

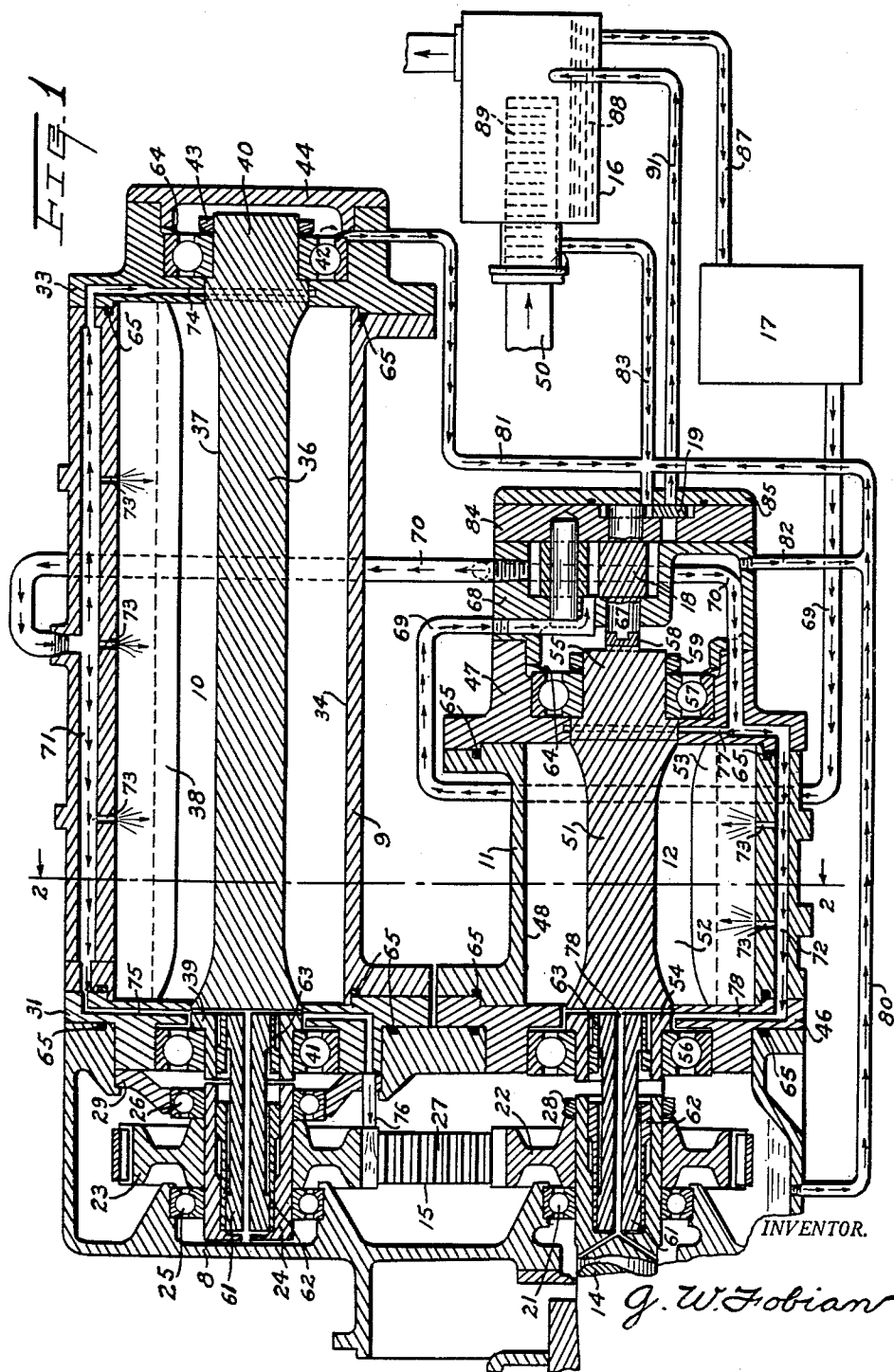
Nov. 22, 1960

G. W. FOBIAN
ROTARY COMPRESSOR

2,961,151

Original Filed Aug. 12, 1955

