May 14, 1929. C. H. KINDL 1,713,183

IGNITION COIL

Filed June 22, 1927 2 Sheets-Sheet 1

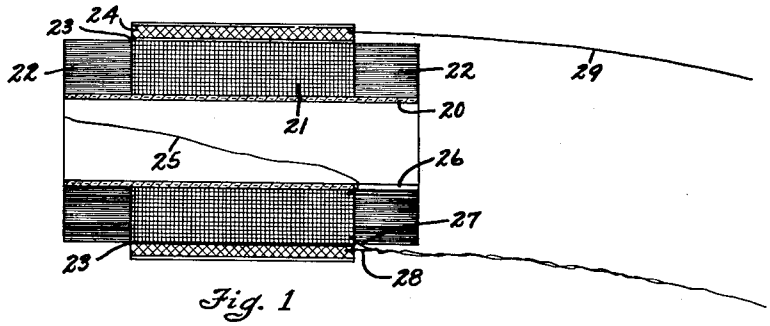


Fig. 1

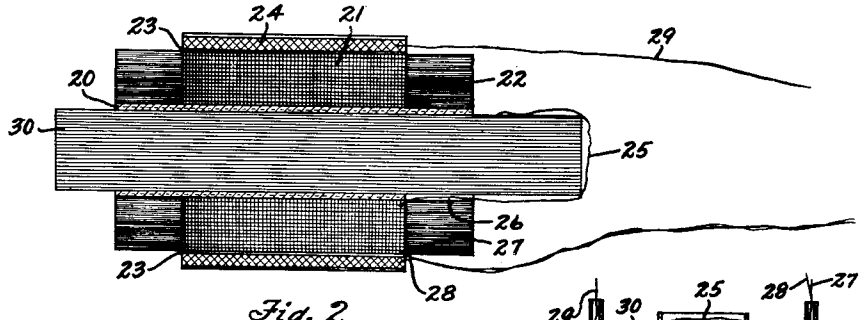


Fig. 2

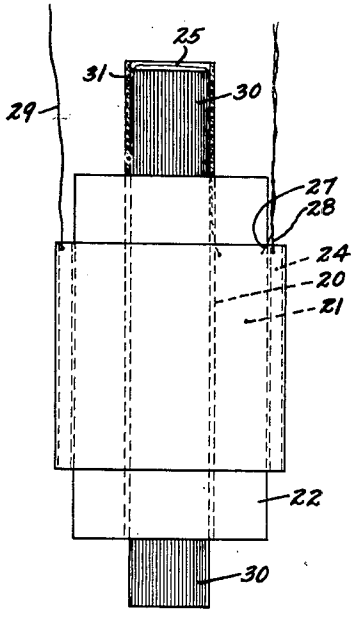


Fig. 3

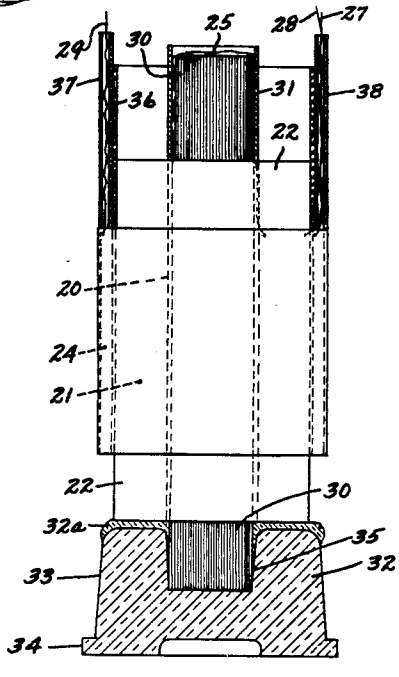


Fig. 4

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IGNITION COIL

