

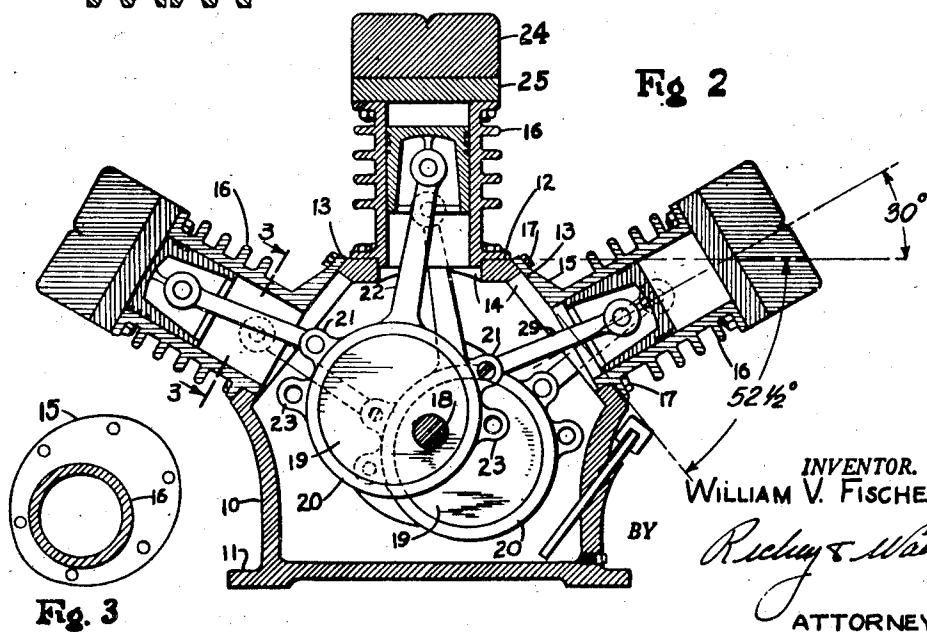
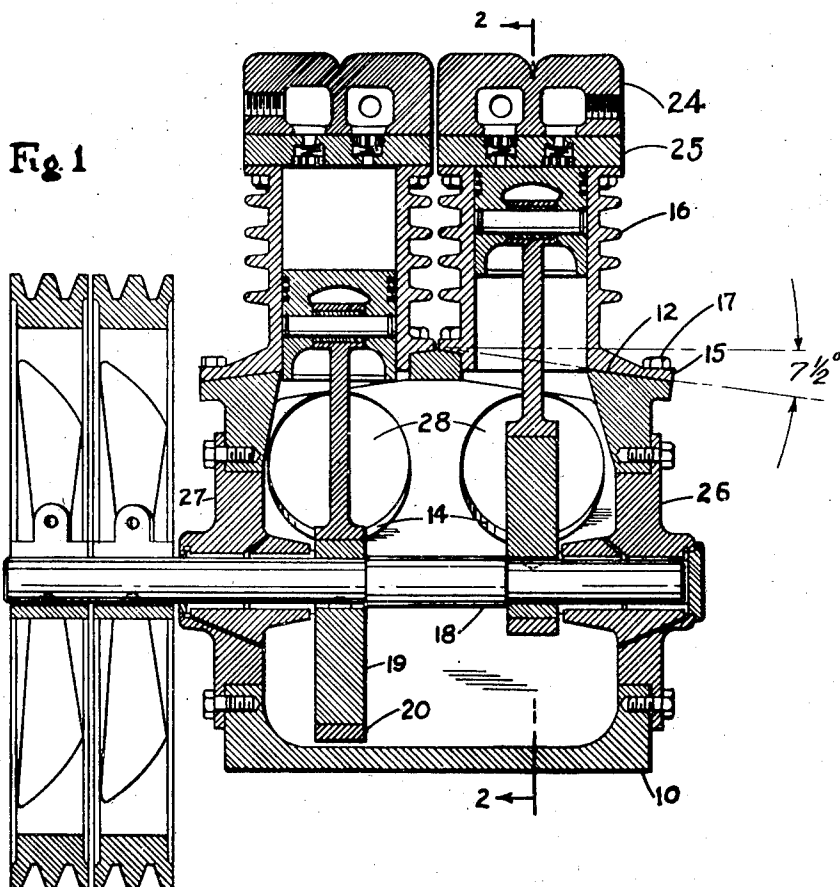
Nov. 23, 1948.

