Sept. 22, 1936. L. F. HAHN 2,055,408

TERMINAL CAP FOR SPARK PLUGS

Filed June 9, 1932

Fig. 1.

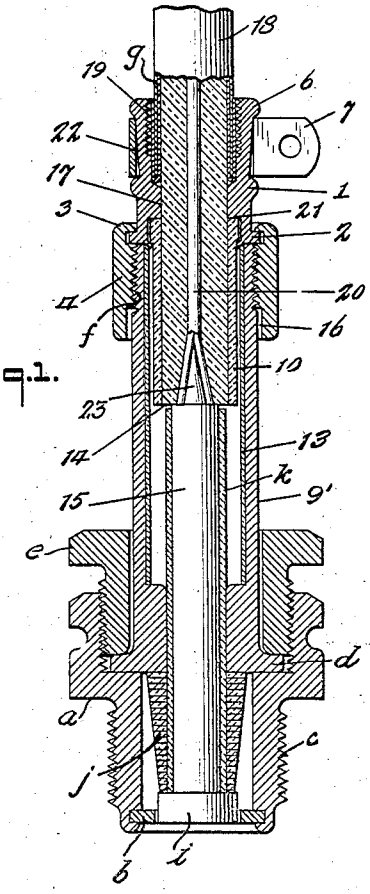


Fig. 2.

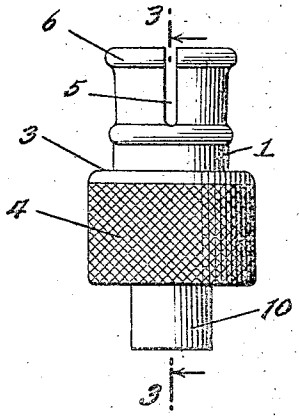
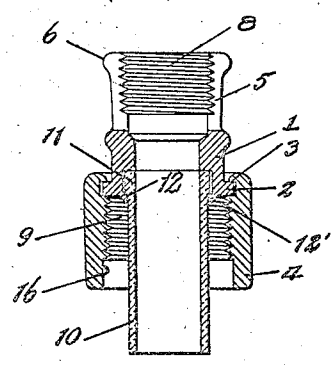


Fig. 3.



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TERMINAL CAP FOR SPARK PLUGS

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Application June 9, 1932, Serial No. 616,248

31 Claims. (Cl. 123—169)

The present invention relates to spark plugs for internal combustion engines and embodies, more specifically, an improved terminal cap construction for spark plugs. More specifically, the invention embodies a terminal cap which is adapted for use in connection with shielded spark plugs for the type shown and described in my copending application Serial No. 396,950 filed October 3, 1929.

The subject matter of this disclosure was copied from application Serial No. 509,919 filed January 20, 1931, and became involved in interference No. 69,307, Hahn vs. Hahn and Grant. This interference terminated in an award of priority in favor of the sole party, the applicant herein, in decision of examiner of Interferences dated May 18, 1936.

In the use of shielded spark plugs of the above type and of other types now available, it has been found that the cover of the ignition cable is frequently softened due to the heat developed in the spark plug in operating conditions. The extent of such softening being sufficient to cause the covering to adhere to the insulation which separates it from the shield of the spark plug, thus making it extremely difficult to separate the cable from the plug without injuring both the insulation of the cable and the plug insulation between the first insulation and the shield. Furthermore, in connecting and disconnecting the cable from the plugs of existing designs, it has been necessary to disconnect the ignition cable and its metallic covering from the terminal cap of such plugs. There it is necessary to inspect or remove spark plugs frequently, this operation is slow and rather difficult to perform effectively and it is within the contemplation of the present invention to provide a terminal cap construction for shielded spark plugs by means of which the foregoing disadvantages are overcome.

An object of the invention, accordingly, is to provide an improved terminal cap construction for shielded spark plugs by means of which the ignition cable may be effectively connected and disconnected from the spark plugs to facilitate the inspection and removal of the plugs.

