W. KAISLING.

SWITCH.

APPLICATION FILED FEB. 18, 1909.

975,530.

Patented Nov. 15, 1910.

3 SHEETS—SHEET 1.

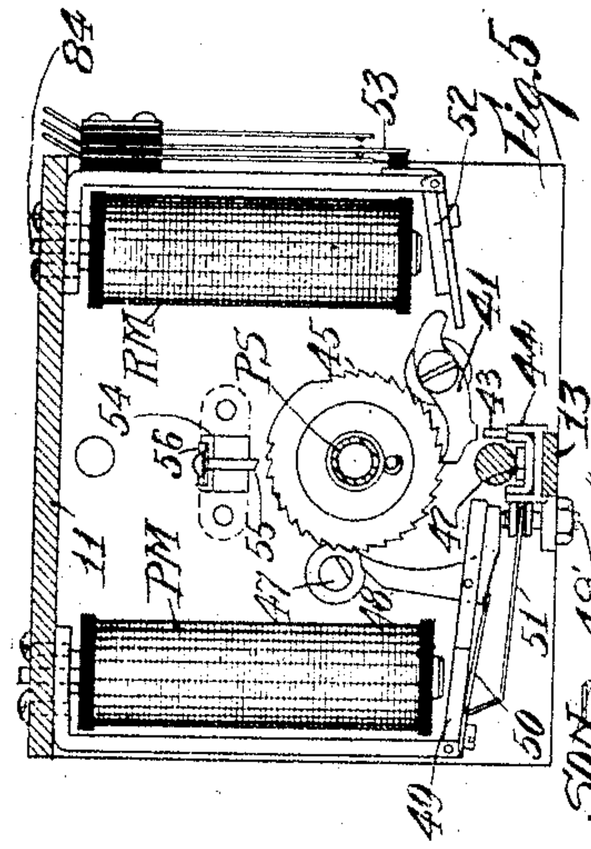

Fig. 4

Fig. 5

