Feb. 14, 1933. F. A. BULLINGTON 1,897,234

ANTIDETONATION COMBUSTION CHAMBER

Filed Nov. 12, 1928

Fig. 1.

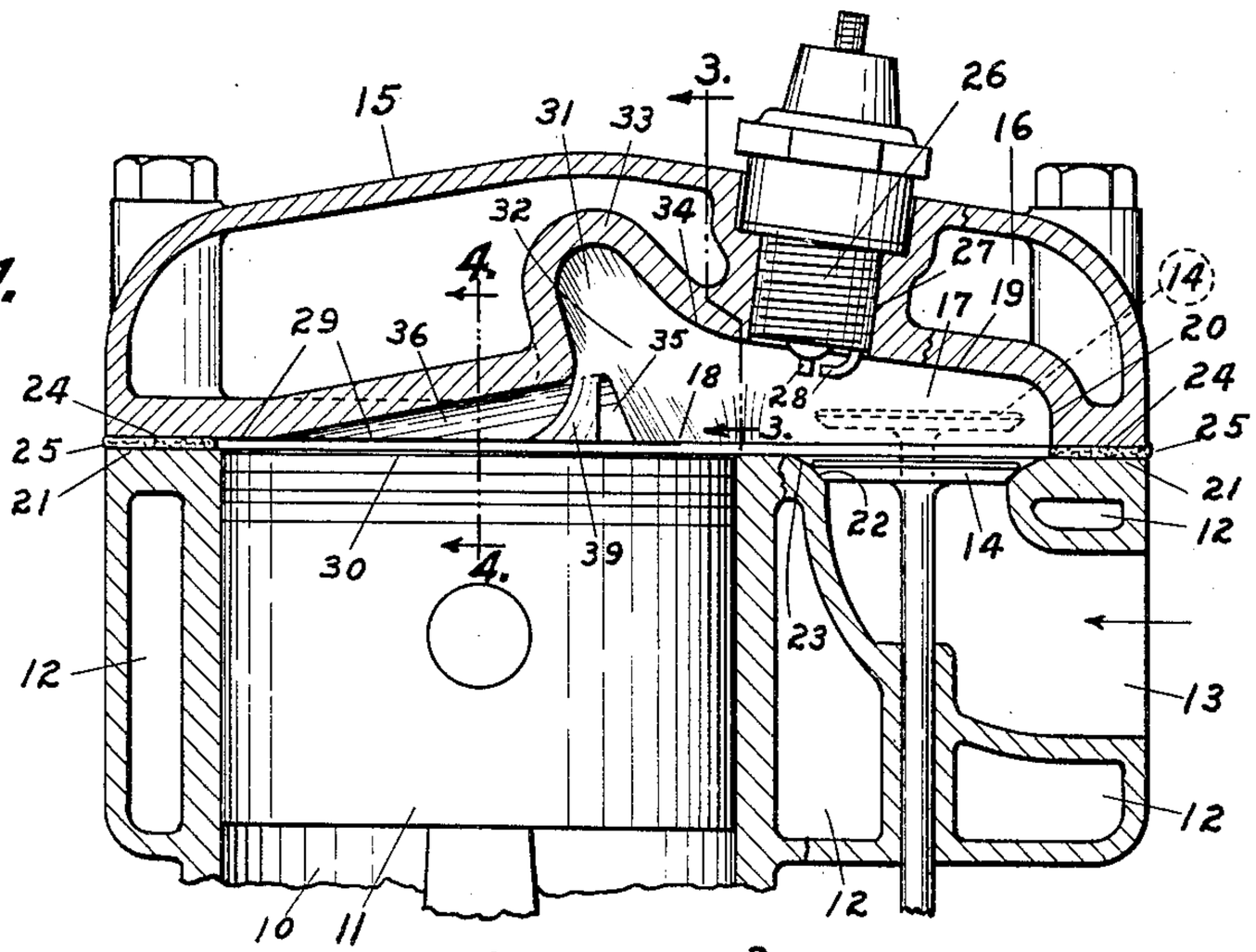

Fig. 2.