3 Sheets-Sheet 1



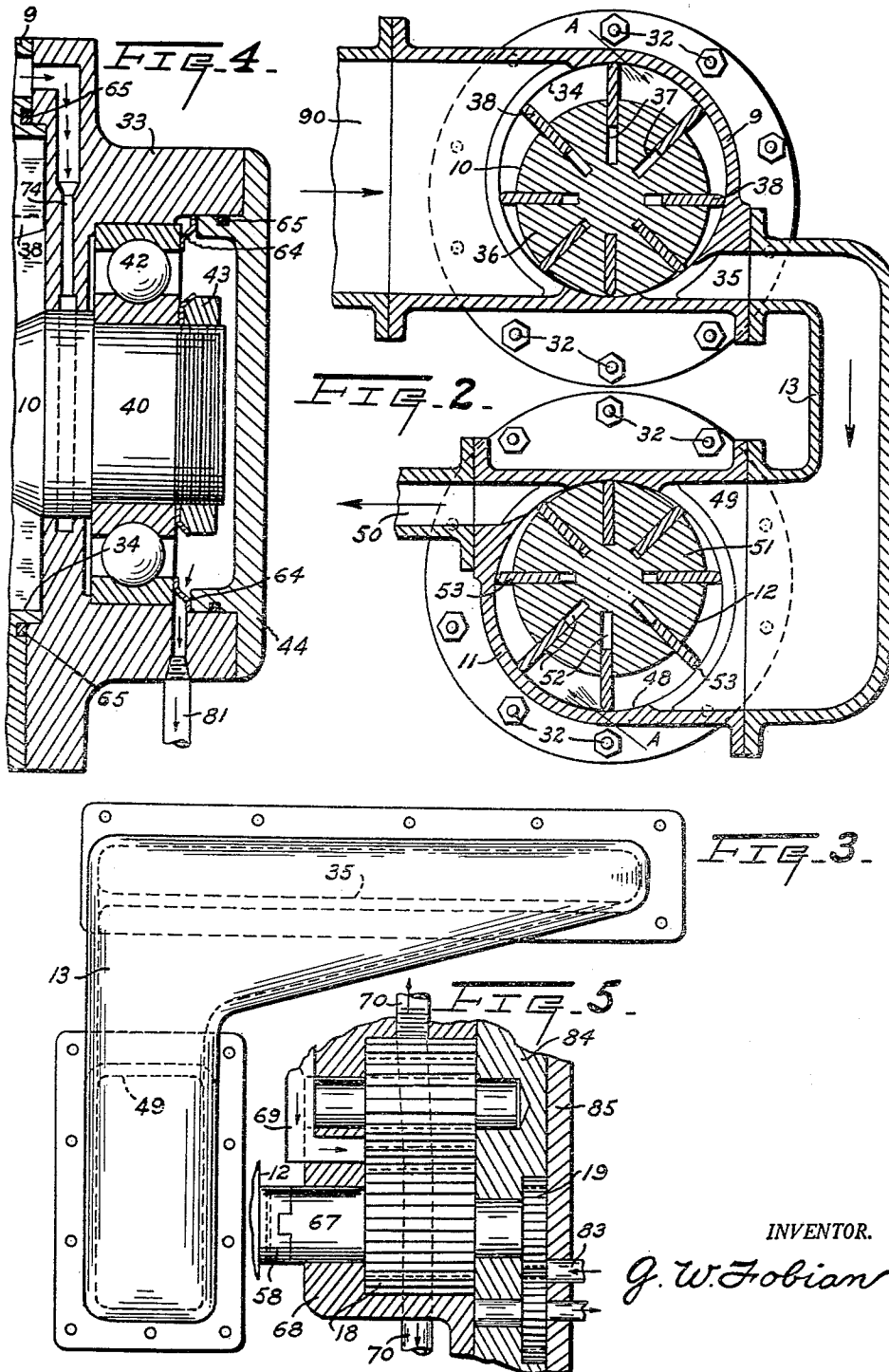
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INVENTOR.

