Aug. 28, 1928.

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R. HENTSCHEL

SUCTION DEVICE FOR MULTISTAGE CENTRIFUGAL PUMPS

Filed March 18, 1926

Fig. 1

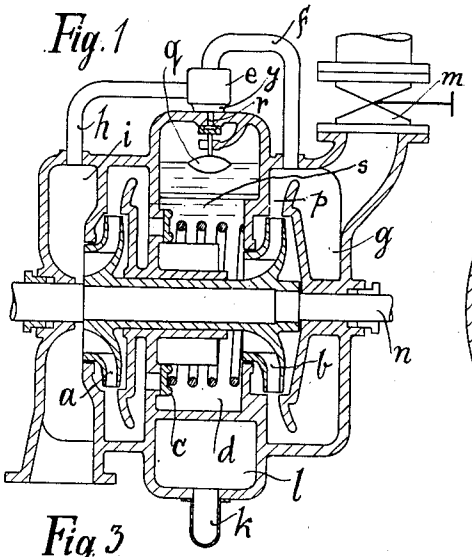


Fig. 2

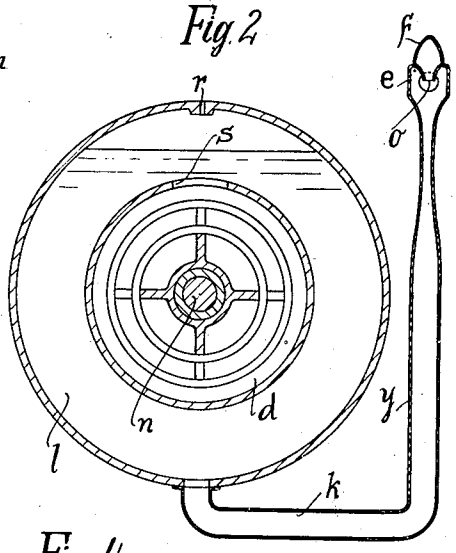


Fig. 3

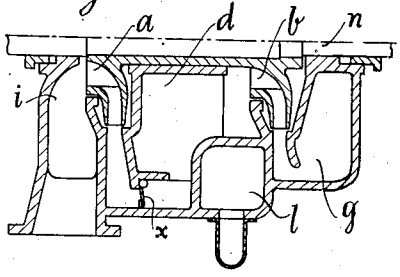


Fig. 4

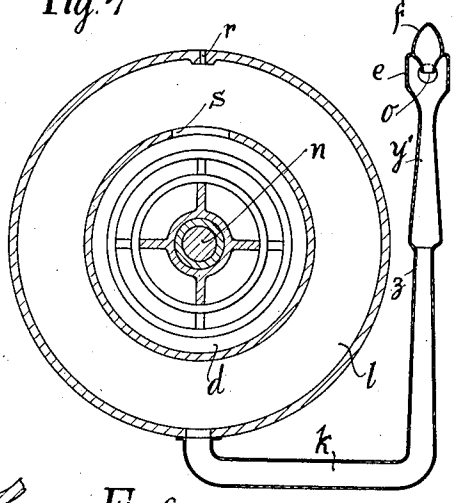


Fig. 5

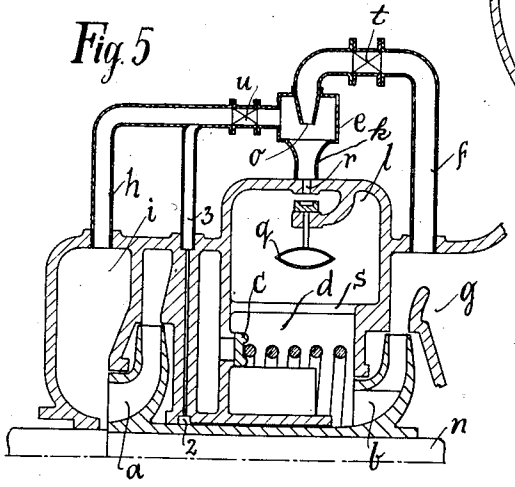
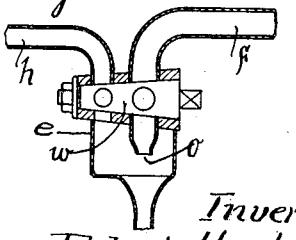


Fig. 6



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UNITED STATES PATENT OFFICE.

