

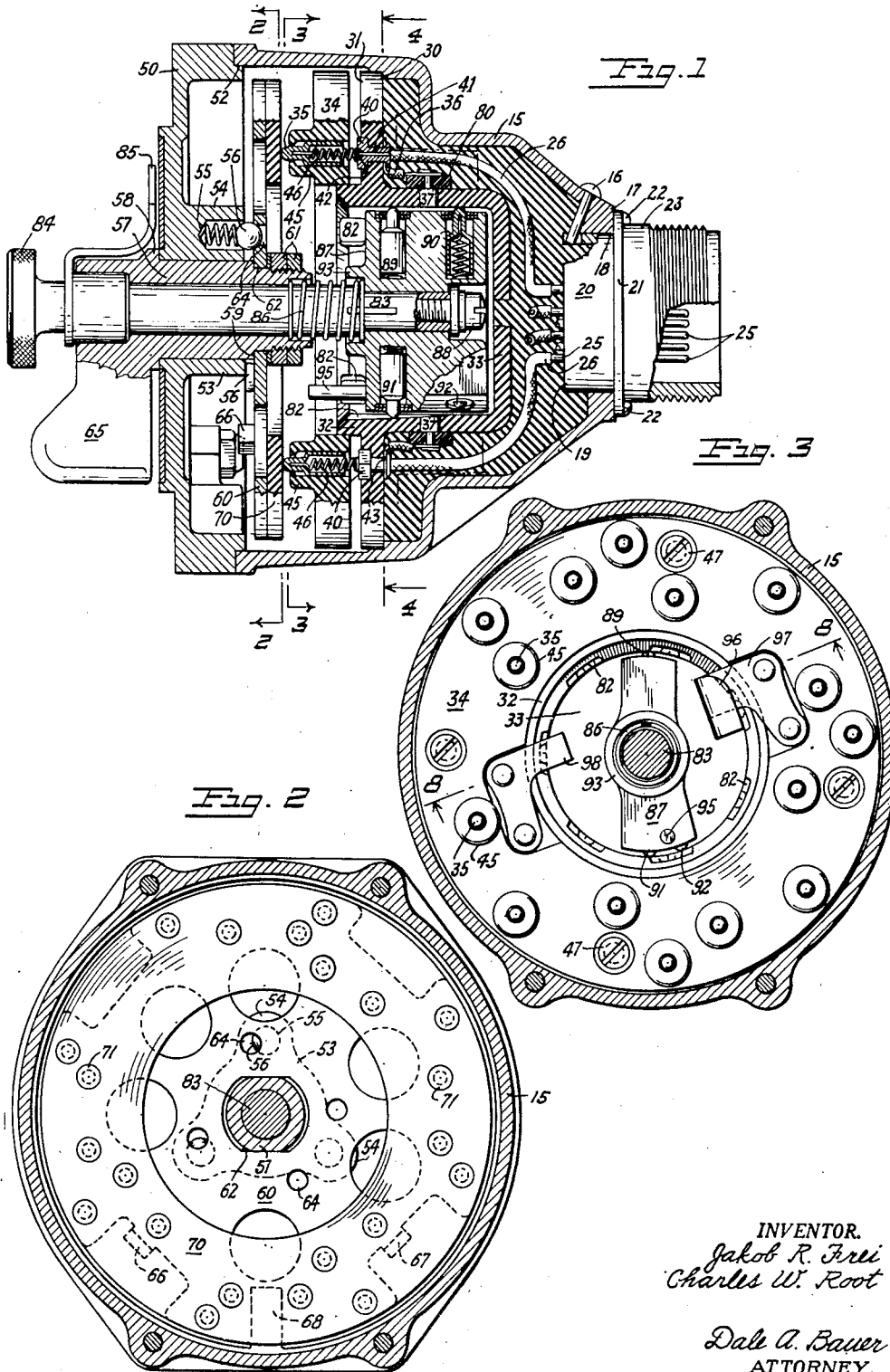
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ELECTRICAL APPARATUS

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2 SHEETS—SHEET 1



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ELECTRICAL APPARATUS

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This invention relates to a bank and plug selector of the type useful in controlling and testing the spark plug banks of internal combustion engines having a plurality of banks of radially aligned cylinders. The invention will be described in this particular use, but it is to be understood that this particular description is for purposes of illustration only and does not constitute a limitation within the natural scope of the invention.

