Oct. 22, 1929. C. B. REDRUP 1,732,659

INTERNAL COMBUSTION AND OTHER ENGINE , PUMP , AND THE LIKE

Filed May 4, 1925 3 Sheets-Sheet 1

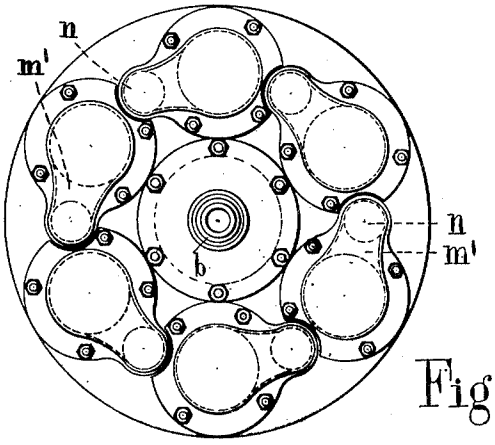


Fig. 1.

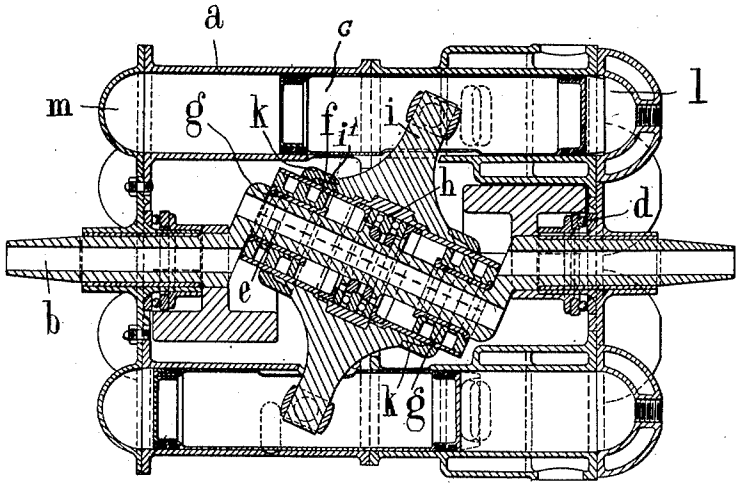


Fig. 2.

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INTERNAL COMBUSTION AND OTHER ENGINE , PUMP , AND THE LIKE

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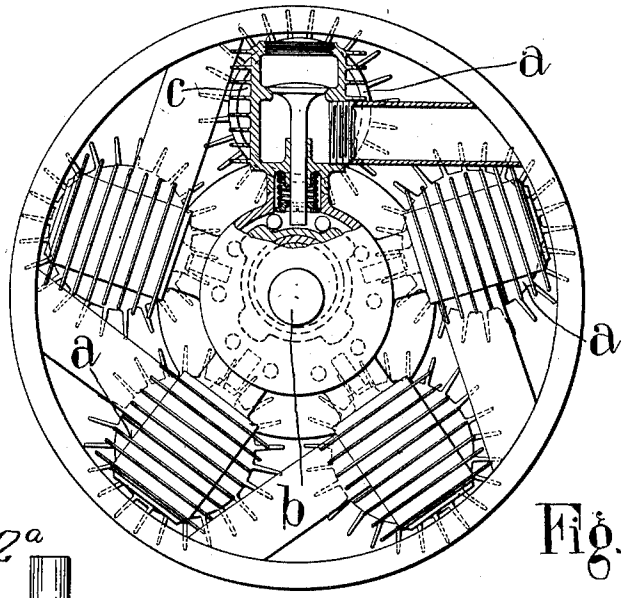
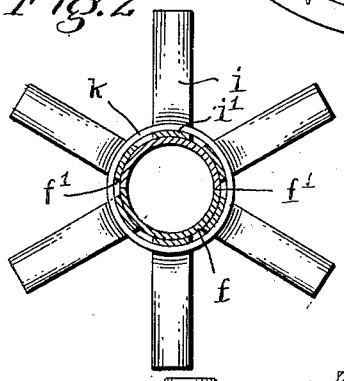


Fig. 6.

Fig. 2a



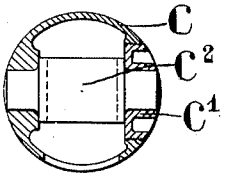
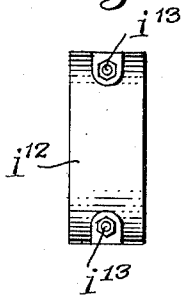


Fig. 3.

Fig. 9.



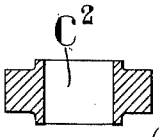


Fig. 5.

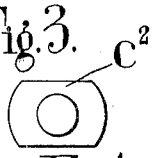


Fig. 4.

