June 11, 1963 G. D. FRASER 3,093,300

AXIAL FLOW COMPRESSOR

Filed Jan. 31, 1961

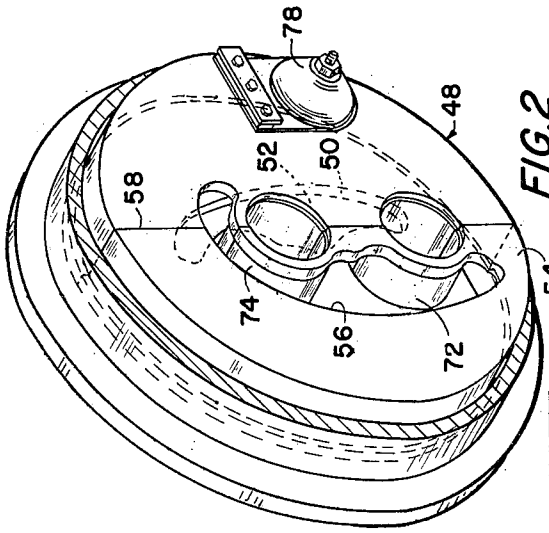


FIG. 2

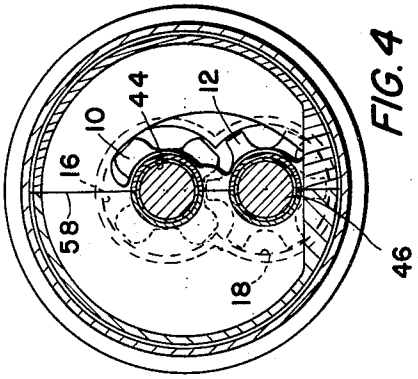


FIG. 4

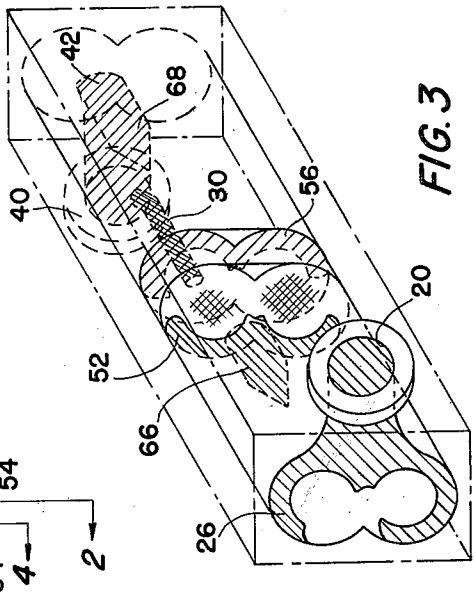


FIG. 3

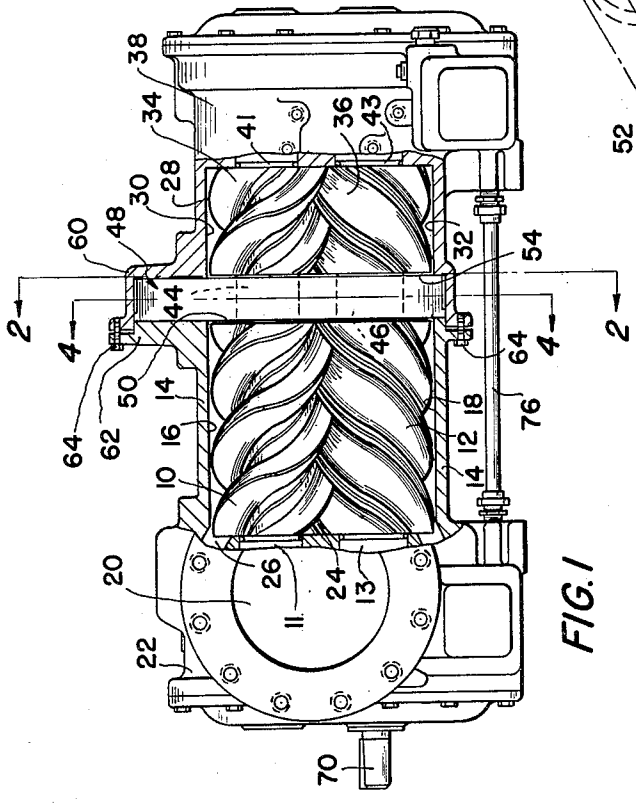


FIG. 1

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AXIAL FLOW COMPRESSOR

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This invention relates to gas handling rotary machines having at least two stages for gas compression or expansion and particularly to that type of machine which is provided with male and female helical intermeshing screw type rotors which, as they turn, positively displace fluid in a substantially axial direction with respect to the rotors if the machine be a compressor or pump, or, if a motor, the chamber formed by the rotors expands to produce the motive force.