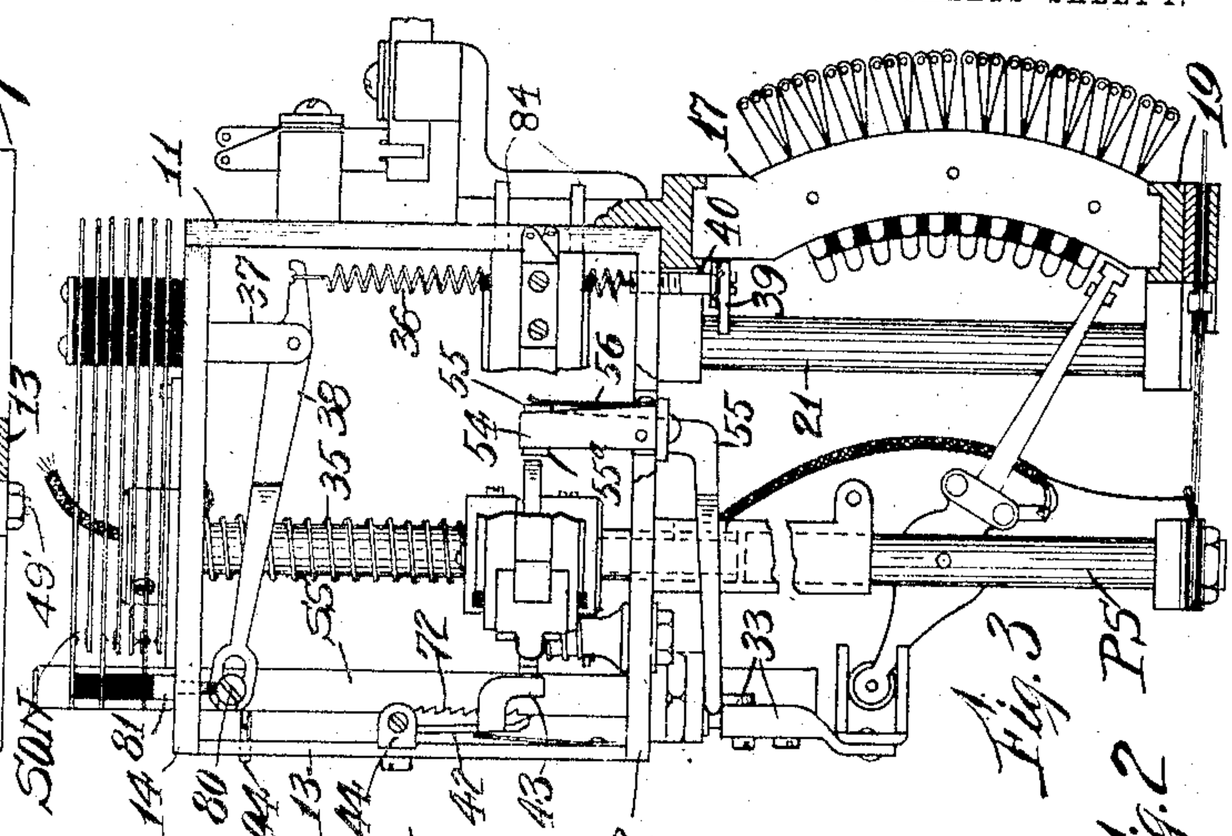

Fig. 3

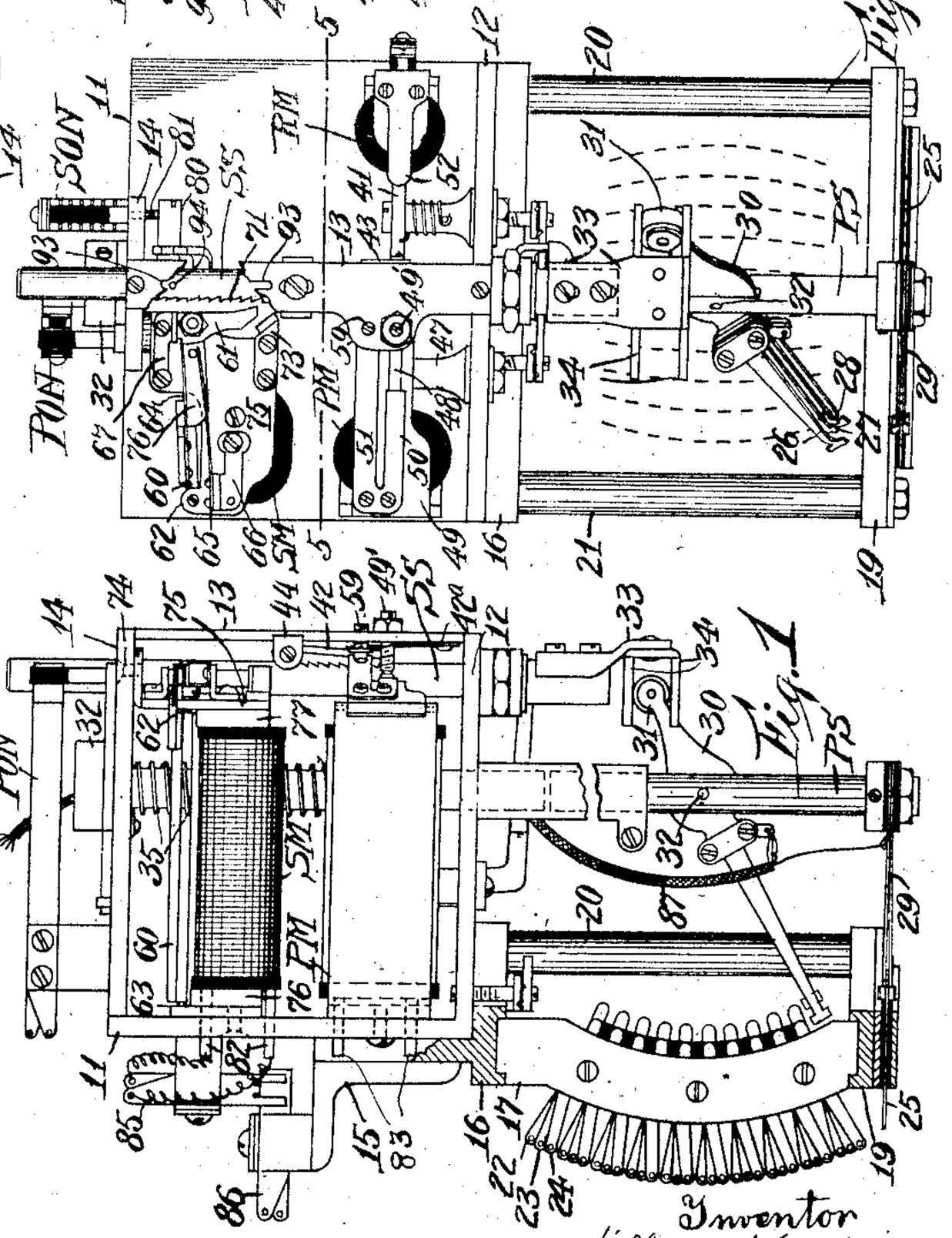

Fig. 2

Fig. 1

Witnesses

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3 SHEETS—SHEET 2.