W. V. FISCHER  
COMPRESSOR

2,454,600

Filed Oct. 4, 1944

2 Sheets-Sheet 1



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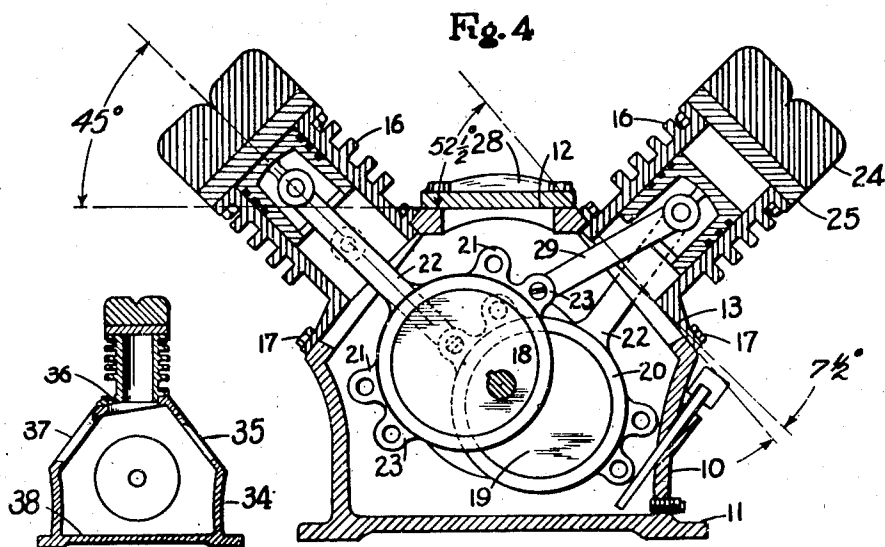


**Fig. 8**

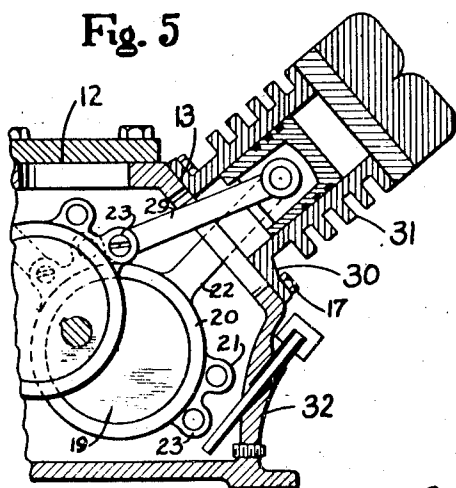
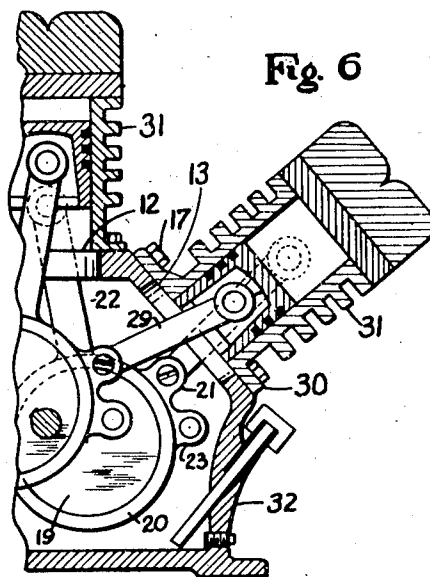
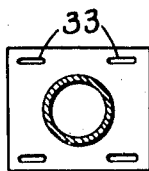


**Fig. 7**



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## UNITED STATES PATENT OFFICE

2,454,600

## COMPRESSOR

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Application October 4, 1944, Serial No. 557,161

8 Claims. (Cl. 230—172)

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This invention relates broadly to gas compressors and more specifically to improvements in the design and organization of certain of the parts thereof.

The invention further relates to improvements in the compressor described in my co-pending application entitled "Compressor pump," Serial No. 550,945, filed August 24, 1944, now issued as Patent No. 2,452,232.

A primary object of this invention is to provide a compressor embodying a plurality of interchangeable parts which are designed for modified aggroupment to produce either a two, four, or six cylinder machine with delivery rates proportionate to the number of cylinders.

Other objects and advantages of the invention reside in the economies realized by the purchaser of the improved compressor and the convenience attained in the conversion thereof to a machine of low, medium, or high volumetric delivery.

A further object is provided by the lower unit costs realized in the manufacture of standard parts adaptable for interchangeable usage in each of three sizes of compressors.

Other objects and advantages more or less ancillary to the foregoing and the manner in which all the various objects are realized will appear in the following description, which considered in connection with the accompanying drawings, sets forth the preferred embodiment of the invention.

