June 27, 1950 S. B. ECKERT 2,513,083

WOBBLER DRIVE MECHANISM

Filed May 24, 1945 3 Sheets-Sheet 1

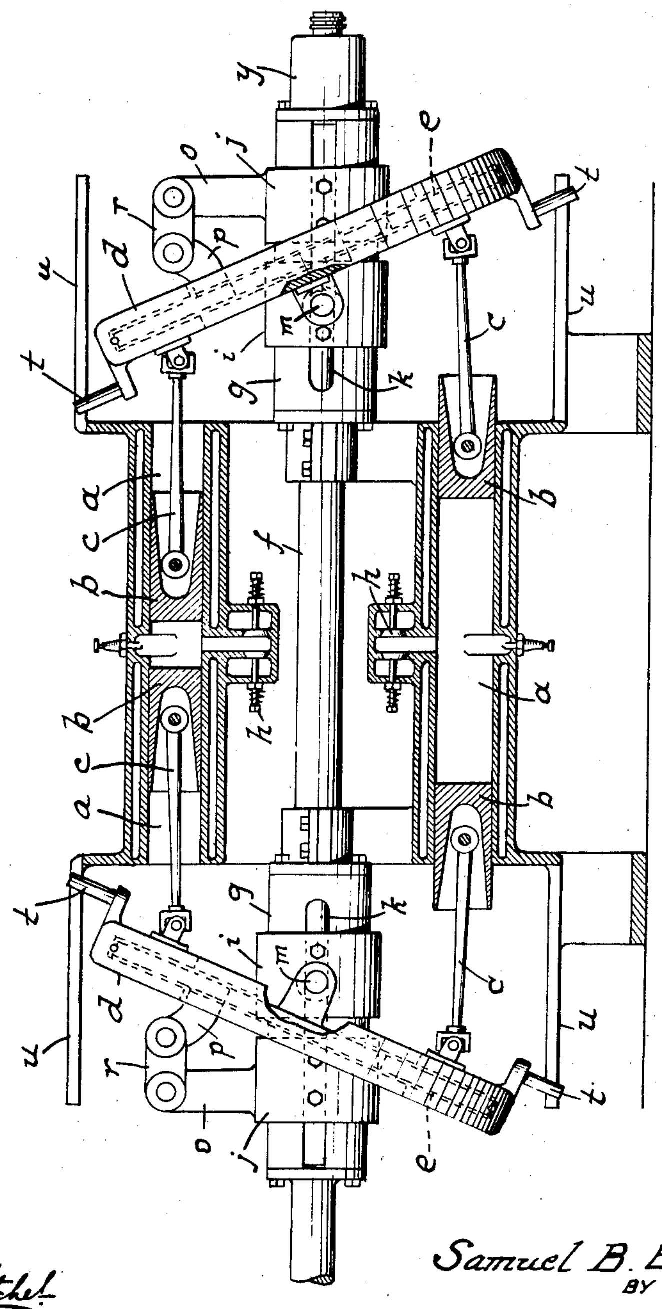

FIG. 1.

INVENTOR

Samuel B. Eckert

BY

Busser and Harding

ATTORNEYS.

WITNESS:

