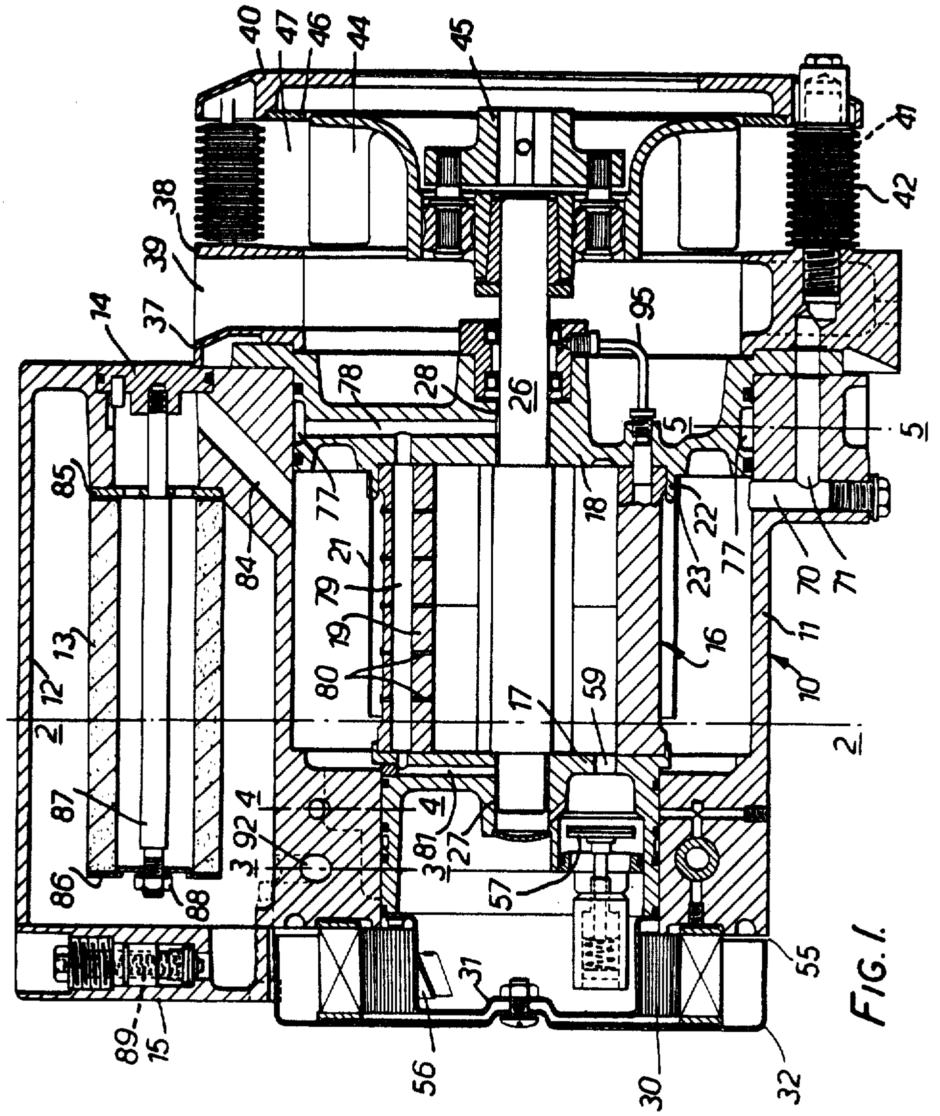

FIG. 1.

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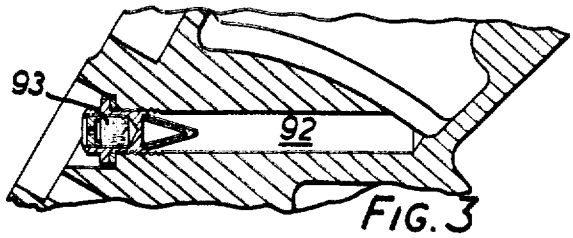

