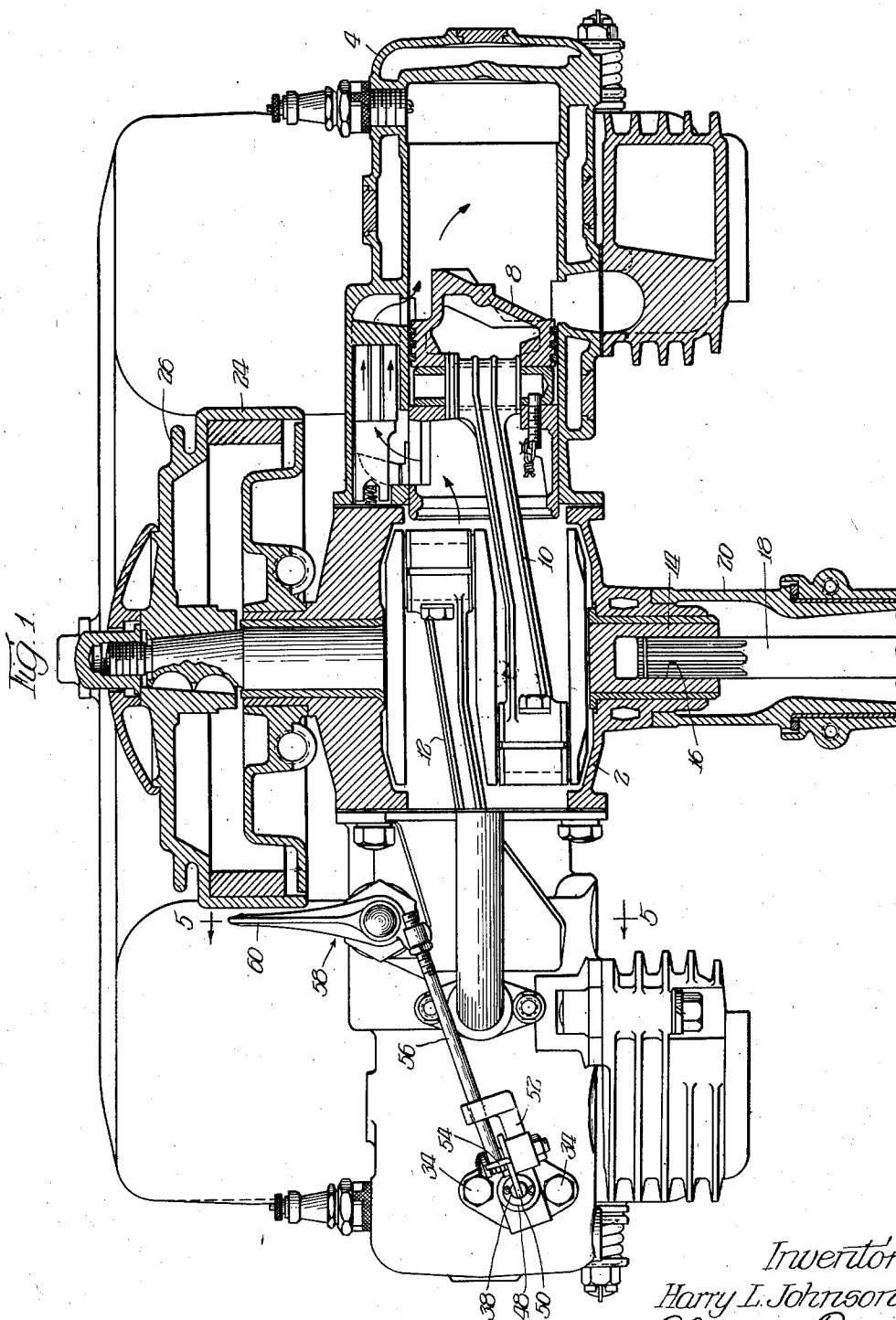


Feb. 11, 1930.

