Jan. 31, 1928. 1,657,840

J. H. NELSON

ELECTRIC SWITCH

Filed Feb. 18, 1927 2 Sheets-Sheet 1

Fig. 1.

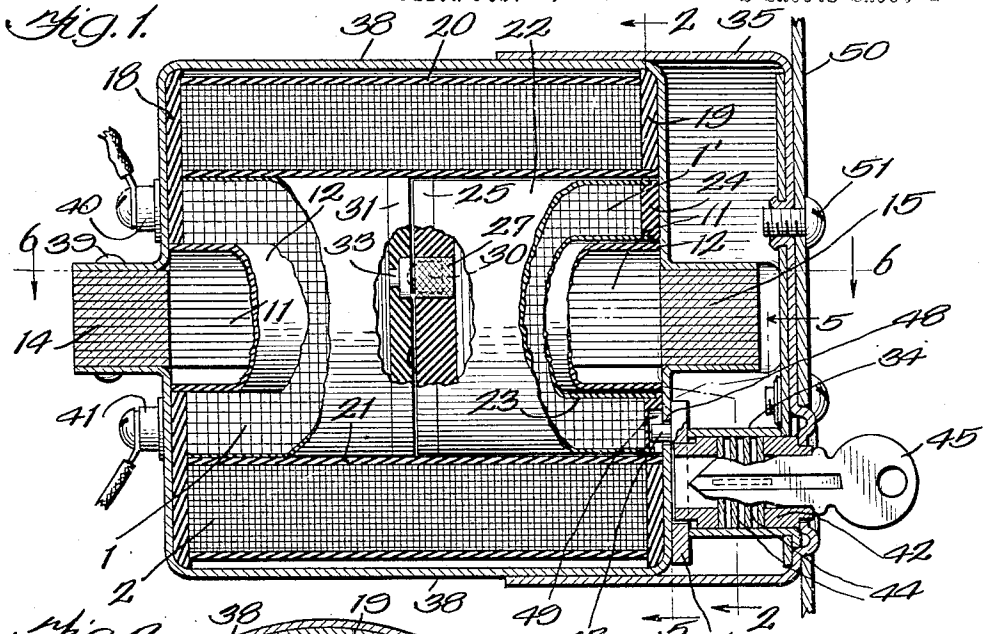



Fig. 2.

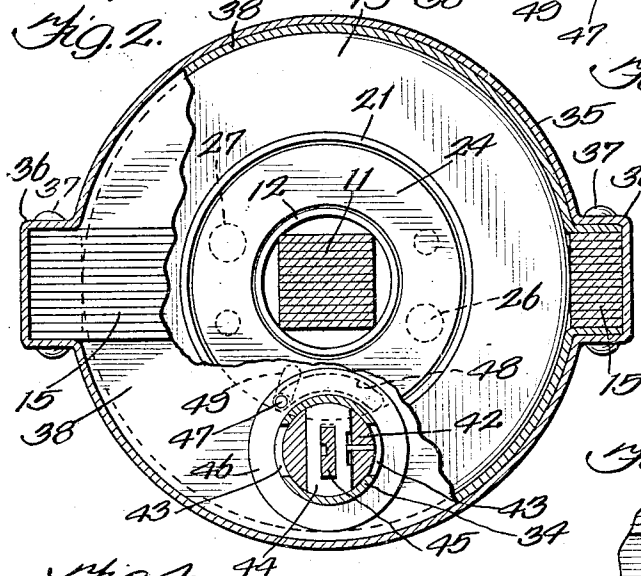



Fig. 3.

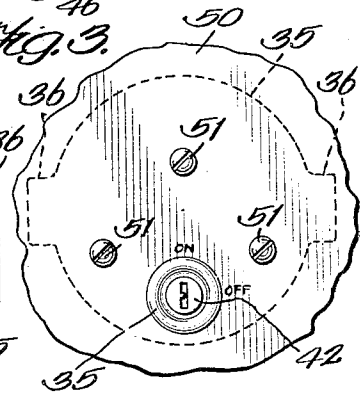



Fig. 4.

