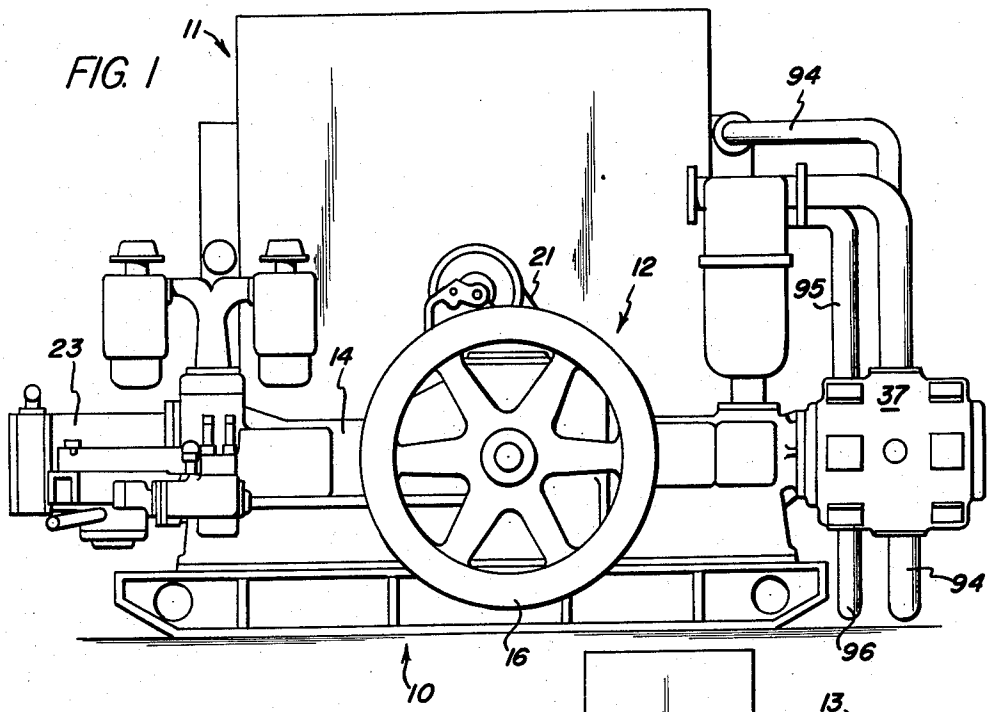
Oct. 4, 1960 H. G. MUELLER 2,954,918

COMBINATION ENGINE AND COMPRESSOR UNIT

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FIG. 1



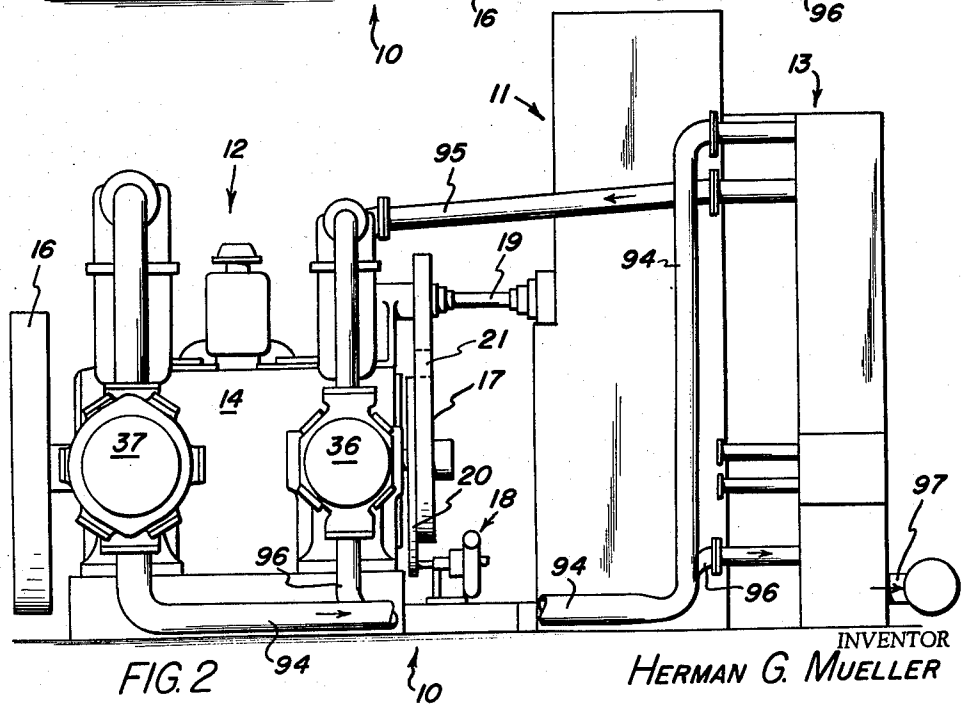


