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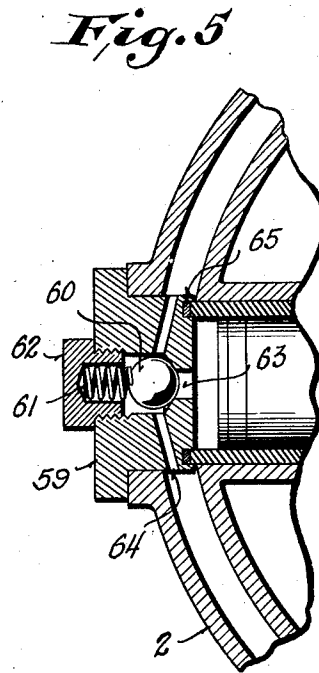
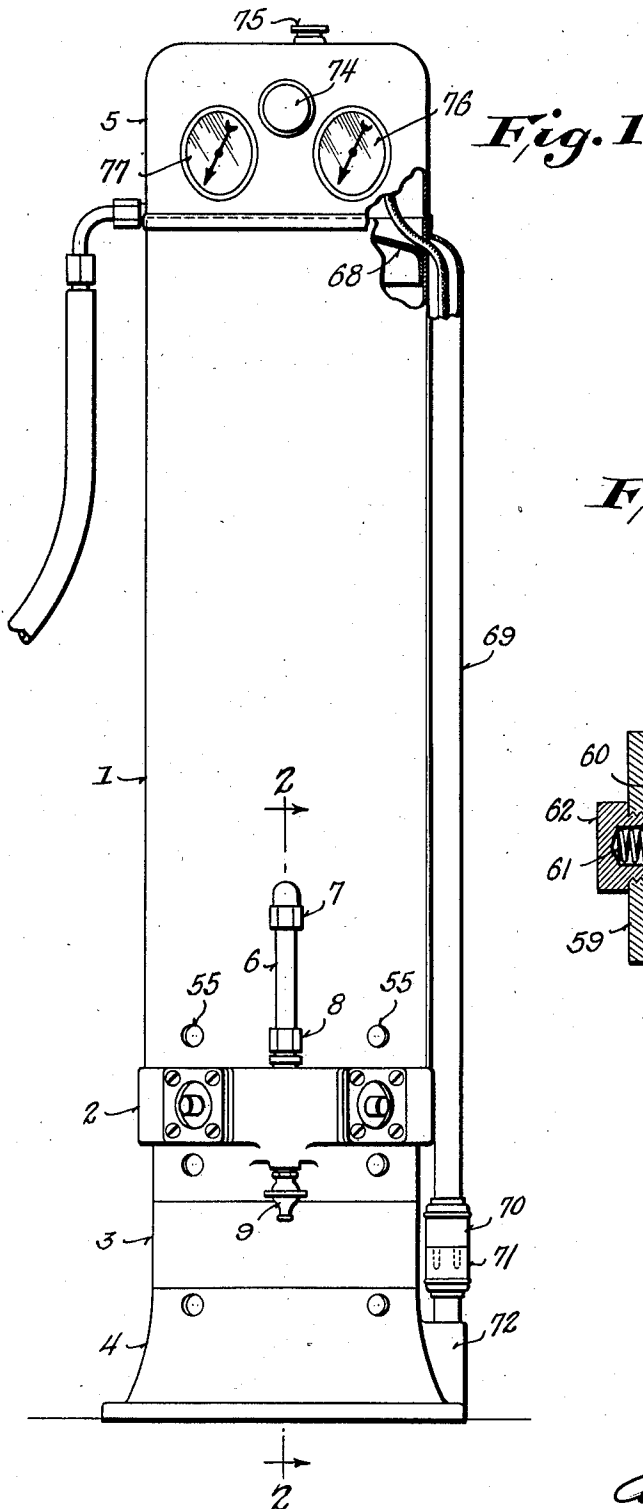
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2,053,593

