

Aug. 10, 1926.

1,595,148

C. W. GARDNER

INTERNAL COMBUSTION ENGINE

Filed April 17, 1922

4 Sheets-Sheet 1

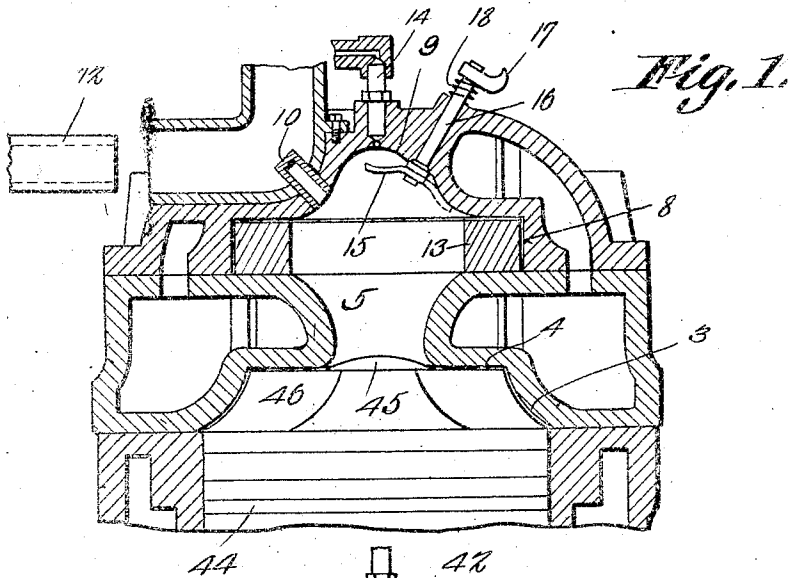


Fig. 5.

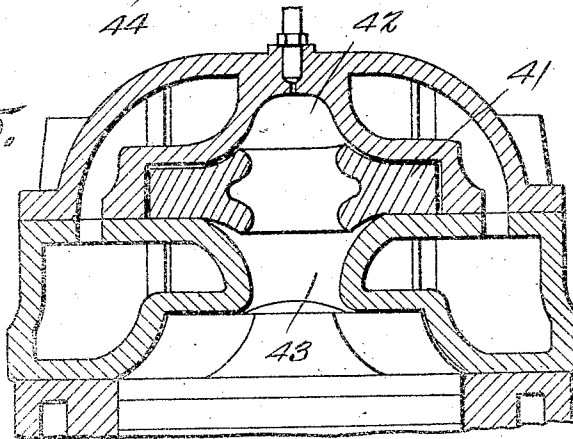


Fig. 11.

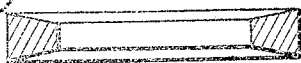
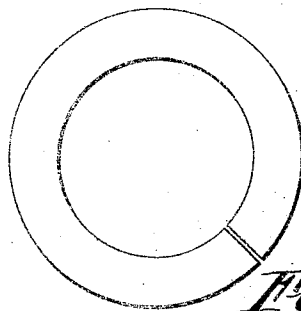


Fig. 12.

by E.F. Gardner, Survivor of Community Estate.
at new

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Fig. 2.

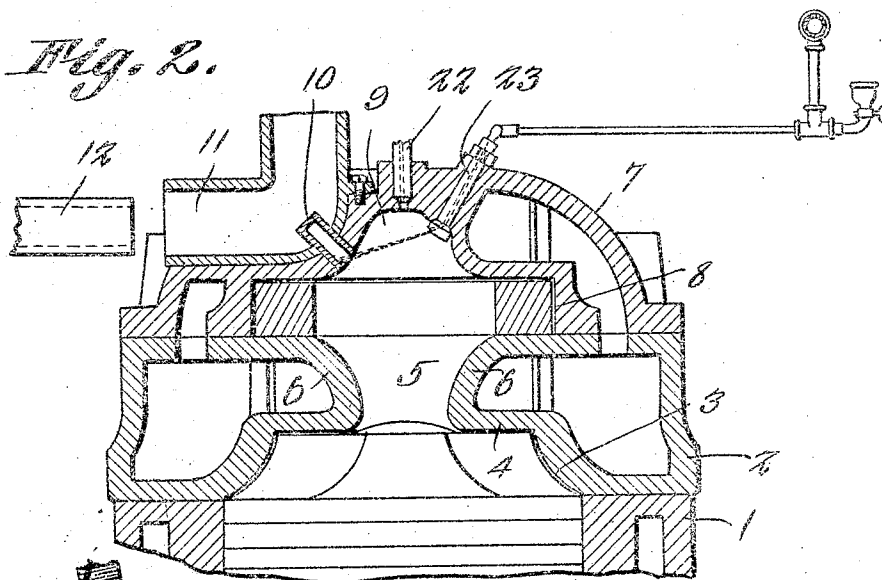


Fig. 3.

