

Oct. 18, 1966

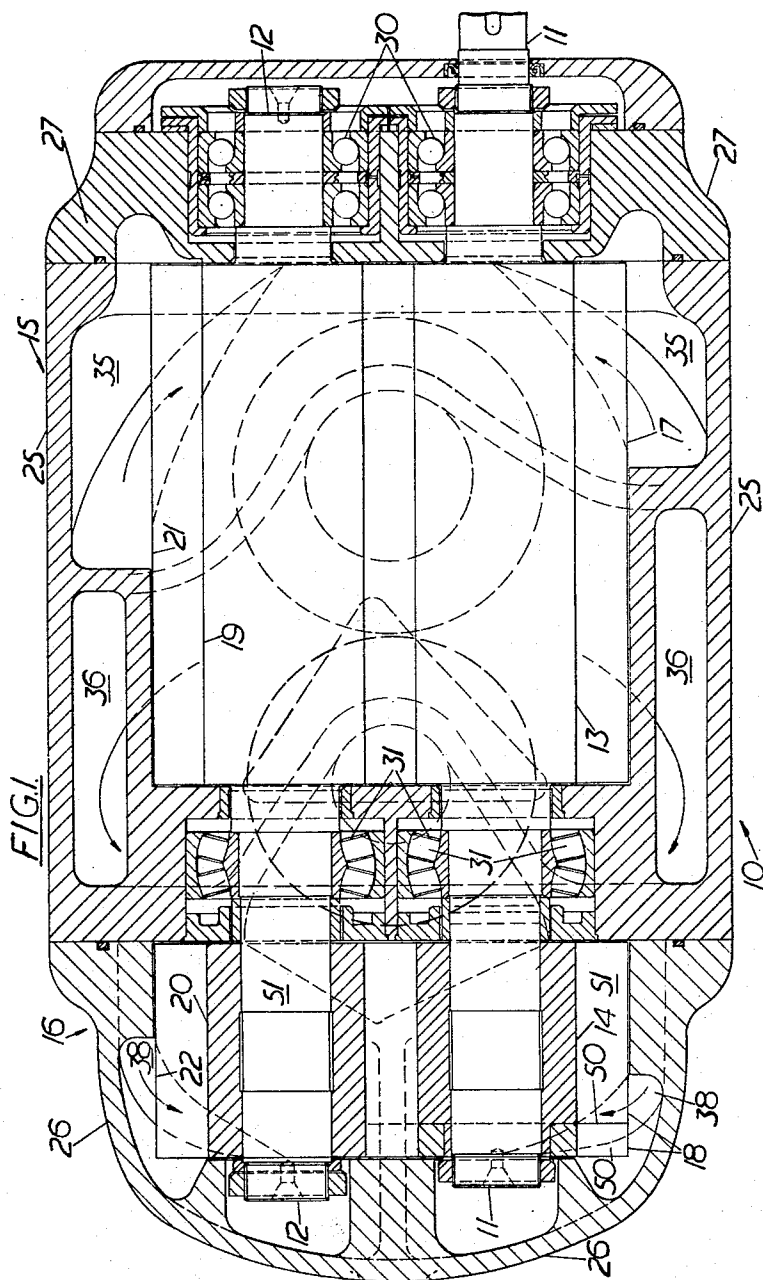
H. B. VAGENIUS

3,279,682

SCREW AIR COMPRESSORS

Filed Feb. 20, 1964

4 Sheets-Sheet 1



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