Nov. 19, 1935. R. S. MOORE 2,021,262

INTERNAL COMBUSTION ENGINE

Filed Oct. 24, 1934 2 Sheets-Sheet 1

Fig. 1.

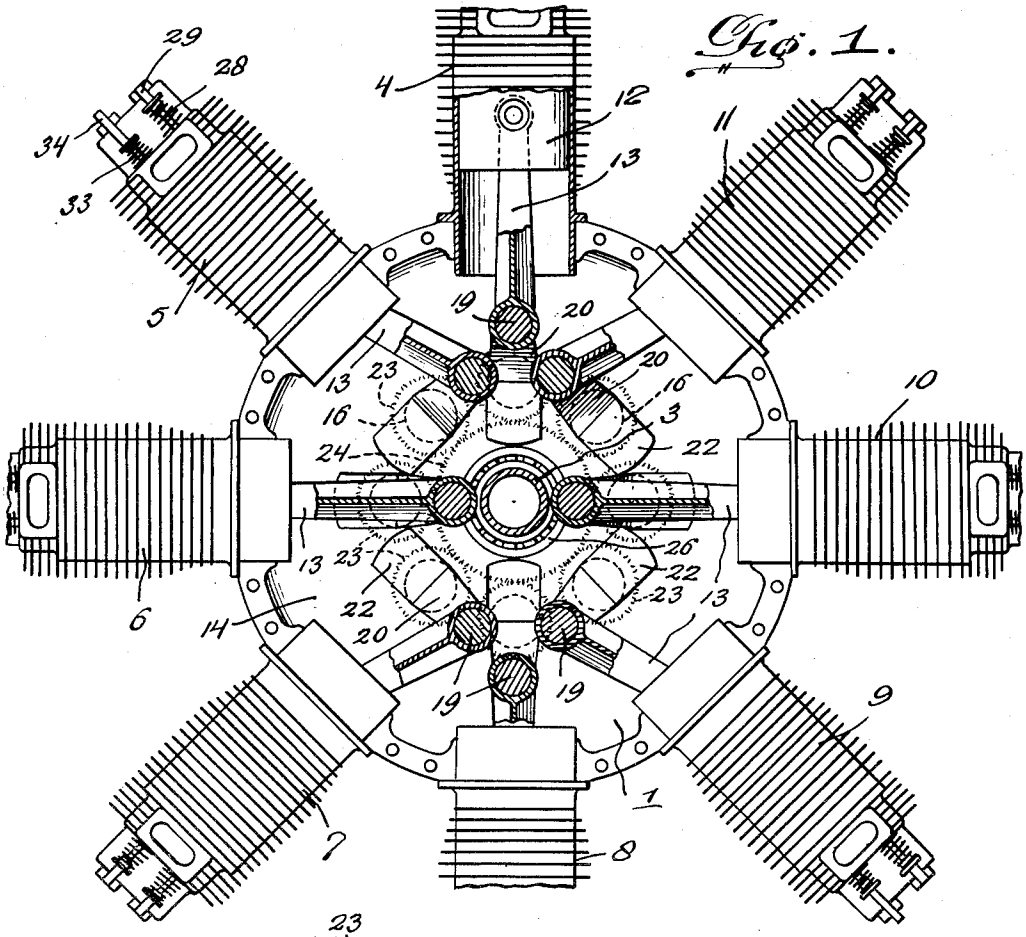
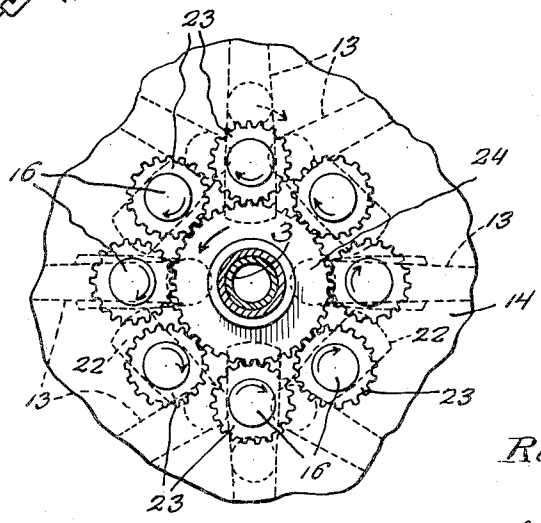


Fig. 3.



