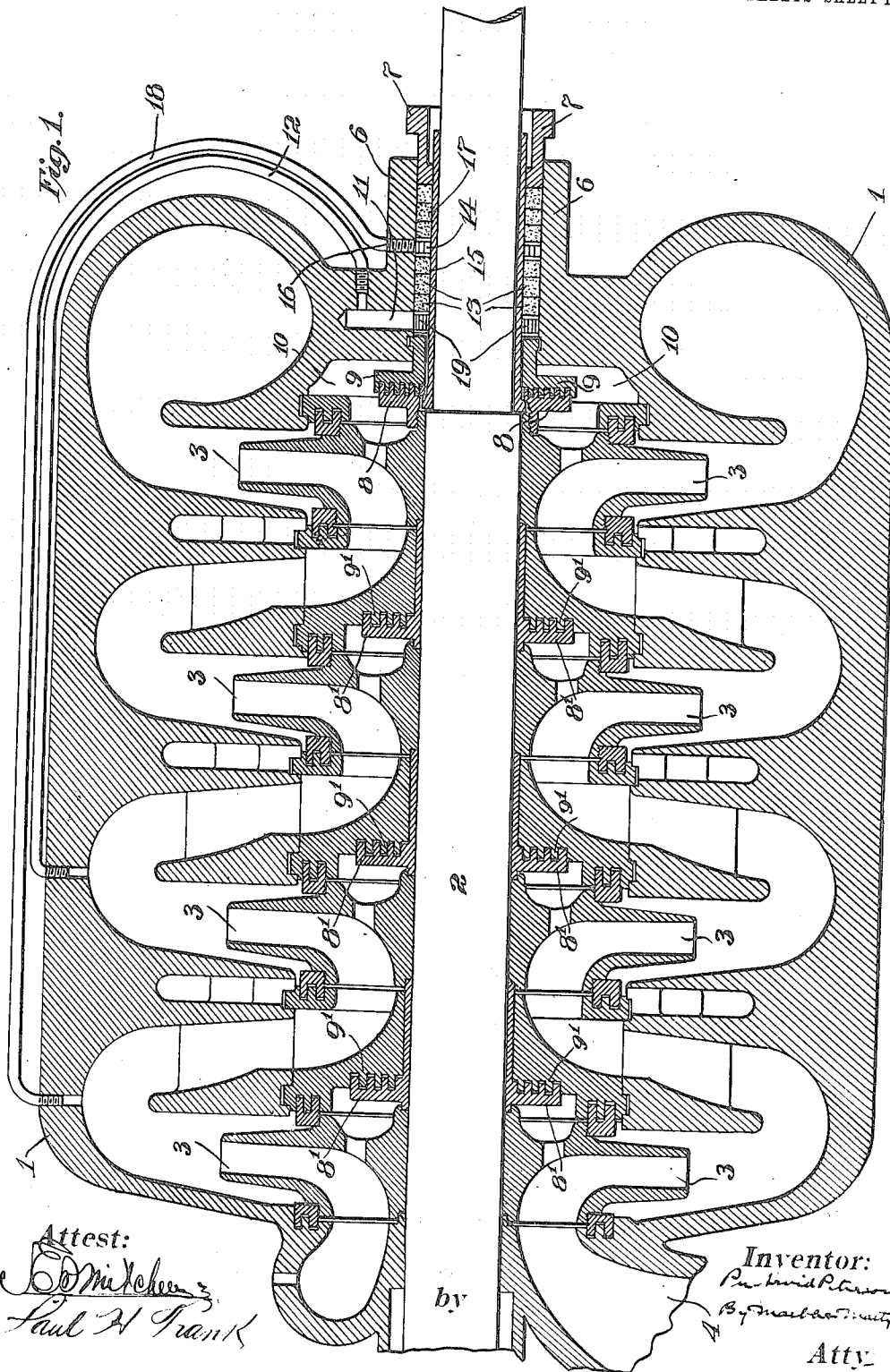


P. A. PETERSON.
 PRESSURE ENGINE.
 APPLICATION FILED MAR. 8, 1912.

1,123,364.

Patented Jan. 5, 1915.
 2 SHEETS-SHEET 1.