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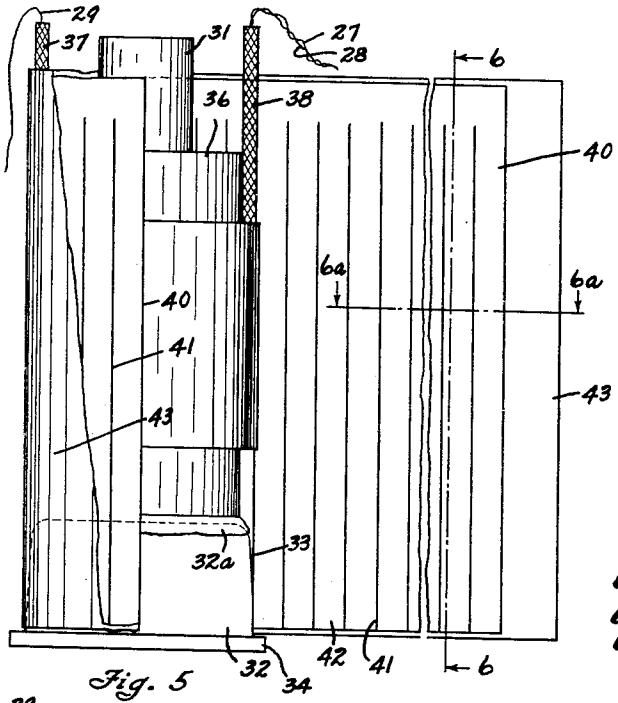


Fig. 5



Fig. 6a

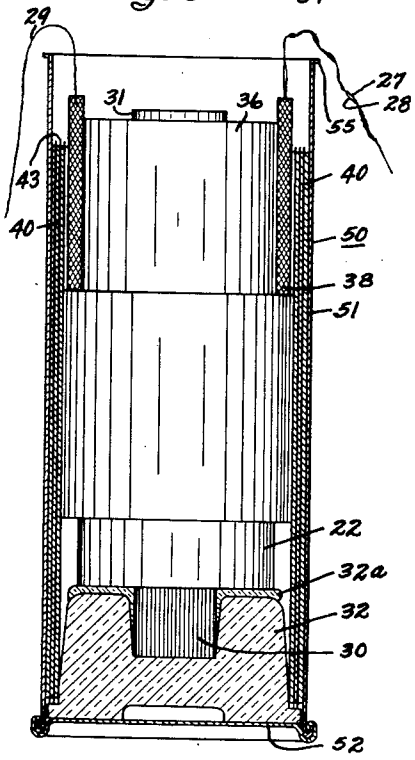


Fig. 7

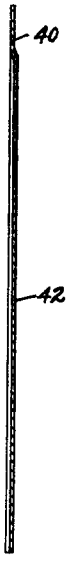


Fig. 6

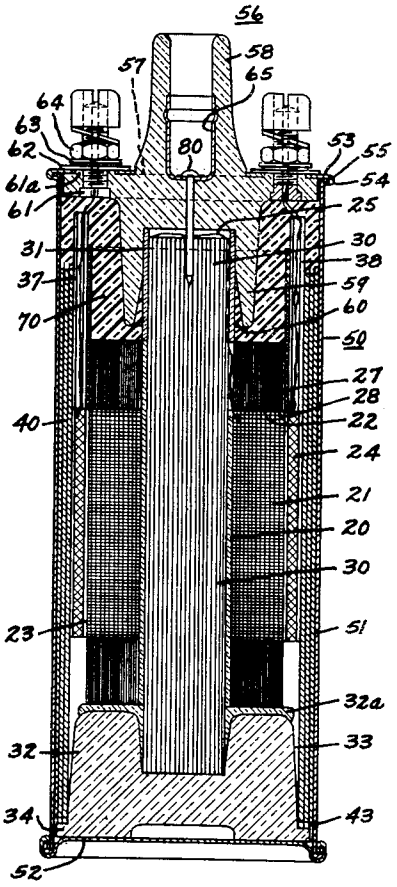


Fig. 8

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Patented May 14, 1929. 1,713,183

UNITED STATES PATENT OFFICE.