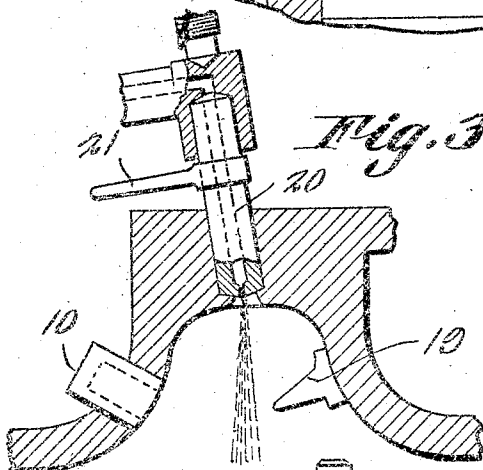


Fig. 4.

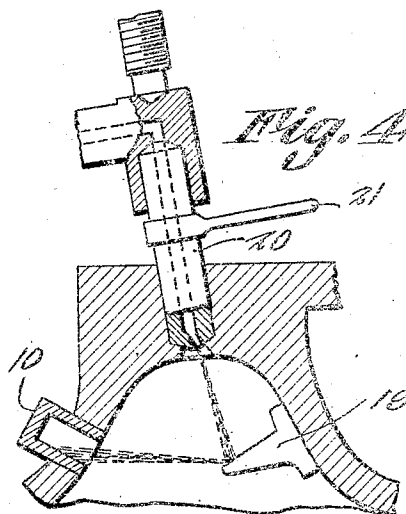
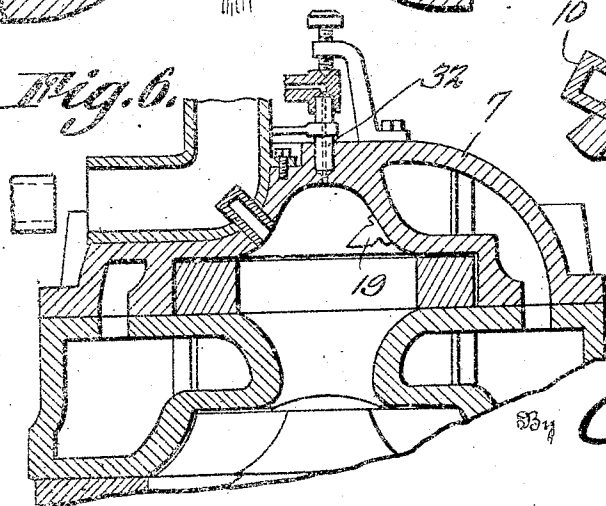


Fig. 6.



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Fig. 7.

