J. ZEITLIN.

INTERNAL COMBUSTION ENGINE WITH VARIABLE PISTON STROKE.

APPLICATION FILED AUG. 24, 1915.

1,160,966.

Patented Nov. 16, 1915.

2 SHEETS—SHEET 1.

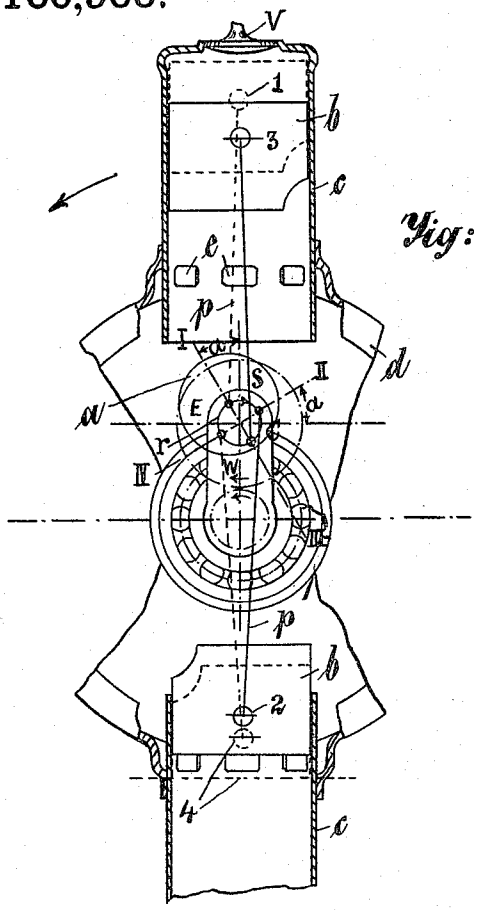


Fig: 1.

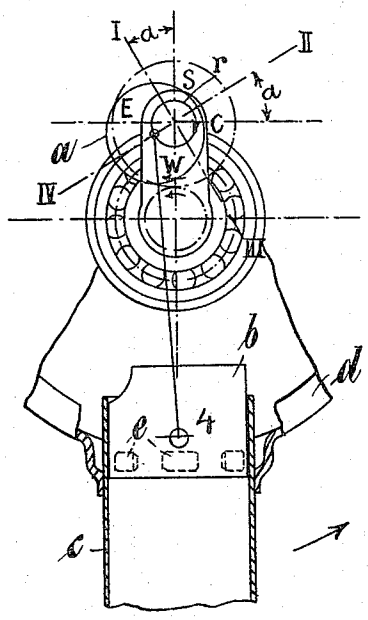


Fig: 2.

