July 24, 1928. 1,678,309

E. W. SWARTWOUT

STEAM ENGINE

Filed Dec. 18, 1918 3 Sheets-Sheet 1

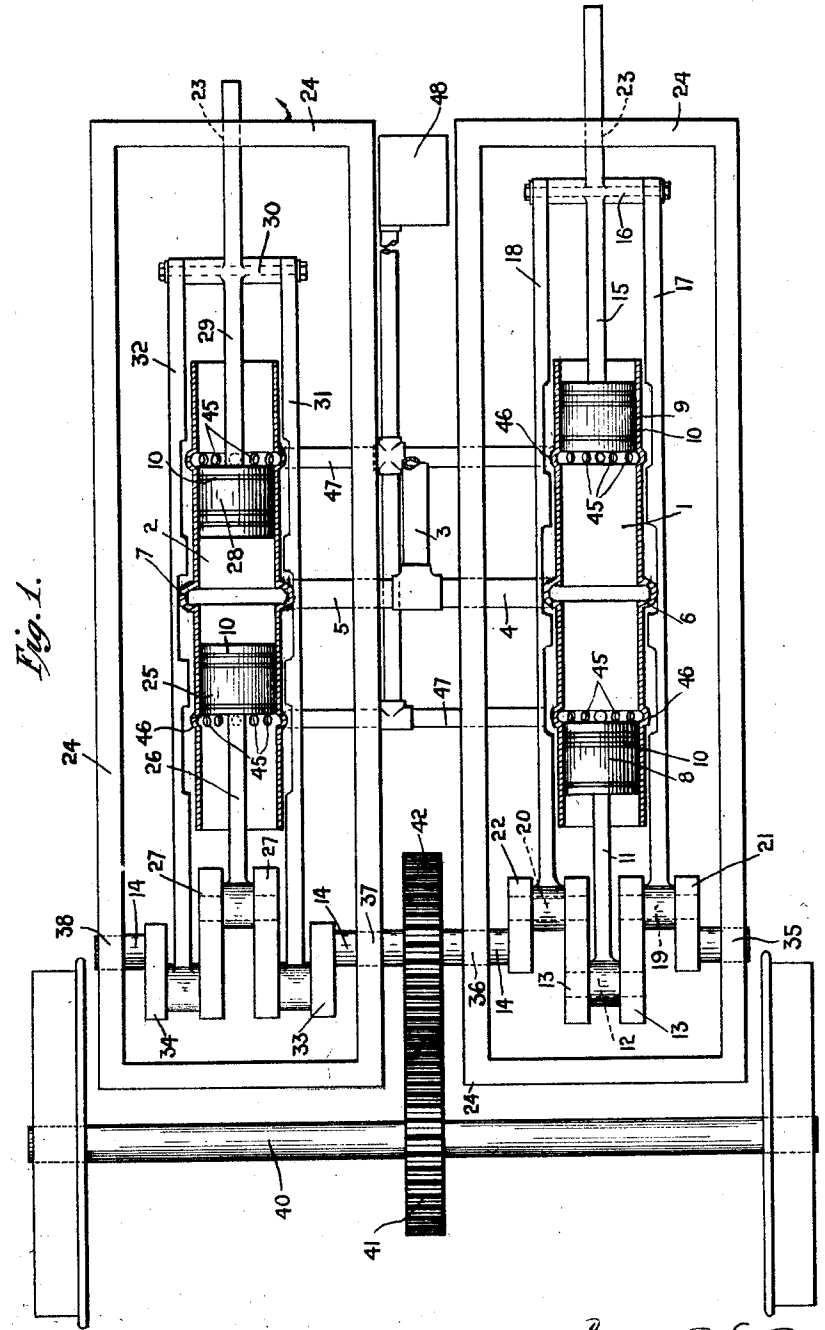

Fig. 1.