FIG. 2

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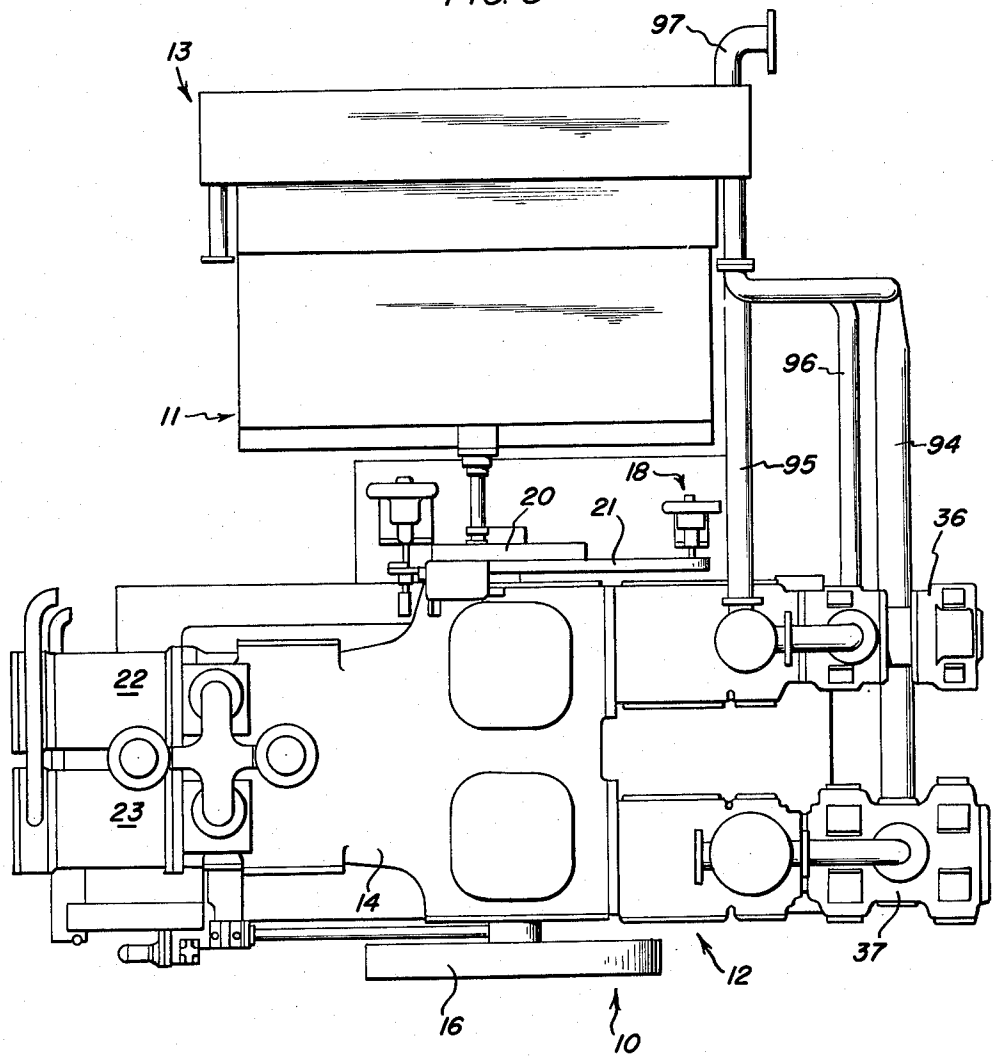
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COMBINATION ENGINE AND COMPRESSOR UNIT