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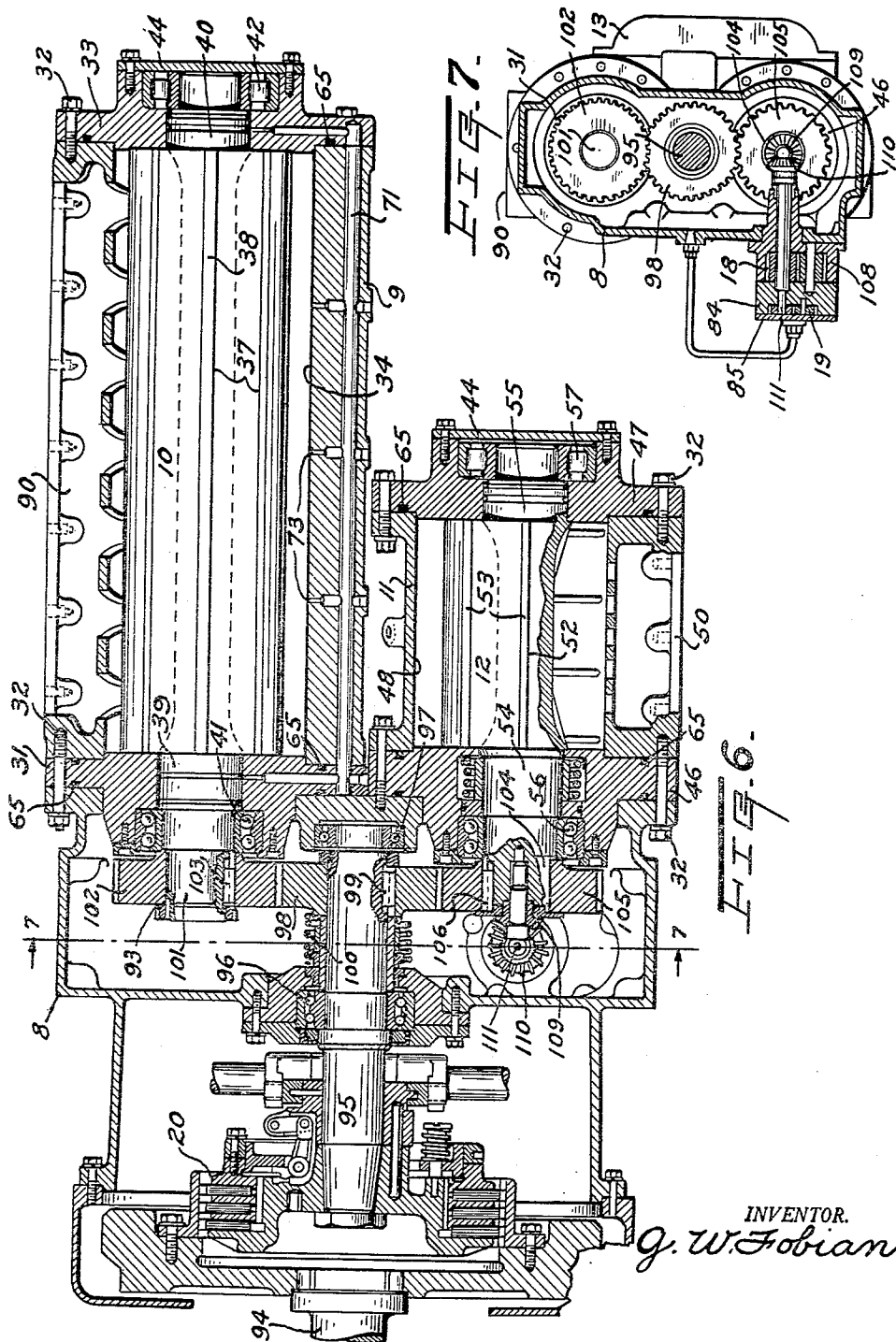
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2,961,151

ROTARY COMPRESSOR

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Original application Aug. 12, 1955, Ser. No. 528,076.
Divided and this application May 5, 1958, Ser. No. 733,010

4 Claims. (Cl. 230—158)

This application is a division of my co-pending application Serial No. 528,076, filed August 12, 1955.

The present invention relates generally to improvements in the art of compressing air or other gases, and relates more specifically to improvements in the construction and operation of rotary gas compressors of the multi-stage type.

The primary object of this invention is to provide an improved rotary compressor which is simple and durable in construction, and highly efficient in operation.

Some of the more specific objects of the invention are as follows:

To provide a rotary compressor assemblage embodying low and high pressure stages which are independently accessible for inspection and necessary renewal of worn parts.

To provide a compressor unit of the revolving vane type in which the rotors are effectively balanced, and which may be disposed in various positions without detrimentally affecting the efficient functioning of the unit.

To provide improved instrumentalities for driving the rotors of a multi-stage compressor so as to permit independent expansion or contraction of the several compression rotors without affecting the others, and wherein the relative speed of the several rotors may be varied.

To provide various other improvements in the details of construction of multi-stage compressors of the radiating and revolving vane type, whereby the economy and efficiency of such machines is enhanced.

These and other more specific objects and advantages of the invention will be apparent from the following detailed description from which it will be noted that the gist of the improvement is the provision of a rotary gas compressor embodying a mounting housing or casing having parallel low and high pressure compression cylinders projecting from one side thereof and which is provided with means for conducting compressed gas from the low to the high pressure cylinder, a gas compressing rotor revolvable in each cylinder, and driving mechanism for transmitting rotation to the high and low pressure rotors, each rotor being independently removable from the unit without disturbing others.

A clear conception of the features constituting the present improvement and of the construction and operation of several typical compressors embodying the same, may be had by referring to the drawings accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a central longitudinal section through one form of improved two-stage rotary gas compressor of the sliding revolving vane type, showing the lubricating and cooling system thereof diagrammatically and also showing the oil pumps driven from the free end of the high pressure rotor;

Fig. 2 is a transverse section through the same rotary compressor, taken along the line 2—2 of Fig. 1;

Fig. 3 is a side elevation of the conduit casing for con-

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ducting the initially compressed gas from the low pressure stage to the high pressure stage of the compressor illustrated in Figs. 1 and 2;

Fig. 4 is an enlarged fragmentary central vertical section taken through the overhung end of the low pressure cylinder and its end closure of the same compressor;

Fig. 5 is a similarly enlarged fragmentary central vertical section through the oil conditioning and circulating pumps of the two-stage compressor shown in Figs. 1 and 2 and which are driven from the front of the high pressure rotor;

Fig. 6 is a central longitudinal section through a modified form of the improved two-stage rotary gas compressor, with the lubricant cooling system omitted but showing the oil pumps driven from the driving end of the high pressure rotor; and

Fig. 7 is a transverse section through the two-stage compressor of Fig. 6 taken along the line 7—7 and drawn to a reduced scale.

