E. GRIFFITH.

COMPOUND PISTON FOR INTERNAL COMBUSTION ENGINES AND THE LIKE.

APPLICATION FILED JUNE 20, 1918.

1,309,891.

Patented July 15, 1919.

3 SHEETS—SHEET 1.

Fig. 1.

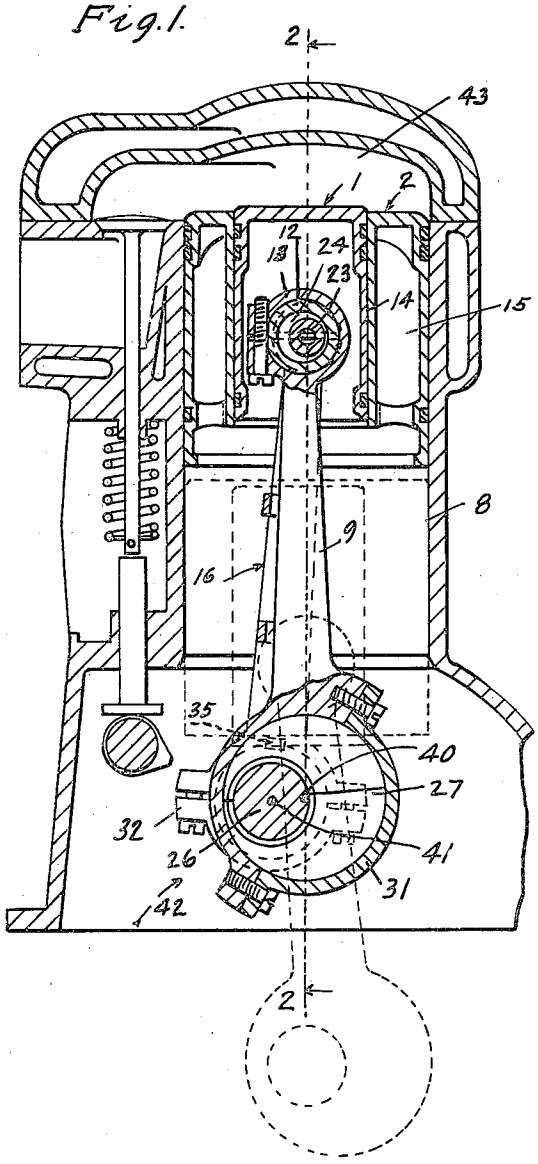


Fig. 2.

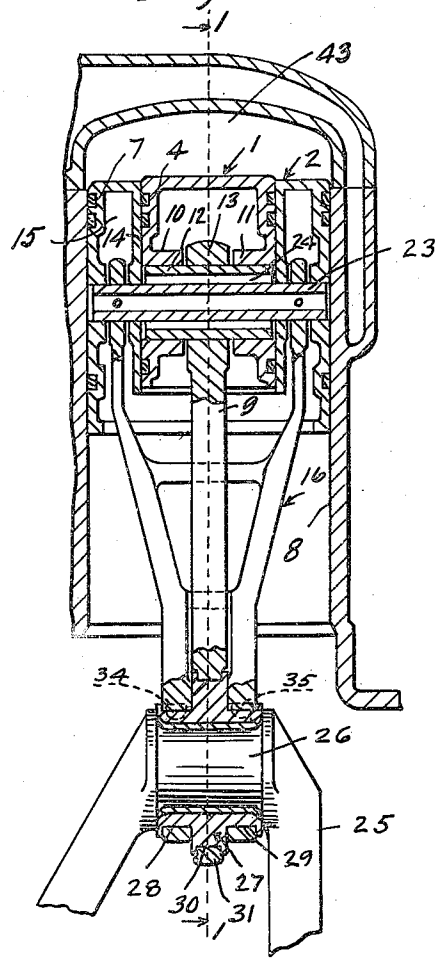
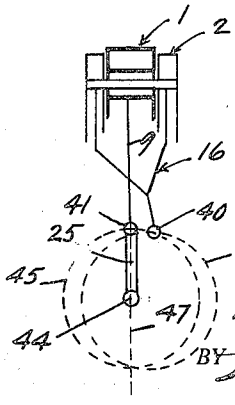


Fig. 3.



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Fig. 4.

