F. O. HARTMAN.

HIGH POTENTIAL SWITCH.

APPLICATION FILED DEC. 17, 1906.

949,182.

Patented Feb. 15, 1910.

2 SHEETS—SHEET 1.

Fig. 15.

Fig. 16.

Fig. 17.

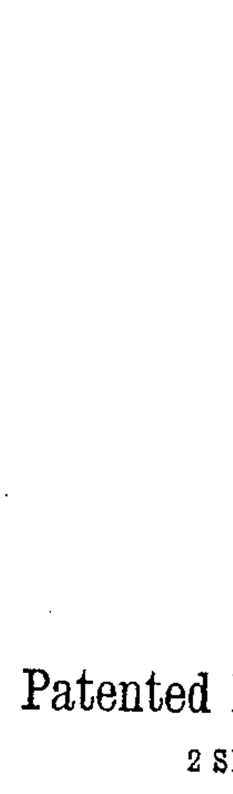


Fig. 18.

Fig. 1.

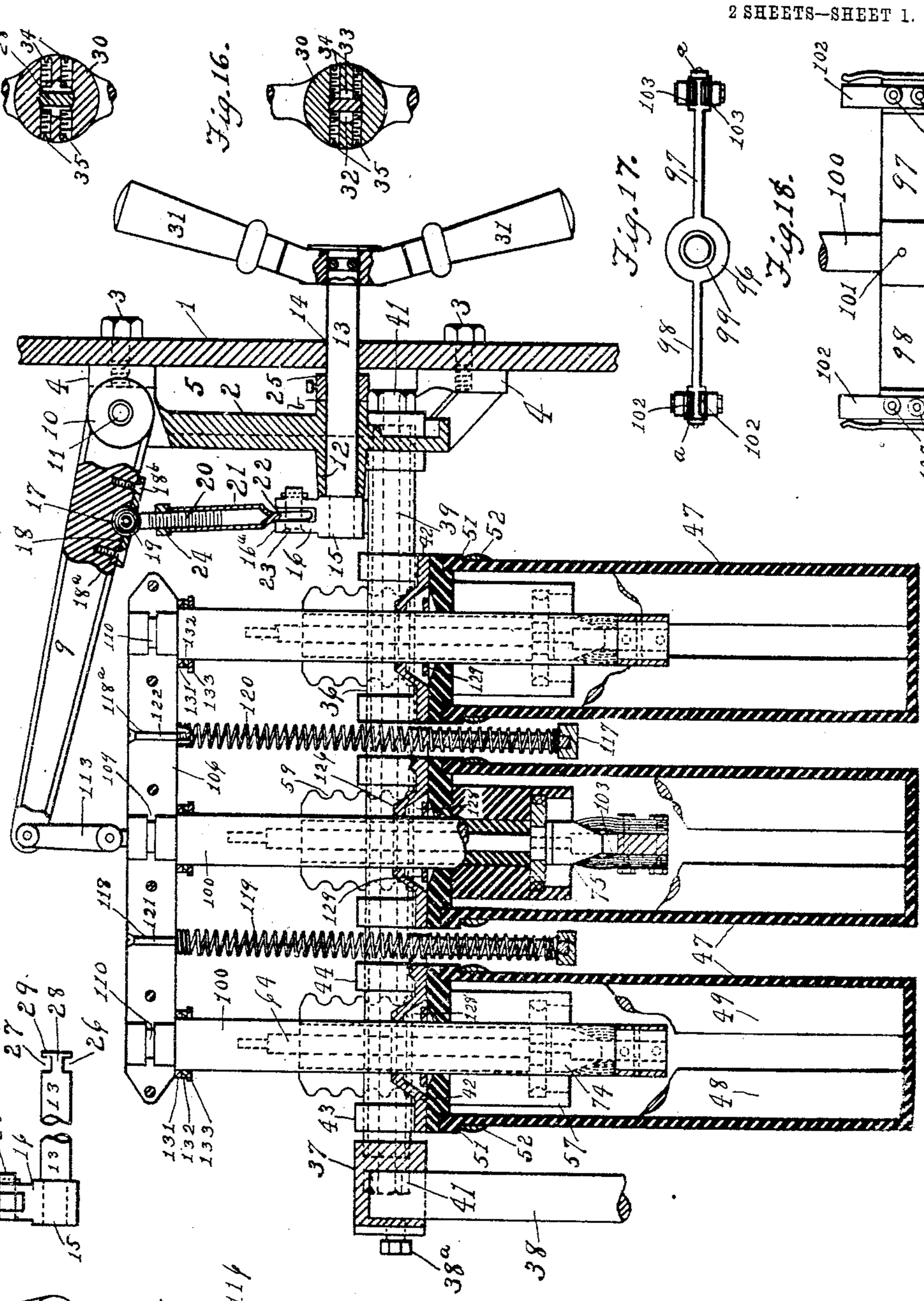
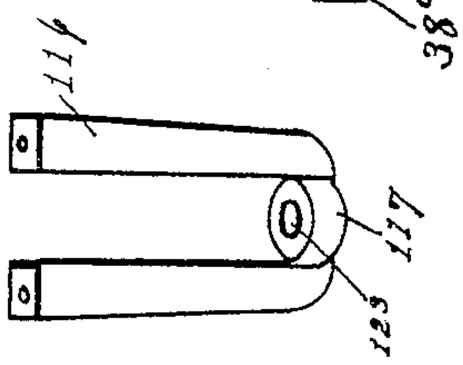


Fig. 13.