Attest:
Ed. Mitchell
 Paul H. Frank

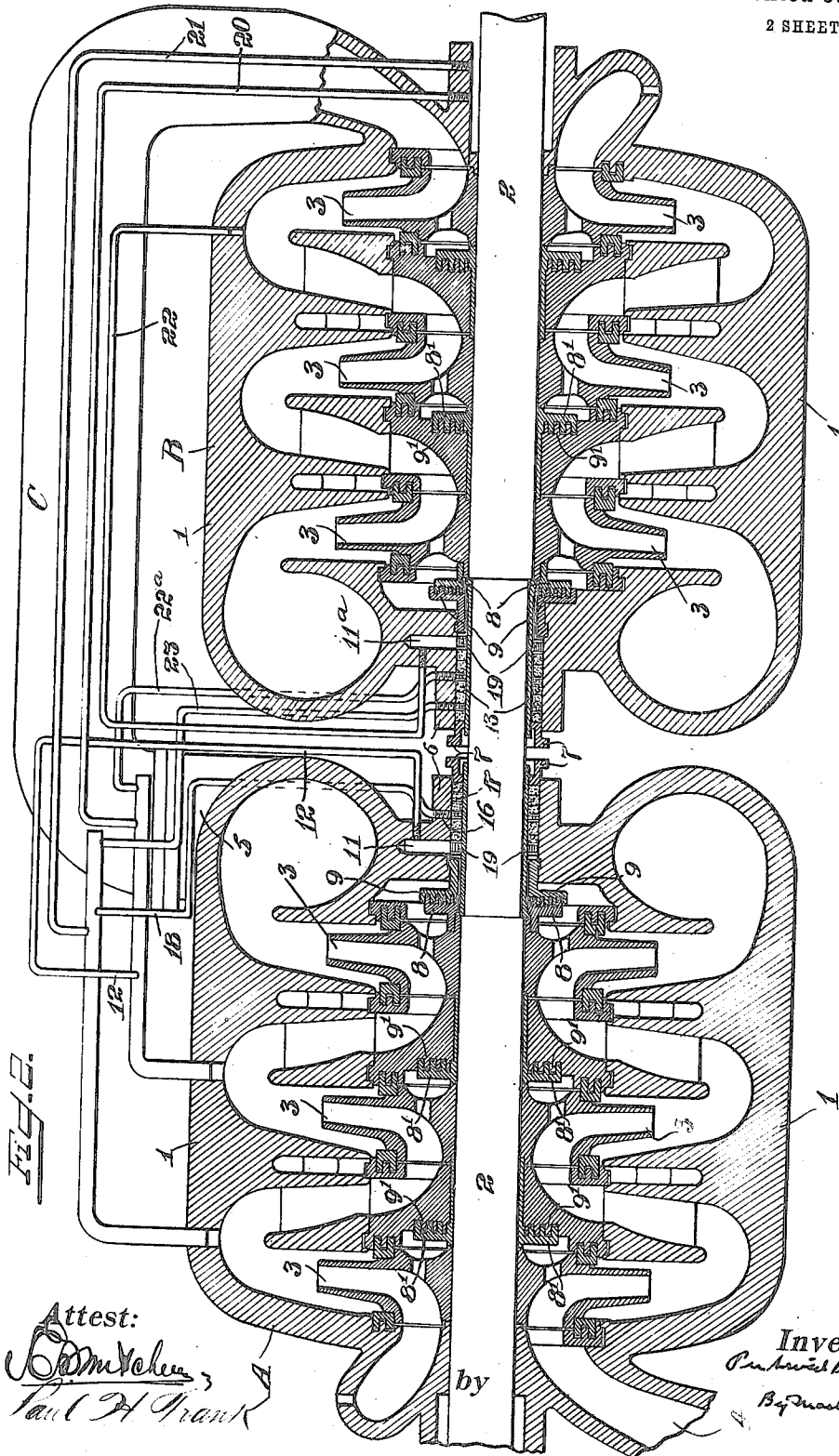
by

Inventor:
 P. A. Peterson
 By Marshall Smith
 Atty.

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Attest:
Paul H. Frank
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Inventor:
P. A. Peterson
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Attys

UNITED STATES PATENT OFFICE.

PER ARVID PETERSON, OF TRENTON, NEW JERSEY, ASSIGNOR TO DE LAVAL STEAM TURBINE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

PRESSURE-ENGINE.

1,123,364.

Specification of Letters Patent.

Patented Jan. 5, 1915.

Application filed March 8, 1912. Serial No. 682,457.

To all whom it may concern:

Be it known that I, PER ARVID PETERSON, a subject of the King of Sweden, and a resident of Trenton, in the county of Mercer and State of New Jersey, have invented certain new and useful Improvements in Pressure-Engines, of which the following is a specification.

