March 11, 1947. E. E. HEWITT ET AL 2,417,197

AIR COMPRESSOR APPARATUS

Filed Aug. 21, 1943 2 Sheets-Sheet 1

Fig. 1

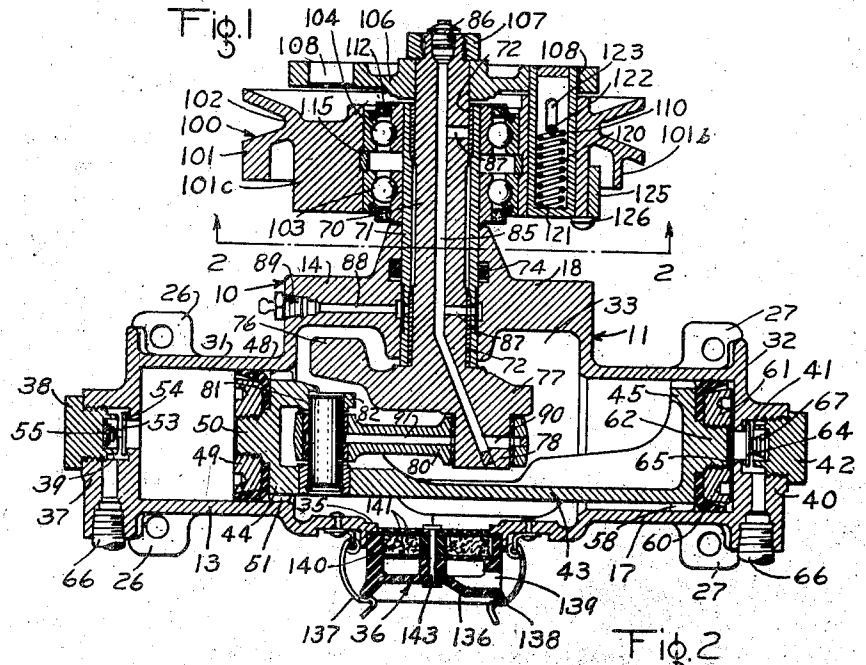


Fig. 2

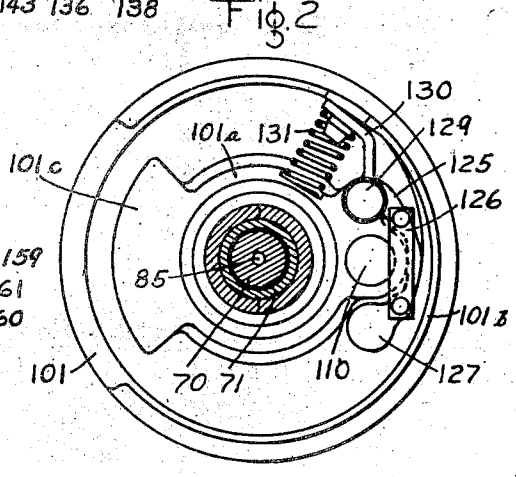
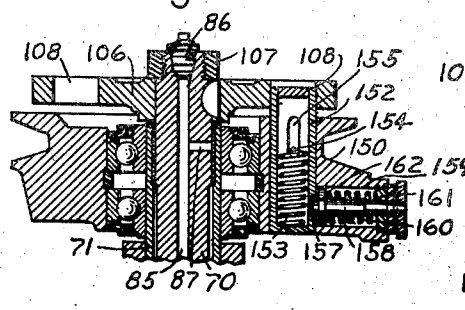


Fig. 5



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Filed Aug. 21, 1943 2 Sheets-Sheet 2