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FIG. 3



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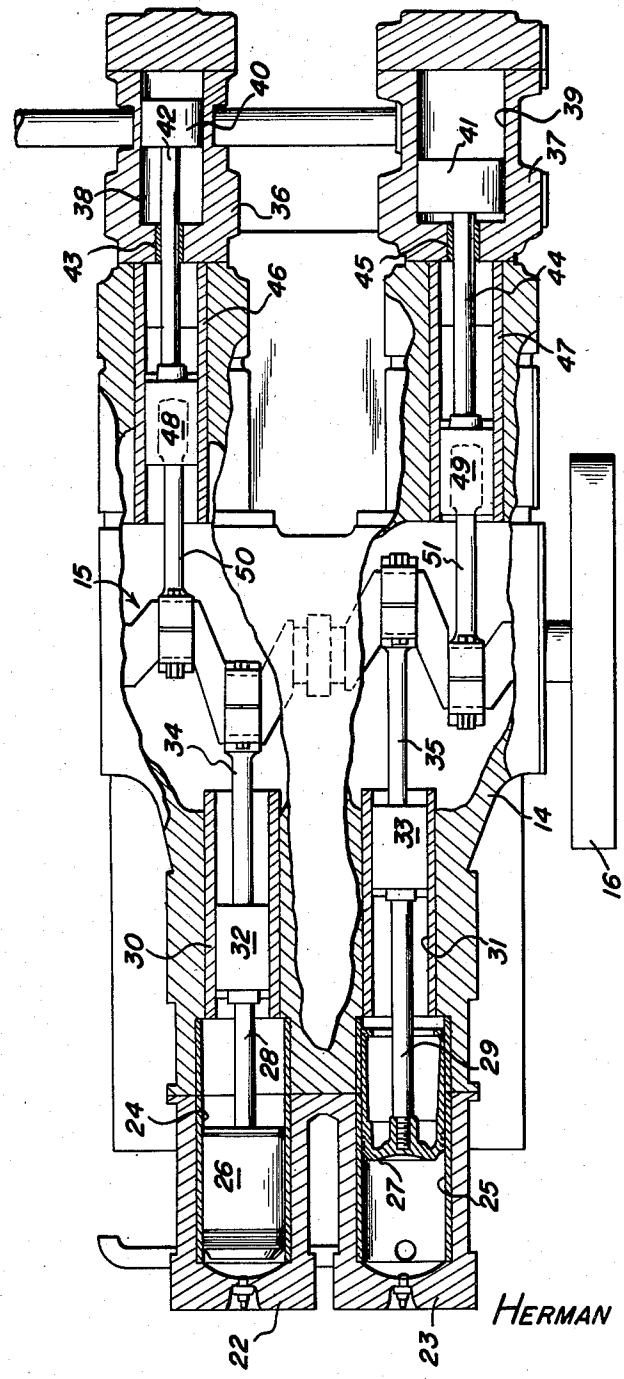
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COMBINATION ENGINE AND COMPRESSOR UNIT

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FIG. 4



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COMBINATION ENGINE AND COMPRESSOR UNIT