While the typical embodiments of the invention illustrated and described herein each comprises a two-stage high speed rotary compressor of the radially sliding vane type wherein the compressed air is cooled by the injection of cold lubricating oil into the rotor cylinders, it is not the intent to unnecessarily limit the use of all of the improved features to such an assemblage; and it is also contemplated that specific descriptive terms employed herein be given the broadest possible interpretation consistent with the disclosure.

Referring to the drawings, the two-stage rotary compressor shown in Figs. 1 to 5 inclusive comprises in general, a compressor mounting and transmission housing 8; a low pressure cylinder 9 projecting laterally away from one side wall of the housing 8 and having a rotor 10 revolvable therein; a high pressure cylinder 11 projecting laterally away from another portion of the same side wall of the housing 8 and having a rotor 12 revolvable therein; a conduit forming casing 13 connecting the interiors of the cylinders 9, 11; a main shaft 14 drivingly connected directly to the high pressure rotor 12; a chain drive 15 for transmitting rotary motion from the shaft 14 to the low pressure rotor 10 within the housing 8; and a cooling and lubricating system consisting of a combined compressed air receiver, oil separator and sump 16 and an oil cooler 17 cooperating with a main oil pump 18 and with a scavenging pump 19 to constantly circulate lubricant through various portions of the unit.

With the exception of the air receiver, oil separator, and sump 16 and of the cooler 17, all of the elements are preferably supported from the mounting housing 8, thus providing a compact and relatively portable unit. The main shaft 14 may be driven by an electric motor, internal combustion engine, or from any other suitable source of power, through a suitable clutch assembly 20 in a well-known manner, and is journaled in an anti-friction bearing 21 confined within the housing 8. The chain drive 15 for the low pressure rotor 10 of the compressor shown in Fig. 1, comprises a lower sprocket 22 secured to the main shaft 14 within the housing 8, an upper sprocket 23 secured to a stub shaft 24, journaled in similar anti-friction bearings 25, 26 also confined within the mounting housing, and an endless chain 27 drivingly interconnecting the sprockets 22, 23, but this chain drive 15 may be replaced by any other suitable type of positive drive such as shown in Fig. 6 and which will be later explained. The lower gear or sprocket 22 is detachably secured to the end of the main shaft 14 by a ring nut 28 and the stub shaft bearing 26 is mounted in a detachable support 29 carried by the housing 8 so as to permit convenient assembling and removal of the chain drive 15, but this drive and its bearings 21, 25, 26 are normally completely confined and sealed within the housing 8, see Fig. 1.

The low pressure cylinder 9 has one end head 31 firmly but removably attached to the housing 8 by bolts 32 as shown in Fig. 2, and also has an opposite end closure head 33 at its overhung or free end, likewise attached. The bore 34 of the cylinder 9 is disposed eccentrically of the axis of the confined rotor 10; and this cylinder 9 is of considerably greater length than the high pressure cylinder 11, and has an inlet for free air at the side of the bore 34 remote from its smaller outlet 35 which communicates with the conduit casing 13. The low pressure rotor 10 has a cylindrical body 36 provided with radial slots 37 within each of which a flat vane 38 is slideably confined so as to constantly contact the bore 34 when the rotor is revolving, and the body 36 has opposite supporting ends 39, 40 which are journaled in anti-friction bearings 41, 42 respectively mounted in the adjacent end closure heads 31, 33. The bearing 42 may be detachably secured to the free end 40 of the rotor 10 by a ring nut 43 or otherwise, and the end closure head 33 is provided with a detachable sealing plate 44, as shown in Figs. 1 and 4.

The shorter high pressure cylinder 11 has one end head 46 also firmly but detachably secured to the housing 8 by bolts 32 as in Fig. 2, and has an opposite end closure head 47 likewise attached. The bore 48 of this cylinder 11 is disposed eccentrically of the axis of the high pressure rotor and the cylinder 11 has a relatively large inlet 49 for initially compressed air delivered from the conduit casing 13 at one side of the bore 48, and communicates with the compressed air receiver 16 through a smaller duct 50 at the opposite side of its bore, see Fig. 2. The high pressure rotor 12 also has a cylindrical body 51 which is provided with radial slots 52 within each of which a flat vane 53 is slideably confined to constantly engage the bore 48 by centrifugal force, and the body 52 has opposite cylindrical supporting ends 54, 55 coaxially of the shaft 14 and which are journaled in anti-friction bearings 56, 57 respectively mounted in the adjacent end heads 46, 47. The outer end 55 of the rotor 12 is also provided with a universal coupling 58, and is confined within the end head 47 by means of a ring nut 59.