Fig. 3

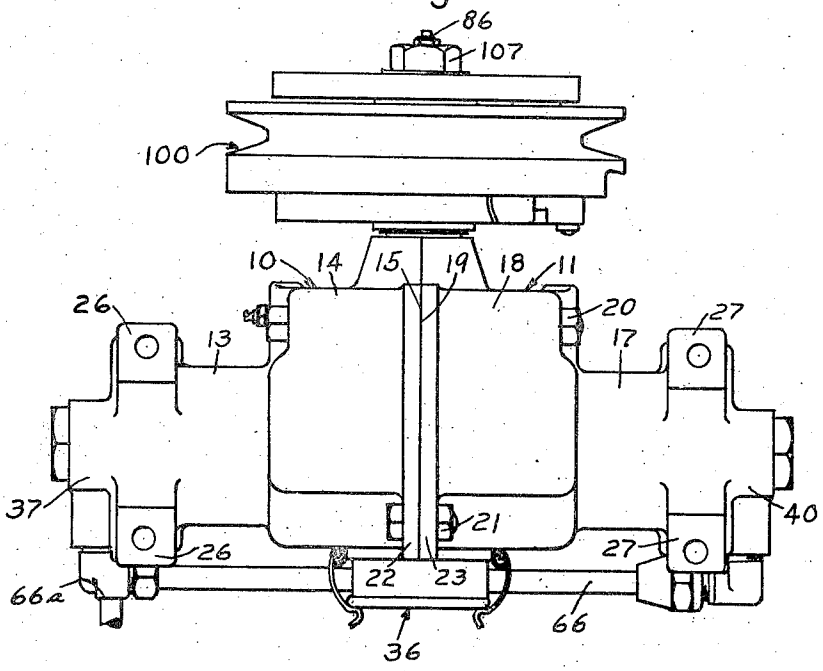
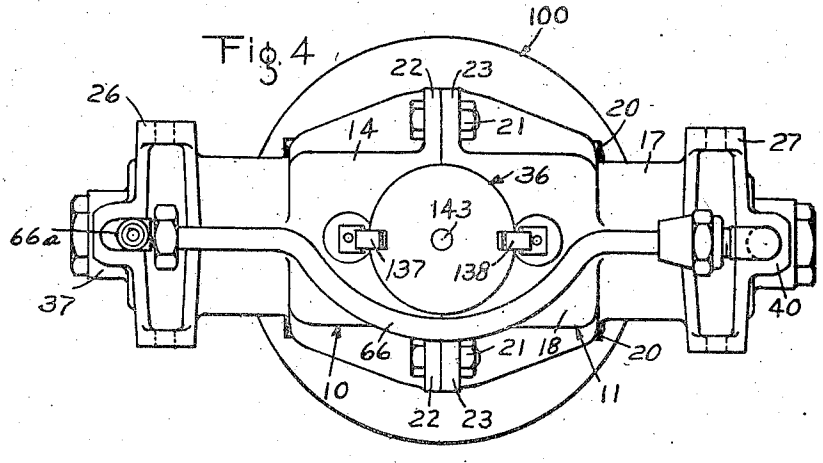


Fig. 4



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AIR COMPRESSOR APPARATUS

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7 Claims. (Cl. 230—187)

1

This invention relates to air compressors, and more particularly to a single stage air compressor adapted to be substituted for that shown in Fig. 1. automotive vehicle.

Trucks and other automotive vehicles, particularly those employed in military operations or other work requiring the making of long trips far from any center of service and supply, may be economically equipped with light-duty compressors that can be operated at any time to afford a quick supply of compressed air for inflating tires or other equipment. Various types of compressors for automotive service have heretofore been proposed, but many of these machines are considered unsuitable for quantity production, or impracticable under the unfavorable operating conditions sometimes encountered, by reason of constructions requiring expensive or scarce materials, or involving weak and unserviceable designs, or embodying excessively heavy and bulky assemblies.

It is a principal object of our invention to provide an improved single stage air compressor of compact form suitable for belt-drive connection with a vehicle engine, which is so constructed and arranged as to require a relatively low driving torque for fast operation to deliver a large volume of air under high pressure, and which embodies a design facilitating its manufacture by mass production methods.

Another object of the invention is to provide an improved compressor of the above type having a symmetrical, two-part casing structure that may be readily assembled or taken apart for repairs, and which constitutes a compact, properly balanced unit adapted to be mounted in any convenient position in association with an automobile engine or the like.

A further object is to provide a compressor of the class described having an improved piston and valve structure, and other features of construction rendering the apparatus suitable for operation under dustry service conditions for long intervals, without requiring frequent inspection or repairs.

