Aug. 22, 1950 D. E. JACK ET AL 2,519,473

PUMP IMPELLER

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FIG. 1.

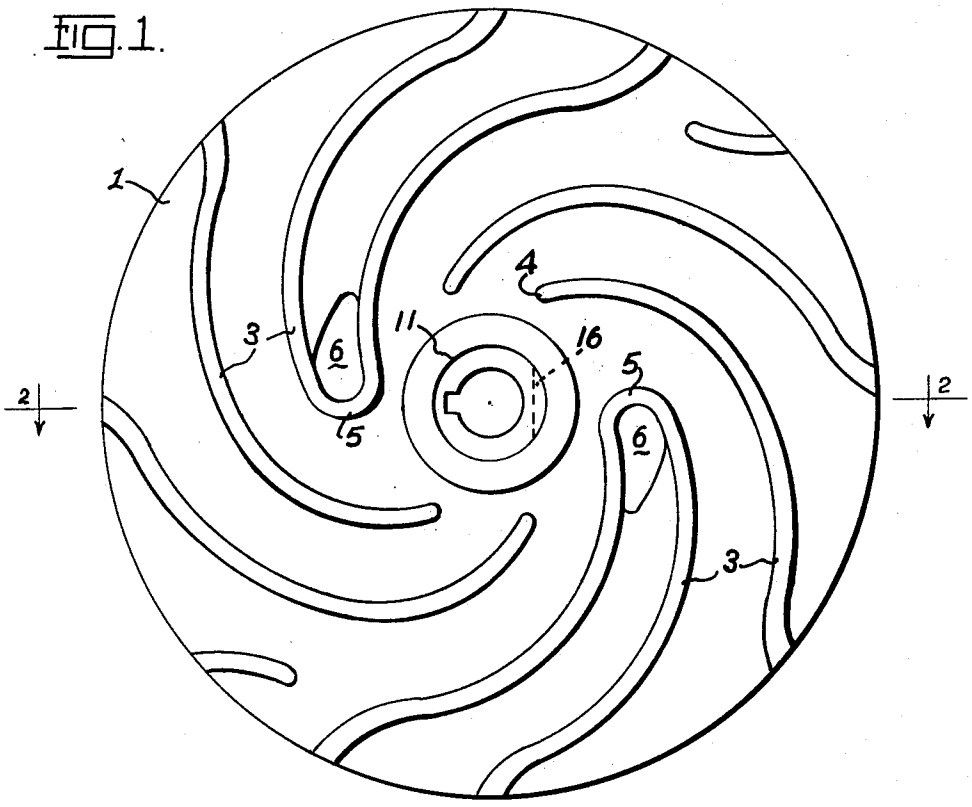
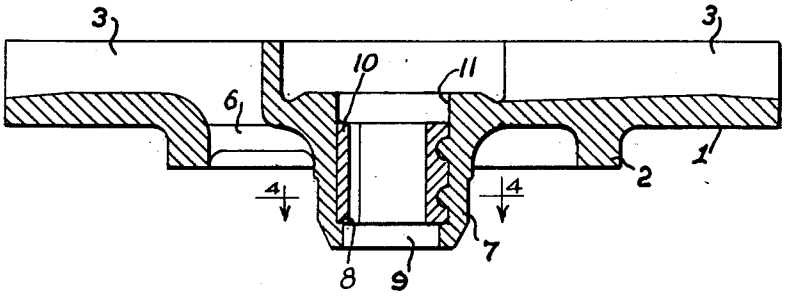


FIG. 2.



