

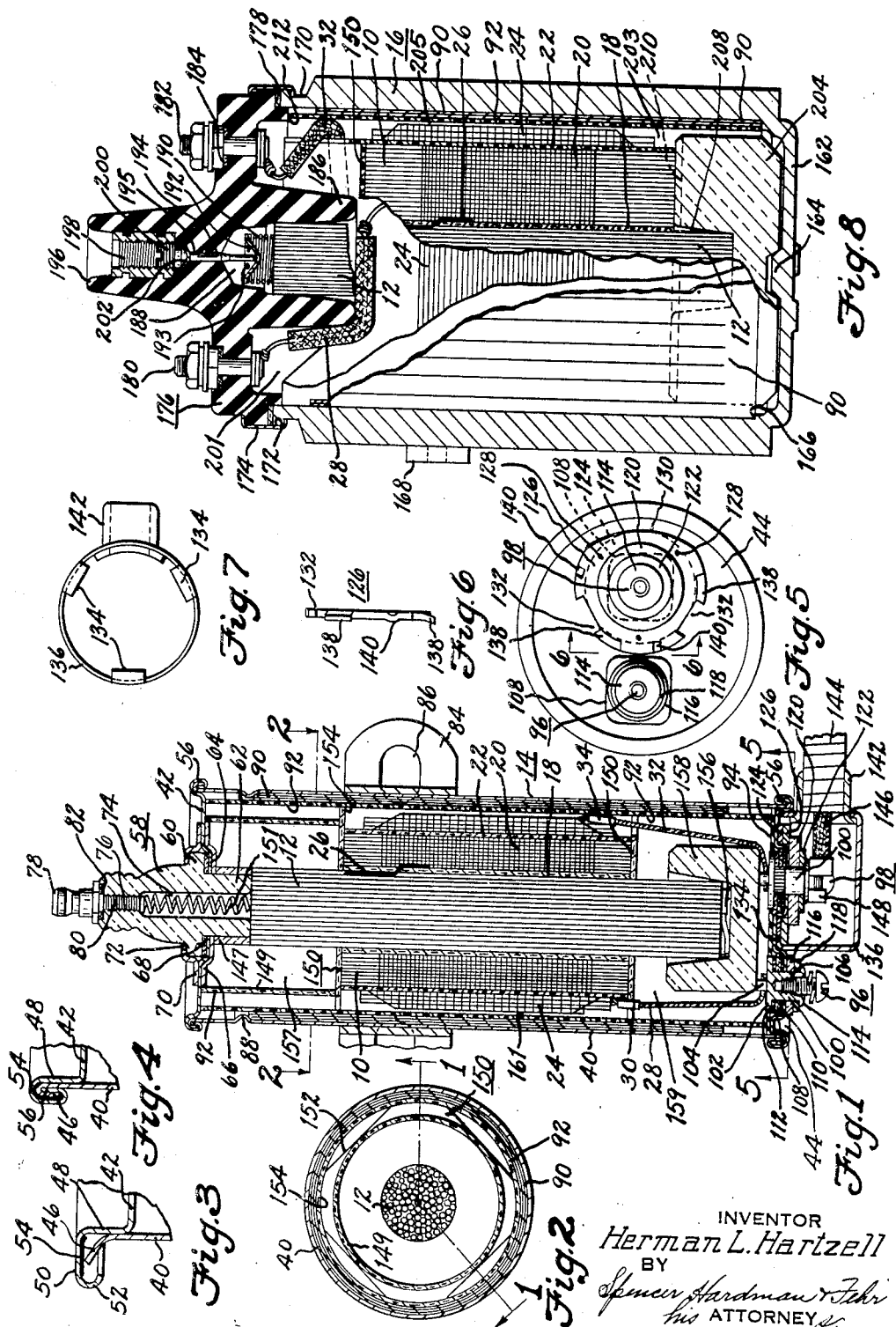
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IGNITION COIL

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IGNITION COIL

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This invention relates to ignition coils for automotive engines and is directed particularly to ignition coils whose winding assemblies are enclosed in fluid tight casings and impregnated with an oil or wax.