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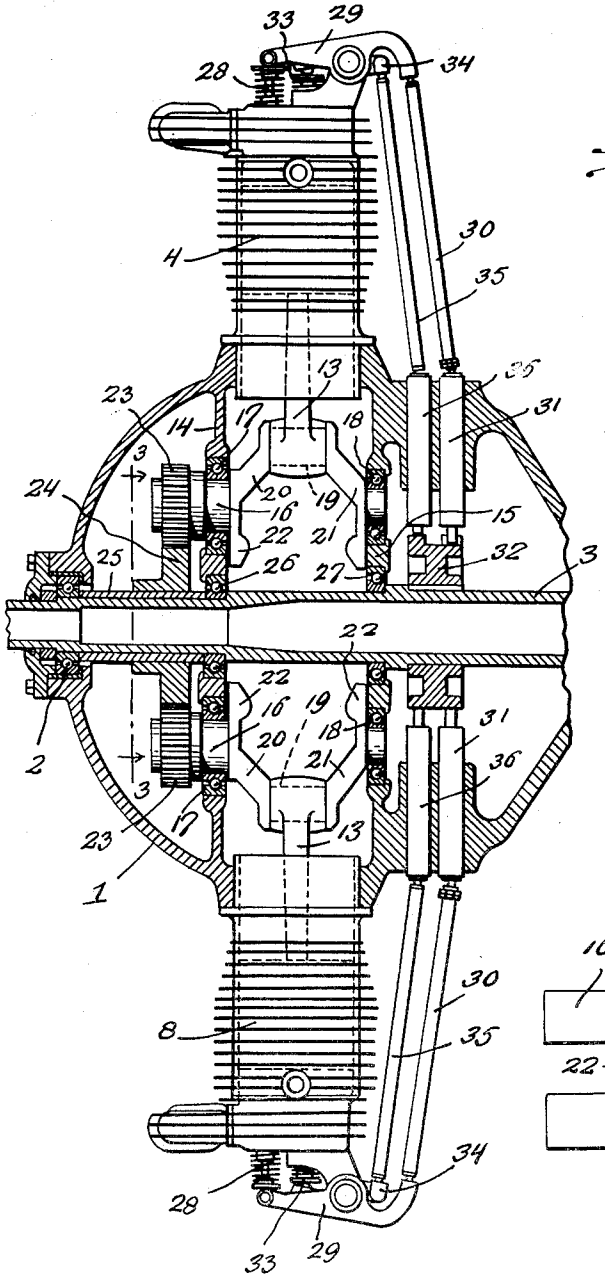


Fig. 2.

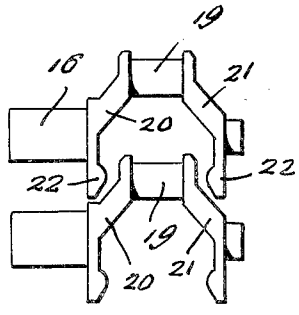


Fig. 4.

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Patented Nov. 19, 1935 2,021,262

UNITED STATES PATENT OFFICE

2,021,262

INTERNAL COMBUSTION ENGINE

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Application October 24, 1934, Serial No. 749,829

2 Claims. (Cl. 74—44)

The invention relates to new and useful improvements in an internal combustion engine, and more particularly to an engine wherein the cylinders are disposed radially to the main actuating shaft.

An object of the invention is to provide an engine of the above type having four or more cylinders wherein the operating parts for actuating the shaft are so constructed and arranged that the cylinders may be operated in a successive order.

A further object of the invention is to provide an engine of the above type wherein there is an auxiliary shaft associated with each cylinder and geared to the main actuating shaft for operating the same, and wherein the engine is so constructed that the auxiliary shafts may be placed relatively close to the center of the main actuating shaft and the cylinders operated in successive order without any interference between the operating cranks in the auxiliary shafts.