Fig. 12.

Fig. 14.



Witnesses

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2 SHEETS—SHEET 2.

Fig. 2.

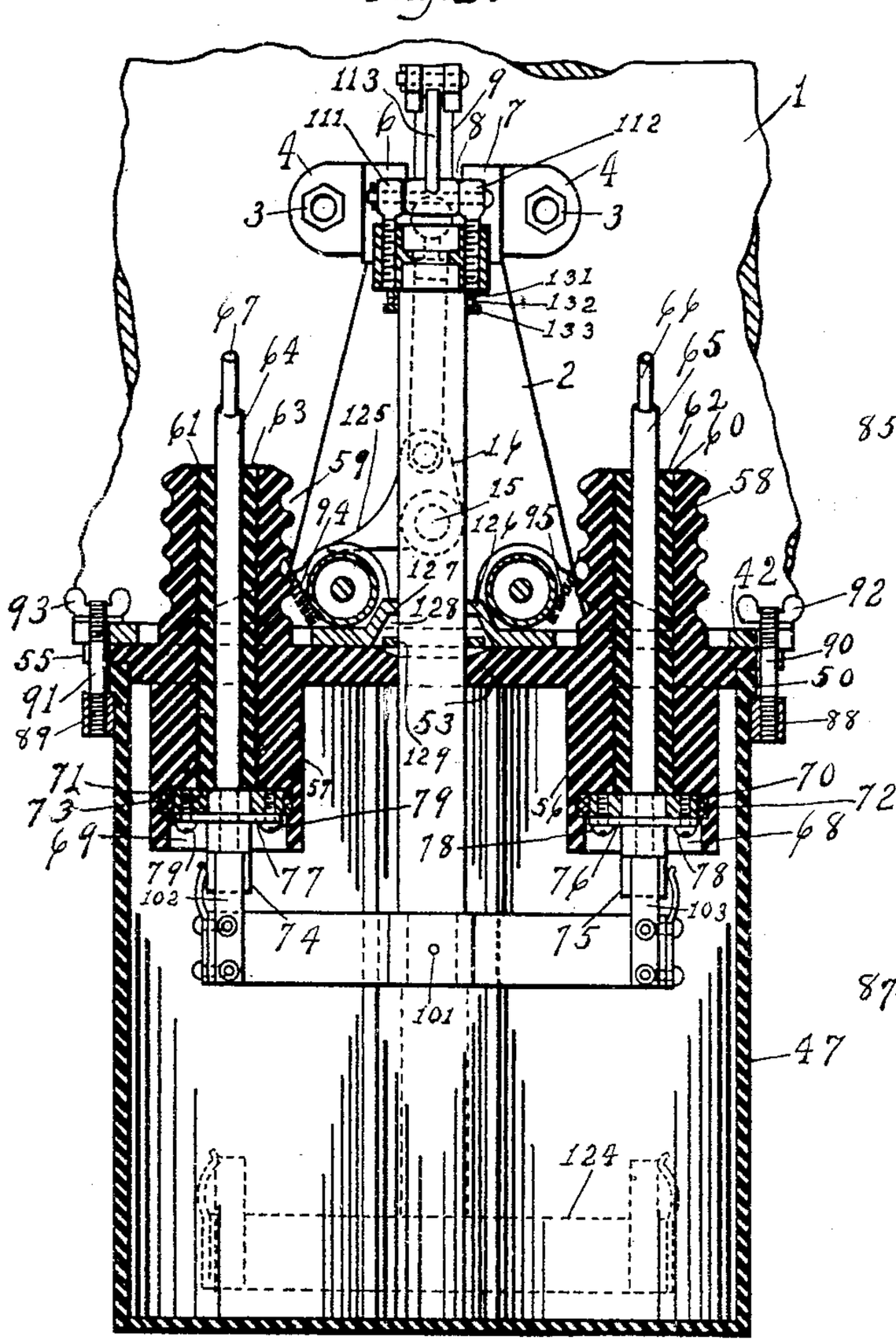


Fig. 3.