The invention has to do more particularly with a machine of this type operating in stages, each stage having a pair of such rotor elements, and the second stage operating on the discharge of the first stage.

It is an object of the invention to provide a construction in which the enclosing casing of such a machine is compact and relatively simple to manufacture.

A further object is to provide a casing for such a machine formed in sections, one of which forms an intermediate passage between the stages and eliminates the necessity of external conducting passages therebetween.

These objects are attained, in brief, by providing a casing containing first and second stages, each stage including a pair of intermeshing rotors cooperating with each other and the casing to form a variable displacement chamber therebetween and mounted in axially spaced relationship to the rotors of the other stage, locating a partition between the first and second stages and engaging the end faces of the rotors of both stages to cooperate with the rotors to form the variable displacement chambers of both stages, and providing the partition with a passageway means for receiving gas discharged from the first stage and feeding it to the second stage. In a specific embodiment of the invention, the partition is hollow and includes a pair of axially spaced walls, one wall containing a gas discharge outlet port for the first stage and the other wall containing a gas inlet port for the second stage with the two ports being angularly displaced from each other relative to the axes of the rotors.

Other objects and advantages of the invention will be in part pointed out and in part obvious hereinafter.

The drawing illustrates an improved form of the invention and includes

FIGURE 1, a longitudinal view of a two-stage compressor to which the invention is applied, the casing being shown broken away to disclose the inner construction,

FIG. 2 is a sectional view in perspective taken along the line 2—2 of FIG. 1 and showing the partition interposed between the two stages of the compressor,

FIG. 3 is a diagrammatic representation indicating the porting areas and, in part, the important flow areas of the fluid handled by the machine, and

FIG. 4 is a cross section through the partition or intermediate section of the casing taken at the line 4—4 of FIG. 1 looking in the direction of the arrows.

Referring to the drawing and more particularly to FIG. 1, the machine which is here illustrated as a two stage machine, is provided with a first stage pair of rotors including a male rotor **10** and a female rotor **12** intermeshing and adapted to turn within the first stage section **14** of the casing. Rotors **10** and **12** fit within intersecting circular bores **16** and **18**, respectively, and their outer extremities form a substantial seal therewith and with each other, as is well known in the art, to form a variable displacement chamber which progresses from

the inlet end of the casing to the discharge end. Each rotor **10** and **12** has a shaft extension **11** and **13** supported in parallel relationship in an inlet head **22**. When the machine is used as a compressor the chamber so formed positively displaces fluid which has been introduced by way of the inlet **20** in the inlet head **22** which provides an end face **24** abutting the ends of rotors **10** and **12** and which is provided with an inlet port **26** also indicated diagrammatically by the shaded portion so designated in FIG. 3.

The second stage of the machine is housed within a second section **28** of the casing similarly provided with a pair of intersecting cylindrical bores **30** and **32** containing a shorter pair of rotors **34** and **36**, the former being the male rotor and the latter the female rotor, each having a shaft extension **41**, **43**, respectively, supported in a discharge head **38**. Fluid being handled by rotors **34** and **36** is discharged into the discharge head **38** having a discharge outlet **40** and provided with a port **42** also indicated in FIG. 3. The shaded area connecting port **42** with discharge **40** in FIG. 3 indicates the passage of discharge air or other working fluid in the discharge head **38**.