Internal combustion engines of certain types used, for instance, in aircraft have radially projecting rows of cylinders, each row containing a plurality of cylinders and each cylinder adapted to be fired by a plurality of spark plugs, usually two to each cylinder. The left hand plugs in each row of cylinders are served by a magneto or by one coil of a double-coil magneto, the right hand plugs being served by a separate magneto or by the other coil of the double-coil magneto. In a radial engine having seven rows of cylinders with four cylinders to the row, there are thus 56 spark plugs, some of which may not be functioning. It is a time consuming labor to test each spark plug for purposes of replacement, and it is highly desirable that some means be found whereby the spark plugs may be tested bank by bank in order that the pilot can readily determine what banks contain inoperative plugs. In this specification the term "bank" will be used to indicate those plugs which are connected with and fired by a single magneto coil. It is substantially impossible to locate an inoperative or misfiring cylinder by sound when so many plugs are functioning, but a trained pilot can frequently tell by sound when an engine of fewer cylinders is not properly functioning.

The foregoing statement is designed as a simple introduction to the complex problems which were met and overcome in the invention of the apparatus herein described. The great complexity of the problem will be better understood after the operation of the apparatus is comprehended from a study of the specification and drawings. It is within the conception of this invention to control the operation of the banks of spark plugs of an internal combustion engine by selectively grounding the magneto coils that serve the banks, and the invention will be described, for the sake of simplicity, as a means of grounding the primary windings of the magnetos.

It is an object of this invention to make a compact, sturdy instrument that may be simply and selectively operated to ground all primary windings of all the magneto coils that serve an internal combustion engine, to ground the primary windings of the magneto coils serving the right hand banks of spark plugs, to ground the primary windings of all the magneto coils serving the left hand banks of spark plugs, and to selectively ground the primary windings of individual magneto coils. Other objects of the

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invention will be in part apparent and in part set forth as the description of the invention proceeds.

The above and further objects and novel features of the present invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 of the drawings is a vertical sectional view through a bank and plug selector embodying the principles of this invention;

Fig. 2 is a section on the line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a section on the line 3—3 of Fig. 1 looking in the direction of the arrows;

Fig. 4 is a section on the broken line 4—4 of Fig. 1 looking in the direction of the arrows;

Fig. 5 is a bottom view of the casing showing the connection pins;

Fig. 6 is a top view of the casing, showing the head and dials;

Fig. 7 is a section showing details of switch construction with grounding contacts engaged;

Fig. 8 is a section on the line 8—8 of Fig. 3;

Fig. 9 is a plan view of a control slot;

Fig. 10 is a section on the line 10—10 of Fig. 9;

Fig. 11 is a view taken perpendicularly to a control slot on the upper segment of the ring member; and

Fig. 12 is a view taken perpendicularly to the ring member in a position 180 degrees from Fig. 11.

Referring to the figures of the drawings, wherein like numerals refer to like parts, and particularly to Fig. 1, the numeral 15 indicates a casing which is functionally designed to contain the operating parts of the apparatus, being comparatively small at its lower or base part and enlarged at the top or head end. A plug 16 is provided in the side of the casing cooperating with a groove in the member 20 for purposes of alignment. Injection of plastic insulating compounds after the assembling of the working parts has been completed is carried out through a hole in the center of member 33. The base 17 of the casing 15 is flat and is provided with a hole 18 through which is passed the inner end 19 of a cylindrical member 20 having a flange 21 that is affixed to the flat end 17 of casing 15 by rivets or the like 22. The outer portion 23 of the cylindrical member projects from the casing and is provided with screw threads or other suitable connecting means for the reception of a cable conduit or the like. Within the cylindrical member 20, mounted in insulating

material 24, are contact pins 25 (Fig. 5) which project both inwardly and outwardly beyond the insulating material to serve as appropriate connections for leads from the various magneto coils and for leads to the various contacts, to be hereinafter described, within the instrument.