My invention relates to improvements in multistage pressure engines, for example, centrifugal pumps, and particularly to improvements in means for preventing leakage through the stuffing boxes of multistage engines operating under high pressure, and my invention comprises the connection of the stuffing boxes on the pressure side of the engine, at one or more intermediate points, to stages of the engine wherein the pressure is less than the pressure to which the inner portion of the packing is subjected; whereby, the outer portion of the packing is subjected to a relatively low pressure only and whereby there is a relatively small difference of pressure on the two sides of each section of the packing.

The object of my invention is to facilitate the prevention of leakage through the stuffing boxes of multistage pressure engines, such for example as centrifugal pumps.

I will now proceed to describe my invention which reference to the accompanying drawings in which I show my invention applied to a multistage centrifugal pump and will then point out the novel features in claims.

In the drawings: Figure 1 shows a longitudinal section of a multistage centrifugal pump, embodying my invention; and Fig. 2 is a similar sectional view of a structure comprising two multistage centrifugal pumps connected in series and having a common impeller shaft, the stuffing boxes on the pressure side of one pump and the stuffing boxes on both sides of the other pumps, having pressure-relieving connections, such as hereinbefore referred to.

In this specification I illustrate and describe my invention as applied to multistage centrifugal pumps, such pumps being one type of pressure engine to which my invention is applicable. I employ the term "pressure engine" as inclusive of centrifugal pumps, blowers, and steam and other fluid pressure turbines.

Referring first to Fig. 1; the pump illus-

trated in this figure embodies the inventions of the patents of A. E. Guy Nos. 962,023 dated June 21, 1910, and 972,366, dated October 11, 1910, and also embodies certain features set forth in my companion application for Letters Patent filed March 8, 1912, Sr. No. 682,455. For present purposes, however, the details of construction of the pump casing, impellers, labyrinthine packing, etc., need not be considered, as they are not involved in the present invention.

In Fig. 1, 1 designates the pump casing, 2 the impeller or rotor shaft and 3, 3 impellers or rotors mounted on said shaft. The number of these impellers is immaterial to the present invention, and the pump may be constructed in as many stages as may be desired. 4 designates the supply duct and 5 the usual discharge duct. 6 designates the stuffing box at the pressure side of the pump, such stuffing box comprising a gland 7, and also comprising packing material arranged to be compressed by said gland. In the structure shown I have provided labyrinthine packing-rings 8 and 9 in the balancing chamber 10 between the last impeller and the end wall of the casing, this being one of the features claimed in my application filed March 8, 1912 Sr. No. 682,455 above mentioned; and between labyrinthine packing ring 9 and the packing material within the stuffing box, I have provided, in the end wall of the casing a chamber 11 connected by a conduit 12 to an earlier stage of the pump, in this case, the second stage. The effect of this connection is to reduce the total pressure to which the packing in stuffing box 6 is subjected, to the pressure obtaining in that stage of the pump to which duct 12 is connected, *i. e.*, in the construction shown, to the pressure of the second stage.

The packing within the stuffing box 6 comprises a suitable number of rings 13, usually of some compressible packing material, such packing, in the arrangement shown, being divided into two sections, by a substantially rigid spacer 14 of a section such that flow-channels are provided into which water flowing past the first section of the packing will collect; and this spacer 14 is so located that it comes substantially opposite a port 16 leading to a point having a pressure still lower than the pressure to which chamber 11 is connected, so that the difference between the pressures to which

the two sides of the second section of packing, 17, is subjected, is also relatively small. The spacer 14 prevents obstruction of the port 16 by the packing, which obstruction, if it occur, might interfere with the "bleeding off" of the pressure through port 16 and duct 18. Port 16 might be connected to atmosphere, in which case substantially any leakage through the packing would pass off, through port 16; but by preference port 16 is connected by a duct 18 to a stage of the pump earlier than that to which duct 12 is connected, for example, to the first stage of the pump, as shown in the drawings.

It will be seen that by dividing the packing of the packing box into sections, and connecting the packing box, between each two sections of the packing, to an appropriate pressure point, *i. e.*, to a point the pressure of which is intermediate the pressures to which the extreme sides of such two sections of the packing are subjected, the pressure of the balancing chamber 10 is gradually stepped down, with respect to the packing, each section of the packing being subjected to a relatively small pressure-difference, for which reason there is relatively little tendency for leakage past each section of the packing, and therefore the wear of the packing is relatively small and there is practically no leakage from the stuffing box, notwithstanding that the pump may be operating against very high pressures. To preserve a passage for fluid into chamber 11, a spacer 19, similar to spacer 14, is provided opposite such chamber 11.