WITNESSES

INVENTOR
Everett W. Swartwout
BY
Henry J. Lucke
ATTORNEY

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E. W. SWARTWOUT

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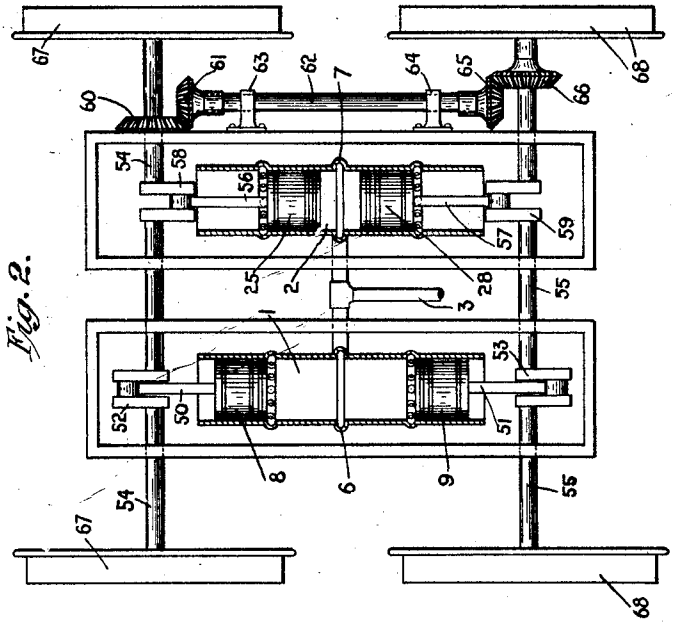

Fig. 2.

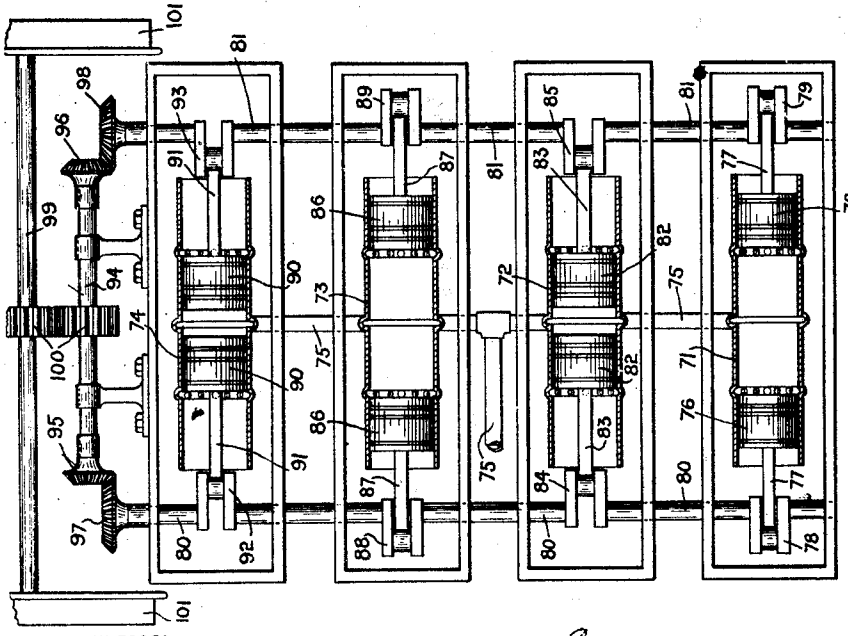

Fig. 3.

WITNESSES

INVENTOR

Everett W. Swartwout

BY

Henry J. Lucke

ATTORNEY

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Fig. 4.