A further object of the invention is to provide a terminal cap construction which is adapted to be secured initially to the ignition cable and which is readily and effectively secured to the spark plug in such fashion as to permit the cap and cable to be applied and disconnected therefrom with facility without disturbing the connection of the cap to the cable.

It is a further object of the invention to provide a shielded spark plug and terminal cap construction by means of which adhesion of insulation of the ignition cable to any part of the spark plug is effectively prevented.

A further object of the invention is to provide an improved terminal cap construction of the above character wherein means is embodied for effectively connecting the cap to the ignition cable.

A further object of the invention is to provide in combination with a shielded spark plug, a terminal cap construction and means for securing an ignition cable thereto, wherein an auxiliary insulating sleeve is provided which may be readily removed from the plug when the cable and cap is removed, whereby adhesion of the cable to the plug is prevented.

Further objects, not specifically enumerated above, will be apparent as the invention is described in greater detail in connection with the accompanying drawing, wherein:

Figure 1 is a view in section, showing a shielded spark plug and terminal cap constructed in accordance with the present invention.

Figure 2 is a view in side elevation, showing a terminal cap constructed in accordance with the present invention.

Figure 3 is a view in section, taken on line 3—3 of Figure 2, and looking in the direction of the arrows.

Referring to the above drawing, a shielded spark plug is shown comprising a tubular shell *a* provided at its lower end with an annular electrode *b* and provided externally with threads *c* for mounting the same in an engine cylinder, a long metal jacket 9' provided with a flanged end *d* is intruded into the upper end of the shell *a* and is secured in place by a nut *e* threaded into the upper end of the shell. The jacket 9' projects above the shell and nut and is provided at its upper end with threads *f* adapted to be engeged by a coupling nut 4. The plug is provided with a terminal cap consisting of a sleeve 1 provided with a bore 17 adapted to have an electric lead 18 extend therethrough and the lower end

of which sleeve is provided with a flange 2 which is engaged by a rolled over portion 3 of the coupling nut. The upper portion of the sleeve is slotted as shown at 5 to form fins 6 which are suitably compressed when an ignition cable is inserted therein to secure the latter effectively to the nut. Compression of the fins is effected by a suitable clamp 7 and the interiors of the fins are preferably formed with grooves 8 which, for convenience of manufacture, may be produced by a threading tool. These grooves enable the fins to grip the ignition cable more effectively. The coupling nut is provided with threads 9 which engage the cooperating threads *f* on the jacket 9', as clearly shown in Figure 1.

In order that adhesion of covering of the ignition cable to the spark plug may be prevented an insulating sleeve 10 is provided, in the specific form shown, this insulating sleeve being carried by the sleeve 1. The sleeve 10 is preferably formed of lava or other suitable heat resistant dielectric material and is provided with an enlarged end portion 11 which forms a shoulder 12 and at its upper end abuts against a shoulder 21 formed in the sleeve 1. A portion of the metal of the flange 2 may be rolled over the shoulder 12 as indicated at 12' to secure the sleeve 10 effectively to the cap. Although the construction is described as mounting the sleeve 10 upon the cap, it will be understood that this sleeve may constitute an independent element which is loosely mounted within the cap and plug. The length of the sleeve 10 is preferably sufficient to extend within the insulation 13 of the jacket 9' to a point adjacent the end 14 of the spark plug spindle 15. The internal diameter of the insulating sleeve 10 is preferably not less than the diameter of the bore 17 of the sleeve member 1, in order that no difficulty may be encountered in inserting the ignition cable through the insulating sleeve. The nut 4 is preferably formed with a skirt or bored out portion 16 to conceal the threads *f* of the spark plug and improve the appearance thereof. In securing the cable or other electric lead 18 to the cap, the metallic covering *g* is preferably rolled back as at 19. The turned back portion is inserted within the fins of the sleeve and the clamp 7 is tightened to cause the grooves or teeth within the fins to grip the turned back portion of the cable effectively. The tightening of the clamp 7 in its engagement with the frusto-conical waist portion 22 of sleeve 1 not only secures the metallic covering effectively to the fins but securely grips the ignition cable itself so that wires 20 thereof are held firmly in contact with the terminal point 23 at the upper end of the spindle 15.