The driven end 39 of the rotor 10 and the corresponding end 54 of the rotor 12, are each drivingly connected to their adjacent drive shafts 24, 14 respectively, by means of a floating spline shaft 61 and hardened spline collars 62, 63 coacting therewith, and these spline shafts 61 are of sufficient length to afford effective transmission of high speed rotary motion to the rotors 10, 12 even though there may be slight misalignment between the shafts 24, 14 and the rotors 10, 12 driven thereby. The rotor trunnion bearings 41, 56 nearest to the housing 8 are formed with their inner races firmly secured to the adjacent rotor shaft ends 39, 54 but the outer races are adapted to slide or float in the adjacent end heads 31, 46 respectively so as to permit longitudinal expansion of the rotor bodies 36, 51 to take place only within the sealed housing 8.

The opposite end bearings 42, 57 of the rotors 10, 12 coact with the adjacent closure heads 33, 47 so as to limit the axial movement of the outer or free ends of the rotors and to maintain a definite clearance between the vanes 38, 53 and these end heads 33, 47. Both the inner and outer races of the bearings 42, 57 are therefore firmly attached to the adjacent closure heads 33, 47 and rotor ends 40, 55 respectively; and in order to avoid the use of shims while maintaining the desired clearance, relatively strong annular wave springs 64 which coact with the outer races, may be provided, as shown in Figs. 1 and 4. These springs 64 should be sufficiently strong to resist the rotor end thrust due to the weight of the rotors 10, 12 when the unit is tilted at an angle relative to the horizontal with the free ends of the cylinders 9, 11 below their opposite ends. With this construction, the rotors 10, 12 are both pressure balanced and no axial displacement will result due to unbalanced pressures acting upon the rotor ends, since all of the bearings are subjected to fluid pressure and

are sealed from the ambient atmosphere by numerous sealing rings 65.

The improved cooling and lubricating system described below for dissipating the heat of compression and for properly conditioning the lubricant and lubricating all of the bearings and other parts of the unit which may be subject to wear forms the subject matter of my patent application Serial No. 528,076, heretofore identified. The two positive displacement pumps 18, 19 which comprise a part of this system, are of the rotary gear type as shown in Figs. 1 and 5, and one of the intermeshing gears of each of these pumps is mounted upon a common drive shaft 67 which is drivingly connected to the high pressure rotor end 55 by the universal coupling 59 so that the pumps 18, 19 will both be operating whenever the compressor rotors are revolving. As illustrated in Figs. 1 and 5, main oil pump 18 is confined within a casing 68 detachably secured to the end outer head 47 of the high pressure cylinder 11, and has its intake connected by a conduit 69 to an oil cooler 17 of any suitable type. The discharge conduit 70 of the main oil pump 18 has two intercommunicating branches of which the upper branch connects with an elongated duct 71 formed in the wall of the low pressure cylinder 9, while the lower branch connects a duct 72 formed in the wall of the high pressure cylinder 11.

Each of the ducts 71, 72 has a number of cool oil injection nozzles 73 directed tangentially into the interior of the adjacent cylinder 9, 11 as indicated by the arrows A in Fig. 3, and the oil delivered from these nozzles 73 under pressure, not only lubricates the vanes 38, 53, but also cools the air which is being compressed by the rotors 10, 12. The duct 71 formed in the upper cylinder 10 communicates at one end with a passage 74 which surrounds the free end of the low pressure rotor 10 and is adapted to supply lubricant to the bearing 42, and the opposite end of this duct 71 communicates with another passage 75 which has branches leading to the bearing 41, and also has a branch communicating with a nozzle 76 for spraying lubricant upon the chain drive 15, as shown in Fig. 1. The duct 73 formed in the lower cylinder 11 communicates at one end with a passage 77 surrounding the free end of the high pressure rotor 12 and which is adapted to supply lubricant to the bearing 57 and coupling 58, and the other end of this duct 72 communicates with a passage 78 having branches leading directly to the bearing 56 and to the bearing 21.

The lower portion of the sealed interior of the housing 8, and the lower portions of the interiors of the cylinder end heads 33, 47 are connected by conduits 80, 81, 82 respectively with the intake opening of the sump pump 19, and an oil transporting conduit 83 leading from the compressed air receiver 16 also communicates with this sump pump inlet. The sump or scavenging pump 19 is confined within a housing plate 84 which is detachably secured to the main pump casing 47 and forms a closure for one side of the main pump chamber, and a closure cover 85 is detachably secured to the housing plate 84. The end head 47, casing 58, housing plate 84 and cover 85 may all be united by means of common bolts 32, so that upon removal of these bolts both pumps 18, 19 may be dismantled and the high pressure cylinder 11 will also be opened for inspection.