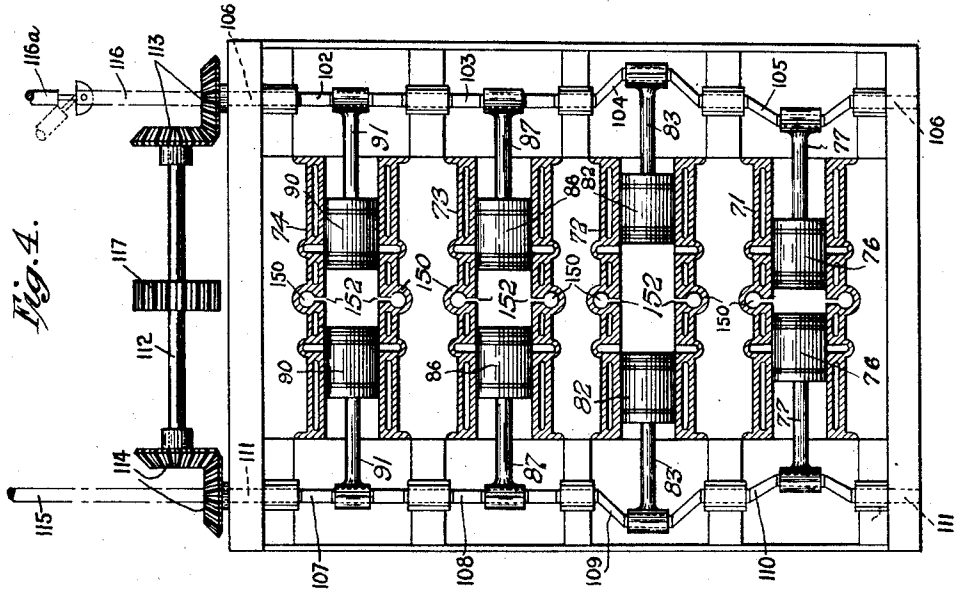
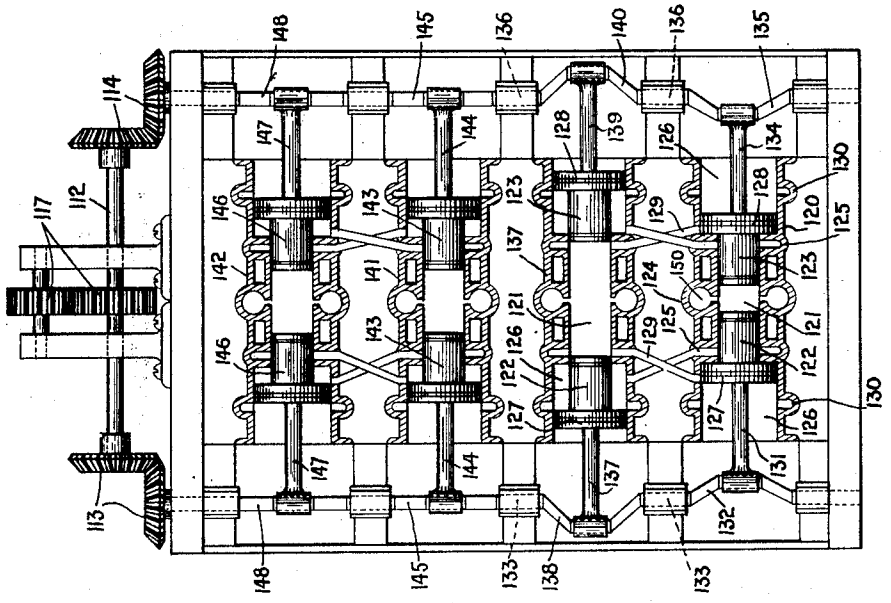


Fig. 5.



WITNESSES

INVENTOR

Everett W. Swartwout

BY

Henry J. Lueke

ATTORNEY

Patented July 24, 1928. 1,678,309

UNITED STATES PATENT OFFICE.

EVERETT W. SWARTWOUT, OF WHITE PLAINS, NEW YORK.

STEAM ENGINE.

Application filed December 18, 1918. Serial No. 267,228.

This invention relates to steam engines.

An object of the invention is to provide an improved construction and arrangement of a steam engine wherein the high temperature parts are protected from radiation to the atmosphere and thereby to reduce the heat losses. In one form of the invention, say, as applied to a uniflow type of engine, the inlet of the steam to the cylinder of the engine is arranged intermediate the ends of the cylinder and suitable exhaust ports disposed adjacent the ends of the cylinder, preferably without the provision of any head or other closure at the ends of the cylinder.

Pursuant to a preferred form of my invention, the engine comprises a plurality of cylinders, common means for leading the steam to substantially a central portion of each cylinder, a pair of pistons of the trunk type disposed in each cylinder, exhaust ports provided adjacent the opposite ends of each cylinder which are respectively covered and uncovered by the pistons of such cylinder for the regulation of the exhaust steam from such cylinder, a pair of shafts respectively driven by the pistons of such plurality of cylinders and means for synchronizing the rotation of such driven shafts.

Further features and objects of the invention will be more fully understood from the following description and the accompanying drawings, in which

Fig. 1 is a top plan diagrammatic view of a two-cylinder uniflow engine embodying my invention;

Fig. 2 is a horizontal section and partial plan diagrammatic view of a two cylinder uniflow engine, showing a modification of my invention as applied to a vehicle;

Fig. 3 is a horizontal section and partial plan diagrammatic view of a four cylinder uniflow engine, showing a further modification;

Fig. 4 is a horizontal section and partial plan view of a system of four cylinders having a further modification;

Fig. 5 is a horizontal section and partial plan view of a system of four cylinders provided with differential pistons, and shown arranged in compound relation.

The form of the invention shown in Fig. 1 comprises two cylinders driving a single crank shaft.

In the particular arrangement as shown, the cylinder 1 is arranged substantially parallel to the cylinder 2 and may be supplied with steam from a common source by means of the steam header 3 leading to the separate inflow pipes 4, 5. The steam admitted to the respective inlet belts 6, 7, is controlled by suitable valves respectively of the cylinders 1, 2, which may be operated with suitable variable cut-off means of any approved valve control mechanism.