Still another object of the invention is to provide an air compressor exhibiting the above advantages and having automatically controlled driving means adapted to prevent inadvertent operation of the compressor at excessive speeds.

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

Fig. 1 is a longitudinal sectional view of an air compressor constructed in accordance with a preferred form of our invention;

2

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is an exterior elevational view of the compressor as shown in Fig. 1;

Fig. 4 is an end view of the compressor as shown in Fig. 3; and

Fig. 5 is a fragmentary sectional view illustrating a modified form of driving pulley mechanism adapted to be substituted for that shown in Fig. 1.

According to the invention as illustrated in the drawings, the air compressor is of a single stage type, and is provided with a pair of oppositely disposed cylinders in which is mounted a double piston unit that is operative through the medium of a crank shaft and belt-driven pulley. Referring to Fig. 3 of the drawings, the casing structure of the compressor consists of only two main parts, designated as a body section 10 and a complementary body section 11. These body sections are substantially alike in form, and are adapted to be bolted together for housing all of the operating elements of the compressor with the exception of the driving pulley assembly. The body section 10 has a cylinder portion 13 and a crank case portion 14 terminating in a flat sealing surface 15. The complementary body section 11 of the casing structure likewise includes a cylinder portion 17 and a crank case portion 18 having a sealing surface 19 adapted to be held in abutting relation with the sealing surface 15, when the parts are assembled.

The two body sections 10 and 11 are adapted to be held together by four bolts, two of which are identified in Fig. 3 by the reference character 20, that are inserted through suitable apertures in the casing sections adjacent the driving pulley assembly of the compressor. The other two bolts 21 are relatively short and are inserted through suitable openings in flanges 22 and 23 carried by the body sections 10 and 11, respectively, as shown in Figs. 3 and 4.

Also best illustrated in Figs. 3 and 4 of the drawings are the mounting brackets for supporting the compressor assembly, comprising four projecting lug portions 26 suitably apertured and aligned in integral pairs on the outer end of the cylinder portion 13, and four similar lug portions 27 integrally formed on the cylinder portion 17 of the other body section. It will be observed that the lug portions 26 and 27 are conveniently disposed for facilitating the mounting of the compressor in any of a number of different positions. As hereinafter more fully explained, the lug por-

tions 26 and 27 are in addition adapted to serve as cooling fins in providing maximum cooling surface for the compressor cylinders.

With reference to Fig. 1 of the drawings, it will be seen that the cylinder portion 13 of body section 10 has formed therein a piston bore 31 which is disposed in alignment with a piston bore 32 in the opposite cylinder portion 17 of the other body section. The piston bores 31 and 32 both open into a centrally disposed crank case chamber 33 defined within the abutting portions 14 and 18 of the two body sections. This chamber communicates with an air intake opening 35 that is defined by the body sections 10 and 11 and that is adapted to be covered by a removable air filter unit 36, hereinafter described. The outer end of the cylinder portion 13 has a boss portion 37 fitted with a screw-threaded cap member 38, which, together with the portion, defines a small valve chamber 39 communicating with the piston bore 31. A similar boss portion 40 is formed on the cylinder portion 17 and contains a valve chamber 41, which is closed by a cap member 42.

Operatively mounted within this casing structure is a double piston or movable abutment comprising a longitudinally disposed shank 43, having formed at one end a piston head 44 which is slidably fitted in the piston bore 31, and at the opposite end a similar piston head 45 slidably mounted in the other piston bore 32. The piston head 41 is adapted to compress air in the bore 31, and for this purpose is provided with a flexible annular packing cup 48, which may be made of rubber or a similar material and is held on the piston head by means of a ring element 49 having screw-threaded connection with a central stud 50. The skirt of the packing cup 48 is adapted to engage and seal against the wall of the bore 31 during each compression stroke of the piston head 44, and is also adapted to perform the function of an inlet valve during each suction stroke, by controlling admission of air to the piston bore 31 through a plurality of lateral slots 51 formed in the peripheral portion of the piston head. Back flow of air from the valve chamber 39 to the piston bore 31 is prevented by a discharge valve 53, which is disposed in valve chamber 39 and is normally maintained in engagement with an annular seat rib 54 by a spring 55 supported on cap member 38.