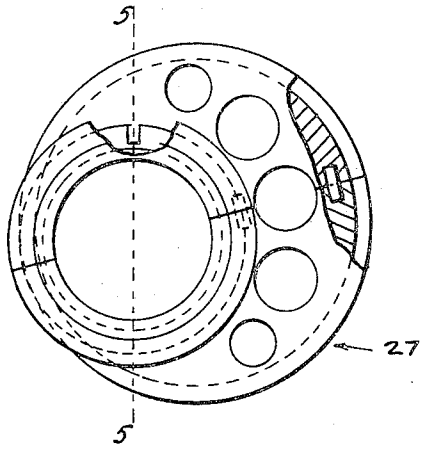


Fig. 5.

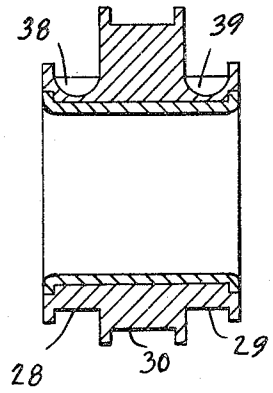


Fig. 7.

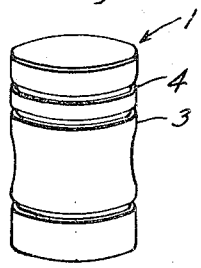


Fig. 6.

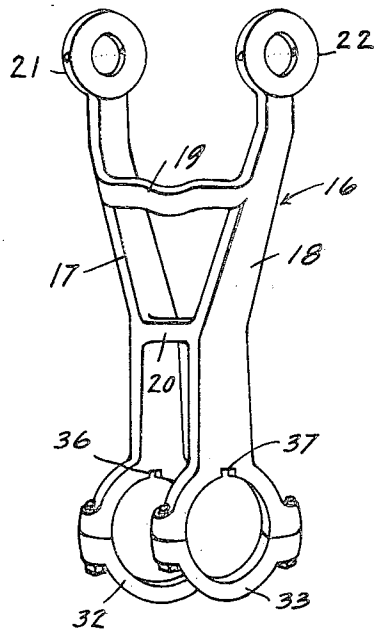
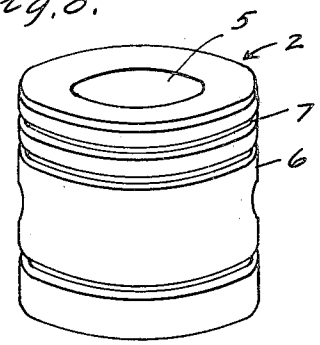


Fig. 8.



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3 SHEETS—SHEET 3.

Fig. 9.

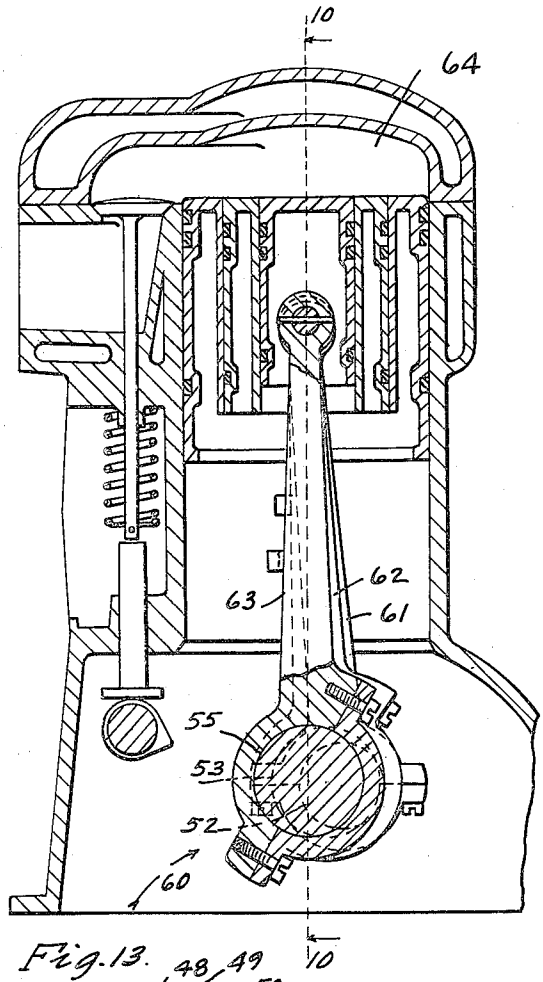


Fig. 10.