In the cylinder 1 is provided the pair of pistons 8, 9, each preferably of the trunk type and having peripheral packing rings 10. The piston 8 is pivotally connected at one end to the connecting rod 11 whose opposite end is pivotally connected to the crank pin 12 of the crank arms 13 of the crank shaft 14. The piston 9 is similarly pivotally connected to one end of the connecting rod 15, carrying cross-head 16, the ends of which are respectively pivotally connected by the reach rods 17, 18 to the crank pins 19, 20 of the crank arms 21, 22 of the crank shaft 14. The rod 15 is suitably supported at its free end, as by suitably slidably mounting its free end in a suitable opening 23 in the bearing frame 24 as shown.

In a similar manner, the piston 25 of the cylinder 2 is connected by the connecting rod 26 with the pair of crank arms 27, 27 of the crank shaft 14 and the other piston 28 connected by the connecting rod 29 to the cross-head 30, in turn pivotally connected by the respective reach rods 31, 32, with the crank arms 33, 34, of the crank shaft 14.

The crank shaft 14 is mounted in suitable bearing journals 35, 36, 37, 38, which may be positioned in the frames 24, as indicated.

The driving shaft 14 is connected by any suitable means with any suitable driven means and in Fig. 1 I have indicated the driven means as a shaft 40 coupled to the driving shaft 14 by means of the intermeshing gears 41, 42, respectively fixed on the driven shaft 40 and the driving shaft 14. In the present embodiment I have shown the axle 40 of a self propelled vehicle, but it is obvious that the engine of my invention may be employed as a source of mechanical energy for any mechanism which it is desired to propel.

For the purpose of attaining substantially equal and distributed thrusts on the crank shaft 14, the pistons of the respective cylinders in a two cylinder system may be arranged in 180 angular degree relationship, in which relation at the instant of initial

diverging movement of the two pistons in any given cylinder, the two pistons of the other cylinder are in the position of initial converging movement, or, in general, during the stage of diverging movement of the two pistons of any cylinder, the pistons of the other cylinder are in the stage of converging movement.

It will further be noted that upon entry of the steam through the inlet belt, as indicated in cylinder 2 of Fig. 1, the piston 25 acts to rotate the crank arms 27 in clockwise, or anti-clockwise direction, as desired, whereas the other piston 28 exerts its turning movement on the crank shaft 14 through the respective reach rods 31, 32 acting on the crank arms 33, 34, each respectively disposed at 180 angular degrees from the crank arms 27. Upon the pistons attaining the extreme limit of their respective strokes, as indicated with respect to cylinder 1 by the positions of the pistons 8, 9, the exhaust ports 45 are uncovered by the respective pistons, to exhaust the steam into the exhaust belt 46. As shown, each exhaust belt 46 is disposed adjacent the end of the cylinder, and the exhaust belts of each cylinder or of both cylinders, as indicated diagrammatically in Fig. 1, may be connected to a common exhaust piping 47 leading to a condenser 48.

The embodiment of my invention as shown in Fig. 2, represents a simplified form as applied to a pair of shafts in general, and specifically to a plurality of axles of a self-propelled vehicle or other conveyance, as above stated.

Referring to Fig. 2, the cylinders 1, 2, are provided with substantially central inlet belts 6, 7, as aforesaid, supplied with steam by the common header 3, operated and controlled similarly as above stated. The pistons 8, 9 of the cylinder 1 are respectively connected by the connecting rods 50, 51, pivoted to the respective crank arms 52, 53 of the respective axles 54, 55. Similarly, the pistons 25, 28 of cylinder 2 are pivotally connected by the connecting rods 56, 57 with the crank arms 58, 59 respectively, of the axles 54, 55. For the purpose of synchronizing the axles 54, 55, I have provided one form of synchronizing means comprising intermediate gearing such as the gear 60 fixed to the axle 54 and meshing with the gear 61 fixed on the intermediate shaft 62, suitably mounted on the bearing brackets 63, 64, carried by the body or other fixed part of the vehicle and further comprising the gearing 65 fixed on the shaft 62 meshing with the gear 66 fixed on the axle 55. In the present embodiment, I have shown, as the form of mechanism to which the mechanical energy originated by the engine, is transmitted the wheels 67, 68, mounted on the respective axles 54, 55 of a self-propelled vehicle. In such two cylinder system, as indicated in Fig. 2, the respective crank arms 52, 58 of the shaft keyed in a well known manner to the respective shafts 54, and the crank arms 53, 59 are suitably fixed to the shaft 55 in 180 degrees angular relation.