Referring to the drawings:

Fig. 1 is a longitudinal sectional view of the improved air compressor showing the two-cylinder assembly;

Fig. 2 is a transverse section on line 2—2 in Fig. 1; but modified by the addition of two pairs of cylinders to form a six cylinder unit;

Fig. 3 is a transverse section on line 3—3 of Fig. 2 illustrating the offset relation of the cylinders and the mounting flanges thereof;

Fig. 4 is a view similar to Fig. 2 showing the arrangement of the parts when organized to produce a four cylinder compressor;

Fig. 5 is a transverse sectional view of a portion of a four cylinder compressor embodying modified forms of crankcase and cylinders;

Fig. 6 is similar to Fig. 5 illustrating the use of the modified form of cylinder in a six cylinder compressor;

Fig. 7 is a transverse section through a cylinder showing an alternate flange design; and

Fig. 8 is a transverse sectional view of a crankcase of further modified form with cylinders on the upper face thereof.

Referring first to Fig. 2, the compressor com-

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prises a crankcase 10 of prismoidal form with inclined sides in the upper portion thereof and a flanged mounting base 11. The upper face 12 of the crankcase is substantially parallel to the base 11, while the oblique or inclined faces 13—13 are disposed in transverse section at angles of 52½ degrees relative to the face 12. Elliptical openings 14 are provided in the faces 12 and 13—13 to accommodate the reception of elliptical mounting flanges 15 in the cylinders 16, each of which is identical in form and configuration. The cylinders 16 are secured to the crankcase by mounting bolts or studs 17 which engage bolt holes in the elliptical flanges 15. The elliptical openings 14 and the flanges of the cylinders on oblique faces 13—13 have their minor axes parallel to the longitudinal axis of the crankcase 10. The axes of the cylinders 16, however, are disposed normal to the minor axes of the ellipses of the flanges 15 and at 7½ degree angles from the normal to the major axes of said ellipses. Thus rotation of the cylinders through one hundred and eighty degrees will alter the position of the cylinder radially by fifteen degrees.

The cylinders are offset on the major axes of the elliptical mounting flanges 15 as shown in Fig. 3, the structure being designed to accommodate rotation of the cylinders in the manner heretofore described when mounted on faces 13—13 with the medial axes of the cylinders normal to the drive shaft 18.

From the foregoing it will readily be recognized that the cylinders 16, when mounted on faces 13—13, will be disposed at angles of 45 degrees or 30 degrees to the face 12 depending upon the rotational position of said cylinders, since the faces 13—13 are inclined at 52½ degree angles to the face 12 and the cylinder mounting flanges 15 are inclined at 7½ degree angles to a plane normal to the medial axis of the cylinders.

Referring now to Fig. 1, the upper face 12 of the crankcase 10 is formed in complementary configuration to the mounting flanges 15 to accommodate the securement of the cylinders 16 in perpendicular relation to said face. For this purpose the cylinders 16 are mounted on the upper face 12 in quarter-turned relation to the cylinders on faces 13—13 and the face 12 is inclined at 7½ degree angles from the center to the forward and rearward ends thereof.

The drive shaft 18 is machined for the keyed support of the cams 19 which transmit their rotary motion to the master connecting rod sleeves 20 journaled thereon. Each sleeve 20 is

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provided with a pair of apertured bosses 21 in equi-spaced relation with the master rod 22, for connecting articulate links as shown in the six cylinder compressor illustrated in Fig. 2. The sleeves 20 are further provided with a second pair of apertured bosses 23 for use in the four cylinder modification shown in Fig. 4. The two master rods 22 reciprocate in the upper or central cylinders in the two or the six cylinder compressor; however, in the four cylinder arrangement, one master rod 22 operates in each bank of cylinders as shown in Fig. 4.

The cylinder heads 24 and valve plates 25 are secured to the cylinders by symmetrically spaced studs allowing the rotative adjustment of parts to facilitate the connection of conduits.

When it is desired to double the capacity of the two cylinder compressor, two additional cylinder assemblies, including pistons and connecting rods, are employed. Access to the interior of the crankcase 10 is attained by removing the end bearing cover plates 26 and 27. The two vertically disposed cylinders are removed from the face 12 and installed together with two new cylinders on faces 13—13, the base portion thereof being arranged to position the cylinders at 45 degree angles to the face 12 and at 90 degree angles to each other. Two of the four cover plates 28 removed from faces 13—13 are then installed to close openings 14 in the upper face 12. The two master rods 22 and the articulate links 29 are then assembled in operative position as shown in Fig. 4.