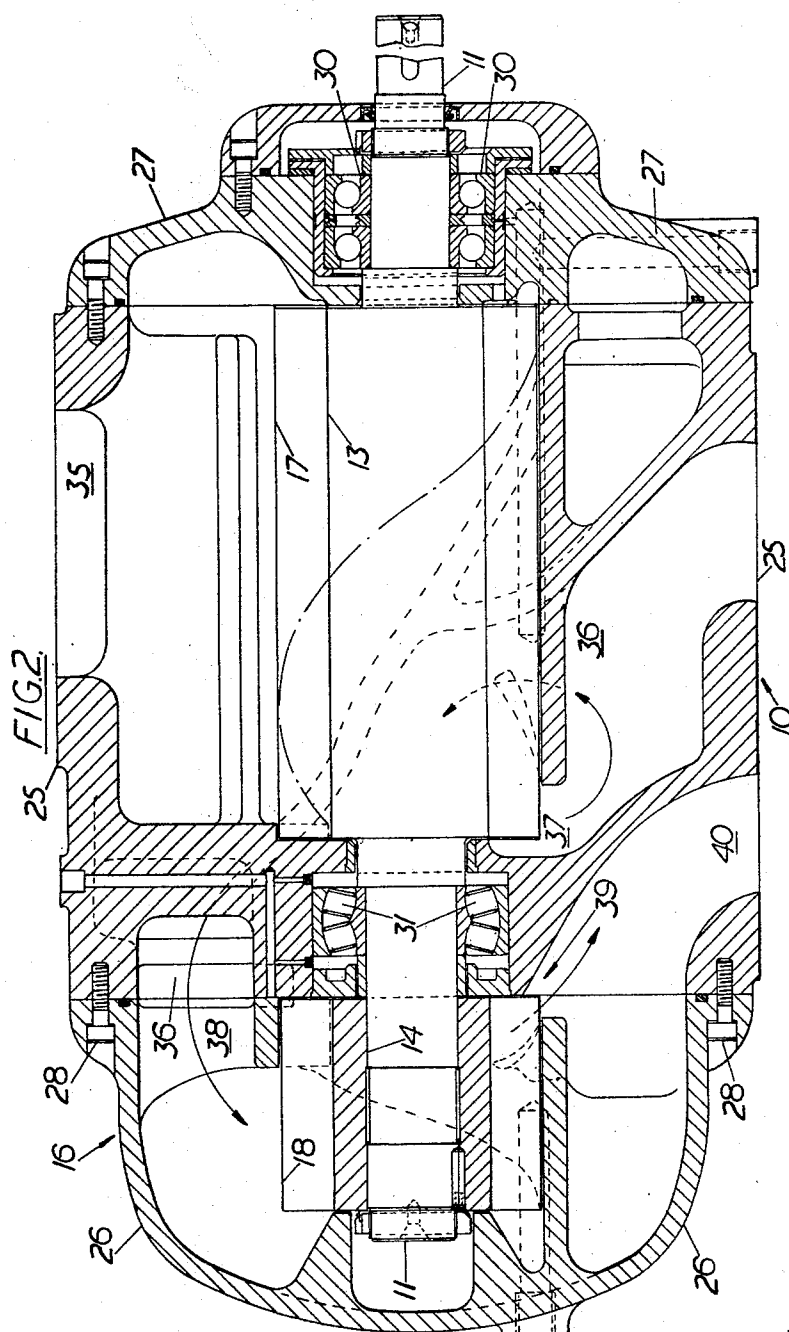
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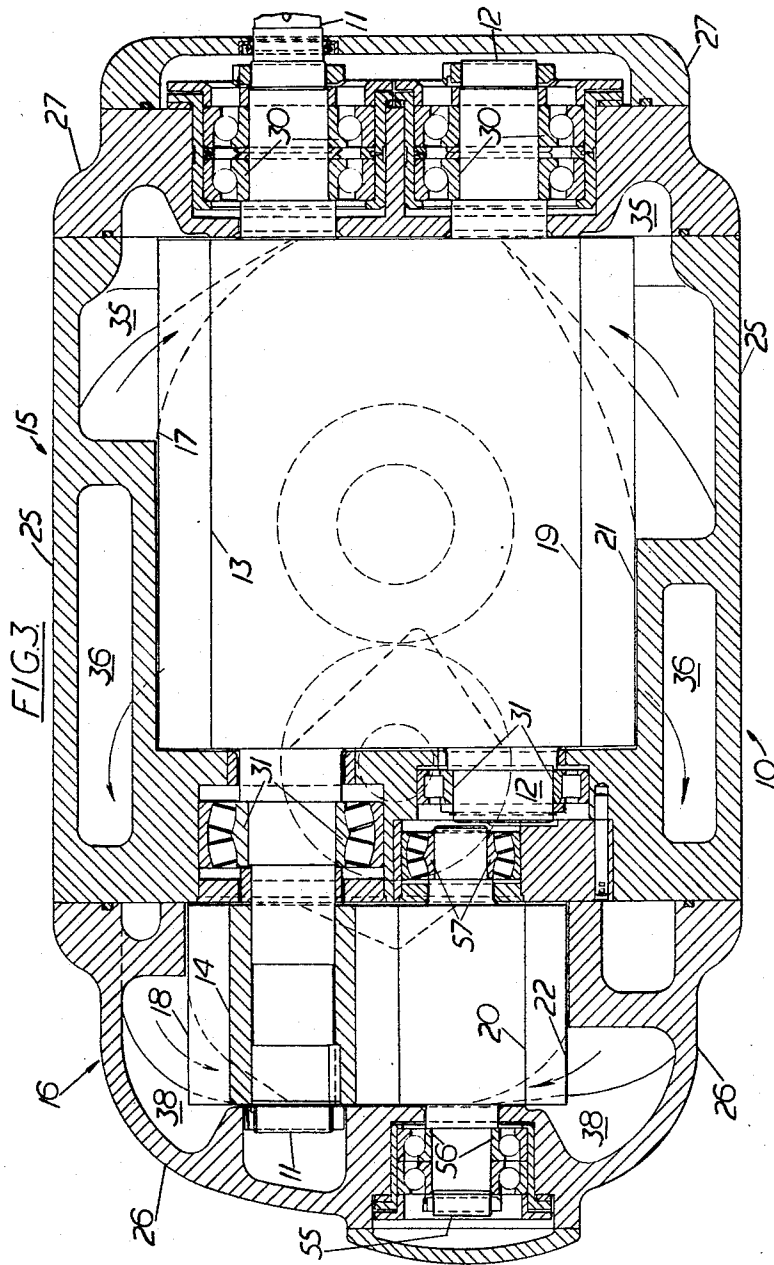
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FIG. 4.