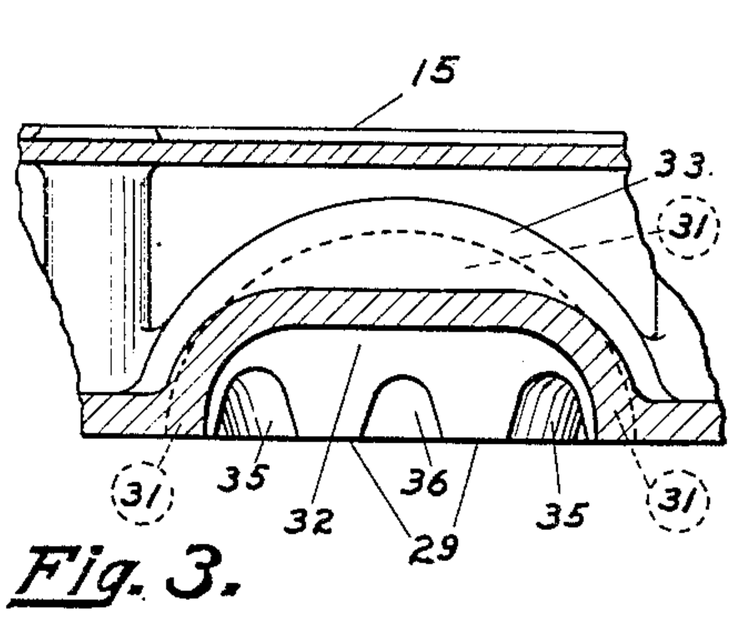

Fig. 3.

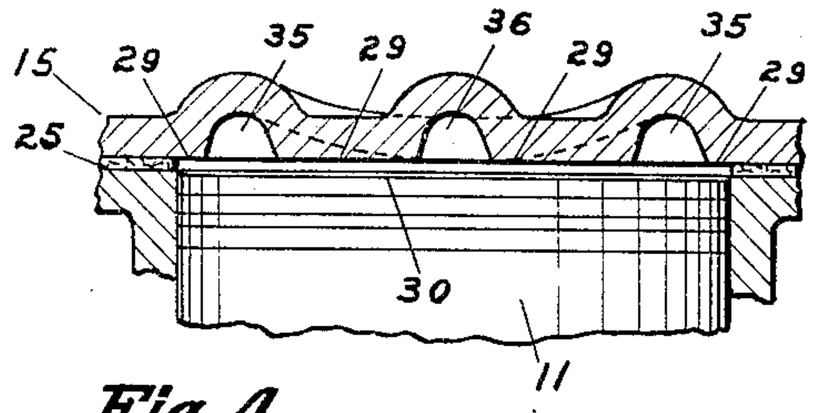

Fig. 4.

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UNITED STATES PATENT OFFICE

FRANK A. BULLINGTON, OF KANSAS CITY, MISSOURI, ASSIGNOR TO BULLINGTON ENGINE HEADS, OF KANSAS CITY, MISSOURI, A COMMON LAW TRUST CONSISTING OF HENRY C. TAMMEN, HOWARD P. TREADWAY, AND FRANK A. BULLINGTON

ANTIDETONATION COMBUSTION CHAMBER

Application filed November 12, 1928. Serial No. 318,965.

My invention relates to internal combustion engines and more particularly to antidetonation combustion chambers for internal combustion engines.

It is a purpose of my invention to provide a combustion chamber of the above mentioned character by providing a cylinder head in which space is provided in the form of a pocket adjacent the spark plug for absorbing the combustion pressure wave following ignition of the charge adjacent the spark plug.