As noted above, the insulating sleeve 10 need not be secured to the sleeve 1 but may function just as effectively if it is inserted within the spark plug loosely. Furthermore, the insulating sleeve need not extend within sleeve 1 but it is sufficient that the length thereof extends from a point adjacent the spindle 15 to a point adjacent the sleeve 1 so that there is no possibility of adhesion between the insulation of the ignition cable and the spark plug. Adhesion of the insulation of the ignition cable to the insulating sleeve 10 is not detrimental, since the sleeve 10 will not adhere to the spark plug but may be withdrawn whenever desirable. The spindle 15 is provided at its lower end with a coacting electrode *i* and between the same and the flange *d* is disposed a mica disk form of insulation *j* for minimizing heat transference to the spindle 15 and metallic jacket 9'. An insulating extension *k* in the form of a tubular shell *k* extends through the insulation *j* and extends to the top of the spindle 15; the upper portion being contained within the lower part of the insulation 13 and forming in effect a continuation of the insulating sleeve 10.

It will thus be seen that a terminal cap has been provided for shielded spark plugs which greatly facilitates the connection of ignition cables thereto and which furthermore prevents adhesion between the cable and the plug. By securing the cable initially to the terminal cap, the connection of the cable to the plug is greatly facilitated since the cap may be readily secured to the plug and removed therefrom to permit inspection and removal of the plugs. The elements of the cap are simple of construction and readily manufactured and afford a simple and effective means for securing the cable to the cap, prior to the securing of the cap to the plug.

While the invention has been described with specific reference to the accompanying drawing, it will be apparent that it is adapted for use in connecting an electric cable to any electrical device, and it is not to be limited, save as defined in the appended claims.

I claim:

1. A cap for spark plugs comprising a sleeve adapted to receive an ignition cable, means to secure the ignition cable to the sleeve, a flange on the sleeve, and a second sleeve engaging the flange on the sleeve, and a second sleeve engaging the flange rotatably and provided with means to secure the first sleeve to a cylindrical element of a spark plug, said flange forming a shoulder against which the spark plug element engages when the cap is secured thereto.

2. A cap for spark plugs having a sleeve adapted to receive an ignition cable, the sleeve being formed with a bore forming a restricted portion and a shoulder, means to secure the ignition cable to the sleeve, means for securing the sleeve to a cylindrical element of a spark plug, and means mounting the last named securing means upon the sleeve rotatably.

3. A cap for spark plugs having a sleeve adapted to receive an ignition cable, means to secure the ignition cable to the sleeve to project below the sleeve and into the spark plug, means for securing the sleeve to a cylindrical element of a spark plug, and a protective sleeve carried by the cap and spaced between the spark plug and the portion of the ignition cable below the sleeve.

4. A cap for spark plugs having a sleeve adapted to receive an ignition cable, the sleeve being formed with a bore forming a restricted portion and a shoulder, means to secure the ignition cable to the sleeve, means for securing the sleeve to a cylindrical element of a spark plug, and a protective sleeve carried by the cap and seated against the shoulder.

5. A cap for spark plugs having a sleeve adapted to receive an ignition cable, the sleeve being formed with a bore forming a restricted portion and a shoulder, means to secure the ignition cable to the sleeve, means for securing the sleeve to a cylindrical element of a spark plug, a protective sleeve carried by the cap and seated against the shoulder, and means to secure the protective sleeve against the shoulder.

6. A cap for spark plugs having a sleeve adapted to receive an ignition cable, the sleeve being formed with a bore forming a restricted portion and a shoulder, means to secure the ignition cable to the sleeve, means for securing the sleeve to a cylindrical element of a spark

plug, a protective sleeve carried by the cap and seated against the shoulder, and a turned over portion on the bore engaging the protective sleeve to secure the same against the shoulder.