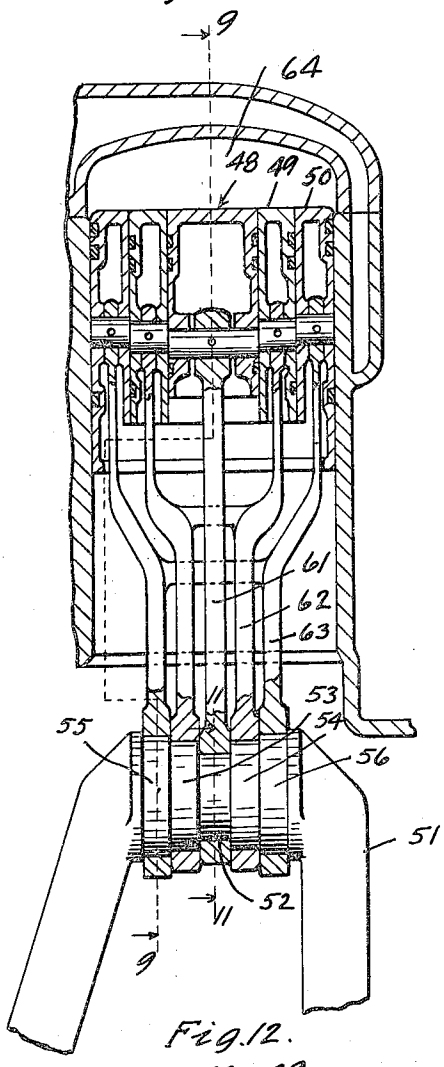


Fig. 13.

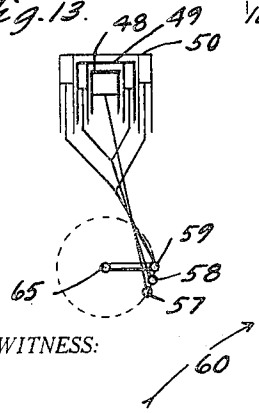


Fig. 11.

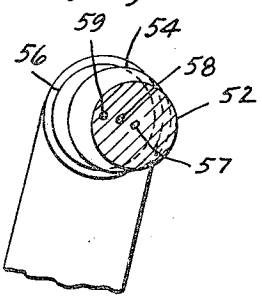
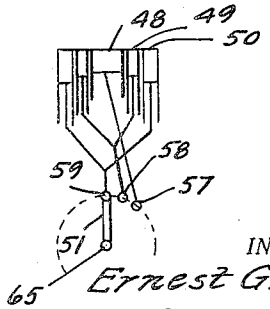


Fig. 12.



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UNITED STATES PATENT OFFICE.

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COMPOUND PISTON FOR INTERNAL-COMBUSTION ENGINES AND THE LIKE.

1,309,891. Specification of Letters Patent. Patented July 15, 1919.

Application filed June 20, 1918. Serial No. 241,039.

To all whom it may concern:

Be it known that I, ERNEST GRIFFITH, a citizen of the United States, residing at Long Beach, in the county of Los Angeles and State of California, have invented new and useful Improvements in Compound Pistons for Internal-Combustion Engines and the like, of which the following is a specification.

My principal object is to make a piston and piston transmission in two or more parts, each part having an independent stroke, the stroke of one part being ahead of the stroke of the succeeding part delivered at a different angle of thrust to the crank shaft, so as to split up the force of the explosion in internal combustion engines, overcome the dead center, avoid the liability of back-firing, and reduce the vibration, thereby dispensing with the necessity of a fly wheel, which as well known, serves to store energy which is drawn upon when the explosion takes place before the crank shaft has reached the dead center, thus reducing the change or direction of torque.

Figure 1 is a vertical central section crosswise of the crank shaft and showing a compound piston and piston transmission embodying the principles of my invention, the view being taken on the line 1—1 of Fig. 2.

Fig. 2 is a sectional detail on the line 2—2 of Fig. 1.

Fig. 3 is a diagram illustrating the piston transmission to the crank shaft.

Fig. 4 is a side elevation upon an enlarged scale of the compound crank pin bearing.

Fig. 5 is a sectional detail on the line 5—5 of Fig. 4.

Fig. 6 is a perspective of one of the connecting rods.

Fig. 7 is a perspective of the inner compound piston member.

Fig. 8 is a perspective of the outer compound piston member and taken on the line 9—9 of Fig. 10.

Fig. 9 is a view analogous to Fig. 1 and showing a three part piston and piston transmission whereas Figs. 1–8 show a two part piston and piston transmission.

Fig. 10 is a view analogous to Fig. 2 and taken on the line 10—10 of Fig. 9.

Fig. 11 is a sectional detail on the line 11—11 of Fig. 10.

Fig. 12 is a view analogous to Fig. 3.