It is another purpose of my invention to provide a combustion chamber of the above mentioned character by providing means for distributing initial combustion pressure in the cylinder head extending over the end of the cylinder and adapted to distribute said initial combustion pressure substantially uniformly over the head of the piston operating in said cylinder, at the time of initial combustion. Said distributing means is also preferably so arranged as to subdivide the terminal combustion and to diffuse the pressure wave of said terminal combustion to thereby prevent the occurrence of detonation. By terminal combustion, I mean the burning of the last portion of the fuel charge, which is usually that portion most remotely located with relation to the spark plug, or in such a portion of the fuel charge as will be considerably diluted with inert gas remaining in the combustion chamber from a preceding explosion. Detonating combustion, as commonly encountered in high compression engines, particularly those employing ordinary gasoline for fuel, apparently occurs and is associated with such terminal combustion as defined above.

The above mentioned features of my present invention are provided to prevent the occurrence of detonation, making it possible to use extremely high compression and explosion pressures with the resultant advantages of increasing the power capacity of a given size of engine and of decreasing of fuel consumption per unit of power developed.

It is another object of my invention to provide a combustion chamber for high compression engines which will produce smooth operation of such engines and thereby secure advantages of high speed operation without encountering objectionable vibration. This is accomplished by the pressure distributing means referred to above. Said pressure distributing means comprising terminal combustion diffusing means. Such distributing means are shown, broadly, in my application Serial #233,167, filed November 14, 1927 and the distributing means shown in the present application are an improvement over those shown in the above referred to application.

My improved distributing means are shown in this application, as being employed in a cylinder head of the type having a flat wall portion overlying the cylinder and closely approached by the piston at the end of its compression stroke, for the purpose of effecting displacement of fuel into the valve pocket combustion chamber to produce turbulence of the contents thereof and concentration of combustible fuel mixture in close proximity to the spark plug for rapid burning of the fuel charge. The pressure distributing means shown comprises an opening into the cylinder at one side thereof from the valve pocket chamber, and a plurality of grooves or channels in the flat wall portion of the cylinder head extending in spaced relation from the portion of the combustion chamber that extends over the end of the cylinder at the side thereof adjacent the valve pocket. These grooves or channels are preferably arranged in a spreading relationship from a point adjacent the valve pocket to provide a finger-like formation, said grooves approaching each other at the extremities thereof most remote from said valve chamber.

More specifically, the distributing means included in my invention comprise a pair of arcuate tapering grooves, located one on each side of the axial center of the cylinder and substantially concentric therewith, but of smaller radius of curvature than the cylinder, approaching each other closely at their ends and providing a substantially circular flat wall portion between the same. Preferably, in addition thereto, a central straight

tapering groove is provided extending across said circular flat wall portion substantially midway between the arcuate grooves and terminating between the ends thereof. All said grooves are shaped so as to decrease in cross sectional area and in depth in a direction from the valve pocket combustion chamber to the extremities thereof remote from said valve pocket chamber, diminishing substantially to zero at such extremities.

It is a very important function of the grooves to provide a substantial subdivision of that portion of the fuel charge which must, of necessity, be the last to burn, and to provide an attenuated form to each subdivision of the fuel charge so that as combustion proceeds therethrough the cross sectional area of the unburned fuel is being constantly reduced to the end that the final burning or terminal combustion will occur in only that small quantity of fuel confined in the narrow space between the piston and the cylinder head between the ends of the grooves. This arrangement for extreme final terminal combustion will probably be effective only at slow and medium engine speeds for, at high speed of operation, where detonation is not ordinarily encountered, the piston will be advanced on its power stroke in greater spaced relation from the cylinder head before combustion is completed. Thus the arrangement described provides the subdivision of the last portion of the charge to burn, where necessary, to avoid detonation.

The grooves furthermore serve to control terminal combustion due to provision of wall surfaces of relatively large area as compared with the amount of fuel contained in the grooves, to provide heat radiating means of relatively large capacity, to cool that portion of the fuel charge in which final or terminal combustion occurs, thus reducing further the tendency of the fuel to detonate.