The opposite piston head 45 is likewise provided with lateral slots 58 and a flexible packing cup 60, that is held in place by an annular nut 61 secured to a stud 62 projecting from the piston head. Communication between the piston bore 32 and valve chamber 41 is controlled by a valve element 64, which is normally held on a seat rib 65 by a spring 67.

It will be observed that both the valve chamber 41 and the valve chamber 39 are connected to a common discharge manifold or conduit 66, which, as is best shown in Figs. 3 and 4, is disposed closely adjacent the casing structure of the compressor, with one end of the manifold secured to the boss portion 37 and the other end to the boss portion 40 by means of suitable pipe fitting assemblies. The central portion of the manifold 66 is preferably arranged substantially in the plane occupied by the air filter unit 36 and may be bent sufficiently to clear that element. At the end supported by the boss portion 37 of body section 10, the discharge manifold 66 is equipped with an extension 66a, to which a suitable pipe fitting or hose coupling may be attached. This arrangement of the extension 66a adjacent the junction

of the manifold 66 with the casing insures proper support for the necessary pipe coupling elements.

For reciprocating the movable abutment just described, there is provided a crank shaft 70, an intermediate portion of which is journaled in a sleeve member 71 having one end tightly fitted and clamped between suitable concavities formed in the portions 14 and 18 of the respective body sections 10 and 11. The sleeve member 71 is preferably equipped with anti-friction linings 72 made of a suitable bearing metal, and is securely held against slipping between the complementary body sections with the aid of a resilient packing ring 74 of rubber or the like, which also tends to absorb vibration and acts as a seal. The end of the crank shaft 70 extending into the crank case chamber 73 carries a counter-weight portion 76 and an oppositely disposed crank arm 77, which terminates in a crank pin 78. Journaled on the crank pin 78 is one end of a connecting rod 80, the opposite end of which is pivotally connected to a wrist pin 81, which is mounted in bridging relation with the portion of the shank 43 adjacent piston head 44 and a suitable bearing lug thereof, designated by the numeral 82.

The air compressor constructed in accordance with our invention is adapted to be lubricated by grease or a relatively heavy oil, in order to reduce to a minimum any tendency of the compressor to discharge lubricant vapor with the compressed air during operation under normal service conditions. As shown in Fig. 1, the crank shaft 70 is provided with a longitudinally arranged lubricant duct 85, which may be supplied with lubricant by way of a suitable pressure fitting 86 inserted in the outer end of the crank shaft. The duct 85 communicates through branches 87 with the crankshaft bearings. An auxiliary lubricant duct 88 also leads to duct 85 and terminates at another pressure fitting 89 screwed into the body section 10. The end of the lubricant duct 85 within the crank pin 78 communicates by way of a branch 90 with the connecting rod bearing, and also with a lubricant duct 91 passing through the connecting rod 80 to the bearing surrounding the wrist pin 81.

Mounted on the outer end of the crank shaft 70 is a driving pulley assembly, indicated generally by the reference numeral 100, which comprises an annular pulley member 101 having a V-shaped channel 102 adapted to receive a driving belt, not shown. A pair of ball bearing assemblies 103 and 104 are provided to support the pulley member 101 in rotatable relation with the sleeve member 71. The driving pulley assembly 100 also includes a coupler disk 106 which is keyed or otherwise secured to the end of the shaft 70 for rotation therewith, and is held in place by means of a lock nut 107 screwed onto the end of the shaft. The coupler disk 106 has a plurality of spaced apertures 108 formed therein at equal distances from the axis of the disk, and is adapted to be cooperatively interlocked with the pulley member 101 through the medium of a spring-pressed plunger 110, which is constructed and arranged for engagement in one of the apertures 108 when the compressor is to be operated, as hereinafter explained.

The ball bearing assemblies 103 and 104 are preferably of the felt-sealed type equipped with felt sealing elements, such as that indicated by the numeral 112. The outer races of the ball bearing assemblies are separated by an annular member 115 embedded in the interior wall of the pulley member 101. The inner races of the ball

bearing assemblies are tightly fixed to the stationary sleeve member 71, that of the bearing assembly 104 being disposed adjacent the coupler disk 106, and the inner race of the other bearing assembly 103 occupying a position close to extensions of the body sections 11 and 10, as shown in Fig. 1.