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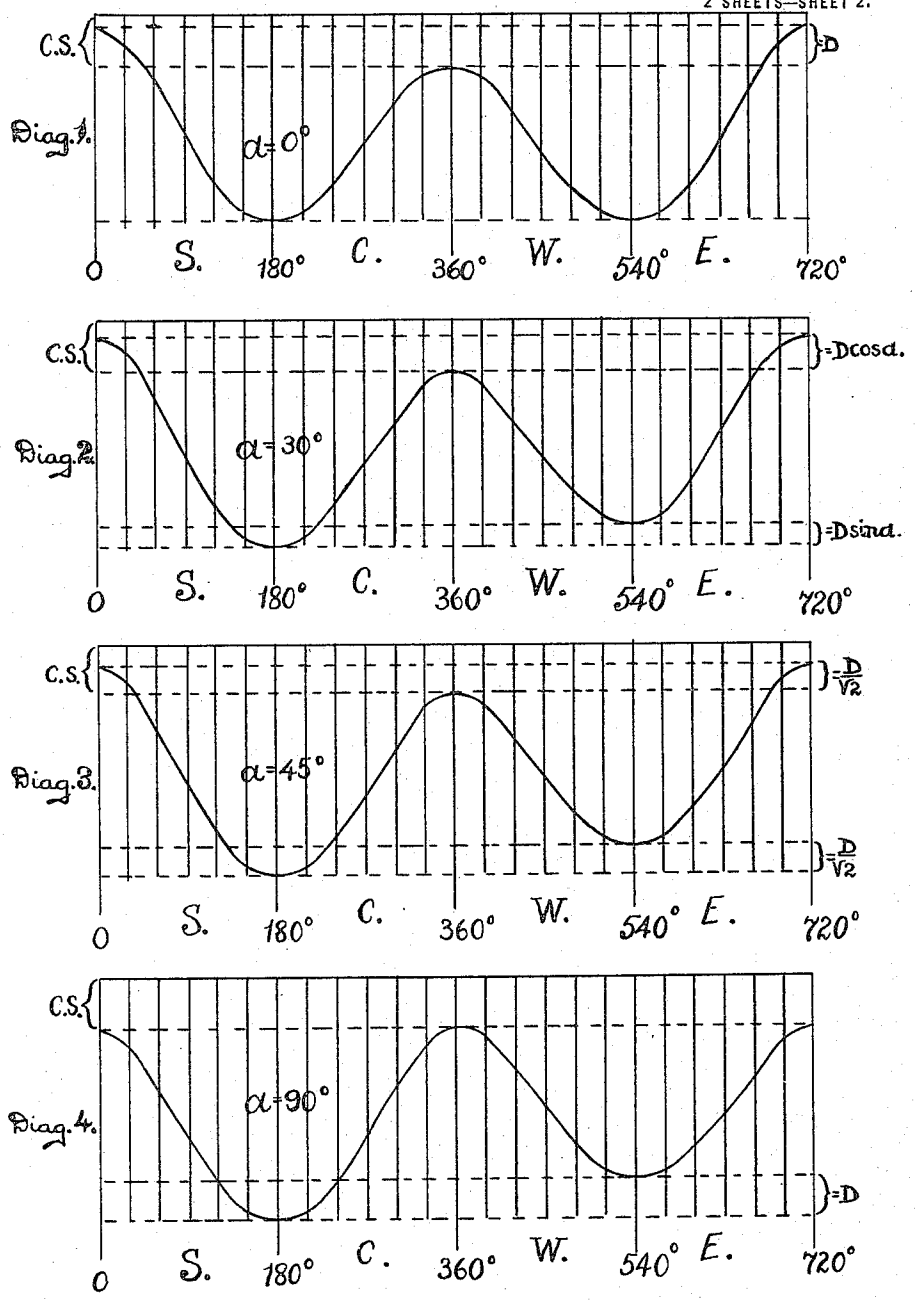


Fig: 3.

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE WITH VARIABLE PISTON-STROKE.

1,160,966. Specification of Letters Patent. Patented Nov. 16, 1915.

Application filed August 24, 1915. Serial No. 47,129.

To all whom it may concern:

Be it known that I, JOSEPH ZEITLIN, subject of the Czar of Russia, residing at 115 Bishop's Mansions, Fulham, in the county of London, England, have invented new and useful Improvements in Internal-Combustion Engines with Variable Piston-Strokes, of which the following is a specification.

This invention relates to internal combustion engines in which besides the usual relative movements of pistons and cylinders there is an additional relative movement between each piston and its cylinder of such a character as to result in a differential piston stroke, such additional relative movements being effected by causing the centers of the big ends of the connecting rods to traverse a circular path around the crank pin as for example by forming the big ends of the connecting rods as eccentric straps which engage with eccentric sheaves arranged to revolve on the crank pin at half the speed of the engine, substantially as and in the manner described in the specification filed with application for United States Patent under Serial No. 844,695 by me.

According to the present invention I admit the fuel or explosive mixture to the cylinder through ports which are uncovered by the piston at the end of the suction stroke, but which are not uncovered at the end of the working stroke; and in order to do this the eccentric is so set that when the crank is on a dead center, with the piston at the end of the exhaust stroke, the line joining the axis of the eccentric with its center, forms an angle to the rear of the crank of 90° or less. Further, by making the said angle of less than 90° the piston is made to enter the compression space at the end of the exhaust stroke as well as uncovering ports at end of suction stroke; and by properly selecting the angle the addition to piston travel due to the eccentric can be divided in any desired proportion, between these two particular phases of the piston cycle, viz: at end of exhaust stroke for better clearance of the spent gases and at the end of suction stroke for admission of fuel or combustible mixture.

In applying this invention to radially disposed multicylinder engines, or to engines with fixed crank and revolving cylinders, the eccentric sheaves are arranged and assembled on the bush in the same manner as described in specification referred to above and the bush with the eccentric sheaves and gear wheel, as a whole, are given a new initial position in relation to the crank shaft.