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FIG. 5

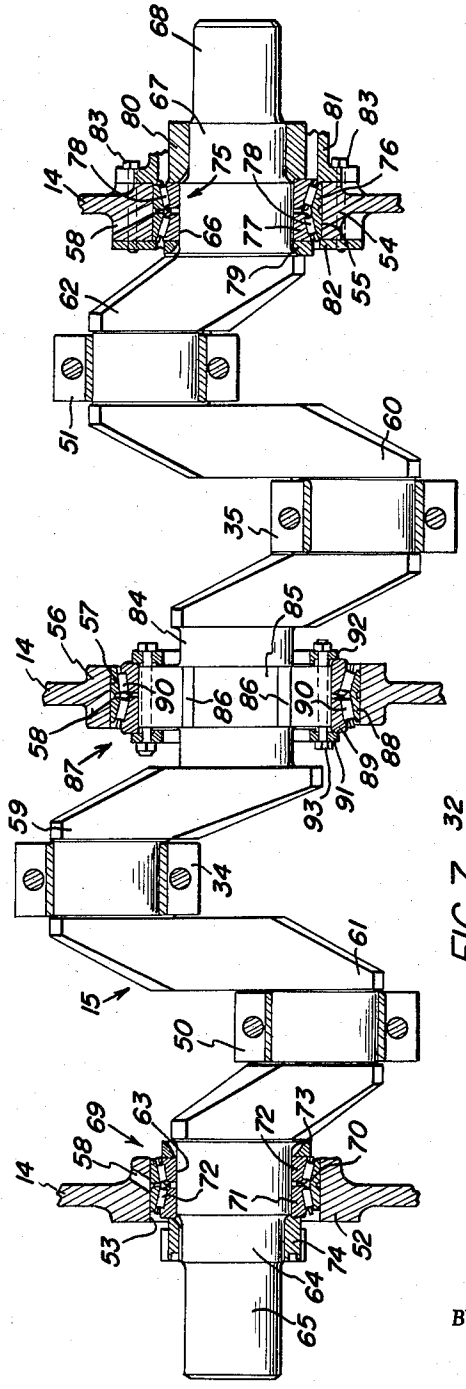


FIG. 6

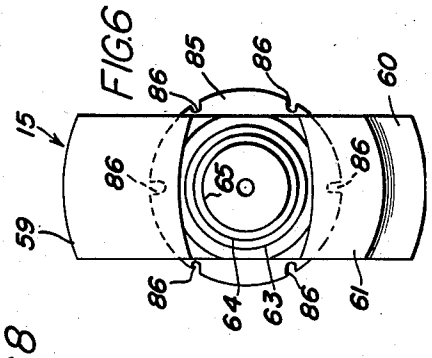


FIG. 8

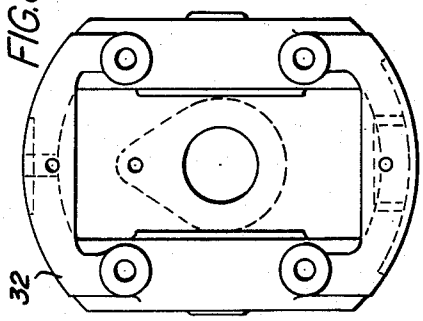
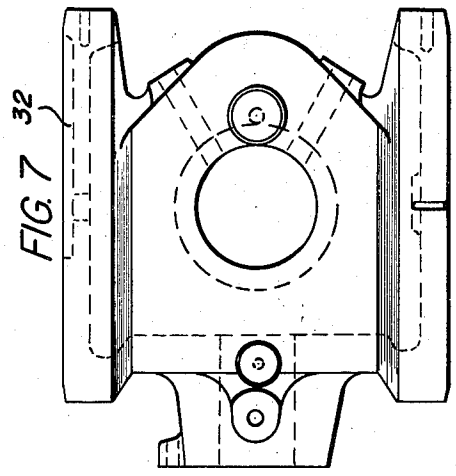


FIG. 7



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United States Patent Office

2,954,918

Patented Oct. 4, 1960

2,954,918

COMBINATION ENGINE AND COMPRESSOR UNIT

Herman G. Mueller, Erie, Pa., assignor to Ajax Iron Works, Corry, Pa.

Filed July 3, 1958, Ser. No. 746,513

1 Claim. (Cl. 230—56)

The present invention relates to a combination engine and compressor unit, and particularly to such a unit having a balanced relationship between the compressor cylinders on the one hand and the engine cylinders on the other.

The primary object of the invention is to provide a combination engine compressor unit wherein the compressor pistons have a substantially slower feet per minute linear speed than the engine pistons.

Another object of the invention is to provide a combined engine and compressor unit in which the compression piston throws are substantially shorter than the engine piston throws.

A further object of the invention is to provide a crankshaft structure for a combination engine compressor wherein roller bearings provide the main bearing support of the crankshaft.

A still further object of the invention is to provide a combination engine compressor wherein the engine pistons are arranged in counterbalanced relation and the compressor pistons are arranged in counterbalanced relation with each compressor piston arranged in counterbalanced relation to the adjacent engine piston.

A still further object of the invention is to provide a combination engine compressor of the class described above wherein the engine cylinders and the compressor cylinders are arranged in horizontal generally opposed relation.

Another object of the invention is to provide a combination engine compressor of the class described above which can be easily assembled, has a long service free life, and efficiently compresses gas with a minimum fuel consumption.

A further object of the invention is to provide a unit of the class described above wherein the reduced compressor piston speed permits easier lubrication thereof with a reduced wear factor of the type leading to overhauls.