Further increase in capacity is obtained by installing two additional cylinders on the upper face 12. To this end, the master rod and articulate links are repositioned to form the six cylinder compressor illustrated in Fig. 2, the four cylinders on the oblique faces 13—13 being rotated one half turn in such reassembly. The resulting compressor comprises three banks of cylinders defining angles of 60 degrees, each bank embodying two cylinders having the pistons therein disposed in opposed dead center relation (see Fig. 1). The use of an even number of opposed cams effectuates an equal distribution of compressive charges throughout each cycle of either the two, four, or six cylinder machine.

Referring now to Figs. 5 and 6 which illustrate a modification of cylinder design, the flange 30 on the cylinder 31 is disposed perpendicularly to the medial axis of said cylinder, and said cylinder is unequally spaced from the ends of said flange and from the holes for the bolts 17; thus rotation of the cylinder through an angle of 180 degrees will effect a translational change of position of the cylinder. In the four cylinder compressor the cylinders on the oblique faces 13—13 are positioned closer to the face 12 (Fig. 5) than they are in the six cylinder machine (Fig. 6). This provides operative clearance of the articulate links 29 with the bores of the cylinders 31 and also accommodates the ready interchangeability of parts. The upper face 12 of the modified crankcase 32 is a plane surface to accommodate the perpendicular mounting of the modified cylinders 31.

Fig. 7 is a view illustrating a modified cylinder flange. The slots 33 in the flange engage with the studs 17 on the faces of the compressor to accommodate the repositioning of the cylinders, said slots being disposed to locate the cylinders properly at the opposed limits of travel.

The compressor shown in Fig. 8 embodies a modified form of crankcase 34 having three adjacent faces on the upper portion thereof. The

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outer faces 35 and 37 are disposed at angles of 52½ degrees relative to base 38, and the intermediate face 36 is disposed at 7½ degrees to said base. The outer faces 35 and 37 function, as in the heretofore described preferred embodiment, to accommodate the support of the cylinders 16 in either a 45 or a 60 degree relation to the cylinders mounted on the intermediate face. Since the 7½ degree inclination of the intermediate face 36 conforms to the angle of the cylinder flanges, said cylinders may be mounted thereon in perpendicular relation to the base 38. This form of crankcase provides an intermediate face having a plane surface and thus simplifies the machining thereof.

The inherent advantage of a structure which facilitates the manufacture of three sizes of compressors (substantially three to one ratio of output) from assemblies of parts of identical typal form is obviously invaluable in an industry in which hundreds of varying sizes and types of compressors are catalogued at the present time. Moreover, the accessibility of parts, the ease of conversion of the machine from one size to another and the broad range of delivery output thereof inures by way of economy to the purchasers and users of such machines.

Although the foregoing description is necessarily of a detailed character, in order that the invention may be completely set forth, it is to be understood that the specific terminology is not intended to be restrictive or confining, and that various rearrangements of parts and modifications of detail may be resorted to without departing from the spirit or scope of the invention as herein claimed.

I claim:

1. A compressor embodying cylinders, pistons therein, mechanism for reciprocating said pistons, a housing having one face substantially horizontal, two oblique faces adjacent thereto disposed at 52½ degree angles to the horizontal, said oblique faces having transversely elongated openings therein, cylinders having mounting flanges thereon inclined at 7½ degree angles from planes normal to their medial axes for mounting said cylinders on said oblique faces at either 30 or 45 degree angles to the horizontal, said substantially horizontal face having openings therein, beveled surfaces adjacent said openings for mounting cylinders thereon, the cylinders being mounted on the housing, connecting links coupled with said pistons, and means in said reciprocating mechanism for mounting said connecting links to form an operative two cylinder compressor when cylinders are mounted on the substantially horizontal surface, a four cylinder compressor when cylinders are mounted on the oblique faces at 45 degree angles, or a six cylinder compressor when cylinders are mounted on the substantially horizontal face and on the oblique faces at 30 degree angles to the horizontal face.

2. An air compressor comprising a crankcase, a plurality of similar cylinders, flanges thereon having bolt holes therein arranged in a symmetrical pattern eccentric to the axes of the cylinders, one horizontal cylinder-receiving face on said crankcase, two oblique cylinder-receiving faces adjacent to said horizontal face disposed downwardly in angular relation thereto, cylinder supporting studs on said faces arranged in a symmetrical pattern to receive said cylinders, a drive shaft in said crankcase, eccentric cams thereon, sleeves journaled on said cams, pistons in said cylinders, connecting links intermediate said pistons and

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said sleeves, unequally spaced apertured bosses on said sleeves for the support of said connecting links in operative clearance with the bores of said cylinders when the eccentric cylinder flanges are mounted on said studs with the narrow portion of the flanges faced in one direction or in the opposed direction.

