

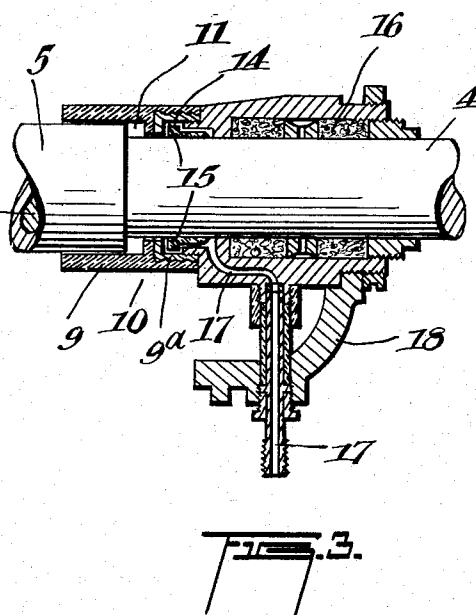
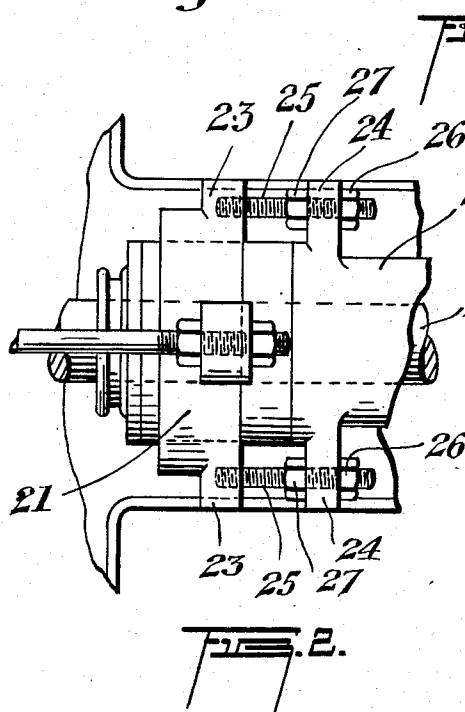
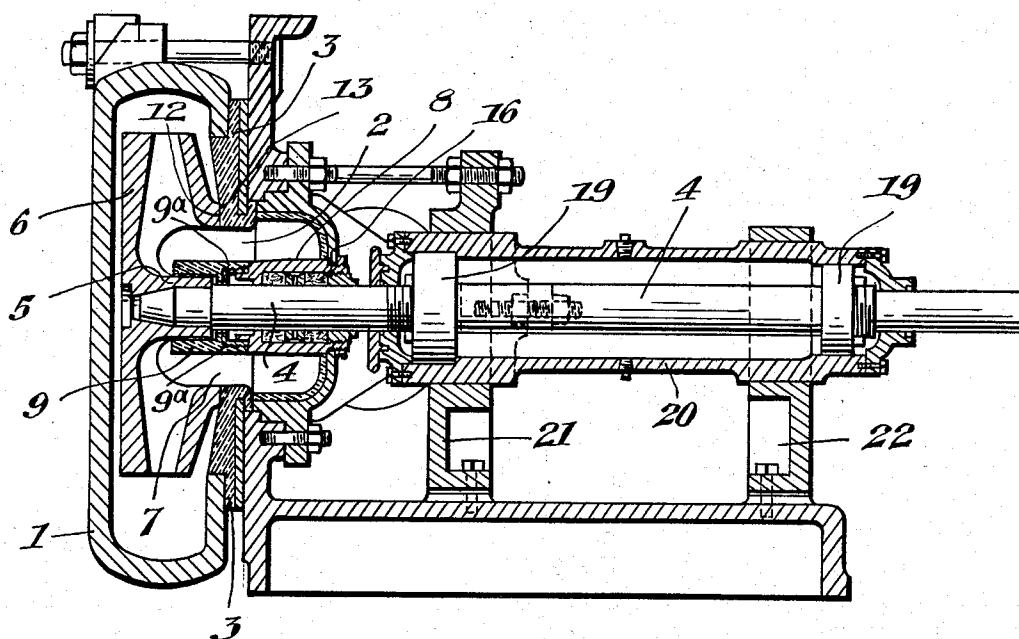
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CENTRIFUGAL PUMP

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CENTRIFUGAL PUMP

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5 Claims. (Cl. 103-103)

This invention relates to centrifugal pumps adapted for the pumping of liquids containing abrasive material such as sand. Such pumps are largely used, for example, in mines to pump ore pulp which contains particles of an abrasive or gritty nature.