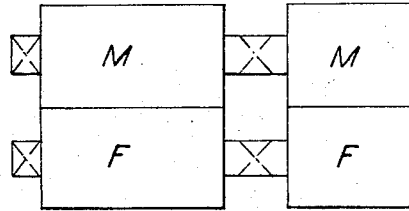


FIG. 5.

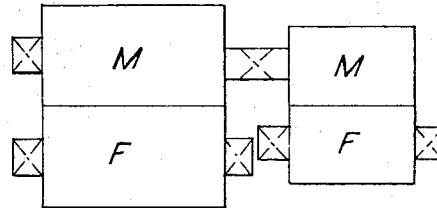


FIG. 6.

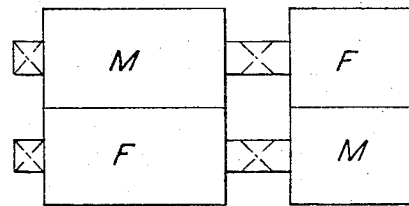


FIG. 7.

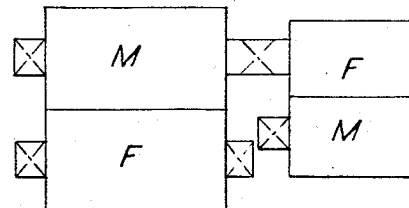
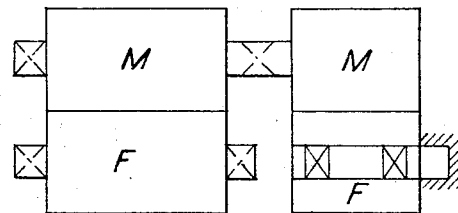


FIG. 8.