A still further object of the invention is to provide an engine of the above type wherein the cranks in the auxiliary shafts are so constructed and arranged that their paths of rotation overlap without interfering with one another.

In the drawings—

Figure 1 is a view partly in side elevation and partly in section showing an engine embodying the improvements;

Fig. 2 is a view partly in elevation and partly in vertical section through the engine, said section extending longitudinally of the actuating shaft;

Fig. 3 is a detail in side view showing the arrangement of the gears carried by the auxiliary shafts which impart rotation to the main actuating shaft, and

Fig. 4 is a detail showing adjacent cranks and the construction of the same which permits their paths of rotation to intersect without interference between the cranks.

The invention has to do with an internal combustion engine of the type wherein there is a central casing in which is mounted a main actuating shaft. Carried by this central casing is a plurality of radially disposed cylinders. As illustrated, there are eight cylinders. In each cylinder is a reciprocating piston to which the piston rod is connected, and associated with each cylinder is an auxiliary shaft mounted in suitable bearings carried by the casing. There is a gear carried by each auxiliary shaft, and the gears mesh with the gear carried by the main actuating shaft. The gears are preferably so timed that the main actuating shaft will rotate once for two rotations of the gears carried by the auxiliary shafts. In each auxiliary shaft is a crank to which the piston rod is connected. These cranks are so constructed that their paths of rotation may intersect. This enables the auxiliary shafts to be placed relatively close to the main actuating shaft, and transmitting gears of relatively small dimensions used. It also enables a relatively large number of cylinders to be used, the axes of which are all arranged in a single plane and without any conflict between the rotating cranks. Associated with each cylinder are valves and valve tappets, and these are operated from a cam on the main actuating shaft. A single cam may be used for all of the tappets, as the cylinders are fired in one, two, three order, that is, a successive order, and the shaft is rotated once for two reciprocations of the piston in each cylinder.

Referring more in detail to the drawings, the invention is shown as embodied in an internal combustion engine which includes a main crank casing 1 of any suitable design. It is shown in the drawings as having a bearing 2 at one side thereof through which extends the main actuating shaft 3. Mounted on the crank casing are eight cylinders, numbered respectively, 4, 5, 6, 7, 8, 9, 10 and 11. These cylinders are radially disposed, that is, their longitudinal axes intersect the axis of the main actuating shaft. These longitudinal axes of the several cylinders all lie in a single plane which cuts the actuating shaft at right angles. The cylinders may be mounted in any suitable way on the crank casing, and detail description thereof is not thought necessary. In each cylinder is a piston 12 and a piston rod 13 which is attached to the piston.

The crank casing is provided with webs 14 and 15. Mounted in suitable bearings in these webs is an auxiliary shaft 16, and there is an auxiliary shaft associated with each cylinder. The bearings for the auxiliary shaft are indicated at 17 and 18. The auxiliary shaft is provided with a crank which is of novel construction. The crank consists of a crank pin 19 which is carried by laterally spaced arms 20, 21 which are extended so as to provide counterbalancing members 22, 22. These arms are so constructed that the paths of reciprocation of the cranks may intersect without conflict between the cranks, if they are properly timed. In other words, as shown in Fig. 4, the lower crank pin 19 passes between

the arms 20 and 21 and the counterbalancing members 22, 22 without conflict therewith.

Each auxiliary shaft 16 carries a gear wheel 23, and these gear wheels of the auxiliary shaft mesh with a gear wheel 24 mounted on a sleeve 25 which is keyed to the main actuating shaft 3. These auxiliary gear wheels 23 are so dimensioned relative to the gear wheel 24 that each auxiliary gear wheel 23 rotates twice for each rotation of the gear wheel 24. Therefore, the main actuating shaft will be rotated once for two reciprocations of the pistons in each cylinder; in a four-cycle engine, it will rotate once for each firing of the cylinders, the cylinders being operated in one, two, three order, or in a successive order, as above noted.

