

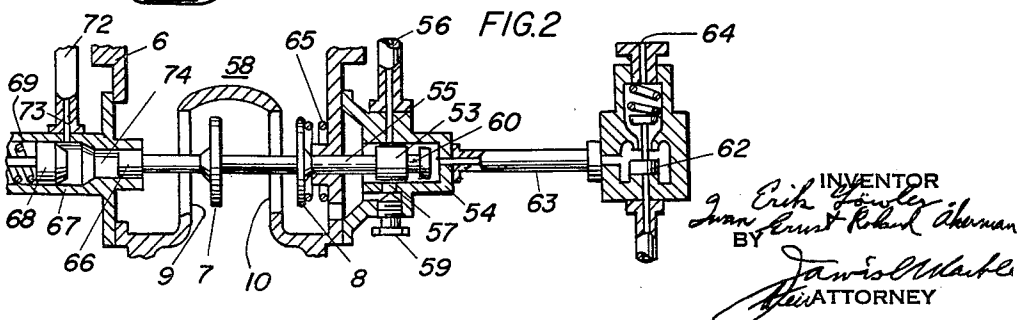
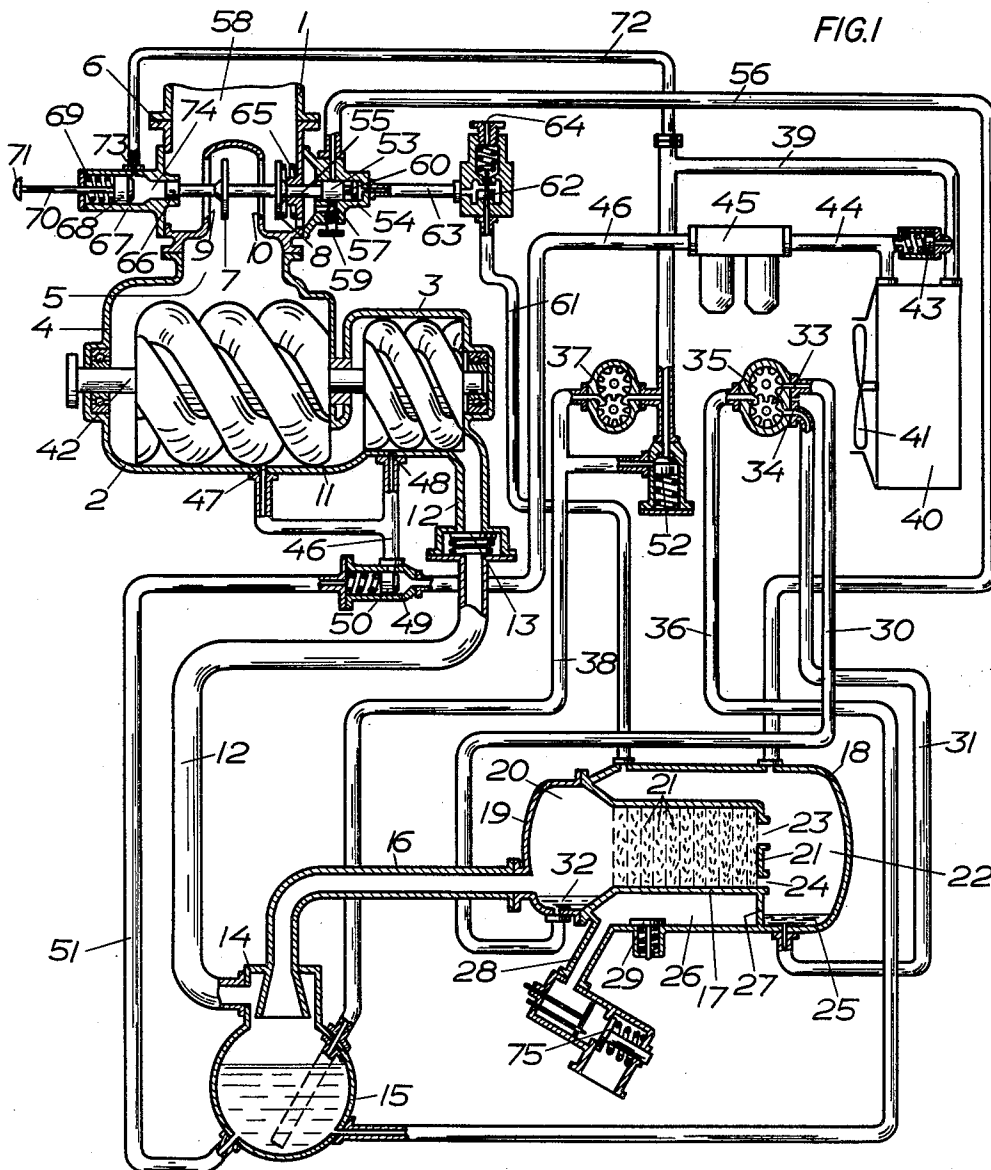
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COMPRESSOR UNITS

