H. F. SADGEBURY.

SPARK PLUG.

APPLICATION FILED NOV. 10, 1913.

1,269,860.

Patented June 18, 1918.

2 SHEETS—SHEET 1.

FIG. 1.

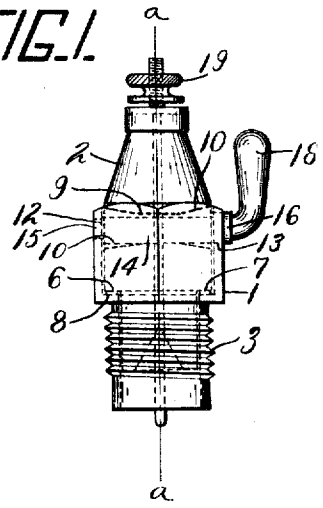


FIG. 2.

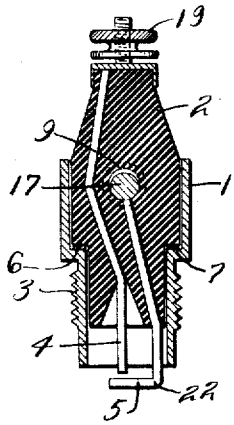


FIG. 3.

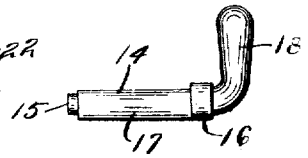


FIG. 4.

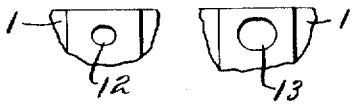


FIG. 5.

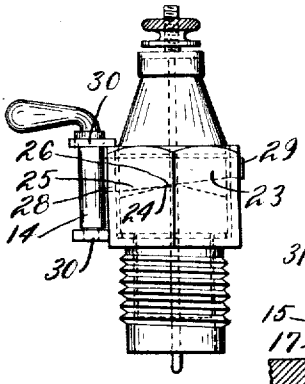


FIG. 6.

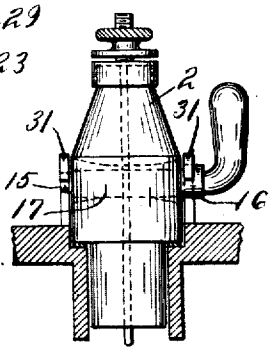


FIG. 7.

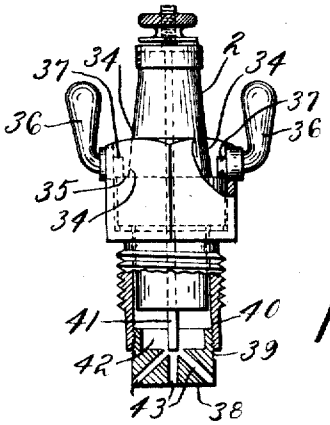


FIG. 9.

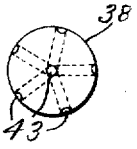
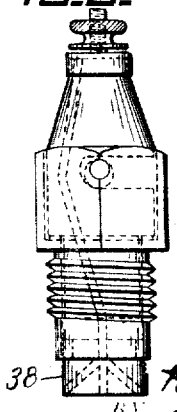


FIG. 8.



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2 SHEETS—SHEET 2.

FIG. 10.

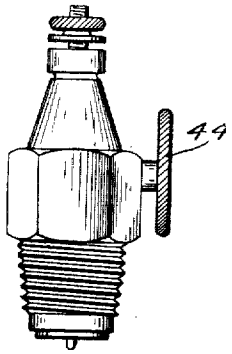


FIG. 12.

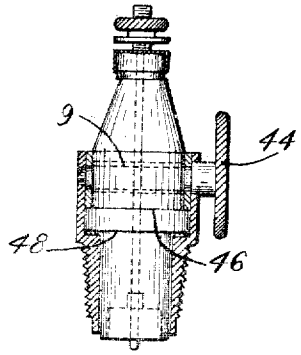


FIG. 13.

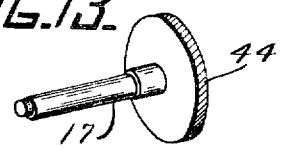
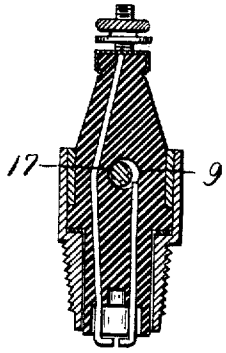


FIG. 11.



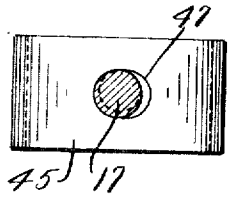
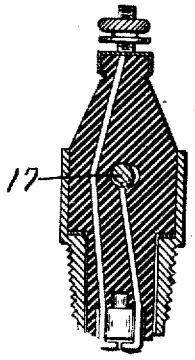


FIG. 14.

FIG. 15.



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UNITED STATES PATENT OFFICE.

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SPARK-PLUG.

1,269,860. Specification of Letters Patent. **Patented June 18, 1918.**

Continuation of application Serial No. 660,059, filed November 13, 1911. This application filed November 10, 1913. Serial No. 800,161.

To all whom it may concern:

Be it known that I, HERMAN F. SADGEBURY, a citizen of the United States, residing at 128 Park street, in Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Spark-Plugs, of which I declare the following to be a full, clear, and exact description.

This invention relates to spark plugs for internal combustion engines and more particularly to a way of securing the insulator in the cylinder whether by securing it in a bushing detachably mounted in the cylinder as is customary or by omitting the detachable bushing and securing the insulator directly in an opening in the engine cylinder. It is filed as a continuation or substitute for my pending application No. 660059 filed November 13, 1911 disclosing all that is disclosed in said pending application but containing additional matter besides.

One of the main objects of this invention was to provide such connection between the insulator and the member in which it is to seat and such means for holding the former in the latter as to permit of very rapid removal of it therefrom and without the necessity of using a wrench or any tool in such operations. Along with the provision of quick attachability and detachability of the insulator it was of course also remembered that the means for fixing and holding the insulator in place would have to be highly effective to hold the latter effectively in place in its seat so as to prevent leakage of gas from the cylinder when under compression and it was an object of my invention to provide means accomplishing this.

The above objects are accomplished with my invention by the use of a rotatable member having a handle shaped for convenient grasping by the hand, so that it may be manually turned and having a bearing or bearings in some fixed member such as the bushing in which the insulator is to seat, or if there is to be no bushing, in a bearing or bearings rigid with the engine casing, and having a cam portion, or a portion eccentric to the axis of the bearings which acts either directly, or through some intermediate connection, upon the insulator, when the rotatable member is merely rotated, and without being given any other movement whatever, in such a way as to force the insulator firmly to its seat and hold it there until the rotatable member is rotated to withdraw the cam or eccentric portion of the rotatable member from pressing on the insulator. When the insulator is thus freed the rotatable member is adapted to be withdrawn from its bearings, if need be, to permit complete withdrawal of the insulator from its seat. This withdrawal of the insulator is useful and desirable for such purposes as cleaning the insulator, cleaning or adjusting the electrode or electrodes carried thereby, for priming the engine, or even substituting another insulator or substituting another element for the insulator for use for some other purpose such as an attachment for connecting a pump with the engine so that the latter may operate the former.