An ignition coil for internal combustion engines is required, considering its size, to carry current of relatively great magnitude while the engine is in operation for a substantial proportion of the engine operating time. The current flow may be regarded as practically continuous so far as concerns the heating effects upon the coil. A considerable portion of the current impressed upon the windings of the coil results in the heating of the component parts, including the windings which may alter the electrical resistance of the unit as a whole, and may also amount to destructive influences upon the parts of the coil. It is therefore necessary for efficient operation to maintain the temperature of the coil below a certain maximum. It has been customary to depend upon the use of thin walled metal casing members closely arranged about the windings for conducting the heat developed by the windings to the exterior of the casing, where cooling would be effected by a draft of air flowing about the casing. Due to the increased speed tendency of the present day automotive engine, that method of cooling is not satisfactory, and therefore applicant has devised an ignition coil construction of smaller mass in which there is a direct liquid communication between the windings of the ignition coil and its enclosing casing by which the unit as a whole can be more adequately controlled and effectively cooled.

With the foregoing in mind it is an object of this invention to improve the efficiency of an ignition coil by filling all of the voids of the enclosure with an impregnating medium so that the working temperatures of the coil are better controlled, and so that heat developed during its operation is more readily dissipated for cooling.

Another object of the invention is to provide a method of impregnating ignition coils with oil, wax or like substances.

Still another object of the invention is to provide an ignition coil with a housing having a fluid seal at the juncture of housing members and terminal supports, so that an ignition coil may be impregnated with a fluid medium and maintained in sealed condition.

Still another object of the invention is to provide a terminal connection for a housing member that will be proof against leakage in an oil impregnated construction.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of the present invention is clearly shown.

In the drawing:

Fig. 1 is a longitudinal sectional view of an oil impregnated ignition coil for relatively moderate service, the section being substantially as indicated by the line and arrows 1—1 of Fig. 2.

Fig. 2 is a transverse sectional view through the ignition coil, substantially as indicated by the line and arrows 2—2 of Fig. 1.

Fig. 3 is an enlarged detail in section illustrating one step in the method of assembling the coil casing and end members.

Fig. 4 is an enlarged detail in section illustrating the juncture of the casing and end member after the assembly has been completed.

Fig. 5 is a plan view of the top end of the coil with the terminal enclosing cup having been removed.

Fig. 6 is a view in elevation of a lock plate for the terminal cover, it being a view substantially as indicated by the line and arrows C—C of Fig. 5.

Fig. 7 is a bottom plan view of the terminal enclosing cap after removal from the lock plate as shown in Fig. 1.

Fig. 8 is a longitudinal sectional view of a heavy duty ignition coil illustrating certain modifications of construction.

With specific reference to the drawing, an ignition coil comprises an assembly of coil windings 10, mounted upon a bunch of core wires 12 which are enclosed within a casing 14 (Fig. 1) or casing 16 (Fig. 8). Particularly with respect to the model illustrated in Fig. 1 and shown in inverted position, the winding assembly 10 consists of a paper tube 18 upon which there is a secondary winding 20 covered by a layer of insulation 22 around which is a primary winding 24. At the inside end of the secondary there is a lead 26 that is tucked inside of the end of the tube 18 where it is electrically engaged by the core wires 12 when they are finally packed within the tube 18. The outside secondary lead and the inside primary lead are twisted together and joined to a conductor 28 by means of a clip and solder connection 30. The outside primary winding is joined to a conductor 32 in a similar manner as at 34.

The winding assembly thus constructed is adapted for mounting within a housing member which in the moderate service model comprises

a sheet metal can 40 of tubular construction having sealed seams fitted with end members 42 and 44 secured thereto in double crimped and sealed relation. The end member 42 (bottom member when the coil is installed), is preferably secured to the can 40 first, the details of which procedure are illustrated in Figs. 3 and 4. Each end of the can 40 terminates in a diverging flange 46 and each of the end members 42 and 44 has a right angular wall portion 48 which transforms the end member into a shallow cup, at the top of which is a planar flange 50 terminating in a roll 52. The cylindrical wall 48 of the end member snugly fits within the end of the can 40, and the diverging flange 46 of the can passes within the roll 52, where it is adapted to encounter the planar portion 50, a compressible gasket 54 of oil and heat resisting material, such as rubber latex bonded cork, being disposed therebetween. That loose assembly of housing parts is illustrated in Fig. 3 which is a relation preparatory to rolling down and sealing in the form illustrated in Fig. 4, wherein the diverging flange 46 is folded back along the can 40, and the rolled edge 52 is compressed and flattened down to compress the gasket 54 between the successive layers of casing material. That relation is accomplished by forcing the end member and the can together endwise of the can while the folding, seaming or crimping of the can end and rolled edge is accomplished. The completely fluid-sealed juncture is indicated at 56, and both end members are sealed to the can 40 in the same manner and by the same means.