Fig. 13 is a view analogous to Fig. 12 and showing the parts on a quarter stroke whereas Fig. 12 shows the parts passing the dead center.

In the construction shown in Figs. 1–8 the compound piston consists of the inner cylindrical member 1 and the outer annular member 2. The inner member 1 is provided upon its periphery 3 with ring grooves 4 and when the rings are applied the member 1 fits in the central opening 5 of the member 2 and the member 2 has a periphery 6 provided with ring grooves 7. The periphery 6 of the member 2 fits in the piston cylinder 8.

The connecting rod 9 is inserted upwardly between internal bearings 10 and 11 of the member 1 and a hollow wrist pin 12 is inserted through the bearings 10 and 11 and through the bearing 13 in the upper end of the connecting rod 9. The member 2 is provided with a casing around the opening 5, said casing forming the cylinder 14 for the member 1, there being an annular chamber 15 around the cylinder 14, said chamber 15 being open at the bottom. The connecting rod 16 consists of two bars 17 and 18 connected by braces 19 and 20, said braces 19 and 20 being off-set to pass around the connecting rod 9, and bearings 21 and 22 are formed at the upper ends of the bars 17 and 18. The bearings 21 and 22 are inserted upwardly into the chamber 15 and a wrist pin 23 is inserted through the member 2 and through the bearings 21 and 22 and through the hollow 24 of the wrist pin 12. The hollow 24 is enough larger than the wrist pin 23 to allow the members 1 and 2 to move endwise relative to each other to the desired extent. The opening 5 is eccentric relative to the periphery 6 so as to off-set the center of the wrist pin 23 relative to the center of the wrist pin 12, thereby giving the connecting rods 9 and 16 different angularities relative to the crank shaft.

The crank 25 of the crank shaft has the usual crank pin 26 and a compound connecting rod bearing 27 is mounted upon this crank pin. The compound connecting rod bearing 27 is a split sleeve having two concentric bearing portions 28 and 29 and an eccentric bearing portion 30. The split

bearing 31 is formed upon the lower end of the connecting rod 9 and fits the eccentric bearing portion 30 and split bearings 32 and 33 are formed upon the lower ends of the bars 17 and 18 of the connecting rod 16 and fit the concentric bearing portions 28 and 29. Keys 34 and 35 are applied to key seats 36 and 37 in the bearings 32 and 33 and corresponding seats 38 and 39 in the bearing portions 28 and 29 so as to hold the compound bearing 27 from rotating relative to the connecting rod 16.

In assembling the connecting rods 9 and 16 and the bearing 27 the bearing 27 is set so that the center 40 of the eccentric portion 30 is substantially on a horizontal plane with the center 41 of the concentric portions 28 and 29, so that when the crank pin 26 is in its elevated position, as in Fig. 1, the center 40 will be ahead of the center 41 with the crank pin traveling in the direction indicated by the arrow 42, and then when the explosion takes place in the chamber 43 and the crank pin 26 is close to or on the dead center the bearing 30 will have passed the dead center and the impulse of the explosion coming through the member 1 and connecting rod 9 to the bearing 30 will assist in carrying the crank pin 26 over the dead center. As shown in Fig. 1 the parts 1 and 2 are off-set to the left while the centers 40 and 41 are off-set to the right, so that the effective forces of the connecting rods 9 and 16 are crossed, the object being to split up the forces by the divergent angularities, reduce the strain at the point of passing the dead center, reduce the liability of backfiring, that is when the crank pin refuses to pass the dead center and goes backwardly, and reduce the vibration of the engine.

In Fig. 3 the compound piston is twisted a quarter turn relative to the crank shaft in order to show the connections. The center 41 is in a direct line between the center 44 of the crank shaft and the piston member 1 and on the dead center. The center 41 travels in the line 45 concentric to the crank shaft center 44 while the center 40 travels in the line 46 eccentric to the center 44. The path of travel of the center 40 is considerably longer on the down stroke from the dead center line 47 than on the up stroke and the crank pin leverage is considerably greater. While the relative movements of the members 1 and 2 are only slight, still the impact of the explosion in the chamber 43 is communicated through the member 1 to the eccentric 30 and through the member 2 to the concentrics 28 and 29 and the impulses are delivered over separate lines to different parts and are communicated to the crank shaft at different angles and at different times. Especial attention is again called to the fact that the eccentric 30 does not rotate and that its chief purpose is to off-set the centers 40 and 41 and change the crank pin angularity.