7. A cap for spark plugs having a sleeve adapted to receive an ignition cable, the sleeve being formed with a bore forming a restricted portion and a shoulder, means to secure the ignition cable to the sleeve, means for securing the sleeve to a cylindrical element of a spark plug, a protective sleeve carried by the cap and seated against the shoulder, an enlarged shouldered end on the protective sleeve, and a turned over portion on the bore engaging the enlarged shouldered portion of the protective sleeve to secure the same against the shoulder.

8. A cap for spark plugs having a sleeve adapted to receive an ignition cable, means to secure the ignition cable to the sleeve, and a threaded sleeve rotatably mounted on the sleeve freely to secure the sleeve to a cylindrical element of a spark plug.

9. A cap for spark plugs having a sleeve adapted to receive an ignition cable, means to secure the ignition cable to the sleeve, means for securing the sleeve to a cylindrical element of a spark plug, and a protective sleeve carried by the cap, the bore of the protective sleeve being at least as great as that of the first sleeve.

10. A cap for spark plugs having a sleeve adapted to receive an ignition cable, means to secure the ignition cable to the sleeve, means for securing the sleeve to a cylindrical element of a spark plug, and a protective sleeve carried rotatably by the cap.

11. A connecting cap having a sleeve adapted to receive an ignition cable, means to secure the ignition cable to the sleeve, means for securing the sleeve to an electrical device, and means mounting the last named securing means axially fixed but freely rotatable upon the sleeve.

12. In a spark plug, the combination of a tubular metallic jacket of high heat conducting capacity, a spindle in the jacket, projecting therefrom and provided at its lower end with an electrode, insulating means between the electrode and the adjacent end of the jacket, between the spindle and jacket and extending to the top of the spindle and still other insulation constituting a tube distinct from said insulating means, insertable in the upper end of the jacket and when so inserted positioned between the spindle and jacket and extending to the top of the jacket and means for securing said tube to the jacket.

13. In a spark plug, the combination of an air cooled metallic tubular jacket adapted to receive an electric lead in its upper end, an electrode carrying spindle centered in the jacket and having its upper end spaced below the upper end of the jacket and adapted to be connected to the intruded electric lead, an insulating sleeve surrounding the upper portion of the spindle, a second insulating sleeve contained in the upper portion of the jacket encircling the first named insulating sleeve and projecting above and below the upper end of the spindle, and a third insulating sleeve positioned above and constituting in effect a continuation of the first named sleeve separable therefrom and substantially contained within the outlines of the second named sleeve.

14. In a spark plug, the combination of an air cooled open top metal jacket, a spindle extending axially of the jacket and provided at its upper end with means within the outlines of the jacket for connection with an electric lead, insulating means surrounding and engaging the spindle, other insulating means lining the upper portion of the jacket bore, extending above the upper end of the spindle and adapted to enclose the intruded end of the electric lead, and an electric lead provided at its intruded end with a sleeve secured thereto and forming a third insulation positioned for the most part in the jacket above the spindle and adapted to position insulation between the intruded end of the electric lead and the insulating means which lines the jacket and a metallic member for securing said sleeve to the jacket.

15. A connecting cap comprising a sleeve having a bore adapted to receive an ignition cable, means at one end of the sleeve to secure the same to an electrical device, the other end of said sleeve having its outer surface flaring outwardly to a maximum diameter from a section of minimum diameter, and a clamp engaging the external flaring surface over an extended area axially thereof.

16. A connecting cap for spark plugs, comprising a sleeve having a bore adapted to receive an ignition cable, means to secure the ignition cable to the sleeve, means for securing the sleeve to an electrical device, and means mounting the last named securing means upon the sleeve in an axially fixed but freely rotatable fashion.

17. A cap for spark plugs comprising a sleeve adapted to receive an ignition cable, means to secure the ignition cable to the sleeve, a coupling nut threaded internally for securing the sleeve to a sleeve element of a spark plug, a skirt on the coupling nut to overlie the spark plug sleeve, and means mounting the coupling nut upon the sleeve rotatably.