In Fig. 3, I have indicated a four cylinder arrangement for power purposes of whatsoever character as may be desired. The four cylinders 71, 72, 73, 74, are each provided with inlet belts arranged respectively substantially centrally of each cylinder, and may be supplied with steam or other suitable medium maintained at substantially constant pressure by means of a common supply, (not shown) connected with the inlet piping 75. The pair of pistons 76, 76 of the cylinder 71 are connected by the connecting rods 77, 77, to the crank arms 78, 79 of the respective shafts 80, 81. Similarly, the pair of pistons 82, 82, of the cylinder 72 are connected by the connecting rods 83, 83 to the respective crank arms 84, 85 of the respective shafts 80, 81. Similarly, the pair of pistons 86, 86 of the cylinder 73 are connected by the connecting rods 87, 87 to the crank arms 88, 89 of the shafts 80, 81; and, lastly, the pair of pistons 90, 90 are similarly connected by the connecting rods 91, 91, to the respective crank arms 92, 93 of the shafts 80, 81. By suitably affixing the several crank arms in spaced relation to one another the pairs of pistons of the respective cylinders 71, 72, 73, 74 may be connected for such four cylinder system in 90 degree angular relationship, sequentially or staggered in the order named.

The shafts 80, 81 are synchronized by means of the intermediately connected gearing comprising the intermediate shaft 94 to which are fixed the gears 95, 96 respectively meshing with the gear 97 fixed on the shaft 80 and the gear 98 on the shaft 81.

The cylinders of the system are suitably mounted on a common base or other suitable support as diagrammatically indicated, and the shafts 80, 81 and 94 mounted in suitable bearings, as will be understood.

In Fig. 3 I have indicated the shaft 94 driving the driven shaft 99 through the gearing 100, which shaft 94 which in the present embodiment is shown as the axle of a self-propelled vehicle having the wheels 101, 101.

Fig. 4 indicates another embodiment of a multicylinder system of substantially duplicated construction in cylinder and operating parts, and normally operating under substantially uniform pressure conditions. The arrangement shown in Fig. 4 corresponds generally to that shown in Fig. 3, and like parts have been indicated by like reference numbers. However, in the arrangement shown in Fig. 4, the respective crank arms 102, 103, 104 and 105 of the primary shaft 106 are arranged in somewhat different angular relationship, the first two named being displaced from one another by 180 an-

gular degrees, the last two named being similarly displaced from one another by 180 angular degrees, but the first two named crank arms being displaced by 90 degrees respectively from the last two named crank arms. Similarly, the crank arms 107, 108, 109 and 110 are angularly arranged on the other primary shaft 111. The primary shafts 106, 111 are synchronized by means of the intermediate shaft 112 and the sets of intermeshing gears 113, 113 and 114, 114.

In the embodiment of my invention shown in Fig. 4, the mechanical energy is transmitted to the shaft 112. Mounted on this shaft is the gear wheel 117 which may be geared to any desired mechanism in a well known manner. The motion is also transmitted to the shafts 115, 116 for a similar purpose. The shaft 116 is diagrammatically shown coupled by a universal connection to a displaceable driven shaft 116ª.

In the arrangement shown in Fig. 5, the four cylinder system comprises two pairs of two cylinders, each pair of which may be connected in compound relation, as shown. In this embodiment of the invention, each cylinder comprises a set of high pressure pistons and a set of low pressure pistons. For the sake of simplicity, said two sets of pistons are respectively combined as integral units, functioning as differential pistons, i. e., a high pressure piston being connected to a low pressure piston, and the interior of the cylinder arranged of corresponding diameters to provide for the working chambers for the respective high and low pressure pistons.

Thus, the cylinder 120 comprises the substantially central chamber 121 constituting effectively two working chambers in which are disposed the pair of high pressure pistons 122, 123. The inlet belt of high pressure steam is indicated at 124 and the high pressure exhaust belts at 125. The working chambers 126 for the low pressure steam are disposed more closely adjacent the ends of the cylinder 120 in which working chambers 126 are respectively disposed the low pressure pistons 127, 128. The inlet belts of the low pressure chambers 126 are indicated at 129 respectively and the exhaust belts respectively indicated at 130.