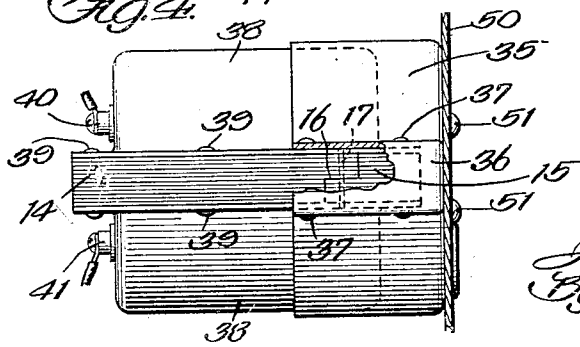
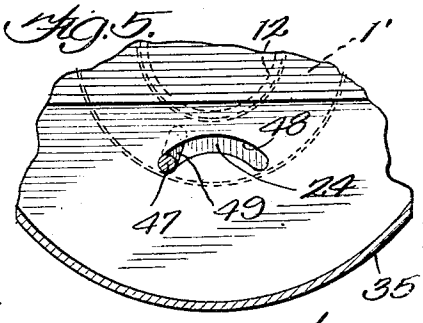



Fig. 5.




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Filed Feb. 18, 1927 2 Sheets-Sheet 2

Fig. 6.

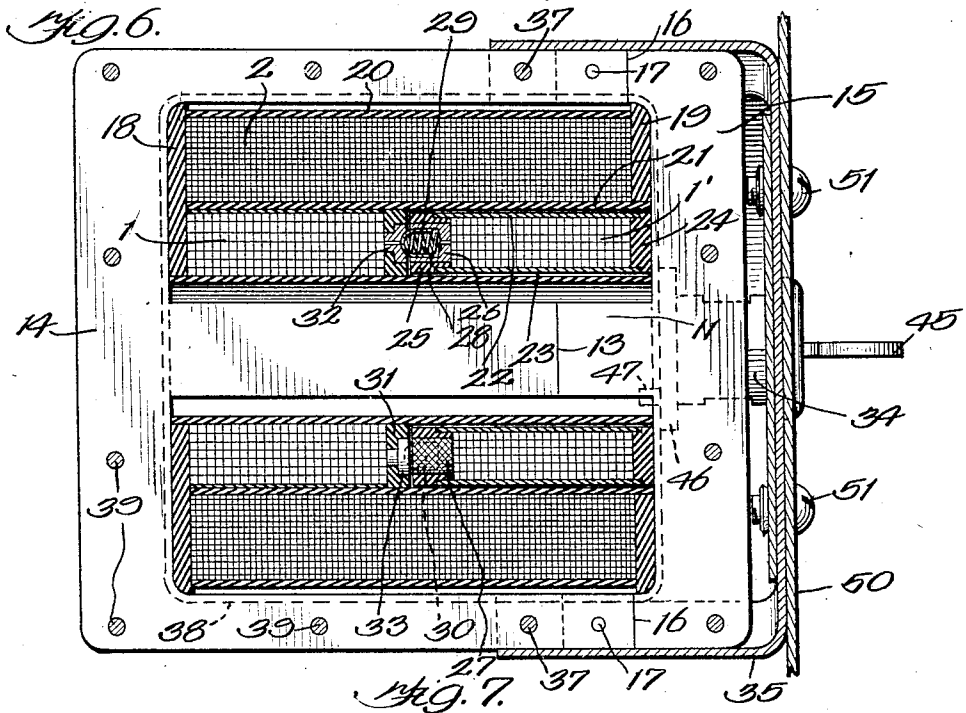



Fig. 7.