The pocket-like recess in the combustion chamber, which is one feature of my invention, serving as means to avoid detonation, is preferably located substantially directly over the entrance from the valve pocket combustion chamber to the cylinder and is arranged so as to have its entrance closely adjacent the ignition means. Such as arrangement is shown in a broad sense in my application Serial #174,285, filed March 10, 1927.

In the form of the invention shown in the present application, said pocket is shown as being of a relatively small capacity as compared with the pocket or chamber shown in a similar location in my application Serial #174,285, referred to above, and is preferably of an arcuate form and decreases in cross sectional area from its opening into the main combustion space in the cylinder head, to the closed opposite wall portion thereof, which forms the bottom or inner end wall of the pocket, said recess or pocket preferably being inclined at an oblique angle away from the spark plug from its open side toward its closed end wall.

One of the purposes of the pocket is to provide a chamber or recess for receiving and retaining a portion of the hot burned gas, remaining after the combustion of a charge, during the intake of a fresh fuel charge, and to serve as a heat radiating cooling means for the said hot contents of said recess and pocket during the intake stroke of the engine, the fresh fuel charge being drawn directly into the cylinder without entering said pocket or recess. This will effect greater volumetric efficiency for the engine due to the isolation of a portion of the hot inert burned gas.

Another of the purposes of the pocket or recess referred to is to provide means for receiving fresh fuel mixture from the cylinder during the compression stroke of the piston, said fuel displacing at least a portion of the inert gas contained in the pocket, said displaced inert gas being mingled with the fresh fuel mixture contained in the remainder of the combustion space in the cylinder head. The pocket will thus contain a combustible mixture of relatively greater diluted character than that in the greater portion of the combustion chamber in the cylinder head, by reason of the greater inert gas content therein, and will therefore possess slower burning characteristics than the greater quantity of fuel contained in the remainder of the combustion chamber, which last mentioned quantity will burn more rapidly and cause a rapid rise of pressure due to its combustion. The contents of the detonation preventing pocket or recess, which will be burning slowly, will then be subject to the combustion pressure originating from the burning of the richer fuel mixture in the remainder of the combustion chamber, and will act as a cushioning means therefor, thus reducing or eliminating the tendency toward detonating combustion.

It is also a purpose of my invention to arrange the valves in shallow recesses provided therefor in the cylinder block so that the same are sunk below the bottom of the valve pocket in order to make the valve pocket wall over the valves as low as possible at the extremity of the pocket remote from the cylinder, and reducing the size of the valve pocket to a minimum at this extremity. By this arrangement the volume of fuel adjacent the ignition means in said valve pocket is relatively greater than would be the case if the size of the pocket were not reduced at the extremity thereof referred to above.

Other objects and advantages of my invention will appear as the description of the drawing proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details of structure shown or described, but that I intend to in-

clude as part of my invention all such obvious changes and modifications of parts as would occur to a person skilled in this art and as would fall within the scope of the claims.

In the drawing:

Fig. 1 is a vertical sectional view through the cylinder head and the adjoining portion of the cylinder block, the lower portion of said cylinder block being broken away, the major portion of said cylinder head and cylinder block being shown in section on the transverse diameter of the cylinder and a portion thereof adjacent the valves being shown in section on the transverse diameter of one of the valves.

Fig. 2 is a fragmentary bottom plan view of the cylinder head, the location of the valves and cylinder relative thereto, when in position, being indicated diagrammatically thereon in broken lines.

Fig. 3 is a fragmentary section taken on the line 3—3 of Figs. 1 and 2 and

Fig. 4 is a similar section taken on the line 4—4 of Figs. 1 and 2.