The oil cooler 17 and the combined compressed air receiver, oil separator, and oil reservoir are all shown of reduced normal size and diagrammatically in Fig. 1, and the cooler 17 may be of any suitably refrigerated and well-known type having a clean oil supply conduit 87 communicable with the oil collecting basin 88 at the bottom of the compressed air receiver 16. The high pressure compressed air delivered from the second or high pressure stage of the compressor is adapted to be delivered through the discharge duct 50 and a filtering element 89 in order to remove entrained oil therefrom and to deposit the filtered oil into the oil reservoir, and atmospheric air

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or other gas is adapted to be supplied to the first or low pressure stage through another duct 90 shown in Fig. 2. Any suitable type of filter or oil extracting mechanism may obviously be utilized instead of the filtering element 89, and the outlet of the scavenging pump 19 also communicates with the oil collecting reservoir through a conduit 91 as illustrated in Fig. 1.

When the various parts of the improved rotary gas compressor illustrated in Figs. 1 to 5 inclusive have been properly constructed, the mounting housing 8 may be secured to a sturdy support such as the clutch casing of an internal combustion engine or other rotary motor having the driven shaft 14 of its clutch properly prepared for the reception of the lower sprocket 22, bearing 21, spline shaft 61 and spline collar 62. These elements may then be applied to the shaft 14 and to the interior of the housing 8 through one opening in the wall of the housing from which the high pressure stage of the compressor is to be ultimately assembled, and the upper stub or counter shaft 24, bearings 25, 26 and sprocket 23 can be likewise assembled within the upper interior of the housing 8 through another opening in the housing wall which is normally closed by the bearing plate 29. The chain 27 may thereafter be applied to the sprockets 22, 23 and after the plate 29 has been inserted within the housing side wall the assembled driving mechanism is ready for the attachment of the compressor parts.

The initial or low pressure stage of the compressor comprising the cylinder 9, rotor 10, end heads 31, 33 and splined driving assembly, may be assembled and applied as a unit to the upper opening in side wall of the housing 8 with the aid of bolts 32, and the final or high pressure stage comprising the cylinder 11, rotor 12, end heads 46, 47, and splined driving assembly, either with or without the pumps 18, 19 attached may be likewise assembled and applied as an independent unit to the lower opening in the side wall of the housing 8 with the aid of other bolts 32, in order to complete the two-stage compressor. The various conduits 69, 70, 80, 81, 82, 83 and the conduit casing 13 may thereafter be applied to complete the assemblage, and the compressor may be just as readily dismantled to permit access to any of its parts. It is important to note, however, that the two stages of the compressor unit may be applied and removed independently of each other, and that the pumps 18, 19 may also be applied or removed without affecting the high pressure stage from which they are suspended.

When the compressor of Fig. 1 has been thus assembled and connected to the receiver 16 and cooler 17, and an abundant quantity of cooling and lubricating oil has been provided, the normal operation of the system is as follows. Rotary motion supplied from the power source through the control clutch will be imparted directly to the high pressure rotor 12 through the lower spline shaft 61, and from this rotor 12 to the main and scavenging pumps 18, 19 through the universal coupling 58 and shaft 67, while such rotary motion is also being transmitted through the chain drive 15 and upper spline shaft 61 to the low pressure rotor 10. The two rotors 10, 12 will thus be revolved simultaneously at approximately the same speeds, but are free to expand and contract longitudinally and independently of each other, by virtue of the provision of the spline shafts 61 and spline collars 62, 63.

Free air will then be drawn into the low pressure cylinder 9 through the inlet conduit 90, by the rapidly revolving vanes 38 of the rotor 10 and after being initially compressed, the air is delivered through the outlet 35 and conduit casing 13 into the high pressure cylinder inlet 49. As the initially compressed air passes through the high pressure cylinder 11 it is finally compressed by the revolving vanes 53 of the rotor 12, and the high pressure air is delivered to the receiver 16 through the conduit 50 and filter 39. The compressed air may thereafter be withdrawn from the receiver 16 as required, and while

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the rotors 10, 12 are thus performing their compressing functions, the main oil pump 18 and the scavenging pump 19 are also operating to constantly circulate oil through the cooling and lubricating system.

The cold oil withdrawn from the cooler 17 by the main pump 18 through the conduit 69 is forced through the conduits 70 into the ducts 71, 72 and from thence through the nozzles 73, passages 74, 75, 77, 78, and nozzle 76. The oil delivered through the nozzles 73 into the interiors of the cylinders 9, 11, not only lubricates the revolving and radially sliding vanes 38, 52, but also constantly and effectively cools the air which is being compressed by the rotors 10, 12 as it passes through the cylinders. The oil flowing from the ducts 71, 72 through the passages 74, 77 at the overhung ends of the cylinders 9, 11 constantly lubricates the bearings 42, 57 and the adjacent ends of the rotor bodies 36, 51. The oil delivered from the cylinder ducts 71, 72 through the passages 75, 78 at the opposite ends of the cylinders 9, 11, likewise constantly lubricates the bearings 41, 56 and the spline shafts 61, the collars 62, 63, and the sprocket bearings 21, 25, 26, while the chain drive 15 and these sprocket bearings are additionally lubricated by the oil discharged from the nozzle 76.

