

March 27, 1945.

G. K. NEWELL

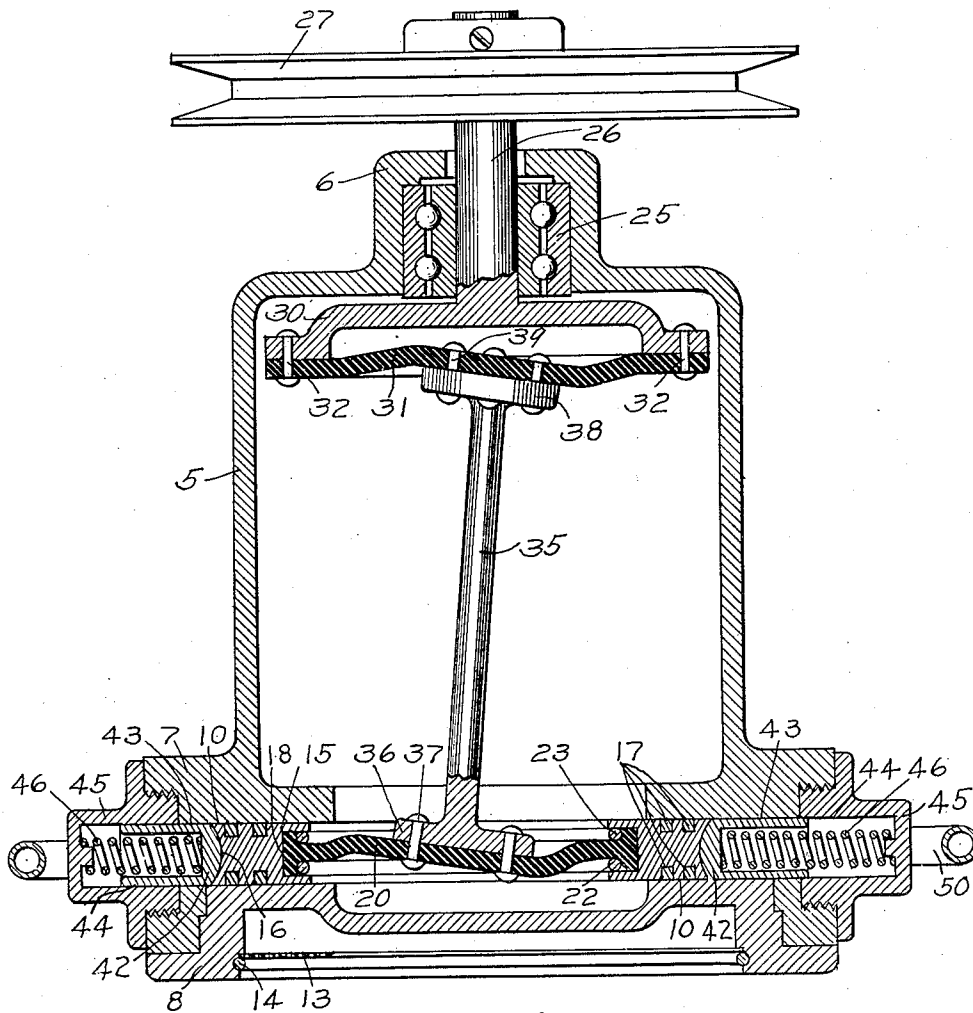
2,372,335

AIR COMPRESSOR

Filed Nov. 2, 1943

2 Sheets-Sheet 1

Fig. 1



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Fig. 2

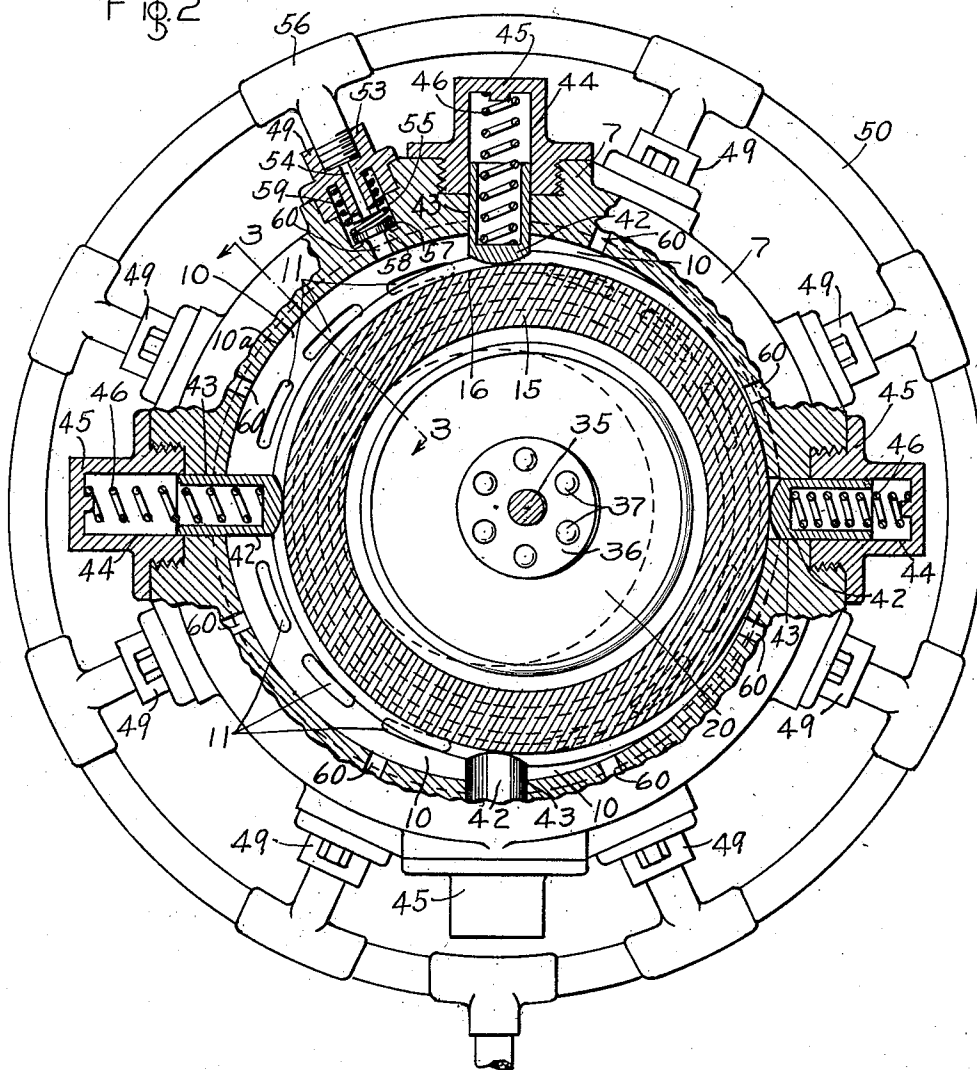
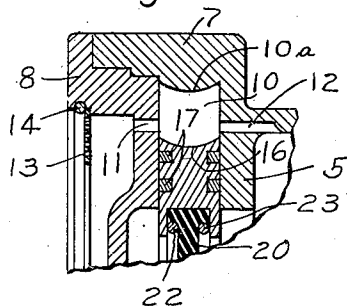


Fig. 3



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AIR COMPRESSOR

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5 Claims. (Cl. 230—145)

This invention relates to fluid compressors, and more particularly to a rotary air compressor.

Builders of conventional rotary compressors have in the past been handicapped by the necessity for working to very close manufacturing tolerances in order to prevent leakage past the vanes or other fluid compressing elements. In rotary compressors heretofore proposed, the operating parts have usually been subject to excessive friction causing rapid wear of the fluid compressing elements, which condition has generally been made more severe due to the difficulty of providing adequate lubrication.

It is an object of my invention to provide an improved rotary fluid compressor having a relatively simple and sturdy construction, and which is designed for manufacture at a low cost by application of modern mass production techniques.

It is another object of the invention to provide an improved rotary compressor including a fluid compressing member having an eccentric rolling motion and operative to compress fluid by a novel application of centrifugal force developed through the medium of a flexible driving means.