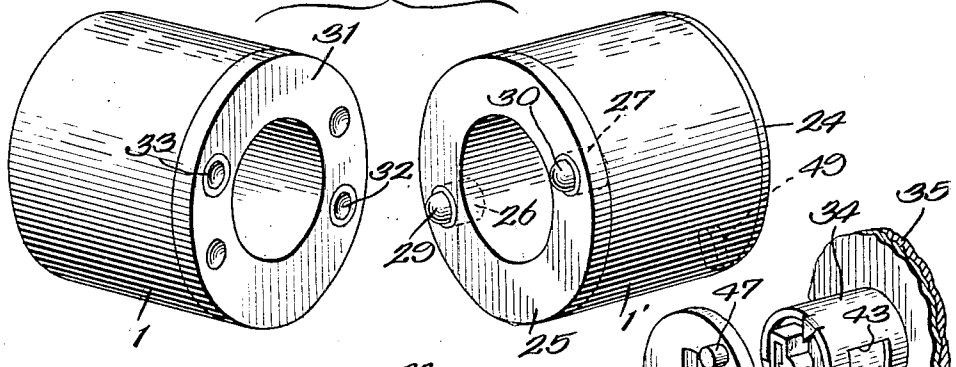
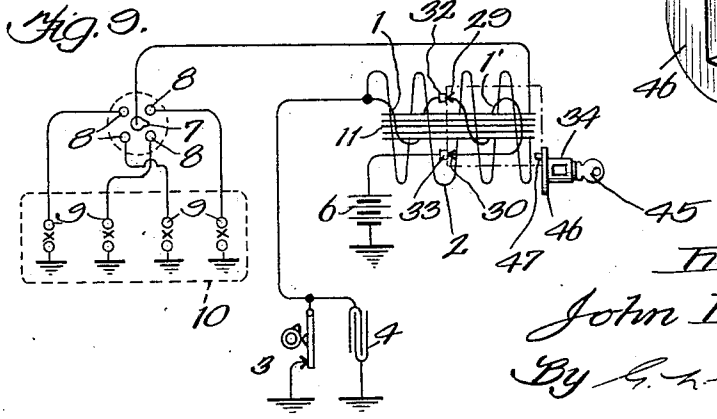



Fig. 8.




Fig. 9.




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# UNITED STATES PATENT OFFICE.

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## ELECTRIC SWITCH.

Application filed February 18, 1927. Serial No. 169,347.

My invention relates to electric current conducting winding elements and to circuit controlling switches in electrical association therewith.

The invention finds particular utility in connection with spark producing circuit systems employed for producing sparks in cylinders of internal combustion engines that are employed in the power plants of automobiles or other automotive vehicles. The invention has for its general object the provision of an improved assembly of the winding elements and the associated switches whereby the switches and the circuit terminals thereat are guarded from unwarranted access and the combined structures are simplified and occupy less space than hitherto.

In carrying out my invention, the switch employed in such a structure is sandwiched or confined between coils of the winding which serve to obstruct access to the switch. Where the device is inclusive of primary and secondary windings of an induction coil used in an ignition system, one of these windings, the primary winding for example, is mechanically split into two coils and the switch is located between these coils. In the preferred embodiment of the invention, the coils between which the switch is placed are cylindrical and tubular, these coils being coaxial and arranged in tandem and being sufficiently spaced apart along their common axis to receive the switch therebetween. The other winding of the induction coil, the secondary winding if the primary winding is mechanically split into two coils as described, desirably surrounds the coils of the first winding and the switch interposed between these coils. The secondary winding, being in the zones of the switch and the two coils of the primary winding between which the switch is disposed, effectively prevents the access of switch disturbing tools applied from the exterior of the device transversely to the axis thereof. Said primary coils, themselves, effectively prevent access of switch disturbing tools to the switch along the axis of these coils. Where the structure is provided with a magnetizable core, as in the case of an induction coil, the core portion within the inner winding serves to guard the switch from access through the interior of the device.

To enable the employment of simple mechanism for operating the switch, the two coils between which the switch is sandwiched are relatively rotatable upon their common axis or are otherwise relatively movable, the adjacent faces of these coils carrying complemental contacts of the switch whereby the switch is placed in circuit opening or circuit closing adjustment, according to the position to which the coils are relatively placed. One of the coils is desirably fixed and the other is movably mounted, a handle being provided for operating the latter coil. This handle is preferably in the nature of a key that is acceptable by a lock which is adjustable by the key to hold the movable coil in circuit opening position, in the case of an ignition circuit, upon the withdrawal of the key and which permits the key to operate this coil to circuit closing position upon the insertion of the key which thus constitutes a removable handle.

Where a coil is employed to act as an operating element of the switch, I do not wish to be limited to the employment of another coil in conjunction therewith, it being obvious that other means may be employed in conjunction with the first coil for confining the switch contacts.