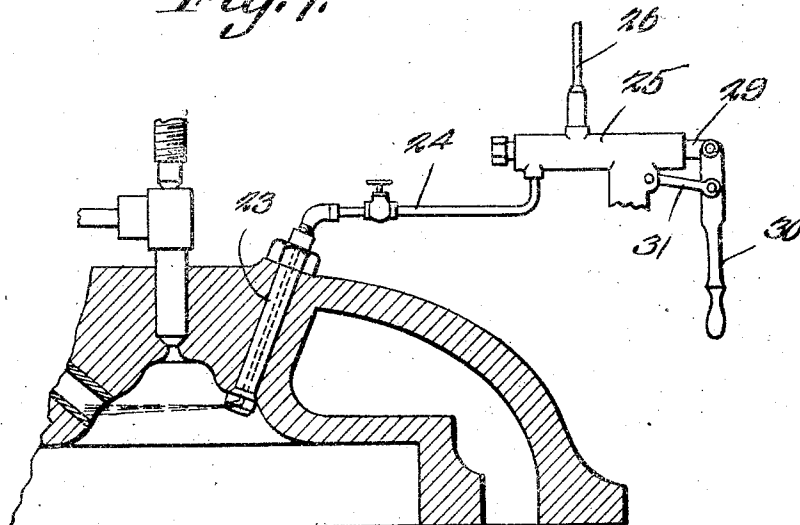
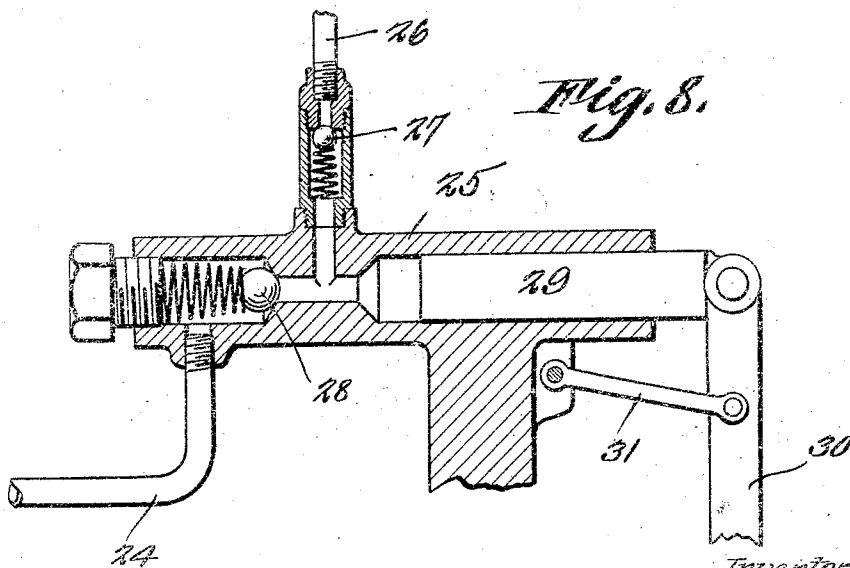


Fig. 8.



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C. W. GARDNER
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Fig. 9.

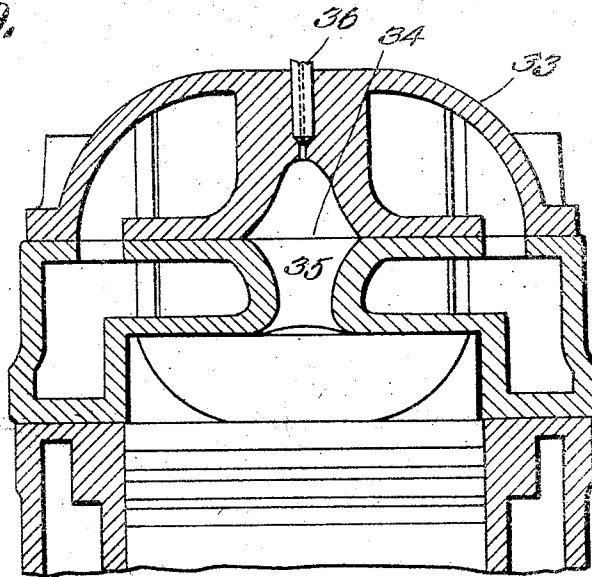
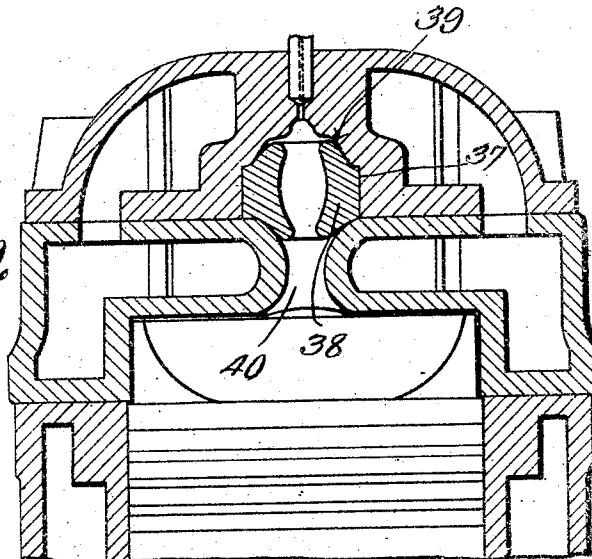


Fig. 10.



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By C. A. Snow & Co.
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UNITED STATES PATENT OFFICE.

CHARLES W. GARDNER, DECEASED, LATE OF AUSTIN, TEXAS; BY ELIZABETH F. GARDNER SURVIVOR OF COMMUNITY ESTATE, OF AUSTIN, TEXAS.

INTERNAL-COMBUSTION ENGINE.