AIR COMPRESSOR

Filed Oct. 2, 1933

3 Sheets-Sheet 1



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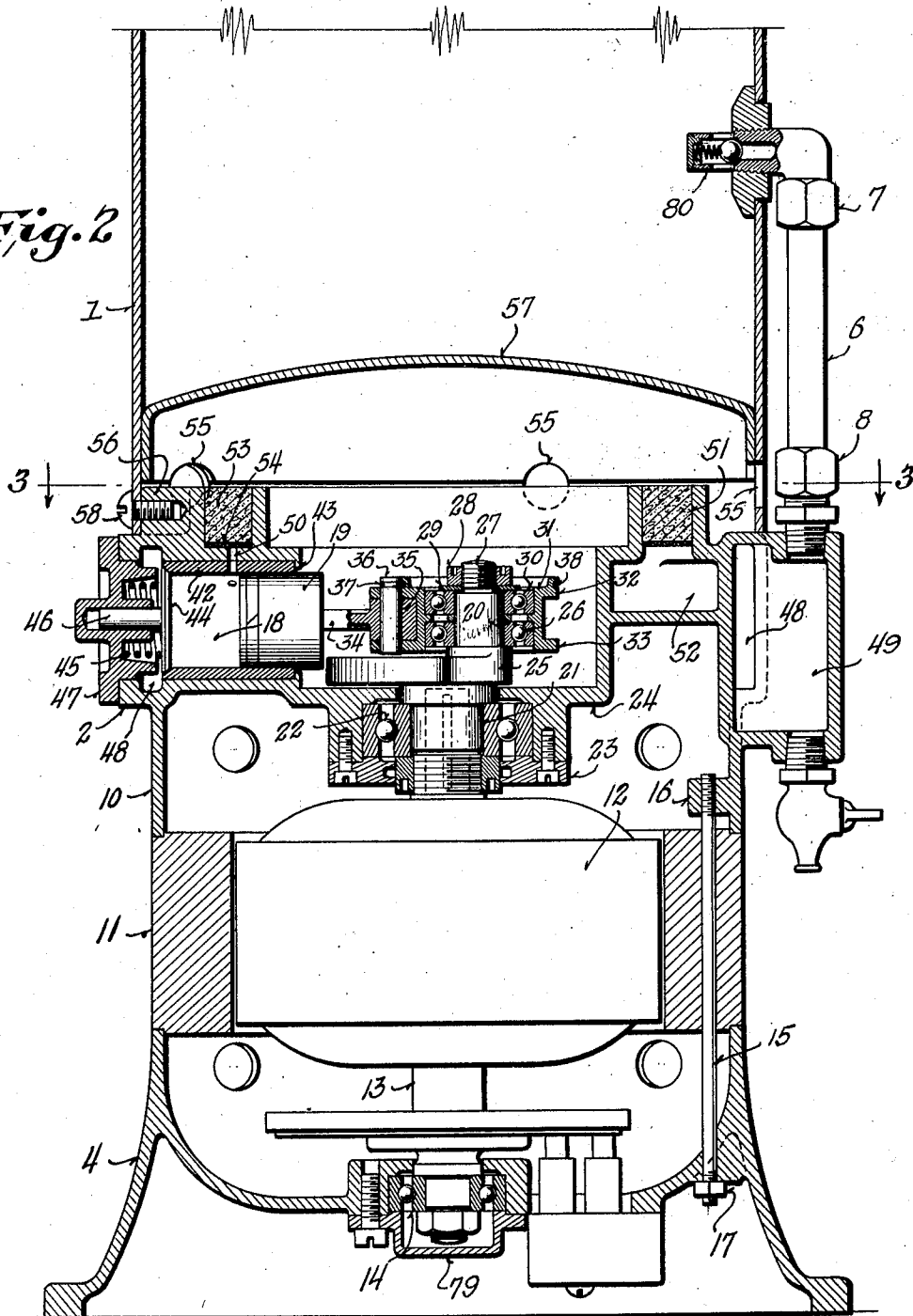
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Fig. 2