I will explain my invention more fully by reference to the accompanying drawings in which Fig. 1 is a longitudinal sectional view of a so-called induction coil equipped in accordance with the preferred embodiment of my invention, portions being broken away and partially shown in elevation; Fig. 2 is a sectional view on line 2—2 of Fig. 1; Fig. 3 is a front view of a portion of the structure shown in Fig. 1; Fig. 4 is a side view on a smaller scale, parts being broken away; Fig. 5 is a sectional view of a part of the structure on line 5—5 of Fig. 1; Fig. 6 is a sectional view on line 6—6 of Fig. 1; Fig. 7 is a perspective view illustrating the two coils, that carry the complemental switch contacts, in separated relation; Fig. 8 is a perspective view of the preferred form of locking mechanism; and Fig. 9 is a diagrammatic view illustrating one circuit arrangement.

The hollow current conducting element illustrated is inclusive of a winding mechanically divided into two generally cylindrical tubular coils 1, 1′ that are preferably coaxial and arranged in tandem. In the embodiment of the invention illustrated, these

two coils are serially electrically connected with and together constitute the primary of an induction coil that is employed in a circuit serving to produce sparks in the cylinders of an internal combustion engine. Another winding 2 is illustrated which, in this instance, is secondary to the winding 1, 1', this secondary winding being shown as surrounding the primary winding in the embodiment of the invention illustrated. The primary winding has one terminal grounded through a circuit interrupter 3 whose contacts are shunted by a condenser 4. The other terminal of the primary winding is grounded through a battery 6. The secondary winding 2 also has one terminal grounded through the circuit interrupter 3, the other terminal of the winding 2 being connected with the revolving arm 7 of a distributor whose waiting contacts 8 are successively engaged by said arm, these waiting contacts being connected with the electrodes 9 of spark plugs or other gas igniting elements that are contained in the various cylinders of the internal combustion engine, indicated at 10, that is equipped with the ignition system.

I have shown an 8-shaped magnetizable core for the windings of the induction coil, this core having its middle member 11 received within the aligned bores of the two primary coils 1, 1', the core member 11 being desirably surrounded by a tubular sleeve of insulation 12 in fixed relation with the core, this sleeve being tightly received within the bore of the coil 1, whereby this coil is fixed with respect to said core. Said sleeve is loosely received within the bore of the coil 1' to permit the latter coil to be moved, this coil being preferably adapted for turning movement entirely within its own zone. The core member 11 is shown as being formed in two sections which abut, as indicated at 13 in Fig. 6. One of these core sections is shown as being integrally formed with the three-sided external core member 14 and the other of said core sections as being integrally formed with the three-sided external core member 15, the core members 14 and 15 having interlapping ends, as indicated at 16 in Fig. 4, which are maintained in magnetic circuit closing relation by means of the pins 17. The core members 14 and 15 surround the windings 1, 1', 2 and serve to hold the windings in relation to each other.

I have shown liners 18 and 19 of insulation between the winding 2 and the intermediate portions of the members 14 and 15, the liner 18 being also interposed between the primary coil 1 and the mid portion of core member 14. These liners are tightly fitted between the core and the coils 1 and 2 so that these coils are firmly fixed with respect to the core. The winding or coil 2 may have a sheet of insulation 20 surrounding the same and the bore of this winding may be furnished with a tubular lining 21 of insulation, the coil 1 being tightly received in the annular space between the sleeve 12 and the lining 21 whereby this coil is further tightly held in place with respect to the core. The coil 1' is desirably encased within a jacket of insulation that is composed of a shell 22 surrounding this coil, a sleeve or lining 23 received in the bore of the coil, an outer ring 24 joining the outer rims of the parts 22 and 23, and an inner ring 25 joining the inner rims of the said parts 22 and 23. Clearance not only intervenes between the sleeve 12 and the lining 23 of the coil 1' but clearance also intervenes between the shell 22 of this coil 1' and the lining 21 of the winding 2 and clearance further intervenes between the opposing faces of the coils 1, 1' so that the coil 1' may be turned, thereby enabling its use as a switch operating member. To this end, the ring 25 that is in fixed relation with this coil constitutes a contact carrier, this ring having embedded therein two metallic spring barrels 26 and 27 which are connected with the ends of the wire that forms the coil thereby constituting the terminals of this coil. These spring barrels contain springs 28 that press upon contacts 29 and 30 that are received in said spring barrels. The coil 1 desirably carries a ring of insulation 31 at the end thereof which is adjacent the ring 25 and this ring 31 carries contacts 32 and 33, the contact 32 constituting one terminal of the coil 1 and the contact 33 being the means by which the entire winding 1, 1' is grounded through the battery 6, when the circuit is closed. The coil 1 thus constitutes a carrier for the contacts 32 and 33 that are complemental to the contacts 29 and 30. The complemental contacts 29 and 32 together constitute a switch that is looped into an intermediate portion of the primary winding 1, 1'. While both switches 29, 32 and 30, 33 are desirably employed, the invention is not to be limited thereto.