In accordance with the variation in the position of the piston at the end of the suction and the end of the working strokes respectively, ports of appropriate size and shape are arranged at the outer end of the cylinder through which combustible mixture is admitted either wholly or in part in which case said ports serve as auxiliary inlet ports. These ports remain closed during the whole of the working stroke, so that ignition of the combustible mixture of any kind through the ports cannot take place however late the exhaust ports may remain closed during the working stroke.

When the combustible mixture is fed to the cylinder or cylinders by way of the crank case—the ports in the cylinder or cylinders are arranged to communicate with a passage or passages leading to the crank case.

Referring to the drawings Figures 1 and 2 illustrate diagrammatically the application of this invention to a rotary cylinder engine and represents the same cylinder and piston in the four main instantaneous positions while passing the dead points. Fig. 3 is a series of diagrams illustrating piston displacement.

Circle r represents the locus of the center of the big end of the connecting rod p about the axis of the crank pin. Angle α represents the lag which is given to the eccentric sheaves a from the normal setting required for the entire variation at the top of stroke. In the example illustrated in Figs. 1 and 2 a lag of 30° has been chosen. Taking D to be the radius of the circle r I get with a lag of angle α a variation in the position of the piston b at the outer end of the cylinder approximity equal to D sin α, while the variation of the piston b at the top of the stroke is approximately equal to D cos α.

The lines I, II, III, IV, divide the circle r into four quadrants S, C, W, E, corresponding respectively to the suction, compression, working and exhaust strokes, while the points of intersection of these lines with the circle r correspond with the four instantaneous positions 1, 2, 3, 4, of the piston b as shown in Figs. 1 and 2 of the working cycle, and in diagram 2 of Fig. 3 these points correspond with the positions of the piston b at 0° or 720°, 180°, 360° and 540° of the cycle respectively.

Between the extreme positions of the piston *b* in the outer end of the cylinder *c*, namely positions 2 and 4, Figs. 1 and 2 the ports *e* are provided in the cylinder walls which in this case are shown as communicating with the interior of the crank case *d* and serve to feed explosive mixture to the cylinders *c* therefrom.

Following the four consecutive positions of the piston, it will be seen that the piston *b* uncovers these ports *e* at the end of suction stroke when traveling from position 1 to position 2 and the center of the big end of the connecting rod *p* traverses the quadrant S of the circle *r*. Through these ports *e* the explosive mixture or fuel is admitted. Next the piston *b* is brought into position 3 at the end of the compression stroke; then the piston *b* descends in its working stroke from position 3 to position 4 (see also Fig. 2) when the ports *e* remain closed, the piston *b* acting as a positive valve cutting off communication between the cylinder and crank case so that no ignition of the fuel or explosive mixture in the crank case *d* can possibly take place. Finally, the piston *b* ascends to its first position the burnt gases escaping through the valve *v* assisted at the end by the piston *b* sweeping the whole or part of the compression space.

Diagram 1, Fig. 3 illustrates the piston travel when the eccentrics are normally positioned for the exclusive differentiation at the top of the stroke for the purpose of clearing the spent gases from the clearance space, that is to say the addition to the stroke is manifest at the end of the exhaust stroke only.

With a lag of 90° the differentiation will be wholly by way of addition at the end of suction stroke instead of the end of exhaust stroke (see diagram 4, Fig. 3). With a lag of 45°—there will be differentiation of equal amount at the end of exhaust and end of suction stroke.

With a lag of less than 45° there will be a smaller differentiation at the end of suction stroke than at the end of exhaust stroke, and with a lag of more than 45° the reverse will take place.

It is obvious that the present invention can equally be applied to stationary or revolving cylinder engines—more particularly to the radially disposed multicylinder types.

I claim:—

In a four cycle internal combustion engine, a closed crank case forming a fuel receptacle, a cylinder carried by the crank case and having fuel supply ports communicating with the crank case and an exhaust port at its opposite end, a shaft extending through the crank case and having a crank located within the crank case, a piston reciprocable within the cylinder, an eccentric mounted on the crank, means to cause rotation of the eccentric once about the crank during two revolutions of the crank about the axis of its shaft, and a piston rod connecting the piston and eccentric, said eccentric being angularly displaced ninety degrees or less at the end of the exhaust stroke to cause the piston to open communication through the fuel ports between the crank case and cylinder at the end of the suction stroke only and to prevent opening of such communication throughout the working stroke.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH ZEITLIN.

Witnesses:
CHARLES J. R. BULLOUGH,
WALTER CARVEL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."