The above principle of operation is applied in a number of different forms of construction herein shown and described and unquestionably other forms can readily be devised making use of my novel principle of operation. The number herein disclosed, however, are believed sufficient to completely indicate my invention and tell how it may be made use of.

In the preferred form of embodiment the insulator is provided with a transverse hole through which the rotatable member passes when in place, and turning of the rotatable member, when in place with its cam or eccentric portion within and in coöperation with the hole in the insulator, forces the insulator firmly to its seat and holds it there until the rotatable member is turned to release the pressure on the insulator. To remove the insulator entirely from its seat the rotatable member is pulled axially out of its bearings and the opening in the insulator whereupon the insulator is completely freed for manual removal from its seat.

In another form illustrated I make use of two pins or rotatable members having cam or eccentric portions projecting over shoulders on the insulator instead of having a single rotatable member extending through the insulator.

In still another form I use a single rotatable member but have it extend through a notch in the side of the insulator instead of through a hole through the insulator.

I have still further illustrated a form in

which the rotatable member does not extend transversely of the insulator at all, but has bearings on the bushing and extends generally longitudinally of the plug and at the side of the insulator and with the direction of action of the cam or eccentric portion of the rotatable member transverse to the axis of the insulator. In this form I make use of a wedge extending through a transverse opening in the insulator having end bearings in the bushing and abutting at one end against the rotatable member and adapted, when the rotatable member is rotated in its bearings, to be moved transversely of the plug and in such movement by reason of its wedge action on the insulator, forcing the latter, at an angle to the direction of movement of the wedge firmly against its seat in the bushing.

It will be seen that in all these forms it is immaterial so far as my broad invention is concerned, whether the cam or eccentric portion of the rotatable member acts directly upon the insulator or through some intermediate element or elements; also that it is immaterial whether the effective action of the cam or eccentric portion of the rotatable member is in the direction of seating movement of the insulator or some other direction with suitable connections, such as the wedge shown, for changing the direction of action of the force applied to cause it to act to move the insulator firmly against its seat.

In the preferred form in which the rotatable member extends transversely through the insulator I may so shape the hole in the insulator that the rotatable member cannot turn all the way over but only slightly past the position at which it has imparted the greatest movement or displacement to the insulator, whereupon its cam or eccentric portion engages the side of the opening in the insulator and prevents its further rotation in that direction, and since the rotatable member is then slightly past its position imparting the greatest throw to the insulator the latter will have to be again tightened somewhat against its seat before the rotatable member can be turned back to its starting position. With this construction when the insulator is fully in place it is more or less locked there by the eccentric or cam portion of the rotatable member which effectively resists any jarring or light taps tending to loosen the rotatable member and through it free the insulator. Of course this limiting of the rotative movement of the rotatable member may be accomplished in other ways so as to accomplish the locking action on the insulator. For example, the bushing or engine casing may be provided with a stop against which some part of the rotatable member will engage, when rotated the desired extent, and thus limit, instead of the insulator, the rotation of the rotatable member.

The above locking action of the rotatable member is not necessary, however, and, in fact, I prefer to so locate the transverse hole in the insulator that such will not result, as the friction between the cam or eccentric portion of the rotatable member and the insulator is sufficient to resist all occurring accidental jars or taps which might tend to loosen the parts. But if it is desired to provide for limiting the rotation of the rotatable member I may make use of some fixed stop or projection on the bushing or casing to limit this rotation.

More specifically it was an object of this invention to have the insulator carry both electrodes and my invention embodies a novel arrangement of these electrodes and provides for electrical connection from one of them to the engine cylinder by means of the rotatable member when the latter is holding the insulator in its seat. Removal of the rotatable member therefrom breaks the electrical connections and prevents sparking at the electrodes when the rotatable member is not in place. By this construction one can quickly, by merely removing the rotatable members of his spark plugs, render his engine inoperative by others not having rotatable members fitting his spark plugs. It is not to be considered necessary to my broad invention for fixing the insulator in place, that the insulator carry both electrodes for it may, if desired, carry but one, the engine casing or spark plug bushing carrying the other in some well known manner, and in this case the rotatable member would not serve as part of the electrical connections at all. To the end that both electrodes can be removed with the insulator for cleaning or adjustment and that their relationship will not be changed in removing the insulator, I prefer to mount both electrodes in the insulator so that they are both carried by the same element. Some of the forms have shown both electrodes as carried by the insulator and some but one and I may or may not, as desired, have the rotatable member when in place directly engage with one end of one electrode. In one form shown a little gap in which an additional spark will jump if desired is provided.

Since in the preferred form the bearings for the rotatable member are not of the same diameter and the rotatable member must be placed in them in the same relationship, and since in practice it is found that the bushings when screwed in the engine casing will not always present a single set of bearings in the position most convenient for insertion and removal of the rotatable member, I may if desired provide a plurality of bearings or sets of bearings for the rota-

table member arranged at different peripheral points about the bushing so that some one set of bearings will always be, when the bushing is in place in the engine, in position very convenient for reception of the rotatable member.

It is a preferred embodiment to have the transverse opening in the insulator counter bore at it sends leaving a bearing portion at the center of the opening in the insulator upon which the rotatable member, directly or through some intermediate element, acts. By such provision the force for fixing the insulator in place against its seat is applied over a smaller area, and by being applied near the axis of the insulator allows the latter to better tilt in any direction and be more squarely seated against its seat thus making a more effective gas tight connection between it and the member in which it is fitted.

I also prefer to elongate slightly one or both of the fixed bearings in which the rotatable member works, in a direction substantially at right angles to that at which the cam or eccentric portion of the rotatable member is to act in tightening the insulator in place so that the rotatable member can have a slight angular or bodily displacement so as to readily adjust itself to take care of any slight variations in the location of the transverse opening in the insulator so far as such occur in the plane of the opening at right angles to the axis of the insulator. This provision is of most utility in connection with the forms of the invention in which the side of the opening in the insulator does not limit the rotative movement of the rotatable member, but which movement, if limited at all, is limited by some other element than the insulator such as some projection in the bushing, and in fact is most preferable in the form which I most prefer in which there is not provided any means or construction to limit the rotation of the rotatable member but in which the latter can be rotated in either angular direction to or from its insulator seating position.

Besides consisting in the operation and construction above outlined my invention consists in various novel combinations and relationships of elements which will now be more specifically described in connection with the accompanying drawings which form part of this specification, and in which

Figure 1 is a front elevation of a completed plug embodying my novel way of fastening the insulator in place in its preferred embodiment.

Fig. 2 is a view of the same in section on the line $a-a$ of Fig. 1.

Fig. 3 is a view of the preferred embodiment of the rotatable member used for fastening the insulator in place.