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3,279,682

SCREW AIR COMPRESSORS

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Claims priority, application Great Britain, Feb. 23, 1963, 7,372/63

3 Claims. (Cl. 230—158)

This invention relates to machines of the kind having coacting rotors for effecting compression or expansion of a fluid, working medium. Such machines are normally used as air compressors and will be described hereinafter and in the claims as such.

Screw air compressors are well known which comprises two interacting rotors, a male rotor and a female rotor, in a common casing. The male rotor is formed with a series of helical lobes which engage corresponding helical lands in the female rotor. There may be, for example, four lobes on the male rotor and six lands on the female rotor, though any suitable numbers of lobes and lands may be used. Considering one such land in the female rotor, air is admitted through an inlet port and completely fills the land. As the rotors rotate, the inlet port is closed and the point of engagement between the land and the corresponding lobe on the male rotor moves along the land thus compressing the air trapped in the land by the casing, the air being released when the outlet port is reached. If, for design reasons, it is difficult or inefficient to compress the air to the desired pressure in a single stage, two compressor stages may be provided in tandem. It has also been proposed to inject oil into the compressor both to absorb the heat of compression and to improve the sealing between the rotors.

The present invention provides a screw air compressor having two stages in tandem, each stage comprising interacting male and female rotors, and in which two rotors, one from each stage, are mounted on a common shaft, said shaft being supported on only two bearings of which one is mounted at each end of the first stage.

The present invention also provides a screw air compressor having two stages in tandem, each stage comprising interacting male and female rotors, and in which the second stage rotors have a diameter different from that of the first stage rotors.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGS. 1 and 2 are respectively sectional plan and elevational views of a first embodiment;

FIG. 3 is a sectional plan view of a second embodiment;

FIGS. 4 and 5 diagrammatically illustrate the two embodiments of FIGS. 1 to 3;

FIGS. 6 and 7 diagrammatically illustrate modifications of these embodiments; and

FIG. 8 diagrammatically illustrates another modification of the invention.

Referring now to FIGS. 1 and 2, an oil-injected tandem, screw air-compressor 10 according to the invention, is provided with two parallel shafts 11 and 12. On the first shaft 11 is provided the male rotors 13 and 14 of the first and second stages 15 and 16 respectively, the rotors being provided with the helical formations 17 and 18 that are well known in the art. The male rotor 13 of the first stage 15 is formed integral with the shaft 11 and its lobe formation 17 has a right handed helix whereas the male rotor 14 of the second stage 16 is keyed or otherwise secured to the shaft 11 and its formation 18 has a left-handed helix. On the second shaft 12 are provided the

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female rotors 19 and 20 of the two stages 15 and 16, the female rotors being formed with similar helical land formations 21 and 22 and engaging their corresponding male rotors. It should be noted that the land formation 22 of the second stage female rotor 20 again has an oppositely directed helix from the first stage, female rotor 19 and again is formed separately from the shaft 12. It may, however, be secured to the shaft or it may be free to move circumferentially around the shaft 12.

A casing encloses the shafts and rotors to allow a minimum clearance around the rotors and consists of a main casing 25, a secondary casing 26 and an end casing 27. The main casing 25 extends from the outer end of the first stage rotors 13 and 19 to the inner end of the second stage rotors 14 and 20, the secondary casing 26 is secured by bolts 28 to one end of the main casing 25 and encloses the second stage rotors 14 and 20, and the end casing 27 is secured to the other end of the main casing 25 and covers the exposed ends of the first stage rotors 13 and 19.

The two shafts 11 and 12 are similarly mounted in bearings in the casing, a first bearing 30 being provided at the end of each shaft remote from the second stage and a second bearing 31 being provided between the two stages i.e. bearings are provided at each end of the first stage rotors 13 and 19.