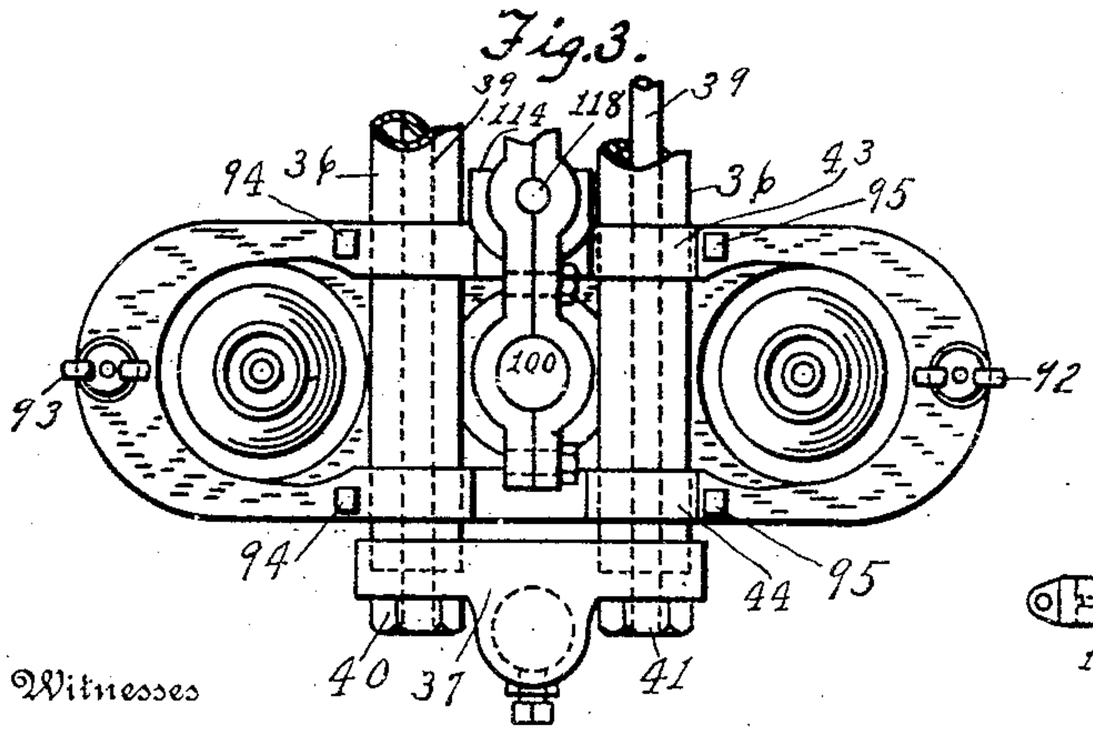


Fig. 4.

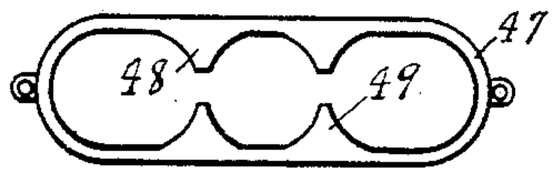


Fig. 5.

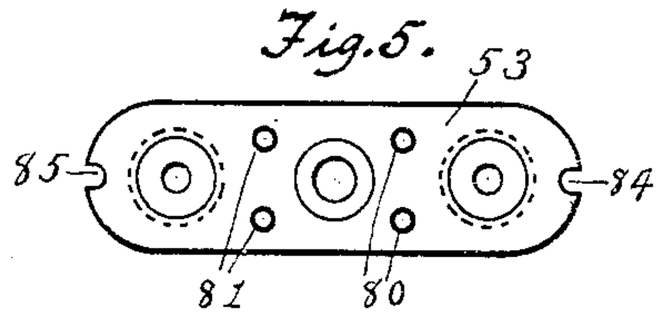


Fig. 6.

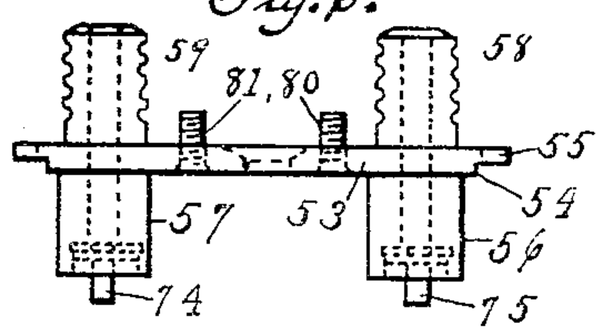


Fig. 7.