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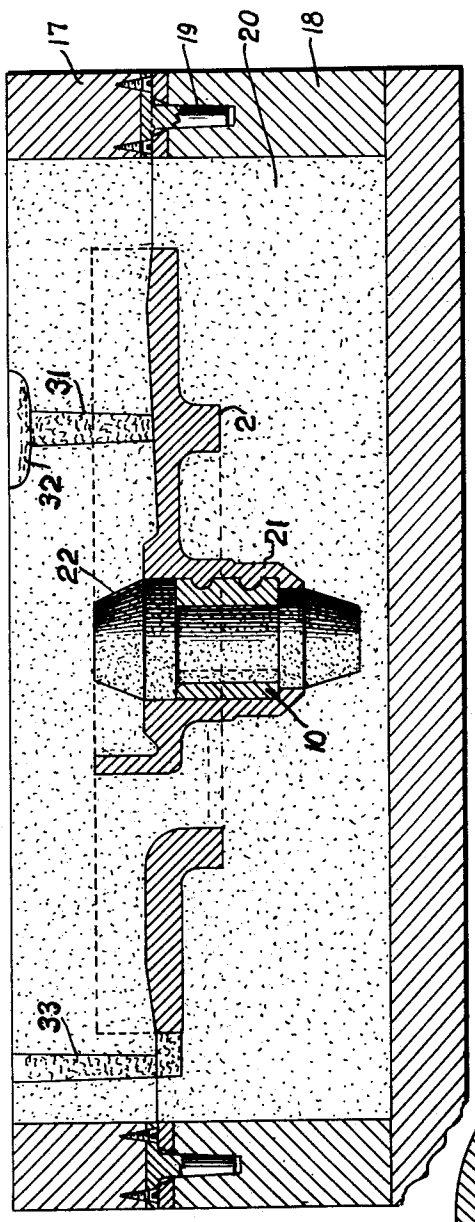


FIG. 3.

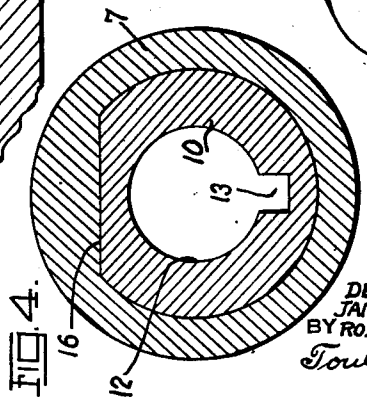


FIG. 4.

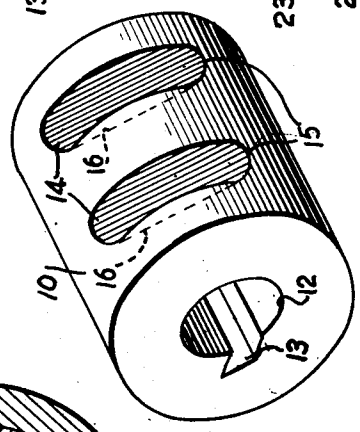


FIG. 5.

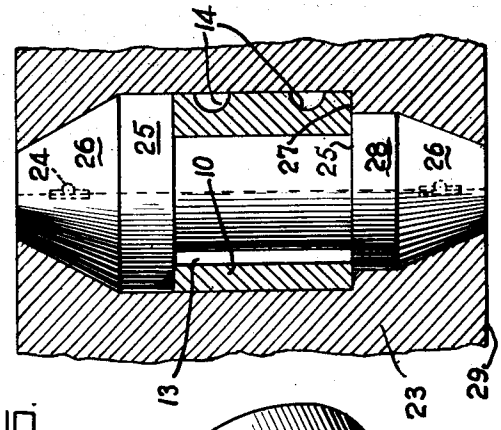


FIG. 6.

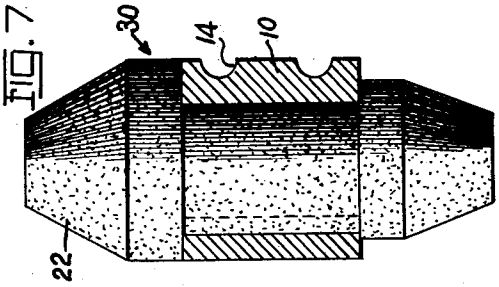


FIG. 7.

