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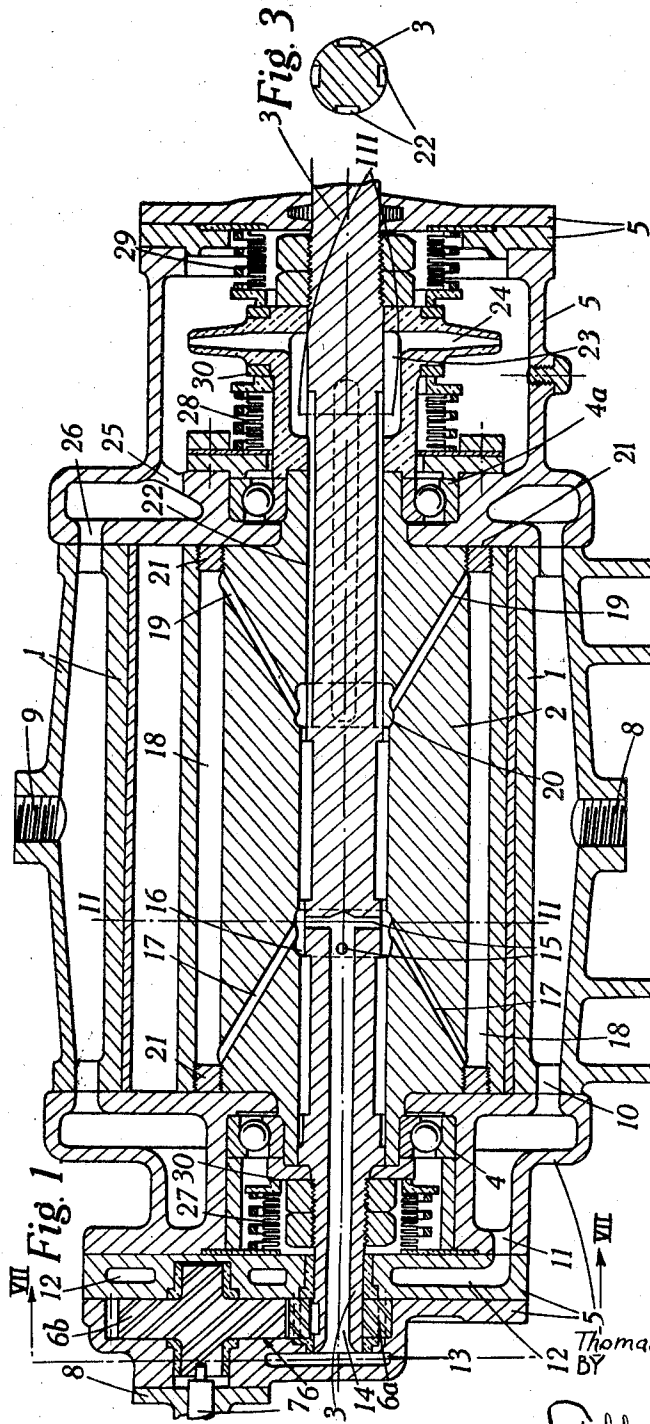
T. W. NICHOLS