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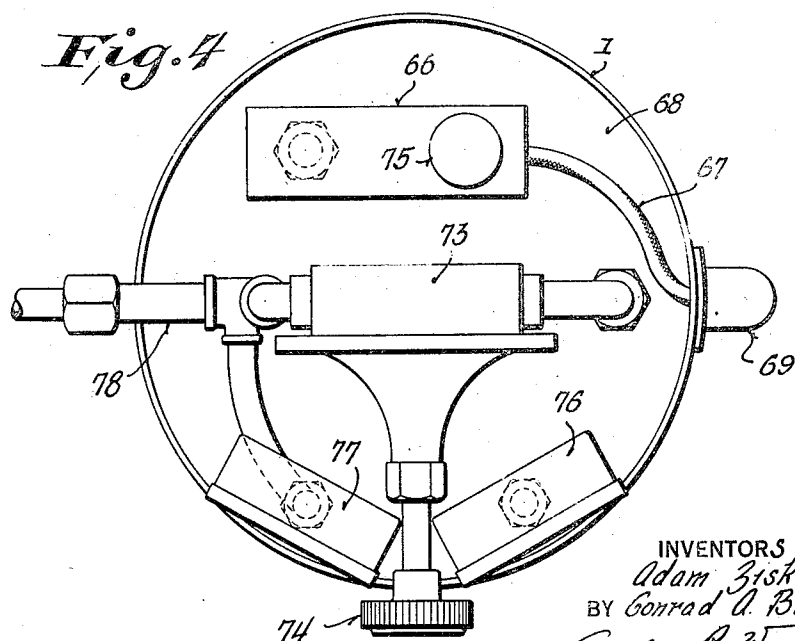
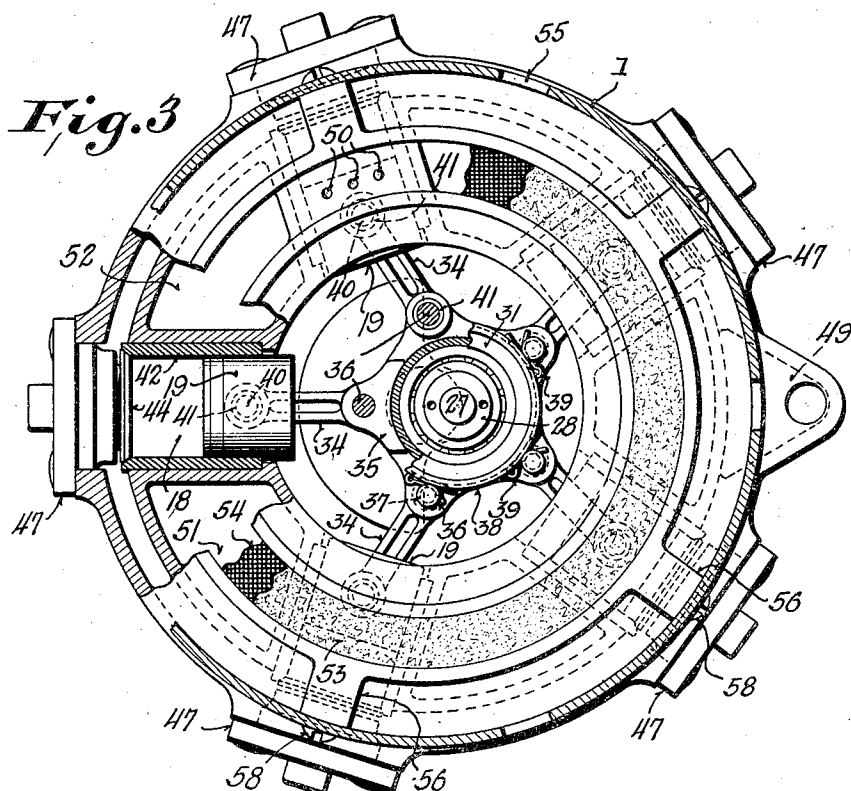
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3 Sheets-Sheet 3



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2,053,593

AIR COMPRESSOR

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Application October 2, 1933, Serial No. 691,812

16 Claims. (Cl. 230—58)

This invention relates to air compressors.

Objects of this invention are to provide a novel form of air compressor in which no oil whatsoever contacts with the air either before, during, or after compression, in which means are provided in which the construction is such that self-lubricating material forms one of the relatively sliding surfaces or relatively movable parts of the air compressor, so that the air is drawn in, compressed, and stored without contact with any oil whatsoever.

In certain classes of work, for example supplying compressed air or other gas in dispensing beverages, such, for example, as beer, it is highly desirable, though heretofore unaccomplished, to supply compressed air absolutely free from any oil or oil fumes or any smell of oil. This requirement also exists in other types of compressed air work. Although this is only one instance of the need of compressed air free from oil fumes or oil, it is obvious that there are numerous other conditions under which it is required, such for instance, as dental work, spraying, and so forth.

Further objects are to provide a unitary structure in which a motor and a compressor are formed as a unit and may be used as such, if desired, but in which such composite unit formed of the motor and compressor form, in effect, the relatively heavy base of the unitary structure, the upper portion of the structure consisting of a storage tank mounted directly upon the compressor and surmounted by automatic control and indicating devices controlling the operation of the motor in accordance with the air pressure, and also controlling the pressure of the discharged air by means of an automatic pressure reduction valve, suitable gauges being provided and the entire upper structure being covered by a closure cap merging into the outline of the tank.