The means for operating the coil 1' as a contact actuator is desirably inclusive of a locking structure that contains a hollow lock member or shell 34. This shell is held in fixed relation to the magnetic core of the device by being fixedly secured to the end wall of a preferably metal skirted cap 35, the skirt of the cap being formed with lateral channel portions 36 that receive parts of the core, rivets 37 being employed to assemble the core and cap skirt. The cap skirt may be further secured in position by being spot welded to the core and to shell portions 38 that project into the cap and which receive the core between them, these shell portions being riveted to the core, as indicated at 39, and also spot welded thereto, if desired. Said shell portions constitute a convenient

means for carrying binding screws 40 and 41 by which the device may be connected in circuit. The lock shell 34 receives the tumbler barrel 42 which is rotatable in said shell that has openings 43 in its opposite sides into which the tumblers 44 may be projected. This tumbler barrel is adapted to receive a key 45 for the purpose of withdrawing the tumblers from the openings 43 to permit the tumbler barrel to be turned, it being understood that, in the embodiment of the invention illustrated, the switches 29, 32, and 30, 33, are locked open when the tumblers 44 are received in the openings following the withdrawal of the key. When the switch is to be closed to render the circuit operative the key is inserted to withdraw the tumblers from their locking positions, the key thereafter being turned to turn the tumbler barrel to place said switches in closed adjustment. The tumbler barrel is brought into turning relation with the coil 1′ to operate said switches through the intermediation of a ring 46 that is in fixed connection with the inner end of the tumbler barrel, and a pin 47 projecting from the inner face of the ring and passing through an arcuate slot 48 in an end wall of one of the shell portions 38, this pin entering a radial slot 49 in the ring 24.

The space in which the switches are contained is thoroughly guarded from access by the structure which has been described, the sleeve 12 which contains the midcore member 11 being effectively closed at its ends by the core and by the shell parts 38. Moreover, said switches are so located as to be inaccessible even without these precautions. The front of the structure is further guarded by the skirted cap 35 which encloses the lock structure, this cap being secured upon the rear of the panel board 50 by means of the screws 51. The ring 46 serves to cover the arcuate slot 48 so as to guard against the admission of mercury at this point if it should be attempted to defeat the device by means of mercury, the construction illustrated being such, however, as to make it practically impossible to admit short circuiting fluid to the switch contacts, even without this precaution.

The fixed coil 1 constitutes a guarding member between which and the movable coil 1′ the switch contacts are confined. I do not wish to be limited to the employment of the coil 1 acting as a contact guarding member operating in conjunction with the movable coil 1, for the purpose of guarding the contacts. The shell portions 38 and the cap 35 constitute a casing which encloses all of the coils of the switching mechanism and receives the locking mechanism that is in control of the switching mechanism. It may be also said that the coils 1′ and 2 constitute a casing that encloses the switch contacts and receives the contact actuating coil 1 that serves substantially to close the casing in so far as accessibility to the contacts is concerned.

Changes may be made without departing from the invention.

Having thus described my invention, I claim:

1. The combination with two coaxial electric conducting coils placed in tandem; of a circuit controlling switch having complemental contacts confined between said coils, one of said coils being rotatable upon its axis and in actuating relation with one of said contacts; an additional electric current conducting coil closely surrounding the aforesaid coils and said contacts; and a locking structure in controlling relation to the contact actuating coil.

2. The combination with two coaxial electric current conducting coils placed in tandem; of a circuit controlling switch having complemental contacts confined between said coils, one of said coils being rotatable upon its axis and in actuating relation with one of said contacts; and a locking structure in controlling relation to the contact actuating coil.

3. The combination with an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil; an additional electric current conducting coil surrounding said guarding member, the first aforesaid coil and said contacts, one of the first two aforesaid elements being in actuating relation with one of said contacts; and a locking structure in controlling relation to the contact actuating element.