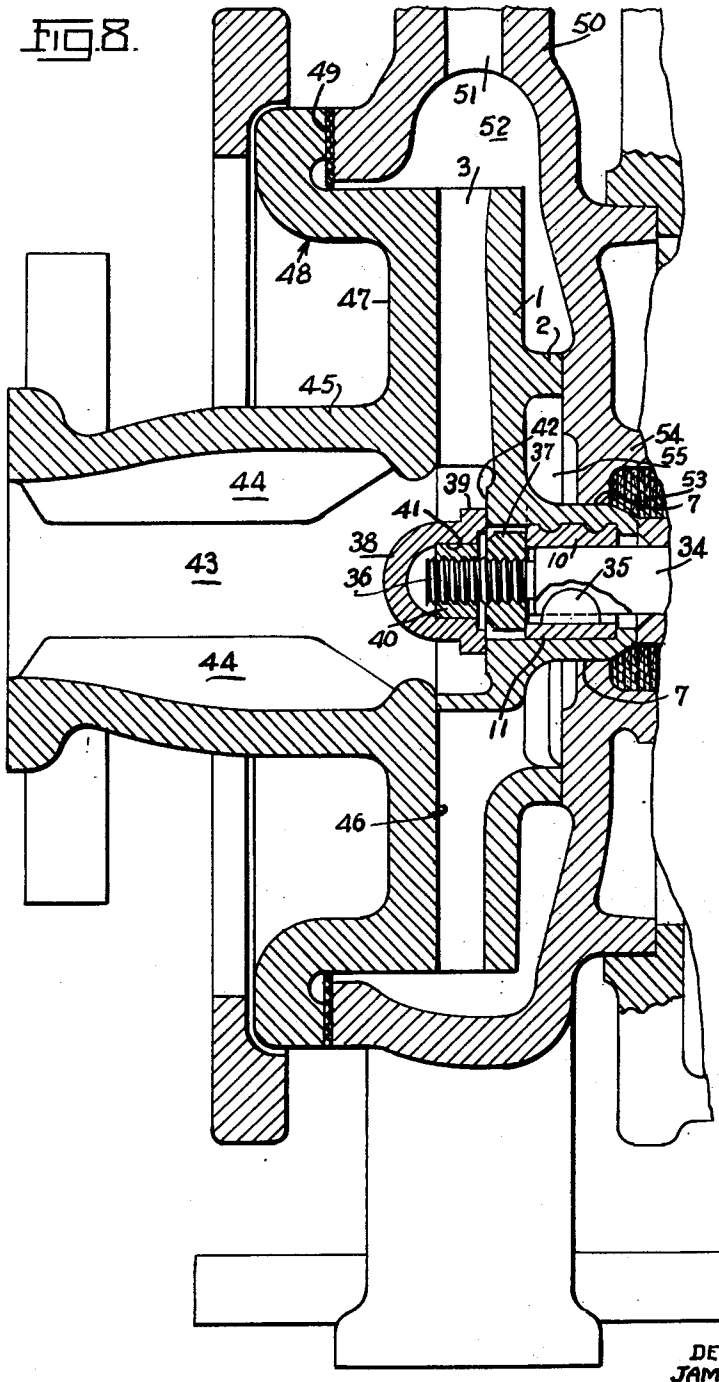
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Fig. 8.



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UNITED STATES PATENT OFFICE

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PUMP IMPELLER

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Application August 10, 1946, Serial No. 689,758

3 Claims. (Cl. 287—53)

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The present invention relates to centrifugal pumps and more particularly to the impeller of a pump which is designed especially for handling corrosive fluids.

When employing a pump for handling an acid-containing solution, the parts of the pump which come into contact with the corrosive liquid are usually made of non-attackable metal such as silicon iron. Metal of this character is so hard that it is practically unmachinable. The impeller travels at considerable speed and contains vanes which makes the element quite heavy so that the problem of securing the impeller to the actuating shaft is exceedingly difficult. Various ways of accomplishing this end have been heretofore proposed, most of them centering about the use of a heavy sleeve, threaded on the interior for receiving a threaded portion of the shaft and molded within an annular groove contained in the impeller hub. However, it was found that due to the extreme stresses and strains set up between the shaft, and the hub, the sleeve tended to work loose and the shaft became slightly unthreaded in the sleeve so that the impeller, after long heavy use would begin to wobble on the shaft.