H. L. JOHNSON
METHOD AND APPARATUS FOR RELIEVING COMPRESSION
IN OUTBOARD MOTORS FOR STARTING
Filed July 5, 1928

1,746,533

3 Sheets-Sheet 1



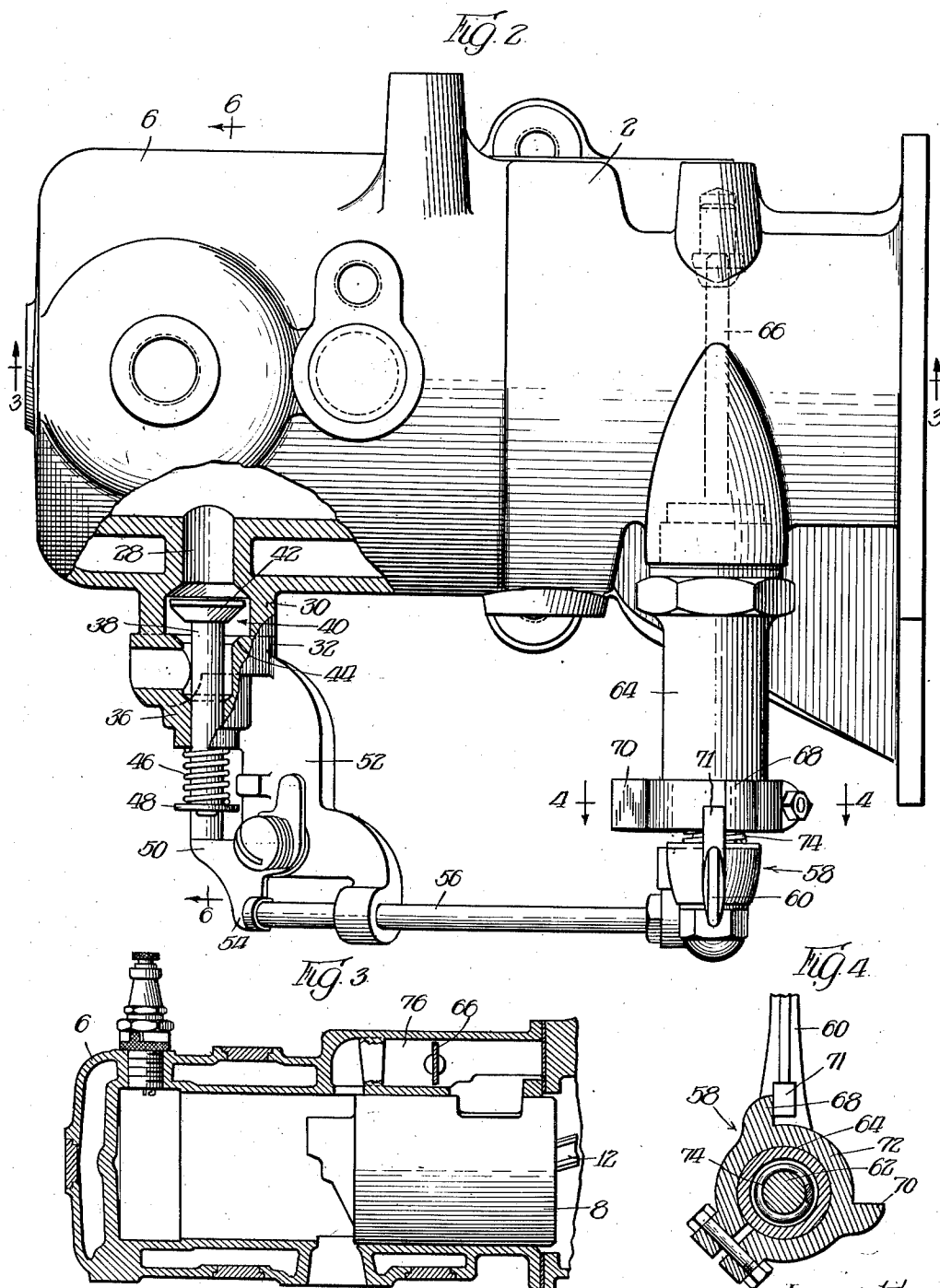
Inventor:
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3 Sheets-Sheet 3