An inlet port 35 is provided in the casing adjacent the first bearings 30, i.e. remote from the second stage, to allow air to enter the first stage of the compressor and passages 36 are provided in the casing to pass the air from the outlet 37 of the first stage adjacent the second bearings 31 to the inlet 38 of the second stage which is at the ends of the second stage rotors 14 and 20 remote from the first stage. The outlet 39 from the second stage is thus also adjacent the second bearing 31 and an outlet port 40 is provided there in the casing.

In the embodiment illustrated, the port 40 is provided in the main casing 25 but it could equally well be provided in the secondary casing 26.

By providing the outlet or high pressure ends of both stages at opposing ends thereof, the thrusts on the shafts 11 and 12 due to the pressure differentials between the ends of the rotors act in opposite directions and are largely balanced out. The bearings 30 and 31 are basically journal bearings which may be designed to absorb the small resultant axial thrust.

As the second bearings 31 are provided adjacent the high pressure ends of the rotors, there is little deflection of the shafts 11 and 12 at this point and this leads to improved performance and ease of manufacture as the clearances, both axial and radial, between the casing and the high pressure ends of the rotors are critical.

Although, as described hereinbefore, the second stage rotors 14 and 20, which are short compared with the first stages at opposing ends thereof, the thrusts on the shafts from the outlet end of the first stage, the embodiment could be modified by providing the overhung shafts at the inlet end of the first stage.

Moreover, one of the second stage rotors may be split transversely as indicated at 50 and the two parts thereof, 50 and 51, locked together with a slight angular displacement thus adjusting and mitigating the back lash between the two male and female rotor systems.

The oil injection could be dispensed with or replaced, by, for example, water injection. If a lubricant is not injected into the compressor, timing gears are necessary between the male and female rotors, and moreover the air is passed between the two stages through an inter-cooler which may be external or integral.

In FIG. 3 of the accompanying drawing is shown another embodiment of the invention, and, as it is similar to the embodiment of FIGS. 1 and 2, corresponding parts

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carry corresponding reference numerals. Again, the compressor shown in FIG. 3 comprises two male rotors 13 and 14 on a common shaft 11 which is mounted in bearings 30 and 31 in a casing consisting of the three parts 25, 26 and 27. The first stage female rotor 19 is mounted on the shaft 12. However to allow for a higher inter-stage pressure and therefore a higher overall pressure ratio, the second stage rotors 14 and 20 have a diameter that is different from the diameter of the first stage rotors 13 and 19 and therefore the second stage female rotor 20 is not overhung on the shaft 12 but is provided with its own shaft 55 mounted in bearings 56 and 57.

The modifications described hereinbefore with regard to the embodiment of FIGS. 1 and 2 are also applicable to the embodiment of FIG. 3.

It is also possible to interchange the male and female rotors of the second stage for both the embodiments described hereinbefore, this being diagrammatically illustrated in FIGS. 4 to 7, of which FIGS. 4 and 5 illustrate the embodiments hereinbefore described and FIGS. 6 and 7 illustrate the embodiments with the second stage rotors interchanged.

In FIG. 8 further modification is illustrated in which the free-running second stage rotor is mounted on bearings on a stationary shaft.

I claim:

1. A screw compressor comprising a casing, side-by-side shafts rotatably mounted in the casing, and two pairs of

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side-by-side interacting male and female rotors mounted on the shafts in tandem and co-operating with the casing, to provide two compression stages, wherein the outlets of both stages are located at opposing ends of the rotor pairs, and at least one of the shafts carries two rotors namely one from each stage, and is supported on only two bearings one at each end of one of the rotors so that the other rotor is overhung.

2. A screw compressor according to claim 1, wherein the casing is in two detachably interconnected parts enclosing the respective pairs of rotors.

3. A screw compressor according to claim 1, wherein the rotors of one pair are of a different diameter from the rotors of the other pair.

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