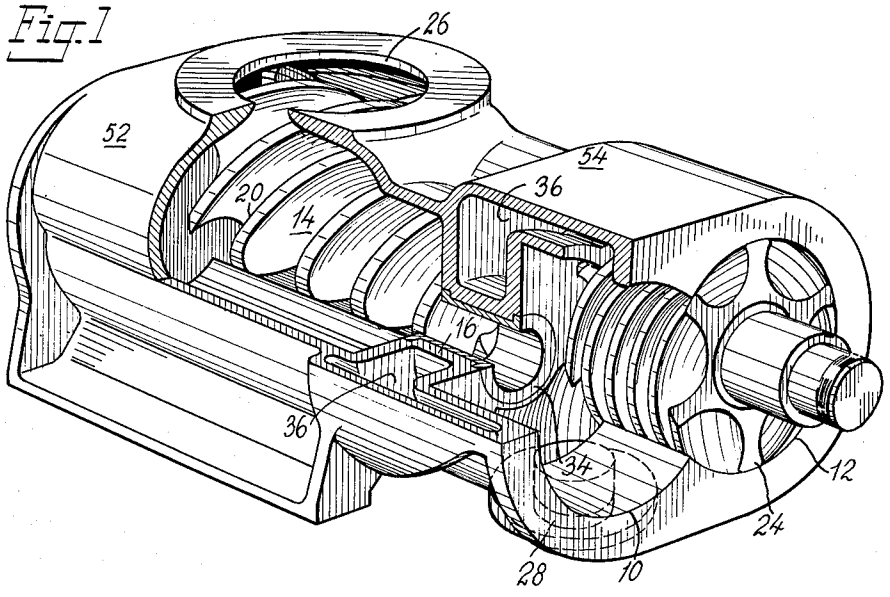
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ROTARY MACHINE

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Fig. 1



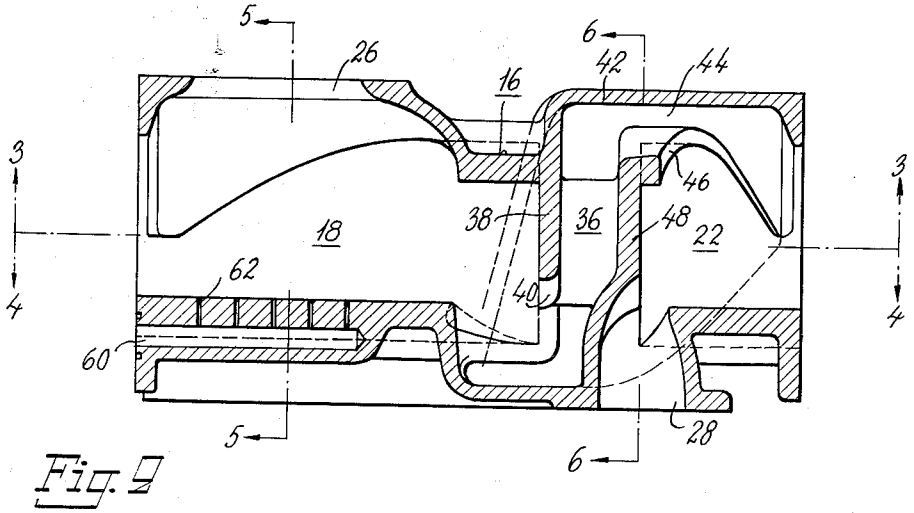




Fig. 2

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ROTARY MACHINE

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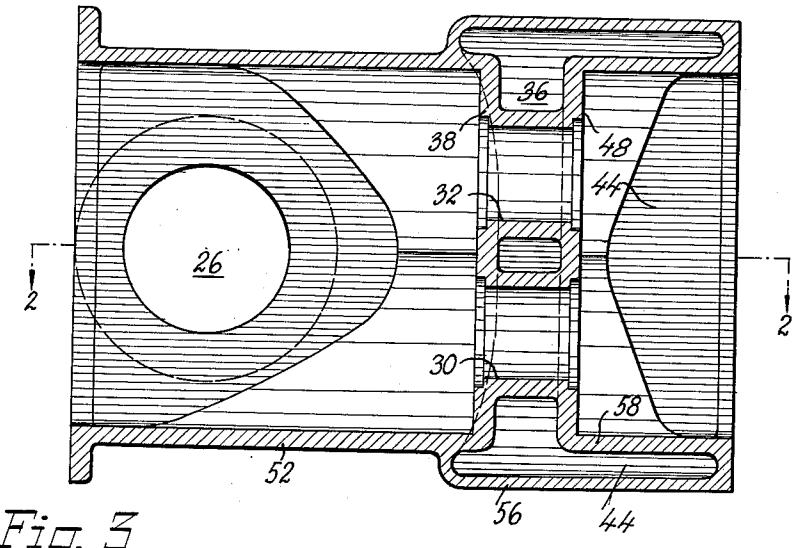