Fig. 4 shows two broken away portions of the bushing of Fig. 1, in which the bearing openings for the rotatable member are situated showing these openings elongated in a plane at right angles to the axis of the plug.

Fig. 5 shows a different modification in which the rotatable member is not arranged transversely of the plug but acts to force the insulator longitudinally of the plug through the medium of a transversely movable wedge.

Fig. 6 shows a method of securing the insulator directly in an opening in the cylinder omitting entirely the separate bushing shown in the other forms.

Fig. 7 shows still another modification in which two rotatable members are employed and in which the insulator carries but one electrode and has no transverse opening through it. This view also shows applied to the bottom of the bushing an adjustable element having diverging openings for spreading the exploding gas in various directions in the cylinder upon ignition in the chamber between the insulator and the adjustable element.

Fig. 8 shows a different modification in which instead of the diametrical opening through the insulator a notch projecting in from one side is formed. This view also shows a side view of the adjustable element on the lower end of the bushing shown in Fig. 7 and shows the same as forming one electrode. This adjustable element can of course be omitted from these forms and the bushings may in other ways carry the other electrode or the insulator may as in the other cases carry both electrodes one of them making connection with a rotatable member when the latter is in place.

Fig. 9 is a bottom plan view of the adjustable element of Figs. 7 and 8.

Fig. 10 is still another modification in which the rotatable member is provided with a knurled head for grasping for manual rotation and in which the rotatable member acts through a ring surrounding the insulator and resting on a shoulder on it, to hold the insulator in place against its seat in the bushing.

Fig. 11 is a sectional view of Fig. 10.

Fig. 12 is a view similar to Fig. 11 but not showing the insulator and rotatable member in section. This view is taken at right angles to the view in Fig. 11.

Fig. 13 is a perspective view of the form of rotatable member used in Figs. 10 to 15.

Fig. 14 is a view in side elevation of the ring through which the rotatable member acts to hold the insulator in place showing the rotatable member in section, and

Fig. 15 is a view similar to Fig. 11 of another embodiment of the invention in which the rotatable member acts directly on the insulator to hold it in place and in which

the removable rotatable member is in direct contact with one of the electrodes when the insulator is locked in place in the bushing. In this form also the opening in the insulator is so located, that one of its sides prevent complete rotation of the rotatable member but stops it after just passing the position effecting maximum displacement of the insulator.

In the preferred form shown in Figs. 1 and 2, the plug is composed of two main parts, the bushing 1 and the insulator 2, the former having an externally threaded portion 3, by means of which it can be removably secured in a threaded opening in the wall of an engine cylinder. The insulator 2 is adapted to be removably secured within the bushing 1. The insulator in this form carries both electrodes, 4 and 5, for the spark though it may carry but the one 4, if desired, leaving the other to be carried by the bushing. By the removal of the insulator from the bushing the electrode or electrodes carried thereby are also taken out of the engine for examination, cleaning, or adjustment, without the necessity of unscrewing the bushing from the engine. The member 1 is preferably of non-circular shape at its upper portion whereby it can be conveniently operated by a wrench for insertion in and removal from the cylinder. The bushing 1 is hollow and the diameter of the axial opening is larger at the upper end than at the lower externally threaded end, there being formed at the place where the diameter of the axial opening changes an internal shoulder 6.

The exterior of the insulator 2 is shaped at its intermediate and lower portion to fit in the opening in the bushing 1. It is provided with a shoulder 7 adapted when the insulator is in place in the bushing to rest on the shoulder 6 being, in use however, preferably separated therefrom by a gasket 8 of asbestos, copper asbestos, soft copper or other suitable material adapted to assist in forming between the shoulders a fairly gas tight connection to prevent escape of gas under compression in the cylinder. Instead of this type of gas tight connection between the insulator and bushing I may omit the gasket entirely and grind very smoothly the contacting surfaces of the shoulders 6 and 7 which does very well in practice in forming a gas tight fit or I may employ, instead of the shouldered connections between the bushing and insulator, a conical fit between these members throughout their length or such of their length as desired, either grinding the contacting conical internal and external surfaces and omitting a gasket of other material between them or omitting such smoothing operation on the surfaces and fitting a suitable gasket between the conical surfaces.

As indicated above the insulator is firmly forced against its seat and held there, regardless of the particular form of seating connection between the insulator and bushing, by means of a rotatable member journaled in fixed bearings and having a portion acting as a cam, eccentric or crank when the rotatable member is turned to engage the insulator and force it firmly against its seat in the bushing. In the form illustrated in Figs. 1 and 2 and now being described the portion of the insulator above the shoulder is provided with a diametrical opening 9 counter bored at both ends at 10 and having the intermediate straight portion 11 which is engaged by the rotatable member when the latter is rotated, to force the insulator against its seat in the bushing. The bushing is provided near its top with diametrically opposite holes 12 and 13, one or both of which are elongated somewhat in the plane of the openings at right angles to the axis of the plug, and the vertical dimension of the openings at right angles to the elongation of the openings are different for the different holes. The rotatable member 14 has two concentric bearing portions 15 and 16 of different diameters and corresponding respectively with the vertical dimensions of the holes 12 and 13 in the bushing. Between the bearing portion 15 and 16 is the cam, eccentric or crank portion 17 which, so far as its function is concerned, may be either in general concentric with the bearings 15 and 16 but having a cam portion on one side, may be shaped off the center of the bearings 15 and 16 on the order of a crank, or may be just turned around but eccentrically to the bearings 15 and 16. Still other forms of the construction might suggest themselves but the one shown is believed sufficiently illustrative. In it the intermediate portion of the rotatable member between the concentric bearing surfaces 15 and 16 is circular but turned eccentrically to the axis of the concentric bearing portions 15 and 16.

All that is necessary is that this portion of the rotatable member is of such shape or contour that when the member is rotated some portion of it whose periphery does not form a circle concentric with the axis of the bearings 15 and 16 will swing around and by engaging the insulator, and in the preferred form the bottom of the middle portion 11 of the diametrical opening in it, force the insulator longitudinally of the bushing to firmly seat it against its seat in the bushing. When the parts are in place the rotatable member extends through the transverse opening in the insulator and has its bearings 15 and 16 resting respectively in the holes 12 and 13 in the bushing. In this position the cam, eccentric, or crank portion 17 of the rotatable member 14 is within

the opening 9 of the insulator and when the parts are tight the rotatable member is in such angular relationship that the part of portion 17 projecting farthest from the axis of the bearing 15 and 16 is against the lower surface 11 of the opening 9 and is holding the insulator firmly against its seat. Rotation of the rotatable member causes the eccentric or cam portion 17 of it to move upwardly and release its pressure on the insulator. When the parts are thus loosened the rotatable member may be axially withdrawn from the holes 12 and 13 and the opening 9 of the insulator after which the latter can be normally withdrawn from the bushing. The rotation of the member by the operation of the handle brings the cam, eccentric or crank portion in contact with the insulator or electrode means at a point that is in substantial alinement over the bearing axis of the member, as well as with the point of contact of the member against the bushing; so that these points being so situated cause a substantially "dead center" effect of the parts involved. The result is, there is little or no tendency to cause the member to be turned backward or forward by the reacting forces created when the member is rotated and the cam portion is brought into contact with the insulator. At least, no moment of force of sufficient effect to exceed the frictional resistance created by the reacting forces. This is mainly due to the fact that the movement tending to rotate the cam either way by the reacting forces is exerted so close to the axis of the rotatable member as to be acting practically on the line of the axis, and therefore produces a moment of force insufficient to overcome the frictional resistance of the member against rotation. Should the insulator be stuck somewhat in its seat, turning of the rotatable member through substantially 180 will, similarly, through action of the portion 17 upon the upper surface of the portion 11 of the opening 9, positively force the insulator upwardly to loosen it. After this loosening operation the rotatable member is axially withdrawn and the insulator can be freely removed. The rotatable member in the form illustrated in Figs. 1 and 2 is provided with a bent portion 18 forming a handle through which it can be conveniently manually rotated, inserted and withdrawn.

