O. ENGEL.

ARRANGEMENT OF CONTACTS FOR SWITCHES.

APPLICATION FILED MAR. 31, 1908.

907,481.

Patented Dec. 22, 1908.

2 SHEETS—SHEET 1.

Fig. 3

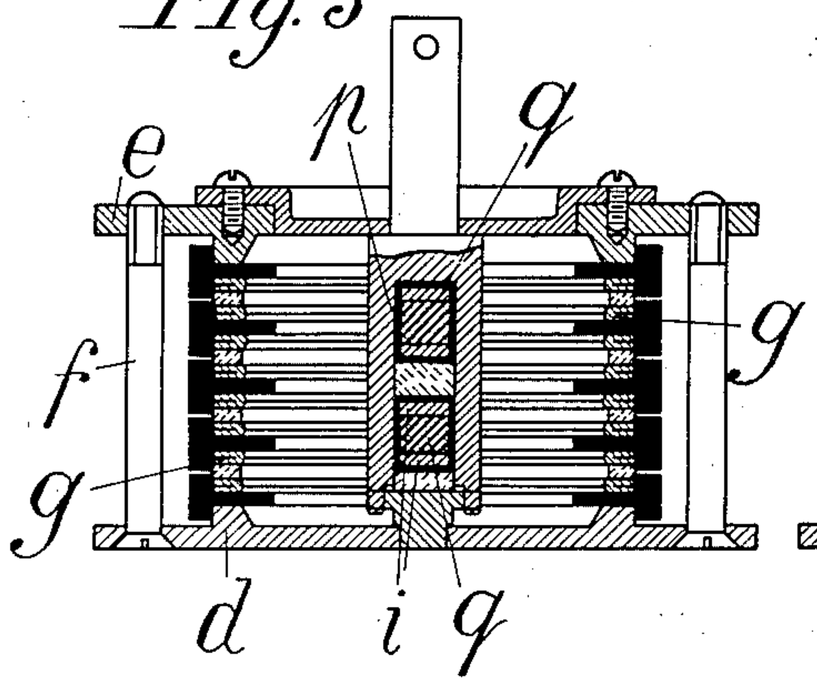

Fig. 2

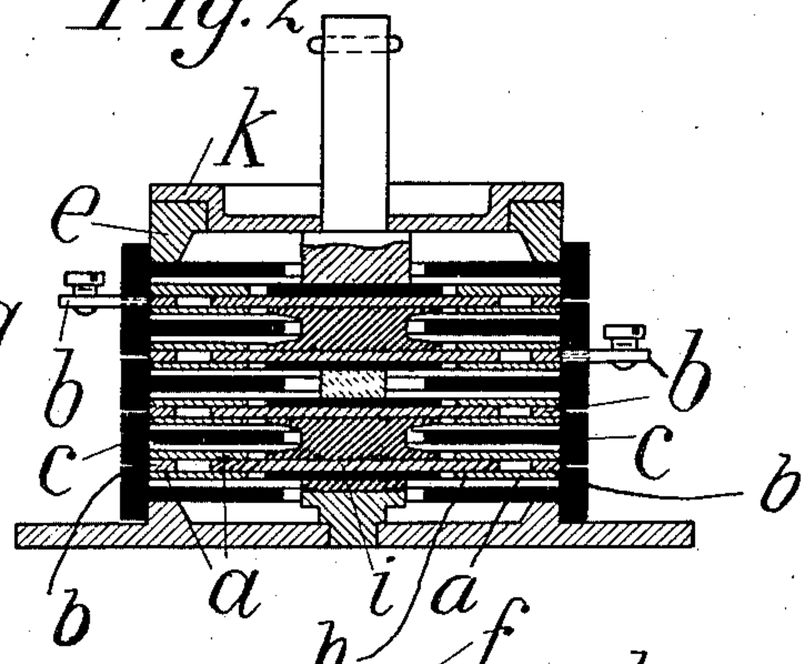

Fig. 1

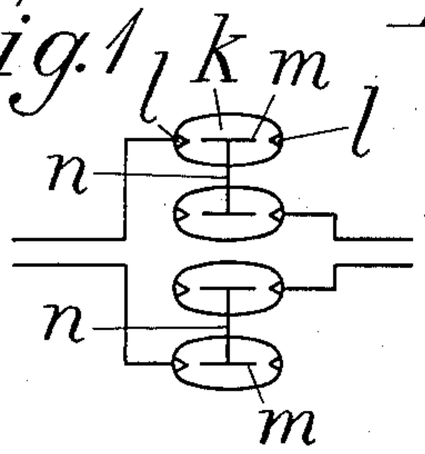