Difficulties have hitherto been experienced in the operation of such pumps by reason of wear on the impeller shaft caused by abrasive material entering the packing through which the shaft passes into the casing. Various arrangements have been suggested to avoid this difficulty, but all have more or less serious drawbacks and their practical application appears to have been limited. One of them consisted in surrounding the impeller shaft with a sleeve which abutted the impeller hub and in introducing water between the sleeve and the shaft, which escaped between the adjacent faces of the sleeve and hub in order to prevent the entry of grit between the sleeve and shaft. One difficulty with this arrangement is that no provision is made for taking up wear, so that when the pump is in operation the clearance between the sleeve and the impeller increases, with the result that increasing amounts of water must be used with consequent undesirable dilution of the solution being pumped. Such provision for keeping the proper clearance between the sleeve and the hub could be made in the arrangement in question only if the wear between the impeller and casing were identical with that between the sleeve and the hub, a condition which in practical operation is very unlikely to occur. If the pump cannot be adjusted to compensate for the wear which takes place between the inlet side of the impeller and the casing, eddy currents between the impeller and the casing are set up when the pump is in operation which tend to direct pressure towards the junction of the sleeve and hub, thus causing additional wear of one or other of these parts from the outside, and in addition aiding in the admission of abrasive particles into the sleeve not only directly but also indirectly by reducing the suction exerted by the impeller. In the other arrangement the shaft packing was mounted on a flexible diaphragm to permit longitudinal adjustment of the shaft carrying the runner so that contact between the runner and casing at the inlet side could be maintained in spite of wear of the parts and eddy currents reduced. The principal difficulty with this arrangement was that excessive wear resulted from keeping the fixed gland in sufficiently close con-

tact with the rotating hub, and the packing was not adequately protected from the entry of grit between it and the shaft.

The construction of the present invention avoids these disadvantages and has been satisfactorily and widely used for some time now in a number of Canadian mines, one of which is a very large one. The pump according to the invention comprises a fixed pump casing having an inlet opening at one side through which extends an axially adjustable rotary shaft to which is fixed an impeller having an inlet opening registering with the inlet opening in the casing. The shaft extends through a fixed packing gland, through which it may be axially moved for the purpose of maintaining contact between the impeller and casing around the inlet opening to prevent eddy currents from the pressure to the suction side of the pump. On the packing gland is mounted a fixed sleeve which extends freely but nevertheless closely around the shaft and the hub substantially to the point of centrifuge, the sleeve being of greater internal diameter than the external diameter of the hub for a distance inwardly from its outer end substantially greater than the distance by which the hub extends into the sleeve when the impeller and the casing are new and unworn. In this way provision is made for inward movement of the hub relatively to the sleeve upon axial adjustment of the shaft to take up wear at the contacting faces of the impeller and casing. It is usually desirable to provide a water supply pipe leading to the space between the sleeve and the shaft, for supplying water to flow along the space to the outer end of the sleeve and remove from the sleeve abrasive material which may have entered it.

The extension of the sleeve around the hub and shaft, forward to the point of centrifuge, assures that the opening between the sleeve and shaft shall be at a point where pressure on it will be very low, so that material is unlikely to be forced into it and any that does enter has to work its way back a long way with little assisting force before it reaches the packing gland. Moreover, construction of the sleeve in such a way that it is of greater internal diameter than the external diameter of the hub for a substantially greater length than that by which the hub extends into the sleeve when the impeller and casing are new, means that adjustment of the shaft to keep the contacting faces of these parts together can be easily effected by external means without having to take the pump apart

and replace parts before the end of their full useful life. Thus eddy currents, which might assist the entry of particles into the sleeve and might cause an attack on the sleeve or packing gland, are prevented in a very simple way.

The invention will be described in greater detail in the accompanying drawing, in which

Figure 1 is a longitudinal section through the pump and its mounting.

Figure 2 is a plan view of the means for effecting axial adjustment of the shaft.

Figure 3 is a sectional detail of the sleeve and gland with a water supply pipe.

The pump comprises a casing 1 having an inlet opening 2 at one side thereof, the walls of the casing at that side being preferably formed of rubber as indicated at 3. Extending into the casing through the inlet opening 2 is a rotary shaft 4, fastened to the reduced end of which is the central hub 5 of an impeller 6 having an inlet opening 7 which registers with the inlet opening 2 of the casing. The shaft 4 extends into the casing through a fixed packing gland 8, on the end of which is mounted a fixed sleeve 9 extending freely, as can be seen from the slight clearance illustrated, around the shaft and the hub substantially to the point of centrifuge, i. e. a point of low pressure, and preferably formed, as indicated, of rubber with a metal base 9a for attachment purposes. The internal diameter of the sleeve 9 is slightly greater than the external diameter of the hub 5 and continues so for a distance inwards from the outer end of the sleeve which is substantially greater than the distance by which the hub extends into the sleeve (Fig. 3), at least when the impeller and casing are new. As illustrated, the external diameter of the hub 5 is greater than the normal diameter of the shaft 4, though this is not essential from the point of view of the invention. If the diameters were the same, then the sleeve would, of course, at no point be of smaller internal diameter than the external diameter of the hub. In the case illustrated however the sleeve is of reduced internal diameter at 10 and an annular chamber 11 is formed between the inner end of the hub 5 and the part 10 of reduced diameter. Around the openings in the impeller and casing are continuous annular walls 12 and 13 respectively, the maintenance of face contact between which prevents the eddy currents discussed above. As the impeller and casing wear at these walls, the shaft is moved axially to keep them in contact and, since the gland and sleeve are fixed, the hub thus gradually moves into the space 11, which is made long enough so that the hub will not strike the part 10 of the sleeve until the maximum amount of permissible wear in the impeller and casing has been taken up.