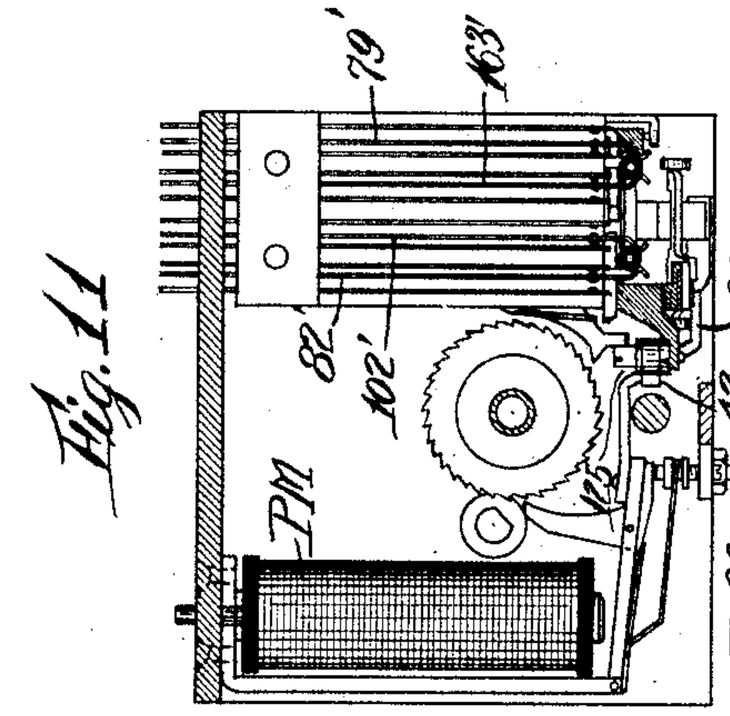

Fig. 11

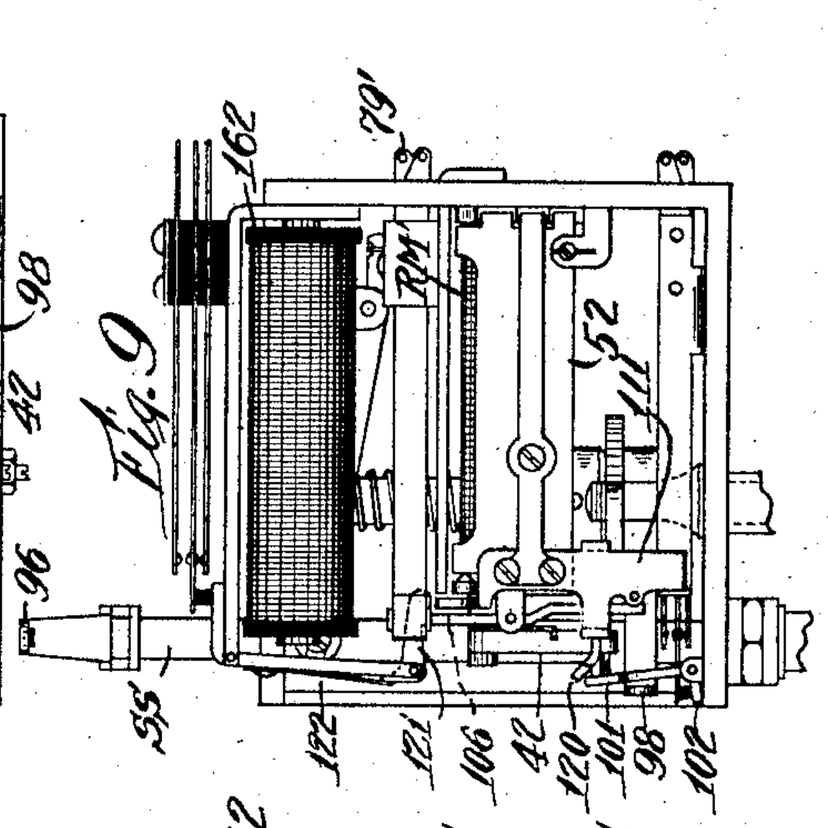

Fig. 9

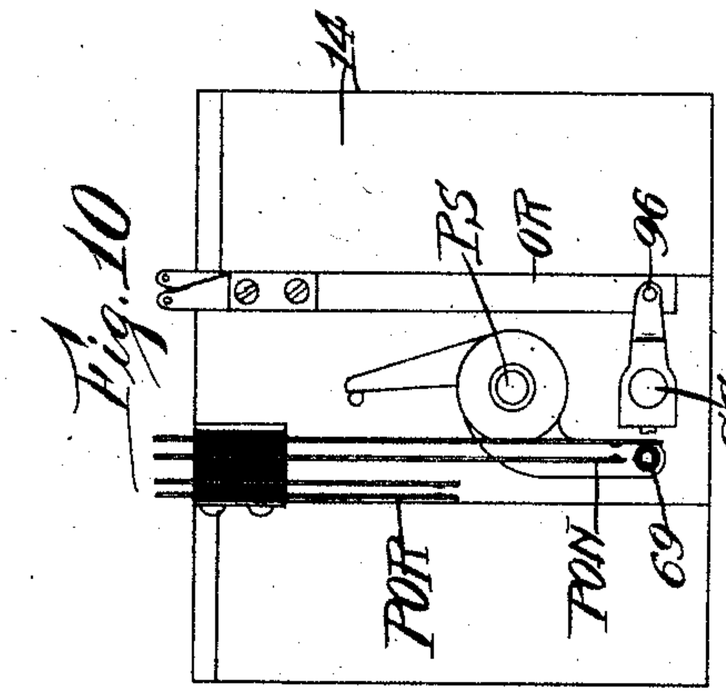

Fig. 10

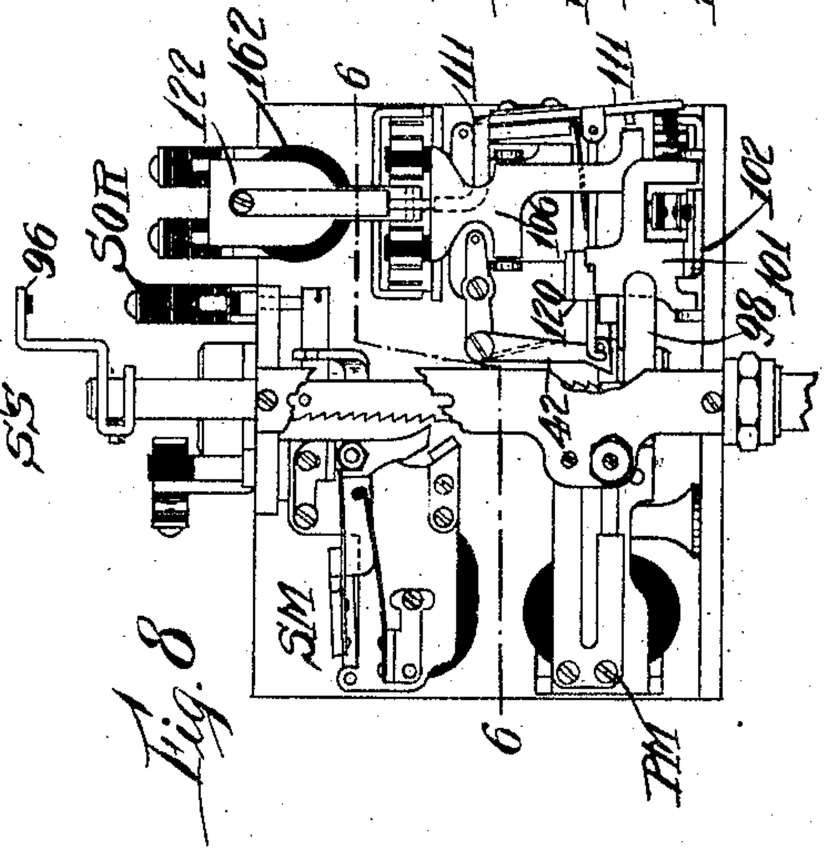

Fig. 8

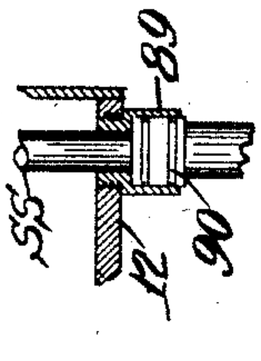

Fig. 6

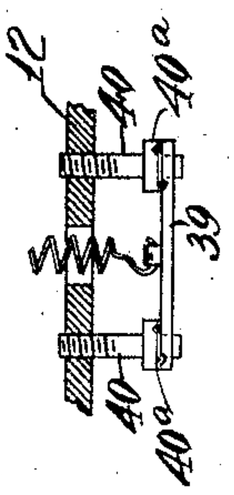

Fig. 7

Witnesses
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SWITCH.