Another object of the invention is to provide a unit of the instant type wherein the leverage of the engine piston with respect to the compressor piston is increased by reason of the difference in travel of the pistons.

Other objects and advantages will become apparent in the following specification when considered in the light of the attached drawings, in which:

Figure 1 is a side elevation of the invention.

Figure 2 is an end elevation of the invention.

Figure 3 is a top plan view of the invention.

Figure 4 is an enlarged fragmentary horizontal section through the engine and compressor cylinders shown partly broken away for convenience of illustration.

Figure 5 is a grossly enlarged detail side elevation of the crankshaft with the bearings shown in cross-section.

Figure 6 is an end elevation of the crankshaft removed from the engine.

Figure 7 is a side elevation of the crosshead.

Figure 8 is an end elevation of the crosshead.

Referring now to the drawings in detail wherein like reference characters indicate like parts throughout the several figures, the reference numeral 10 indicates generally a combination engine and compressor constructed in accordance with the invention.

The combination engine compressor 10 includes a heat exchange radiator 11 for cooling the water of the cooling system in the engine compressor unit 12. A compressed gas cooling heat exchanger indicated generally at 13 is provided for cooling the gas after compression before delivery to the point of use to remove the heat of compression therefrom.

The engine compressor unit 12 includes a block 14 having a crankshaft generally indicated at 15 mounted therein with a flywheel 16 secured to one end thereof. The opposite end of the chankshaft 15 carries a drive pulley 17 thereon by means of which a water pump generally indicated at 18 and a fan shaft 19 are driven by belts 20, 21, respectively.

The block 14 is provided with a pair of spaced apart parallel horizontal cylinders 22, 23 provided respectively with bores 24, 25. The cylinders 22, 23 are engine cylinders and are provided with pistons 26, 27, respectively, for reciprocation therein. A piston rod 28 extends inwardly from the piston 26, and a second piston rod 29 extends inwardly from the piston 27.

A crosshead guide 30 extends inwardly in aligned relation from the bore 24, and a second crosshead guide 31 extends inwardly in aligned relation from the bore 25. A crosshead 32 is secured to the piston rod 28 and is slidably arranged in the crosshead guide 30. A second crosshead 33 is secured to the piston rod 29 and is slidably arranged in the crosshead guide 31.

A connecting rod 34 extends inwardly from the crosshead 32 connecting the crosshead 32 to the crankshaft 15. A second connecting rod 35 extends inwardly from the crosshead 33 connecting the crosshead 33 with the crankshaft 15. The pistons 26, 27 are moved in the bores 24, 25 by explosions of natural gas or any other desired fuel in the normal manner.

The block 14 on the side thereof oppositely of the cylinders 22, 23 is provided with a pair of compressor cylinders 36, 37 arranged in horizontal spaced apart parallel relation. The compressor cylinders 36, 37 are spaced apart an amount somewhat greater than the spacing between the engine cylinders 22, 23, as can be best seen in Figure 4.

The compressor cylinders 36, 37 are provided with bores 38, 39, respectively, and have pistons 40, 41, respectively, slidably arranged therein. The piston 40 has a piston rod 42 secured thereto and extending inwardly therefrom through a compression seal 43 formed in the inner end of the cylinder 36. The piston 41 has a piston rod 44 secured thereto and extending inwardly therefrom through a compression seal 45 formed in the inner end of the cylinder 37.

The block 14 is provided with a compressor crosshead guide 46 arranged in aligned relation to the cylinder 36, and a second compressor crosshead guide 47 arranged in aligned relation with the cylinder 37. A crosshead 48 is slidably mounted in the crosshead guide 46 and is connected to the piston rod 42. A crosshead 49 is slidably mounted in the crosshead guide 47 and is connected to the piston rod 44. A connecting rod 50 extends between and connects the crosshead 48 to the crankshaft 15, and a second connecting rod 51 extends between and connects the crosshead 49 to the crankshaft 15.

In Figures 7 and 8, the crosshead 32 is illustrated in detail, however, it should be understood that the crossheads 33, 48, 49 are each constructed identically thereto.