Application filed April 17, 1922. Serial No. 554,318.

This invention relates to internal combustion engines of any of the various types designed to use native crude and fuel oils, and also to those engines which, with more or less success, have been developed for burning shale oils, tar oils, and the like.

Up to the present time the only practical engines capable of burning heavy oils have been the "Diesel" engines and the high compression, solid injection engines, and, in more recent years engines of the surface ignition type. The Diesel and high compression, solid injection engines have been very heavy in construction and expensive and have also been subject to failure at times because the heat generated has resulted in cracking of the cylinder heads. In the more recent surface ignition type of engines, otherwise known as "semi-Diesel," "hot bulb," "hot-head," "solid-injection" etc. engines, there is comparatively low compression, the construction is lighter and the cost is thus materially reduced. In these engines the fuel is injected through a small nozzle but owing to the low compression which is not sufficient to provide good combustion, other means, such as a hot bulb or a hot compression chamber, are provided for supplying the necessary heat. The parts of the engines of this type are usually without a water jacket or are only partially water cooled so that the heat generated by the combustion and given off within the cylinder or combustion chamber produces the necessary combustion. These heated parts soon become destroyed and the cylinder head to which they are attached quickly fails. Furthermore difficulty is encountered in keeping the parts at the proper temperature to insure good combustion.

It is an object of the present invention to provide a permanent and efficient combustion chamber for Diesel and high compression engines and the like, means being provided whereby the heat can be varied so as to insure the proper burning of the fuels used, the improvements being applicable as well to surface ignition engines and the like as to those of the Diesel and high compression type.

Another object is to provide simple and efficient means for furnishing additional heat needed in comparatively low compression engines to insure good combustion.

A further object is to provide a means

for automatically regulating the temperature in the combustion chamber, so that when the engine is under no load or under a light load and the combustion chamber would ordinarily cool off, the temperature desired is maintained instead of being reduced thus insuring proper combustion.

Another object is to provide an engine which does not depend on manual means for controlling the heat.

A still further object is to provide an engine having means whereby the compression pressure can be varied readily to meet the requirements of the fuel to be burned.

A further object is to provide a supplemental heating means to facilitate starting of the engine.

A still further object is to combine with the supplemental heating means a deflecting means whereby the fuel directed into the engine will be sprayed upon the heating means.

With the foregoing and other objects in view which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that, within the scope of what is claimed, changes in the precise embodiment of the invention shown can be made without departing from the spirit of the invention.

In the accompanying drawings the preferred forms of the invention have been shown.

In said drawings—

Figure 1 is a section through one end portion of the cylinder of the surface ignition, semi-Diesel type to which the present improvements have been applied.

Figure 2 is a section showing a modified structure in which the fuel for priming is sprayed directly to the heating tube.

Figure 3 shows a portion of a structure utilizing a rotatable nozzle and a deflector whereby fuel may be directed either to the heating tube or directly into the combustion chamber.

Figure 4 is a view similar to Figure 3 and showing the nozzle shifted to direct the jet against the deflector.

Figure 5 shows a structure for utilizing a multiple spray in connection with a modified form of heat ring.

Figure 6 is a view showing a structure

similar to that in Figure 1 but which does not employ a deflector.

Figure 7 is a section through another form of structure utilizing a priming nozzle as shown in Figure 2 but provided with a force feed or injection pump.

Figure 8 is a section through the pump mechanism shown in Figure 7.

Figure 9 is a section through a portion of a high compression engine embodying certain improvements and which has no heat ring.

Figure 10 is a similar view showing a high compression engine provided with a heat ring whereby very heavy fuels can be burned.

Figure 11 is a section through one form of heat ring that can be used.

Figure 12 is a plan view thereof.

Figure 13 is a section through another form of heat ring.

Figure 14 is a section through another modified form of heat ring.

Figure 15 is a section through a heat ring of another form.

Referring to the figures by characters of reference 1 designates a portion of the cylinder of the engine which is water cooled as ordinarily. Suitably secured on this cylinder is a head 2 water cooled as shown. A central recess 3 is formed in one face of the head, one end of this recess opening into the cylinder while the walls of the recess converge along curved lines to an annular shoulder 4 surrounding a central passage 5. The walls of this passage diverge away from the cylinder along curved lines as shown at 6 so as to form a Venturi tube opening through the outer face of the head. The wall 6 merges along curved lines into the shoulder 4.