In Fig. 5, sixteen contact pins 25 are illustrated, but since this description has been directed toward the control of an engine having 7 rows of cylinders and 14 banks of spark plugs, it will be understood that only 14 of the pins will be in use, each of the 14 magneto windings being connected by an appropriate lead to the outer end of a pin. The inner ends of the pins are connected by appropriate leads 26 to two sets of switch contacts whose mounting and function will follow.

The inner wall of the casing 15 is provided with an annular shoulder 30 upon which rests the annular flange 31 that projects from the ring 32 of a cup-shaped member 33. The cup-shaped member 33 is composed of insulating material such as an appropriate plastic, and carries upon the flange 31 an annulus 34 of insulating material that serves, in combination with the annular flange 31, as a mounting for the leads 26 and the set of spring pressed contacts 35 projecting therefrom. Also connected to the leads 26 by appropriate leads 36 is a set of contacts 37 mounted in the ring 32 of the cup-shaped member 33.

The invention comprehends novel means for rendering all banks of plugs inoperative by grounding the primary windings of all magneto coils. In order to accomplish this control appropriate leads are brought from the primary windings of each magneto coil to the pins 25 and from pins 25 are connected by the leads 26 with spring pressed contacts 35 whose operative members are equal in number to the number of primary windings served, and means are provided whereby, by the simple turning of a switch, all the contacts 35, and the primary coils electrically connected thereto, may be grounded, thus preventing generation of induced currents in the secondary coils and making all the banks of spark plugs inoperative.

The leads 26 and 36 are attached at their ends to appropriate connections 40 in the annular flange 31. The connections 40 comprise hollow pins 41 with conical recesses 42. The leads 36 have annular ends 43 that fit over the ends of the pins 41, and are held in position by turning the ends of the pins over the ends of the leads. The insulation is stripped from the ends of wires 26, the wires are pushed through the hollow pins 41, and their ends are soldered in the conical recesses. The soldered ends are simultaneously machined flush, making contact faces upon which rest springs 46. The annulus 34 is provided with recesses within hollow cylindrical bosses 45, mounted in places corresponding to the pins 41 and containing contacts 35 that are biased by springs 46. The outer ends of the bosses 45 are provided with inwardly directed annular flanges that cooperate with shoulders on the contacts 35 to prevent the springs 46 from ejecting the contacts from the sleeve. The same shoulders serve, internally, as seats for the springs 46, the other ends of which are based upon the machined faces of pins 41. A plurality of mounting bolts 47 pass through the annulus 34 and the annular flange 31 into appropriate seats provided in the casing 15 to hold the parts firmly seated in assembled relation upon the shoulder 30.

Members 34 and 31 are separated by appropriate lands or studs formed on the face of one of them.

The spring contacts 35 are placed in a pattern on the annulus 34 so that by the use of a cooperating pattern on the movable switch member different groups of the contacts 35 may be selectively grounded. It will be observed that there are 15 such contacts shown in Fig. 3 of the drawings but it will be understood, since there are only 14 banks of spark plugs to be served, that one of these contacts is not connected to a magneto winding. In constructing the apparatus the pins 25 and the connections 40 are given letters, numbers, or other distinguishing identification so that the leads 26 may be correctly connected. The number of contacts will depend upon the number of electrical devices that are to be served by the apparatus, and the location and pattern of the contacts on flange 31 will be varied to achieve the most efficient operation under the particular circumstances of service.

Novel moving switch elements providing for the simultaneous grounding of all the contacts 35, are mounted in a head 50 that is mounted by appropriate bolts 51 on the large end of the casing 15. The head 50 has an internal annular flange 52 that serves to center it, and the instruments mounted therein, with respect to the cooperating fixed elements which are mounted in the member 33. The head 50 is centrally provided with an internally directed annular boss 53 having three enlargements 54 provided with seats 55 for spring pressed balls 56. Within the center annular portion of the boss 53 is revolvably mounted a cylindrical shaft 57 having an abutment flange 58 engaging the outer surface of the head 50 and having an inner shoulder 59 serving as an abutment for the metal plate 60 that is mounted on and to turn with the inner end of the shaft 57. Lock nuts 61 serve for purposes of assembly of the parts. The inner end of the shaft 57 is flattened, as shown in Fig. 2, and the plate 60 is centrally provided with an opening 62 having cooperating flattened portions, whereby the turning of the shaft will turn the plate.