In the modification shown in Figs. 9–13 the compound piston consists of the central circular member 48, the intermediate annular member 49, and the outer annular member 50 all arranged concentrically and moving longitudinally relative to each other. The crank shaft crank 51 has a compound crank pin consisting of the concentric bearing face 52, the intermediate eccentric bearing faces 53 and 54, and the outer eccentric bearing faces 55 and 56. Starting from the center 57 of the concentric bearing face 52, the center 58 of the eccentric faces 53 and 54 and the center 59 of the eccentric faces 55 and 56 are in a circumferential line with the center 57 at the front when the crank shaft is moving in the direction indicated by the arrow 60, the center 59 at the rear, and the center 58 in the middle. A connecting rod 61 connects the bearing face 52 to the piston member 48, a connecting rod 62 connects the eccentric bearing faces 53 and 54 to the piston member 49, and a connecting rod 63 connects the eccentric bearing faces 55 and 56 to the piston member 50, and the connecting rods are substantially of the same length, so that at the end of the up stroke or at the end of the down stroke the parts 48, 49 and 50 will be substantially flush on the faces of their heads.

If the parts are standing in the position shown in Figs. 9 and 12, at the time an explosion takes place in the chamber 64 the centers 57 and 58 have passed the dead center line and the center 59 is on the dead center. The impact of the explosion against the piston member 48 will be directed through the connecting rod 61 to the point 57 which is considerably beyond the dead center, and the impact of the explosion will be communicated through the piston member 49 and connecting rod 62 to the point 58 which is also beyond the dead center, and only a small part of the impact of the explosion will be communicated through the piston rod 63 to the point 59 on the dead center, and the forces exerted at the points 57 and 58 will easily carry the point 59 over the dead center. In this construction the impulse is broken up into three parts and one or more of the parts is devoted to carrying the other parts over the dead center.

In this construction the members 48, 49 and 50 have considerable differential motion. On the quarter turn, as shown in Fig. 13, the member 48 is considerably depressed relative to the member 49 and both members 48 and 49 are depressed relative to the member 50, and obviously on the other quarter turn the positions will be reversed.

All the centers 57, 58 and 59 travel around the center 65 and the movements of the compound piston members 48, 49 and 50 are substantially equal but the corresponding movements do not take place in unison.

The crank pin action is broken up into three different parts by the compound crank pin and the impact of the explosion in the chamber 64 is broken up into three different parts by the members 48, 49 and 50 and transmitted to the compound crank pin from three different lines at three different times.

Thus I have produced a compound piston and compound transmission from the piston to the crank shaft.

It is obvious that any desired number of cylinders may be used in connection with a single crank shaft, each cylinder or any desired number of cylinders being provided with compound pistons and compound transmissions.

Among the leading advantages I expect to derive from this construction is the elimination of or reduction in the weight of the fly wheel, the reduction of vibration, and the elimination of the tendency to back-fire. These features are especially desirable in aeroplane construction and are more or less desirable in other constructions such as automobiles, motor boats, and the like.

Various changes may be made without departing from the spirit of my invention as claimed.

I claim:

1. An internal combustion engine comprising a cylinder, a combustion chamber at one end thereof, a plurality of pistons slidably mounted upon each other, the cross-sectional area of any of said pistons being at least a major part of any other of said pistons, a crank shaft and connecting rods forming a compound transmission from the pistons to the crank shaft, said connecting rods being of substantially the same lengths and the same strokes, the strokes being differently timed.

2. An internal combustion engine comprising a cylinder, a combustion chamber at one end thereof, a plurality of pistons of substantially equal cross-sectional areas slidably mounted upon each other, a crank shaft, and connecting rods forming a compound transmission from the pistons to the crank shaft, said connecting rods being of substantially the same lengths and the same strokes, the strokes being differently timed.

3. A cylinder, a plurality of pistons mounted to reciprocate relative to each other therein, a crank shaft, and separate power transmission connecting rods varying in angularity connected to said pistons and to said crank shaft, said connecting rods being of substantially the same lengths and the same strokes, the strokes being differently timed.

4. An internal combustion engine comprising a cylinder, a combustion chamber at one end thereof, an annular piston engaging said cylinder, a second piston mounted within said first piston, the cross sectional areas of said pistons being substantially equal, a crank shaft, and independent transmission connecting rods connecting said pistons to the crank shaft and so arranged that when said pistons are at the extreme end of the movements the lines of direction of the power transmitted to said crank shaft from said pistons pass on opposite sides of the center of the crank shaft, said connecting rods being of substantially the same lengths and the same strokes, the strokes being differently timed.

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

ERNEST GRIFFITH.