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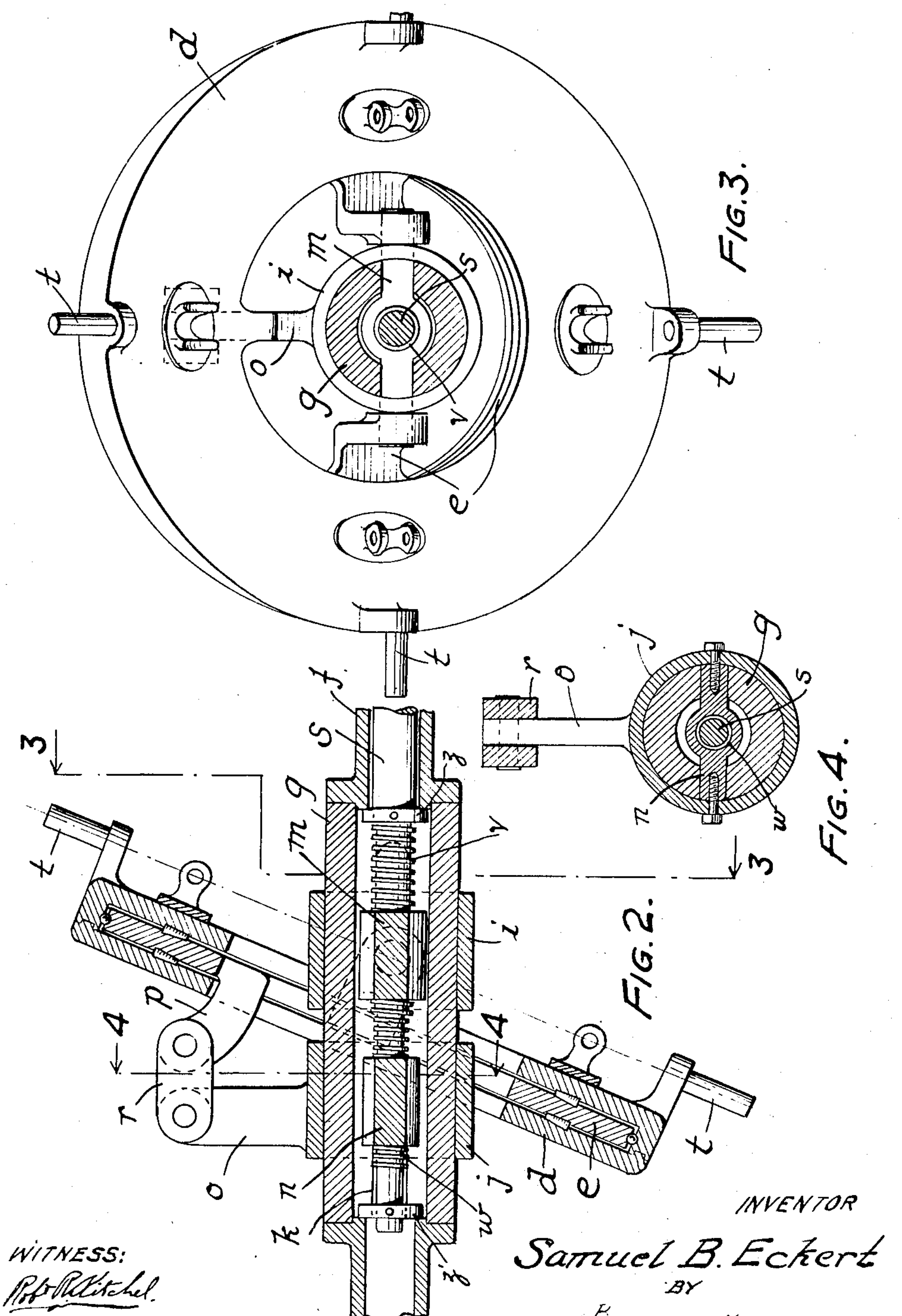

WITNESS:

INVENTOR

Samuel B. Eckert

BY

Busser and Harding

ATTORNEYS.

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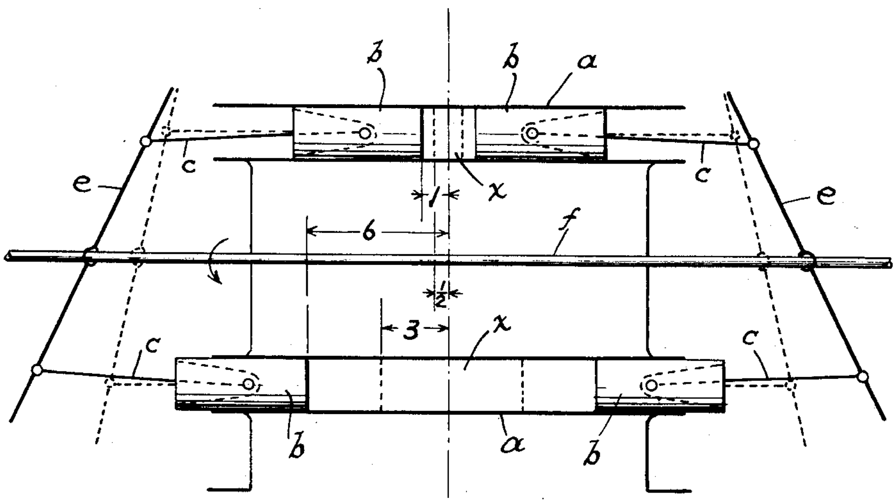

FIG. 5.

INVENTOR

Samuel B. Eckert

BY

Busser and Harding

ATTORNEYS.

WITNESS:

Robt R. Kitchel

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WOBBLER DRIVE MECHANISM

Samuel B. Eckert, Haverford, Pa.