Secured on the head 2 is a super-head or cap 7 likewise water cooled as shown and having a circular recess 8 in that face thereof fastened to the head 2. In the structure shown in Figures 1 and 2 this cap or super-head has a dome-like recess 9 extending from and merging into the recess 8 and extending through the wall of the recess 9 is a heating tube 10 the outer closed end of which projects into a flue or chimney 11 which is secured firmly to the cap or super-head and is designed to receive a flame from a blow torch 12.

Seated within the recess 8 is a heat ring 13 the size and shape of which is dependent upon the character of the fuel to be burned. This ring is normally loose within the recess 8 but will expand when heated to a predetermined temperature so as to come into contact with the water cooled wall of the recess 8 and thus be chilled thereby.

The recess 9, the space within the ring 13, and the passage within the Venturi tube cooperate to form a combustion chamber and discharging into this chamber through the

center of the dome-like recess 9 is a fuel nozzle 14. In the construction shown in Figure 1 this nozzle is designed to project a jet of fuel against a deflecting tongue or projection 15 supported within the recess 9 by a rotatable stem 16. This stem can be rotated by means of a finger piece 17 and a spring 18 can be used for holding the stem frictionally in any position to which it may be moved. The tongue or projection 15 is adapted to be extended into the path of the fuel jet during the starting of an engine so that the fuel will be deflected into the heating tube 10. After the engine has started, however, the tongue or projection can be swung downwardly or laterally away from the path of the jet so as to contact with the wall of the recess 9 and be cooled thereby. Consequently the danger of burning off the projection during the operation of the engine is obviated.

Instead of providing an adjustable deflecting element such as described a stationary deflecting projection such as shown at 19 in Figures 3 and 4 may be used. This projection is mounted on the water cooled wall of the cap or super-head. The nozzle 20 in this construction is adapted to be rotated, as by means of a handle 21. When the nozzle is in one position the fuel will be sprayed past the projection or deflector and into the combustion chamber. When it is desired to start the engine, however, the nozzle can be rotated from the position shown in Figure 3 to the position shown in Figure 4, thus to throw the jet of fuel against the deflecting projection 19 which, in turn, will spray the fuel into and against a heating tube 10.

Another means for starting an engine of low compression has been illustrated in Figure 2. This structure does not use a deflector but, instead, utilizes, in addition to the usual feed nozzle 22, a priming nozzle 23 seated in the cap or super-head 27 and adapted to project a jet of fuel into and against the heating tube 10. The priming fuel can be directed to the nozzle by gravity as shown in Figure 2 or a forcing means such as illustrated in Figures 7 and 8 can be used. In this construction the nozzle 23 is connected by a valved tube 24 to a pump casing 25 provided with a feed tube 26. As shown in Figure 8 a spring pressed check valve 27 is adapted to close communication with the feed tube during the ejection of fuel from the pump while another spring pressed check valve 28 is adapted to close communication with the tube 24 during the suction of fuel into the pump. A plunger 29 is mounted for reciprocation in the pump casing and is adapted to be operated by a lever 30. This lever may be provided with a moving fulcrum on a link 31. Obviously by pulling the lever 30 in one direction

priming fuel will be sucked into the casing 25 from the tube 26 and by shifting the plunger in the opposite direction the fuel will be forcibly ejected through nozzle 23 as illustrated in Figure 7.

By referring to Figure 6 it will be noted that the nozzle 32, corresponding with the nozzle 20 shown in Figures 3 and 4, can be arranged perpendicularly within the cap or super-head 7, this nozzle having its outlet so positioned that by turning the nozzle the liquid fuel can be directed either against the deflector 19 or straight into the combustion chamber.

In high compression engines it is not always necessary to use heat rings, this being particularly true where medium grade fuel oils are used. In Figure 9 one form of high compression engine has been illustrated, the cap or super-head 33 being formed with a recess 34 corresponding with the recess 9 but opening directly into the passage 35 instead of into a ring receiving recess as in Figure 2. The walls of the recess 34 and of the passage 35 are curved in this structure along substantially the same lines as in the forms heretofore described and as no heating tube is necessary the nozzle 36 can discharge directly into the combustion chamber made up of the recess 34 and passage 35. Where very heavy grades of oil are used in high compression engines it is preferred to utilize a heating ring within the super-head or cap. Such a structure has been shown in Figure 10 wherein a recess 37 is formed in the cap or super-head and a heating ring, illustrated at 38 is seated in the recess, this ring and the structure shown having an opening therethrough of greater diameter at its center than at its ends, the inner end of the opening being smaller than the outer end. The ring has its opposed faces shaped to fit into the recess 39 in the cap or super-head and to fit into one end portion of the passage 40. In other types of high compression engines the heat ring can be of relatively larger diameter, as shown at 41 in Figure 5 and need not extend so far into the recess 42 or into the passage 43. As shown in Figures 11 to 15 inclusive various other kinds of rings can be used, this depending on the type of engine, the kind of fuel employed, and the degree of heat to be normally maintained. All of these rings except that illustrated in Figure 14 are formed in one piece. The ring shown in Figures 11 and 12 is split but such a ring cannot be used where automatic regulation of temperature as hereinafter pointed out, is to be secured.