Fig. 3

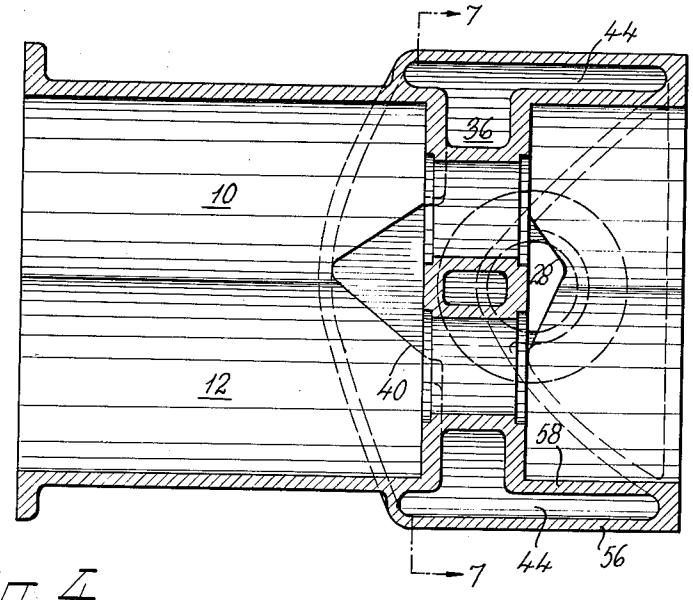



Fig. 4

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ROTARY MACHINE

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Fig. 5

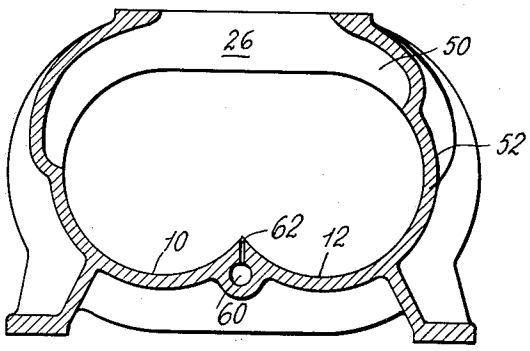



Fig. 6

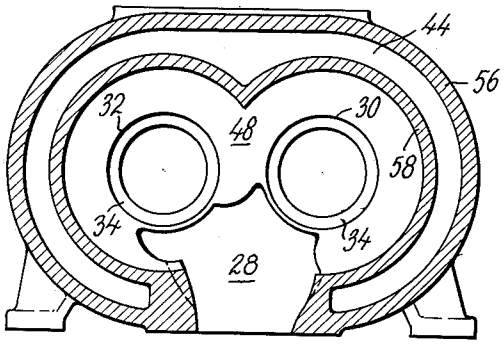
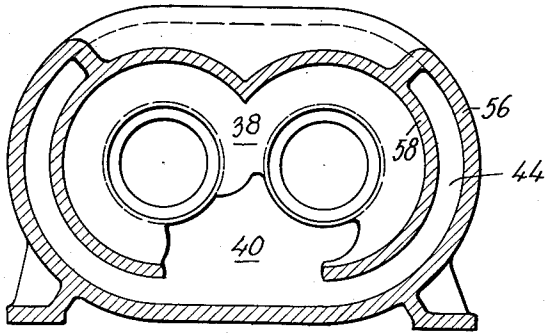



Fig. 7




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3,084,851

# ROTARY MACHINE

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3 Claims. (Cl. 230—143)

The present invention relates to rotary machines of the kind having rotor sections cooperating with each other and provided with helical lands and grooves for effecting compression or expansion of a working medium. It has previously been proposed in such devices to operate in stages in such a way, taking a compressor as an example, that a first stage performs a first compression which is further followed by a second compression stage. Both these stages normally must be separated from each other by means of a sealing to eliminate flow losses for which reason a pipe connection or the like is necessary between the outlet of the first stage and the inlet of the second stage in order to provide the passage of the working medium through the successive pressure stages of the rotary machine.

According to the conventional design such a connection consists of the combination of flanges at the outlet of the first stage and the inlet of the second stage as also an external line of pipe connecting both stages.