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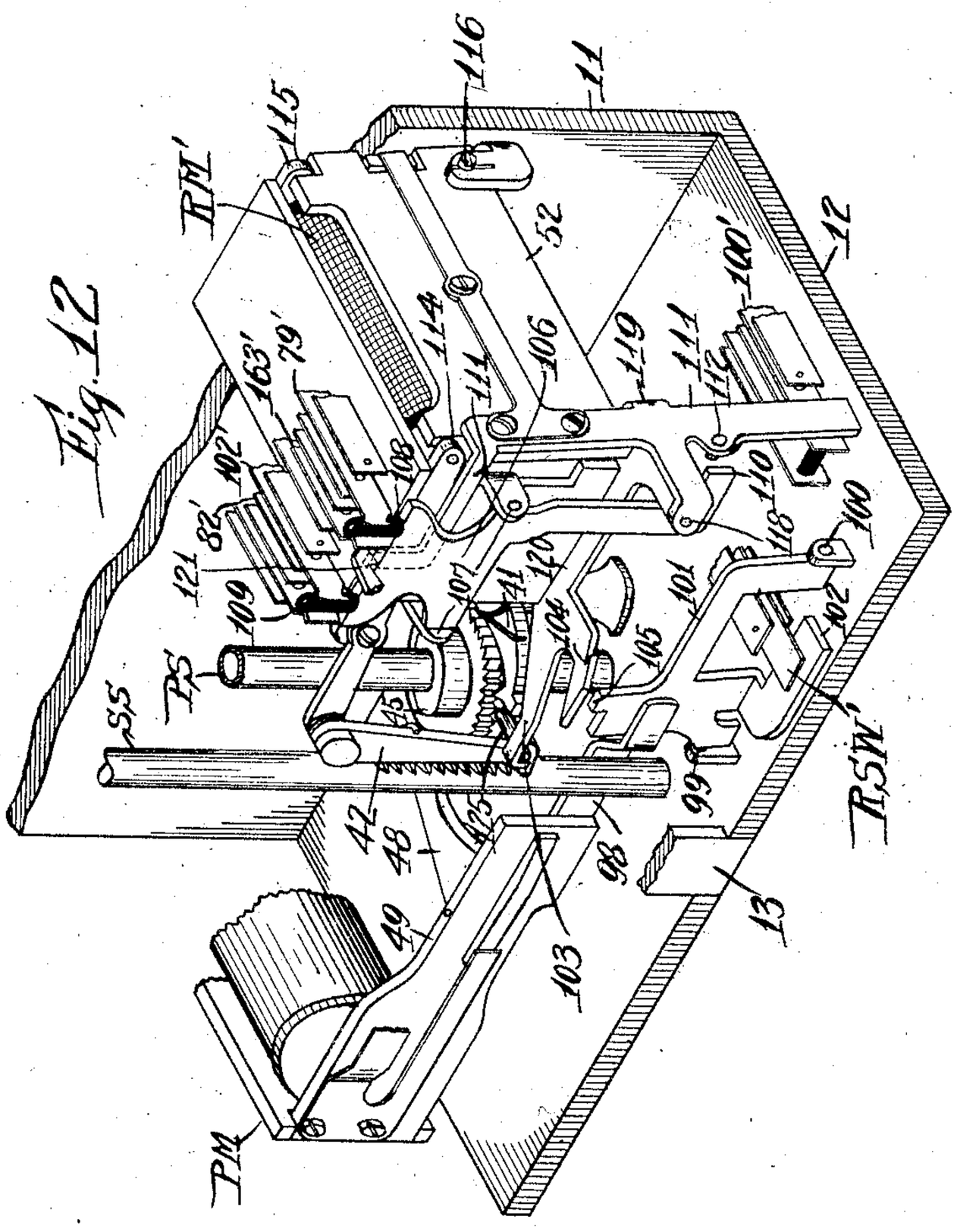
975,530.

Patented Nov. 15, 1910.

3 SHEETS—SHEET 3.

Fig. 12



Witnesses

Carolyn Weber

A. H. Dyson

Inventor

William Kaisling

By Thomas H. Ferguson

Atty

UNITED STATES PATENT OFFICE.

WILLIAM KAISLING, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO KELLOGG SWITCHBOARD & SUPPLY COMPANY, A CORPORATION OF ILLINOIS.