The central portion of the plate 60 is provided with holes 64 that are circularly aligned with the balls 56 and so spaced with relation thereto that as the plate is turned the balls 56 are thrust sequentially into the holes 64, giving the plate a plurality of fixed positions from which it can be displaced only by effort. In order to facilitate the turning of the shaft 57 and the plate 60, the outer end of the shaft is provided with a handle 65, and in order to limit its motion to a selected number of positions, stops 66, 67 are bent outward from the material of which the plate is made into cooperating relation with a stop 68 projecting inwardly from the head 50. The switch member is thereby provided with a number of fixed positions within a limited range of motion.

Affixed to the inner face of the plate 60 is an annulus 70 of insulating material bearing on its inner surface a plurality of contacts 71 each of which passes through an insulating ring and is affixed to the plate 60. Because of their connection to the metal plate 60, these contacts are all grounded. The contacts 71 are arranged in a pattern that cooperates with the pattern of contacts 35, so that in various selected positions of the annulus 70 different groups of contacts 35 and the apparatus connected therewith will

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be grounded. The apparatus illustrated is provided with four positions for the handle 65 of the shaft 57, the four positions being indicated in Fig. 6 as "off," "L," "R" and "both." Within the limits set by the stops 66, 67, 68 are four positions fixed by the ball positioning mechanism hereinbefore described, in the first of which the handle 65 points to the word "off" and every contact 35 is grounded through a contact 71, as illustratively shown in Fig. 7. Since the contacts 35 are connected with the primary coils of the magnetos, all the magneto coils are grounded in this position of the switch and no current can be induced in the secondary windings thereof, and no current is being supplied to the spark plugs of the engine.

In the second position of the switch handle 65, shown as "L" in Fig. 6, the movable contacts have been shifted so that only half the contacts 35 are grounded through contacts 71, the grounded contacts being all connected to the right-hand banks of spark plugs, so that the left-hand banks of spark plugs are free to function. In the third position "R" as shown in Fig. 6, the movable contacts have again been shifted so that the left-hand banks of spark plugs are now grounded and the right-hand banks are functioning. It is therefore apparent that the mechanism as thus far described is capable of selectively operating the engine on either bank of plugs, or of making both banks of plugs inoperative. It is thus made possible for an operator to test the motor, first, with the left-hand banks of plugs operating, and then with the right-hand banks in operation. By cutting out half the plugs and comparing the operation of the engine under one bank with the operation of the engine under the other bank, a skilled operator can frequently locate sources of trouble in one or the other bank of plugs. In cases where such equipment is available, the power output of the two banks can be compared as a means of locating suspected trouble in one or the other bank.

The fourth position of the handle 65, indicated by the word "both" in Fig. 6, positions the ring 70 so that no contacts 35 touch any of the contacts 71 and no contacts 35 are grounded. In this position, therefore, both banks of spark plugs are operative. By this mechanism, therefore, there is provided a switch handle and a dial by means of which an operator can run on both banks of spark plugs, on either bank selectively, or can make both banks inoperative.

Novel means are also provided for the selective testing of individual banks of plugs in order that the operator may more accurately locate those defective plugs, or wiring, the presence of which was more generally indicated by the tests carried out on the right and left-hand banks operated as hereinbefore described. Means are therefore provided, which are normally held in inoperative position, for selectively testing the right and left plug banks of particular cylinder rows, comprising means for selecting a particular row of cylinders and associated means for grounding the right or left bank of spark plugs in that row. The ring 32 of the cup-shaped member 33 is provided with a number of contacts 37 corresponding to the number of coils that serve the plug banks; being in the case being described, fourteen in number. These contacts are circularly aligned, equally spaced about the circle, and mounted in holes in the ring 32. A ring 80 of insulating material closely

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fits the outside of the ring 32 and is provided with a series of smaller holes conforming in location to the holes in ring 22. Each contact 37 has a part conforming to the size of the hole in ring 32 and a stud that passes through the smaller holes in ring 80 and receives the end of a lead 36, so that each coil of the magneto is connected through a pin 25, a lead 26, and a lead 36 with a contact 37. As shown in Fig. 3, there are seven positioning grooves 82 formed in the inner circumference of the ring 32. These grooves as shown in Fig. 9, are broad and relatively deep near the open end of the ring member 33, are narrowed to a point flush with the inner circumference of the ring, and become progressively shallow toward the pointed end. The sides of the grooves are bevelled, the angle being easier toward the tip and more abrupt in the deeper portion of the groove. The purpose of these grooves is to position a novel rotatable switch member and to permit limited pivotal motion thereof so that contacts therein may selectively engage with the contacts 37 to ground individual coils.