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ROTARY COMPRESSOR, EXHAUSTER, PUMP, AND THE LIKE

Filed Dec. 7, 1936

3 Sheets-Sheet 1



INVENTOR

Thomas Winter Nichols

BY

Albert M. Austin
ATTORNEY

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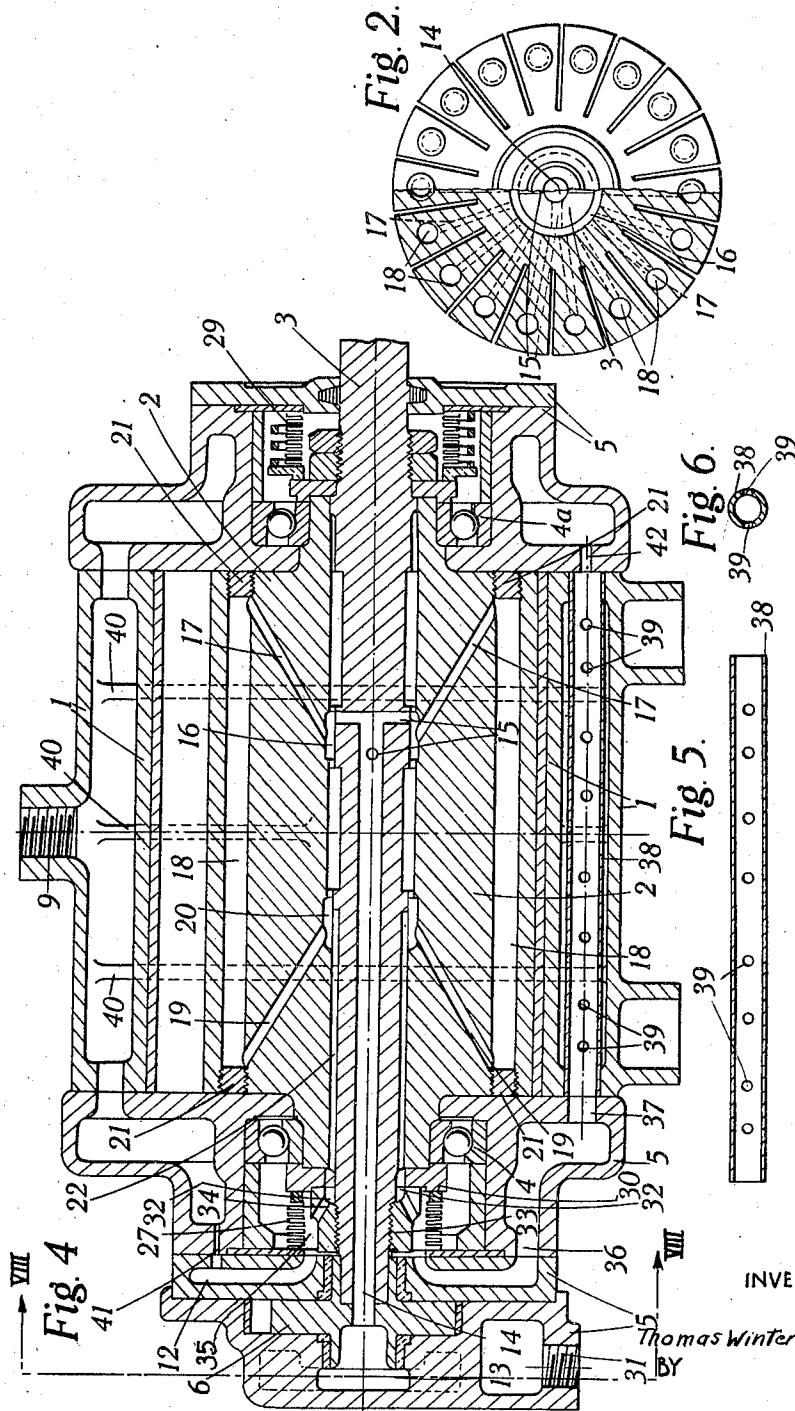
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Fig. 7.

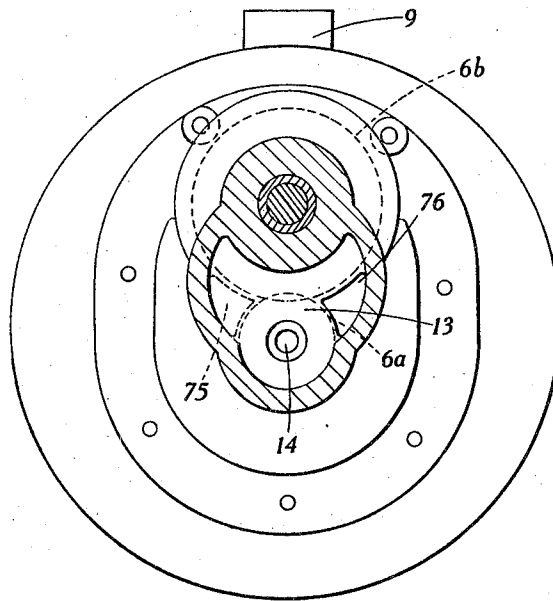
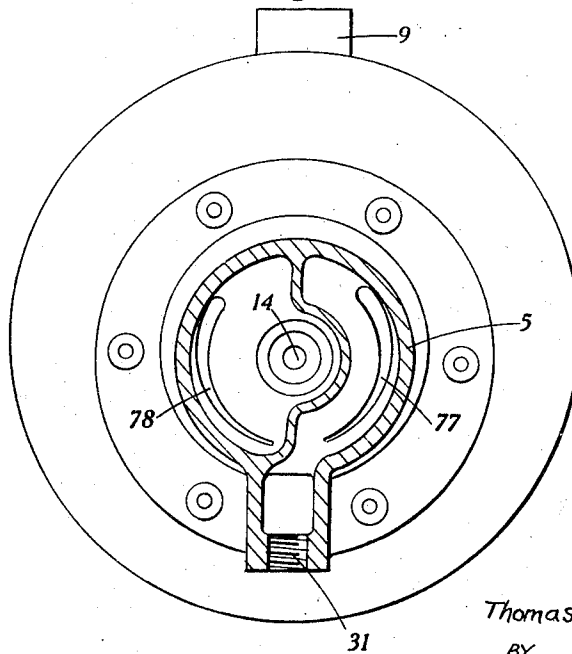