It was further proposed to introduce melted fusible metal in the space between a turned-down end of the shaft and a hollow compartment formed within the impeller hub. However, the tremendous forces involved in sudden starting or stopping the heavy impeller were sufficient to cause the shaft to become loose from the metal except in cases of relatively small impellers or small starting torques.

In accordance with the present invention we have devised a unique method and apparatus for securing the shaft to the interior of the impeller hub in such a way that an immovable rigid joint is secured between these elements, even in the case of extremely large impellers and considerable starting torques and yet there is a provision for deliberately unloosening and detaching the shaft from the impeller.

Accordingly, the primary object of the invention is to provide an improved securing means between an actuating shaft and a heavy bladed impeller, designed for large and abrupt starting torques and constituting the power element of a large capacity pump.

Another object is to provide an improved combination of a pump impeller and the actuating shaft by which the impeller is securely but detachably held on the shaft regardless of the load imposed on the impeller and also regardless of

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the heavy strains and stresses set forth during the starting and stopping operations.

The above objects are carried out in brief by casting a sleeve of machinable metal in the interior of the impeller hub and securing the sleeve to the hub by the use of cast keys which prevents rotational and longitudinal movement of the element with respect to the impeller hub. The shaft is provided with a threaded end portion which receives a nut bearing against the sleeve to hold the impeller tightly but detachably in place.

The invention will be better understood when reference is made to the following description and the accompanying drawings in which:

Figure 1 represents a plan view of the impeller together with the attachment insert and looking directly at the vanes.

Figure 2 is a sectional view taken along line 2—2 in Figure 1.

Figure 3 is a sectional view taken across a mold and showing the manner in which the impeller is molded about the machinable insert.

Figure 4 is an enlarged sectional view taken along line 4—4 in Figure 2.

Figure 5 is a perspective view of the metal insert which is molded into the impeller.

Figure 6 is a fragmentary view looking into the lower half of a core box designed to provide the proper shape for the impeller bore and for accommodating the metal insert.

Figure 7 shows the core with the insert in place after being removed from the core box.

Figure 8 represents a fragmentary assembly view showing the manner in which the actuating shaft is secured to the pump impeller.

Referring more patircularly to Figures 1 and 2 reference character 1 designates the heavy backplate of an impeller having a downwardly extending flange 2. On the opposite side of the backplate a number of vanes 3 are provided, these vanes having a curvilinear shape and preferably molded directly on the backplate. Some of the vanes terminate at the position marked 4 while other vanes are connected together as indicated at 5, depending on the specific character of the work and also on the speed of the impeller for which the pump is designed. Within the two oppositely disposed pairs of vanes which are connected together there is an opening 6 through the backplate in order to create a suction to the rear of the impeller and thus relieve this portion of the pump of leakage fluid as will be explained at length when describing the assembly drawing (Figure 8). The hub 7 of the impeller is made

hollow and a shoulder 8 is provided within the bore 9. A metal insert 10 is positioned within the enlarged portion 11 of the bore and against the shoulder 8.

As shown in Figure 5, the metal insert 10 is of cylindrical construction and has a bore 12, also a longitudinally extending keyway 13. There is a pair of spaced grooves 14 extending across the outer periphery of the element, these grooves being straight at the bottom when looking at the end of the element, but having a curved configuration at the bottom as seen along the periphery of the element. The grooves can therefore be considered as representing a gouged out recess curved in one direction as indicated at 15 and straight in the other direction as indicated at 16. The purpose of these grooves or recesses will be explained hereinafter.