The insulator of my plug may be of any suitable substance such as porcelain or mica but I prefer to use a form of lava or other stone. It is provided with a contact screw 19 at its upper end adapted to be electrically connected with one pole of a battery. From the screw there extends longitudinally through the insulator a conducting wire which projects centrally out through a conical recess in the lower end of the insulator, the wire not going straight through from one end of the insulator to the other but being bent around the opening 9 so as to leave sufficient insulation between it and the opening 9 as well as between it and the exterior of the insulator. While, as stated above, it is not necessary to have the insulator carry both electrodes I prefer to have it do so and, in the form being described and illustrated in Figs. 1 and 2, another electrode 5 extends longitudinally of the insulator from about the center of the opening 9 to the lower end of the insulator from which it projects near the periphery. The projecting portion of this electrode is bent laterally at 22 beneath the end of the electrode 4 and between these portions of the two electrodes in proximity to each other the spark is adapted to pass. The upper end of the electrode 5 makes electrical connection with the portion 17 of the rotatable member, which is made of metal, when the latter is holding the insulator in place and through this rotatable member the electrode electrically connects with the engine cylinder from which the circuit is continued in the usual way back to the other pole of the battery. As indicated above in the objects, the rotatable member may or may not, as desired, directly contact with the electrode 5 for it may be just close enough to the electrode so that a spark will also leap across the gap between these elements, if such is desired, as is sometimes the case. In either case axial removal of the rotatable member serves to effectively break the electrical circuit for the spark which will not occur until the rotatable member is again properly inserted in place.

As shown in Fig. 4 the bearings 12 and 13 for the rotatable member 14 are elongated to permit a little angular or bodily displacement of the rotatable member to take care of variations in location in a transverse plane of the opening 9 of the insulator which may occur in practice. Either or both of them may be so elongated or, by accurately locating the hole in the insulator and those in the bushing, this elongation of the holes 12 and 13 may be omitted entirely though I prefer in practice to elongate at least one of these a little.

In the form of the invention shown in Fig. 5 the shape of the opening in the insulator is changed as is also the horizontal holes in the bushing as instead of the rotatable member passing through them a wedge 23 passes through these holes and opening, which wedge has an inclined portion 24 engaging the similarly inclined portion 25 of the intermediate lower portion 26 of the transverse opening 27 of the insulator. The ends of the wedge have straight bearing portions 28 and 29 of different size adapted to work in correspondingly shaped holes in the bushing. The wedge of this form is adapted to be moved transversely through the

insulator by means of the same kind of a rotatable member 14 as in the preferred embodiment but mounted vertically in bearings 30 projecting from the side of the bushing. The difference in construction of this form over the preferred form described above is that the rotatable member instead of extending transversely through the insulator and acting directly upon it to force it against its seat, has its effective action transverse to the axis of the plug, and acts through the wedge to force the insulator at right angles against its seat in the bushing. To remove the insulator of this form from the bushing the rotatable member must first be loosened and moved vertically endwise from its bearings and then the wedge extending through the opening in the insulator is withdrawn whereupon the latter is free to be removed. The reverse of this operation takes place in assembling the parts.

Fig. 6 may be described as showing a modification in which the bushing is omitted entirely as a part of the plug. In this the insulator seats directly in an opening in the engine cylinder in the same way the insulator of Figs. 1 and 2 seats in the bushing 1. Ears 31 projecting from the cylinder have bearing hooks against the lower surfaces of which the rotatable member seats at its bearing surfaces 15 and 16 as its portion 17 is forcing the insulator in place or holding it there. The action of the parts is otherwise the same as in the form of Figs. 1 and 2.

In Fig. 7 another modification is shown in which the insulator 2 is cut away at diametrically opposite portions at 34 to form shoulders 35, and, instead of a single rotatable member being used, passing through the insulator as in Figs. 1 and 2 two short rotatable members 36 are employed each working in its single individual bearing in the bushing and having a portion 37 adapted to engage its shoulder 35 of the insulator and the two together acting to force the latter against its seat in the bushing. In this form but one electrode is shown as carried by the insulator though obviously this form is also susceptible of having the insulator carry both electrodes as by running one end of one to one of the shoulders 35 for engagement with its rotatable member 36 when the latter is tightened down in place. In this form, to remove the insulator, both rotatable members are rotated to loosen them and then are axially withdrawn, whereupon the insulator may be axially removed.

In connection with this form carrying but one electrode I have shown an adjustable element 38 screw threaded at 39 to detachably coöperate with internal screw threads 40 on the lower end of the bushing. In this way the distance of this element 38 from the electrode 41 carried by the insulator can be varied. The upper side of the element 38 is chambered at 42 and between the element and the lower end of the electrode a combustion chamber including the chamber 42, is formed. Downwardly extending and diverging openings 43 start adjacent the electrode 41 and extend through the element 38, and these openings serve to spread the ignited and flaming gases in the combustion chamber as they rush out through them after being ignited. The ignition in the combustion chamber is caused by sparks passing from the electrode 41, to the adjacent points on the upper surface of the element 38 which is of metal and being electrically connected with the bushing, serves as the other electrode with a plurality of contact points around the end of electrode 41. By means of the rushing of ignited gases in all directions from the combustion chamber through the small openings 43 in the element 38 the ignited and burning gases are distributed more or less through the cylinder and a more complete ignition and combustion of all the fuel in the cylinder results. The spark gap can be varied by merely adjusting the element 38 vertically in the lower end of the bushing. Of course this feature of the invention can be used even though the insulator carries both electrodes, and can be applied to my preferred form by merely extending the lower end of the bushing shown in Figs. 1 and 2, and internally screw threading this lower end and screwing the element 38 therein. In this form the element 38 would not need to form an electrode but would serve to form the combustion chamber and to deflect the ignited gases as they rush therefrom into the cylinder after having been ignited by the spark passing between the electrodes shown in Figs. 1 and 2 which in such case would occur within the combustion chamber.