Fig. 8.



INVENTOR
Thomas Winter Nichols

BY

Albert M. Austin

ATTORNEY

UNITED STATES PATENT OFFICE

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ROTARY COMPRESSOR, EXHAUSTER, PUMP,
AND THE LIKE

Thomas Winter Nichols, London, England, as-
signor of one-half to Tilghman's Patent Sand
Blast Company, Limited, Broadheath, near
Manchester, England

Application December 7, 1936, Serial No. 114,629
In Great Britain December 9, 1935

7 Claims. (Cl. 230—210)

This invention relates to improvements in the construction of rotary compressors, exhausters, pumps and the like, the machines having water cooled rotors, and has for its objects the simplifying of the manufacture of the machine to permit of the water passages or ports through the shaft and the rotor being more easily machined, the arranging and enclosing or embodying of a circulating pump or pumps within the end cover or covers, an improvement in the arrangement of the packing or packings to prevent leakage through the end covers or to or from the water spaces, and means for improving the circulation of the cooling water around the outside of the bore of the casing.

In rotary compressors, exhausters, pumps and the like of the type comprising a rotor mounted on a shaft or shafts and arranged parallel but eccentric to the bore of the casing or stator leaving a crescent shaped space between the rotor and the bore of the casing the rotor having vanes or blades radially slidable in slots, it is desirable in order to obtain efficient cooling of the machine that water be circulated through the rotor, preferably through each segment of the rotor situated between each pair of adjacent blades, as well as only around the outside of the casing bore which is the general method.

When only a small number of blades are fitted to the rotor it is possible to core the water passages through the rotor but when a large number of blades are fitted to the rotor the segments become narrow and it is preferable to machine these passages or ports.

Other objects are to obtain an efficient circulation of the cooling water through the shaft and the rotor by means of a suitable pump or pumps embodied or enclosed in the end cover or covers of the machine with various forms of water ports or passages through or on the shaft. These ports may be drilled from one or both ends of the shaft or be grooved as by milling, keywaying or splining on the periphery of the shaft or in the bore of the rotor or in both the shaft and rotor bore, or there may be any suitable combination of partly drilled ports and partly grooved ports as preferred. Instead of grooves or passages in the bore of the rotor the ports may be drilled in the rotor if desired and various types of pumps may be used.

As a further improvement the cooling water after being circulated through the rotor may be led to the bottom of the water jacket of the casing and circulated around the outside of the bore before leaving the machine.

For convenience the terms air-compressor and air in that connection will hereinafter be used to include compressors, exhausters and pumps working upon air or other gases and the term water in connection with the cooling system to include other possible liquid cooling agents.

Other objects and advantages of the invention will appear from the description which follows of the two forms of machine which are illustrated by way of example in the accompanying drawings:—

Fig. 1 is a longitudinal section of a machine wherein an ordinary gear pump is embodied in the outer end cover to force the cooling water through the shaft and the rotor to an impeller enclosed within the opposite end cover, which delivers the cooling water to the outlet at the top of the casing.

Fig. 2 is an end view of the rotor with a half section on the line II, II.

Fig. 3 is a section of the shaft on the line III—III showing the grooved ports on the shaft arranged as splines or keyways.

Fig. 4 is a longitudinal section of a machine wherein a vane pump is embodied in the outer cover to force the cooling water through the shaft and rotor, the cooling water being led through grooved ports back to the outer end of the machine and then by suitable ports to a diffuser tube arranged at the bottom of the casing and after circulating around the bore to pass out of the machine at the top of the casing.