FIG. 3

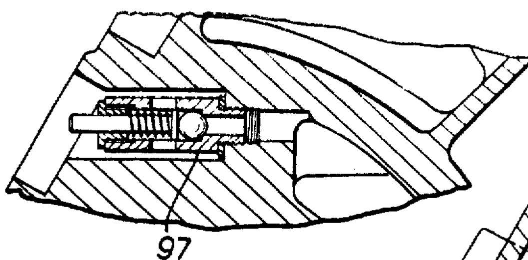

FIG. 4

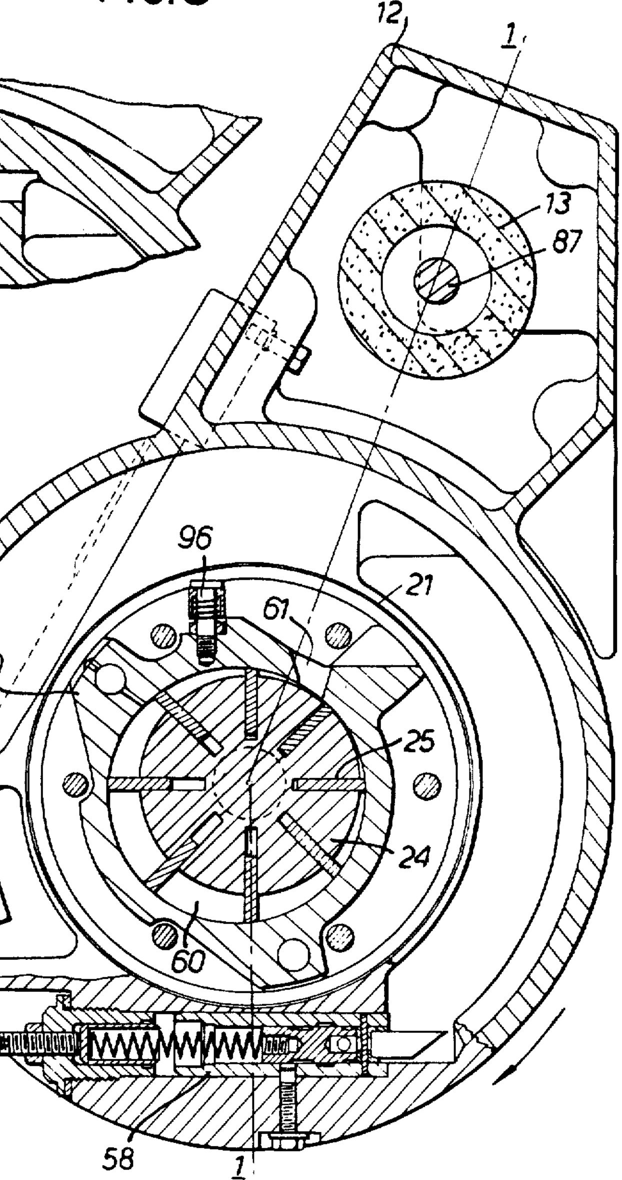

FIG. 2

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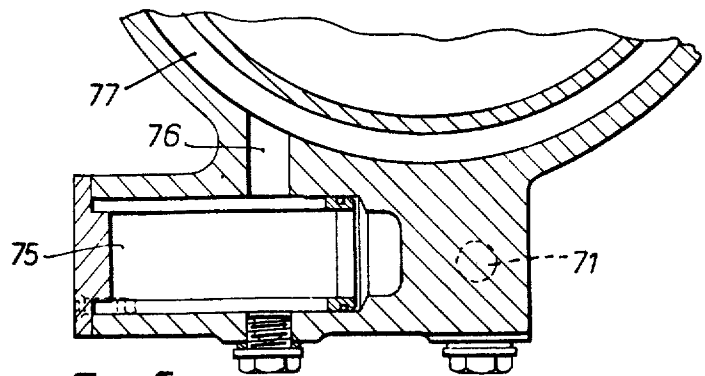

FIG. 5.

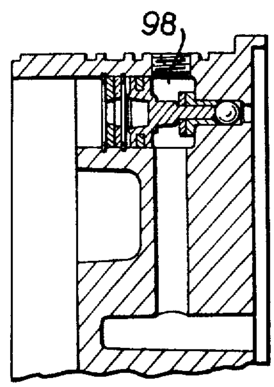

FIG. 6.

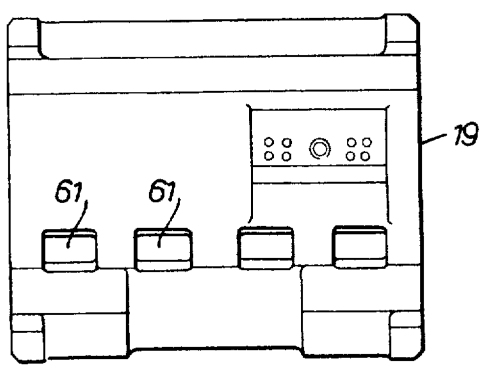

FIG. 7.

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3,669,579

COMPRESSORS

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Int. Cl. F01c *21/04;* F04b *49/00;* F04c *29/02*
U.S. Cl. 418—83 6 Claims

ABSTRACT OF THE DISCLOSURE

A compressor of the eccentric vane type in which a mixture of compressed air and oil is delivered through a number of ports distributed along the length of the compressor stator into a chamber which affords a sump and a deflecting wall on which the oil is deposited. Thereafter the compressed air passes through a separator which removes the remaining oil from it.