The form shown in Fig. 8 is similar to that just described except that a single rotatable member is employed which instead of passing through a diametrical opening in the insulator passes through a notch cut in the side of the insulator, and serving the same purpose as the opening 9 of Figs. 1 and 2.

Relative to the embodiment of my invention shown in Figs. 10 to 15 the operation is more or less the same as in the other figures. A type of screw thread on the bushing is shown which is different from that which is shown in connection with the other figures, though this does not affect my invention at all as also does not the different construction of the end of the rotatable member which instead of a bent handle of the other forms, consists of a knurled head 44. In the form shown in Figs. 10 to 14 I propose to force and hold the insulator in place not by direct engagement of the portion 17 of

the rotatable member with the bottom of the transverse opening 9 in the insulator but through the medium of a ring 45 surrounding the insulator and located between it and the bushing and resting upon and acting against the upwardly facing shoulder 46 on the periphery of the insulator. The ring 45 has oppositely disposed openings 47 through which the rotatable member passes as well as passing through the transverse opening 9 in the insulator and the extremities of the portion 17 of the rotatable member are located in these openings 47 when the parts are in place and serve when the rotatable member is rotated to force down the ring 45, and by reason of its seating on the shoulder 46 of the insulator, force the donwardly facing shoulder 48 of the insulator downward against its seat or shoulder in the bushing or against a gasket on the seat in case a gasket is used. In this form I have shown the openings in the ring of such shape and location as to have a corresponding side of each opening nearer the axis of rotation of the rotatable member than the other sides so that the portion 17 of the latter member will be carried against such sides of the openings in the ring after just passing the position at which it displaces the ring and insulator downwardly the maximum distance, which sides of the openings in the ring will thus serve to prevent further rotation in that direction of the rotatable member. Also when the rotatable member is thus stopped from further rotation it cannot return to release the insulator without sufficient force being applied to rotate it back past its position calling for maximum displacement of the insulator. By this construction the rotatable member when rotated until it is stopped by the sides of the openings 47 in the ring acts more or less as a lock against unseating of the insulator by any accidental jar or tap.

A similar action is presented in the form shown in Fig. 15 which in this respect differs only from the form of Figs. 10, 11, and 12 in that the ring 45 of the last mentioned form is done away with and the opening in the insulator shaped and located just like the openings in the ring thus presenting a construction in which the locking and seating operation of the insulator is the same except that the portion 17 of the rotatable member coacts directly with the bottom and side of the opening in the insulator and not through the intermediate ring. Of course in this form, I do not need the upwardly facing shoulders on the insulator within the bushing and the insulator is shown as completely filling the bushing at this point. In the illustration in Fig. 15 I also show the upper end of one electrode in direct contact with the rotatable member instead of slightly separated therefrom as in Fig. 11 to form a sparking gap at the juncture.

The above description I believe sufficiently illustrates my invention so that one skilled in the art can readily make and use it. I wish it to be distinctly understood however that the various forms are merely illustrative as I now perceive various other forms in which it may be embodied but which it seems needless to describe herein. As concerns my novel way of forcing the insulator of a spark plug to its seat and holding it there it is immaterial whether the insulator carries both electrodes or not or whether, if carrying both, the second one makes electrical connection with a engine for return to the battery or magneto, through the rotatable member or not. I have shown and now prefer such construction it being a very convenient arrangement and one in which the usefulness of the plug may be temporarily and quickly destroyed so that the engine cannot be run, by merely removing the rotatable member from its place. This provides means whereby the owner of an engine can, by merely removing the rotatable member, readily prevent removing of his engine by someone not intended to run it and having no rotatable member of such size and shape as to fit his plug. This feature of the invention I however also desire protection for and accordingly present claims directed to it. I also consider it to be immaterial so far as my novel way of fastening the insulator in place is broadly concerned, whether the rotatable member acts directly on the insulator or through an intermediate element such as the ring shown in Fig. 11 or the wedge shown in Fig. 5; whether the rotatable member extends transversly of the plug as in most of the figures or longitudinally as is illustrated in Fig. 5; whether there is a single rotatable member as in most of the figures or a plurality of them as in Fig. 7; whether the rotatable member extends through the insulator or just over it as in Fig. 7; or whether as in Fig. 5 another element passes through the insulator; or, if some element is to pass through the insulator, whether it is through a notch in the side of the latter or through a transverse opening in it; whether the rotatable member is to be prevented from complete rotation when in place and is rotatable in but one direction to seat the insulator to its seat as is the case with the forms of Figs. 10 to 15, or whether the rotatable member can be rotated in either direction to maximum displacement of the insulator, and in either direction to release the insulator as in the forms shown in Figs. 1 to 9; or if complete rotation of the rotatable member is prevented whether this is done in the manners shown in Figs. 10 to 15 or in some other

way such as by some stop on the bushing for coöperating with some part of the rotatable member. In fact the rotatable member need not be of the shape as shown but all that is necessary is that it be so constructed so that at some portion or portions along its axis of rotation its periphery is not a complete circle concentric with its axis of rotation so that such portion or portions will when the member is rotated coöperate either by direct engagement or through some intermediate element or means, so as to move the insulator to its seat and hold it there so long as the rotatable member is not turned to release it. I have shown the member as having between its concentric bearing portions a portion circular but turned eccentric to the axis of the bearing portion or portions but plainly the member might be a substantially straight member of circular cross section but with a peripheral projection or cam at the desired point; or the same result would be accomplished by a member of circular cross section with some point or portion bent out of alinement with the portion to form its bearing. It is also not even necessary to the use of my broad invention that a bushing be used as in some cases, as with engines specially made, I desire to eliminate the usual bushing adapted to detachably engage within an opening in the engine cylinder and journal my rotatable member directly in bearings on the engine casing as shown in Fig. 6, the insulator seating in such case similarly to the way it seats in the bushing in my other forms. It is only necessary that the rotatable member be prevented by some fixed member at its bearings from moving in a direction reverse to that in which the eccentric portion of the member acts when forcing the insulator to its seat. The throw of the eccentric portion of the rotatable member I may vary as desired and it is not even necessary that the rotatable member displace the insulator the maximum amount in order for the friction between the parts to hold them in their moved position. It has been found in practice that the rotatable member can be stopped in positions causing a varying displacement of the insulator yet the friction without the locking effect described with reference to Figs. 10 to 15 will be sufficient to retain the rotatable member and the insulator in their moved position sufficiently well for all practical purposes. This provides, by varying the extent of rotation of the rotatable member, for varying the pressure with which the insulator is held in place as desired or by more or less rotation of the rotatable member obtaining the pressure desired in spite of slight variations of the parts in manufacture. In fact by carefully selecting the desired resiliency for the rotatable member a pressure for the insulator on its seat is provided for which is substantially constant for all conditions and which cannot be exceeded no matter how much force is applied to the rotatable member in rotating it. This feature I propose to use in manufacture and is of value in preventing so much pressure being applied as to injure the gasket and affect its durability or efficiency. In many forms of plugs this often occurs when the insulators are fastened in place by means of a wrench and where it is easy to apply more than the necessary power. My rotatable member is designed for manipulation wholly by the fingers and without a wrench and by varying the throw of the eccentric portion and its periphery or the distance from the axis of the rotatable member at which the fingers act, or both, it is easy to provide so that too much force will not be applied. The provision of counter boring the ends of the transverse opening in the insulator is just as useful in connection with any of the forms where an opening extends through the insulator, though not shown in connection with Figs. 10 to 15. Such is also the provision for elongating the holes forming bearings in the bushing for the rotatable member.