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IGNITION COIL.

Application filed June 22, 1927. Serial No. 200,695.

This invention relates to the manufacture of induction coils, particularly to ignition coils for internal combustion engines.

One of the objects of the present invention is to reduce the cost of manufacture of ignition coils, and in order to accomplish this object the invention contemplates certain novel combinations of elements comprising the coil and certain novel combinations of steps by which the coil is manufactured.

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

In the drawings:

Fig. 1 is a longitudinal sectional view of the primary and secondary windings of the coil.

Fig. 2 is a view similar to Fig. 1 showing the addition of the center core to the assembly of windings shown in Fig. 1.

Fig. 3 is an elevation of the assembly of the primary and secondary windings and the center core and a tube surrounding one end of the center core and a lead wire of the secondary windings which is grounded upon the core, said tube being shown in section.

Fig. 4 is a view showing in side elevation the assembly of windings and center core positioned upon a non-conducting base which is shown in longitudinal section.

Fig. 5 is a view showing in elevation the assembly of parts shown in Fig. 4 and the beginning of the wrapping of the magnetizable material about this assembly.

Fig. 6 is a sectional view on the lines 6—6 of Fig. 5 showing the formation of the strip of magnetizable material which is wound about the exterior of the windings.

Fig. 6ª is a sectional view on the line 6ª—6ª of Fig. 5.

Fig. 7 is a view partly in section of the assembly shown in Fig. 5, this assembly being shown within a metal container or coil case which is shown in longitudinal section.

Fig. 8 is a longitudinal sectional view of the completed coil.

Referring to Fig. 1 of the drawings, the first step in the manufacture of an ignition coil according to the present invention consists in winding upon a non-conducting tube 20 a plurality of turns of relatively fine wire constituting a secondary winding 21. Each layer of turns of the winding 21 are separated by a few turns of paper, the side margins of which are indicated at 22 and project beyond the windings 21. After winding the secondary coil 21 it is covered with several layers of insulating paper which forms when wound upon insulated tube 23. The secondary coil is then impregnated by immersing in a bath of molten insulating material such as a mixture of rosin and beeswax. After the insulating compound is allowed to solidify between the turns of the coil 21 and the turns of the paper 22, a primary winding 24 comprising relatively few turns of relatively coarse wire is wound upon the secondary coil 21. The inside turn of the coil 21 is provided with a lead wire 25 which may extend through a notch 26 provided by slitting the tube 20. The outside last turn of the secondary 21 is provided with a lead 27 which is grounded upon the inside lead 28 of the primary 24. 29 designates the outside lead of the primary 24. The insulating varnish surrounding the leads 27, 28 is removed by scraping the leads, the leads being twisted together and attached by soldering.

Then, a center core comprising a bundle of relatively small wires 30 is passed through the center tube 20 as shown in Fig. 2; and the lead 25 is passed around one end of the core 30 as shown in Fig. 2. A relatively short non-conducting tube 31 is placed around the core 30 and the wire 25 so as to maintain the latter in contact with the core which is to provide a terminal for a secondary circuit of the ignition coil.

There is provided a non-conducting base 32 preferably of porcelain which has conical wall 33, the largest diameter of which is approximately the diameter of the primary winding 24. The base 32 is provided with a flange 34 which is slightly smaller in diameter than the internal diameter of the housing which is to surround and enclose the ignition coil windings. The base 32 is provided with a central recess 35 adapted to receive one end of the core 30. Before assembling the windings 21 and 24 and center core 30 with the base 32, the lower end of the core 30, as viewed in Fig.

3, and the lower margins of the paper 22 are immersed in melted beeswax and then quickly pressed upon the porcelain base 32 while the beeswax is still soft. After the beeswax clinging to the paper and core solidifies, the base 32 will be rigidly attached to the assembly of the core and windings. A tube 36 is placed around the upper margins of the paper 22, a sleeve of non-conducting material 37 is placed around the primary lead 29, and a non-conducting sleeve 38 is placed around the leads 27 and 28.