A high tension terminal is provided by the bottom end member, which in the instance of the moderate service coil embraces a porcelain insulator 58 having a flange 60 forming a shoulder at one end of a cylindrical portion 62 adapted to project through an aperture centrally of a depression 64 of the head member 42. For reinforcing the end member and forming a secure abutment for the insulator, there is provided a dished washer 66 attached to the inside of the end member. A gasket 68 of oil and heat resisting material rests in the depression of the end member and engages the face or shoulder of the insulator flange 60, and a second dished washer or flanged ring 70, closely surrounds the flange 60 and is secured to the end member 42. The peripheral flanges of the discs or washers 66 and 70 may be secured to the end member 42 by spot welding or otherwise. With the insulator 58 disposed within the cylindrical portion of the washer 70, and against the gasket 68, the upper edge of the disc 70 is crimped over against the outer surface of the flange 60, while the parts are held together under a pressure of something like 400 pounds. As a result, a fluid tight seal around the flange of the insulator is effected, the seal being maintained by the crimped edge 72 of the flanged ring 70. The insulator 58 is further characterized in that it has a longitudinal bore 74, reduced at its outer end to incorporate an internally threaded portion 76 adapted to receive a high tension terminal member 78 having a threaded stem 80. In the final assembly a gasket 82 of heat and oil resisting material is disposed between the end of the insulator and a shoulder of the terminal 78.

For mounting upon the engine block, bulk head or other support, the can 40 is fitted with a bracket 84 apertured at 86 for reception of suitable clamp devices. At a short distance from the upper end of the can an inwardly rolled

rib 88 is provided that forms a seating portion for locating an assembly of magnetic strips forming the outside iron 90 of the ignition coil. As in the usual practice, this assembly of outside iron constitutes a metallic sheet transverse of which there are several slits. The mutilated or slitted sheet of iron is then rolled into cylindrical form and inserted within the can 40, where it expands to engage the side walls substantially as shown with one inner end portion engaging the shoulder or abutment formed by the rib 88. Extending throughout substantially the entire length of the casing 40 there is a tubular insulator 92 which in effect forms a liner within the assembly of outside iron 90. One end of this insulator engages the head member 42, while the other end of the tubular insulator is in close proximity to the head member 44, an end insulator 94 being disposed therebetween.

For closing the opposite end of the can 40, the top end member 44 is fashioned similarly to the end member 42 insofar as the juncture between the head member and can 40 are concerned for effecting the sealed connection terminating in the double rolled rim 56, described with respect to Figs. 3 and 4. The end member 44 is further fashioned to support a pair of terminal members such as a distributor terminal 96 and a battery terminal 98 to which a lock switch unit may be attached. The construction of the terminal members 96 and 98 is identical, in that each comprises a conductive element 100 having a flange or head 102 and a terminal attaching portion 104, the shank portion 106 being recessed and tapped at 108 to receive a terminal screw. The tapped recess 108 does not extend all the way through the element 100, but leaves a portion of solid metal so that there will be no fluid leak through the element.

At appropriate points the head member 44 is formed with rectangular depressions 108 that receive a similarly shaped insulator 110 on each side of which is disposed a gasket 112 of oil and heat resisting material. These elements having been passed over the shank of the conductive element 100, they are thence disposed between the flange 102 and the inside bottom of the depression 108 after the shank of the conductive element 100 has been passed through the aperture of the depression 108. Element 100 receives an insulator 116 and a metal washer 118 against which the recessed end of the element 100 is peened over, similar to a tubular rivet, as indicated at 114 in Fig. 1.