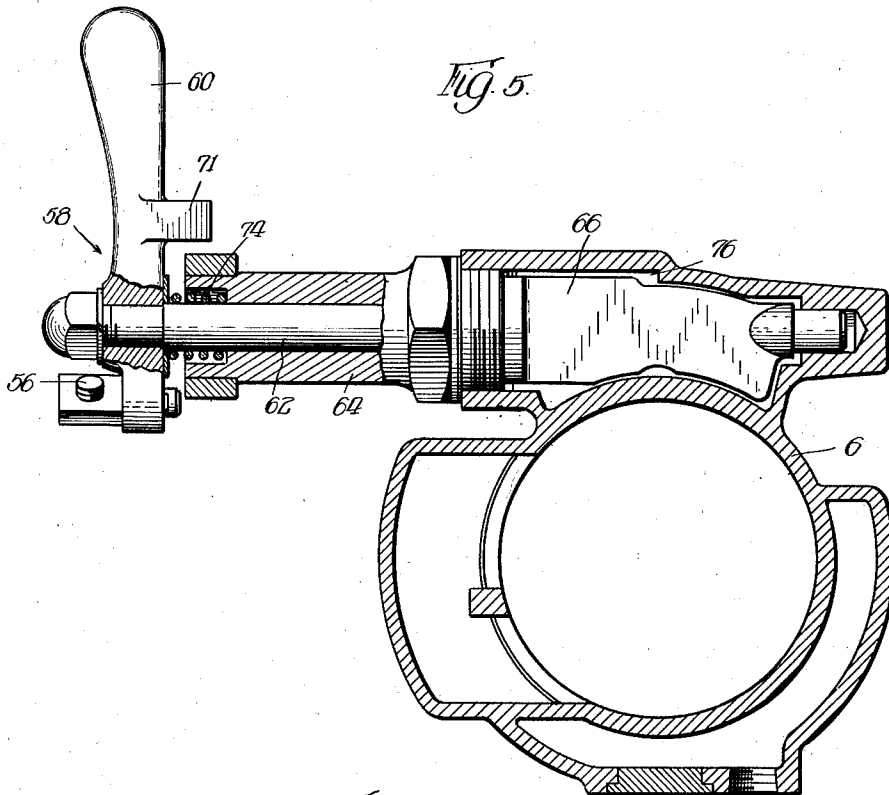
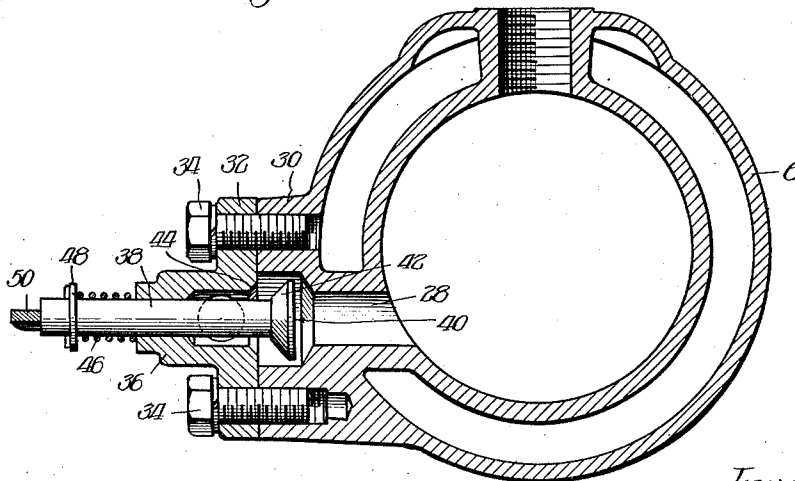


Fig. 6.