It is sometimes convenient, where very high pressures are to be worked against, to couple two pumps in series. In such case, the stuffing box on the pressure side of the low pressure pump, and stuffing boxes on both sides of the high pressure pump, may have their total pressures stepped down in the manner hereinbefore described. This is illustrated in Fig. 2, wherein A designates a low pressure pump and B a high pressure pump, the inlet passage of pump B being connected to the discharge chamber of pump A, by a conduit C. Each of these pumps A and B is of the general structure illustrated in Fig. 1, and chamber 11 of pump A is connected by a duct 12 to the second stage of pump A while port 16 of pump A is connected by a duct 18 to the first stage of pump A, as in Fig. 1. Pump B has the packing box on its inlet side connected, by ducts 20 and 21, to ducts 12 and 18 respectively; while for stepping down the pressure against the packing on the discharge side of pump B, chamber 11^a of pump B is connected by a duct 22 to the first stage of pump B, the said stuffing box having two other connections at 22^a and 23, to ducts 12 and 18 of pump A. The relieving of pressure, by means of chamber 11 and duct 12, has the

further advantage that thereby the labyrinthine packing ring 8 acts as a balancing piston to counteract end thrust due to pressure of the fluid on the labyrinthine packing rings 8' of the other stages of the pump. It will be understood that the pressure of the fluid within the labyrinthine passages between rings 8' and 9' necessarily produces an end thrust toward the inlet side of the pump; but since pressure behind the labyrinthine ring 9' is relieved, to a large extent, by means of duct 12, the pressure exerted by the fluid in the balancing chamber 10 of the last stage of the pump, is in the opposite direction, that is to say, toward the discharge end of the pump.

What I claim is:—

1. A multistage rotary pressure engine comprising in combination a casing divided into stages, a rotor shaft and rotors thereon, said casing provided at one end with a packing chamber surrounding said shaft, labyrinthine packing between the last stage of the engine and said packing chamber, and other packing within said packing chamber, said casing provided with means connecting said chamber, at a point between the labyrinthine packing and other packing, with a point of lower pressure than the pressure to which the inner side of said packing chamber is subjected.

2. A multistage rotary pressure engine comprising in combination a casing divided into stages, a rotor shaft and rotors thereon, said casing provided at one end with a packing chamber surrounding said shaft, labyrinthine packing between the last stage of the engine and said packing chamber, other packing within said packing chamber comprising a plurality of sections, and spacing means separating said sections, said casing provided with means connecting said packing chamber at a point between said labyrinthine packing and the first packing section, to a point of lower pressure than the pressure to which the inner side of said packing chamber is subjected, and further provided with means connecting said packing chamber, at a point intermediate the packing sections, with a point of still lower pressure.

3. The combination of two rotary pressure engines connected in series and constituting the one a low pressure engine, and the other a high pressure engine, each such engine comprising a packing chamber and a rotor shaft passing through said packing chamber, and means connecting such packing chamber of the high pressure engine at one or more intermediate points with one or more stages of the low pressure engine.

4. The combination of two multistage rotary pressure engines connected in series and constituting the one a low pressure engine and the other a high pressure engine,

each such engine comprising a rotor shaft, the high pressure engine having at each end a packing chamber through which its rotor shaft passes, means connecting the packing chamber at the low pressure end of the high pressure engine, at one or more intermediate points, with one or more stages of the low pressure engine, and means connecting the packing chamber at the high pressure end of the high pressure engine, at an intermediate point, with a stage of the high pressure engine other than the highest pressure stage thereof.

5. The combination of two multistage rotary pressure engines connected in series and constituting the one a low pressure engine and the other a high pressure engine, each engine comprising a rotor shaft, the high pressure engine having at each end a packing chamber through which its rotor shaft passes, means connecting the packing chamber at the low pressure end of the high pressure engine, at one or more intermediate points, with one or more stages of the low pressure engine, and means connecting the packing chamber at the high pressure end of the high pressure engine at an intermediate point, with a stage of the high pressure engine other than the last stage

thereof, and other means connecting said last named packing chamber at a further intermediate point to a stage of the low pressure engine.

6. A multistage centrifugal pump comprising in combination a casing divided into stages, an impeller shaft and impellers thereon, balancing chambers being provided in rear of said impellers, labyrinthine packing between each of said balancing chambers, and the adjacent joint between the shaft and the casing, said labyrinthine packing comprising a ring on the shaft and a ring carried by the casing, and means for relieving pressure in rear of the labyrinthine packing of the last stage of the pump, whereby fluid pressure on the labyrinthine packing of the last stage of the pump tends to neutralize fluid pressure on the labyrinthine packing of the other stages of the pump.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

PER ARVID PETERSON.

Witnesses:

E. S. ROSS,
H. M. MARBLE.