Fig. 4

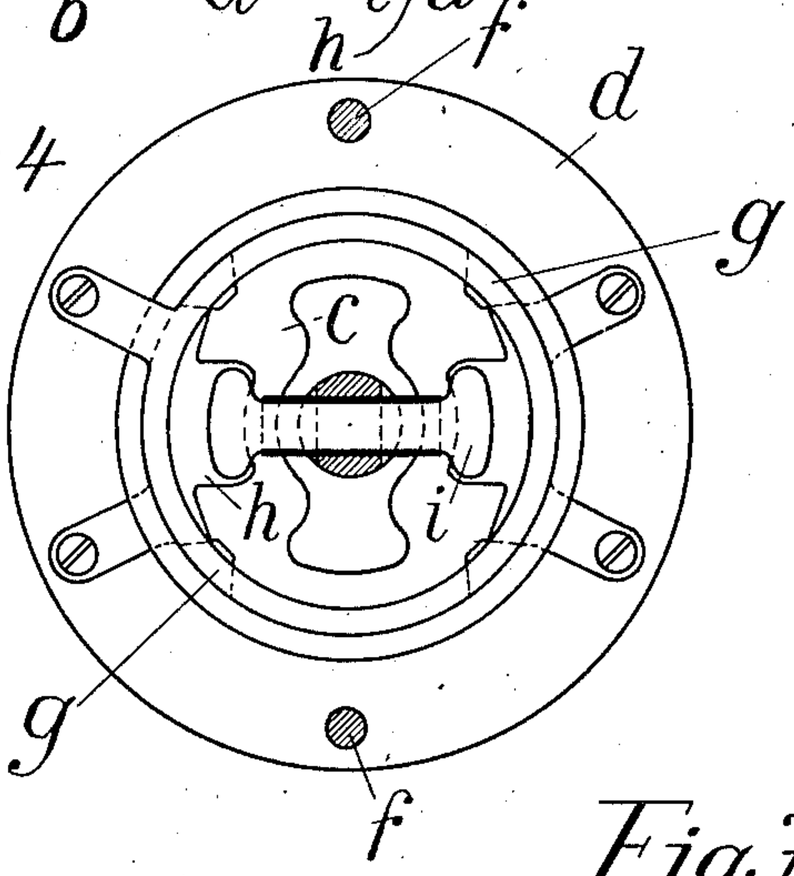

Fig. 5

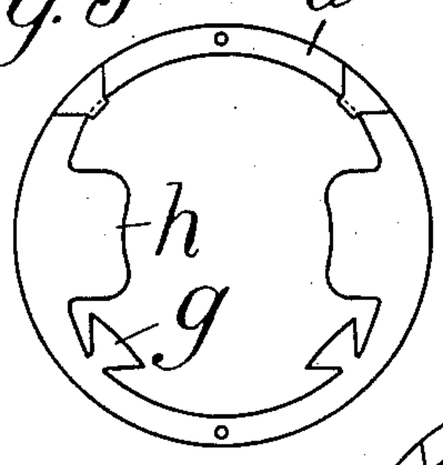

Fig. 5a

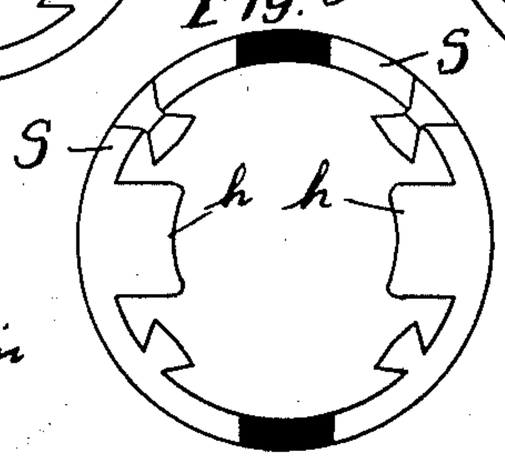

Fig. 6

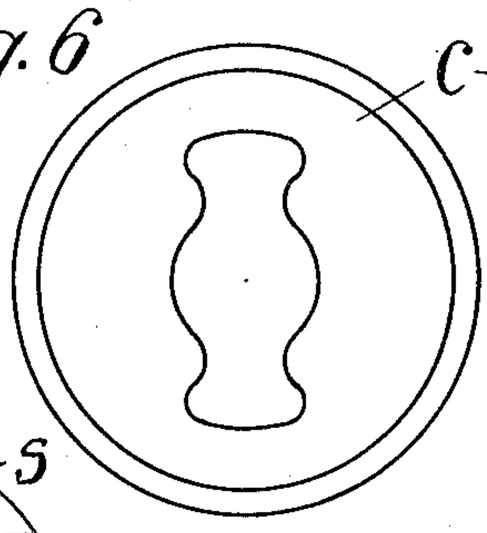

Fig. 7

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2 SHEETS—SHEET 2.