SWITCH.

975,530. Specification of Letters Patent. Patented Nov. 15, 1910.

Application filed February 18, 1909. Serial No. 478,665.

To all whom it may concern:

Be it known that I, WILLIAM KAISLING, a citizen of the United States, residing in Chicago, county of Cook, State of Illinois, have invented new and useful Improvements in Switches, of which the following is a specification.

The present invention is directed to improvements in selective switches and more particularly to mechanisms for use in connection with circuits of selective telephone systems.

I have shown the invention embodied in a switch having wipers adapted to be adjusted in two intersecting planes, but the invention as defined in the claims is not limited to switches of this character.

Features of the present invention are improved arrangements for mounting the various electromagnets employed in connection with selective switches; improved mountings of the actuating magnets with relation to the switch driving parts controlled by them; improved coöperation between the primary and secondary actuating and retaining pawls, and the release magnet means; improved mechanical connecting devices by which the circuit connections of the switches may be established, and an improved restoring spring arrangement.

The invention further includes certain detailed arrangements more particularly pointed out in the following description and defined in the claims.

In carrying out the present invention, I have given particular attention to providing a device wherein the parts most susceptible to arrangements are all so located as to be readily accessible for repairs and adjustment.

Referring to the drawings, Figure 1 is a left elevation of a switch embodying the invention, the contact bank being shown in section; Fig. 2 is a front elevation of the switch; Fig. 3 a right elevation thereof; Fig. 4 shows in detail the primary off-normal combination of the switch; Fig. 5 the primary and release magnets and associated parts, this being a sectional view on line 5—5 of Fig. 2; Fig. 6 shows a dash-pot for the secondary shaft; Fig. 7 the method of connecting the lower end of the secondary restoring spring; Fig. 8 is a front elevation showing the switch frame and its actuating magnet mechanism as modified and adapted to perform certain functions in addition to those required of the structure of Figs. 1 to 7; Fig. 9 is a side elevation of the switch frame and parts as so adapted; Fig. 10 shows off-normal and primary over-run switch arrangements, while Fig. 11 is a sectional view on line 6—6 of Fig. 8; Fig. 12 is a view in perspective of the lower portion of the modified switch designed to show particularly principal interlocking parts of the switch so adapted.

Referring first to Figs. 1 to 3, the main switch frame is composed of the two frame plates 11 and 12, joined at right angles and the two narrow frame members 13, 14, member 13 extending parallel with the plate or member 11, while member 14 is parallel with plate 12. At their junction points, these four frame members are tightly fastened together, to form a rigid rectangular support for the remaining switch parts with the exception of the switch bank proper. The latter is preferably composed of ten groups of ten contact sets each, and each group is preferably a self-contained unit containing ten sets of contacts 22, 23, 24 insulatingly supported between the arcuate plates 17, 17. Ten such units support vertically between curved holding members 16, 19, comprise the bank as a whole, the bank presenting an inner contact surface as of a segment of a sphere as indicated in Fig. 2, wherein each contact set 22, 23, 24, is represented by a single short line. The plates 17, 17, the bank units having been placed between them, are held in place by the posts 20, 21, fastened at their upper ends to the plate 16, and having their lower ends extending through plate 19 and provided with nuts. The plate 16 has a vertically extending portion by which the bank may be rigidly attached to an angle iron 15 forming a horizontally extending member of the customary mounting frame. The main switch frame may then be placed so that the angle formed by plates 11 and 12 fits in the angle of plate 16, the two being then fastened in any convenient manner, whereby the moving parts carried by the switch frame will be in adjusted relation with the bank.

The wiper contacts 26, 27, 28 are adapted to be first rotated step by step from left to right, each step bringing them opposite a

different vertically extending group of contact sets; whereafter the inwardly extending contact-making ends of the wipers are rotated upwardly, each step causing them to engage a successive set of contacts 22, 23, 24. The first adjustment may be called primary, and the second, secondary. For effecting the primary adjustment, a rotary primary shaft PS is provided, having a slot through which the member 30, which carries the wipers, extends, being pivoted at 32. By turning shaft PS, the wiper ends will obviously be rotated beneath the lower edge of the contact bank. The primary shaft PS extends through the frame members 12 and 14 being journaled thereto and held in place by the hub 32 fastened to its upper end.

To effect the secondary adjustment of the wipers, secondary shaft SS is provided, extending through members 12 and 14, said shaft being longitudinally movable down and up. At its lower end, is fastened a member 33 having two horizontal and curved plates 34, 34, between which fits a wheel 31, pivoted to member 30. When shaft PS is rotated, this wheel is carried sidewise between plates 34, 34, which are broad enough so that in every primary adjusted position, wheel 31 will be between them. When shaft SS is moved downward, wheel 31 turns between plates 34, as wiper support 30 is rotated on pivot 32 and the contact ends of the wipers rotate upward.

For rotating the primary shaft, magnet PM is provided whose armature 49 (see Fig. 5) carries the pivoted pawl 48, whose stop 47 is in the form of a post extending upward from frame plate 12. Fastened to armature 49, is a leaf-spring having bifurcations 50 and 51, (or two separate springs may be used), the former bearing upon pawl 48 to press it toward ratchet 45, while the latter serves as a restoring spring for armature 49, its right end being suitably connected to a tension adjusting screw 59, best shown in Fig. 2. The adjustable screw 49′, provided with a lock nut, limits the back stroke of the pawl 48. By successive actuations of magnet PM, thrusts of pawl 48 will be effected, moving ratchet 45, rigid upon shaft PS step by step, whereby the wipers receive their primary adjustment. The spiral spring 35, having one end fastened to shaft PS and the other to plate 14, tends to restore shaft PS, when the latter is rotated, but primary retaining pawl 41 engages successive teeth of ratchet 45, preventing back movement. Hub 32 at the top of shaft PS has an arm provided with a stud 69 which normally holds primary off-normal spring PON in the position shown. Whenever shaft PS leaves normal, stud 69 frees said spring when the off-normal contacts by their tension assume their alternate positions, to be again restored by said stud when shaft PS restores. An arm 68 of hub 32 contacts with pin 70, extending up from plate 14 when the primary shaft reaches normal to stop it.