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5 Claims. (Cl. 74—60)

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It is well understood that within reasonable limits increasing the compression ratio of an internal combustion engine greatly improves its power output and fuel efficiency. If, however, such an engine is designed for a compression ratio of (say) 7 to 1 and is then operated under normal conditions with the butterfly valve only partially open, the average compression ratio at which the engine operates is only about one-quarter of its full capacity. It has been calculated, as well as determined by experiment, that with such reduction in compression ratio the efficiency of the engine is reduced approximately one-half, involving serious waste of fuel.

The object of my invention is to adjustably vary the stroke of the piston (thereby varying the charge admitted to the cylinder) and at the same time maintain constant the ratio of volumes of the cylinder at the two end strokes of the piston; that is, to maintain, at all loads, a constant compression ratio and hence uniform maximum efficiency and fuel economy.

The invention is embodied in an engine of the so-called crankless opposed piston type, in which adjusting means are provided to (1) vary the position of the piston at the end of its in-stroke to thereby vary the charge of combustible gases admitted to the cylinder and (2) at the same time vary the length of the stroke of the piston so that the charge drawn into the cylinder will always be compressed to the same predetermined pressure.

A preferred embodiment of the invention is shown in the drawings, in which—

Fig. 1 is a longitudinal view, partly in section, of the engine.

Fig. 2 is an enlarged longitudinal sectional view of the mechanism, including the piston-stroke adjusting device, between the pistons and the main driving shaft.

Fig. 3 is a cross-sectional view on the line **3—3** of Fig. 2.

Fig. 4 is a cross-section on the line **4—4** of Fig. 2.

Fig. 5 is a diagram showing how the desired compression ratio may be maintained at different adjustments controlling piston stroke.

The engine is, as hereinbefore stated, of the opposed piston type and comprises cylinders *a*, within each of which reciprocates opposed pistons *b*. No mechanism is shown for actuating the inlet and exhaust valves *h* since these may be of the conventional type actuable by the conventional type of half time cam shaft and valve lifts. Each piston is, through a connecting rod *c*, at-

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tached, through a universal joint, with a collar or wobbler element *d* at the corresponding end of the engine. This collar is U-shaped in cross-section and embraces the peripheral portion of a rotatable disc *e*.

On an enlargement *g* of the hollow main driving shaft *f* (see Fig. 2) are slidable two sleeves *i* and *j*. Extending through longitudinal slots *k* in the enlarged part *g* of the shaft *f* are cross-heads *m* and *n* secured to the sleeves *i* and *j* respectively. These sleeves are thus made to rotate with the shaft. The cross-heads are machine-finished so that they may freely move through the slot *k*, but cannot rotate relative to the shaft. The disc *e* is pivoted, at its center, to the cross-head *m*. To the sleeve *j* is secured an arm *o* and to the disc *e* is secured an arm *p*, these arms being connected by a link *r*.

Secured to each collar *d* are pins *t* slidable in a slotted arm *u* secured to the engine casing, thereby neutralizing the tendency of the collar *d* to revolve with the disc *e*.

From the foregoing description it will be understood that reciprocation of the pistons effects rotation of the disc *e*, cross-heads *m*, *n*, sleeves *i*, *j* and the main drive shaft *f*, *g*.

The centers of cross-heads *m*, *n* are threaded to receive the screw-threaded portions *v* and *w*, respectively, of a shaft *s* that extends through the hollow main drive shaft. Shaft *s* is driven from a small controllable motor *y*, which is controlled from the throttle (not shown). The threads *v* and *w* are of different pitch, the thread *v* being of steeper pitch, so that, when the shaft *s* is rotated in one direction or the other, while both cross-heads are moved in the same direction, one will move a further distance than the other. The effect will be to swing the disc *e* on its pivot in one or the other direction, thereby increasing or reducing the length of stroke of the pistons. The shaft *s* may be held in place by any suitable means, for example, by a thrust collar *z*, *z'* secured to the shaft.

All the mechanism hereinbefore described is duplicated at both ends of the engine, the only difference being that the two pairs of threads at opposite ends of the shaft *s* are respectively right hand and left hand threads, so that, when the shaft *s* is rotated in one direction or the other, the two discs will be swung in opposite directions.

The thread *v* is of larger diameter than the thread *w* so that when the cross-head *m* is moved such distance toward the cross-head as to surround any part of the thread *w* the latter will not engage the thread on cross-head *m*.