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SUCTION DEVICE FOR MULTISTAGE CENTRIFUGAL PUMPS.

Application filed March 18, 1926, Serial No. 95,591, and in Germany April 11, 1925.

This invention relates to a suction device for multi-stage centrifugal pumps by means of a hydraulically operated jet air pump, and it has, in comparison with the commonly known suction devices of this type for its object a simplification of construction and operation and saving of power by utilizing for the production of the pressure in the water for working of the jet air pump the multi-stage centrifugal pump to be evacuated.

An embodiment of the invention is illustrated, by way of example, in the accompanying drawing in which:

Fig. 1 is a vertical longitudinal section through a two-stage form of construction.

Fig. 2 is a cross section on line 2—2 of Fig. 1.

Fig. 3 is a longitudinal section through the lower half of the centrifugal pump with another valve arrangement between the two pump stages.

Fig. 4 is a cross section corresponding with that of Fig. 2 showing a modification of the jet pump.

Fig. 5 shows, on larger scale, a longitudinal section through the upper half of the centrifugal pump shown in Fig. 1 comprising an arrangement for the return of leak water into the water circulation of the jet air pump and

Fig. 6 shows in section a constructional detail of the jet air pump.

The first stage with the impeller *a* is separated from the second stage with an impeller *b* by a spring-controlled ring valve *c* so that for the second impeller *b* a comparatively large inlet space or flow channel, e. g. the annular space *d*, extending between the two stages is created. The jet air pump *e* communicates by pipe *f* with the pressure space *g* of the second stage, by pipe *h* with the suction space *i* of the first stage and by pipe *k* with the annular space *l*.

For operating the jet air pump *e* the inlet space *d* of the second stage is almost completely filled with water, and after the shutting off device or the regulating slide valve *m* has been closed the shaft *n* of the centrifugal pump carrying the two impellers *a*, *b* is revolved. A continuous flow of water through the jet nozzle *o* of the air pump *e* is thus produced the air being sucked off from the suction space *i* of the first stage through the pipe *h*. The sucked off air flows with the working water in circulation into the outer annular space *p* of the impeller *b* where it is separated at the highest point of the water level and escapes into the atmosphere through the floating valve *q* and port *r*. The circulating water flows through the upper slot *s* of the inner annular space *d* in the intermediate casing back into the second impeller. The annular space *d* and the annular space *p* may form one single space.

If, after the suction, the impeller *a* begins to deliver, the water pressure produced at this occasion opens the ring-valve *c* and closes the floating valve *q*. By the opening of the regulating valve *m* the centrifugal pump begins now to deliver and the air pump *e* may be shut off by the closing of the jet water- and air-pipe so that from this moment it does not consume any energy.

The shutting off of the jet air pump may be effected, as indicated in Fig. 5, by means of cocks *t*, *u* in the pipes *f* and *h*. In the form of construction shown in Fig. 6 the shutting off is simplified by the arrangement that the jet water- and air-pipes *f*, *h* may be simultaneously shut off by a common multiple way cock *w*.

For the ring valve *c* one or several other shutting off devices may be substituted, for instance after the manner of the check flap *x* of Fig. 3.

Under general conditions the use of a mixing nozzle, such as *y*, Fig. 2 of suitable dimensions and having a single tapered portion directly connecting with the jet pump *e* will be found sufficient for securing an aspirating action of required suction force to effect a vacuumizing of the suction stage and the filling of the same with water from the source of supply in a rapid manner and within a reasonable period of time. In some instances, however, the operation might be unduly prolonged because of unfavorable head conditions and the presence in the supply line of a large amount of air or gas tending to unseat the valve *c* and to reduce the suction force of the jet air pump. For the purpose of meeting such conditions I provide a compound type of mixing nozzle, such as shown in Fig. 4, in which a tapered nozzle portion *y'* of greater length than the tapered portion *y* of Fig. 2 is employed together with a second tapered portion or nozzle *z*. The mixed air and water flowing successively through these nozzles causes an increased velocity flow of the water, with an increase of suction in the pump *e*, and a

compression of the air flowing with the water into the space *l*, whereby an increase of pressure in the space *d* is created, producing a counter-pressure in the first stage to keep the valve seated.