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COMPRESSOR UNITS

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This invention relates to improvements in compressor units in which oil or other suitable liquid is injected in the compression chambers of the compressor for cooling, lubricating and sealing purposes. One object of the invention is to provide an improved control system for such compressor units. Other and more detailed objects will become apparent as the ensuing portion of this specification proceeds.

The invention is illustrated by way of example on the accompanying drawing, in which FIG. 1 illustrates diagrammatically a two stage compressor unit with oil injection and FIG. 2 illustrates a portion of the valving arrangements on a somewhat larger scale.

In the drawing 1 indicates the air intake pipe to the compressor which consists of a low pressure portion 2 and a high pressure portion 3. In the illustrated embodiment the compressor portions 2 and 3 are screw type compressors but the invention is also applicable to other types of compressors, such as sliding vane rotary compressors, reciprocating piston compressors, or the like. The illustrated compressor is provided with an air inlet casing 4 providing an inlet chamber 5 and communicating with the air intake pipe 1 through an air inlet control valve casing 6, in which a pneumatically balanced twin valve or throttle member 7, 8 is movable towards and away from seats 9, 10 in which the members 7 and 8, respectively, fit with a suitable clearance, permitting a very reduced flow of air to the inlet chamber 5 in closed position of the members 7, 8. The air compressed in the low pressure portion 2 of the compressor is conveyed through a chamber 11 to the high pressure portion 3 and from said high pressure portion a discharge conduit 12 conducts the compressed oil laden air over a spring loaded check valve 13 to a cyclone type oil separator 14 in which a first separation of the main portion of the oil in the compressed air takes place. The separated oil is collected in an oil tank 15 on which the separator 14 is provided. A conduit 16 conveys oil laden air from the separator 14 to a second oil separator 17 which is disposed within an air receiver 18. The air receiver 18 is provided with an end cover 19 to which the conduit 16 is attached and which together with the oil separator 17 forms an admission chamber 20 in which some separation of oil is also produced. The oil laden air then passes through the filter sections or discs 21 of the separator 17 which take care of most of the remaining oil in the compressed air. The oil separator 17 is a cylindrical body in which the filter discs 21 are provided and which is open over the whole cross section towards the admission chamber 20 of the separator and provided with an end wall 21 at the outlet end communicating with an air receiver chamber 22 through an opening 23 close to the top of the separator. A further opening 24 is provided in the end wall 21 at the bottom of the separator 17 for draining oil accumulated in the lower portions of the separator to an oil accumulation space 25 at the bottom of the receiver chamber 22. The receiver 18 has a further chamber 26 encircling the separator 17 and the space 25 is partly separated from the receiver chamber 26 by a partition 27 which extends upwards to about half the height of the separator 17. 28 is an air discharge conduit which leads to the conventional air take-out of the compressor unit over a check valve 75. 29 is an automatic

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spring loaded drain valve which opens at a certain low pressure, for instance 2 kilogrammes per square centimeter (kg./cm.^2) above atmospheric, in order to drain off any condensed water accumulated in the receiver chamber 26.