I consider it quite an advantage in my invention to be able, by merely sufficiently rotating the rotatable member when turning it to release the pressure on the insulator, in the forms shown in Figs. 1 to 4, and 8 to 15, to positively carry the insulator away from its seat. This I consider quite an advantage because in some forms of plugs it often occurs that the insulator becomes more or less stuck in its seat or bushing so as to require some little effort to loosen it even when the member which holds it in place is no longer effective. It is obvious that in my invention embodied in the preferred form, merely rotating the rotatable member so as to carry its eccentric portion into coöperation with the upper side of the transverse opening 9 in the insulator will serve to force the insulator up instead of down and positively unseat the insulator should it be stuck in its seat. To apply this to the form shown in Fig. 6, in which the useful bushing is eliminated, the bearings for the rotatable member would, of course, have to be formed to coöperate not only with the upper portion of the rotatable member as shown but also would extend beneath the bearing portions of such rotatable member.

With my improved way of forcing and holding a spark plug insulator in place the latter can be conveniently and readily removed without the use of a wrench and equally as conveniently restored to its place in the cylinder. In putting the insulator of my preferred form of Figs. 1 and 2 in place it is first placed by hand to its seat so as to aline its transverse opening with the bearings for the rotatable member. The rotatable

member is then inserted into its bearings and through the opening in the insulator. Turning of the handle 18 of Figs. 1 and 2 so as to stand upright then rotates the rotatable member to cause its portion 17 to force the insulator firmly against its seat, and friction of the parts is sufficient to hold the parts in this position for all practical purposes until it is desired to remove the insulators. When such is desired all that is necessary is to rotate the rotatable member until it sufficiently frees the insulator when it can be axially removed. When removed the insulator is free for longitudinal removal from its seat. If the insulator is stuck in place turning of the handle 18 vertically downward when the rotatable member is in place will positively move the insulator upwardly from its seat and eliminate the sticking so that upon removal of the rotatable member the insulator may be readily withdrawn.

The terms "cam," "eccentric," "crank," "lever" where used in the claims individually are to be interpreted in a generic sense to cover all the terms, where such interpretation is consistent with the novel operation of this device and the other phraseology of the claims.

Having described my invention and various embodiments of it what I claim as my invention is:—

1. In a spark plug for internal combustion engines, the combination of a fixed member having an opening; a bearing fixed relative to said member; an insulator adapted to seat in said opening and carrying an electrode; and a rotatable member adapted to rotate within said bearing and having a cam portion adapted when the rotatable member is rotated to force the insulator against its seat in the opening.

2. In a spark plug for internal combustion engines, the combination of a fixed member having an opening; an insulator carrying an electrode adapted to seat in said opening; bearings fixed relative to said fixed member; and rotative means mounted to rotate in said bearings and having a cam portion adapted to force the insulator to its seat when the rotatable means is rotated.

3. In a spark plug for internal combustion engines, the combination of a fixed member having an opening; an insulator carrying an electrode adapted to seat in said opening; bearings fixed relative to said fixed member; and rotative means mounted in said bearings and having a cam portion adapted to force the insulator to its seat when the rotatable means is rotated in one direction and to move the insulator from its seat by movement in the other direction.

4. In a spark plug for internal combustion engines, the combination of a bushing adapted to be removably secured in an engine cylinder and having a bearing fixed relative thereto; an insulator adapted to be removably secured in said bushing and carrying an electrode; and a rotatable member adapted to be removably journaled in said bearing and having a cam portion adapted to coact with the insulator when the rotatable member is rotated to move the insulator relative to the bushing.

5. In a spark plug for internal combustion engines, the combination of a bushing adapted to be removably secured in an engine cylinder and having a bearing fixed relative thereto; an insulator adapted to be removably secured in said bushing and carrying an electrode; and a rotatable member adapted to be removably journaled in said bearing and having a cam portion adapted to coact with the insulator when the rotatable member is rotated to move the insulator in either direction relatively to the bushing.

6. In a spark plug for internal combustion engines, the combination of a bushing adapted to be removably secured in an engine cylinder and having a bearing fixed relative thereto; an insulator adapted to be removably secured in said bushing and carrying an electrode; and a rotatable member adapted to be removably journaled in said bearing and having a cam portion adapted to coact with the insulator when the rotatable member is rotated to move the insulator against its seat in the bushing.

7. In a spark plug for internal combustion engines, the combination of a bushing adapted to be removably secured in an engine cylinder and having a bearing fixed relative thereto; an insulator adapted to be removably secured in said bushing and carrying an electrode; and a rotatable member adapted to be removably journaled in said bearing and having a cam portion adapted to coact with the insulator when the rotatable member is rotated to move the insulator to its seat in the bushing and hold it there until the rotatable member is turned to release it.

8. In a spark plug for internal combustion engines, the combination of a bushing having diametrically opposite concentric bearing openings; an insulator having a transverse opening therethrough carrying an electrode and adapted to seat in the bushing; and a rotatable member having concentric bearing portions for location in the bearing openings in the bushing and an intermediate portion for working in the transverse opening in the insulator, the periphery of such intermediate portion extending farther from the axis of the concentric bearing portions at some points than at others so as to, when the rotatable member is rotated in its bearings, engage the inside of the opening in the insulator and move the latter relatively to the bushing.

9. In a spark plug for internal combustion engines, the combination of a bushing having diametrically opposite concentric beari g openings; an insulator having a transverse opening therethrough carrying an electrode and adapted to seat in the bushing; and a rotatable member having concentric bearing portions for location in the bearing openings in the bushing and an intermediate portion for working in the transverse opening in the insulator, the periphery of such intermediate portion extending farther from the axis of the concentric bearing portions at some points than at others so as to, when the rotatable member is rotated in its bearings, engage the inside of the opening in the insulator and move the latter relatively in either direction to the bushing.

10. In a spark plug for internal combustion engines, the combination of a bushing having diametrically opposite concentric bearing openings; an insulator having a transverse opening therethrough carrying an electrode and adapted to seat in the bushing; and a rotatable member having concentric bearing portions for location in the bearing openings in the bushing and an intermediate portion for working in the transverse opening in the insulator, the periphery of such intermediate portion extending farther from the axis of the concentric bearing portions at some points than at others so as to, when the rotatable member is rotated in its bearings, engage the inside of the opening in the insulator and move the latter relatively to the bushing against its seat in the latter.