In order to prevent that, especially with longer suction-times, too much of the circulating water required for the suction flows through the annular gap of the shaft bearing in the intermediate casing over into the suction space or into the first impeller, the leak water can be returned into the circulating-water circulation. This is effected, according to Fig. 5, in such a manner that the leak-water flowing off through the shaft-bushing is collected in an annular space 2 and sucked off again through the channel 3 by the jet air pump.

In more than two-stage centrifugal pumps several stages may be used for sucking off the air, and inversely.

I claim:—

1. A multistage centrifugal pump having a suction stage, a compression stage provided with a valved outlet, a flow passage between said stages, a hydraulically operated jet air pump operative under water pressure produced in said pressure stage, conducting connections between said jet air pump and said suction and compression stages, means for opening or closing said connections for opening or closing communication between said jet air pump and said suction and pressure stages, and a valve normally closing said flow passage and adapted to open under a predetermined pressure in the suction stage.

2. A multistage centrifugal pump having a suction stage, a compression stage provided with a valved outlet, a flow passage between said stages, a water and air chamber between the stages and in communication with the flow passage, said chamber having an air vent outlet, a valve governed by the water level in said chamber and controlling said vent outlet, a hydraulically operated jet air pump operative under water pressure produced in said pressure stage, connections between said jet air pump and said suction and compression stages, means for opening or closing communication between said jet air pump and said suction and pressure stages, and a valve normally closing said flow passage and adapted to open under a predetermined pressure in the suction stage.

3. A multistage centrifugal pump having a suction stage and a pressure stage, a hydraulically operated jet air pump operative under water pressure produced in said pressure stage, air and water flow channels between the jet air pump and the suction and pressure stages, a flow passage between the pressure stage and suction stage, an automatic valve controlling said passage, and means controlling said channels for opening and closing communication between the jet air pump and the suction and pressure stages.

4. A multistage centrifugal pump having a suction stage and a pressure stage, a hydraulically operated jet air pump operative by water pressure produced in the pressure stage and including a mixing nozzle, a flow passage between the suction and pressure stages, a normally closed valve governing said passage and adapted to open under a predetermined pressure in the suction stage, valve controlled conductors for connecting said jet air pump with the suction and pressure stages, and a second mixing nozzle connected to said mixing nozzle of said jet air pump for converting into pressure the flow energy of the water and air mixture so as to hold the valve governing the flow passage closed against pressure in the suction stage when the jet air pump is in action.

5. A multistage centrifugal pump having a suction stage, a pressure stage provided with a valve controlled outlet, a water and air chamber disposed between said stages, a flow passage between said stages and communicating at its highest level with said chamber, a normally closed valve controlling communication between the suction stage and said passage and adapted to open under a predetermined pressure in the suction stage, an automatic vent for the discharge of air from the water and air chamber, a hydraulically operated jet air pump operative under water pressure produced in the pressure stage, air and water flow channels respectively connecting said jet air pump with the suction and pressure stages, valves for opening and closing said channels, and a mixing pipe connecting the water and air chamber with the jet air pump.

6. A multistage centrifugal pump having a suction stage, a pressure stage provided with a valve controlled outlet, an air and water chamber between said stages provided with an air vent outlet, a flow passage between said stages communicating at its highest level with the water and air chamber, a normally closed valve controlling communication between said passage and the suction stage and adapted to open under a predetermined pressure in the suction stage, a hydraulically operated jet air pump operative under water pressure produced in the pressure stage, conductors connecting the jet air pump with the suction and pressure stage and the air and water chamber, respectively, valves for opening and closing the conductors between the jet air pump and the suction and pressure stages, and means for conducting leak water from the jet air pump back to the pressure stage.

7. A multistage centrifugal pump having a suction stage, a pressure stage provided with a valve controlled outlet, an air and

water chamber between said stages provided with an air vent outlet, a flow passage between said stages communicating at its highest level with the water and air chamber, a normally closed valve controlling communication between said passage and the suction stage and adapted to open under a predetermined pressure in the suction stage, a hydraulically operated jet air pump operative under water pressure produced in the pressure stage, conductors connecting the suction and pressure stages with said jet air pump, valves for opening and closing said conductors, and a conductor connecting the air and water chamber with the jet air pump, said conductor being provided with a plurality of mixing nozzles.

In testimony whereof I affix my signature.

ROBERT HENTSCHEL.