft 15 is made of mild steel or alloy steel, butt-welded as at 15k to the corrosion-resistant portion of the shaft. It will be understood that the desirability of employing mild steel or alloy steel for this end-portion of the shaft is determined by the relative costs of corrosion-resistant steel and mild steel as compared with the cost of making this additional weld.

Thus, it will be seen that there has been provided in this invention a fluid pump and method of producing the same, in which the various objects hereinbefore noted together with many practical advantages are successfully achieved. It will be seen that the pump is particularly adapted to handle mildly corrosive fluids or corrosion promoting fluids containing abrasive material, under the conditions of starting and stopping, long periods of idleness, alternating with long periods of operation, and the heat and cold, shock and vibration, all encountered in actual, practical use, with a minimum of leakage, adjustment and repair. It will be further seen that the pump readily lends itself to efficient and economical production at a minimum of increased cost over heretofore known and/or used general duty pumps of the class indicated and at much less cost than heretofore known and/or used special pumps of the character indicated.

While as illustrative of the practice of my invention the composite pump shaft is machined to desired specifications, either before or after the butt-welding operation, and the shaft then finished by grinding without heat treatment being given, it will be understood that where such procedure is found desirable, as where a special alloy steel is employed in conjunction with a corrosion-resistant iron or steel which is hardenable by heat-treatment, the finished shaft may be given a desired heat treatment, either to relieve local strain in the metal, as by an annealing treatment, or to harden both sections of the shaft as by hardening and tempering.

As many possible embodiments may be made of my invention and as many changes may be made in the embodiment hereinbefore set forth it is to be understood that all matter described herein or shown in the accompanying drawing is to be interpreted as illustrative, and not in a limiting sense.

I claim:

1. In a fluid pump, including a pump housing and a fluid circulating member positioned within said housing, a pump shaft operatively associated with said member and extending outwardly of said housing, the portion of which that extends within and adjacent said housing and contacts the fluid handled by the pump being of rustless iron analyzing approximately, 10 per cent to 30 per cent chromium, 0 per cent to 20 per cent nickel and the balance substantially iron.

2. In a fluid pump, a pump shaft comprising a rustless iron portion and a low-carbon steel portion butt-welded thereto.

3. In a fluid pump, a composite pump shaft comprising an intermediate rustless iron section and low-carbon steel extreme sections butt-welded to said intermediate section.

4. In the production of pump shafts, the art which includes, butt-welding a length of rustless iron bar stock to a length of iron or steel bar stock and thereafter machining and finishing the composite bar to desired specifications.

5. In the production of pump shafts, the art which includes, butt-welding a length of rustless iron analyzing approximately, 10 per cent to 30 per cent chromium, 0 per cent to 20 per cent nickel and the balance substantially iron to a length of iron or steel bar stock, and thereafter machining and finishing the composite bar to desired specifications.

6. In a fluid pump, a pump shaft comprising a rustless iron portion and a low-carbon steel portion welded thereto, said rustless iron portion containing about 18 per cent chromium, about 8 per cent nickel, and the balance substantially iron.

7. In a fluid pump, a pump shaft comprising a rustless iron portion and a low-carbon steel portion welded thereto, said rustless iron portion containing about 12 per cent chromium with the balance of the metal substantially iron.

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