With respect to the terminal 98, its element 100 receives an insulator 120 and metal washer 122. In the instance of the terminal 98, the square embossment 108 through which the element 100 extends is surrounded by a spacing washer 124 and a larger diameter lock plate 126 which are secured to the end member 44 by spot welding, or otherwise, such as indicated at 128 in Fig. 5. The insulating washer 120 extends over the inner edge of the lock plate 126 as shown in Fig. 1. The lock plate 126 is extended peripherally over the spacer 124 and is provided with a cut-away portion 130 and with notches 132 for receiving inwardly extending radial lugs 134 of a terminal cover member 136 (Fig. 7). The cut-away portion 130 and notches 132 extend inwardly to the periphery of the lock plate 126. The internal diameter of the cap 136 is slightly greater in diameter than the lock plate 126. Portions of plate 126 between the cut-away portion 130 and the notches 132 provide flanges overhanging

the spacer 124. Portions 138 of these flanges are struck inwardly toward the head member 44 to provide rotation stops, and other portions of the flanges intervening are provided with corrugations or cross ribs 140 extending also toward the head member 44 to provide detents. Looking upon Fig. 5, the terminal cover 136 is assembled with respect to the coil and member 44 by passing the lugs 134 through the cut-away portion 130 and the notches 132, and then rotating the cap 136 in a clockwise direction until the lugs 134 engage beneath the flanges of the lock plate and pass beneath the corrugated portions 140 to rest between one of them and the near edge of a deflected portion 138. Thus the cover is coupled to the head member 44 since its lugs 134 are confined between the flanges of plate 126 and outside wall of member 44. In certain aspects, this form of coupling resembles a bayonet slot connection. The terminal cover 136 usually incorporates a hub portion 142 secured to the cover 136 in any desired manner, as by spot welding, and is usually rigidly assembled with an armor 144 by spot welding, staking or the like. The armor encloses an insulated conductor 146 ending with a terminal clip 148 adapted to be secured to the terminal 98.

These several sub-assemblies of the ignition coil are assembled in their final relation in the following manner. The can 40 is so positioned that the high tension terminal 78 is lowermost. A tubular insulator 147 forming an inner iron support tube is passed over the inner end 62 of the high tension insulator so that it rests against the inner periphery of the flange ring 66. A spacing tube 149 of insulating material is then disposed against the inner surface of head member 42 so that it embraces the outer periphery of the ring member 66. A coil spring 151 is then placed in the bore 74 of the insulator 58, to act as a connector between the terminal 78 and the coil core when assembled. The winding assembly 10, including the centrally disposed core wires 12 is then fitted at each end with a winding locator 150, the winding locator being generally rectangular in plan such as to provide the flat edges 152 with rounded corners 154, so as to just fit within the tubular insulator or outer iron liner 92. The winding assembly so fitted is inserted in the housing assembly so that the winding locators move along inside of the insulator 92 and until the winding assembly is supported at the lower end by the end 62 of the insulator 53 and spacing tubes 147 and 149. The ends of the core wires 12 will then have engaged the exposed end of the spring conductor 151 and compressed it toward the reduced end of the insulator 58. The conductors 28 and 32 of the windings passing between the flats 152 of the winding locator 150 and the inner wall of the insulator 92 are secured at their ends to the lugs 104 of terminal elements 100 by crimping and soldering or as may be desired. Then a spring washer 156 is placed against the exposed end of the core wires 12, and a core cup 158 which is usually of porcelain, is inverted over the washer 156 and about the end of the core. The leads having been fixed to the terminals 96 and 98 with the end insulator 94 between the core cup 158 and head member 44, the end assembly 44 is then assembled upon the open end of the casing 40 as illustrated in Fig. 3, and is secured in its sealing relation as illustrated in Fig. 4, and as has herein been described.

From the foregoing description, it is apparent

that the coil includes a sealed casing enclosing a winding assembly that is rigidly and centrally spaced therein so as to present the end spaces 157 and 159 between the ends of the winding assembly and the end members 42 and 44, respectively, that are connected by the cylindrical space 161 between the casing insulator 92 and the outside of the primary winding 24. It is these spaces, and the voids of the assembly that communicate with the spaces that are subsequently filled with the impregnating mediums.