11. In a spark plug for internal combustion engines, the combination of a bushing having diametrically opposite concentric bearing openings; an insulator having a transverse opening therethrough carrying an electrode and adapted to seat in the bushing; and a rotatable member having concentric bearing portions for location in the bearing openings in the bushing and an intermediate portion for working in the transverse opening in the insulator, the periphery of such intermediate portion extending farther from the axis of the concentric bearing portions at some points than at others so as to, when the rotatable member is rotated in its bearings, engage the inside of the opening in the insulator and move the latter relatively to the bushing against its seat in the latter and hold it there until the rotatable member is turned to release it.

12. In a spark plug for internal combustion engines the combination of a hollow bushing having an internal shoulder; an insulator having an external shoulder adapted to rest on the internal shoulder; a plurality of diametrically opposite holes in the bushing; a transverse hole in the insulator; and a rotatable member mounted in the holes in the bushing and insulator and having a cam portion within the opening in the insulator for forcing the shoulder in the insulator firmly against the shoulder in the bushing when the rotatable member is rotated the cam portion of the rotatable member serving when its cam portion is rotated beyond a position calling for maximum displacement of the insulator to lock the insulator firmly in place and to lock itself against turning to release the insulator.

13. In a spark plug for internal combustion engines, the combination of a bushing adapted to be removably secured in an engine cylinder; an insulator adapted to rest therein and carrying a plurality of electrodes; a contact screw electrically connected with one of the electrodes; a transverse hole in the insulator; diametrically opposite holes in the bushing; and a rotatable member mounted in the transverse hole in the insulator and the openings in the bushing adapted to removably secure the insulator and bushings together.

14. In a spark plug for internal combustion engines, the combination of a bushing adapted to be removably secured in an engine cylinder; an insulator adapted to rest therein and carrying a plurality of electrodes; a contact screw electrically connected with one of the electrodes; a transverse hole in the insulator; diametrically opposite holes in the bushing; and a rotatable cam bearing member mounted in the transverse hole in the insulator and the openings in the bushing adapted to removably secure the insulator and bushings together.

15. In a spark plug for internal combustion engines, the combination of a bushing; an insulator adapted to seat therein and carrying an electrode; and a single rotatable member rotatable about an axis at an angle to the axis of the plug for the purpose of locking the insulator in the bushing.

16. In a spark plug for internal combustion engines, the combination of a bushing; an insulator adapted to seat therein; a transverse opening through the insulator; a member located in the opening and coacting with the bushing to hold the insulator in place; and an electrode electrically connected with the transverse member in the insulator and therethrough with the bushing.

17. In a spark plug for internal combustion engines, the combination of a bushing; a removable insulator therefor and carrying an electrode; a rotatable member having a cam portion for forcing the insulator against its seat in the bushing; and means for preventing further movement of the rotatable member after the cam has reached its position effecting sufficient displacement of the insulator relative to its bushing.

18. In a spark plug for internal combus-

tion engines, the combination of a bushing; an insulator adapted to seat therein and carrying an electrode; and a rotatable member having a cam portion for forcing the insulator in place in the bushing when the rotatable member is rotated the insulator adapted to prevent further rotation of the cam after it has reached its position displacing the insulator the most in the direction of its seat.

19. In a spark plug for internal combustion engines, the combination of a member; a removable insulating element carrying an electrode; and a rotatable member having a portion of its exterior eccentric to its axis of rotation such portion serving when the member is rotated to attach the insulating element to the first mentioned member.

20. In a spark plug for internal combustion engines, the combination of a bushing; a removable insulator adapted to be attached thereto carrying an electrode; and a member removably journaled for rotation in the bushing and having a cam portion serving when the member is rotated to move the insulator transversely to the axis of the rotatable member and attach it to the bushing.

21. An insulator for spark plugs having a transverse opening extending therethrough adapted to receive a securing member for the insulator; an electrode extending from the opening to one end of the insulator forming one spark terminal; and a second electrode extending longitudinally through the insulator and forming another spark terminal.

22. An insulator for spark plugs having a transverse opening extending therethrough adapted to receive a securing member for the insulator, counter bored at its ends, an electrode extending from the opening to one end of the insulator forming one spark terminal; and a second electrode extending longitudinally through the insulator and forming another spark terminal.

23. In a spark plug for internal combustion engines, the combination of a hollow bushing having diametrically opposite bearing openings therein; an electrode carrying insulator adapted to seat in said hollow bushing and having a transverse opening therethrough counter bored at its ends; and a rotatable member passing through the insulator opening and journaled in the bearing openings in the bushing and having a portion intermediate its bearings where its periphery is at greater distances from the axis of rotation of the member at some places than at others adapted when swung around upon rotation of the rotatable member to engage the bottom of the opening in the insulator intermediate the counter bored portions and force the insulator against its seat in the bushing.

24. In a spark plug for internal combustion engines, the combination of a bushing; an insulator having a transverse opening carrying an electrode and adapted to seat in the bushing; a rotatable member extending through the opening in the insulator and having cam portion for forcing the insulator in place in the bushing when the rotatable member is rotated; and bearing openings in the bushing for the ends of the rotatable member one of these being elongated in a direction concentric to the axis of the plug.

25. In a spark plug for internal combustion engines, the combination of a hollow bushing; an insulator adapted to seat therein and carrying an electrode; an electrode forming element attached to the lower end of the bushing and forming a chamber between it and the lower end of the insulator within which is the electrode carried by the insulator; and diverging openings in the electrode forming element for spreading the ignited gases when rushing therethrough after being ignited by sparks passing between the electrodes, the walls of said diverging openings provided with a plurality of points around the entrance to the openings between which and the electrode on the insulator a series of sparks occur.

26. In a spark plug for internal combustion engines, the combination of a hollow bushing; an insulator adapted to seat therein and carrying an electrode; an electrode forming element adjustably attached to the lower end of the bushing and forming a chamber between it and the lower end of the insulator within which is the electrode carried by the insulator; and diverging openings in the electrode forming element for spreading the ignited gases when rushing therethrough after being ignited by sparks passing between the electrodes, the walls of said diverging openings provided with a plurality of points around the entrance to the openings between which and the electrode on the insulator a series of sparks occur.

27. In an article of the class described, the combination with an insulator carrying an electrode, of a bushing containing a seat for the insulator and having a plurality of diametrically disposed bearing openings, and cam bearing means rotatable in the bearing openings to engage the insulator and force it against its seat in the bushing.

28. A spark plug comprising a bushing having openings at right angles to the axis of the bushing, an insulator carrying an electrode having an opening coöperating with the holes in the bushing, a rotatable member to be inserted through the openings in the bushing and insulator and having the portions engaging the bushing concentric to one axis and the portion engaging the insulator concentric to a different axis.

29. A spark plug comprising an electrode carrying insulator, a bushing having an opening to receive the insulator and bearings fixed with reference thereto, and a rotatable member adapted to coöperate with said bearings and having a portion of its periphery projecting to engage the insulator whereby when the member is rotated the insulator will be moved axially in one direction or the other depending upon the direction in which the member is rotated.

30. In a spark plug, the combination of a bushing, electrode carrying insulating means adapted to seat therein, and a single rotatable member rotatable about an axis extending at a large angle to the longitudinal axis of the bushing for the purpose of forcing the means firmly against its seat in the bushing and automatically holding it there.