This invention relates to the construction of compressors of the eccentric vane type.

According to the present invention a compressor of the eccentric vane type includes a rotor having a number of sliding vanes mounted to rotate about an eccentric axis in a cylinder in a stator, affording a crescent-shaped space divided by the vanes into a number of working chambers, and has means for delivering oil into the working chambers, and/or the air inlet thereto, from a sump surrounding the lower part of the stator, characterised in that the air is delivered from the stator through a number of delivery ports distributed along the length of the stator into a chamber which extends down at points distributed along its length to the surface of the oil in the sump and affords a deflecting wall opposite the delivery ports on which oil can be deposited from the air and can dribble down into the pool of oil.

The deflecting wall may be afforded by a part-cylindrical shield dividing an annular chamber located about the stator into inner and outer compartments which communicate with one another at the bottom through a gap or an opening in the shield and together form the oil sump. While at the top they communicate with one another only at a first end, while the outer compartment has an outlet at the opposite, or second, end, so that the compressed air from the stator has to flow longitudinally first along the inner compartment to the first end, where it is deflected and decelerated to flow in the opposite direction through the outer compartment.

In another aspect of the present invention a compressor of eccentric vane type includes a rotor having a number of sliding vanes mounted to rotate about an eccentric axis, in a cylinder in a stator, affording a crescent-shaped space divided by the vanes into a number of working chambers, and has means for delivering oil into the working chambers and/or air inlet thereto from a sump surrounding the lower part of the stator, in which the casing comprises a main casting supported at one end (referred to as the driving end) where it is connected to a driving motor, and affording a pair of tunnels (open at the opposite or inlet end), a lower tunnel in which the stator is fitted, and an upper tunnel which accommodates a final oil separator in the form of a tube which is accessible by removing a cover from the inlet end of the upper tunnel. The final oil separator may be of ceramic material.

The lower tunnel at its inlet end may have a cover which is removable to provide access to an off-loading valve closing the inlet when the delivery pressure exceeds a predetermined value. The off-loading valve may be controlled by a servo valve disposed in a transverse horizontal bore in the bottom of the casting at its inlet end and responding to oil pressure to admit such pressure to a piston surface of the off-loading valve.

In addition the upper tunnel may be closed by a cover incorporating a minimum pressure valve through which the compressed air is delivered and which closes if the delivery pressure falls below a given pressure to prevent further fall of pressure.

Further features and details of the invention will be apparent from the following description, given by way of example, of one specific embodiment with reference to the accompanying drawings, in which:

FIG. 1 is a longitudinal section generally on the line **1—1** of FIG. 2 of a compressor of the eccentric vane type,

FIG. 2 is a section generally on the line **2—2** of FIG. 1,

FIGS. 3, 4 and 5 are respectively detail sections on the lines **3—3**, **4—4** and **5—5** respectively of FIGS. 1 and 2,

FIG. 6 is a sectional view of a vacuum relief valve, and

FIG. 7 is a plan view showing the delivery ports distributed along the length of the cylinder.

The construction may be regarded as a development of that described in British patent specification No. 1,134,224.

It will be convenient to refer first to the main parts of the compressor and then to mention further details in conjuction with a description of the path followed by the air and by the oil.

The compressor comprises a main casting **10** consisting of a cylindrical lower part **11** and a generally pentagonal upper part **12** which respectively afford a lower tunnel and an upper tunnel. The upper tunnel accommodates a final separator **13** and is closed at one end which will be termed the drive end, to the right in FIG. 1, by a drive end upper cover **14** and at its opposite, or intake, end by an intake end upper cover **15**.

The lower cylindrical tunnel has a portion of reduced diameter at the intake end and is occupied by a stator assembly **16** comprising an intake end cover **17** a driven end cover **18** and between them a cylinder **19**. These are secured together by screws (not shown) and serve to close both ends of the cylindrical lower tunnel. As shown in FIG. 2 the cylinder **19** is of somewhat irregular external cross-section but is of considerably smaller size than the larger portion of the cylindrical lower tunnel **11** so as to leave between the two an irregular annular space of which the lower portion forms an oil sump while the upper portion forms a delivery manifold.

In accordance with one feature of the present invention this space is divided into inner and outer portions by a cylindrical deflector tube **21**.