For moving secondary shaft SS downward to cause the secondary travel of the wipers, secondary magnet SM is provided with an armature-actuated pawl 61, adapted to engage teeth of an adjacent ratchet 71 cut in shaft SS. Armature 60 of magnet SM extends the length of the magnet spool, being pivoted at 63 to a plate of brass between pole-piece 76 and plate 11, and at 62 to a plate 75, which may be of brass, screwed to pole-piece 77 and having an angular extension screwed to plate 14 at 74. By this latter attachment, the forward end of magnet SM is rigidly held in place. This plate 75 has fastened to it the forward and back stops 73 and 67 respectively for pawl 61. It also carries a lug 66, to which is fastened spring 65 for restoring the armature 60, said spring at its free end engaging a pin upon the angular plate 76, fastened to the armature. This plate 76 has screwed to it spring 64 for holding pawl 61 toward shaft SS. Successive actuations of armature 60 effect thrusts of pawl 61 to engage successive teeth of ratchet 71, driving shaft SS downward. As best shown in Fig. 3, a stud 80 on said shaft is loosely engaged by the forked end of a lever arm 38, pivoted to a downwardly extending post 37. The short arm of lever 38 is engaged by one end of secondary restoring spring 36, whose other end extends through frame plate 12 and engages a hook on the piece 39, fitting about the adjustable screws 40, threaded to plate 12. Each screw 40 has an enlarged portion 40^a (see Fig. 7), against which piece 39 is drawn by spring 36. Shaft SS is thus driven downward against the tension of spring 36, which would move it back were it not for secondary retaining pawl 42, pivoted to piece 44 upon frame member 13 and pressed by a spring against an adjacent ratchet 72, cut in shaft SS (see Fig. 3). Said pawl 42 engages successive teeth of the ratchet as shaft SS is moved down and holds it against back movement. The stud 80 on shaft SS frees stud 81, which extends through frame 14, on the first step of the shaft, whereupon the secondary off-normal, SON, springs by their tension move stud 81 down and assume their alternate positions. On restoration of shaft SS, stud 80 lifts stud 81 and so restores said springs. A long slot 93, cut in frame member 13, has extending through it a pin 94, rigid upon shaft SS, the said slot, in conjunction with the pin, serving as a guide to prevent possibility of shaft SS turning while being actuated or restored.

To restore the mechanism, it is only necessary to energize release magnet RM, whose armature 52 then engages primary retaining pawl 41 and rotates it about the post sup-

porting it, (Figs. 2 and 5), to cause it to free ratchet 45. The back of pawl 41 then engages a projection 43 on secondary retaining pawl 42 and draws said pawl free of the ratchet of shaft SS. Then spring 36 moves shaft SS up to normal, whereafter spiral spring 35 restores the primary shaft when the wipers will be at normal. When normal is reached, magnet RM deënergizes and pawls 41 and 42 are moved by their associated springs to again engage their respective ratchets.

A secondary off-normal pawl 55 is provided (Figs. 3 and 5), pivoted between the vertical guides 54, mounted on frame plate 12. An extension of piece 33 on shaft SS normally engages the horizontal arm of pawl 55 and holds it in such position that the knife edge 55ª is clear of the adjacent primary ratchet 45. On the first step of shaft SS, piece 33 clears pawl 55, whereupon spring 56 moves said pawl to engage any adjacent tooth of ratchet 45. Thus when shaft SS is restoring, pawl 55, being in engagement with ratchet 45, counteracts the tension of spring 35 while the pawl 41 is disengaged. When shaft SS reaches normal, at which time the wipers will be free of the edge of the contact bank, piece 33 rotates pawl 55 to free ratchet 45 and spring 35 is effective to restore the primary shaft.

When the switch above described is employed for line selecting purposes, it is necessary to have a so-called group contact for each group of contact sets. I have indicated these at 25. The group wiper 29 is rigid upon shaft PS and is thus actuated and restored by the primary adjusting means.

Having considered the general construction of the switch and its operation, some more specific details of improvement will next be referred to.

It will be noted that all electromagnets mounted on the switch mechanism extend horizontally, or at right angles with the shafts, and each magnet is at its rear screwed to the one frame plate 11, being individually detachable. According to this arrangement, the terminals 82, 83, 84 of the magnets SM, PM and RM, respectively, are extended through suitable orifices in plate 11, so that they all appear adjacent to one another on one and the same side of the switch. Moreover, when, as will sometimes be found convenient, an electromagnet having relay springs is to be mounted upon the switch frame, the terminals of such relay springs will be led through an opening in plate 11, just as are the terminals 82, 83, 84. By this means, all soldered connections (except of course those of the conductors of cord 87 to the wiper contacts) are placed on an open plane surface, adjacent to one another and perfectly accessible.

The jack springs 85 are mounted upon frame plate 11 so as to be adjacent to the electromagnet terminals and the spring terminals, to which they may be connected by short wires, as required by the system for which the switch may be used. These jack springs are adapted to slide from and to connection with the jack springs 86, mounted upon angle iron 15 as the main switch frame is moved from and to its operative relation with the switch bank.