31. A spark plug comprising an electrode carrying insulator, a bushing adapted to receive the same, and a member rotatably engaging in the bushing and insulator to rotate about an axis at an angle to the longitudinal axis of the insulator adapted to press in opposite directions on the insulator and bushing when rotated, to force and hold the insulator against the seat in the bushing.

32. A spark plug comprising in combination, a bushing, an electrode carrying insulator removably mounted in the bushing, and a crank-like member rotatably engaging in the bushing and insulator and serving when rotated to force the insulator firmly against its seat in the bushing and to hold it there by reason of the crank-like member assuming a substantially "dead center" relationship between the insulator and bushing.

33. In a spark plug, the combination of a bushing member, an insulator member adapted to seat therein, and a rotatable member rotatable about an axis at an angle to the axis of the other members and fulcruming against one of the first mentioned members and acting against the other in substantially alining but oppositely directed lines of action passing through points close to the fulcrum point whereby the moment of force tending to rotate the rotatable member through the reaction of the first said members will be too small to overcome the frictional resistance against the rotatable member.

34. In a spark plug, the combination of a bushing, an electrode carrying insulator adapted to seat in connection therewith, and a rotatable member rotatably engaging the insulator and bushing about an axis at an angle to the longitudinal axis of the insulator, said axis being on a line that will pass through the projected transverse area of the insulator, said member serving to force the insulator to its seat.

35. In a spark plug, the combination of a fixed member having an opening, a bearing fixed relative to said member, an electrode carrying insulator adapted to seat in the member, and a rotatable member adapted to rotate against said bearing and having a portion adapted to act against the insulator when the member is rotated to press the insulator against the seat in the fixed member, said rotatable member having means whereby it may be operated.

36. In a spark plug, the combination of a fixed member having an opening, a bearing fixed relative to said member, an electrode carrying insulator adapted to seat in the member, and a rotatable member adapted to rotate against said bearing and having a portion adapted to act against the insulator when the member is rotated to press the insulator against the seat in the fixed member, said rotatable member being so arranged through the insulator and fixed member as to require complete removal from both the same to permit them to be separated from each other.

37. In a spark plug, the combination of a bushing member, a separable member including an insulator, adapted to seat therein, and a rotatable member rotatable about an axis at an angle to the axis of the other members and fulcruming against one of the first mentioned members, and acting against the other in substantially alining but oppositely directed lines of action passing through points close to the fulcrum point, whereby the moment of force tending to rotate the rotatable member through the reaction of the first said members will be too small to overcome the frictional resistance against the rotatable member.

38. In a spark plug, the combination of a relatively fixed member; an electrode carrying insulator adapted to seat therein; and a single pressure applying element rotatable about an axis at a large angle to the axis of the insulator to lock the insulator to its seat.

39. An insulator for spark plugs having a portion adapted to be engaged by a securing member for the insulator, an electrode extending from said portion to one end of the insulator forming a spark terminal, and a second electrode extending longitudinally through the insulator and forming another spark terminal.

40. In a spark plug, the combination of a relatively fixed member; an electrode carrying insulator adapted to removably seat therein; and an element, removable, by movement in a plane transverse to the axis of the insulator, and adapted to be so actuated as to apply pressure to the insulator in the direction of its axis to lock the insulator to its seat.

41. In a spark plug, the combination of a relatively fixed member; an electrode car-

rying insulator adapted to removably seat therein; and an element, provided with an operating handle by which said element may be removed by movement in a plane transverse to the axis of the insulator and by which said element may be actuated so as to apply pressure to the insulator in the direction of its axis to lock the insulator to its seat.

42. In a spark plug, the combination of a relatively fixed member; an electrode carrying insulator adapted to removably seat therein; and an element, removable by movement in a plane transverse to the axis of the insulator and extending over a portion of the insulator, said element being adapted to be so actuated as to apply pressure to the insulator in the direction of its axis to lock the insulator to its seat.

43. In a spark plug, for internal combustion engines, the combination of a fixed member having a seat and an opening, an electrode carrying insulator adapted to pass into the opening and against the seat and a single manipulatively operable yielding pressure applying element for forcing the insulator against its seat in the fixed member and holding it there in opposition to pressure exerted from the engine chamber when the plug is in use in the same.

44. A spark plug comprising a fixed member having an opening and a seat for an insulator, an electrode carrying insulator adapted to pass into the opening and against the seat and a fastening member disposed transversely in the insulator and means whereby the fastening member may be manually operated to exert yielding pressure on the insulator to force the same firmly against its seat in the fixed member.

45. In a spark plug, the combination of a bushing, an electrode carrying insulator adapted to seat therein and rotatable, yielding, pressure applying means adapted to rotate about an axis at an angle to the longitudinal axis of the insulator in coöperation with the insulator and bushing to force the insulator against its seat in the bushing.

46. In a spark plug, the combination of a bushing, an electrode carrying insulator adapted to seat therein and a rotatable, somewhat yielding, fastening member forcing the insulator against the seat in the bushing when the fastening member is rotated when in coöperation with the insulator and bushing.

47. In a spark plug, the combination of a bushing, an electrode carrying insulator adapted to seat in connection therewith and a rotatable resilient member rotatably cooperating with the insulator and bushing about an axis at an angle to the longitudinal axis of the insulator, said axis being on a line that will pass through the projected transverse area of the insulator, said resilient member serving, when rotated, to force the insulator against its seat.

48. In a spark plug, a bushing, an electrode carrying insulator adapted to seat in the bushing and a crank like resilient member rotatably engaging with the bushing and insulator and serving, when rotated, to force the insulator against its seat in the bushing and to hold it there by reason of the crank like member assuming a substantially "dead center" relationship between the insulator and bushing.

49. In a spark plug, a bushing member, an insulator member carrying an electrode and adapted to seat therein and a resilient member rotatable about an axis at an angle to the axis of the other members and acting against the other in substantially alined but oppositely directed lines of action passing through points close to the fulcrum point whereby the moment of force tending to rotate the rotatable member through the reaction of the first said member will be too small to overcome the frictional resistance against the resilient rotatable member.

50. In a spark plug, a bushing, an electrode carrying insulator adapted to seat therein and a cam like yielding fastening member adapted to be rotated to apply a gradually increasing yielding pressure of the insulator against its seat in the bushing.

51. In a spark plug, a bushing, an electrode carrying insulator adapted to seat therein having yielding fastening means for holding the insulator against its seat in the bushing, said yielding means directly engaging the insulator and bushing and manually manipulative to apply a yielding pressure on the same.

52. In a spark plug, the combination of a relatively fixed member, an electrode carrying insulator of relatively frangible material adapted to removably seat therein and a single yielding pressure applying element acting directly upon the insulator and rotatable to apply a yielding pressure to lock it to its seat.

In testimony whereof I affix my signature in the presence of two witnesses.

HERMAN F. SADGEBURY.

Witnesses:

CHESTER H. BRASELTON,

R. J. HAYNES.