4. The combination with an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil; an additional electric current conducting coil surrounding said guarding member, the first aforesaid coil and said contacts, the first aforesaid coil being rotatable and in actuating relation to one of said contacts; and a locking structure in controlling relation to the contact actuating coil.

5. The combination with two electric current conducting coils; of a circuit controlling switch having complemental contacts confined between said coils, one of said coils being movable and in actuating relation with one of said contacts; an additional electric current conducting coil closely surrounding the aforesaid coils and said contacts; and a locking structure in controlling relation to the contact actuating coil.

6. The combination with an electric current conducting coil; of a contact guarding

member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil; an additional electric current conducting coil surrounding said guarding member, the first aforesaid coil and said contacts, the first aforesaid coil being in actuating relation to one of said contacts; and a locking structure in controlling relation to the contact actuating coil.

7. The combination with an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil; and an additional electric current conducting coil surrounding said guarding member, the first aforesaid coil and said contacts, the first aforesaid coil being rotatable and in actuating relation to one of said contacts.

8. The combination with an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil; and an additional electric current conducting coil surrounding said guarding member, the first aforesaid coil and said contacts, the first aforesaid coil being in actuating relation to one of said contacts.

9. The combination with one member in the form of an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil; and an additional electric current conducting coil surrounding said guarding member, the first aforesaid coil and said contacts, one of the aforesaid members being in actuating relation with one of said contacts.

10. The combination with an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil, said coil being in actuating relation to one of said contacts; and a locking structure in controlling relation to the contact actuating coil.

11. The combination with an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil, said coil being rotatable and in actuating relation to one of said contacts; and a locking structure in controlling relation to the contact actuating coil.

12. The combination with one member in the form of an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil, one of the aforesaid members being in actuating relation with one of said contacts; and a locking structure in controlling relation to the contact actuating element.

13. The combination with two coaxial electric current conducting coils placed in tandem; of a circuit controlling switch having complemental contacts confined between said coils, one of said coils being rotatable upon its axis and in actuating relation with one of said contacts; and an additional electric current conducting coil closely surrounding the aforesaid coils and said contacts.

14. The combination with two electric current conducting coils; of a circuit controlling switch having complemental contacts confined between said coils, one of said coils being movable and in actuating relation with one of said contacts; and a locking structure in controlling relation to the contact actuating coil.

15. The combination with an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil; and an additional electric current conducting coil surrounding said guarding member, the first aforesaid coil and said contacts.

16. The combination with two electric current conducting coils; of a circuit controlling switch having complemental contacts confined between said coils, one of said coils being movable and in actuating relation with one of said contacts; and an additional electric current conducting coil closely surrounding the aforesaid coils and said contacts.

17. The combination with two electric current conducting coils; of a circuit controlling switch having complemental contacts confined between said coils and operable from the exterior of the coils; and an additional electric current conducting coil closely surrounding the aforesaid coils and said contacts.

18. The combination with two coaxial electric current conducting coils placed in tandem; of a circuit controlling switch having complemental contacts confined between said coils and operable from the exterior of the coils; and an additional electric current conducting coil closely surrounding the aforesaid coils and said contacts.

19. The combination with one member in the form of an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental

contacts confined between said coil and guarding member and operable from the exterior of said coil, one of the aforesaid members being in actuating relation with one of said contacts.

20. The combination with an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil, said coil being rotatable and in actuating relation to one of said contacts.

21. The combination with an electric current conducting coil; of a contact guarding member; a circuit controlling switch having complemental contacts confined between said coil and guarding member and operable from the exterior of said coil, said coil being in actuating relation to one of said contacts.

22. The combination with two coaxial electric current conducting coils placed in tandem; of a circuit controlling switch having complemental contacts confined between said coils, one of said coils being rotatable upon its axis and in actuating relation with one of said contacts.

23. The combination with two electric current conducting coils; of a circuit controlling switch having complemental contacts confined between said coils, one of said coils being movable and in actuating relation with one of said contacts.

24. The combination with two electric current conducting coils in close proximity; of a circuit controlling switch having complemental contacts confined between said coils and operable from the exterior of the coils; and a locking structure in controlling relation to the switch.

In witness whereof, I hereunto subscribe my name.

JOHN H. NELSON.