Two conduits 30 and 31 convey liquid oil accumulated at 32 in the admission chamber 20 and at 25 in the receiver chamber 22 to separate suction portions 33 and 34, respectively, of a gear pump 35 which pumps the oil back through a conduit 36 to the oil tank 15. The connections of the conduits 30, 31 to the pump 35 in the described manner makes it possible to duly consider the difference in pressure between the spaces 32 and 25. An oil pump 37 draws oil from the oil tank 15 through a conduit 38 and pumps oil through a conduit 39 to an oil cooler 40 provided with a suitable cooling fan 41 mounted on or driven from the main shaft 42 of the compressor. 43 is a spring loaded by-pass valve which is connected in parallel to the oil cooler 40 and 44 is a conduit from the oil cooler to an oil filter 45 from which a conduit 46 leads to injection nozzles 47, 48 in the compression chambers of the compressor. The by-pass valve 43 permits oil to flow directly from the conduit 39 to the conduit 44 when the resistance in the oil cooler is too great, for instance due to low oil temperature. A check valve 49 with a spring loaded valve member 50 is provided in the conduit 46 which valve is loaded by a very weak spring and by the difference in pressure between the conduit 46 and the oil tank 15 which for this purpose is connected to the bottom of the valve casing 49 through a conduit 51. 52 is an adjustable spring loaded by-pass check valve for the pump 37, the setting of which controls the pressure on the oil injected in the compression chambers of the compressor. Said valve also avoids excessive oil pressures when oil temperature is low or compressor speed high.

The present compressor is unloaded through throttling of the air intake passage to the air intake chamber 5 by means of the balanced twin throttle valve members 7, 8. The unloading device for the compressor is combined with the twin valve members 7, 8. It consists of a piston valve member 53 provided in a housing 54 and connected to the stem 55 of the twin valve members 7, 8. A conduit 56 forms a communication between the chamber 26 of the air receiver 18 and the housing 54, said conduit being continued by a conduit 57 leading to the inlet chamber 58 in the air intake pipe 1. The passage in the conduit 57 is controlled by a needle valve member 59 and the communication between the conduit 56 and the conduit 57 is controlled by the valve member 53 which has a transverse passage formed by a reduced portion or annular groove 60 on the member 53 which in the extreme left hand position on the valve members 7, 8 provides a communication between the conduit 56 and the conduit 57 and the intake chamber 58. A conduit 61 connects the air receiver 18 to a control valve 62 which is connected to the end of the housing 54 by a conduit 63. The control valve has a vent passage 64 to which the conduit 63 is connected when the control valve is inoperative.

When the compressor is at rest, a spring 65 moves the twin valve members 7, 8 to the left in the figure so that the air intake to the compressor is throttled as far as possible, the only passage to the air intake chamber 5 being the clearance between the members 7, 8 and the seats 9, 10. Simultaneously the air receiver 18 is vented to the atmosphere through the conduit 56, the groove 60, the conduit 57 and the air intake chamber 58. The control valve 62 is then in a position in which the conduit 63 is vented to the atmosphere through the vent passage 64 and the passage in the control valve to the conduit 61 is closed.

The stem 55 of the twin valve members 7, 8 is also

connected to a piston 66 which is movable in a valve casing 67 which also contains a piston valve 68 loaded by a spring 69 and connected by a rod 70 to a button 71. A conduit 72 connects the pressure oil conduit 39 with the casing 67. The opening 73 of said conduit in the casing 67 is controlled by the valve member 68.

When the compressor is at rest no oil pressure exists in the conduit 39 and consequently there is no oil pressure in the conduit 72 and in the space 74 in the housing 67. The spring 69 therefor moves the valve member 68 to close position.

When the compressor is started the twin valve members 7, 8 throttle the air flow to the inlet chamber 5 so that a certain vacuum is produced in said chamber. The compressor now runs idle and only a small quantity of compressed air is delivered to the receiver 18, which air flows back to the intake chamber 58 through the conduit 56, groove 60, conduit 57, and valve 59 which latter controls the pressure in the receiver 18 when the compressor runs idle and unloaded. Oil is injected in the compression chambers when the compressor runs idle but the valve member 68 prevents pressure oil from reaching the space 74. By running the compressor idle as described it is possible to run the engine and compressor warm.