Further objects are to provide a unitary construction in which the relatively heavy base formed of the electric motor and the compressor unit merge into the outline of the tank, such, for example, as a cylindrical tank, so that the entire structure has no exposed running parts, but instead in which the unitary construction provides a substantially cylindrical unit which is complete in itself and which requires no additional fittings whatsoever.

Further objects are to provide a construction in which the automatic electrical control mechanism, namely, the pressure responsive mechanism for controlling the motor, is connected by means of wiring with the motor forming a portion of the base of the apparatus, such wiring being carried in

permanently mounted conduit secured to the tank, and the base and the upper portion having interengaging electrical connectors so that when the tank is removed, the connection is automatically broken without having any loose wires whatsoever, and when the tank is replaced, the connection is again made, all without the need of disconnecting or reconnecting any wires whatsoever.

Further objects are to provide a unitary air compressor construction in which the motor and air compressor constitute a relatively heavy base for the device, the lighter tank structure being mounted thereon and in this manner avoiding noise and vibration, the air compressor being also so constructed that a substantially perfect balancing of the moving parts is obtained, thereby additionally avoiding vibration and noise.

Further objects are to provide a unitary air compressor construction in which the air compressor unit is preferably annular, though obviously it may take other shapes, and is provided with a plurality of radial cylinders and with a floating centrally located crank shaft for driving the pistons of the cylinders, such floating shaft being slidably coupled to the driving shaft of the motor, thereby dispensing with the end frames of the motor, the base of the apparatus itself carrying the lower bearing for the motor.

In greater detail, objects of this invention are to provide an air compressor in which the radial cylinders are lined with sleeves and in which either these sleeves or the pistons themselves are formed of a self-lubricating material, such as an alloy of graphite and metal, for instance, or other self-lubricating material, in which the articulated ends of the connecting rods are also bushed with this material, and in which a driving head is supported through the medium of ball bearings from the crank so that an oilless construction results, the compressor being divided off from the motor by a transverse partition formed preferably integrally with the compressor unit, suitable ventilation for the motor being provided by openings in the lower and upper portion of the structure that forms the housing for the motor, the upper portion of the air compressor unit constituting an intake chamber, the unit itself being preferably provided with an annular intake chamber equipped with a removable ring of filtering material.

Further objects are to provide an air compressor in which removable valve guiding means close the outer openings through the body portion of the compressor in alignment with the radial cylinders, and, in one form of the invention, in

which the valve itself directly seats upon the sleeve lining the cylinder, the construction providing an annular chamber circumscribing the cylinders and into which the cylinders discharge past the valves.

Further objects are to provide an air compressor which may be formed in any size, such, for example, as a small unit suitable for use in taverns, or in sand blasting, or in other work where a relatively small compressor is desired, although obviously as the description of the invention proceeds, it will be apparent that the compressor can be made in any size desired.

Further objects are to provide an air compressor in which novel means are used to secure the pins for the connecting rods to the driving head carried by the crank in a manner to provide an extremely compact and secure construction, and in which the construction lends itself to the locking of one piston rod rigidly to the driving head carried by the crank so that this piston rod forms a master rod for suitably holding the driving head, the other piston rods being articulated at each end.

Embodiments of the invention are shown in the accompanying drawings, in which:

Figure 1 is an elevation of the unitary air compressor, with parts broken away.

Figure 2 is an enlarged vertical sectional view on the line 2—2 of Figure 1, such view being broken away.

Figure 3 is a plan view on the line 3—3 of Figure 2, with parts broken away.

Figure 4 is a view of the top of the apparatus with the cap removed.

Figure 5 is a fragmentary sectional view showing a further form of valve.

Referring to the drawings, particularly Figures 1 and 2, it will be seen that the unitary air compressor construction comprises a storage tank 1, an air compressor unit or body portion 2, an electric motor unit 3, a finishing support or base portion 4, and a cover 5 surmounting the storage tank, the compressor and motor, together with the finishing base portion 4, constituting, in effect, the relatively heavy base of the apparatus. The air compressor unit is joined to the tank by means of a short pipe 6 provided with detachable fittings 7 and 8. It is also preferable to provide a drain cock 9 for the air compressor unit.