As shown, each low pressure piston 127 may be directly connected to the high pressure piston 122, thereby deriving what may be termed a differential piston. One such differential piston 122—127 is connected by the connecting rod 131 to the crank arm 132 of the shaft 133. The other differential piston 123—128 is connected by the connecting rod 134 to the crank arm 135 of the shaft 136. The coacting cylinder 137 is constructed and arranged with similar high pressure and low pressure working chambers 121, 126 and similar sets of differential high pressure and low pressure pistons 122—127 and 123—128, each respectively connected by the connecting rod 137 to the crank arm 138 of the shaft 133 and by the connecting rod 139 to the crank arm 140 of the shaft 136. Such two cylinders 120, 137 form the two cylinder arrangement having the general characteristics of the hereinabove described arrangement shown in Fig. 1, but in addition and supplemental thereto may be arranged in compound relation, the effective two high pressure chambers of each cylinder being respectively interconnected with the two low pressure chambers of the other cylinder, and vice versa.

The cylinders 141, 142 are similarly constructed and arranged, the compound pistons 143 of the former being connected by the connecting rods 144 to the crank arms 145 and the compound pistons 146 being connected by the connecting rods 147 to the crank arms 148.

Whereas I have described my invention by reference to specific forms thereof, it will be understood that many changes and modifications may be made without departing from the spirit of the invention, as defined by the appended claims.

I claim:

1. A steam engine comprising a cylinder, means disposed intermediate the ends of said cylinder for solely the inflow of steam into said cylinder, a pair of elongated pistons operatively mounted within said cylinder, means disposed the adjacent ends of said cylinder for solely the exhaust of steam from said cylinder and arranged to be covered and uncovered by said pairs of pistons, rotating means operated by one of said pistons, rotating means operated by the other of said pistons and shaft means for operatively connecting and synchronizing said first-named rotative means with said second-named rotative means.

2. A steam engine comprising a cylinder, means disposed intermediate the ends of said cylinder for solely the inflow of steam into said cylinder, a pair of elongated pistons operatively mounted within said cylinder, means disposed adjacent one end of said cylinder for solely the exhaust of steam from said cylinder and arranged to be covered or uncovered by one of said pistons, means disposed adjacent the opposite end of said cylinder for solely the exhaust of steam from said cylinder and arranged to be covered and uncovered by the other of said pistons, a shaft driven by one of said pistons and means associated with said shaft for synchronizing said other piston with said one piston.

3. The combination with a supply of a medium supplied at substantially constant pressure, of a cylinder, a pair of pistons disposed in said cylinder in sealing relation

with the interior of said cylinder, admission means leading to a substantially central portion of the interior of said cylinder, exhaust means disposed respectively adjacent the opposite ends of said cylinder, a set of shafts actuated respectively by said pistons and means for synchronizing said shafts.

4. The combination with a source of medium supplied at substantially constant pressure, of a plurality of cylinders, each cylinder comprising a pair of pistons disposed in sealing relation with the interior of said cylinder, admission means leading to a substantially central portion of the interior of said cylinder and exhaust means each comprising a plurality of circularly arranged ports disposed respectively adjacent the opposite end of said cylinder, a set of shafts operated by said pairs of pistons and comprising crank arms related in angular degrees equal to the quotient of 360 degrees divided by the number of said cylinders and means for synchronizing said shafts.

5. A steam engine comprising a cylinder, a pair of pistons mounted within said cylinder, steam admission means leading to a central portion of the interior of said cylinder and steam exhaust means for each of said pistons, respectively and arranged to be covered and uncovered by said pistons respectively, said steam admission means comprising a space disposed laterally of the interior of said cylinder and serving as a clearance for said cylinder.

6. The combination with a supply of a compressed medium, of a cylinder, a pair of pistons disposed in said cylinder in sealing relation with the interior of said cylinder, admission means leading to a substantially central portion of the interior of said cylinder for the admission of the compressed medium thereto, exhaust means disposed respectively adjacent the opposite ends of said cylinder and synchronizing means for effecting the simultaneous movement of said pistons in opposite directions within said cylinder.

7. In an engine actuated by a compressed medium, the combination of a plurality of cylinders, each cylinder being provided with a pair of pistons, admission means for each cylinder leading to a substantially central portion of the interior of the cylinder, exhaust means for each cylinder disposed respectively adjacent the opposite ends of the cylinder, and synchronizing means for effecting the simultaneous movement of each pair of pistons in the respective cylinders in opposite directions.

In testimony whereof, I have signed this specification this 9th day of December, 1918.

EVERETT W. SWARTWOUT.