Other objects and advantages of the invention will appear in the following more detailed description thereof, taken in connection with the accompanying drawings, in which

Fig. 1 is a vertical sectional view of a rotary fluid compressor constructed in accordance with the invention;

Fig. 2 is a plan view, partly in section, of the compressor shown in Fig. 1; and

Fig. 3 is a fragmentary sectional view taken substantially along the line 3—3 of Fig. 2.

Referring to Fig. 1 of the drawings, the compressor may comprise a generally cylindrical housing 5 having a bearing portion 6 formed at one end thereof and an enlarged annular portion 7 at the opposite end, to which may be bolted or otherwise secured a circular head plate 8. Defined between the enlarged annular portion 7 and the head plate 8 is a circular compression chamber or channel 10, as is best shown in Fig. 2. This circular channel communicates with the atmosphere through a plurality of spaced apertures or inlet ports 11 formed in the head plate 8, and also by way of a plurality of similarly spaced apertures 12 formed in the adjacent wall of the housing 5, as shown in Fig. 3. To minimize passage of dust through the inlet ports formed in the head plate 8, a screen 13 is preferably secured thereto by means of a snap ring 14. It will be noted that the inlet ports 11 are disposed at the sides of the channel 10 and

are spaced inwardly from the outer or peripheral wall 10a thereof. On reference to Fig. 3 of the drawings, the outer wall 10a of the annular compression chamber 10 will be seen to be arcuate in section.

Slidably mounted within the channel 10 between the head plate 8 and the enlarged portion 7 of the housing is an annular fluid compressing member or rotary piston member 15, the maximum diameter of which is smaller than that of the channel, to permit eccentric operation of the rotary piston to uncover a number of the inlet ports 11 at one side, at any given moment, while the opposite side of the piston member engages the convex wall 10a, as is best shown in Fig. 2 of the drawings. The peripheral wall 16 of the rotary piston 15 is made concave in form to correspond with the wall 10a of the channel 10, as shown in Fig. 3. A plurality of annular packing rings 17, preferably formed of a carbonaceous or other self-lubricating material, may be mounted in suitable annular grooves formed in the rotary piston 15. The packing rings 17 are arranged on both lateral sides of the rotary piston for engagement with the walls of the channel 10 provided by the casing portion 7 and by the head plate 8, respectively.

The rotary piston 15 has an annular recess 18 within which is secured the peripheral flange of a flexible disk-shaped web member 20, which may be made of a suitable yieldable material such as a rubberized fabric, leather, or composition, and which is adapted to be firmly held in place within the rotary piston by means of a pair of snap rings 22 and 23. Mounted in the bearing portion 6 of the housing 5 is a ball bearing assembly 25, within which is journaled a rotary shaft 26 carrying on its outer end a sheave 27. The end of the shaft 26 within the housing 5 carries a circular flange 30, the peripheral portion of which is secured by rivets 32 to a flexible web member 31 that is formed of the same material as that of which the web member 20 is composed. For coupling the two web members 31 and 20 together, there is provided a connecting rod 35, which is normally disposed along the axis of the web members and has a head 36 secured by means of rivets 37 to the central portion of the web member 20, and a head portion 38 similarly secured by means of rivets 39 to the central portion of the web member 31.

As is best shown in Fig. 2, the circular channel 10 is divided into four compartments, or chambers, by means of four plungers 42, which are operatively mounted in the portion 7 of the

casing structure and are disposed radially at equally spaced points about the annular rotary piston 15. Each of the plungers 42 is slidably mounted within a bore 43 formed in the casing portion 7 and extends into a similar bore 44 formed in a cap member 45 having screw-threaded connection with the casing. A coil spring 46 is interposed between the inner wall of each cap member 45 and the adjacent plunger 42 for urging the plunger inwardly and into sliding engagement with the annular piston 15. It will be observed that the inner end of each plunger 42 adjacent the annular piston 15 is suitably rounded to insure proper sealing engagement with the concave surface 16 of the rotary piston, as is best shown in Fig. 1. Each of the plungers 42 is of course adapted to engage the opposite lateral walls of the channel 10 provided by the casing portion 7 and by the end plate 8 previously described, so as to form substantially pressure-tight partitions dividing the circular channel.