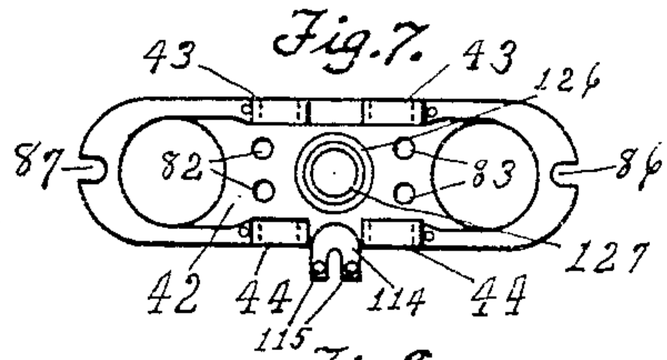


Fig. 8.

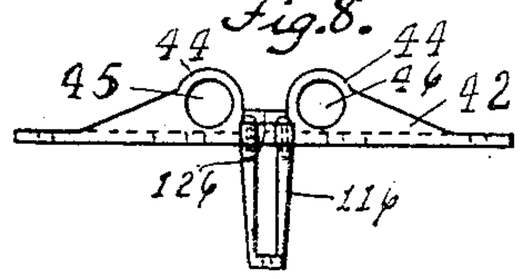


Fig. 9.

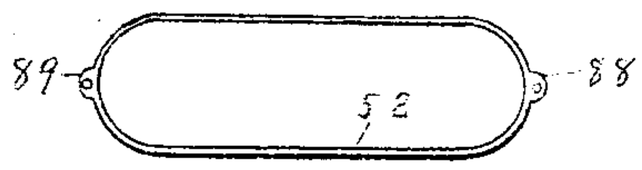


Fig. 10.

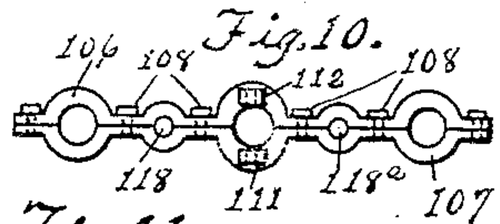
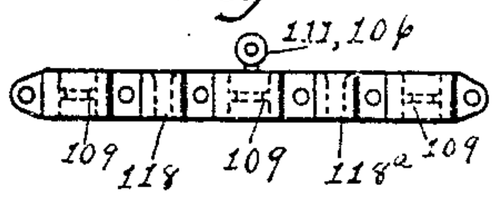


Fig. 11.



Witnesses

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FRANK O. HARTMAN, OF MANSFIELD, OHIO.

HIGH-POTENTIAL SWITCH.

949,182. Specification of Letters Patent. Patented Feb. 15, 1910.

Application filed December 17, 1906. Serial No. 348,095.

To all whom it may concern:

Be it known that I, FRANK O. HARTMAN, citizen of the United States, residing at Mansfield, in the county of Richland and State of Ohio, have invented certain new and useful Improvements in High-Potential Switches, of which the following is a specification.

My invention relates to high potential oil switches or circuit breakers of the oil-break type in which the circuit is ruptured in an insulating fluid.

The primary objects of my invention are to provide a safe and efficient means of rupturing high potential circuits and to provide improved means of insulating the live parts of such a switch from the metal supporting frame and operating mechanism.

In practice, high tension oil switches are constructed either two, three or four pole for the purpose of controlling respectively single, three or two phase circuits.

A further object of my invention is to provide a means of constructing these several combinations, or a plurality of switches, from single pole elements, thus greatly diminishing the number of parts required to meet the conditions of modern high tension practice. The three pole switch shown in the accompanying drawing is adapted to be used for a four pole switch by the substitution of longer sections of steel tubing and a longer cross-head and operating lever-arm and adding the necessary switch elements, and a two pole switch is provided by omitting one of the switch elements and using shorter sections of tubing and a shorter cross-head and operating lever arm.

It is well known that different potentials require different degrees of separation between phases; therefore one of the objects of my invention is the construction of a switch mechanism that will permit a wide separation of phases without materially increasing the weight of the switch, which is accomplished by the use of a separable supporting frame with means of adjustment.

Another important feature of my invention is the means provided of insulating the live parts of each switch from metal supporting frames and operating mechanism which I accomplish by employing a separate cell composed of indurated fiber for each phase of the circuit, such cells comprising a tank for containing oil or other insulating liquid, and a cover for such tank provided with bushings, arranged to project downward into the oil and upward over the top of the cover.

Another feature of my invention is the method of constructing the tank, cover and bushings of insulating material, to wit: indurated fiber.

My invention further consists in the operating mechanism employed to make and break the circuit together with the make and break contacts.