According to the invention, the plunger 110 is arranged for movement into and out of engagement with the coupler disk 106 for establishing and disestablishing the driving connection between the pulley member 101 and the crank shaft 70 of the compressor, the disconnecting or uncoupling operation being automatically accomplished upon operation of the apparatus at a predetermined speed. As shown in Fig. 1, the plunger 110 is subject to the pressure of a coil spring 120, which is interposed between the end wall 121 of the plunger and a pin 122 secured to the pulley member 101. The pin extends through a longitudinally arranged slot 123 formed in the plunger. The spring 120 is adapted to urge the plunger 110 inwardly toward the body of the compressor and away from interlocking engagement with the coupler disk 106.

For maintaining the plunger 110 in its engaged position, as shown in Fig. 1, there is provided an inertia responsive mechanism including a lever 125 carrying a locking bar 126, which is adapted for overlapping engagement with the plunger 110 while the latter is interlocked with the coupler disk 106. The lever 125 is further shown in Fig. 2 as comprising a weighted portion 127 extending beyond a curved portion to which the bar 126 is riveted, and a journal portion which is pivotally mounted on a pin 129 carried by the pulley member 101. An extension 130 of the lever 125 projects beyond the pin 129 to receive the end of a coil spring 131, which is seated on a flat portion of the hub 101a of the pulley member. The spring 131 is arranged to bias the lever 125 in a clockwise direction with respect to the pin 129, as viewed in Fig. 2, so that the bar 126 is normally urged toward the position in which it is illustrated. The lever 125 and the elements associated therewith are compacted within a skirt portion 101b of the pulley member, which is thus adapted to act as a stop limiting outward movement of the lever under the force of inertia developed during operation at or above the predetermined speed. It will be noted that a suitable counterweight portion 101c is formed on the pulley member diametrically opposite the lever 125.

The air filter unit 36, which as already stated covers the inlet opening 35 in the casing structure, comprises a substantially cylindrical body 136 which may be made of a plastic material, and which is held in place by a pair of spring clips 137 and 138. The spring clips are pivotally attached to suitable brackets riveted to the respective body sections of the casing structure at opposite sides of the opening 35, and are adapted to engage an annular flange provided on the body 136, as shown in the drawing. A lateral opening 139 formed in the body 136 provides communication from the atmosphere through a chamber containing curled hair felt, or other straining material 140 to the crank case chamber 33 of the compressor. The straining material 140 is contained between a pair of perforated plates 141 which are secured to the body 136 by means of an axially disposed rivet 143, so that the entire body unit 36 may be removed for cleaning purposes, and later installed again without loss of any of its elements.

In actual practice, the air compressor constructed in accordance with our invention is preferably mounted on or in association with the engine of a truck or other automotive vehicle, with the driving pulley assembly 100 so located as to enable operation thereof by the fan belt, or by an auxiliary belt driven by the engine. By reason of the compact, symmetrical form of the compressor assembly, and the plurality of conveniently located mounting lug portions 26 and 27 previously described, the compressor may readily be accommodated to any of a number of supporting brackets associated with the engine. Mounting of the compressor is further facilitated by reason of the fact that the structure does not include the usual oil filled crankcase, the compressor being thus adapted to operate with equal efficiency in all positions.

In operation, when the plunger 110 is positioned in engagement in one of the apertures 108 of the coupler disk 106, the pulley member 102 may be rotated by the vehicle engine to drive the crank shaft 70 at a speed corresponding with the speed of the engine. As it rotates the crank shaft 70 acts through the medium of the connecting rod 80 to reciprocate the piston heads 44 and 45 within the respective cylinders. It should be understood that each of the piston heads 44 and 45 is operative, during its suction stroke, to draw air from the atmosphere into the piston bore by way of the strainer unit 36, crank case chamber 33, and the slots in the piston head leading past the associated packing cup, and that the air compressed on the subsequent compression stroke of the piston head is discharged past the associated discharge valve into the manifold 66. The flow of atmospheric air past the respective packing cups 48 and 60 carries off some of the heat developed therein during operation of the piston head, while heat of compression is also dissipated by radiation from the surfaces of the exterior mounting lug portions 26 and 27 carried on the compressor cylinders 11. The packing cups are thereby protected from the possibility of damage that might follow an excessive rise in temperature.