Even if such design of the stages into one single machine constitutes an improvement in relation to the possibility otherwise conceivable to realize multi-stage compression or multi-stage expansion, respectively, between separate single stage machines connected in series, the arrangement of previous single machines has been subject to the following deficiencies.

The external connection between the pressure stages complicates the design of the machine. It is further to be noted that expensive work for the assembly is added thereto.

The invention has for its aim to provide an improved arrangement by means of which a multi-stage machine of the kind here dealt with can be designed as an integral unit without requiring any external connections between the stages of the aggregate. For that reason it is proposed that the connection between the stages comprises a channel located in the casing itself accordingly hidden therein so that an external bulky and less attractively appearing line of pipe is made superfluous.

The rotary machine according to the invention for operation with a medium in at least two stages for compression or expansion of the same by means of helical male and female rotors intermeshing with each other is in first hand characterized in that respective pair of successive stages are connected by means of a channel or duct enclosed and built into the casing encircling the rotors.

A preferred solution in practice of the problem of the invention is characterized by an intermediate wall separating the pair of successive stages and provided with an internal hollow chamber having a first opening in connection with the one pressure stage and the second opening in connection with the other pressure stage, of which the one opening acts as outlet from the one pressure stage and the other as inlet for the other pressure stage.

The hollow chamber of the intermediate wall extends preferably perpendicularly to a plane through the central axes of the rotors with the inlet and outlet to the hollow chamber located diagonally in relation to each other.

In such a design are further the inlet and outlet in respective pressure stage located diagonally in relation to each other.

Preferably the rotary machine according to the invention is so designed that the high pressure ends of both pressure stages are located adjacent.



Other details and advantages characteristic of the invention will appear from the following description of an embodiment of the invention shown in the annexed drawings.

FIG. 1 shows a perspective view partly in section of a rotary machine according to the invention.

FIG. 2 shows a vertical longitudinal section of the rotary machine taken along the line 2—2 in FIG. 3.

FIG. 3 shows a horizontal longitudinal section taken in the direction of the arrows 3—3 in FIG. 2.

FIG. 4 shows a horizontal longitudinal section taken in the direction of the arrows 4—4 in FIG. 2.

FIG. 5 shows a vertical cross-section along the line 5—5 in FIG. 2.

FIG. 6 shows a vertical cross-section along the line 6—6 in FIG. 2.

FIG. 7 shows a vertical cross-section along the line 7—7 in FIG. 4.

The rotary machine which is now to be described is constructed according to the principles given in the U.S. Patent 2,622,787 as regards the design of the helical profiles of the rotors and as regards the assemblage into two pressure stages according to the U.S. Patent 2,804,260. The choice of these designs in combination with each other is to be regarded only as an example of a preferred embodiment, for which reason the invention is not to be regarded as limited thereto but as embracing all the forms which are within the scope of the appended claims. As evident from FIG. 1 particularly, the rotary machine according to the invention is designed as a two-stage machine, more specifically a compressor. In the casing, bores 10 and 12 are provided for two rotor sets of which for the sake of clarity only the female rotor set 14 is shown. By means of an intermediate wall 16 the casing is divided into two stages, the one stage 18 containing the rotor sections 20 of the low pressure stage and the other stage 22 the rotor sections 24 of the high pressure stage. The rotor sections of the respective rotor sets are interconnected in some suitable way at least in one of the rotor sets. As shown, the pitch of the rotor sections of the low pressure stage is larger than the pitch of the rotor sections of the high pressure stage. The exemplified embodiment further shows that the wrap angle of the helical profile in the respective stages is mainly the same, in the example approximately 240°. The number of helical lands of the female rotor is six in the exemplified embodiment, implying that the set of female rotors cooperates with a set of male rotors provided with four lands. Further the pitches of the rotor sections in the respective stages are directed oppositely to each other in order to balance the axial thrusts in both of the bearings which support each rotor set in end walls covering the ends of the housing. Since this design already is known per se, these end walls have been omitted in the drawing in order to make the same clearer.

In the low pressure stage 18 the casing is provided at the top with an inlet opening 26 for the working medium and at the bottom in the high pressure stage 22 with an outlet 28 for the fully compressed medium.

The intermediate wall 16, which divides the machine into the two pressure stages 18 and 22, is provided with bores 30 and 32 for a member which connects the rotor sections in each rotor set. These bores are preferably provided with an axial bearing 34 which may be divided into halves. Said axial bearing supports each rotor set in the intermediate wall and acts for that reason to prevent the deflection which otherwise should occur if each rotor set was supported solely at its outer ends. If the length of the machine is shorter such intermediate bearing, however, may be dispensed with and replaced by a convenient

sealing arrangement in order to reduce the flow losses through the intermediate wall.