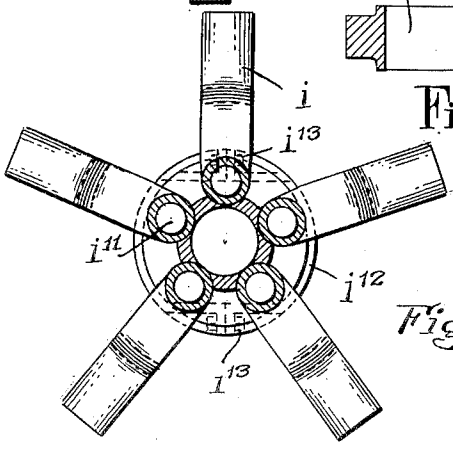


Fig. 8.

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INTERNAL COMBUSTION AND OTHER ENGINES, PUMPS, AND THE LIKE

Filed May 4, 1925 3 Sheets-Sheet 3

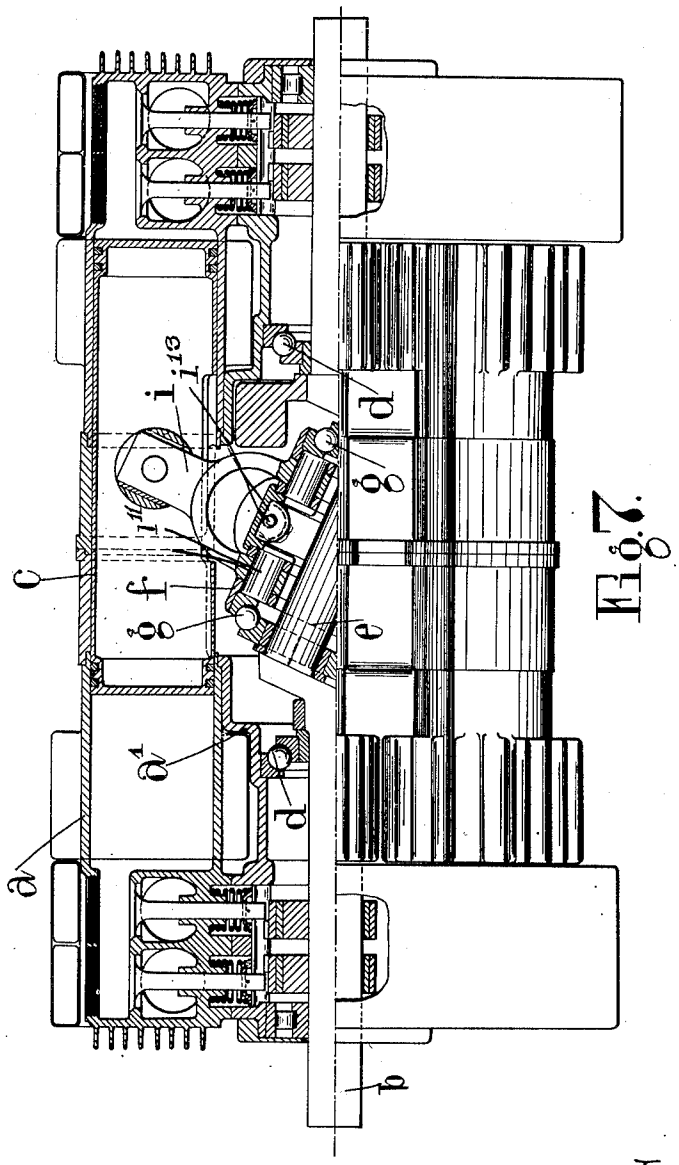


Fig. 2.

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UNITED STATES PATENT OFFICE

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INTERNAL-COMBUSTION AND OTHER ENGINE, PUMP, AND THE LIKE

Application filed May 4, 1925, Serial No. 27,957, and in Great Britain May 9, 1924.

This invention relates to internal combustion and other engines, pumps, and the like of the axial type, that is, of the type comprising a plurality of cylinders forming or secured to a casing in which is housed a crank shaft parallel with the axes of the cylinders and arranged concentrically therein, and a plurality of arms carried upon an inclined crank pin on the crank shaft and connected to the pistons within the cylinders.

The object of the present invention is to provide improvements in the construction and arrangement of engines and the like of the above character, and the invention consists in an internal combustion or other engine, pump, or the like of the type referred to in which each piston is connected to an arm, the arms being individually mounted so that each individually is movable in its own plane circumferentially about the crank pin but is rigidly held in the longitudinal direction of the crank pin, this arrangement having the advantage of relieving the arms of all lateral stress and enabling a simple and substantial connection to be made between the arm and its piston while at the same time a very large diameter of arm in proportion to the diameter of piston may be employed.

The accompanying drawings illustrate two modes of carrying out the invention.

Figure 1 is an end view of one form of engine constructed in accordance with the invention;

Figure 2 is a longitudinal sectional elevation;

Figure 2ª is a section through the boss of Figure 2 and removed from the crank pin.