From the foregoing description it will be understood that the pitch of each of the threaded portions of shaft *s* is so arranged as to insure such movement of the disc *e* as will vary the volume of combustible gases admitted into the cylinders *a* and at the same time insure that in the reciprocation of the pistons the compression space *x* is varied in such a way as to maintain the same compression ratio regardless of the volume of the charge taken into the cylinder. This will be clearly understood by reference to Fig. 5. In this figure the discs *e* are adjusted, as shown in full lines, to allow a relatively long stroke of the pistons to thereby admit a relatively large charge. The distance between the pressure face of each piston and the midway point of the cylinder is shown, at the outstroke, as a distance of 6 units of measurement and at the instroke as 1 unit of measurement, giving a compression ratio of 6 to 1. When the disc is adjusted to the dotted line position to thereby admit a smaller charge, the distances between the pressure face of each piston and the midway point of the cylinder are reduced (for example) to 3 units at the outstroke and ½ unit at the instroke, giving the same compression ratio of 6 to 1. This ratio is maintained constant regardless of the predetermined length of stroke of the piston.

It will be understood that my improved construction is sharply distinguishable from constructions that are adapted to be adjusted to vary the compression ratio through varying the length of stroke, my improvement being intended and adapted to avoid any variation in the compression ratio, that is, to maintain constant the relationship between the volume of the cylinder with the piston at the bottom of its stroke and the volume of the cylinder with the piston at the top of its stroke, thereby enabling the engine to at all times operate at maximum efficiency and economy.

What I claim and desire to protect by Letters Patent is:

1. In an internal combustion engine comprising a rotatable engine shaft, two sets of opposed cylinders disposed about said shaft and having their axes parallel thereto, wobbler elements toward opposite ends of and non-rotatable with the shaft, one for each set of cylinders, members toward opposite ends of and rotatable with the shaft and in their rotation imparting movement to the wobbler elements, and pistons reciprocatory in said cylinders and operatively connected with said wobbler elements; the improvement which comprises two pairs of cross-heads near opposite ends of the shaft, slidable along, but held from rotation relative to, the said shaft, means, including screw threads of different pitch engaging the two cross-heads of a pair, adapted to move the two cross-heads of each pair simultaneously in the same direction but to different distances, each of said rotatable members having a pivotal connection with one of the two cross-heads at the corresponding end of the shaft, and connections between each rotatable member and the other cross-head at the corresponding end of the shaft effective to change the angle of the wobbler element when said cross-heads are so moved.

2. In an internal combustion engine comprising a rotatable engine shaft, two sets of opposed cylinders disposed about said shaft and having their axes parallel thereto, wobbler elements toward opposite ends of and non-rotatable with the shaft, one for each set of cylinders, rotatable members toward opposite ends of and rotatable with the shaft, pistons reciprocatory in said cylinders and operatively connected with said wobbler elements; the improvement which comprises two pairs of sleeves, one pair at each of the opposite end portions of the shaft, slidable upon and rotatable with the shaft, each of said rotatable members being pivotally connected with one sleeve of the pair of sleeves at the corresponding end portion of the shaft, a link connection between each of said rotatable members and the other sleeve of the corresponding pair, and means including screw threads of different pitch engaging the two sleeves of a pair, adapted to simultaneously slide the corresponding two pairs of sleeves in opposite directions while at the same time sliding the two sleeves of each pair different distances in the same direction.

3. In an internal combustion engine comprising a rotatable engine shaft, two sets of opposed cylinders disposed about said shaft and having their axes parallel thereto, wobbler elements toward opposite ends of and non-rotatable with the shaft, one for each set of cylinders, members toward opposite ends of and rotatable with the shaft and in their rotation imparting wobbling movement to the wobbler elements, pistons reciprocatory in said cylinders and operatively connected with said wobbler elements; the improvement which comprises two cross-heads slidable along, but held from rotation relatively to, said shaft, means so pivotally connecting each rotatable member with both corresponding cross-heads that relative movement of said cross-heads along the shaft swings such rotatable member and its corresponding wobbler element to change their angular position on the shaft, a second shaft extending within the main shaft having near each end two threaded portions engaging interior threads in the two cross-heads respectively, said threaded portions being of different pitch to thereby, when said second shaft is rotated, move said cross-heads in the same direction but to different distances.

4. The construction defined in claim 3 in which said two threaded portions are of different diameters so that the threaded portion of smaller diameter engaging one cross-head can enter the threaded interior of the other cross-head without engaging the same.

5. The construction defined in claim 1 in which each rotatable member is pivotally connected at its center with one of the corresponding cross-heads and in which the connection of such rotatable member with the other corresponding cross-head comprises a sleeve carried by the last named cross-head and slidable on the shaft, an arm on the wobbler element between its center and periphery, an arm on said sleeve, and a link connecting said arms.

SAMUEL B. ECKERT.

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