If the speed at which the driving pulley assembly 100 is rotated to operate the compressor exceeds a predetermined rate, so that the centrifugal force acting on the weighted portion 127 of the lever 125 shown in Fig. 2 becomes great enough to move the lever in a counterclockwise direction about the pin 129, in opposition to the force of the spring 131, the bar 126 is then moved out of engagement with the plunger 110. With the plunger 110 thus released, the spring 120 acting thereon, as shown in Fig. 1, becomes effective to force the plunger out of engagement with the coupler disk 106 carried by the crank shaft of the compressor. The pulley member 101 is thereafter free to rotate at the speed determined by the driving engine speed, but operation of the compressor is discontinued.

It will be apparent that the driving pulley assembly 100 thus embodies an efficient feature of construction automatically operating to prevent excessively rapid operation of the compressor assembly. When the compressor is mounted on a motor driven vehicle, the inertia responsive uncoupling mechanism also serves to prevent inadvertent operation of the compressor when the vehicle is driven over the road by an operator who has forgotten to render the compressor inoperative, after having used it in inflating tires or the like.

In Fig. 5 of the drawings there is illustrated in fragmentary form a modified driving pulley assembly that may be substituted for the assembly 100 shown in Fig. 1. The driving pulley assembly shown in Fig. 5 includes a pulley member 150 journaled on ball bearing assemblies supported on the stationary sleeve 71, the coupler disk 106 secured to the compressor crank shaft 70, and means for connecting the coupler disk to the pulley member including a spring pressed plunger 152 carried by the pulley member. The plunger 152 is slidably mounted in a bore formed in the pulley member 150 for operation into or out of engagement in one of the several apertures 108 formed in the coupler disk. A coil spring 153 is interposed between the end wall of the plunger and a pin 154 fitted through a slot 155 in the plunger for urging the latter element toward its disengaged position. In this form of the apparatus, the plunger 152 is provided with a lateral opening 157 adapted to receive the end of an inertia responsive latch member 158, which is disposed in a radially arranged bore 159 in the pulley member. A coil spring 160 is interposed between a ring 161 secured to the pulley member 150 and a collar 162 formed on the latch member 158 for urging the member inwardly toward the plunger 152.

In principle, the operation of the pulley assembly shown in Fig. 5 is like that of the apparatus already described with reference to Fig. 1. So long as the compressor is driven at a safe speed, the spring 160 maintains the latch chamber 158 in engagement with the aperture 157 in plunger 152. The plunger thus is sufficient to lock the driving pulley member 150 to the coupler disk 106 and crank shaft 70. Upon rotation of the pulley member 150 at a rate exceeding the predetermined speed, however, the latch member 158 moves outwardly under the force of inertia and releases the spring pressed plunger 152, which is then withdrawn from the aperture 108 in the coupler disk.

It will now be seen that the improved air compressor embodying the features of our invention, as hereinbefore described, incorporates maximum effectiveness of design and structural strength in a compact and durable unit that is markedly suitable for assembly by the application of modern mass production techniques. The two-part compressor casing, the symmetrical form of the completed unit, and its carefully balanced operating elements, together with the protective features including the automatic coupler or unloading mechanism associated therewith, all contribute to attainment of the objects and advantages of the invention as initially presented.

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

1. An air compressor comprising a symmetrical casing structure consisting only of two substantially similar sections secured together to provide a central crank case chamber intermediate oppositely disposed cylinder chambers, unitary piston means having opposed air compressing heads reciprocatively mounted in said cylinders, respectively, a sleeve member clamped between said sections against movement, crank shaft means mounted in said crank case chamber and journaled in said sleeve member for operating said unitary piston means, and driving means supported on said sleeve member for operating said crank shaft means.