I attain these and other objects by the mechanism illustrated in the accompanying drawing in which;

Figure 1, is a vertical cross-sectional side view of my switch of the three pole type taken through the center showing the laminated contacts in contact with the contact blocks, and a side view partly in section of the operating mechanism of the switch, also showing method of attaching it to the switch board. Fig. 2, is a transverse cross-sectional side view of one of the switch elements showing the laminated contacts in contact with the contact blocks, and an end view of the operating mechanism; also the position of the laminated contacts in dotted lines when the circuit is broken. Fig. 3, is a plan view of Fig. 2 showing broken sections of steel tubing which pass through suitable apertures formed in the metal supporting frame whereby the tank, cover and metal supporting frame are suspended; also a broken section of the cross-head to which the movable bridging contacts are attached. Fig. 4, is a top view of the interior of one of the indurated fiber tanks with the cover removed showing inwardly projecting portions extending toward each other to form a barrier. Fig. 5, is a top view of one of the indurated fiber covers of the tanks. Fig. 6, is a side view of the cover of one of the tanks showing the indurated fiber bushings, which are made integral therewith, also showing the fixed contact blocks attached thereto. Fig. 7, is a top view of one of the metal supporting frames showing outwardly projecting lugs extending from one side to which a spring holding yoke is attached. Fig. 8, is a side view of Fig. 7, showing spring holding yoke attached thereto and apertures formed in the metal supporting frame to receive the sections of steel tubing upon which they are mounted. Fig. 9 is a plan view of an iron band that encircles the outer periphery of the tanks adjacent to the

outwardly extending flange formed contiguous with the top of each tank. Figs. 10 and 11 are top and side views, respectively, of the cross-head showing detail of construction. Fig. 12, is a detail side view of the crank which is attached to one end of the operating rod. Fig. 13 is an end view of the crank showing bifurcated end with bolt inserted therein; also broken section of the operating rod with tee shaped end. Fig. 14 is a plan view of the spring holding yoke. Fig. 15, is a cross-sectional end view of the hub of the operating lever showing it fitted to the operating rod and extending over the tee shaped end of the operating rod with adjusting screws positioned to admit of partial rotation of the operating lever independent of the rotation of the operating rod. Fig. 16 is a similar view except that the adjusting screws are shown in contact with the flat portion of the tee to prevent independent rotation. Fig. 17 is a bottom view of the bracket with arms made integral therewith to which the movable bridging contacts are attached with a broken section of a wooden rod which is attached to the bracket. Fig. 18 is a side elevation of Fig. 17, showing position and shape of arcing springs.

In the drawings 1 represents a broken section of an ordinary switch board to which the standard 2 is securely attached by the bolts 3—3 which pass through suitable apertures formed in the switch board and are adapted to engage with the screw-threaded inner peripheries of apertures formed in the feet 4—4 of the standard 2 leaving an opening 5 between the bed of the standard and the face of the switch board.

The upper portion of the standard is constructed with projecting lugs 6 and 7 spaced apart to form an opening 8. An operating lever arm 9 having a boss 10 provided on one end, is fitted to the opening 8 between the lugs 6 and 7 and pivotally journaled therebetween by the bolt 11. The free end of the operating lever arm 9 extends outwardly from the standard 2 and is made of such a length as will leave the free end thereof approximately over the center of the cross-head which will be described hereinafter. The length of the operating lever arm 9 is determined by the number of switch elements that it is desired to use. Directly underneath the lugs or bifurcated portion of the standard, an elongated horizontal bearing 12 is formed extending outwardly from the base of the standard and inwardly into the space 5. An operating rod 13 is fitted to an aperture 14 in the switch-board and extends into the elongated bearing 12 of the standard 2 leaving one end 15 projecting beyond the face of the elongated bearing. A crank 16 having its free end 16^a bifurcated, is rigidly secured to the projecting end 15 of the operating rod 13. A ball and socket bearing 17 is formed in the under portion of the operating lever arm 9 together with the plate 18 which is attached to the operating lever arm through the medium of the screws 18^a—18^b. A ball 19 is fitted to the socket bearing 17 having a screw-threaded tang 20 depending therefrom. A tubular connecting bar 21 having one end of its inner periphery screw-threaded is provided with the opposite end 22 flattened to fit loosely the bifurcated free end of the crank 16. The tang 20 engages with the screw-threaded inner periphery of the tubular connecting rod 21 as shown and the flattened end 22 of the tubular connecting rod is pivotally secured to the crank by the bolt 23 thereby forming what is commonly called a toggle joint connecting the operating rod 13 with the operating rod 9 and imparting movement thereto when the operating rod 13 is rotated. The length of the toggle joint can be varied forcing the operating lever arm to travel in a higher or lower plane by screwing the tang in or out of the tubular connecting rod 21. A jam nut 24 is provided to securely retain the tang in position after adjustment.