Rotatably mounted within shaft 57 is a shaft 83 having a knurled finger knob 84 whereby it may be operated by hand, and a pointer 85 cooperating with the upper portion of the dial on the head 50 as shown in Fig. 6. The shaft 83 is normally held in the position shown in Fig. 1 by a coil spring 86 that bears at one end against the shaft 57 and at the other end against the switch head 87. The switch head 87 has a keyed mounting on the end of shaft 83 and is held in position thereon by bolt and washer 88 which are counterbored in the end of the switch head. The upper portion of the switch head is comparatively narrow as indicated in Fig. 3, and is provided with a spring pressed plunger or detent 89 and a spring pressed contact 90 which are aligned in parallel with the axis of the shaft 83. The lower part of the switch head is broader than the upper part and has a similar plunger 91 and contact 92 which are spring pressed but are not aligned in parallel with the axis of the shaft 83. The plunger 91 is positioned 180 degrees from the plunger 89, but the contact 92 is not positioned 180 degrees from the contact 90.

In the normal inward position of the head 87, which is maintained by the spring 86, the plungers 89 and 91 ride upon the insulating material of the ring 32 out of the plane of contacts 37. The contacts 90 and 92 are likewise out of the plane of contacts 37 so that in the inward position of the switch head no contact will be made between contacts 90 and 92 and the contacts 37. In this position, therefore, the contacts 37 are entirely ineffective. The spring pressed plungers 89 and 91 ride in and cooperate with the tapered grooves 82, which because of their shape serve to give very fine control of the contacts 92 and 90.

When it is desired to test the right and left banks of a particular row of cylinders, the switch 65 may be turned to the "both" position and the knob 84 turned so that the pointer 85 indicates the row of cylinders that is to be tested. In Fig. 6, the pointer indicates row 3. Having selected the row that is to be tested, the knob 84 is pulled outwardly against the resistance of spring 86 and turned so that the pointer indicates the "L" to the left of the number 3. When the pointer 85 indicates the number 3, the plunger 91, or the plunger 89, as the case may be, rides in the narrow portion of one of the grooves 82, holding

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the contacts 90 and 92 in such position that, when shaft 83 is pulled outwardly, neither will touch a contact 37. In connecting the contacts 37 with the windings of the magnetos, care is taken to connect the right and left banks of each row to oppositely located contacts in the ring 32. Thus, as shown in Fig. 1, the two visible contacts 37 are respectively connected to the right and left plug banks of cylinder row No. 3. When the shaft 83 has been pulled outward until the annular flange 93 rides upon the inner end of the shaft 57, the contacts 90 and 92 are aligned with the row of contacts 37, and the plunger 91 has entered the broad part of the groove 82, wherein it may be swung to the limits permitted by the side walls of the groove. By rotating the knob 84 to the left until the plunger reaches the wall of the groove, the pointer 85 is brought in line with the letter "L" to the left of the number 3 on the dial, and the contact 92 is brought into contact with the contact 37 connected to the right-hand plug bank of cylinder row No. 3 so that the plugs of that bank are grounded. In that position of the switch only the left hand plug bank of cylinder row No. 3 is working, and any irregularity in its operation can be detected.

Having tested the left bank, the operator may now rotate the knob 84 until the plunger reaches the other wall of the groove, in which position the pointer 85 indicates the letter "R" to the right of the number 3, the contact 92 is withdrawn from its associated contact 37, and the contact 90 makes engagement with a contact 37 connected with the left-hand bank of plugs, leaving the right-hand bank in operation. In this position the operation of that bank can be observed, or tested if such apparatus is available. When the testing has been completed, the knob 84 may be released, and the spring 86 and the groove 82 will force the switch head to inoperative position.