Fig. 5 is a longitudinal section of the diffuser tube.

Fig. 6 is a cross section of the tube.

Fig. 7 is a view of a cross-section taken along line 7—7 of Fig. 1; and

Fig. 8 is a view of a cross-section taken along line 8—8 of Fig. 4.

Referring to Fig. 1, 1 designates the stator or casing of the machine in which is embodied the usual inlet and outlet (not shown) usual to air or gas compressors, 2 the rotor mounted on the shaft 3 and secured to it in any approved manner, the shaft 3 being carried in suitable bearings 4, 4a, preferably of the ball or roller type, in the end covers 5. 6a and 6b designate the wheels of a gear pump 6, the wheel 6a being secured to and being driven by the shaft 3, the wheel 6b being driven by the wheel 6a. The wheel 6b if desired may be arranged to drive the shaft 7 of a mechanical lubricator attached to the end cover as indicated at 8 and may be made larger in diameter than the wheel 6a to give a suitable reduction in speed to the lubricator shaft 7.

In this design the cooling water enters, at the bottom of the water jacket formed in the casing 1 through the inlet 8, the water circulating around the casing 1 in the known manner to pass out through the opening 9 situated at the top of the casing 1. The inlet of the cooling water to the gear pump 6 is led from the bottom of the casing 1 through the ports 10 and 11 to the recess 12 in the cored plate of the end cover and from the recess 12 by a suitable port 75 (Fig. 7) to the suction side of the gear pump 6. The cooling water is delivered from the gear pump 6 through a suitable port 76 (Fig. 7) to the recess 13 which connects with the inlet of the passage 14 in the shaft 3.

The cooling water passes along the passage 14 in the shaft 3 and is guided by the radial ports 15 to a diffusing recess 16, then by the inclined passages 17 to the passages 18 in each segment of the rotor and from the passages 18 by the inclined passages 19 to the recess 20. The passages 18 are closed at each end of the rotor by suitable plugs 21 and a set of ports 17, 18 and 19 are arranged in each segment of the rotor.

By way of ports 22 which are grooved in the shaft 3 on its periphery (or if preferred, in the bore of the rotor) the cooling water is led to the recess 23 which communicates with or forms the inlet to the pump of impeller type 24. The delivery of the cooling water from the impeller pump 24 passes through the ports 25 and 26 to leave the machine through the outlet 9 at the top of the casing 1 or a separate inlet may be provided for the gear pump and a separate outlet for the impeller pump 24 as preferred.

Suitable packings 27, 28, 29, preferably of the bellows type are arranged at both ends of the machine and, if required, specially tough or hardened faces 30 are provided to suit the type of packing used, to prevent water entering the bearings or the working air spaces of the machine.

Referring to Fig. 4, 1 designates the casing or stator which has the usual inlet and outlet (not shown) for the passage of the air or gas to be compressed through the machine, 2 designates the rotor and 3 the shaft to which the rotor is secured in any preferred manner; 6 designates a vane pump for circulating the cooling water through the machine and is attached to the shaft 3 and is driven by it in any preferred manner.

The inlet of the cooling water to the pump 6 is by way of the passage 31, a suitable port or passage connecting this port with the suction port 77 (Fig. 8) of the pump 6. The cooling water is discharged from the pump 6 through the discharge port 78 and passes through the recess 13 to the inlet passage 14 of the shaft 3 and passing along the drilled passage 14 is led by the radial ports 15 to the recess 16 in the rotor 3.

From the recess 16 the cooling water passes through the inclined passages 17 to the longitudinal passages 18 and then by the inclined passages 19 to the recess 20 in the rotor 3. Similar passages to 17, 18 and 19 are arranged in each segment of the rotor 3 between the adjacent blades, the longitudinal passages 18 being suitably plugged at 21 at each end of the rotor. The cooling water then passes from the recess 20 through the grooved ports 22, of which there may be any preferred number, to the recess 32 in the locking nut 33, then through the radial ports 34, of which preferably there are six in the nut 33,

to the space 35 between the bellows or other suitable packing 27 and the nut 33.