In order that the cord or cords for the wiper connections may not hang loose and so be subject to injury, the primary shaft PS is made hollow and the cord or cords are led through the said shaft.

It will be observed that the primary magnet PM, with its armature, its pawl, and the springs for the armature and pawl, is a self-contained unitary device capable of being removed in a few seconds by the loosening of its attaching screws, whereupon another properly adjusted one may be as quickly put in its place. The same is true of magnet SM and its associated parts, the magnet in this case not only carrying the parts mentioned, but the front and back stops for pawl 61. Release magnet RM is also a readily removable unit, but of course does not support its controlled pawl 41.

As indicated in Fig. 6, a dash-pot 89 is fastened to frame plate 12, in which a plunger or piston 90, fastened to shaft SS, normally rests. As shaft SS reaches normal after being actuated as before described, plunger 90, in entering dash-pot 89, encounters an air cushion and the jar occurring on restoration is materially reduced.

The modification of the switch, shown in Figs. 8 to 12, may be used in connection with various circuit arrangements; for example, with a circuit such as that shown at the right of Fig. 1, Part 1, in the application of A. H. Dyson, Serial No. 342,355, filed November 7, 1906, for telephone systems. In the structure of Figs. 8 to 12, the same bank and wiper arrangements used in the structure already described are employed, and the primary and secondary shaft and off-normal contact provisions are the same. In Figs. 8 to 12, the primary and secondary magnets, their pawl and ratchet mechanisms, are like those of the preceding figures and operate in like manner. Mounted upon the modified switch now being considered, are four contact springs 79′, 163′, 82′ and 102′, and these springs are to be shifted to close their alternate contacts after the secondary magnet completes its operation and before release magnet RM releases the selector. Upon the front of magnet RM′, is pivoted at points 107 an irregular shaped member 106, carrying upon its top surface a pair of studs 108, 109, whereof 108 nor-

mally lies within and between the bent cam surface ends of springs 79′, 163′, while stud 109 occupies a corresponding position with respect to the ends of springs 82′, 102′. A controlling magnet 162 is carried by the switch frame, being directly above said springs, which has an armature 122 with a suitably pivoted hook 121. When magnet 162 is energized, armature 122 moves hook 121 so that it slips over the top of member 106 into engaging relation therewith. When magnet 162 is thereafter deënergized, its armature is spring retracted and pawl 121 draws member 106, tilting it about its pivots, outwardly with respect to the associated springs, so that studs 108, 109, act upon the bent cam surfaces of their respective springs to force them apart to their alternate positions. The restoration of these parts is effected by magnet RM′ as hereafter described. A so-called release switch contact RSW is included in the modified structure, being arranged to be shifted to its alternate position on the first actuation of magnet PM and to be restored upon the energization of magnet RM′. Additional features contained in the structure of Figs. 8 to 12, as compared with the first described mechanism, include provisions for holding the primary and secondary actuating pawls 41, 42, normally disengaged from their associated ratchet and for placing them in engaging relation with said ratchets on the first primary step. Also a so-called primary over-run contact POR, adapted to be closed by stud 69 on an eleventh primary step, and a secondary over-run contact SOR adapted to be closed by an arm 96 fastened to shaft SS on an eleventh secondary step, are provided.

Considering now the general operation of the mechanism of Figs. 8 to 11, actuations of primary magnet PM are first caused effecting primary adjustment of the primary shaft and wipers as before. On the first actuation of magnet PM, an arm 98 upon armature 49 engages a reciprocating member 101, pivoted at 99, 100, tilting its upper surface projection 105 to engage an uprising forwardly extending projection of the pawl member 120, which is pivotally supported at 118, 119, upon an arm 111 carried by armature 52 of magnet RM′. As the upper part of member 101 moves toward frame plate 11, member 120 is raised until its pawl 103 is lifted free of a pin 125 upon secondary retaining pawl 42, which is then free to be moved by its spring against secondary shaft SS. Pin 125 extends through pawl 42 and normally holds pawl 41 free of ratchet wheel 45, but when pawl 42 moves to shaft SS, pin 125 is drawn away from pawl 41 and the latter is spring-moved to engage the ratchet. As the movement of member 101 continues, projection 105 comes beneath an off-set 104 in member 120 and the latter drops slightly so that an interlock exists at 104—105, member 101 being then held in tilted position independently of arm 98 controlled by magnet PM. By the tilting of member 101, its angular extension 102 is raised to shift spring RSW′ from its lower to its upper contact and while the interlock at 104—105 continues, said spring will be maintained in shifted position. Actuations of primary magnet PM, after the first one, serve only to advance the primary shaft mechanism. After the primary adjustment is completed, actuations of magnet SM are caused to effect the secondary wiper adjustment, as before. After this control magnet 162 is energized and deenergized, its armature-controlled hook 121 operates upon member 106 to move studs 108—109 to shift their associated springs as before described. The mechanism is then in fully operated position and is ready for restoration upon the energization and deënergization of release magnet RM′. Upon the energization of said magnet, release switch RSW′ is restored to normal, and upon the subsequent deënergization contact springs 79′—163′ and 82′—102′ are restored; also upon deënergization, retaining pawls 41, 42 are withdrawn from their ratchets and the wipers and off-normal switches are restored upon the restoration of shafts PS and SS occurring as before. It will be noted that the present structure differs from that first described, in that the shafts are now restored upon the deënergization of the release magnet, instead of upon its energization.