Within the cylinder is a rotor **24** having slots containing vanes **25** and formed integral with a shaft **26** carried by bearings **27** and **28** respectively in the intake end cover **17** and drive end cover **18** so that the rotor rotates about an axis eccentric in relation to the inner surface of the cylinder. At the intake end is an air filter **30** of corrugated paper mounted between an inner cap **31** and an outer cap **32**.

At its drive end, the compressor is provided with, and mounted upon, a structure that will be termed a lantern comprising a pair of rings **37** and **38** connected together by integral spacers **39** and a third ring **46** connected to the ring **38** by integral spacers **47**. Two bolts **41** of cruciform section pass through a number of oil cooling rings **42** and are secured to the ring **38**. The shaft carries a fan **44** for drawing in air through the gaps between the spacers **39** and delivering it out between the oil cooling rings **42**. The fan is driven by a coupling **45** which is connected to the shaft of a motor. The motor is bolted to a ring **40** which is bolted to the ring **46** of the latern.

It will now be convenient to describe further details of the compressor in conjunction with a description of the path taken by the air and the oil through it.

The air enters at the intake end through a narrow annular gap **55** between the outer cap **32** and the main casting **10** and flows inwardly through the corrugated paper air cleaner **30** and through an opening **56** in the inner cap **31**. It then flows through an unloader valve **57** actuated by a servo device **58**. This valve is subject to the pressure in the bottom part of the sump, and hence to the delivery pressure, and when this pressure rises the valve admits the pressure to the unloading valve and causes the latter to close against the action of its spring so as to restrict or cut off the intake of air to the compressor.

The unloader valve leads to an inlet port **59** opening through the intake end cover into the crescent shaped space **60** between the cylinder **19** and the rotor **24**, which is, of course, divided into separate working chambers by the vanes **25**. As the rotor rotates each working space is reduced in volume to compress the air in it as the working space is rotated towards a series of delivery ports **61**. There are four such delivery ports extending in a line along the whole length of the cylinder.

As referred to above the lower half of the roughly annular space between the stator and the lower tunnel in the main casting forms a sump which is filled with oil to about the level of the axis. As the upper part of this space communicates with the delivery ports and is therefore at delivery pressure the whole of the oil is subjected to the delivery pressure, which may for example be of the order 100 pounds per square inch. As described below the oil is admitted to the working chambers of the compressor at a point where the oil is partially compressed, for example to a pressure of 30 pounds per square inch, and this difference of pressure maintains a circulation of the oil through the oil cooler and the remainder of the lubricating cooling and sealing system.

Thus from the bottom of the sump the oil passes down a vertical passage **70**, along a longitudinal passage **71** and along the grooves of one of the cruciform bolts **41** into the oil cooling rings **42**. Each of these is in the form of a flat hollow ring blocked at one point so as to leave a C-shaped channel, to one end of which the oil is admitted and from the opposite end of which it is withdrawn into another of the cruciform bolts **41**. It flows along the latter to an oil filter **75** and thence up a vertical passage **76**, shown in FIG. 5, which opens into an annnular groove **77** in the periphery of the main drive end cover. Entering this groove near its lower end it travels round to a point near its upper end and thence flows inwards through a radial passage **78** to lubricate the drive end bearing **28**. The radial passage **78** also communicates with a longitudinal gallery **79** from which a number of small radial passages **80** open into the working chamber at a point at which, as already referred to, the pressure might be about 30 pounds per square inch. At its inlet end the gallery **79** communicates with a radial passage **81** leading to the inlet end bearing **27** to lubricate it.

Thus a continuous supply of oil is fed into the air in the working chambers as well as into the bearings in order to seal cool and lubricate the compressor.

The mixture of air and oil emerges from the delivery ports **61**. As already described the cylindrical deflector tube **21** has a portion immediately opposite the delivery ports so that the mixture of air and oil strikes against it and deposits a substantial portion of the oil on its inner surface. A feature of the present arrangement is that this oil is not obliged to travel along with the air to one end of a delivery gallery but can immediately trickle down in a circumferential direction on the inside of the deflector tube. In fact the tube is in the form of a strip of metal bent round to the form of a cylinder with a gap between its ends and held in place on a tubular flange **22** by a jubilee clip **23**. Thus the deflector tube has a longitudinal slot at the bottom extending throughout its length through which oil can pass. This however is unimportant since it will be realised that the whole of the space both inside and outside the tube below the level of the axis is occupied by a pool of oil.

Meanwhile the air flows longitudinally along the inside of the deflector tube to the intake and where it is open. At this point it undergoes a change of direction and a change of velocity as it emerges into the upper part of the main casting where it flows longitudinally from the intake end to the drive end of the upper part of the tunnel outside the deflector tube.