Referring in detail to the drawing, my improved cylinder head is shown as being applied to a cylinder block having the cylinder 10 therein in which the piston 11 operates in the usual manner. The cylinder 10 is provided with a water jacket having the spaces 12 provided therein for the circulation of a cooling medium, such as water. The usual inlet and exhaust passages are provided in the cylinder block, the inlet passage 13 being shown in Fig. 1 with which the inlet valve 14 is associated. The exhaust valve 15 is shown in dotted outline in Fig. 2, showing its position relative to the inlet valve.

Associated with said cylinder block is a cylinder head 15 which is provided with the space 16 for cooling medium and which is further provided with a valve pocket combustion chamber 17, which overlaps the cylinder 10 at 18, said valve pocket combustion chamber 17 being provided with an inclined wall portion 19 so that said combustion chamber decreases in depth toward the wall 20 thereof remote from the cylinder. The combustion chamber 17 is relatively shallow so as to make the same of a minimum capacity at the portion thereof most remote from the cylinder, and in order to reduce the depth of said chamber as much as possible the valves are located below the top surface 21 of the cylinder block, the valve seats 22 being provided in countersunk or recessed portions 23 in said cylinder block. The cylinder head is provided with a flat wall portion 24 that serves as a clamping face cooperating with the flat top wall portion 21 to clamp the gasket 25 therebetween. The valve pocket combustion chamber 17 is provided with suitable ignition means shown in the form of a spark plug 26 mounted in the threaded opening 27 in the cylinder head, the terminals 28 thereof being located in the valve pocket combustion chamber 17 near the opening from the valve pocket chamber into the cylinder.

The cylinder head is provided with a restricting flat wall portion 29 overlying the cylinder and having mechanical clearance from the head portion 30 of the piston 11 when the same is at the end of its compression stroke. This restricting wall portion 29 serves to restrict the application of initial combustion pressure to the head 30 of the piston 11. The cylinder head is further provided with a cavity having a pocket or recess portion 31 which is located closely adjacent the ignition means 26 and said pocket has its opening or entrance 32 leading into the valve pocket forming portion 17 of said cavity closely adjacent said ignition means.

Said recess portion or pocket 31 is of an arcuate shape, as will be clear from Figs. 2 and 3, in which the outline thereof is shown in dotted lines. Said pocket is furthermore provided with a closed inner wall portion 33, the only opening into the same being the opening 32 which overlies with the cylinder 10 at the side thereof adjacent the valves. It will be further noted that the pocket or recess portion 31 has its walls inclined at an oblique angle relatively to the axis of the cylinder so that it extends away from the ignition means 26 from the opening 32 leading into the pocket toward the closed inner end wall 33 thereof, the wall of the pocket 31 and the wall 19 merging in a gradual curve 34, so that the flame resulting from initial combustion in the valve pocket chamber 17 will more readily enter said pocket 31. The pocket 31 serves as a combustion pressure cushioning chamber and absorbs the explosion pressure wave originating at the ignition means 28. The side walls 40 of the valve pocket converge toward the cylinder to direct the fuel toward the center of said cylinder.

In operation the chamber 31 will be filled with inert hot burned gas when the fresh fuel mixture enters through the valve 14. The tendency will be for the fresh fuel mixture to be drawn into the cylinder 10 during the suction stroke of the piston 11 past the entrance 32 of the chamber 31, thereby avoiding the mingling of fresh fuel mixture with the hot burned inert gas confined in said pocket 31. During the compression stroke the fresh fuel mixture enters the chamber or pocket 31 and will create a certain amount of turbulence therein which will cause the hot inert burned gas to be mixed with the fresh fuel mixture, diluting the same to a greater extent than will be the fuel mixture in the valve pocket combustion chamber 17. When ignition occurs the contents of the valve pocket combustion chamber 17 will

burn more rapidly than the contents of the supplemental chamber 31, the pressure wave due to the explosion of the charge in the chamber 17 will enter the chamber 31 and due to the slower burning qualities of the fuel mixture therein, the pressure wave will be cushioned as it enters said supplemental chamber 31, thus serving to prevent detonation of the fuel charge.