Fig. 8

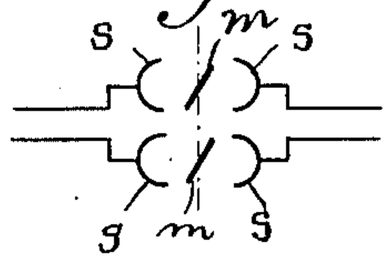


Fig. 9

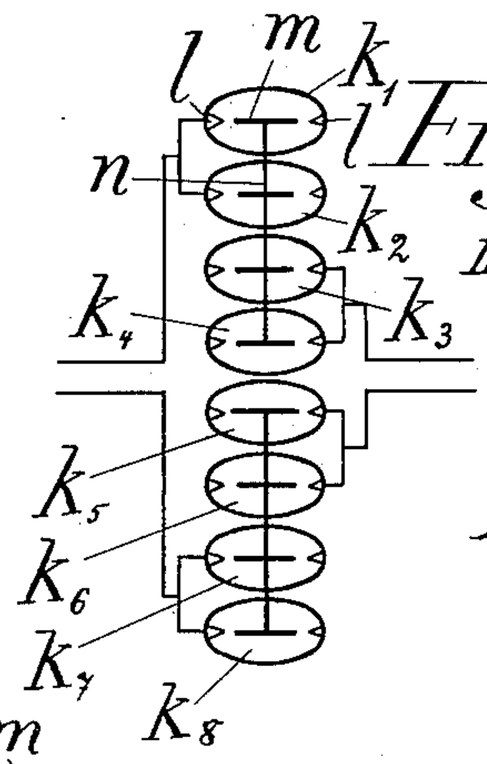


Fig. 10

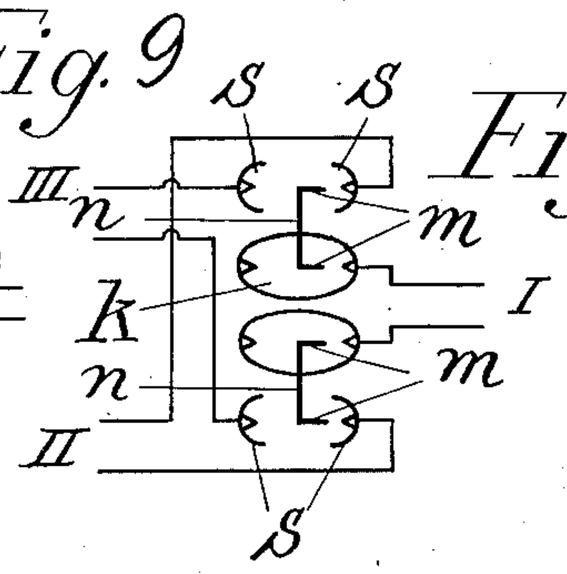


Fig. 11

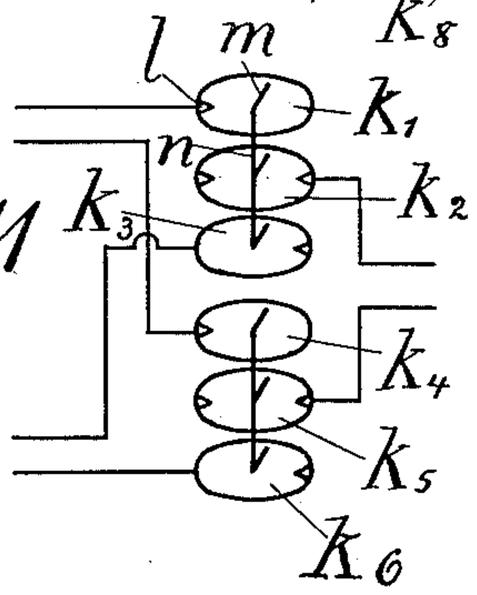


Fig. 12

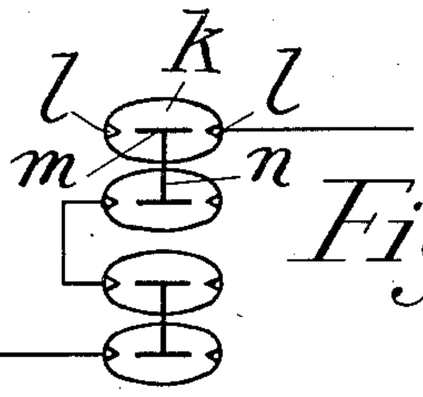


Fig. 13

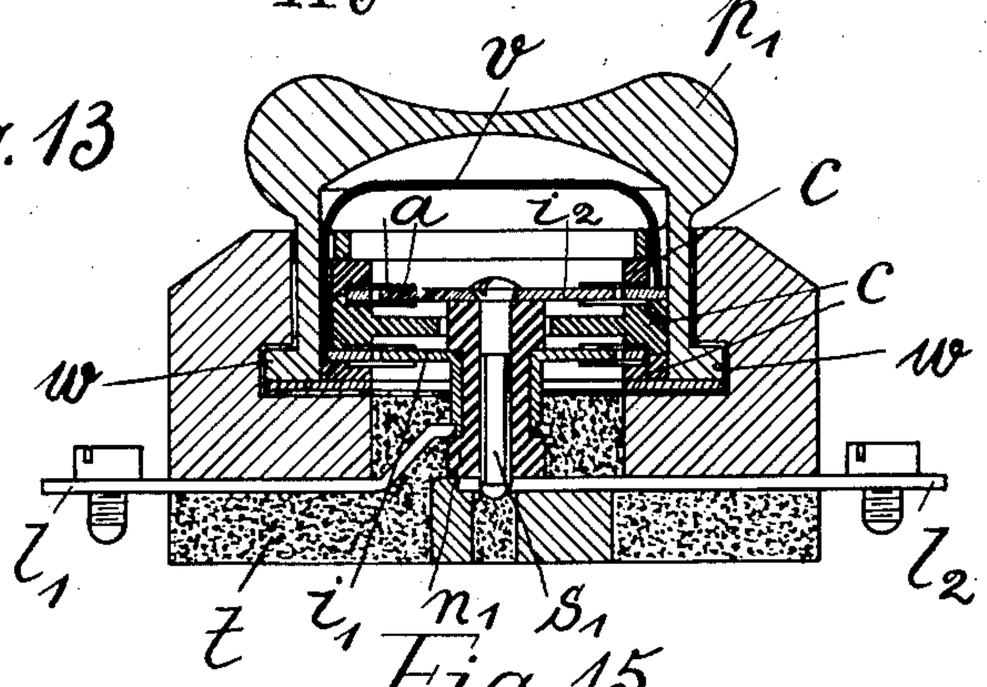


Fig. 14

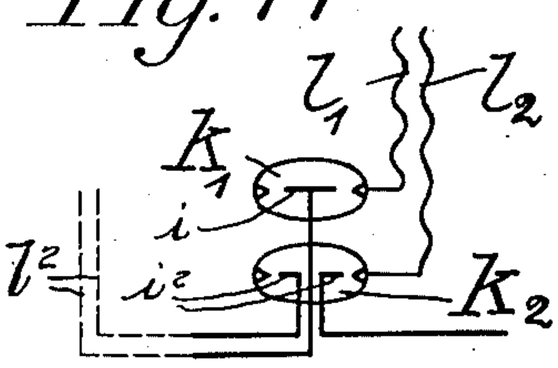


Fig. 15

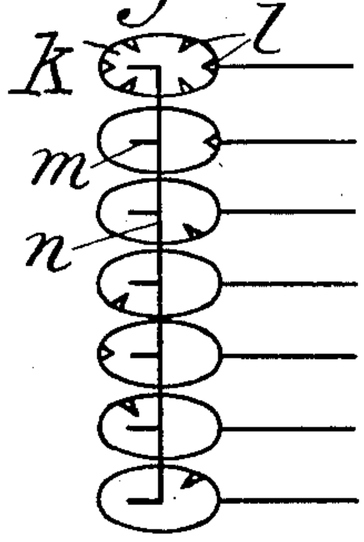
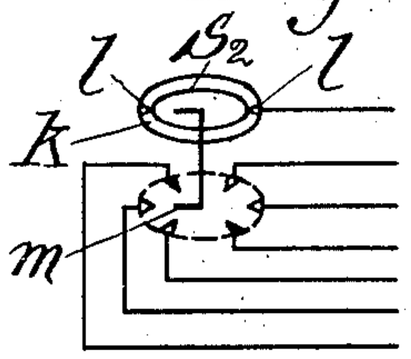


Fig. 16



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OTTO ENGEL, OF BERLIN, GERMANY.

ARRANGEMENT OF CONTACTS FOR SWITCHES.

No. 907,481. Specification of Letters Patent. Patented Dec. 22, 1908.

Application filed March 31, 1908. Serial No. 424,438.

To all whom it may concern:

Be it known that I, OTTO ENGEL, a subject of the German Emperor, and resident of Berlin, Germany, have invented certain new and useful Improvements in Arrangements of Contacts for Switches, Safety Devices, Plug-Contacts, and Like Devices, of which the following is a specification.

The subject-matter of the present invention is an improved arrangement of contacts which may be employed particularly in switches and in controllers, safety devices, detachable connections, as well as in collectors of electrical machines also under certain definite circumstances.