The spent lubricant which accumulates within the sealed housing 8 is delivered by the conduit 80 to the scavenging pump 19 into the oil reservoir. The lubricant circulating system is completed by the oil being constantly delivered from the oil reservoir through the conduit 87 to the cooler 17, so that abundant quantities of oil are continually being delivered to the cylinders for cooling purposes and to all bearings and other moving parts for lubricating purposes, while entrained oil is being removed from the compressed gas by the filter 89. All of this compression and cooling of the air and lubrication of parts is effected automatically while the compressor rotors 10, 12 are revolving at high speed, and when the unit stops, the various ducts, conduits and passages remain filled with oil so that lubrication is available the moment the machine is re-started.

Referring to Figs. 6 and 7, the modified compressor illustrated therein is similar in structure and operation to the embodiment of Fig. 1, except for the rotor driving mechanism and the disposition of the scavenging and oil circulating pumps 19, 18. In this modification, the two-stage rotary compressor comprises a mounting and transmission housing 3 having parallel low and high pressure cylinders 9, 11 projecting laterally away from the common side wall of the housing and provided internally with high and low pressure rotors 10, 12, the cylinders 9, 11 being interconnected by a conduit 13 and having air inlet and discharge ducts 90, 50 associated therewith, respectively; a variable speed gear drive 93 confined within the housing 3 for transmitting rotary motion from a power shaft 94 through a friction clutch to a rotor driving shaft 95 and from the latter to the rotors 10, 12; and a cooling and lubricating system consisting of a combined compressed air receiver, oil separator and sump 16 and an oil cooler 17 cooperating with the scavenging pump 19 to constantly circulate lubricant through various portions of the compressor unit in a manner similar to that shown in Fig. 1.

In the rotary compressor of Figs. 6 and 7, the main power shaft 94 may be driven by any suitable type of motor such as an internal combustion engine, and the shaft 94 may be drivingly connected to the counter shaft 95 by manipulation of the friction clutch 20 confined within the housing 3. The shaft 95 is journaled in anti-friction bearings 96, 97 mounted within the housing 3 and has a gear 98 drivingly attached thereto by a key 99, and a seal spring 100 is interposed between the gear 98 and the bearing 96. The supporting end 39 of the low pressure rotor 10 which is journaled in the bearing 41 has an integral extension 101 to which a pinion 102 is drivingly attached by a spline 103, while the correspond-

ing supporting end 54 of the high pressure rotor 12 which is journaled in the bearing 56 has an integral end extension 104 to which another pinion 105 is likewise drivingly attached by a spline 106, and both of these pinions 102, 105 mesh with the gear 98 and are confined within the housing 8.

As in the embodiment of the invention previously described, the low pressure cylinder 9 has one end head 31 removably attached to a wall of the housing 8 by bolts 32 while its opposite end is provided with a removable end head 33 likewise attached and having a cover plate 44 detachably secured thereto; and the high pressure cylinder 11 also has one end head 46 removably attached to the same housing side wall by bolts 32 while its opposite end is provided with a removable end head 47 likewise attached and which also has a cover plate 44 detachably secured thereto. The low pressure rotor 10 is mounted in anti-friction bearings 41, 42 supported in the end heads 31, 33 respectively, while the high pressure rotor 12 is likewise mounted in anti-friction bearings 56, 57 carried by the end heads 46, 47 respectively; and these rotors 10, 12 also have radial slots 37, 52 therein within which flat vanes 38, 53 are slidably confined so as to coact with the cylinder bores 34, 48 respectively.

Each of the cylinders 9, 11 of the modified compressor is also provided with an elongated oil distributing duct 71 having a series of cool oil injection nozzles 73 directed tangentially into the adjacent cylinder bore, through which cool oil is adapted to be constantly delivered under pressure by the main circulating pump 18 so as to both lubricate the vanes 38, 53 and to cool the air which is being compressed in the several stages. The oil storage, cooling and removing system of this modified assemblage is the same as in Fig. 1, but the oil circulating gear pump 18 is mounted within a casing 103 detachably secured to the housing 8 and is adapted to be driven by means of bevel gears 109, 110 directly from the end extension 104 of the high pressure rotor 12. The scavenging pump 19 which is housed and confined within an auxiliary casing 84 detachably secured to the main pump casing 103, by means of a removable cover plate 85, is simultaneously operable by the same shaft 111 which drives the pump 18, and both of the pumps 18, 19 are located outside of the housing 8 so that they may be readily opened for inspection and cleaning without disturbing the compressor stages.

The normal functioning and operation of the modified compressor illustrated in Figs. 6 and 7 is substantially the same as that shown and described in connection with Figs. 1 to 5 inclusive, and in both cases the high and low pressure rotors 10, 12 are independently removable from their confining cylinders 9, 11 respectively remote from the common housing 8. However, in the modification of Figs. 6 and 7, the relative speeds of the two rotors 10, 12 may be readily varied by merely substituting a gear 98 and pinions 102, 105 of different ratios in the gear drive 93, and the pumps 18, 19 may also be readily removed or inspected without disturbing the high pressure stage and the high pressure rotor 12 may also be removed or inspected without disturbing these pumps. The modified compressor therefore has distinct advantages over the other, and it is also more compact and durable while also insuring quiet operation.