Male rotors **10** and **34** are in this instance formed as a unit with a short cylindrical connecting section **44** therebetween, and likewise female rotors **12** and **36** are connected by a short cylindrical connecting section **46**. Casing sections **14** and **28** are provided with an intermediate casing section or partition **48** which has two interconnected parts cooperating with the rotors of the first and second stage to control the discharge from the first stage rotors and to control the inlet to the second stage rotors. In this instance intermediate section **48** is hollow and provided with a plane faced wall **50** abutting the ends of rotors **10** and **12** and the ends of the cylindrical bores **16** and **18**. An outlet port **52** is provided in the face of wall **50** to pass fluid discharged from the first stage into the interior of section **48**. A second wall **54** parallel to wall **50** and abutting the inlet ends of second stage rotors **34** and **36** is also provided with an inlet port **56** to convey fluid from the interior of section **48** to the space between rotors **34** and **36**. Intermediate section **48** is formed in two symmetrical halves, being split as shown at the joint **58**, so as to fit about the portions **44** and **46**. The portions of section **48** are held together in an encircling flange **60** formed integrally with either the first or the second casing section **28** and arranged to abut the flange **62** formed on the first casing section **14**. Flanges **60** and **62** are suitably bolted together by the screws **64**.

As above described, fluid entering the first casing section **14** is entrapped by rotors **10** and **12** and carried axially to the first stage discharge ports **52** to be contained within the reservoir space within the hollow intermediate casing section **48**. Such fluid is admitted to the second stage at port **56** to be engaged by rotors **34** and **36** and carried axially to discharge port **42** and thence discharged at outlet **40**. As is well understood in the art the space between the lobes and grooves of the rotors forms a distorted pyramid as indicated at the shaded portions **66** and **68** in FIG. 3, becoming progressively smaller thereby compressing the fluid contained therein. It is understood that the rotors **10** and **12** and those shown at **34** and **36** are suitably driven from a shaft **70** adapted to be attached to a suitable source of motive power (not shown) and the rotors are suitably journaled in inlet head **22** and discharge head **38**. The rotors may be coupled together by synchronizing gearing (not shown) or one may be driven by the other through the direct contact therebetween.

Another feature of the porting arrangement as described hereinbefore, is that there is no low spot for liquid to settle between stages and to be picked up as a slug to enter the second stage. Any liquid in the compressor,

such as used for cooling purposes, flows through the machine substantially without changing level or settling.

A bypass valve **78**, positioned on the face of wall **54** of intermediate casing section **48**, controls the flow of fluid through a passage **80** communicating outlet **40** directly with the interior of intermediate casing section **48** and port **52**. Such control is provided to permit fluid to flow from port **52** into outlet **40** but to prevent return flow from outlet **40** into the interior of intermediate casing section **48**. Passage **80** serves to bypass the operational flow path of the fluid in the intermediate casing section **48** and in the second stage section **28** when the compressor is started, such bypass permitting fluid which is initially compressed in the first stage section to flow out freely therefrom through passage **80** into outlet **40** until sufficient pressure is built up in outlet **40** to cause valve **78** to close such that thereupon the fluid follows the operational path as hereinbefore described. With such an arrangement, when starting the compressor, power for initial compression of fluid in the compressor is utilized to the best advantage.

To reinforce the end walls **50** and **54** suitable spacers **72** and **74** may be provided surrounding the shaft portions **46** and **44**, respectively, but preferably they do not form bearings therewith which would necessitate difficult machining of the intermediate casing **48**.

As shown in FIG. 1 an interconnecting pipe **76** is provided to convey oil from the discharge head **38** to the inlet head **22** for circulation and lubrication of the bearings and gears. The lubrication system, not being a feature of this invention, is not described in detail herein.

Thus, by the above construction are accomplished, among others, the objects hereinbefore referred to.

I claim:

1. A plural stage axial flow gas handling machine comprising: a casing containing a pair of gas handling expansible-contractable positive displacement stages including first and second stages; each stage including a pair of inter-meshing screw-type rotors cooperating with each other to form an expansible-contractable positive displacement chamber therebetween and mounted in axially spaced relationship to the rotors of the other stage; a partition secured to the casing and located between the rotors of said first and second stages; said partition being hollow and including a pair of axially spaced walls, each of which is located adjacent one of said stages and engages the end faces of the rotors of that stage to cooperate with the rotors in forming the expansible-contractable positive displacement chamber of that stage; one of said walls containing an outlet port from the first stage and the other wall containing an inlet port for the second stage with said ports being angularly displaced from each other relative to a plane passing through the axes of the rotors; and said partition being formed in at least two interfitting arcuate sections which can be separated for assembly and disassembly of the machine.

2. The machine of claim 1 wherein: said casing is formed of at least two casing sections, one casing section housing the first stage rotors and the other housing the second stage rotors; and said partition is removably secured to and between said two casing sections.

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