The essence of the invention consists substantially in the following:—The contact elements consist of thin rings or portions of rings, deviating according to requirements from a circular shape and provided with suitably shaped contact surfaces stacked in layers one above the other with intermediate layers of insulating rings to form one hollow cylindrical body; these layers are held together in suitable manner, for example by two end frames pressed one towards the other. Within this cylindrical body are disposed the interior contacts, which in themselves represent a rigid body comprising, so far as is necessary, a stack of conductive and insulating layers likewise alternately arranged. This interior contact-body is revoluble on the central axis of and with regard to the exterior contact-stack, and in a given case is also movable longitudinally. The interior contacts coöperate with the exterior contacts in definite positions and the exterior or interior contacts are preferably elastic in order that the contacts may be pressed together sufficiently.

The particular features of the structures presently described and the advantages of same over known structures of similar character are as follows: Owing to the arrangement of the contact elements and intermediate insulating pieces to form a laminated body, the whole structure is rendered extremely compact. Further, it is impossible for arcs which occur when the current is interrupted to continue, since the interruptions take place in chambers which are separated from one another and from metal parts by radially projecting insulating walls or partitions. Further, by arranging the contacts and intermediate insulating layers sufficiently close together, in case it is necessary, a closed explosion-proof contact chamber may be formed which does not require an additional casing. If required, the chamber thus formed may be filled with oil or other insulating fluids. In case such apparatus are used for heavy currents several contact disks may be connected in parallel. Should the switches be used for high tension current, the entire required area on which sparking occurs may be subdivided by connecting several contact disks in series. Contact-bodies of equal diameter and of the same or different heights may be formed in this manner for a large number of different types of switches, and consequently the same casings may be used if necessary with covers of different height. If the individual exterior contacts are made as entire rings or somewhat large segments, the further advantage is obtained that conductors can be connected at optional places of the periphery of the switch, whereas in the usual construction of contacts, the conductor which was to be connected had to be passed frequently in a loop to its contact and correspondingly larger casings were required on account of the indirect course of the conductor. Further, in switches with instantaneous action the mechanism necessary for their operation may be attached more simply and more securely to the frame, which holds the contact-stack together and particularly to the upper connecting plate, than in like switches with an insulating base.