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UNITED STATES PATENT OFFICE

HARRY L. JOHNSON, OF WAUKEGAN, ILLINOIS, ASSIGNOR TO JOHNSON BROTHERS ENGINEERING CORPORATION, OF SOUTH BEND, INDIANA, A CORPORATION OF INDIANA

METHOD AND APPARATUS FOR RELIEVING COMPRESSION IN OUTBOARD MOTORS FOR STARTING

Application filed July 5, 1928. Serial No. 290,627.

My invention relates to compression relief devices for multi-cylinder engines and particularly to outboard or inboard motor engines having a plurality of cylinders.

One of the objects of my invention is to provide an easy cranking of the motor without changing the explosive mixture.

Still another object of my invention is to provide a compression relief device to facilitate the starting of outboard motors or other engines having a plurality of cylinders which device is arranged to not only relieve the compression in one of the cylinders but will also increase the intensity of the explosion in the other cylinder.

Still another object of my invention resides in providing a compression relief device for one of the cylinders of a gas engine, particularly of the double opposed two-cycle type.

A further object of my invention is to provide a compression relief device of economical and durable construction which will serve to greatly facilitate the starting of outboard motors or other two-cycle engines having a plurality of cylinders, said device being constructed and arranged to relieve the compression in one of the cylinders and simultaneously cut off the gas supply therefrom so as to increase the quantity of mixture to be fired in the other cylinder.

More specifically, it is an object of my invention to provide a simple and effectively operable compression relief device which may be manually operated through the agency of a suitable lever or handle, said handle being designed to effect the actuation of a valve in one of a plurality of cylinders whereby the compression of said cylinder is relieved, and simultaneously effecting the actuation of another valve to obstruct the flow of gas into said cylinder, thereby permitting an increased amount of gas to pass into the working cylinder and consequently intensifying the initial explosive force within said working cylinder.

Still another object of my invention resides in my improved method of starting a multiple cylinder internal combustion engine.

These and other objects of my invention

will be apparent from a perusal of the following specification when taken in connection with the accompanying drawings wherein:

Figure 1 is a side view of one embodiment of my invention as applied to an outboard motor of the double opposed cylinder type, certain portions of the motor being shown in section in order to more clearly illustrate parts otherwise hidden;

Figure 2 is an enlarged plan view of the cylinder shown at the left of Figure 1, a portion thereof being broken away to more clearly disclose the specific construction of the compression relief valve;

Figure 3 is a vertical sectional view taken centrally and longitudinally of the cylinder as viewed along the line 3—3 of Figure 2;

Figure 4 is a detailed sectional view of the manually operable lever mechanism taken substantially along the line 4—4 of Figure 2;

Figure 5 is a vertical sectional view taken transversely of one of the cylinders along the line 5—5 of Figure 1; and

Figure 6 is also a transverse vertical section of said cylinder taken along the line 6—6 of Figure 2.

In general, my invention relates to a device for facilitating the starting of gas engines of multiple cylinder type and particularly two-cycle engines of the double opposed type wherein the compression due to the simultaneous outward movement of the two cylinders renders the cranking of the motors particularly difficult for starting. My invention resides in providing one, and only one, of the cylinders of the double opposed motor with a pressure relief valve of sufficient proportions so as to relieve that cylinder from compression and thereby leaving only the compression of the other cylinder to be overcome in cranking the engine. In types of motors wherein there are more than two cylinders either of the double opposed type or other arrangements, my compression and relief can be extended so as adequately to relieve the compression in a portion of the cylinders so that the engine can be manually cranked or can be cranked from a relatively small prime movement.

Referring now to the drawings in detail, I have illustrated one form of my invention in connection with an outboard motor of the two-cycle double opposed type. The details of the construction of the motor and the arrangement of the cylinders in a double opposed two-cycle formation is not new except in so far as it is new in combination with a relief valve for one of the cylinders only and the means for maintaining the charge in the other cylinders. The structure shows the usual type of crank case 2 and the double opposed cylinders 4 and 6 in which operate pistons 8 connected by means of the connecting rods 10 and 12 for driving the usual engine shaft 14. This shaft is provided with a splined recess 16 in which detachably fits the drive shaft 18 passing through the tubular sleeve 20 of well known construction. The opposite engine shaft 22 has connected thereto the usual combined flywheel and magnetos 24 well known in the art and the upper portion of this combined flywheel and magnetos is provided with a starting disk 26 adapted to receive a rope or other flexible cable therearound for manually cranking the motor.