Figures 3 to 5 are views illustrating details of the piston construction;

Figure 6 is an end view, partly in section, and with the end of one of the cylinders removed, of a modified form of engine in accordance with the invention, and

Figure 7 is a longitudinal elevation, half in section, of the engine shown in Figure 6.

Figure 8 is a section through the boss of Figure 7 removed from the crank pin.

Figure 9 is a detail view showing an inner split collar member shown in Figure 7 between the two pins by which the arms forming part of the crank mechanism are pivotally mounted.

In carrying my invention into effect in one convenient manner as, for example, in its application to the production of an internal combustion engine and as illustrated in Figures 1 to 5, I form my improved engine with a plurality of cylinders *a* arranged to form a casing surrounding a crank shaft *b* disposed within the casing so as to be parallel to the direction of movement of the pistons *c* within the cylinders, the crank shaft being carried in bearings *d* at the ends of the casing and having a crank pin *e*, the axis of which is inclined to the axis of the shaft.

Mounted upon the crank pin is a substantial boss *f* preferably divided by a longitudinal slit *f'* into two parts to facilitate assembling and having end bearings *g* and a central thrust bearing *h* and upon such boss I mount the reduced ends *i'* of a series of separate arms *i* or a star member, the arms being equal in number to the number of cylinders and being equal in number to the number of cylinders and being so arranged as shown in Figure 2ª that while they are free to move circumferentially in relation to the boss they are rigidly held in the longitudinal direction thereof. This may be effected, for example, by arranging the arms or segmental portions of the star member to be retained in position by a ring nut *k* at each end of the boss, such ring nuts also serving to hold the two halves of the boss together.

In an alternative construction as shown in Figure 7 each arm may be mounted upon a hinge formed with pins arranged preferably at each end of the boss, one of the arms being made fast to the boss to prevent rolling and in general any construction which will permit of the radial movement of the arms to relieve them of lateral stresses and to prevent relative movement between the arms and piston may be adopted in accordance with the invention.

When the invention is applied to an internal combustion engine of, say, the two-stroke type as in Figures 1 to 5, the casing formed by the cylinders is preferably constructed in two parts to facilitate assemblage

and the cylinders are each provided at one end with a removable water-jacketed combustion head *l* and with a removable pump head *m* at the opposite end of the cylinder, each of such pump heads being provided with an extension *m'* (Figure 1) at one side to communicate with a transfer pipe *n* located between the cylinders and leading to the inlet port of its appropriate cylinder.

Figures 3 to 5 show one convenient method of arranging for the insertion and removal of the gudgeon pin, each piston being for this purpose provided with a removable bush *c'* secured into a boss upon the piston and adapted to retain the gudgeon pin c^2 in position.

Figures 6 and 7 show a modified form of engine constructed on similar lines to the foregoing, and similar parts are denoted by the same reference letters.

In this construction, however, the cylinders do not in themselves form the casing, but are secured to a stepped conical casing *a'* and may be air or water cooled, such construction being especially suitable for light engines such as aircraft engines. Further, the crank shaft and star member are mounted on ball bearings and mechanically operated inlet and exhaust valves are employed in place of the piston controlled ports of the first modification and, moreover, the engine shown is a 10-cylinder engine, each cylinder acting alternately as a working cylinder and as a pump.

Referring to Figures 7, 8 and 9 it will be seen that the hub assembly is made up of two grooved rings with extended sleeves enveloping the races for the balls *g* and the arrangement is such that first the grooved rings are threaded over the shaft and then the races for the balls *g* with the split bushes within the outer races are assembled on the shaft ends whereupon the arms *i* are secured in position by means of pins i^{11} which are inserted from the inside. Subsequently the split collar i^{12} is mounted upon the crank pin between the grooved rings to which the arms *i* are pivoted and is tightened up by the bolts i^{13}.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In an internal combustion engine or other engine pump or the like, a crank shaft, a plurality of cylinders arranged circularly around said crank shaft with their axes parallel to the axis of said shaft, an inclined crank pin upon said shaft, a piston within each of said cylinders, an arm connected with each piston and means individually mounting said arms on said crank pin whereby each arm individually is slidably movable in its own plane circumferentially about the crank pin but is rigidly held against displacement in the longitudinal direction of the crank pin.

2. An internal combustion or other engine, pump, of the like according to claim 1 wherein said mounting means includes a two-part boss mounted upon said crank pin, said parts being joined along generating lines, and upon which the arms are mounted and friction reducing means interposed between said pin and said boss.

3. An internal combustion or other engine or pump according to claim 1 wherein said mounting means includes a two part boss mounted upon the crank pin on which boss the arms are mounted, and a ring nut at each end of said boss for holding the parts of the boss together and for retaining the arms in position.

In testimony whereof I have signed my name to this specification.

CHARLES BENJAMIN REDRUP.