The impeller shown in Figures 1 and 2 is intended primarily for pumping corrosive fluids, such as acids which readily attack an ordinary machinable metal. For this reason the impeller and all other parts of the pump which come in contact with the liquid must be made of a metal which can withstand corrosion. We may employ silicon iron for this purpose and while this material is readily moldable it is not machinable other than responding to abrasive action such as grinding. Inasmuch as the insert 10 is intended to house the shaft of the impeller the bore 12 must be cut and ground to accurate size and the keyway 13 must also be splined. It is therefore necessary that the element be made of a machinable metal such as steel. The recesses 14 can therefore be readily cut in the periphery of the element.

Due to the difference in the character of the metal of the impeller and element 10, it is necessary to mold the insert within the impeller hub and for this purpose a mold similar to that shown in Figure 3 may be used. This mold may comprise a cope 17 and a drag 18 together with the usual metal dowels 19 for locating the cope and drag when preparing the mold. The impeller 1 can be molded either in wood or metal and placed within the sand 20 of the mold at the parting line so that the backplate and the depending portion of the hub extends into the drag of the mold as is well understood in the molding art. The vanes of the impeller are accommodated by the cope of the mold. The pattern of the impeller is solid at the center portion of the hub showing only the outer configuration of the hub indicated at 21. The usual core plugs are secured to the hub of the pattern to leave oppositely disposed conically shaped openings in the mold for receiving the core 22 when the pattern is removed from the mold.

The core 22 is made in a core box indicated at 23, split down the middle and suitably doweled as indicated at 24.

There is a semi-circular opening indicated at 25 in each half of the core box which align with one another when the box is brought together on its dowel pins 24. The opening 25 has a diameter corresponding to the bore 11 of the impeller and is provided at each end with a pair of conically shaped openings 26 having generally the shape of a frustum of a cone. The cylindrical opening 25 in the core box is provided with a shoulder 27 directly above an opening 28 of smaller diameter than the opening 25. The metal insert shown in Figure 5 is placed within the core box against the shoulder 27. The bottom of the box indicated at 29 is then placed on a support and sand, properly

treated, is packed into the interior of the box to the top of the upper conical bore 26. After packing the sand tightly within the core box the latter is opened by withdrawing the two halves from one another, leaving a core of sand indicated generally at 30 in Figure 7, and holding metal insert 10 in a vertical position on the support. The core is then baked to form a hard surface and if desired, a layer of lead powder can be applied to its exterior surface.

The tapered ends of the core are then inserted in the conical openings left in the mold by the plugs on the pattern and the impeller is ready to be poured. A pouring hole 31 is provided through the sand of the core terminating at the top in a funnel opening 32. This pouring hole preferably extends to the web portion of the backplate rather than terminating at the upper edge of one of the vanes because most of the metal will be contained in the backplate and it is necessary to cause the metal to flow to this element in the most direct manner and in the greatest volume. An overflow riser 33 may extend from the outer periphery of the backplate. Silicon iron is melted, then poured through the opening 31 forming all parts of the impeller including the vanes 3, the depending flange 2 and the hub 7. The holes 6 in the backplate may also be formed by a coring job as is well known in the molding art. The metal flowing into the hub fills the recesses 14 with silicon iron to form a strictly rigid key effect by completely mating with the keyways in the element 10, and thus preventing this element from either rotating within the hub or from moving longitudinally with respect to the hub. After the molded metal has cooled and hardened, the risers 31 and 33 are broken off in any suitable manner, and if desired, the critical surfaces on the impeller such as the lower surface of the flange 2 and the upper surfaces of the blades 3 are ground to proper thickness. The bore within the machinable element 12 can also be machined and if necessary ground to the size since this insert is made of machinable metal, although it may be entirely feasible to grind the bore to its proper diameter at the same time that the keyway 13 is formed and before the metal is inserted in the mold. No further machining of the insert is therefore necessary in this case.