At the drive end of the tunnel it flows up an inclined passage **84** into the interior of the final separator **13**. This is in the form simply of a ceramic tube provided with a washer **85** and an end plate **86** and held in place by a bolt **87**.

Comparing the present construction with that of the prior specification referred to above it will be noted that the use of a tubular separator of this type greatly simplifies the construction of the compressor since the final separator does not require any complicated shaping of the tunnel in which it is situated. The separator is accessible by removing the intake end upper cover **15**, whereupon the nut **88** can be removed and the filter withdrawn. In operation the air flows out through the separator throughout its periphery, into the intake end upper cover **15**, and the oil collects on its outer surface and drips down into the bottom of the upper tunnel. The intake end upper cover **15** contains a minimum pressure valve **89** to ensure that even if the load imposes no back pressure the delivery pressure will never fall below a certain minimum value so as to maintain the circulation of oil. From the minimum pressure valve the air is discharged laterally through an outlet coupling (not shown).

Meanwhile the oil collecting in the bottom of the upper tunnel flows along a tangential passage **92** to an oil return orifice **93** described more fully in the prior specification referred to above and shown in FIG. 3. From the oil return orifice it flows towards the axis through a passage (not shown) in the intake end cover and is mixed with the air being drawn in through the unloading valve.

Any oil weeping past the bearings is returned to the appropriate space at suction pressure through pipes **95**.

In addition an oil release valve **96** consisting of a plate pressed by a spring onto a number of small holes, communicates with a working chamber of the pump so that if the pressure in the working chamber, due to an excess of oil in it, exceeds the delivery pressure the valve can open and relieve it. In addition a safety valve **97** in the upper part of the sump is provided to allow any excess pressure to escape. In addition a vacuum relief valve **98** communicates with the air intake so as to restrict the vacuum that can be produced when the off-loading valve closes in order to avoid the noise known as vacuum scream.

It will be appreciated that the layout described is of relatively simple basic construction accommodated in a main casting with two parallel tunnels, the parts likely to require access being accessible from the intake end. Thus the unloader valve **57** is accessible to the intake end by removing the inner and outer caps **31** and **32** and the paper filter. Similarly the minimum pressure valve is accessible in the intake end upper cover. The servo device **58** extends in a transverse horizontal direction across the lower part of the intake end of the main casting where it is also readily accessible.

As already described the complete final oil separator **13** can be removed by merely taking off the intake end upper cover **15** and undoing the nut **88**.

What I claim as my invention and desire to secure by Letters Patent is:

1. A compressor of the eccentric vane type including a housing, a stator mounted in said housing in such a manner as to define a chamber surrounding it, a cylinder in said stator, a rotor having a number of sliding vanes mounted to rotate about an eccentric axis in said cylinder so as to afford a crescent-shaped space divided by the vanes into a number of working chambers, means forming an oil sump surrounding the lower part of said stator, means for delivering oil from the sump into the air before it leaves the working chambers, a number of delivery ports distributed along the length of the stator through which oil-laden air is delivered, a part-cylindrical shield dividing the chamber about the stator into inner and outer compartments which communicate with one another at the bottom through a gap in the shield and together form the oil sump, while at the top they communicate with one another only at a first end, while the outer compartment has an outlet at the opposite, or second, end, the shield being so located that the oil-laden compressed air delivered through the stator ports impinges directly on a part of the shield and thence has to flow longitudinally first along the inner compartment to the first end, where it is deflected and decelerated to flow in the opposite direction through the outer compartment, while the oil can dribble down into the sump both inside and outside the shield at points distributed along its length.

2. A compressor as claimed in claim 1, in which said housing comprises a main casting supported at one end where it is connected to a driving motor, and defining a pair of tunnels open at its inlet end, said stator being located in the lower one of said tunnels, and a final oil separator located in the upper one of said tunnels, said separator being in the form of a tube which is accessible by removing a cover from the inlet end of the upper tunnel.

3. A compressor as claimed in claim 2 in which the final oil separator is of ceramic material.

4. A compressor as claimed in claim 2 in which the upper tunnel is closed by a cover incorporating a minimum pressure valve through which the compressed air is delivered and which closes if the delivery pressure falls below a given pressure to prevent further fall of pressure.

5. A compressor as claimed in claim 2 in which the lower tunnel at its inlet end has a cover removable to give access to an off-loading valve closing the inlet when the delivery pressure exceeds a predetermined value.

6. A compressor as claimed in claim 5 in which the off-loading valve is controlled by a servo valve situated in a transverse horizontal bore in the bottom of the casting at its inlet end and responding to oil pressure to admit such pressure to a piston surface of the off-loading valve.

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U.S. Cl. X.R.

417—281, 295; 418—96, 179