As shown, the internal diameter of the sleeve is again enlarged inwardly of the reduced part 10 so that the sleeve may be conveniently attached as by screwing onto the end of the gland 8. There is thus formed between the reduced part 10 and the end of the gland 8 another annular chamber 14 which may be empty, but in which preferably runs, as illustrated in Figure 3, a ring 15 fixed to the shaft, leaving only a small space between itself and the sleeve 9, so that a more tortuous path is formed for any material which may enter the sleeve and try to reach the packing 16 in gland 8.

Except under conditions of very low head it is desirable to have a small amount of water under

low pressure flowing outwardly between the sleeve 9 and the shaft and hub. This can conveniently be supplied from a water supply pipe 17 which preferably introduces the water as close to the gland as possible and as shown is formed partly in the gland 8 itself and partly outside the gland where it passes through the wall 18 of the feed pipe to the impeller. Its outer end may be connected to a suitable source of water supply. The outwardly flowing water, of which it is found that there need be only a very small amount, tends to drive out any particles of abrasive material which may have succeeded in entering between the sleeve and the hub or shaft.

Outside the casing the shaft is supported in two appropriate bearings 19 which are mounted in a non-rotating barrel 20 held in bearings 21 and 22. Extending out from the bearing 21, as illustrated in Figure 2, are wings 23, while extending out from the barrel 20 are wings 24. Fixed in the wings 23 are bolts 25 which extend freely through the wings 24, the latter being held in appropriate position on the bolts by nuts 26 and 27. It will be clear that upon loosening the outer nuts 26 and tightening the inner nuts 27 the barrel will be drawn to the right in Figure 1 with the result that the faces 12 and 13 of the impeller and casing respectively will be drawn together. In this way eddy currents, which would otherwise very quickly attack the sleeve 9 or the shaft itself, if there were no sleeve, are prevented.

This is a continuation-in-part of my application Serial No. 85,282, filed June 15, 1936.

What I claim as my invention is:

1. A centrifugal pump adapted for the pumping of liquid containing abrasive material such as sand, comprising a fixed pump casing having an inlet opening at one side thereof, an axially adjustable rotary shaft extending through said opening, an impeller having a central hub fixed to said shaft and an inlet opening at one side thereof registering with the opening in the casing, said impeller and said casing having continuous annular walls adapted to be brought into face contact with each other around said openings, a fixed packing gland through which said shaft may be axially moved for the purpose of maintaining contact between said annular walls to prevent eddy currents from the pressure to the suction side of the pump, a fixed sleeve mounted on said gland and extending freely around said shaft and hub, the outer end of said sleeve being substantially at the point of centrifuge, and said sleeve being of greater internal diameter than the external diameter of the hub for a distance inward from said outer end substantially greater than the distance by which the hub extends into the sleeve when the impeller and casing are unworn, to allow for inward movement of the hub relatively to the sleeve upon axial adjustment of the shaft to take up wear at said annular walls.

2. A centrifugal pump according to claim 1, in which the shaft is of smaller diameter than the hub and the internal diameter of part of that portion of the sleeve surrounding the shaft is substantially correspondingly smaller than that of the portion surrounding the hub.

3. A centrifugal pump according to claim 1, in which the shaft is of smaller diameter than the hub and the internal diameter of part of that portion of the sleeve surrounding the shaft is substantially correspondingly smaller than that

of the portion surrounding the hub, said part of smaller diameter being separated from the end of the gland by a part of the sleeve of greater diameter whereby an annular chamber is formed between said gland end and said part of smaller diameter.

4. A centrifugal pump according to claim 1, in which the shaft is of smaller diameter than the hub and the internal diameter of part of that portion of the sleeve surrounding the shaft is substantially correspondingly smaller than that of the portion surrounding the hub, said part of smaller diameter being separated from the end of the gland by a part of the sleeve of

greater diameter whereby an annular chamber is formed between said gland end and said part of smaller diameter, a ring being fixed to the shaft and extending freely into said annular chamber, whereby a tortuous path is formed for any substances passing towards the gland.

5. A centrifugal pump according to claim 1, in which the sleeve has a metal base and a main body of relatively soft rubber covering said base, and in which the sleeve is removably mounted on the gland through said base.

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