In addition to the provision of the pocket 31 serving as a combustion pressure cushioning and explosion wave absorbing chamber, combustion pressure distributing and explosion wave diffusing means is provided in the flat restricting wall portion 29 of the cylinder head. Said means preferably comprises a plurality of grooves, said grooves extending from the valve pocket combustion chamber to a point in the cylinder head substantially opposite the valve pocket chamber and remote therefrom. Said means preferably comprises a pair of arcuate grooves 35 which are curved on an arc having a somewhat smaller radius of curvature than that of the cylinder 10, the position of which is shown diametrically in broken lines relative to the grooves in Fig. 2, and a central substantially straight groove 36 may also be provided. The grooves 35, as will be obvious from Fig. 1 and from Figs. 3 and 4, taper from the entrance thereof adjacent the valve pocket chamber 17 to the extreme ends 37 thereof remote from the valve pocket chamber, said grooves decreasing in both width and depth toward the extremities 37, the cross sectional areas thereof decreasing substantially to zero at such extremities. The groove 36 tapers similarly to the extremity 38 thereof, said extremity 38 lying substantially between the extremities 37 of the grooves 35, said extremities 37 being spaced, as clearly shown in Fig. 2.

The entrances of the grooves 35 and 36 are between the pocket 31 and the cylinder 10 and the wall portions of the valve pocket chamber are rounded off between the entrances to said grooves, as indicated at 39, to avoid all sharp corners adjacent thereto and to provide for the easy entrance of some of the contents of the valve pocket chamber into the grooves, particularly the central groove 36.

It will be noted, upon reference to Fig. 2, that the grooves 35 and 36 extend in spaced relation from the valve pocket chamber 17, and are of a finger-like form, tapering toward the extremities thereof, which are closely adjacent each other. As a result the said grooves serve as a combustion pressure distributing means over the end of the cylinder, and serve to distribute the initial combustion pressure substantially uniformly over the head of the piston. A more uniform distribution of said pressure is obtained by spacing the arcuate grooves 35 from the side edge of the cylinder, than would be otherwise the case. The grooves, furthermore, serve to subdivide the portion of the fuel charge over the piston head at the time of initial combustion, and place a relatively small quantity thereof at the point where terminal combustion occurs. This causes such diffusion of combustion pressure as to avoid detonation due to any cumulative explosive action of the explosion pressure waves travelling in the grooves and the terminal combustion of the charge at the point in the cylinder head most remote from the valve chamber. It will be noted that as combustion occurs progressively along the grooves from the valve pocket combustion chamber 17 toward the reduced extremities thereof, the amount of fuel in the grooves to be ignited progressively decreases due to the progressive decrease in cross sectional area of the grooves toward their extremities, and the final or terminal combustion of the charge occurs in the space between the flat wall portion 29 and the piston head 30 between the extremities 37 and 38 of the grooves, and this being a very small quantity of fuel mixture, the detonating effect thereof will be substantially nothing.

Having thus described my invention, what I desire to claim and secure by United States Letters Patent is:—

1. In an internal combustion engine, a cylinder and a cylinder head having a valve pocket combustion chamber at one side thereof and having a combustion pressure cushioning chamber in said head communicating with said valve pocket chamber said head having a wall portion channeled to provide combustion pressure distributing means in said cylinder head extending from said valve pocket chamber over said cylinder.

2. In an internal combustion engine, a cylinder and a cylinder head having a valve pocket combustion chamber at one side thereof and having a combustion pressure cushioning chamber in said head communicating with said valve pocket chamber through an opening substantially overlying said cylinder, said cushioning chamber being otherwise closed said head having a wall portion channeled to provide combustion pressure distributing means in said cylinder head extending from said valve pocket chamber over said cylinder.