Referring particularly to Figures 1, 2 and 3, it will be seen that the air compressor unit comprises a body portion 2, as previously described, which is equipped with a downwardly extending annular flange 10 seating upon the stator 11 of the motor, the motor stator in turn resting upon the finishing base or support 4. The motor armature 12 is carried by the driving shaft 13 and a ball bearing or step bearing indicated generally at 14 is provided for supporting the lower end of the motor shaft.

In purchasing the motor for this apparatus, it is obvious that the end plates are not needed as the finishing base and the compressor together take the place of the end plates of the motor. The three parts may be locked together in any suitable way, as by means of the tie bolts 15, such bolts being threaded into lugs 16 carried by the compressor unit and being provided with nuts 17 at their lower ends.

Referring in greater detail to the air compressor unit, it will be seen that the body portion is provided with a plurality of radial cylinders 18. Each of these cylinders is equipped with a piston

19. The pistons are driven from a crank 20 which is counterweighted as indicated and which is carried by a floating crank shaft 21. This crank shaft is carried by a ball bearing indicated generally at 22 in Figure 2, and has a sliding keyed fit with the upper end of the motor shaft. It is to be noted that the inner race of the ball bearing 22 is locked to the shaft 21 and that the outer race is locked by means of a plate 23 to the transverse partition wall 24 of the compressor structure. Thus this bearing is a floating or semifloating bearing and is so made that the shaft may be directly slipped over the driving shaft of the motor in assembling or disassembling the parts.

The crank 20, of course, may be replaced by an eccentric if desired, and it is to be understood that the term "crank" hereinafter used is intended to be interpreted in its broadest aspect.

This crank 20 is provided with a shouldered portion 25 upon which the inner race of the lower ball bearing 26 rests. It is provided with a threaded reduced upper portion 27 which receives the nut 28 and washer 29 which holds the inner race of the upper bearing 30 in place. The driving head 31 is provided with an intermediate small flange which spaces the outer races apart and thus the driving head 31 is locked against displacement either in an up or down direction and yet is supported by ball bearings from the crank.

The driving head 31 is provided with upper and lower flanges 32 and 33 between which the ends of the connecting rods 34 are received. All of these connecting rods are articulated at both ends at the points where they are connected to the driving head and the cylinders, except one. This connecting rod is shown in Figure 2. It is provided with an enlarged inner head 35 which is curved to fit the outer face of the driving head 31. All of the connecting rods are secured by means of pins 36. The connecting rod just described is immovable with reference to the driving head 31 and constitutes, therefore, a master rod. From Figure 3 it is apparent that it is held against motion with reference to the driving head by means of the enlarged portion 35, as the enlarged portion 35 has an arcuate face which fits closely around the head and prevents rocking of the connecting rod 34 with reference to the head. This provides a very simple mode of locking the master rod to the head so that one rod does not rock with reference to the head.

Each of the pins 36 is provided with a grove which may be seen in Figure 2 and which is shown in dotted lines in Figure 3 and is indicated by the reference character 37. The upper flange 32 of the driving head is provided with an annular groove 38 in alignment with the grooves 37 of the pins. Cotter pins or split pins 39 are employed for locking the crank pins in place. These split pins are merely slipped into the round space formed jointly by the groove 38 in the driving head and the grooves 37 in the connecting rod pins, and consequently locks the pins in place, as shown most clearly in Figure 3. The inner ends of the connecting rods are joined by means of the pins 40 to the pistons 19. It is preferable to bush each end of the connecting rods with a self-lubricating bushing, as indicated at 41 in Figure 3. Obviously it is not necessary to bush the inner end of the master rod previously described.

The body portion is bored out radially for the cylinders and either the pistons or liners for the

cylinders are formed of a self-lubricating material such as an alloy of graphite and metal, though obviously the invention is not to be limited to this specific material, as any other self-lubricating material having long wear may be used.

In the form of the invention shown liners 42 of self-lubricating material are provided for each cylinder. These liners are forced into the cylinders from the outer side inwardly until they strike small flanges 43 carried at the inner ends of the cylinders. The pistons are preferably provided with piston rings as indicated and may be made of any suitable material, such as cast iron. These pistons slide freely within the self-lubricating sleeves and thus use of oil either at the pistons or at the crank or at any of the joints of the connecting rods is wholly avoided.

In the preferred form of the invention, a disk valve 44 is provided and is pressed inwardly by means of a spring 45. This valve is provided with a guiding stem 46 integral therewith and guided within a recess formed in the valve plate or valve guiding means 47. One of these plates is provided for each valve, as is obvious from Figures 1 and 3.