When all the plug banks have been tested the knob 84 may be turned to the position "0" in Fig. 6, in which position a stud 95 on the switch head passes under the over-turned end 96 of a stop 97, preventing the shaft 83 from being pulled outwardly into operative position. Stops 97 and 98 are attached to annulus 34 in such position that the knob 84 cannot be turned beyond the positions "0" and "7R" shown in Fig. 6. The contacts of the moving switch elements are grounded through shafts 57 and 83 and the casing which is provided with a grounding screw 100.

Figs. 11 and 12 are developments of the contact ring taken 180° apart in order to show diagrammatically the relation of grooves, contacts and the plungers in head 87. In comparing these figures it should be remembered that motion of contact 90 to the left is accompanied by motion of the contact 92 to the right and vice versa.

The mechanism that has just been described enables an operator to ground each bank of plugs selectively, to ground the banks of plugs in groups, to ground them all together, and to make the grounding means inoperative so that all plugs are free to operate. These diverse and complex functions are accomplished by a mechanism having in effect only two moving parts, the motions of which are controlled on a single and simple dial. The apparatus is so constructed that individual plug banks cannot be left grounded after testing. The apparatus is sturdy and all the parts thereof are capable of withstanding rough usage. The method of mounting the studs 37 in the rings 32 and 80 is novel and

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highly advantageous. The association of contact patterns produces new and highly advantageous results. It is possible to vary the number and position of contacts on the moving element to effect or to affect the functioning of various combinations of electrical devices. The positioning grooves, in combination with the plungers and the retroactive shaft, are very effective in operation and contribute materially to the success and positive operation of the device. The method of positioning the plate 60 is positive, easy of operation, and of simple construction. Although certain elements of novelty have been stressed, it is to be observed that such expressions are not a limitation or a complete statement of all the details of novelty.

This invention has been described in connection with a particular use, namely the control of the plug banks of a multi-row radial engine, but it is to be understood that the invention may be employed in other connections where it is desired to selectively operate electrical instruments individually or in groups. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. Means for mounting a plurality of electrical contacts comprising an annulus of insulating material having a plurality of holes, and contacts projecting into said holes and having integral projecting studs of a reduced diameter fixedly mounted in a ring of insulating material circumscribing and carried loosely by said annulus, said studs providing for connecting electrical leads to said contacts.

2. Means for mounting electrical contacts comprising inner and outer separable rings of insulating material having aligned holes of different sizes, and a contact mounted in said rings having portions conforming to the sizes of said aligned holes, the smaller portion of said contact providing for connecting an electrical lead to said contact and being peened over to make a firm connection to one of said rings.

3. Switch means for an electrical connection comprising a ring having a plurality of electrical contacts, a rotary switch operable within said ring to make contact selectively with said contacts, said rotary switch having oppositely disposed spring pressed members that make contact with the ring, and positioning grooves in said ring being in number half the number of the contacts and being so arranged that the said opposed spring pressed members make alternate contact with said positioning grooves.

4. In apparatus of the class described, a first set of fixed contacts, a second set of fixed contacts, common switch means having contacts movable individually into electrical operative relation with individual contacts of said first set of contacts, and common switch means having contacts movable collectively into electrical operative relation with a corresponding number of contacts of said second set of contacts.

5. In apparatus of the class described, a metallic casing, a first set of fixed contacts disposed within and insulated from said casing, a second set of contacts disposed within and insulated from said casing, common switch means disposed within and electrically connected with said casing and having contacts movable individually into engagement with individual contacts of said first set of contacts, and common switch means within and electrically connected with said casing and having contacts movable collectively into engage-

ment with a corresponding number of contacts of said second set of contacts.

6. In apparatus of the class described, a fixed annular member having on its outer surface a plurality of electrical contacts arranged in a particular pattern, a movable annular member disposed coaxially with said fixed annular member and rotatably mounted for movement in an arcuate path to different positions, said movable member having on its adjacent inner surface a plurality of electrical contacts arranged in a pattern and of a number such that in three positions of said movable member all of said first-named contacts will be engaged by said second-named contacts, one-half only of said first-named contacts will be engaged by said second-named contacts, and the other half only of said first-named contacts will be engaged by said second-named contacts, respectively, and means for rotating said movable member to said positions.