18. In a spark plug, the combination of a shell provided with an electrode, a unit including a spindle constituting an insulated coacting electrode and a barrel extending above the spindle to form a socket, an insulated electric lead having a flexible metal covering, a metal tubular member through which said conductor is passed and to the outer end of which said metal covering is electrically connected, the end of the insulated lead being inserted in said socket to make electrical connection with the spindle, and a terminal on the inner end of said tubular member, locking detachably with said barrel and forming a swivel connection between the tubular member and the barrel.

19. In a spark plug having a shell and a central spindle insulated from the shell, the combination of a metal barrel with insulation lining extending upward from the shell above the upper end of the spindle to provide a socket for the insertion of an insulated lead into electric connection with said spindle, a connection through which the lead is passed and which has detachable connection with said barrel and an insulating tube about the portion of the insulated lead within said socket, said tube being connected to the lead and arranged to engage at its upper end with said connection.

20. A spark plug including a supporting tubular shell provided with an electrode, a tubular metallic jacket having its lower end demountably positioned in the shell, a coacting electrode carried by the jacket and insulated therefrom, said jacket having its upper end externally threaded and forming a socket for the insertion therein of an insulated high tension lead, a sleeve through which the conductor is passed and said sleeve

provided at its lower end with a flange and a coupling nut engaging said threaded end of the jacket, and provided with an internal upper end overlapping the flange on the sleeve.

21. A spark plug including a supporting tubular shell provided with an electrode, a long upstanding tubular metallic jacket having its lower end demountably positioned in the shell and in electric engagement therewith, a coacting electrode centered axially in the jacket and insulated therefrom, said jacket having its upper end open to provide a socket for the insertion therein of a high tension lead, an insulating sleeve outlining said socket, a connecting sleeve extending above the jacket secured to the high tension lead and readily separable swivel means for securing said connecting sleeve to the upper end of the jacket.

22. Means for fastening a cable on a spark plug or the like, comprising a metallic sleeve connected with said spark plug or the like, a nut screwed on the outer end of said sleeve, a member fastened on said cable, said cable extending through the bore of said nut and engaged therewith, said nut and member provided with means actuated by the rotation of the nut on the sleeve and cooperating for fastening the cable to the sleeve.

23. Means for fastening an electric lead on a spark plug comprising a metallic sleeve having its upper end threaded, an electric lead having a metallic covering, an end of said lead extending beyond its covering and intruded into said sleeve, a telescopic tubular swivel connection through which the lead extends with one tubular part secured to the lead and the other tubular part in threaded engagement with the threaded end of the sleeve, and said connection including clamping means for securing in place the adjacent end of the metallic covering.

24. Means for fastening an electric lead on a spark plug comprising a metallic sleeve having its upper end externally threaded, an electric lead having a metallic covering, an end of said lead extending beyond its covering and intruded into the bore of said sleeve, a swivel connection including telescopic tubular parts with one part encircling and secured to the lead and the other tubular part being internally threaded and adapted to be disposed in threaded engagement with the threads on the sleeve, and said connection including clamping means for securing in place the adjacent end of the metallic covering.

25. A spark plug including a supporting shell provided with an electrode, a long metallic sleeve with its lower end engaging in the shell and its upper end provided with threads forming an element of a fastening means, the bore of the sleeve being reduced adjacent its lower end, with its upper end open, a spindle extending axially through and projecting both above and below the reduced portion of the bore, the lower end of the spindle provided with a head forming the coacting electrode and having its upper end exposed to form a terminal, an insulating sleeve surrounding the spindle above the head, an insulating sleeve forming a lining to the portion of the bore above its reduced portion, an electric lead intruded into the upper end of the long metallic sleeve for electric engagement with said terminal, the lead provided with a metallic covering, and coupling means, a coupling nut engaging the adjacent end of the metallic covering and having a readily releasable engagement with the threads forming the fastening means at the upper end of the metallic sleeve.