The assembly of parts shown in Fig. 4 provides a substantially cylindrical form about which is wrapped several turns of flexible magnetizable material insulated by a strip of paper. The outer wrapping of magnetizable material or outer core iron as it may be called, is provided by slitting cross-wise a strip of soft iron 40, the slits or shear cuts being represented by the lines 41 which extend from one margin of the strip 40 but terminate short of the other margin so as to provide a continuous strip of iron extending lengthwise to which each of the portions 42, separated by the slits 41, are attached. Each strip 42 is slightly out of the planes of its neighboring strips so that adjacent strips will barely touch, thus increasing the resistance to eddy currents. A strip of insulating paper 43 is first placed upon a horizontal support and then the iron strip 40 is placed upon it. The paper strip 43 and the iron strip 40 are wound at the same time about the assembly of parts shown in Fig. 4. This operation can be conveniently performed since the exterior diameter of the primary winding 24 is approximately equal to that of the base wall 33. It will be noted that the paper strip 43 and the iron strip 40 are not wound upon the flange 34 of the base 32. The assembly of parts shown in Fig. 5 with the paper strip 43 and the iron strip 40 completely wound upon the assembly are placed within a sheet metal container 50 including a tubular case 51 and a base 52 which supports the non-conducting base 32. The internal diameter of the tube 51 is such as to accommodate snugly the assembly of parts shown in Fig. 5 when the paper strip 43 and the iron strip 40 are completely wound around the coils.

The cover for the tube 51 is provided by a sheet metal plate 53 having a flange 54 which may be formed around the flange 55 of the tube 51 as shown in Fig. 8. The metal plate 53 supports a body of the molded insulating material 56 which may be characterized as comprising a plate 57 which is fastened against the under side of the plate 53 in a manner to be described, a tubular cable-receiving socket 58 extending upwardly from the plate 57 and an annular skirt 59 extending downwardly from the plate 57 and surrounding a centrally disposed recess 60. The part 57 is secured to the metal plate 53 by hollow screws 61 each of which extends through the plate 57 and an annular boss 61^a extending within a suitable orifice provided by the plate 53. The screws 61 cooperate with nuts 64 to secure the part 57 to the end plate 53. Non-conducting washers 62 are located between metal washers 63 so as to insulate the screws 61 from the plate 53. The cable-receiving socket 58 is provided with a metallic lining member 65 for receiving a suitable metal clip attached to an insulated wire which is inserted within the socket 58.

Before attaching the cover comprising the metal plate 53 and the non-conducting body 56 to the coil case 51, the wire 29 is passed through one of the screws 61 and the other two joined wires 27 and 28 through the other screw 61. Then a quantity of insulating compound such as hydrolene is poured while semifluid into the top of the tube 51 so as completely to fill the space between the insulating tubes 31 and 36 and a part of the space within the tube 50 above these tubes and the outside core iron provided by the coiled iron strip 40. Before the hydrolene is allowed to solidify, the cover provided by the plate 53 and insulating body 56 is placed upon the coil case 51 and the flange 54 of the plate 53 is crimped around the flange 55 of the case 51. The hydrolene or other suitable insulating compound 70 is forced by the annular skirt 59 into such position that upon solidifying it will prevent all movement of the upper end of the coil and the inner and the outer cores thereof. It will be noted that the recess 60 provided within the skirt 59 receives the tube 31 which surrounds the core 30. It will therefore be seen that the upper end of the core is completely braced against lateral movement by the skirt 59 and that the outside core iron provided by the strip 40 is braced against endwise and lateral movement by the insulating compound 70 which is located around the skirt 59. The lower ends of the inner and outer core of the coil are securely braced by the non-conducting base 32. The margins of the paper turns 22 are braced against sidewise and endwise movement by virtue of contact with the solidified beeswax 32^a and with the solidified compound 70. It is therefore apparent that the windings of the coil and the parts comprising the magnetic circuit of the coil are securely braced by suitable non-conducting parts located within the coil housing.