In Fig. 2 of the drawings the division of the circular channel 10 into four compartments, by the plungers 42 engaging the annular piston 15, is clearly represented. Air to be compressed can be drawn through the inlet ports 11 into each of the compartments of the channel 10 thus constituted and then compressed therein, upon rotation of the annular piston member as hereinafter explained, the compressed air being discharged from each compartment into a manifold pipe 50 by way of one of a plurality of discharge valve assemblies 51 that are disposed in pairs intermediate the plungers 42.

Each of the discharge valve assemblies 50 comprises a body member 53 bolted to the portion 7 of the compressor casing, and having formed therein a passage 54 communicating with a valve chamber 55 and with a T fitting 56 connected to the curved manifold pipe 50 surrounding the compressor. A valve element 57 mounted within each valve chamber 55 is adapted to be urged into seating engagement with a seat rib 58 under the force of a coil spring 59 for controlling communication, by way of a port 60, from the adjacent compartment of the annular channel 10 to the valve chamber. It will be understood that two ports 60 are preferably provided for each of the four compartments of the channel 10 formed between the plungers 42 in order to insure volumetric efficiency in the compressing of air regardless of the direction of rotation of the annular piston member 15.

In operation, the sheave 27 is connected by means of a driving belt to a suitable driving means, not shown, and is rotated at a high speed to operate the annular piston member 15 through the medium of the shaft 26, flexible web member 31, rod 35, and flexible web member 20. The annular piston member 15 and web member 20 are normally urged by the spring-pressed plungers 42 into substantially coaxial alignment with respect to the web member 31 and shaft 26, so that during initial rotation of these elements, the piston member at first slides concentrically within the annular channel 10. The absence of any positive centering guide, however, soon results in lateral, off-center movement of the more rapidly rotating piston member 15 until it is thrown into rolling contact with the peripheral wall 10a of the channel, forcing outwardly each of the plungers 42 in turn as it travels through the channel 10.

It will be understood that the mass of the annular piston member 15 is considerable, so that as it is constrained to roll around the peripheral

wall of the recess 10 at high speed, the centrifugal force holding the piston member in rolling contact with the peripheral surface 10a becomes relatively great. As the annular piston member is thus operated eccentrically, it uncovers the inlet ports 11 in succession to draw into each corresponding compartment of the annular channel 10 the air to be compressed. The air thereby trapped in the compartments formed between the spaced plungers 42 is then subjected to compression under a force corresponding to the centrifugal force developed by the rapidly rolling annular piston member 15, the compressed air being forced outwardly past the series of discharge valve elements 57 to the manifold pipe 50 encircling the compressor.

Inasmuch as the annular piston member 15 is of smaller diameter than that of the circular channel 10 in which air is compressed, it will be obvious that somewhat more than one revolution of the piston member will occur before the point of rolling contact between the annular piston member and the wall 10a travels through a complete cycle. Hence the number of revolutions of the contact point continually falls behind the number of revolutions of the annular piston member during operation of the compressor. This result is made possible by the operation of the flexible web members 20 and 31, which are adapted to be flexed through an infinite number of different positions and thus do not impose any definite positional relationship between the point of rolling contact and the rotation of the annular piston member. It will thus be understood that the annular piston member 15 will normally be operated in constant rolling contact with the peripheral surface 10a of the air compression channel 10 in such a manner as to reduce to a minimum the wear and excessive development of heat that might accompany a slipping or sliding condition of the cooperating elements.

A further advantage of my invention springs from the fact that the eccentric motion of the annular piston member 15 and of the packing rings 17 carried thereby is not one of true concentric sliding, but is rather of a form of hypocycloidal motion, in which are combined a lateral oscillatory motion and a certain amount of circular sliding, so that the resultant average rubbing speed of the packing rings on the walls of the annular channel 10 will be considerably less than would be the case if the piston member were rotated concentrically within the housing.

From the foregoing description, it will be apparent that the relatively simple structural features of my improved compressor will enable production of each unit at a low cost, and operation of each device with a moderate power consumption to deliver compressed air that is free from the lubricating oil often discharged by conventional compressors.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A fluid compressor comprising a casing having a circular compression channel opening inwardly, a plurality of spaced yieldable partition elements extending into said channel, lateral inlet ports formed in said casing in communication with said channel, discharge valve means mounted in said casing outwardly of said channel, an annular compressing element of smaller diameter than that of said channel and slidably mounted therein for operation in overlapping relation with said inlet ports successively, said compressing element

having a peripheral surface engageable with said partition elements, and flexible driving means operative to rotate said element in eccentric rolling relation in said channel for progressively uncovering said inlet ports, then covering same while trapping and compressing fluid between said partition elements.