In outboard motors of this type and particularly in the larger power units, considerable difficulty has been experienced in cranking the engines for starting due to the fact that both of the pistons in the double opposed cylinders move outwardly simultaneously on their compression strokes whereby practically double the effort is required to revolve the engine shaft 22 in starting. My invention eliminates this difficulty in starting by substantially or wholly relieving the compression in one of the cylinders only, and not in the other, so that the total compression to be overcome in cranking for starting is considerably reduced. In the instance of a two-cycle double opposed cylinder, it is practically cut one-half.

In the present embodiment of my invention I provide one of the cylinders, as for example cylinder 6, with a port 28, Figures 2 and 6, of sufficient size so that when this port is open and the piston within the cylinder is making a compression stroke, there will be practically no compression within said cylinder. In order to control the opening and closing of this port 28, I provide the cylinder 6 with an integral extension 30 to which fits a cap or closing piece 32 rigidly fastened to the extension 30 by means of suitable bolts 34. This cap or closing piece 32 is in turn provided with a sleeve portion 36 which is designed to receive the stem 38 of a compression relief valve indicated generally by the numeral 40. This valve 40 is provided with a suitable head 42 which is designed to be moved into engagement with a seat 44 through the agency of a coil spring 46 which encircles the outer

portion of the valve stem 38. This spring 46 is interposed between a collar or washer 48 and the outer extremity of the sleeve 36 and serves to normally urge the valve into close relation with respect to the seat 44. The spring 46 also serves to cause the outer end of the valve stem 38 to normally engage a finger 50 which is pivotally mounted upon a bracket arm 52 formed integral with the sleeve 36. Formed integral with the finger 50 and disposed at substantially 90 degrees therefrom is another finger member 54 which is adapted to engage the extremity of an actuating rod 56 of a lever mechanism indicated generally by the numeral 58.

This lever mechanism 58 includes a manually operable handle or lever 60 which is secured at the outer extremity of a rotatable shaft 62. This shaft 62 is rotatable within a fixed sleeve 64 and the inner extremity of said shaft supports a valve 66, Figures 3 and 5. The lower extremity of the lever pivotally supports one end of the actuating rod 56. The degree of movement to which the lever 60 may be subjected is limited by stops 68 and 70 formed integral with a clamping ring 72 which is secured upon the outer extremity of the fixed sleeve 64. A lug 71 provided on the lever 60 is adapted to engage the stops 68 and 70. It will be seen that the lever 60 is capable of being moved through an angle of 90 degrees and a coil spring 74 is interposed between the inner surface of the lever 60 and a shoulder of the sleeve 64, Figure 5 to afford a proper frictional resistance between the lever and the sleeve. The valve 66 traverses a passage 76, Figure 3, which establishes communication between the crank case and the cylinder chamber to permit the flow of gas into said cylinder chamber at the proper period of the cycle of operation.

From the foregoing it will be understood that when the lever 60 is moved to the vertical position shown in the various figures of the drawing with the lug 71 adjacent the stop 68, the actuating rod 56 will be moved to the left, Figures 1 and 2, into engagement with the pivoted finger 54. This causes the finger 50 to engage the valve stem 38 and thereby effect the unseating of the valve head 42. Simultaneously with this unseating operation, the valve 66, Figures 3 and 5, will be rotated to a vertical or closing position within the passage 76. It will thus be apparent that upon the compression stroke of the piston 8 within the cylinder 6 no compression will take place within said cylinder because of the open condition of the valve 40. It will be equally apparent that the closing of the valve 66 will prevent a supply of gas to be introduced into the cylinder chamber and hence the volume of gas fed into the opposite cylinder 4 will be materially increased. In other words, when the lever 60 is moved to the ver-