26. A spark plug including a supporting shell provided with an electrode, a long metallic sleeve with its lower end engaging in the shell and its upper end provided with an element of a fastening means, the bore of the sleeve being reduced adjacent its lower end, with its upper end open, a spindle extending axially through and projecting both above and below the reduced portion of the bore, the lower end of the spindle provided with a head forming the coacting electrode and having its upper end exposed to form a terminal, an insulating sleeve surrounding the spindle above the head, an insulating sleeve forming a lining to the portion of the bore above its reduced portion, an electric lead intruded into the upper end of the long metallic sleeve for electric engagement with said terminal, the lead provided with a metallic covering, coupling means engaging the adjacent end of the metallic covering and having a readily releasable screw threaded engagement with the fastening means at the upper end of the metallic sleeve, and additional insulating means between the electrode forming head at the bottom of the spindle and the lower portion of the metallic sleeve.

27. In a spark plug, the combination of a tubular metallic jacket open at its upper end and provided with insulating material lining the upper portion of its bore, a spindle extending axially of the jacket insulated therefrom, having its upper end spaced below the open top of the jacket and having its lower end projecting below the jacket and provided at its lower end with an electrode, a sleeve projecting above the open end of the jacket and adapted to have an electric lead extend therethrough and through the open end of the jacket for engagement with the upper end of the spindle, and readily separable screw threaded means for detachably securing the sleeve to the upper end of the jacket.

28. A spark plug including a shell, a unit carried by the shell and comprising a tubular metal jacket open at its upper end, a spindle having its upper end contained in the jacket below its upper open end and adapted to be connected to an electric lead, a sleeve having a bore adapted to receive the electric lead and having a part split, a clamping device encircling the split end of the sleeve and a coupling nut connecting the sleeve and jacket.

29. In combination, a spark plug including an open top metallic sleeve forming a jacket, a protective sleeve of insulating material lining the upper portion of the jacket, a third sleeve forming a cap positioned on top of the jacket and forming an upward continuation thereof, means for securing the cap to the jacket, a fourth sleeve constituting a second protective sleeve of insulating material having its upper end secured to the cap, removable therewith, projecting downwardly therefrom and intruded into the upper end of the first named lining sleeve, and an electric lead passed through the cap and having its intruded end surrounded by both protective sleeves.

30. In a spark plug assembly, the combination with a spark plug provided with a socket and a spindle centered in said socket, of an electric lead adapted to be intruded into the socket to make electric connection with the spindle without rotating the lead relative to the spark plug when the attachment is made, said lead provided adjacent its intruded end with a two-part coupling with one part freely rotatable relative to the other when free of the spark plug, the part remote from

the intruded end of the lead being secured to the electric lead and the other part provided with means for engaging the socket forming end of the spark plug thereby to secure the lead to the spark plug.

31. In a device of the class described, the combination of two readily separable parts, one of said parts comprising a spark plug and including an open top jacket and a spindle in the jacket, and the other part comprising an electric lead having an end portion intruded into the open top of the jacket and electrically connected to the spindle, a metallic sleeve secured to the electric lead externally of its intruded end portion and movable therewith and an insulating sleeve telescopically engaging the intruded end portion of the lead and swivel means for securing the metallic sleeve to the jacket to connect the parts together without materially rotating the electric lead relative to the spark plug.

LEWIS FRANKLIN HAHN.

CERTIFICATE OF CORRECTION.

Patent No. 2,055,408. September 22, 1936.

LEWIS FRANKLIN HAHN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, lines 30 and 31, claim 1, strike out the words and comma "and a second sleeve engaging the flange on the sleeve, "; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of December A. D. 1936.

Henry Van Arsdale

Acting Commissioner of Patents.

(Seal)

DISCLAIMER

2,055,408.—*Lewis Franklin Hahn*, New York, N. Y. TERMINAL CAP FOR SPARK PLUGS. Patent dated September 22, 1936. Disclaimer filed July 18, 1941, by the assignee, *Air-Shields Incorporated.*

Hereby enters this disclaimer to claims 3, 5, 9, 12, 14, 18, 19, 21, and 31 of said Letters Patent.

[*Official Gazette August 12, 1941.*]