From the foregoing detailed description of the construction and operation of the typical unit, it will be apparent that the present invention in fact provides a compact and highly efficient rotary compressor wherein the heat of compression is effectively dissipated and all movable parts are abundantly lubricated at all times. All bearings and other moving parts of the unit are sealed against exposure to the ambient atmosphere, and the rotors 9, 10 are balanced but adapted to expand and contract longitudinally independently of each other, while all of the normally concealed parts are also readily ac-

cessible for inspection and possible replacement of worn parts.

The provision of the mounting housing 8 and the suspension of the parallel cylinders 9, 11 from a side wall of this housing, not only facilitates assembling and dismantling of the compressor, but also enables each stage to be inspected or removed without disturbing the other. By driving the main and auxiliary oil pumps 18, 19 directly from the high pressure rotor 12 and by confining these pumps in independent casings, they may be readily opened for inspection without removing or otherwise disturbing the high pressure stage, and the sealing rings 65 interposed between the various housings, casings and cylinders prevent undesirable escape of oil and compressed air and insure maintenance of proper balancing pressures within the unit.

It should be understood that it is not desired to limit the invention to the exact details of construction and operation of the two-stage rotary compressor specifically shown and described herein, for various modifications within the scope of the appended claims may occur to persons skilled in the art.

I claim:

1. A rotary compressor comprising, a housing having a side wall provided with upper and lower spaced openings, a low pressure cylinder having a separate end head spanning said upper opening and detachably secured to both its cylinder and to said wall, a high pressure cylinder independent from said low pressure cylinder and having a separate end head spanning said lower opening and detachably secured to both its cylinder and to said wall, means for detachably securing said low and high pressure cylinders with their respective end heads to said housing wall independently of each other, a gas compressing rotor revoluble in each of said cylinders and each having a propelling shaft journaled in its adjacent end head, a rotor driving element spline connected to each of said rotor shafts, and a main driving shaft extending into said housing and being drivingly connected to said elements, said low and high pressure rotors and their respective propelling shafts being removable from their cylinders and end heads and from said housing without disturbing said driving elements and said main shaft.

2. A rotary compressor comprising, a housing having a side wall provided with upper and lower spaced openings, a low pressure cylinder having an end head spanning said upper opening and detachably secured to said housing wall, a high pressure cylinder separate from said low pressure cylinder and having an independent end head spanning said lower opening and detachably secured to said housing wall, means for detachably securing said low and high pressure cylinders to their respective end heads and to said housing wall independently of each other, a gas compressing rotor revoluble in each of said cylinders and each having a propelling shaft journaled in the adjacent end head, each of said propelling shafts having a rotor driving section detachably spline connected thereto and confined within said housing, and rotor driving mechanism connecting said rotor driving sections within said housing, said low and high pressure rotors and their cylinders and end heads being removable from said housing independently of each other and without disturbing said rotor driving sections and said mechanism.

3. A rotary compressor comprising, a housing having a side wall provided with spaced openings, a low pressure cylinder having a separate end head spanning one of said openings and detachably secured to said housing wall, a high pressure cylinder separate from said low pressure cylinder and having an independent separate end head spanning another of said openings and detachably secured to said housing wall, fastening means for detachably attaching said low and high pressure cylinders to their respective end heads and to said housing wall independently of each other, a gas compressing rotor revoluble in each of said cylinders and each having a propelling

shaft journaled in the adjacent end head, each of said propelling shafts having a rotor driving section detachably spline connected thereto and confined within said housing, and rotor driving mechanism interconnecting said rotor driving sections within said housing, said low and high pressure cylinders and their respective end heads being independently removable from said housing without disturbing said rotor driving sections and said mechanism.

4. A rotary compressor comprising, a housing having a side wall provided with upper and lower spaced openings, a low pressure cylinder having an end head spanning said upper opening and detachably secured to said housing wall, a high pressure cylinder separate from said low pressure cylinder and having an independent separate end head spanning said lower opening and detachably secured to said housing wall, means for detachably securing said low and high pressure cylinders to their respective end heads and to said housing wall independently of each other, a gas compressing rotor revolvable in each of said cylinders and each having a propelling shaft journaled in the adjacent end head, each of said

propelling shafts having a rotor driving section detachably spline connected thereto and spanning the housing interior adjacent to one of said openings, rotor shaft driving mechanism interconnecting said rotor driving sections within said housing, and a main driving shaft extending into said housing and being drivingly connected to said high pressure rotor shaft driving section within said housing, said low and high pressure rotors and their respective propelling shafts being removable from their cylinders and end heads and from said housing without disturbing said shaft end sections and said mechanism.

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