In order that the invention may be clearly understood reference is made to the accompanying drawings in which several embodiments and various modes of employing the same are represented diagrammatically and by way of example, and in which:—

Figure 1 is a diagram of a double pole switch having annular contact disks; Figs. 2 and 3 are vertical sections showing one constructional form of the double pole switch represented in Fig. 1, whereas Fig. 4 is a plan of the same; Figs. 5 and 5[a] are plan views of two modifications of a contact disk removed from the switch, whereas Fig. 6 is a plan of an insulating disk and Fig. 7 a cross-section of the same; Figs. 8, 9, 10, 11 and 12 are diagrams of connections for switches more fully explained hereafter; Fig. 13 is a vertical section through a safety device; Fig. 14 is a diagram showing another mode of connecting the stationary and movable members of the

apparatus shown in Fig. 13. Fig. 15 is a diagram of a controller, and Fig. 16 is a modification of the latter shown diagrammatically.

Referring to the drawing, and particularly to Fig. 1, a double pole switch is here shown diagrammatically in which annular contacts are employed and in which the cut-in and cut-out positions follow one another at an angle of 90°. The switch is represented in the closed position and consists of four contact-layers *k* which are indicated in perspective by closed lines. Each contact layer has two inwardly projecting contacts *l* which are connected in parallel by the knives *m*. Each two contact layers are connected in series by the knives and a connecting member *n*. Figs. 2 to 4 show one constructional form of such a switch.

Referring to Figs. 2 to 4, *a* are the contact layers or disks of which there are always two between insulating disks *c* and separated by a distance disk *b* which may simultaneously serve as connection for the conductor from without. All the disks are pressed together by the two covers or plates *d* and *e* by means of the screws *f*.

In Fig. 5 a contact disk *a*, which has been removed, is shown. *h* are the two contact places; *g* are flaps which can be bent over as indicated at the lower side of the disk in the drawing, so that the contact disks can yield or spring. The horizontal gaps which are produced in this manner in the stack are covered by the over-lapping edges of the insulating disks. Such a disk is represented in Figs. 6 and 7. The double switch-knives *i* are mounted on the shaft of the switch (Fig. 2). Each knife pair is insulated from the shaft by a bushing *p* and is connected by a metal member *q*. Thus when the switch is in its closed position, two contact places of one contact disk are connected in parallel by each knife and two contact disks are connected in series by each set of two knives connected together. The switch-knife body can be inserted into the finished stack through the upper frame-plate *e* which has an opening which can be closed by the cover or lid *k*. For this purpose the insulating disks *c* have the inner hole or perforation adapted to the shape of the knife (see Figs. 4 and 6).

Since the switch-stack represented in the drawing is closed securely as regards insulation both at its cylindrical periphery as well as at its ends, and also owing to its construction will withstand possible interior explosive rushes of current, the switch represented is also, as will be readily understood, explosion-proof without an additional casing being provided. If instead of the selected contact rings each having two places of contact, shorter contact strips each having one place of contact, say segments of the ring as represented in Fig. 5[a], are employed, and if each two segments, which are to be connected by a switch-knife, are laid opposite one another between layers of insulation of equal height, a double pole switch for half the strength of current with two layers as high as the stack are obtained instead of the four layers which were present before. The two switch-knives must then be insulated from one another. Fig. 8 represents diagrammatically such an arrangement in its cut-out position.

Fig. 9 is a diagram of a double pole switch in which two contact disks of the kind shown in Figs. 2 to 5 are always connected in parallel by their switch-knives *m*, and two pairs of contact disks the knives of which are all conductively connected are connected thereby in series. The knives of the disks k_1 to k_4 and of the disks k_5 to k_8 are here electrically connected. Such a switch is suitable for a strength of current twice as great as that represented in Figs. 2 to 4, the individual contacts having otherwise the same dimensions.

Fig. 10 shows diagrammatically a double pole reversing switch with interrupter consisting of four contact layers, namely two layers *k* of entire rings and two layers each having two segments *s* mounted beside one another. For each pole there are two single knives *m* connected with one another situated on the interior contact body. According to the position of the switch axle in each case, the circuit III, as represented, or circuit II, is connected with, or both are disconnected from, circuit I.

Fig. 11 shows a reversing switch having six layers composed only of entire contact rings, but otherwise like that represented in Fig. 10. The knives of the layers k_1, k_2, and k_3 are electrically connected and also those of the layers k_4, k_5 and k_6.

Fig. 12 shows a four-fold subdivision of the circuit by connecting four contact layers and all the four switch-knives in series to a switch for high tension; the system represented would have to be employed for each pole, and thus in triple pole switches of this kind there will be twelve layers.