In order to obviate lateral movement of the operating rod 13 a collar 25 is provided and mounted on the rod between the switch board and one end (*b*) of the bearing 12. The free end of the operating rod 13 has two grooves 26 and 27 formed adjacent to its end and diametrically opposed to each other, leaving a flattened portion 28 and an annular flange 29 forming substantially a tee shaped end. (See Fig. 13.) The hub 30 of the operating handle 31—31 is fitted to the projecting end of the operating rod 13 extending over the tee shaped end as shown in Figs. 15 and 16, thereby providing the spaces 32 and 33 on each side of the flattened portion 28. Screws 34 and 35 are inserted in suitable screw-threaded apertures in the hubs of the operating handle 31—31 arranged diametrically opposed to each other and in alinement with the flattened portion 28. The screws 34 and 35 perform the double function of rigidly connecting the operating handle 31—31 to the operating rod 13 if desired, or they can be adjusted so as to leave spaces between the ends of the screws and the flattened portion thereby providing for more or less lost motion when the handle 31 is rotated to impart movement to the operating rod 13 which affords facilities for breaking the current notwithstanding the fact that the operator might inadvertently hold the operating handle in his grasp. When the movable laminated contacts start upon their downward movement and break the current, the lost motion of the operating handle on the rod permits the partial rotation of the operating rod 13 to

the extent of the adjustment of the screws 34 and 35.

The bed of the standard 2 in its lower extremity has two counterbored apertures provided therein and spaced apart into which one end of tubular supports 36—36 are fitted with their opposite ends fitted to counterbored apertures formed in a bracket 37 which is in turn fitted to the end of the supporting bar 38 and rigidly secured by the set-screw 38ª. The tubular supporting bars 36 are securely held in place by the through-going bolts 39—39 which are threaded on each end passing through the small apertures of the counterbores and held in place by the nuts 40 and 41. The tubular supporting bars are used for the purpose of suspending or hanging therefrom one or more tanks filled with oil or other insulating fluid, in such a manner as to provide means of adjustably spacing the tanks a predetermined distance apart and securely retaining them in their adjusted position.

In order to provide a means of adjustably hanging one or more of the tanks (which will be described hereinafter) to the supporting bars 36—36, I provide a supplementary metal cover or hanger 42 which is provided with upstanding flanges 43 and 44 having apertures 45 and 46 provided therein and arranged parallel and in alinement with each other and adapted to fit over the outer peripheries of the tubular supporting bars 36—36. One or more of the supplementary covers 42 can be mounted on the tubular bars 36 and spaced apart any required distance by making proper provision in the length of the tubular supporting bars and operating mechanism. The tanks that I employ as receptacles for retaining the insulating liquid are essential features of my device and are molded or formed of indurated fiber and constructed as follows:

The body of the tank 47 is formed to conform to the shape shown in Fig. 4 with inwardly extending V shaped projections 48 and 49 which in conjunction with the wooden rods form barriers between the stationary contacts of the switch. The upper portion or open end of the tank has an outwardly extending flange 50 extending around the upper portion of the tank forming a shoulder 51. A band 52 is provided and adapted to encircle the outer periphery of the tank with the upper edge abutting against the shoulder 51 of the flange 50 thereby giving strength and rigidity to the upper and open part of the fiber tank and providing a means of securely attaching the tank to the hanger in a manner described hereinafter. This band is forced in position when the tank is green and is held in position by the baking and subsequent treatment which the tank receives. The cover of the tank 53 is formed or molded to the shape shown in Figs. 5 and 6. The under portion 54 is cut away and formed to fit the inner periphery of the fiber tank leaving the upper portion 55 extending over the face of the upper portion of the tank forming an outwardly extending flange or shoulder (see Fig. 6). Hollow indurated fiber bushings, 56 and 57, are made integral with the cover 53 leaving a smooth portion projecting below the cover 53 of the tank and the upper portion projecting upwardly from the tank with a series of grooves, 58 and 59, formed on the outer peripheries to provide a longer path for the current in case of leakage. The bushings 56 and 57 are provided with apertures, 60 and 61, into which porcelain tubes, 62 and 63, are inserted providing a double insulation. These tubes receive the cable covers, 64 and 65, inclosing the wires, 66 and 67. The lower portion of the bushings, 56 and 57 which depend into the oil tank are counter-bored concentric with the apertures, 60 and 61, leaving recesses 68 and 69. Annular metal rings, 70 and 71, are fitted to the bottom of the counter-bores, 68 and 69, and are held in place by a leaded joint, 72 and 73, filling notches formed in the rings and extending into an annular recess provided in the bushings, adjacent to the bottom of the counter-bores, 68 and 69. Both of these metal rings, 70 and 71, are provided with screw-threaded apertures. Fixed contact blocks, 74 and 75, having outwardly extending flanges, 76 and 77, made integral therewith are provided and fitted to the counter-bored recesses, 68 and 69, and retained in place by the screws 78 and 79 which engage with the screw-threaded apertures provided in the metal rings 70 and 71.