These plates are secured to the body portion by means of screws as shown most clearly in Figure 1, and it is thus a very easy matter to assemble the device. The valves each directly engage and close the outer ends of the sleeves 42 of the cylinder, as shown in Figure 3, and thus a very large opening is provided circumferentially around the valve so that a quick discharge is afforded. In addition to this, the valve seats on this self-lubricating material.

The body portion is provided with an annular discharge chamber 48 which circumscribes the cylinders and which opens into an enlarged portion 49 communicating with the tank by means of the pipe 6, as shown in Figure 2. Thus a common annular discharge passageway is provided in the body portion of the compressor itself into which each radially disposed cylinder discharges.

The inlet for each of the cylinders is provided by means of one or more apertures 50 which are drilled downwardly through the cylinder wall, as shown in Figures 2 and 3. These apertures communicate with an annular intake passageway 51 and if desired, the annular passageway 51 may open into the small segmental passages or spaces 52 between the cylinders. The annular passageway 51 is provided with a removable annular filtering pad or member 53 preferably supported by a gauze screen 54.

The inlet chamber of the air compressor is thus completely separated off from the motor by means of the transverse wall 24. This inlet portion receives air from the outside through apertures 55 formed in the bottom part of the tank and partly in the shouldered portion 56 of the air compressor. The bottom wall of the tank indicated at 57 is spaced upwardly, as shown in Figure 2, and thus forms jointly with the compressor an inlet chamber communicating freely through the relatively large extensive area of the annular intake passage 51 with the cylinders. The filtering pad or member 53 thus presents a very extensive surface to the air entering the cylinders, although the actual apertures leading to the cylinders may be relatively much smaller as indicated. Thus there is no material restriction to the free air flow to the cylinders.

The bottom portion of the tank fits over the shoulder part 56 of the compressor unit and is

looked thereto by means of screws 58, see Figure 2, so that the tank is freely removable.

It is to be understood that other forms of valves may be used. For example, as shown in Figure 5, the valve cap 59 may be provided with a ball valve 60 pressed inwardly by means of a spring 61 carried by a removable caplike member 62. This valve may seat and close an aperture 63 leading into the cylinder, and discharge apertures 64 may be provided as shown in Figure 5. It is preferable, in the event this type of valve is used, to provide a small gasket 65 for each valve cap.

The upper portion of the tank carries a pressure responsive automatic switch indicated generally at 66 in Figure 4 and connected to the motor through the medium of the cable 67. This cable extends outwardly above the top 68 of the tank through an aperture in the side wall and is covered by an ornamental metal conduit 69 rigidly secured to the tank, see Figures 1 and 4. This conduit extends downwardly and carries a plug or other member 70 which fits a complementary member 71 supported from an enlargement 72 formed on the ornamental bottom or base portion 4. Thus when the tank is removed, it is obvious that no thought need be given the wiring as the tank and the rigidly attached member 70 may be lifted directly from the compressor and may be replaced, thus reestablishing the motor circuit.

The top of the tank also carries a reducing valve 73, see Figure 4, controlled by a knob 74 projecting through the cap. It is also preferable to provide the automatic pressure responsive switch 66 with a manual cut-off 75 which projects through the top of the cover 5, as shown in Figure 1. Also it is preferable to provide a gauge 76 for indicating the pressure within the tank and a gauge 77 communicating with the discharge pipe 78 so that the reduced pressure may also be read.

It will be seen particularly from Figure 1 that the tank merges uniformly into the cap 5 at the upper end and at the lower end the compressor and motor unit and supporting base form, in effect, a continuation of the tank so that there are no exposed operating parts on the one hand, and, on the other hand, so that a very compact and ornamental structure results.

It is to be particularly noted that the tank may be most easily removed from the rest of the apparatus by merely loosening one of the fittings, for instance the fitting 8, see Figure 1, and removing the screws 58, see Figure 2, which hold the tank to the compressor unit. Thereafter the tank may be lifted directly from the base portion of the device.

However, the apparatus is so made that no attention whatsoever is required for a great length of time. All of the parts of the compressor are oilless and require no attention whatsoever. Also the motor is supported by ball bearings and if desired, these bearings may be packed with grease, though obviously this is not necessarily required. The lower bearing 14, see Figure 2, which supports the weight of the motor, is easily accessible by merely removing the cap 79 and this bearing may be suitably lubricated.