In order that the greatest possible compression can be obtained the piston of the engine, which has been illustrated at 44 can be formed with a central node 45 adapted to work up into the small end of the pas-

sage 5 in the form of engine shown in Figures 1 and 2 or into the corresponding passages formed in the other structures. The end of the piston is so shaped that it fits snugly in the recess 3 and diametrically opposed depressions 46 are formed in the ends of the piston so as to permit expansion of the exploded fuel from the combustion chamber into the space between the shoulder 4 and the piston.

When it is desired to start a low compression engine the tube 10 is heated either by means of a torch as shown or in any other manner desired. Fuel is ejected into the internal combustion chamber and will be deflected against and into the tube so as to cause ignition of the fuel. After the engine has started the tongue 15 can be swung against the wall of the recess 9 so as to be cooled by the wall. Therefore this tongue will not be burned off because of constant exposure to excessive heat in the engine. Where fixed deflectors such as those shown at 19 are used the operation will be the same but these fixed deflectors are kept cool by the cooled walls from which they extend. Continued operation of the engine will result in the heating of the ring 13 or its equivalent and as this ring is heated it will gradually expand within its recess 8. The heat of the ring will be ample to insure combustion of the fuel under compression but should the ring be heated to an excessive temperature likely to produce "cracking" of the fuel, it will, by expansion, come into contact with the wall of the recess 8 and be cooled thereby. As the ring is thus cooled it will gradually contract away from the wall. Thus it will be seen that the temperature of the ring will be maintained substantially constant. The size of the ring and the shape thereof will control the degree of temperature to be maintained and obviously where one kind of fuel is to be used a ring of particular size and shape should be employed whereas when another kind of fuel is to be used a different shape and size of ring should be employed.

In high compression engines the use of supplemental heating tubes or the like is unnecessary but it is desirable, except where medium or high grade fuel is used, to employ a heat ring which, by expansion and contraction relative to the wall of the cap or super-head will be maintained approximately at a predetermined temperature.

A feature of prime importance resides in the use of curved walls for the Venturi passage and for the other parts of the combustion chamber. In engines of the types heretofore employed for burning heavy fuels the walls have been along straight lines with the result that the expansion thereof due to the heat has resulted in the compression and increased solidification of the metal.

Consequently when the walls have contracted as a result of cooling cracks have been formed therein and the head rendered unfit for use. By employing curved walls at those points where the engine is subjected to the greatest heat and consequently to the greatest expansion and contraction, the metal forming the walls will not solidify and crystallize because of the high degree of expansion but will tend to buckle or yield under the increased pressure due to expansion and, consequently, when the walls contract while cooling they will not crack. It will be noted that in all of the structures illustrated the walls of the combustion chambers are formed along curved lines so that the foregoing advantageous result can be obtained.

What is claimed is:—

1. In an internal combustion engine a combustion chamber having a water cooled wall, a heat ring within and of less diameter than the combustion chamber and having all portions thereof normally spaced from the

wall of the chamber, said ring being expandable by heat to position all portions of its periphery tight against the wall of the chamber thereby to allow direct conduction of heat from the ring to the water cooled wall of the chamber.

2. In an internal combustion engine a combustion chamber having a water cooled wall and top, a heat ring within and of less diameter than the combustion chamber and having all portions thereof normally spaced from the top and wall of the chamber, said ring being expandable by heat to position all portions of its periphery tight against the wall of the chamber, thereby to allow direct conduction of heat from the ring to the water cooled wall of the chamber.

In testimony that I claim the foregoing as the invention of the said CHARLES W. GARDNER, I have hereto affixed my signature.

ELIZABETH F. GARDNER,
*Survivor of Community Estate of Charles
W. Gardner, Deceased.*