The supplementary supporting cover or hanger 42 is securely attached to the indurated fiber cover 53 by the bolts 80 and 81 which engage with the apertures 82 and 83 formed in the supplementary metal cover 42. The indurated fiber cover 53 is provided with notches 84 and 85 which are formed in direct alinement with the notches 86 and 87 formed in each end of the supplementary cover or hanger 42. The band 52 has outwardly extending ears 88 and 89 formed thereon and provided with screw-threaded apertures which aline with the notches 84, 85, 86 and 87 formed in the supplementary cover or hanger 42 and the indurated fiber cover 53. Stud bolts 90 and 91 having one end adapted to engage with the screw-threaded apertures in the ears 88 and 89 are provided leaving the opposite ends extending upward to engage the notches 84, 85, 86 and 87. Wing nuts 92 and 93 engage with the projecting ends of the bolts 90 and 91 and when screwed down securely retain the tank and indurated cover 53 to the supplementary cover and hanger 42, thereby suspending the tank or tanks below the

tubular supporting rods. (See Fig. 2.) The tanks are adjustably retained in place and rigidly secured a predetermined distance apart by the screws 94 and 95 which are inserted in suitable screw-threaded apertures in the supplementary cover or hanger 42 and adapted to contact and press against the outer peripheries of the tubular supporting bars to prevent lateral movement of the tanks.

In the above description I have described but one tank but it will be readily understood that this description will describe all or a plurality of tanks and method of suspending them from the tubular supporting bars.

The bracket 96 has two outwardly extending arms 97 and 98 and is provided with an aperture 99 in the center of which an insulating rod 100, preferably made of wood, is inserted and held in place by a pin 101. To the outer ends of the arms 97 and 98 laminated contacts 102 and 103 are securely attached by the through-going bolts 104 and 105. These laminated contacts are spaced apart such a distance as will bring them in direct alinement with the fixed contact blocks 74 and 75. The upper portion of each rod 100 has an annular groove 110 formed upon the outer periphery. A cross-head formed of two pieces 106 and 107 is provided and fastened together by the bolts 108. The cross-head is also provided with annular ribs 109 that fit the annular grooves 110 formed in the free end of the supporting rods 100 thereby securely connecting the rods and cross-head together. Two upwardly extending ears 111 and 112 are provided and made integral or attached to the center of the cross-head. A link 113 is pivotally attached to the free end of the operating lever arm 9 on one end and the opposite end to the cross-head formed of the two parts 106 and 107 between said ears 111 and 112 connecting the movable laminated contacts to the operating mechanism hereinbefore described. A bifurcated projecting portion 114 is secured to or made integral with the supplementary hanging frame or cover 42 and is provided with apertures 115. A spring holding yoke 116 provided with a circular portion 117 is attached to the projecting portion 114 by suitable fastening means. The yoke is attached to the supplementary metal cover 42 at such a point as will bring it in direct alinement with the aperture 118 formed in the cross-head composed of parts 106 and 107. Coil springs 119 and 120 are provided with one end adapted to rest on the circular portion 117 of the yoke. Both ends of the springs are provided with screw-threaded plugs which are soldered or otherwise fastened to the inner peripheries of the coils of the springs. Screws 121 and 122 are fitted to the apertures 118 and 118[a] with the screw-threaded ends engaging the screw-threaded apertures formed in the screw-threaded plugs. Similar screws are provided to retain the opposite ends in place upon the circular portion 117 of the yoke passing through the apertures 123 and engaging with the screw-threaded plugs attached to the opposite ends of the springs. One or more of these springs are used, the number being determined by the number of phases or poles of the switch. When the laminated contacts are not in contact with the fixed contact blocks, they are in the position shown by the dotted lines 124 and the springs 119 and 120 are compressed and not under tension. When the movable laminated contacts are in contact with the fixed contact blocks, one end of the springs is drawn upward with the cross-head and the springs are under tension exerting a downward pull on the cross-head so that when the operator desires to break the contact and movement is imparted to the cross-head through the medium of the operating mechanism and the operating handle 31—31 is rotated to the right, the break is made rapidly because the instant the laminated contacts are released, the downward pull exerted by the springs forces a much more rapid break that could not be obtained without the use of the springs.

The supplementary metal cover or frame is provided with hollow annular conical projections 126 having apertures 127 for the passage of the insulating rod 100 and the fiber cover directly underneath the conical projections is chamfered to form a chamber 128 with the walls tapered thereby providing a means of counteracting the tendency of the gas or air in the tanks to force the insulating fluid out around the wooden insulating rod. The tapered walls of the chamber direct the course of any oil that is forced into the chamber downward into the tanks. A washer 129 can be fitted to the insulating rod 100 and placed within the chamber 128 to scrape off or clean the rod. In order to cushion and materially prevent the jar or vibration incident to breaking the contact I employ one or more rubber washers 131 and 132 and an iron washer 133 which are fitted to the rods 100 adjacent to and abutting against the under portion of the cross-head. Arcing springs *a* are provided and secured to the ends of the arms 97 and 98.