3. In a compressor, a plurality of similar cylinders formed with elongated flanges, a crankcase having a major axis and formed with three angularly disposed adjacent cylinder-receiving faces having oval openings therein for the reception of the flanges on said cylinders, the outer cylinder-receiving faces of said crankcase being disposed at angles of  $52\frac{1}{2}$  degrees to the line of intersection of a plane perpendicular to the major axis with the plane of the intermediate face, the openings in said intermediate cylinder-receiving face being elongated in the direction of the major axis of the crankcase, the openings in said outer faces being elongated transversely relative to the major axis of the crankcase, and means mounting the cylinders on the crankcase.

4. A compressor comprising a crankcase having a major axis, a plurality of cylinders thereon, pistons in said cylinders, mechanism for reciprocating said pistons, three adjacent cylinder-receiving faces on said crankcase, the outer faces of which are disposed at  $52\frac{1}{2}$  degree angles to the line of intersection of the intermediate face and a plane perpendicular to the major axis, said three faces having openings therein, flanges on said cylinders disposed at angles of  $7\frac{1}{2}$  degrees to planes perpendicular to the axes of the cylinders, whereby the cylinders may be mounted on said outer faces at either 120 or 90 degree angles to each other, said intermediate face of the crankcase being inclined at a  $7\frac{1}{2}$  degree angle to the major axis to accommodate the securement of the cylinder thereon in normal relation to the major axis of the crankcase, and means mounting the cylinders on the crankcase.

5. An air compressor comprising a plurality of similar cylinders, flanges thereon having bolt holes therein arranged in equi-spaced relation in a path eccentric to the axis of the cylinders, a crankcase for the support of said cylinders, cylinder receiving faces thereon disposed in approximately  $52\frac{1}{2}^\circ$  angular relation with each other, cylinder supporting studs therein disposed for engagement with the bolt holes in said flanges, a drive shaft in said crankcase, cams on said shaft, eccentric straps on said cams, pistons in said cylinders, connecting links intermediate said pistons and said straps, and means on said straps for the support of said links in operative position when said cylinders are mounted on said studs with the eccentrically disposed bolt holes arranged in alternate positions 180 degrees apart, whereby rotative adjustment of the cylinders through 180 degrees will effect chordal variations thereof for the support of a different number of cylinders and accommodate operative driving connections for the pistons therein.

6. In a reciprocating machine, a crankcase formed with three adjacent faces adapted to receive cylinders, the cylinder-receiving portions

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of the faces being disposed, with respect to the crankshaft axis of the crankcase and a reference plane containing the said axis as follows: the cylinder-receiving portion of the intermediate one of the faces substantially coinciding with a plane intersecting the reference plane at an angle of seven and one-half degrees in a line perpendicular to the axis, and the cylinder-receiving portions of the outer two faces substantially coinciding with planes intersecting the reference plane at angles of fifty-two and one-half degrees in lines parallel to the axis, and at least two cylinders formed with flanges disposed at an angle of approximately  $82\frac{1}{2}$  degrees to the cylinder axis mounted on the least two of the said cylinder receiving portions.

7. In a compressor, a plurality of cylinders, a crankcase therefor, said crankcase being formed with three faces intersecting at angles of approximately  $52\frac{1}{2}$  degrees relative to each other, said faces having openings therein, the intermediate face being inclined at an angle of  $7\frac{1}{2}$  degrees from its center to its ends, flanges on said cylinders inclined at  $7\frac{1}{2}$  degree angles to a transverse plane through said cylinders, said flanges conforming to said openings and being offset eccentric to the axes of said cylinders to provide for radial alignment of the cylinders in either of two positions on the two oblique faces, said flanges constituting means for securement of said cylinders to the crankcase when supported vertically on said center face or at 30 or 45 degree angles to the horizontal on the oblique faces of said crankcase, said cylinders being secured to said crankcase.

8. A crankcase for a reciprocating machine formed with three adjacent faces adapted to receive cylinders, the cylinder-receiving portions of the faces being disposed, with respect to the crankshaft axis of the crankcase and a reference plane containing the said axis as follows: the cylinder-receiving portion of the intermediate one of the faces substantially coinciding with a plane intersecting the reference plane at an angle of seven and one-half degrees in a line perpendicular to the axis, and the cylinder-receiving portions of the outer two faces substantially coinciding with planes intersecting the reference plane at angles of fifty-two and one-half degrees in lines parallel to the axis, and at least one cylinder formed with a flange disposed at an angle of approximately eighty-two and one-half degrees to the cylinder axis mounted on at least one of the said cylinder-receiving portions.

WILLIAM V. FISCHER.

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