It is to be noted particularly from reference to Figures 2 and 3, that the incoming air entering through the apertures 55 is filtered by the filtering pad 53 and passes into the cylinders through the apertures 50. It leaves the cylinders and enters the annular aperture 48, thereafter passing into the tank, preferably a check valve indicated generally at 80 in Figure 2 being provided. Par-

ticular emphasis is laid on the fact that the air does not come in contact with the oil or with any oil surface or bearing at any part in its passage either into or out of the air compressor. This feature is of particular importance, as has been explained in detail hereinbefore. Obviously this principle could be used with any number of cylinders, one or more as desired. Preferably, however, the cylinders are multiple, as shown in Figure 3, and are so arranged as to assist in the accurate balancing of the device.

The incoming air enters the respective cylinders when the pistons have been drawn to their inner position, as shown in Figure 2, as the ports or entrance apertures 50 are then uncovered. Thereafter on the compression stroke, the piston covers these openings and the air is discharged past the valve 44.

It is to be noted also that the heavy parts of the apparatus constitute the base, that is to say, the motor and the compressor unit. These heavy parts tend to stabilize the apparatus and the relatively lighter tank structure is supported therefrom. Obviously, vibration is not reinforced by the tank as would have been the case had the compressor and motor been supported by the tank. In actual practice this device has been found very quiet in operation and although of small size, it nevertheless is highly efficient and can deliver any required volume of air depending on the proportions of the device.

It is a portable apparatus, although if installed in taverns or similar places, it would be bolted down to its support, such, for example, as the bar, as the device itself is ornamental in appearance. It will be seen further that the apparatus is simple to manufacture and readily lends itself to quantity production.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

We claim:

1. An air compressor comprising an electric motor having a vertical shaft, an air compressor supported from and driven by said motor, a storage tank supported from and fed by said compressor, said motor, compressor and tank forming a unitary structure, pressure responsive automatic control means carried by said tank and controlling said motor, said motor and compressor being detachable from said tank and constituting a base structure, and interengaging detachable electrical connecting means carried by said tank and base structure and respectively connected to said control means and to said motor.

2. An air compressor comprising a unitary structure having an air storage tank, an air compressor including a rotary shaft, a body portion surrounding said shaft, a plurality of radially arranged cylinders in said body portion, pistons within said cylinders driven from said shaft, said body portion being located below said tank, and an electric motor mounted below said compressor and operatively coupled to said shaft, the axes of said tank, said body portion and said motor being in alignment, said electric motor being entirely enclosed within said unitary structure.

3. An air compressor comprising a unitary structure having a tank, an air compressor including a rotary shaft, a body portion surrounding said shaft, a plurality of radially arranged cylinders in said body portion, pistons within said cylinders driven from said shaft, said body portion

being located below said tank, and a motor mounted below said compressor and operatively coupled to said shaft, the axes of said tank, said body portion and said motor being in alignment, said tank, said body portion and said motor having external surfaces which approximately align to form a vertical, approximately cylindrical structure.

4. An air compressor comprising a unitary structure including an electric motor, an air compressor supported by said motor and driven by said motor and having a suction compartment, at least one of each relatively movable portion of said air compressor being formed of a material that does not require oiling, a transverse division wall separating said air compressor from said motor and constituting one wall of said suction compartment, and a storage tank supported from said air compressor, the inlet to said suction compartment being located above said compressor.

5. An air compressor comprising a storage tank, an air compressor supporting said tank, an electric motor supporting said air compressor and operatively coupled thereto, a pressure responsive electrical means carried on top of said tank and controlling said motor, and a cover for said electrical means, said cover, tank, compressor, and motor forming a substantially cylindrical, vertical unitary structure and providing a substantially continuous vertical, cylindrical side wall for the entire structure.

6. An air compressor comprising a body portion having a plurality of radial cylinders, pistons in said cylinders, and a centrally arranged crank for reciprocating said pistons, said body portion having an annular inlet portion provided with a ring of filtering material and having apertures extending from the annular portion into said cylinders and uncovered by the respective pistons when said pistons are at one extreme limit of their stroke.

7. An air compressor comprising a body portion of approximately annular contour and having a plurality of radially arranged cylinders, said body portion having an annular outlet passageway surrounding said cylinders, valves for said cylinders opening into said annular passageway, said body portion having a second annular passageway constituting an inlet portion for said cylinders and having a plurality of apertures communicating with said last mentioned passageway and with the respective cylinders, said apertures being uncovered by the respective pistons when said pistons are at the inner limit of their strokes, and a centrally arranged crank for reciprocating said pistons.