2. In an air compressor, in combination, a pair of separate hollow body sections each having a cylinder portion and an enlarged crank case portion, said crank case portions having matching concavities and apertured corner bolting faces, a movable abutment having opposed piston heads constructed and arranged to fit into the respective cylinder portions of said body sections, a crank shaft operatively connected to said movable abutment, a sleeve member arranged to serve as a journal for said crank shaft and having one end adapted to be received into said concavities and clamped by said body sections against movement in any direction when said body sections are assembled in end to end relationship with each other about said movable abutment and crank shaft, and a plurality of bolts applicable to said bolting faces on the body sections for securing said assembled elements of the air compressor together.

3. In a compressor, in combination, a casing structure, fluid compressing means operatively mounted therein, a sleeve member rigidly supported in said casing structure and extending outwardly thereof, a rotary shaft journaled in said sleeve member and constructed and arranged to operate said fluid compressing means within the casing structure, a pulley member rotatively mounted on said sleeve member, a coupler disk secured to said rotary shaft adjacent said pulley member, locking means carried by said pulley member for engagement with said coupler disk, and inertia responsive means operative to render said locking means ineffective upon rotation of said pulley member at an excessive speed.

4. A single stage tire inflation compressor having a casing structure consisting of two like sections each having a cylinder portion, crank case portion and recessed bearing support portion, said sections being adapted when joined to form an atmospherically open crank case and intake chamber intermediate oppositely disposed compression chambers, a double piston member extending through the crank case and intake chamber and having opposed slotted heads mounted in the respective compression chambers, self-lubricating flexible packing cups carried on said slotted heads and operable to admit air from said crank case and intake chamber by way of the slots in the respective heads to the compression chambers during suction strokes, a tubular sleeve member having a portion adapted to be clamped between the bearing support portions of said casing sections, a crank shaft journaled in said sleeve member and operatively connected to said piston member, rotary driving means adapted to be connected to said crank shaft and journaled on the outer end of said sleeve member, and bolts fitted exteriorly to said casing sections, said bolts serving as the sole securing means for holding said sections and thereby all said other elements in assembled relation.

5. A single stage tire inflation compressor having a casing structure including a cylindrical bearing sleeve member, air compressing means operatively mounted in said casing structure, a rotary operating shaft journaled in said sleeve member for operating said air compressing means, a rotary driving element journaled exteriorly on said sleeve member, and means for detachably coupling said driving element to said operating shaft comprising a coupler element secured to said operating shaft adjacent said

driving element, a manually operable pin carried by said driving element and movable into locking engagement with said coupler element, a spring serving to urge said pin out of such engagement, and inertia responsive centrifuge means constructed and arranged to retain said pin in locking engagement with said element unless said compressor is driven in excess of a preselected speed, in which event said pin must be manually reset when operation of the compressor is to be resumed.

6. An air compressor comprising a casing structure comprising two substantially similar sections each having provided therein an air compressing piston chamber and both sections being secured together in end to end relationship to provide a crank case chamber intermediate the air compressing piston chambers, said crank case chamber being constantly devoid of liquid lubricant, unitary piston means having air compressing heads reciprocatively mounted in said piston chambers, respectively, crank shaft means carried by the casing sections and comprising a crank contained in said crank case chamber and operatively connected to said unitary piston means for imparting reciprocatory motion thereto, an air inlet to said crank case chamber, and means carried by said air compressing heads operative to admit air from said crank case chamber to said piston chambers for compression by said air compressing heads.

7. An air compressor comprising a casing structure comprising two substantially similar sections each having provided therein an air compressing piston chamber and both sections being secured together in end to end relationship with each other to axially align the air compressing piston chambers and to provide a central crank case chamber intermediate the axially aligned air compressing piston chambers, said crank case chamber being constantly devoid of liquid

lubricant, unitary piston means having air compressing heads facing in opposite directions from each other and reciprocatively mounted in said piston chambers, respectively, crank shaft means carried by the casing sections and comprising a crank contained in said crank case chamber and operatively connected to said unitary piston means for imparting reciprocatory motion thereto, flexible packing cups carried by the respective piston heads, an air inlet for admitting air to said crank case chamber, means for admitting air from said crank case chamber and past said packing cups to said piston chambers during suction strokes of said piston heads, and discharge valve means mounted in said casing sections in association with said air compressing piston chambers.

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