As is evident from the drawings the intermediate wall 16 is hollow and the hollow chamber 36 thus obtained acts as a connection between the high pressure stage 18 and the low pressure stage 22. The wall section 38 facing the high pressure end of the low pressure stage 18 forms at the bottom an outlet opening 40 for the working medium compressed in the first stage which via the hollow chamber 36 of the intermediate wall is conducted up to the upper part 42 of the portion of the casing which encloses the high pressure stage 22. The hollow space 44 in said upper high pressure part 42 of the casing passes over into an inlet opening 46 to the high pressure stage located at one outer end of the rotary machine. The finally compressed working medium escapes through the outlet 28 of the rotary machine which in its turn is located adjacent the wall portion 48 of the intermediate wall which faces the high pressure end of the high pressure stage.

The inlet opening 26 is as evident from FIG. 5 passing over into an extension 50 of the jacket portion 52 of the casing which closely encircles the rotor parts of the low pressure stage 18 for the rest. The object of this extension is to provide most favourable admission to the working chamber of the low pressure stage.

The mainly vertical hollow chamber 36 in the intermediate wall 16 separating the both pressure stages passes over as stated in the hollow space 44 extending axially and enclosing the high pressure stage materially as is evident from FIG. 6 according to which this hollow space 44 extends around the rotors down to the high pressure outlet 28. In other words it may be said that the jacket portion 54 of the casing enclosing the high pressure stage is double walled and consists of an external supporting envelope 56 integral with the shell 52 of the low pressure stage and a shell 58 closely encircling the rotor parts of the high pressure stage 22, between which shells 56 and 58 the hollow space 44 is formed.

The double walled jacket portions 56 and 58 of the high pressure stage continues behind the intermediate wall 16 a short distance into the adjacent side of the low pressure stage as is evident from FIGS. 3, 4 and 7 for the purpose of creating a smooth transition between the jacket portions enclosing the different stages. Since each rotor set has rotor sections in the different stages which are of the same rotor diameter the jacket portions 52 and 58 are of the same diameter over the major portions of their circumferences.

The illustrated casing is made in one piece but alternatively the casing may be imagined as composed of an upper and a lower half, that is to say the casing may be divided along a plane through the central axes through the rotors. A varied solution consists of joining the casing in axial direction from suitable structural parts.

The rotary machine may as previously known operate dry that is to say the rotors and the enclosing casing provide close clearances. As alternative FIGS. 2 and 5 show a design provided with admission means for sealing and/or cooling fluid such as oil or water to the low pressure stage. An admission channel 60 distributes the fluid via a number of channels 62 to the low pressure stage. In the device illustrated the fluid injection is effected along the intersection between both the bores 10 and 12 but the location as well as the direction of inflow of the admission channels can be modified. Alternatively or additionally the high pressure stage can be provided with such a fluid supply.



We claim:

1. A two-stage rotary compressor of the helical screw type having a casing structure comprising a barrel portion providing two aligned sets of barrels for low and high pressure compression stages arranged in tandem and in intersecting relation about coplanar axes, each of said sets of barrels providing an inlet port located generally on one and the same side of the plane of said axes and a discharge port located generally on the other side of said plane, said discharge ports being located at the adjacent ends of the respective stages and the inlet ports being located at the ends of the respective stages remote from each other and said casing structure further providing two axially spaced apart partitions normal to said axes located between said sets of barrels to form end walls for the respective stages and a transversely extending transfer passage therebetween, means providing separate connecting passages each coaxial with one of said axes and extending through said transfer passage to join said sets of barrels, an outer casing wall radially spaced from the barrels of the high pressure stage to provide an axially extending duct embracing the major portion of the perimeter of the high pressure stage, one end of said duct being in open and unrestricted communication with said transfer passage laterally to one side of the plane of said axes and the other end of said duct terminating in an opening providing said inlet port for said high pressure stage at the end thereof remote from the low pressure stage, said discharge port for the low pressure stage communicating with said transverse transfer passage laterally to the side of the aforesaid plane opposite said axially extending duct, and male and female rotor members each comprising axially spaced rotor sections having helical lands and grooves disposed in intermeshing sets in said barrels and shaft portions extending through said connecting passages to connect said sections.

2. A compressor as defined in claim 1 in which orifices are provided in the barrel portion of the casing structure for injection of liquid into the low pressure stage of the compressor.

3. A compressor as defined in claim 2 in which said orifices are disposed substantially along the line of intersection between the barrels on the same side of the plane of said axes as the discharge port from the low pressure stage.


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