The wires 29, 27 and 28 are clipped off flush with the top ends of the screws 61 and are attached thereto by soldering. The socket lining member 65 is electrically connected with the core 30 by a pin 80 which is driven through aligned holes in the socket member 65 and in the part 57. The pin 80

is wedged between the wires of the core 30 so as to make good electrical contact therewith and hence with the secondary lead 25 which is held in contact with the core 30 by the tube 31.

The margins 22 of the paper insulation are sealed at the top of the coil 21 by the insulation 70, and at the bottom by the insulation 32^a. The lead 25 is insulated from the lead 27 by the tube 31, the insulation 70, the upper paper margin 22, the tube 36 and the sleeve 38. By this arrangement of insulating devices, the danger of short circuit of the secondary is minimized.

Where the ends of the primary coil 24 do not extend longitudinally beyond the ends of the secondary coil 21, the primary turns may be wound upon the secondary before impregnating the secondary. After winding the primary coil 24, both coils 21 and 24 are impregnated together, thus forming a unitary sub-assembly which is a relatively stiff mass of turns of wire and solidified insulating compound.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, 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. An ignition coil comprising a secondary coil including layers of wire insulated by turns of paper, the coiled side margins of which extend beyond the ends of the layers of wire, a primary coil wound around the secondary coil, a center core extending through the secondary coil and beyond the margins of the paper insulation thereof, a non-conducting base having an annular boss defining a central recess which receives one end of the central core, one end of the secondary coil and the core being attached to the boss of the base by a plastic insulating substance thereby forming a unitary sub-assembly comprising the coils, center core and base, an outer core of flexible iron wrapped about the assembly so as to engage the outer walls of the coil and base, a tubular case closed at its bottom end for receiving said sub-assembly, the base resting upon the bottom of the case, and a top cover for the case providing coil terminals upon the outside thereof, an annular non-conducting skirt upon the inside thereof, said skirt defining a recess for receiving the upper end of the center core, and solidified insulating compound between the skirt and the case and the coils.

2. An ignition coil including a core insulatingly supporting windings, an insulating base, recessed to receive one end of the core, said base being substantially equal in transverse dimensions and being shaped similar to the outer contour of the windings on the core, and adhesive covering on the end of the core and windings adapted to engage the base for securing the base to said core and windings, and a magnetic member fitting upon and surrounding the windings and base and providing an outer magnetic field.

3. An ignition coil including a core insulatingly supporting windings, an insulating base, recessed to receive one end of the core, one portion of the base being shaped similarly to and substantially equal in transverse dimensions to the windings on the core, a plastic covering on the end of the core and windings adapted to engage the base, said covering being adapted to set and thus cement the base to the core and windings, and a plurality of magnetic convolutions wrapped about the windings and base, providing an outer magnetic field.

4. An ignition coil including a core insulatingly supporting windings, an insulating base recessed to receive one end of the core, one portion of the base being substantially equal in transverse dimensions and being shaped similar to the windings on the core, a plastic insulating substance covering the end of the core and winding adapted to be applied to the base for securing said base to said core and winding, and an outer core of flexible, magnetic material wrapped around the windings and base and providing an outer magnetic field.

5. The method of making an ignition coil which comprises, winding the secondary coil about a non-conducting tube, winding the primary coil around the secondary coil, placing a center core within the tube, coating one end of said assembly with a plastic insulating substance, pressing said coated end upon a base before said substance hardens thereby to secure the base to the core and windings, then wrapping around said coils and base a plurality of convolutions of magnetic material to form an outer magnetic field.

In testimony whereof I hereto affix my signature.

CARL H. KINDL.