The block 14 is provided with a forward main bearing support 52 having a cylindrical bore 53 therein. The block 14 is further provided with a rear main bearing

support 54 having a bore 55 extending therethrough. A central main bearing support 56 is formed in the block 14 intermediate the front and rear main bearing supports 52, 54, respectively, and is provided with a bore 57 of substantially larger diameter than the bores 53, 55. Each of the main bearing supports 52, 54, 56 are provided with oil ports 58 to permit the entry of oil into the bores 53, 55 and 57, respectively.

The crankshaft 15 is provided with a pair of oppositely disposed engine throws 59, 60, respectively, to which the connecting rods 34, 35 are respectively connected. The throws 59, 60 are arranged 180 degrees apart with respect to the circumferential spacing about the crankshaft 15 and are equispaced on opposite sides of the longitudinal center of the crankshaft 15. The throws 59, 60 extend radially outwardly from the axial center of the crankshaft 15 an equal amount.

The crankshaft 15 is provided with a compressor throw 61 between the engine throw 59 and the forward main bearing support 52. A second compressor throw 62 is provided on the crankshaft 15 intermediate the engine throw 60 and the rear main bearing support 54. The compressor throws 61, 62 are circumferentially spaced 180 degrees apart with respect to each other and are equispaced on opposite sides of the longitudinal center of the crankshaft 15. The compressor throw 61 is arranged 180 degrees apart from the engine throw 59 with respect to its circumferential spacing and the compressor throw 62 is arranged 180 degrees apart from the engine throw 60 with respect to its circumferential spacing. The connecting rod 50 is secured to the compressor throw 61 and the connecting rod 51 is secured to the compressor throw 62.

The crankshaft 15 is provided with a cylindrical portion 63 adjacent its forward end formed concentric with the axial center of the crankshaft 15. The cylindrical surface 63 has a relatively short reduced cylindrical step 64 formed forwardly thereof and a further reduced relatively long cylindrical step 65 formed on the forward end of the crankshaft 15. At its opposite end, the crankshaft 15 is provided with a cylindrical portion 66 formed concentric with the axial center of the crankshaft 15 and having a reduced step 67 extending outwardly therefrom. A further reduced step 68 is formed on the rear end of the crankshaft 15, as can be seen in Figure 5.

A roller bearing generally indicated at 69 provides the forward main bearing for the crankshaft 15 and has a double tapered outer race 70 mounted in the bore 53. A double tapered inner race 71 is engaged over the cylindrical portion 63 of the crankshaft 15 and a plurality of oppositely sloping roller bearings 72 are interposed between the outer race 70 and the inner race 71 in a conventional manner. The forward main bearing 69 is secured in position with respect to the crankshaft 15 by an inner retainer ring 73 engaging the inner end of the inner race 71 and a forward retainer ring 74 engaging the forward edge of the inner race 71 and secured to the step 64.

A roller bearing generally indicated at 75 serves as a rear main bearing for the crankshaft 15 and has a double taper outer race 76 supported in the bore 55 of the rear main bearing support 54. A double taper inner race 77 is supported on the cylindrical portion 66 of the crankshaft 15 and a plurality of oppositely sloping bearing rollers 78 are interposed between the outer race 76 and the inner race 77 in a conventional manner.

The inner race 77 is anchored to the crankshaft 15 by an inner retainer ring 79 engaging the inner end of the inner race 77 and a rear retainer ring 80 secured to the step 67 and engaging the rear edge of the inner retainer race 77. The outer race 76 is secured to the rear main bearing support 54 by a rear retainer ring 81 at a forward retainer ring 82 engaging respectively the rear and forward edges of the outer race 76 and secured together by a plurality of bolts 83 which extend through the rear main being support 54.

The crankshaft 15 is provided with a central cylindrical portion 84 formed coaxially with the axis of the crankshaft 15 and provided intermediate its opposite ends with a grossly enlarged cylindrical central main bearing boss 85. The main bearing boss 85 is provided with a plurality of longitudinally extending grooves 86, for reasons to be assigned.

A roller bearing generally indicated at 87 forms a center main bearing for the crankshaft 15 and is provided with a double taper outer race 88 supported in the bore 47 of the main bearing support 56. A double taper inner race 89 is mounted on the boss 85 and a plurality of oppositely sloped roller bearings 90 are interposed between the outer race 88 and the inner race 89 and secured therein by conventional means.