In these webs 17 and 18 are also ball bearings 26 and 27 for the main actuating shaft. Associated with each cylinder are intake and exhaust ports. They are located in the head or outer end of the cylinder, and each port is controlled by a valve. As shown, there are two intake valves and one exhaust valve. The intake valves are indicated at 28. A rocket 29 is associated with the intake valves and is operated by a push rod 30 cooperating with a tappet 31 contacting with the control cam 32 carried by the main actuating shaft. A valve for the exhaust port is indicated at 33, and this is operated by a rocket 34 actuated by a push rod 35 and a tappet 36 which bears on the control cam 32. This control cam has one cam projection only which operates in succession for controlling the intake valves, and one projection operating in succession on the exhaust valve. The operating cam projection is so shaped that the intakes will be opened in proper timing for the suction stroke of the cylinders and the exhaust valve will be opened in proper timing for the exhausting of the burnt gases from the cylinders. This control cam operates in succession on the valves of the cylinders, or in a one, two, three order, so that each cylinder will operate in succession to receive, compress and fire its charge.

It will be noted that in the construction as shown in Fig. 1, the cylinders 4 and 8 are opposed to each other, and therefore, their cranks, when the cylinders are operated in succession, will be on their extreme throws away from the center of the casing at the same time, and they will likewise be on their extreme inner throws at the same time, as is evidenced by the piston of the cranks associated with the cylinders 6 and 10. It will also be noted that the cylinders 5 and 9 have their cranks midway between the extremes of its throw toward and away from the center of the casing, and the same is true of the cylinders 7 and 11. This provides a very efficient counterbalancing of all of the actuating parts, so that there is little or no resulting vibration incident to the reciprocating pistons; the pull or push of one piston is counterbalanced by the one which is diametrically opposed thereto.

As noted above, the auxiliary shafts are so disposed that the paths of rotation of the cranks intersect, and yet, there is no conflict between the cranks, as one crank passes between the arms of its adjacent crank. This permits the use of a relatively small actuating gear on the main shaft, and the bringing of the auxiliary shafts in comparatively close to the center of the crank casing. It also permits of the use of four, six, eight or more cylinders, if desired, without any conflict between the cranks, while all of the cylinders are placed with their longitudinal axes in the same plane. This engine readily adapts itself for being built in units and placed side by side until a combined unit of unlimited power may be created.

It is obvious that minor changes in the details of construction and the arrangement of the parts may be made without departing from the spirit of the invention as set forth in the appended claims.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent, is—

1. An internal combustion engine comprising a casing, radially disposed cylinders carried thereby and having their longitudinal axes disposed in a single plane, a piston in each cylinder, a main actuating shaft disposed centrally of the casing, an auxiliary shaft associated with each cylinder and geared to said main shaft, each auxiliary shaft having a crank including spaced arms and a connecting crank pin, said arms being inclined toward each other so that the distance between the outer faces of the arms at the axis of the crank is less than the distance between the inner faces of the arms at the axis of the shaft so that the crank pin on one crank shaft can pass between the arms of an adjacent crank and the auxiliary shafts disposed so that the paths of rotation of adjacent cranks overlap.

2. An internal combustion engine comprising a casing, radially disposed cylinders carried thereby and having their longitudinal axes disposed in a single plane, a piston in each cylinder, a main actuating shaft disposed centrally of the casing, an auxiliary shaft associated with each cylinder and geared to said main shaft, each auxiliary shaft having a crank including spaced arms and a connecting crank pin, said arms being extended to the opposite side of the axis of the auxiliary shaft from the crank pin and serving as a counterbalance therefor, said arms being inclined toward each other from the axis of the shaft to the crank pin so that the distance between the outer faces of the arms at the axis of the crank is less than the distance between the inner faces of the arms at the axis of the shaft and less than the distance between the inner faces of the extensions, so that a crank pin on one crank shaft can pass between the arms and extensions of an adjacent crank and the auxiliary shafts disposed so that the paths of rotation of adjacent cranks overlap.

ROBERT S. MOORE.