2. A fluid compressor comprising a casing having a circular compression channel opening inwardly, a plurality of spaced yieldable partition elements extending into said channel, lateral inlet ports formed in said casing in communication with said channel, discharge valve means mounted in said casing outwardly of said channel, an annular compressing element of smaller diameter than that of said channel and slidably mounted therein, said compressing element having a peripheral surface engageable with said partition elements for rendering same effective to prevent backflow of fluid through said inlet ports, and flexible driving means operative to rotate said element in eccentric rolling relation in said channel for progressively trapping and compressing fluid between said partition elements; said driving means including a flexible web element having its peripheral portion secured to said annular compressing element, a rotary drive shaft journaled in said casing, another flexible web element having its peripheral surface secured to said drive shaft, and a connecting element having its ends secured to the central portions of said web elements, respectively.

3. A fluid compressor comprising a casing, rotary fluid compressing means operatively mounted in said casing, fluid inlet and discharge means associated in said casing with said rotary fluid compressing means, movable partition means mounted in said casing for cooperation with said fluid compressing means and arranged between said inlet and discharge means during compression of fluid, a rotary driving shaft journaled in said casing, a flexible disk element secured concentrically to said rotary fluid compressing means, a flexible disk element carried by said drive shaft, and connecting means joining said flexible disk elements together, whereby said rotary fluid compressing means is constructed and arranged for eccentric rotation in rolling contact with an interior portion of said casing by operation of said drive shaft.

4. A fluid compressor comprising a casing having a circular compression channel opening inwardly with an annular bottom wall and flat side walls, a plurality of concentrically spaced lateral inlet ports formed in said side walls, a plurality of discharge valve means mounted in said casing and including outlet ports communicating with said channel, an annular fluid compressing element of smaller diameter than that of said channel and having flat lateral surfaces slidably en-

gaging said side walls, said compressing element also having a peripheral surface adapted for rolling engagement with said annular bottom wall of said channel for operation to uncover a number of the inlet ports at one side at any given moment while those at the opposite side are closed, a plurality of equally spaced yieldable partition elements extending into said channel in sealing relation with the side walls thereof, said yieldable partition elements having end surfaces disposed in sliding engagement with said peripheral surface of the compressing element for at any given moment cutting off communication between the uncovered inlet ports and the outlet ports of said discharge valve means through which fluid is being discharged under compression, and flexible driving means operative to rotate said compressing element in centrifugal rolling relation in said channel for progressively uncovering said inlet ports, then covering same while trapping and compressing fluid between said partition elements.

5. A fluid compressor comprising a casing having a circular compression channel opening inwardly with an annular bottom wall and flat side walls, a plurality of concentrically spaced lateral inlet ports formed in said side walls, a plurality of discharge valve means mounted in said casing and including outlet ports communicating with said channel, an annular fluid compressing element of smaller diameter than that of said channel and having flat lateral surfaces slidably engaging said side walls, said compressing element also having a peripheral surface adapted for rolling engagement with said annular bottom wall of said channel for operation to uncover a number of the inlet ports at one side at any given moment while those at the opposite side are closed, a plurality of equally spaced yieldable partition elements extending into said channel in sealing relation with the side walls thereof, said yieldable partition elements having end surfaces disposed in sliding engagement with said peripheral surface of the compressing element for at any given moment cutting off communication between the uncovered inlet ports and the outlet ports of said discharge valve means through which fluid is being discharged under compression, and flexible driving means operative to rotate said compressing element in centrifugal rolling relation in said channel for progressively trapping and compressing fluid between said partition elements, said driving means including a flexible web element having its peripheral portion secured to said annular compressing elements, a rotary drive shaft journaled in said casing, another flexible web element having its peripheral surface secured to said drive shaft, and a rigid connecting element having its ends secured to the central portions of said web elements, respectively.

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