tical position, the ease with which the engine may be cranked is materially increased, by reason of relieving the compression within the cylinder 6 and the initial explosive force within the cylinder 4 will be increased because of the increase in volume of gas fed thereto. As soon as the cranking operation is completed, the lever 60 may be swung downwardly to a horizontal position with the lug 71 engaging the stop 70. This causes the lower extremity of the actuating rod 56 to be moved out of engagement with the finger 54 and the coil spring 46, Figure 2, will operate to automatically effect the seating of the valve 40. The valve 66 will simultaneously be rotated so as to establish normal communication between the motor crank case and the chamber of the cylinder 6 so as to permit the normal feeding of gas to said cylinder.

It will be understood that in the construction shown in the drawings wherein the motor is of the double opposed cylinder type, only one of the cylinders is provided with my compression relief valve. The other cylinder has no relief valve therein. It will be likewise understood that in motors having more than two cylinders, the equivalent arrangements may be utilized for relieving the compression in a sufficient number of the cylinders to permit cranking.

One of the great advantages of my present construction resides in the fact that by relieving the compression in one of the cylinders of this double opposed motor, the ignition in the other cylinder will be substantially intensified thereby producing a fatter and hotter spark, and a more complete and quicker ignition. This is due to the fact that the ignition devices on spark plugs of a double opposed motor are in series in the ignition circuit and the sparks simultaneously. When there is no compression in one of the cylinders, this permits a more effective passage of the spark in the remaining cylinder which is under compression.

From the foregoing description it will be seen that in my improved compression relief device, I have provided a construction for effectively starting a multiple cylinder motor, particularly of the double opposed type, without changing the explosive mixture in the working cylinder or cylinders except to increase the amount of mixture supply to said cylinder or cylinders to intensify the initial explosive force. By intensifying the initial explosive force, the starting of the motor is greatly facilitated and the relief of the compression in one of the cylinders greatly minimizes the manual effort required to crank the motor. It is to be understood that my invention is not limited to the particular type of relief valve operating mechanism which has been described, but is capable of many other variations and modifications without

departing from the spirit and scope of the invention. By employing my improved method of starting multiple cylinder gas engines, it will be apparent that the ease with which the starting operation may be effected is greatly facilitated.

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

1. In a device of the class described, the combination of a multiple cylinder gas engine having a pair of cylinders in which the working charges are adapted to be simultaneously compressed, a compression relief device for one of the cylinders only of said engine.

2. In a gas engine of the two-cycle double opposed cylinder type in which the working charges are adapted to be simultaneously compressed, a compression relief for one of said cylinders only.

3. In a gas engine of the double opposed cylinder type, a valved port in one of said cylinders adapted to relieve the compression in said cylinder for starting the motor, and means for preventing the admission of a working charge in said other cylinder.

4. In a gas engine of the two-cycle multiple cylinder type, means for wholly relieving the compression in one of said cylinders to permit easy starting while compressing a working charge in the other cylinder.

5. In a gas engine of a multiple cylinder type wherein the working charges in the cylinders are adapted to be simultaneously compressed in pairs, means for substantially relieving the compression of the working charge in one cylinder of each pair while maintaining compression of the working charge in the other cylinder of each pair and filling the same.

6. In a gas engine of the double opposed type, means forming a compression relief port in one of said cylinders only, said port being of sufficient cross section to substantially completely relieve the compression in said cylinder during the compression stroke of the piston therein, a valve in said port, a spring normally maintaining said valve on its seat and means for holding said valve in open position against the tension of said spring and means for super-charging the other cylinder.

7. A gas engine having two cylinders of the two-cycle type disposed in opposed relation, and pistons operable in said cylinders and adapted to move outwardly on their compression strokes simultaneously, ignition means in each of said cylinders, said ignition means being arranged in series, one of said cylinders having a compression relief port of a sufficient cross section to substantially completely relieve the compression in said cylinder on the compression stroke of the piston therein, said opposite cylinder being constructed and ar-

ranged to maintain the compression of its working charge.