From the space 35, the cooling water passes into the cored space 12 of the end cover to pass by way of ports 36 and 37, to the diffuser tube 38 which is situated, preferably, at the lowest part of the casing 1, but may be situated in any other convenient part of the water jacket of the casing 1 and more than one tube may be used as preferred. A number of small holes 39 are arranged on each side of the tube 38 to pass the water into the water jacket of the casing 1 and preferably suitable ribs 40 are arranged in the water jacket with openings at the top. These ribs help to obtain an even spread of the cooling water over the bore of the casing and prevent the cooling water taking the shortest cut or path to the outlet 9 at the top of the casing.

Small ports 41 and 42 may also be arranged, where preferred, to permit cooling water under pressure to pass into the water spaces of the end covers from the space 12 or the tube 38 to accelerate the flow of the cooling water through the covers.

I claim:

1. A liquid-cooled rotary air compressor having a stator, a jacket surrounding said stator, an eccentric rotor having segments separated by grooves and blades slidable in the grooves, hollow end covers closing said stator, a circulating pump within each end cover, at least one of said pumps being a force pump, passages for cooling liquid circulated by the pumps, the said passages conducting the liquid from one of the pumps through the rotor to the second of the pumps and thence to said jacket, and having portions extending through at least certain of said segments.

2. A liquid-cooled rotary air compressor comprising a stator, an eccentric rotor in said stator having segments separated by grooves and blades slidable in the grooves, a shaft mounting said rotor, hollow end covers closing the ends of said stator, a positive displacement force pump enclosed within an end cover, means for driving said force pump from said shaft, a bearing between the rotor and said pump, passages for conducting the liquid circulated by the pump through the rotor segments, and fluid-tight packing separating the bearing and air spaces of the compressor from the circulating passages.

3. A liquid-cooled rotary air compressor having a stator, an eccentric rotor with grooves separated by segments and blades slidable in the grooves, enclosing end covers, a circulating pump within the enclosure of an end cover, a jacket surrounding the stator, liquid distributing means within the jacket to direct the cooling liquid circumferentially around the stator in a plurality of independent, parallel streams distributed along the length of the stator, and passages for conducting liquid circulated by the pump to the distributing means.

4. A liquid-cooled rotary air compressor having a stator including hollow end covers and having an inlet and an outlet for a cooling fluid, an eccentric rotor having segments separated by grooves and blades slidable in the grooves, a shaft mounting said rotor, a circulating, positive displacement force pump within one of said end covers, and passages leading from said inlet to said outlet for conducting liquid circulated by the pump serially through the stator, shaft, rotor segments, and again through the shaft and stator to the outlet.

5. A liquid-cooled rotary air compressor having

a stator including hollow end covers and having an inlet and an outlet for a cooling liquid, an eccentric rotor with grooves separated by segments and blades slidable in the grooves, a circulating pump enclosed within an end cover and mounted adjacent and driven by an extension of the rotor shaft, passage leading from said inlet to said outlet for conducting liquid circulated by the pump into and along the shaft, thence along the rotor segments and for returning the liquid along the shaft to the end of the machine where the pump is situated and thence to said outlet.

6. A liquid-cooled rotary air compressor having a stator, an eccentric rotor with grooves separated by segments and blades slidable in the grooves, enclosing end covers, passages extending along each segment of said rotor parallel to the axis thereof, inclined passages drilled in from near each end of the said first passages towards the center of the rotor communicating with said first passages, means to plug said first passages at each end of the rotor, a circulating pump, and connecting passages conducting the cooling water to the inner ends of the inclined passages lead-

ing to one end of the rotor and from the inner ends of the inclined passages leading from the other end of the rotor.

7. A rotary air compressor comprising a stator, a rotor, means mounting said rotor for eccentric movement in said stator, an axially extending cooling chamber in said stator, an inlet for cooling liquid at one portion of said chamber, an outlet for cooling liquid at another portion of said chamber, a distributor extending longitudinally of said chamber and communicating with said inlet, said distributor comprising a tubular passage having a plurality of outlet openings spaced longitudinally thereof for admitting a cooling fluid to said chamber at a plurality of points distributed longitudinally of said chamber, and a plurality of spaced partitions upstanding from a wall of said chamber and extending transversely for defining a plurality of passages communicating individually at one end with the openings in said distributor and having common communication at the other end with said outlet.

THOMAS WINTER NICHOLS.