Now, if it be desired to load the compressor, the button 71 is pulled so that the valve 68 opens the passage from conduit 72 to the space 74 causing oil pressure from the compressor oil pump 37 to act on the piston 66 and to move it to the right in the figure so that the twin valve members 7, 8 are moved to open position. The air flow through conduit 56 is simultaneously interrupted by the piston valve member 53, and the compressor continues to operate in this condition until a certain pressure, for instance 7 kilogrammes per square centimeter above atmospheric, has been reached. Then the control valve 62 opens a passage from the conduit 61 to the conduit 63 causing the piston valve 53 and the twin valve members 7, 8 to move to the left in the figure so that the air intake is throttled. The communication between the conduit 56 and the intake chamber 58 is opened and a small quantity of air flows from the receiver 18 to the intake chamber 58. The compressor now runs unloaded with full pressure on the air receiver 18. The air quantity flowing to the receiver when the compressor runs idle or unloaded as above described is sufficient to carry the simultaneously injected cooling oil to the oil separators.

When the pressure in the air receiver has been reduced to a certain extent, for instance to $6\frac{1}{2}$ kilogrammes per square centimeter above atmospheric the control valve 62 interrupts the communication between the conduits 61 and 63 and connects the conduit 63 to the vent passage 64 so that the conduit 63 is vented to the atmosphere which permits the oil pressure in the space 74 to move the twin valve members 7, 8 to the right in the figure thereby reloading the compressor which immediately starts to deliver compressed air to the receiver 18. Simultaneously, the piston valve 53 closes the communication between the conduit 56 and the conduit 57 and the air pressure in the receiver continues to rise until it again reaches the maximum limit, for instance 7 kilogrammes per square centimeter above atmospheric.

It will be appreciated that with the above arrangement failure of the oil pump 37 to deliver pressure oil causes valve members 7, 8 to move to closed position and the valve member 68 to close the opening 73, so that the compressor cannot produce compressed air for useful work until the defect in the oil injection system has been corrected.

It should also be observed that when the compressor has stopped compressed air in the air receiver 18 cannot flood the compressor with oil since in the absence of oil pressure in the conduit 46 air pressure in the oil tank 15 keeps the valve member 50 closed. The discharge conduit 28 of the compressor contains an automatic spring

loaded check valve 75 which when the compressor delivery is interrupted prevents back flow of compressed air from the network connected to the discharge conduit 28.

The invention may be modified in various different ways within the scope of the claims and the above embodiment is only described as an example.

What we claim is:

1. In a compressor unit, a compressor having a compression chamber, means for injecting cooling liquid in said compression chamber, means for conveying compressed fluid from said compressor, a fluid intake conduit leading to the compressor for introducing fluid to be compressed therein, throttle valve means operable in said intake conduit from a first position in which fluid flow to the compressor is partially restricted to a second position in which fluid is unrestrictedly admitted to the compressor and vice versa, means for selectively opening said throttle valve means from said first position towards said second position, means for closing said throttle valve means from said second position towards said first position, said opening means being operatively responsive to pressure in said cooling liquid injecting means, and said closing means being operatively responsive to pressure in said compressed fluid conveying means.

2. In a compressor unit, a compressor having a compression chamber, means for injecting cooling liquid into said compression chamber, a compressed fluid receiver, means for conveying compressed fluid from said compressor to said receiver, means for separating cooling liquid from said compressed fluid, a fluid intake conduit leading to the compressor for introducing fluid to be compressed therein, throttle valve means operable in said intake conduit from a first throttling position in which fluid flow to the compressor is restricted to a second open position in which fluid is admitted to the compressor and vice versa, means operatively connected with said cooling liquid injecting means for moving said throttle valve means from said first position towards said second position in response to pressure in said cooling liquid injection means, and means operatively connected to said compressed fluid receiver for moving said throttle valve means from said second position towards said first position in response to attainment of a certain pressure in said receiver.

3. In a compressor unit, a compressor having a compression chamber, means for injecting cooling liquid in said compression chamber, a fluid intake conduit leading to the compressor for introducing fluid compression therein, throttle valve means operable in said intake conduit from a first position in which fluid flow to the compressor is restricted to a second position in which fluid is admitted to the compressor and vice versa, piston means for moving the throttle valve means from said first position towards said second position, and means operatively connecting said piston means with said means for injecting cooling liquid effecting said movement of said throttle valve means by said piston means in response to a predetermined pressure in said cooling liquid injecting means.