3. In an internal combustion engine, a cylinder and a cylinder head having a valve pocket combustion chamber at one side thereof, a combustion pressure cushioning chamber in said head communicating with said valve pocket chamber and combustion pressure distributing means in said cylinder head comprising grooves extending from said valve pocket chamber over said cylinder.

4. In an internal combustion engine, a cylinder, a piston operating therein, and a cylinder head, said cylinder head having a valve

pocket recess at one side thereof, a restricting wall portion overlying said cylinder and having a smooth surface of substantial area lying substantially parallel to the head of said piston and having pressure distributing, pressure wave diffusing grooves in said restricting wall portion extending from said valve pocket recess.

5. In an internal combustion engine, a cylinder, a piston operating therein, and a cylinder head, said cylinder head having a valve pocket recess at one side thereof, a restricting wall portion overlying said cylinder and having a smooth surface of substantial area lying substantially parallel to the head of said piston and taperng grooves in said restricting wall portion extending from said valve pocket recess.

6. In an internal combustion engine, a cylinder, a piston operating therein, and a cylinder head, said cylinder head having a valve pocket recess at one side thereof, a restricting wall portion overlying said cylinder substantially parallel to the head of said piston and tapering grooves in said restricting wall portion extending from said valve pocket recess said grooves decreasing in cross section away from said valve pocket recess and having the smaller ends thereof approaching each other.

7. In an internal combustion engine, a cylinder, a piston operating therein, and a cylinder head, said cylinder head having a valve pocket combustion chamber at one side thereof, a restricting wall portion overlying said cylinder substantially parallel to the head of said piston, and arcuate grooves substantially concentric with the cylinder extending from said valve pocket chamber and terminating in spaced relation at a point remote from said valve pocket chamber.

8. In an internal combustion engine, a cylinder, a piston operating therein, and a cylider head, said cylinder head having a valve pocket combustion chamber at one side thereof, a restricting wall portion overlying said cylinder substantially parallel to the head of said piston, arcuate grooves substantially concentric with the cylinder extending from said valve pocket chamber and terminating in spaced relation at a point remote from said valve pocket chamber and a central groove extending from said valve pocket chamber and terminating adjacent the spaced ends of said arcuate grooves.

9. In an internal combustion engine, a cylinder and a cylinder head, said head having a valve pocket recess therein overlapping said cylinder at one side thereof and open thereto and a groove-like pocket in said cylinder head having an opening overlying said cylinder at the side thereof adjacent said valve pocket, leading directly into said valve pocket recess, said groove-like pocket being otherwise permanently closed.

10. In an internal combustion engine, a cylinder and a cylinder head, said head having a valve pocket recess therein overlapping said cylinder at one side thereof and a groove-like pocket in the wall of said recess opening directly into said valve pocket recess over the cylinder and being otherwise permanently closed.

11. In an internal combustion engine, a cylinder and a cylinder head having a valve pocket recess, ignition means, said cylinder head having an arcuate groove in the wall of said recess spaced from said cylinder and opening into said recess adjacent said ignition means.

12. In an internal combustion engine, a cylinder a cylinder head having a valve pocket recess overlapping said cylinder at one side thereof, ignition means in said recess, said cylinder head having an arcuate groove in said recess opening into said recess in alignment with the portion thereof overlapping said cylinder and adjacent said ignition means.

13. In an internal combustion engine, a cylinder and a cylinder head having a recess therein extending to one side of said cylinder to provide a valve pocket at one side of said cylinder, a secondary recess in said head communicating with said first recess and grooved combustion pressure distributing means in said cylinder head extending from said first recess over said cylinder.

14. In an internal combustion engine, a cylinder head having a recess therein extending to one side of said cylinder to provide a valve pocket at one side of said cylinder, a secondary recess in said head communicating with said first recess, a restricting wall portion in said head opposite said valve pocket and combustion pressure distributing grooves in said restricting wall portion extending from said first recess.

In testimony whereof, I hereunto subscribe my name this 8th day of November, 1928.

FRANK A. BULLINGTON.