8. In a device of the class described, the combination of a multiple cylinder engine, a compression relief device for one of the cylinders only of said engine, and means for intensifying the normal explosive force in another of the cylinders, whereby the starting of the engine is greatly facilitated.

9. In a device of the class described, the combination of a multiple cylinder gas engine, a compression relief device for one of the cylinders only of said engine, and means operatively associated with the compression relief device for increasing the normal charge and intensity of the normal spark in one of the other cylinders of said engine whereby the starting of the engine is greatly facilitated.

10. In a gas engine of the two-cycle double opposed cylinder type, means for relieving the compression in one of said cylinders, and means super-charging the other cylinder.

11. In a gas engine of the double opposed cylinder type, a valved port in one of said cylinders adapted to relieve the compression in said cylinder for starting the motor, and means for cutting off the supply of mixture to said cylinder during the starting of the motor, and for materially increasing the amount of mixture supplied to the other cylinder whereby correspondingly to increase the explosive force within said last mentioned cylinder during the starting of the motor.

12. In a gas engine of the double opposed cylinder type, a valved port in one of said cylinders adapted to relieve the compression in said cylinder for starting the motor, means for cutting off the supply of mixture to said cylinder for starting the motor, and means for increasing the amount of mixture supplied to the other cylinder, said means being constructed and arranged for contemporaneously opening the valved port and the supply cut-off means.

13. In a gas engine of the multiple cylinder type wherein the cylinders are simultaneously compressed in pairs, means for substantially completely relieving the compression in one cylinder of each pair while maintaining compression in the other cylinder of each pair, and means operable in response to the compression relieving means for cutting off the supply of mixture to the relieved cylinder, and for directing it to the other cylinder whereby the charge in the latter is materially increased for starting the motor.

14. The method of starting a gas engine of the double opposed type which consists in substantially relieving the compression in one cylinder while compressing and firing a working charge in the other cylinder.

15. The method of starting internal combustion engines of the multiple cylinder type wherein the charges in the cylinders are compressed in pairs which consists in diminishing

the charge in one cylinder of each pair while increasing the working charge in the other cylinder of each pair.

16. The method of starting internal combustion engines, wherein the charges of the working cylinders are compressed in pairs which consists in substantially relieving the working charge adapted to be compressed in one cylinder while simultaneously increasing the normal working charge for the other cylinder, and at the same time increasing the normal intensity of the spark in said latter cylinder.

17. In a gas engine of the multiple cylinder type wherein the cylinders are adapted to have their working charges compressed in pairs, means for substantially relieving compression in one of the cylinders of the pair and for super-charging the other cylinder and for increasing the intensity of the normal spark in said super-charged cylinder.

18. An internal combustion engine having a crank case provided with two oppositely disposed cylinders, pistons working in said cylinders, said pistons being constructed and arranged simultaneously to compress the working charges in said cylinders, means for introducing a charge into said crank case to be compressed therein by said pistons, means for simultaneously transferring the charge compressed in said crank case to said cylinders, means for preventing the charge in said crank casing passing to one of said cylinders, and a valved outlet for said last mentioned cylinder for relieving compression therein and ignition means for said cylinders.

19. An internal combustion engine having a crank case provided with two oppositely disposed cylinders, pistons working in said cylinders, said pistons being constructed and arranged simultaneously to compress the working charges in said cylinders, means for introducing a charge into said crank case to be compressed therein by said pistons, means for transferring the charge compressed in said crank case to one of the said cylinders, means for preventing the charge in said crank case passing to the other of said cylinder, and a valved outlet for said last mentioned cylinder for relieving compression therein, and ignition means for said cylinders, and ignition means for passing a spark in both of said cylinders, the spark gases forming said sparks being arranged in series.

In witness whereof, I have hereunto subscribed my name.

HARRY L. JOHNSON.