4. A compressor unit according to claim 3, in which a manually operable valve is provided for controlling the action of said pressure in said cooling liquid injecting means to move said piston means and said throttle valve means from said first position towards the second position.

5. In a compressor unit, a compressor having a compression chamber, pump and conduit means for injecting cooling liquid into said compression chamber, a compressed fluid receiver, conduits means for conveying compressed fluid with some of said cooling liquid entrained therein from said compressor to said receiver, means for separating cooling liquid from said compressed fluid in said receiver, a fluid intake conduit leading to the compressor for introducing fluid to be compressed therein, two pneumatically balanced throttle valve members pro-

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vided on a common valve stem and operable in said intake conduit from a first throttling position in which fluid flow to the compressor is restricted to a second open position in which fluid is admitted to said compressor and vice versa, a spring urging said throttle valve member towards said first position, a first cylinder-and-piston valve means for removing said throttle valve member toward said first throttling position thereof, a regulating valve member communicating with both said receiver and first cylinder-and-piston means and operable to admit compressed pressure fluid from said receiver to said first cylinder-and-piston upon attainment of a certain pressure in said receiver for moving said cylinder-and-piston valve means and said throttle valve members towards said first position, means for venting pressure fluid from the first cylinder-and-piston valve means permitting movement thereof away from said first position toward said second position, a second cylinder having a piston movable therein and attached to said throttle valve stem, and means for introducing cooling liquid pressure into said second cylinder effective on said piston for moving said piston and the throttle valve members from said first position towards said second position upon said venting of said first cylinder-and-piston valve means.

6. In a compressor unit, a fluid compressor having a compression chamber, means for conveying compressed fluid from said compressor, a fluid intake conduit leading to the compressor, throttle valve means operable in said intake conduit from a first position in which fluid flow to the compressor is restricted to a second position in which fluid is admitted to the compressor and vice versa, an oil pump operated when said compressor is operated to provide pressure oil, means for moving said throttle valve means from said first position towards said second position in response to oil pressure produced by said oil pump, and means for moving the throttle valve means from said second position towards said first position in response to attainment of a certain fluid pressure in said fluid conveying means.

7. A compressor unit according to claim 6 having a first conduit for conveying pressure oil from the oil pump to said compression chamber of the compressor for cooling and lubricating the compressor and a second conduit for conveying pressure oil from the oil pump to said throttle valve means for operation of the throttle valve means.

8. In an air compressor unit of the character described for supplying and maintaining compressed air in a receiver therefor from which said compressed air is withdrawn for use under pressure, the combination which comprises an air compressor having a compression cham-

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ber therein, air intake means for introducing air into said compression chamber for compression therein, a compressed air conduit for conducting compressed air from said compressor to said receiver, throttle valve means in said air intake and movable therein from a first throttling position in which flow of air through said intake into said compression chamber is substantially restricted into a second open position in which said flow of air through said air intake is substantially unrestricted by said throttle valve means, pump and conduit means for injecting cooling oil under pressure into said compressor, a liquid-operated piston means for moving said throttle valve means from said first throttling position toward said second open position thereof, means for selectively introducing liquid pressure into said piston means from said cooling liquid pump and conduit means for said movement of said throttle valve means, an air-operated piston means for moving said throttle valve means from said second open position thereof toward said first throttling position, means for introducing compressed air pressure from said receiver into said air-operated piston means, and control means operatively responsive to the pressure of said compressed air in said receiver and to the pressure in said cooling liquid pump and conduit means for selectively and alternatively introducing said air pressure to said air-operated piston and said liquid pressure to said liquid-operated piston for determining said movements of said throttle valve means toward and away from said two positions thereof in response to the maintenance of a predetermined air pressure in said compressed air receiver.

9. Apparatus as recited in claim 8 which also includes spring means for urging said throttle valve means into said throttling position thereof independently of the air pressure in said receiver and upon a decrease of pressure in said cooling liquid pump and conduit means below a predetermined minimum value.

10. Apparatus as recited in claim 8 which also includes check valve means between said compression chamber and said cooling liquid pump and conduit means for interrupting flow of said cooling liquid to said compression chamber when said compressor is not running.

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