Fig. 13 represents a fusible cut-out provided with contacts arranged in accordance with the present invention. The two switch-knives i_1 and i_2 are attached to the base *z* by the screw s_1. The knife i_1 is provided with a bushing to fit over the cylindrical casing n_1 of insulating material surrounding screw s_1. The two knives are insulated from one another. The knife i_1 is connected with the conductor l_1 and the knife i_2 with the conductor l_2. The insulating disks *c* and the contact disks *a* are mounted firmly in the plug p_1. Both kinds of disks are formed as in the switch according to Figs. 2 to 4. The fuse *v* is inserted between the two contact disks. The plug is attached to the base by means of a bayonet-joint, *w* denoting two

bayonet-pins. When the plug is inserted and turned, the contact disks are pushed over the knives and the fuse is thereby connected in circuit. When withdrawing the fuse the plug is first rotated; the spark which is produced by opening the circuit when current is passing through it is still produced in the explosion-proof contact-chamber. The possibility of exchanging the fuses can be prevented by suitable sizes of the opening in the cover.

Fig. 14 represents diagrammatically a double pole detachable connection for conductors. The exterior contact-stack with the two annular contact layers is disposed on the removable part in the manner shown in Fig. 13 and carries the movable conductors l_1, whereas the inner contact-bodies with the fixed connections l_2 for conductors are stationary.

Fig. 15 shows diagrammatically a switch-stack composed of seven annular layers for a resistance, say for a starting switch. The top contact disk has six contact places, whereas the other disks have only one each. The knives are all electrically connected in the manner shown in Figs. 2 and 3, but have only one shank as shown in Fig. 15. When the circuit is closed, the top contact disk is connected with one of the other contact disks according to the position of the switch in each case. Resistances which are not shown in the figure are connected between the disks in known manner. Another more compact form for the same connection, in which only two layers are employed, of which the upper consists of an entire disk and the lower of six segments, is represented in Fig. 16. Here the interior contact-body has above it a whole knife-disk s_2, which slides in two places of contact of the upper circular disk, and below it a one-sided switch-knife m. The segments are placed together in one layer the height of the contacts.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In an apparatus of the character described in combination with a cylindrical member formed by a plurality of conducting segments and insulating layers stacked alternately, and means for holding said stack together, a contact member disposed within said cylindrical member having a plurality of contact elements corresponding in number with said conducting segments and suitably interconnected to connect predetermined segments with each other, one of said members being rotatively disposed relatively to the other member.

2. In an apparatus of the character described in combination with a cylindrical member formed by a plurality of conducting rings and insulating layers stacked alternately, and means for holding said stack together, a contact member disposed within said cylindrical member having a plurality of contact elements corresponding in number with said conducting segments and suitably interconnected to connect predetermined rings with each other, said inner member being rotatably disposed within said cylindrical member.

3. In an apparatus of the character described in combination with a cylindrical stack of conducting rings and insulating layers alternately arranged, and means for holding said stack together, a shaft rotatably disposed concentrically within said stack having contact knives insulated from said shaft and corresponding in number with said conducting rings, said rings having a suitable number of segments adapted to coöperate with said knives and said knives interconnected with each other to connect predetermined rings with each other when said shaft is rotated.

4. In an apparatus of the character described in combination with a cylindrical stack of conducting rings and insulating layers alternately arranged, and means for holding said stack together, a shaft rotatably disposed concentrically within said stack having contact knives insulated from said shaft and corresponding in number with said conducting rings, said rings having a suitable number of segments adapted to cooperate with said knives and said knives interconnected with each other to connect predetermined rings with each other when said shaft is rotated, said insulating layers extending a sufficient distance toward said shaft to form an insulating wall between the contact segments and knives of two adjoining rings.

5. In an apparatus of the character described in combination with a cylindrical stack of conducting rings and insulating layers alternately arranged, and a frame having end plates for holding said stack together and for closing its open ends, a shaft rotatably disposed concentrically within said stack and journaled in said plates having contact knives insulated from said shaft and corresponding in number with said conducting rings, said rings having a suitable number of segments adapted to coöperate with said knives and said knives interconnected with each other to connect predetermined rings with each other when said shaft is rotated, said insulating layers extending a sufficient distance toward said shaft to form an insulating wall between the contact segments and knives of two adjoining rings.

In testimony whereof I have signed my name to this specification in the presence of two witnesses.

OTTO ENGEL.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.