The manner in which the impeller is assembled within the pump and secured to the shaft is shown in Figure 8. The shaft 34 may be driven from an electric motor or automotive engine (not shown). A circular keyway indicated at 35 is provided in the shaft to accommodate a key which also fits the keyway 13 in the metal insert 10. The end of the shaft has a portion 36 of smaller diameter than the main portion, providing a shoulder which is positioned slightly to the right of the left hand edge of the insert 10. This shaft portion 36 is threaded to receive a large hexagon nut 37 for tightening the insert and the integrally secured impeller hub to the shaft. If desired a hollow cap 38 may be provided having a hexagon shaped shoulder 39 for receiving a wrench. The interior of this cap contains a nut 40 secured thereto as indicated at 41 and adapted to engage the threads on the shaft portion 36. When the hexagon nut portion 39 is turned, the interior nut 40 tightens on the threads of the shaft until the flange 39 contacts a raised portion 42 on the impeller positioned opposite the hub 7. Thus the nut 37, which is the main element for securing the impeller to the shaft, tightens against the

machinable element 10 and the cap nut 38 tightens against the impeller to protect the main nut 37 from being tampered with and also to prevent access of corrosive fluid to the main nut 37 and the machinable element. The hemispherical surface on the cap nut 38 serves as a "splitter" to distribute the liquid evenly on all sides as it flows through the intake 43. If desired, liquid directing vanes 44 may be provided so as to reduce any swirling or eddy current loss. The outer edges of the blades 3 are positioned adjacent a flat vertical surface 46 of a web portion 47 of the main pump casting indicated generally at 48. This casting is of the usual type and therefore requires no further explanation other than to state that the outer flange surface indicated at 49 is gasketed against a volute casting 50 which is bored at the center to receive the hub 7 of the impeller. An outlet 51 of the usual type is provided at the periphery of the volute chamber 52 so as to receive the liquid which is forced radially and centrifugally outwardly as the vanes of the impeller rotate. A packing 53 may be inserted and held in position in any suitable manner between a circular flange portion 54 of the volute casting and the impeller hub 7. The openings 6 formed in the backplate of the impeller provide a suction effect to maintain the annular compartment 55 positioned between the flange 2 and the hub of the impeller free from fluid.

It is apparent that the impeller 1 can be readily detached from the shaft 34, if desired, for replacement or repair by simply removing the cap nut 38 and main nut 37. Notwithstanding this detachable feature the impeller is held rigidly in position on the shaft due to the integral effect obtained by the keyways 14 of the insert 10 which receives the same metal as the impeller casting. The joint between the machinable insert 10 and the unmachinable hub 7 of the casting is as strong as the metal of the casting itself so that the same effect is obtained as if the element 10 were made in one piece, out of silicon iron and cast integral with the impeller. However, by providing the insert and securing it to the impeller during the molding operation by cast keys, we have obtained all of the advantages of a noncorrodible metal for the impeller when subjected to acid and a machinable surface in the position where the impeller is carried on the shaft.

It will be understood that various modifications and arrangements in structure could be made without departing from the spirit of our invention and, accordingly, we desire to comprehend such modifications and substitutions of equivalents as may be considered to come within the scope of the appended claims.

Having thus fully described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. As an article of manufacture, a cast impeller for a pump designed to handle corrosive fluids, said impeller being provided with a hub and constituted of corrosion-resistant metal, and a pre-formed sleeve of machinable metal contained within the hub, said sleeve having recesses and projections integral with the hub extending into said recesses and anchored thereto by fused metal, said sleeve when pre-formed being provided with a shaft opening.

2. A pump impeller designed to handle corrosive fluids, said impeller being provided with a hub and constituted of corrosion-resistant metal, a sleeve within said hub, said sleeve being made of machinable metal with a shaft opening in the center and having recesses along the peripheral surface, said impeller being cast over said sleeve and said hub having projections interlocking with said recesses.

3. A pump impeller designed to handle corrosive fluids, said impeller being provided with a hub and constituted of silicon-iron, a sleeve within said hub, said sleeve being made of a machinable metal and having a shaft opening in the center, said sleeve being provided with recesses along the peripheral surface and transverse to the longitudinal axis of the sleeve, said impeller being cast over said sleeve and the hub having projections in interlocking engagement with said recesses to provide a keying effect between the sleeve and the impeller.

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