With respect to the heavy duty type of ignition coil, illustrated in Fig. 8 the essential features of the invention are the same, though the construction by which the improvements are achieved differ somewhat. The winding assembly is essentially the same except for proportions, but provides the leads or conductors 28 and 32 which are adapted to be secured to outside terminals provided by the casing. In this instance the casing comprises a deep cup-like member 16 having an integrally formed bottom wall 162 with an inwardly projecting central boss 164 and inner peripheral shoulders 166 or ledges. The exterior cylindrical portion may be fluted, finned or otherwise provided for rapid cooling. The case 16 is provided with integral, threaded, bosses 168 for receiving screws by which the coil is mounted on a support. The open end of the casing or cup is reduced in form to provide a peripheral groove 170 adjacent a narrow terminating flange 172, adapted to provide a ledge behind which a crimp ring 174 is bent to retain in sealing relation a non-conducting head member 176 that compresses a gasket 178 of oil and heat resisting material. The head member 176 supports terminals 180 and 182 having electrical engagement with the leads 28 and 32 respectively. Oil and heat resisting gaskets 184 provide for the sealing of the terminals in the insulator. The inner side of the insulator provides a tubular boss 186 serving as a cup for one end of the core wires 12, the tubular portion of said boss having an extension 188 for reception of a conductor assembly comprising a coil spring 190 resting against the core wires 12, and supporting a spring cup 192 somewhat of inverted conical form the apex of which extends within the spring and toward the ends of the core wires 12. The spring cup is apertured at 193 and is engaged by a contact pin 194 extending through a small bore 195 of the insulator 176. An outwardly extending tubular extension 196 of the insulator 176 carries a threaded sleeve insert 198 adapted to receive a screw plug 200 for clamping a compressible lead washer 202 against the insulator 176 to seal the hole 195 therein which receives the pin 194 and thereby to prevent the escape of oil from the coil case 16 while also completing the electrical connection between the core wires 12 (electrically connected to the secondary coil lead 26) and the insert 198.

In this embodiment, a core cup 204 which may be of porcelain is disposed in the casing 16 against the bottom wall 162, there being a central depression in the insulator for piloting over the boss 164, and the insulator having a socket 208 for reception at the lower end of the core wires 12. On the upper surface of the core cup 204, there are one or more cross channels 210 indicated by dash lines in Fig. 8, providing for fluid communication between the socket 208 and the periphery of the insulator.

In assembling the coil parts the core cup or insulator 204 is disposed against the bottom wall 162, and the outside iron 90 and the tubular in-

sulator 92 are disposed within the casing so as to rest at one end against the ledge 136. Electrical connections having been completed between the windings and terminals 180 and 182, the winding assembly is thence passed within the tubular insulator 92 where it is substantially centrally positioned by the core cup 264. The gasket 178 being in place the insulating head member 176 is then adjusted in position until an inner edge 212 engages the upper end of the insulating tube 92 and presses it against the shoulder 186. The tubular boss 186 will then engage the winding locator 150 and the windings and press them against the bottom wall of the casing. While the end member is held against the flanged end of the casing under something like 400 lbs. pressure so as to compress the gasket 178 into sealing relation, the clamp ring 174 is then crimped into place, which seals the casing and cover member proof against fluid leakage. The resulting assembly is shown by Fig. 8, where the winding assembly is firmly held centrally of a sealed enclosure so that there are cavities or spaces such as 201, 203 at the ends of the winding assembly, and spaces such as 205 between it and the casing assembly.

Either of the coil constructions thus described is now ready for the final step in completion, which comprises impregnating the construction, or in other words filling all of the spaces, cavities and voids of the assembly within the casing and about the windings with an impregnating medium. While it is proposed to make the assemblies as thus described complete before impregnation, it may be desirable to impregnate the winding assemblies separately before they are assembled within the casing, and then fill the assembly with the impregnating medium after the housing has been closed, after which the sealing plugs may be secured in place.

One satisfactory method for impregnating the completed construction is to assemble the units on a tray within a tank with the high tension terminal insulator free of its sealing means. That is to say, as respects the coil of Fig. 1, the terminal 78 with its gasket 82 will not be in place, but there will be a single free passage from the exterior of the casing to the interior thereof through the threaded bore 76, the enlarged portion 74, and around the springs 151, and thence through the spacing between the core wires 12 and other passages to the spaced portions of the assembly. As respects the form shown in Fig. 8, the screw plug 200, the lead washer 202 and the conducting pin 194 will not be in place, thus allowing free passage into the interior of the assembly, through the insert 193 the bore 195 of the insulator, the apertures 193 of the spring cup and thence in a manner similar to that just described to all the spaces of the assembly. In other words, both of the coil constructions, though the casing members are sealed in fluid tight relation, will be open to the atmosphere of the impregnating kettle through passages extending through the high tension terminal insulator.