A pair of oppositely disposed retainer rings 91, 92 are arranged to engage opposite sides of the boss 85 and opposite sides of the inner race 89. A plurality of bolts 93 extend through the retainer rings 91, 92 and through the longitudinal grooves 86 in the boss 85 to secure the retainer rings 91, 92 in position to clamp the inner race 89 to the boss 85.

It should be noted that the inner diameter of the inner race 89 is sufficiently large to permit the bearing 87 to be moved from its central position over the throws 59, 61 or the throws 60, 62 to either end of the crankshaft in assemblying and disassemblying the crankshaft unit. The enlarged boss 85 provides a fixed seat for the inner race 89 and the construction of the forward main bearing 69 and its retainer rings as well as the construction of the rear main bearing 75 and its retainer rings supports the crankshaft 15 in fixed position against longitudinal movement as well as radial displacement.

A cylinder 37 is somewhat larger than the cylinder 36 and serves as a primary stage compressor feeding the compressed gas therefrom through a conduit 94 to the cooling heat exchanger 13. The cylinder 36 is somewhat smaller than the cylinder 37 and serves as a secondary compressing cylinder receiving compressed gas from the heat exchanger 13 through a conduit 95. Gas compressed in the secondary compressor 36 is returned to the heat exchanger 13 through a conduit 96 and after cooling is fed outwardly from the heat exchanger 13 through a conduit 97.

It should be understood that the heat exchanger 13 has an upper and lower section and the compressed gas from the cylinder 36 is cooled separately from the compressed gas from the cylinder 37.

The pistons 40, 41 in the cylinders 36, 37, respectively, are double acting and compress gas on their outward as well as their inward strokes.

It should be further noted that the stroke of the pistons 40, 41 is somewhat less than the stroke of the pistons 26, 27 due to the reduction in the size of the throws 61, 62 with respect to the throws 59, 60. The balanced relation of the throws 59, 60 with respect to each other, as well as the balanced relationship of the throws 61, 62 with relation to each other and with relation to the throws 59, 60 permits the use of compression strokes of a shorter length than the engine strokes without unbalancing the overall compressor engine combination.

The aforementioned difference in the strokes of the engine pistons 26, 27 with respect to the compressor pistons 40, 41 provides a reduced linear speed for the compressor pistons so as to reduce the wear, improve the lubrication, as well as increasing the efficiency of the compressor, all without reducing the engine speed or horsepower efficiency ratio.

While I have described the preferred embodiment of the invention, it should be understood that numerous structural modifications and adaptations may be resorted to without departing from the scope of the appended claim.

What is claimed is:

A combination compressor engine assembly comprising a generally horizontal block, a pair of spaced apart parallel engine cylinders secured to said block, a pair of spaced apart parallel compressor cylinders secured to said block, said compressor cylinders and said engine cylinders being disposed in a horizontal plane with said compressor cylinders extending from the side of said block opposite said engine cylinders, said compressor cylinders being spaced apart a substantially greater amount than said engine cylinders, a crankshaft mounted in said block having a plurality of throws with one of said throws being aligned with each of said cylinders, a piston in each of said cylinders, means connecting the piston in each of said cylinders to the throw of said crankshaft aligned therewith, the crankshaft throws aligned with said engine cylinders being disposed 180 degrees apart on said crankshaft and being disposed equidistantly on opposite sides of the longitudinal center of said crankshaft, said crankshaft throws aligned with said compressor cylinders being disposed 180 degrees apart on said crankshaft and disposed 180 degrees apart from the adjacent crankshaft throw aligned with one of said engine cylinders, the crankshaft throws aligned with said compressor cylinders being disposed equidistantly on opposite sides of the longitudinal center of said crankshaft, and means mounting said crankshaft in said block for rotation therein, the throws aligned with said compressor cylinders are substantially shorter than the throws aligned with said engine cylinders whereby said pistons in said compressor cylinders will have a substantially shorter stroke than the pistons in said engine cylinders, said means mounting said crank shaft in said block for rotation therein including a plurality of roller bearings detachably secured to said crankshaft and to said block, one of said roller bearings being positioned intermediate the opposite ends of said crankshaft, and having an internal diameter sufficiently large to permit the threading of said bearing over the throws of said crankshaft to assemble said bearing on said crankshaft.

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