7. In apparatus of the class described, a group of circumferentially spaced fixed contacts arranged within a ring of insulating material, oppositely positioned movable contacts disposed within and normally bearing on said ring, spring means for holding said movable contacts normally in inoperative position, cooperating means on said ring and associated with said movable contacts providing for selection of said fixed contacts in pairs, means for moving said movable contacts in opposition to said spring means into operative relation with said fixed contacts and for thereafter moving said movable contacts selectively into contact with each contact of the selected pair of contacts.

8. In apparatus of the class described, a group of circumferentially spaced fixed contacts arranged within a ring of insulating material, an electrical switch positioned within said ring and mounted for rotary and axial movements relative to said ring, said switch having oppositely disposed contacts normally bearing on said ring, spring means for normally holding said switch in inoperative position, cooperating positioning grooves in said ring and oppositely disposed spring-pressed plungers on said switch providing for selection of said fixed contacts in pairs and for controlling the extent of rotation of said switch in opposite directions, and means for moving said switch axially in opposition to said spring means into operative relation with said fixed contacts and for thereafter rotating said switch in said directions to selectively engage said movable contacts with each contact of the selected pair of contacts.

9. In apparatus of the class described, a fixed cup-shaped member of insulating material having an external flange thereon, a first set of contacts circumferentially spaced in the wall of said cup-shaped member, a second set of contacts of a corresponding number arranged in an annular pattern in the outer surface of said flange and electrically connected with said first set of contacts, switch means for selectively placing said contacts individually or collectively in circuit comprising, a first rotary switch disposed within said cup-shaped member and having a contact movable to individually engage the contacts of said first set of contacts, and a second rotary switch including an annular member disposed coaxially with said cup-shaped member and having on its adjacent inner surface a set of contacts arranged in an annular pattern and of a number such that in one position of said annular member all of the contacts of said second set of con-

tacts will be engaged by said second switch-contacts, and in another position one-half only of the contacts of said second set of contacts will be engaged by said second switch-contacts, and in another position the other half only of said second set of contacts will be engaged by said second switch-contacts, and means for rotating said first and second switches independently of each other.

10. In apparatus of the class described, a metallic casing, a flanged cup-shaped member of insulating material fixed within said casing, a first set of contacts arranged in an annular pattern on the outer surface of the flange of said cup-shaped member, a second set of contacts of a corresponding number circumferentially arranged in the wall of said cup-shaped member and electrically connected with said first set of contacts, means for selectively establishing an electrical connection between said casing and said contacts individually or collectively comprising, a tubular metallic shaft disposed coaxially with said cup-shaped member and journaled in said casing, an annular metallic plate fixed on said shaft and having on its inner surface a set of contacts arranged in an annular pattern and of a number such that in one annular position of said plate all of the contacts of said first set of contacts will be engaged by said plate-contacts, and in another annular position one-half only of the contacts of said first set of contacts will be engaged by said plate-contacts, and in another annular position the other half only of said first set of contacts will be engaged by said plate-contacts, and in still another annular position all of the plate-contacts will be disengaged from said first set of contacts, a metallic shaft mounted in said tubular shaft for rotary and axial movements and projecting therefrom toward said cup-shaped member, an annular metallic block disposed within said cup-shaped member and secured to said shaft, a contact on the periphery of said block, spring means for normally holding said shaft and said block in an inoperative axial position with said contact out of engagement with said second set of contacts, means for moving said shaft and said block axially in opposition to said spring means to bring said contact into operative relation with said second set of contacts and for thereafter rotating said shaft and said block to engage said contact with individual contacts of said second set of contacts, and means for independently rotating said tubular shaft.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,349,523	Middlebrook	Aug. 10, 1920
1,414,734	Giovannoni	May 2, 1922
1,721,286	Sweetman	July 16, 1929
1,844,757	Greenwood	Feb. 9, 1932
1,928,414	Douglas	Sept. 26, 1933
1,956,430	Turner	Apr. 24, 1934
1,969,867	Williams	Aug. 14, 1934
2,121,124	Faulkner	June 21, 1938
2,135,267	Alden	Nov. 1, 1938
2,273,011	Batchelder	Feb. 17, 1942
2,376,691	Hasselbaum	May 22, 1945