The operation of the switch is as follows: The operator grasps the operating handle 31—31 in his hands and rotates the operating rod 13 to the right thereby forcing the movable laminated contacts to travel upward forcing them in contact with the contact blocks as shown in Figs. 1 and 2 completing the circuit, and the springs 119 and 120 which are secured firmly to the circular portion of the yoke 117 are pulled apart under

tension as shown in Fig. 1 and constantly exert a downward pull on the cross-head while the movable laminated contacts are in contact with the fixed contact blocks. When it is desired to release and break the circuit, the operator turns the operating handle 31—31 to the left and this forces the movable laminated contact to break from the contact blocks and downward movement is imparted to the movable laminated contacts which is accelerated by the tension of the springs. When the movable laminated contacts are in contact with the contact blocks the toggle joint heretofore described, is forced slightly beyond the "dead center" and is held in such position by the link 16 which forms a stop resting upon the tubular supporting bar. When the switch mechanism is released and the break is made the extent of the downward movement of the laminated contacts is controlled by the stop 125 resting upon the opposite tubular bar which holds the laminated contacts at a certain point of their downward travel.

Having fully described my invention, what I claim and desire to secure by Letters Patent is:

1. A high potential oil switch for electric currents comprising a plurality of switch elements, a supporting frame for such switch elements consisting of a standard and a horizontally projecting tubular frame attached to the same, and means of operating the movable members of such switch elements simultaneously.

2. A high potential oil switch for polyphase currents, with current carrying parts of each phase inclosed in a separate tank, a cover for such tank with hollow bushings projecting above and below the same, means of fastening a plurality of fixed terminals of the switch element to such hollow bushings, a supporting frame for the switch elements consisting of a standard and a horizontally projecting tubular frame attached to the same, and means of attaching said tank and cover to said supporting frame.

3. A high potential switch for electric currents comprising a plurality of switch elements, each element consisting of a tank for containing the insulating fluid, a supplementary metal cover for said tank consisting of a metal plate, a cover made of insulating material with two hollow bushings extending above and below the same, fixed terminals attached to the lower ends of said bushings, a bracket attached to an insulating rod extending outside of said oil tank and adapted to contact with said fixed terminals, means of attaching the oil tank to the metal cover, a supporting frame consisting of a standard and two sections of steel tubing horizontally projecting therefrom, means of clamping the metal cover to said tubing, and an operating device for raising and lowering the bridging contacts, guided by said cover.

4. In a high potential switch the combination of a standard, an operating arm journaled horizontally in said standard, a tubular supporting frame attached to said standard, a plurality of switch elements adjustably supported from said tubular frame and controlled simultaneously by said operating arm.

5. In a high potential switch, the combination of a standard and a tubular frame supported at right angles therefrom, a plurality of single pole switches adjustably supported from said tubular frame, and means of operating the movable contacts of said switches simultaneously.

6. In a high potential switch, the combination of a standard and a tubular frame supported at right angles therefrom, a plurality of oil cells made of indurated fiber, each cell containing a single pole switch, covers for each oil cell, consisting of a metal supplementary cover attached to a cover of indurated fiber with two hollow bushings of the same material projecting above and below the same, means of attaching said oil cells to said tubular frame, and means of operating said switches simultaneously.

7. A high potential switch for electric currents comprising a standard, tubular bars secured to said standard and extending horizontally therefrom, a supplementary metal cover suspended from said tubular bars, a tank composed of indurated fiber, a cover for said tank composed of indurated fiber having indurated fiber bushings made integral therewith, means to attach said tank and indurated fiber cover to the supplementary cover, a plurality of fixed contacts attached to said bushings, movable laminated contacts, an insulating rod secured to said contacts, a cross-head attached to said insulating rod, and an operating mechanism pivotally secured to said cross-head providing means to open and close the circuit.

8. A high potential switch for electric currents comprising a standard, a tubular supporting frame secured thereto, tanks for retaining an insulating fluid adjustably suspended from said supporting frame, and an operating mechanism secured to the standard to make and break the circuit.

9. A switch comprising a standard, a tubular supporting frame secured thereto, an operating rod journaled in an elongated bearing formed in said standard, said operating rod having grooves formed in one end forming substantially a tee shaped end, an operating handle extending over said tee shaped end and provided with a hub, adjusting screws fitted to screw-threaded apertures in said hub to rigidly connect said handles to the operating rod to provide for lost motion of the operating handle

when it is rotated and a lever arm pivotally secured to said frame, a crank securely fitted to one end of the operating rod, a toggle connection connecting the operating rod and lever arm together, supplementary metal supporting covers mounted on the tubular members of the supporting frame, one or more tanks with covers composed of indurated fiber suspending from the supplementary metal cover, and laminated movable contacts pivotally secured to the operating mechanism.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK O. HARTMAN.

Witnesses:

W. L. LEONARD,

WM. BOWERS.