8. An air compressor comprising a body portion of approximately annular contour and having a plurality of radially arranged cylinders, said body portion having an annular outlet passageway surrounding said cylinders, valves for said cylinders opening into said annular passageway, said body portion having a second annular passageway constituting an inlet portion for said cylinders and having a plurality of apertures communicating with said last mentioned passageway and with the respective cylinders, said apertures being uncovered by the respective pistons when said pistons are at the inner limit of their strokes, a centrally arranged crank for reciprocating said pistons, and an annular filtering pad carried within said last mentioned annular passageway.

9. An oil-free air compressor comprising a body portion having a plurality of radially arranged cylinders, each cylinder having a liner of self-lu-

bricating material, a piston positioned within each cylinder, a centrally arranged crank, means connecting said crank with said pistons, said means having articulated portions, said articulated portions being lined with a self-lubricating material, and a valve for each cylinder, said valves, in their open positions, being out of contact with said liners.

10. An air compressor comprising a body portion having a plurality of radially arranged cylinders, pistons mounted within said cylinders, a centrally arranged crank, an antifriction head mounted upon said crank and having annular spaced flanges, a piston rod constituting a distinct and separate unit from said head and rigidly locked to said head, and a plurality of piston rods connected to the remaining pistons and pivotally mounted between said overhanging flanges.

11. An air compressor comprising a body portion having a plurality of radially arranged cylinders, pistons mounted within said cylinders, a centrally arranged crank, an antifriction head mounted upon said crank and having annular spaced flanges, a piston rod constituting a distinct and separate unit from said head and rigidly locked to said head, and a plurality of piston rods connected to the remaining pistons and pivotally mounted between said overhanging flanges, the articulated ends of said piston rods being lined with a self-lubricating material.

12. An air compressor comprising an electric motor having a projecting driving shaft, an air compressor comprising a body portion supported directly by said motor and having a floating shaft slidably and operatively coupled to the free end of said driving shaft, said shaft having an overhanging crank thereon, a driving head mounted upon said crank, said body portion having a plurality of radially arranged cylinders, pistons mounted within said cylinders, piston rods connecting said driving head with said pistons, one of said rods constituting a master piston rod and being rigidly coupled to said driving head, the remainder of said piston rods being articulated with said head and their respective pistons, the articulated end of said piston rods being provided with liners formed of self-lubricating material, and pins passing through said liners and joining said head and the pistons to said piston rods.

13. An air compressor comprising a unitary structure including an air compressor unit having an annular body portion, an electric motor having an annular field structure directly bolted to said body portion and in axial alignment therewith, said electric motor having an armature and a driving shaft, said air compressor

having a floating shaft coupled to said driving shaft and having an overhanging crank, said body portion having a plurality of radially arranged cylinders, pistons within said cylinders operatively coupled to said crank, said body portion having openings extending outwardly and in alignment with said cylinders, valves located at each opening, and a valve guiding means closing each of said openings, said body portion having an annular passageway circumscribing said cylinders and into which said valves open.

14. An annular compressor unit comprising a ring-like body portion, a shaft centrally arranged and carried in a floating manner by said body portion and having an overhanging crank, a driving head carried by said crank, said body portion having a plurality of cylinders provided with liners and having openings in alignment with said cylinders closed by caps, valves guided by said caps and controlling the discharge of the said cylinders, pistons mounted within the cylinders and operatively coupled to the said driving head, said body portion having an annular passageway surrounding said cylinders and into which said valves open, said body portion having an annular inlet passageway provided with openings communicating with said cylinders and uncovered by said pistons when said pistons are at the inner end of their strokes, and filtering material carried within said annular inlet passageway.

15. An air compressor comprising a body portion having a plurality of cylinders, a shaft pivotally mounted within said body portion and having a crank, a head carried by said crank, said head having a groove formed therein, pistons within said cylinders, connecting rods joining said pistons and said head, at least one of said connecting rods having a pivot pin operatively connecting such rod and said head, said pivot pin having a notch formed therein registering with the groove formed in said head, and a locking pin carried jointly by said groove and said notch for locking said pivot pin to said head.

16. An air compressor comprising an electric motor having a vertical shaft, an air compressor unit supported and driven by said motor, and an air storage tank supported and fed by said compressor, said motor, compressor, and tank forming a unitary structure and each being substantially symmetrical about a vertical axis, said tank being complete in itself and having a closed bottom, said air compressor unit being a complete unit independent of said tank.

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