With the coil constructions loaded in a tank fitted with a cover capable of hermetic seal, and so that the passages into the interior of the coil constructions are uppermost, the tank is evacuated for something like two hours and while the load is maintained substantially cold, so that a pressure of some four mm. or less of mercury is accomplished. It is preferable that this step be accomplished slowly particularly at first. The

tank and its loaded coils is then heated and the evacuation continued for something like ten hours or more under temperatures of about 210° F. for the first five hours, which may be increased to 225° for the remainder of the period, the pressure reduction being accomplished to something like 6 mm. or less. By that time, substantially all of the air and moisture will have been removed from all of the voids and spaces of the coil assembly. When this has been accomplished, sufficient impregnating compound is drawn into the evacuated tank to cover the coils to be impregnated, under which condition they are left to stand for a period of one half hour or more under a temperature of 210° to 225° F. That the vacuum may be relieved by admitting dry air followed by heating to a temperature of 225 to 265°, after which the impregnating compound may be returned to the storage tank, though the impregnating tank and its charge of coils is kept at a temperature of about 255° F. or more until the coil units are removed for sealing. The coil units, then will have been completely filled with the impregnating oil or wax, since evacuation of their interiors followed by the introduction of hot impregnating material, fills all of the voids between the core wires 12, and between the turns of the primary and secondary windings, as well as the spaces 157, 159, 161 or 201, 203 and 205, and the like, with the introduced material. The impregnating material finds its way into the coil cavities through the passages in the terminal insulators and thence flows into all of the evacuated voids and spaces to fill the same. Each of the coils is finally sealed with the terminal members and gaskets, while the impregnated coil is still hot from the impregnating cycle, which is at a temperature that is somewhat higher than that that will be experienced by the ignition coil under operative conditions in an ignition circuit of an automotive engine.

In sealing the coil of Fig. 1, the sealing gasket 82 is placed on the threaded end 80 of the terminal 78, and the stem 80 is then coated with a cement so that when the terminal 78 is threaded into the end of the insulator and the cement hardens, the coil casing will be completely sealed against the passage of any fluid either into or out of the casing. In the instance of Fig. 8, the casing is finally sealed by inserting the contact pin or plug 194, until it engages the spring cap 192 and depresses it to compress the spring 190. The soft lead washer 202 is then placed over the end of the pin 194 and is forced into place by the screw plug 200 that is threaded into the insert 193, thereby finally sealing the casing against fluid flow therethrough.

It has been found that ignition coils constructed and impregnated according to the instant disclosure have a longer life than heretofore attained. The impregnating medium which fills all the voids and spaces of the coil construction facilitates cooling of the coil since it provides ready conductive means by which heat generated in the windings is readily communicated to the metal of the casing 40, from which point it is cooled by air flow over the exterior of the same.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A terminal for an ignition coil comprising a casing having a head member with a socketed

aperture therethrough for the location and support of an electric terminal, a recessed rivet having a flange and whose shank is disposed in the aperture of said end member socket, a gasket of rubber bonded cork engaging the bottom of said end member socket for sealing the juncture against fluid flow, an insulating disc disposed between the gasket and rivet flange and commensurate in area with that of the socket, said rivet being peened over against a metallic washer on the opposite side of the said member for effecting seal and insulation of the rivet relative to the head member.

2. An ignition coil comprising in combination, a coil body, a tubular metallic case surrounding the coil body, metallic end members joined to the case by lock seams and situated one at the top and one at the bottom thereof, terminals insulatingly supported by each end member of the case, a lock plate secured about one of the terminals and having bayonet ways between the edge of the lock plate and the end member, and a conductor armor having tongues adapted to traverse the bayonet ways.

3. An oil or wax impregnated ignition coil, comprising in combination, a coil body, a sealed cas-

ing enclosing the coil body, winding locators at each end of the coil body centralizing the coil body with respect to the casing, said locators being spaced from the end closures thereof, and supporting the body from the sides of the casing, and means at each end of the coil body and engaged by the casing end members for positioning the coil body longitudinally of the casing.

4. An ignition coil comprising in combination, a coil body, a tubular metallic case surrounding the coil body, metallic end members joined to the case by lock seams and situated one at the top and one at the bottom thereof, a circuit terminal supported by one of the end members, a lock plate secured to the end member about the circuit terminal and providing bayonet ways between the lock plate and the end member, a terminal cover adapted to enclose one of the circuit terminals and having radially extending tongues cooperable with the bayonet ways, said terminal cover being coupled with the lock plate by substantial relative rotation to engage stops, said stops being located at the ends of the bayonet ways.

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