The armature 52 of magnet RM′ is carried at one side, being pivoted at 114, 115, and has an associated adjustable stop screw 116. Upon energization, the lower edge of armature 52 is drawn toward the shafts PS and SS, and pawl member 120 is advanced sufficiently so that the interlock at 104, 105 is broken. Then spring RSW′, by its tension, is able to force extension 102 down, whereby member 101 is restored to normal as well as the spring RSW′. As projection 105 comes clear of member 120, the latter drops down and its pawl end 103 then engages pin 125, ready to withdraw pawl 42 when armature 52 retracts. The element 111, carried by armature 52, has, above, an angularly extending finger member whose end rests just below hook 121. The energization of magnet RM′ raises said end up, which then lifts the hook to free the member 106, which then moves slightly so that its upper edge is below the horizontal surface of hook 121. Such movement is, however, not sufficient to allow restoration of the springs controlled by studs 108, 109, because a pin 112 in member 111 interlocks with a downwardly extending finger 110 of member 106, so as to

hold the latter in almost fully operated position as long as magnet RM′ remains energized. When said magnet deënergizes, armature 52 withdraws pin 112 and, by the tension of the cam surfaces of springs 79′, 163′, 82 , 102′, the studs 108—109 are moved toward plate 11 and the said springs and element 106 are restored to normal. The retraction of armature 52 further draws pawl member 120 to normal, whereby pawl 42 is withdrawn from its ratchet and pin 125 withdraws pawl 41 and the shafts and their mechanism are free to restore. The springs 100′ are in an obvious manner shifted and restored on energization and deënergization of magnet RM′, respectively.

In illustrating the invention, I have shown mounted upon the switch frame only such electromagnets as control operating parts beyond what an ordinary relay magnet controls. It is frequently employed practice to mount relays controlling local circuits of switch adjusting magnets upon the switch frame itself. Such electromagnets would, if this practice were followed, be mounted upon the back plate 11 and extend parallel with magnets PM, SM and RM, their magnet terminals and contact terminals having their connecting ends led out through to the back of plate 11. The claims, when referring to electromagnet or magnet terminals or contacts, without an especial limiting clause, are not limited in any way to elements of switch adjusting magnets.

A circuit adapted to be employed in connection with the switch structure of Figs. 1 to 7 is illustrated in the application of Alfred H. Dyson, Serial No. 389,180, filed August 19, 1907, at Q in Fig. 1, Part 1. Such a switch structure, without the use of the wiper 29, may also be used in connection with directively operated switch circuits, for example, such circuits as shown at U, V or W in Fig. 1 of said application.

When an individual circuit breaker or interrupter is employed for the primary or secondary magnet of the switch structures shown, they are preferably of the type shown in the U. S. patent to Kaisling, 874,511, dated December 24, 1907. Such an interrupter for the primary magnet may be mounted directly in front of the armature upon the frame plate 12, while that for a secondary magnet may be carried by the plate 75 upon magnet SM in like manner, as shown in said patent.

The invention may be applied in various ways and modified to a considerable extent without departing from its scope.

What I claim is:

1. An automatic telephone switch structure comprising a frame, a bank of contacts secured to said frame, a coöperating wiper, means for advancing said wiper to said contacts, means for releasing said wiper and restoring it to normal, and electromagnets for controlling said advancing and releasing means individually detachably secured to said frame and having their terminals all exposed for connection at one and the same side of the switch structure.

2. An automatic telephone switch structure comprising a frame, a bank of contacts secured to said frame and having their connecting ends exposed for connection at one side of the switch structure, a coöperating wiper, means for advancing said wiper to said contacts, means for releasing said wiper and restoring it to normal, and electromagnets for controlling said advancing and releasing means individually detachably secured to said frame and having their terminals all exposed at the same side of the switch structure as the connecting ends of said bank contacts.

3. An automatic telephone switch structure comprising a frame, bank contacts arranged in a plurality of rows, a coöperating wiper, means for advancing said wiper by a primary motion to the different rows of bank contacts, means for subsequently advancing said wiper by a secondary motion to the contacts of a selected row, means for releasing said wiper and restoring it to normal, and three electromagnets for controlling respectively said primary and secondary advancing and said releasing means, individually detachably secured to said frame and having their terminals all exposed for connection at one and the same side of the switch structure.

4. An automatic telephone switch structure comprising a frame, bank contacts arranged in a plurality of rows and having their connecting ends exposed for connection at one side of the switch structure, a cooperating wiper, means for advancing said wiper by a primary motion to the different rows of said contacts, means for advancing said wiper by a secondary motion to the contacts of a selected row, means for releasing said wiper and restoring it to normal, and three electromagnets for controlling respectively said primary and secondary advancing and said releasing means, individually detachably secured to said frame and having their terminals all exposed for connection at the same side of said frame as the connecting ends of said bank contacts.

5. An automatic telephone switch structure comprising a frame, a bank of contacts secured to said frame, a coöperating wiper, means for advancing said wiper to said contacts, means for releasing said wiper and restoring it to normal, electromagnets for controlling said advancing and releasing means individually detachably secured to said frame and having their terminals all ex-

posed for connection at one and the same side of the switch structure, a row of jacks on the same side of said structure, and conductors electrically connecting said terminals and jacks.

6. An automatic telephone switch structure comprising a frame, a bank of contacts secured to said frame and having their connecting ends exposed for connection at one side of the switch structure, a coöperating wiper, means for advancing said wiper to said contacts, means for releasing said wiper and restoring it to normal, electromagnets for controlling said advancing and releasing means individually detachably secured to said frame and having their terminals all exposed at the same side of the switch structure as the connecting ends of said bank contacts, a row of jacks on the same side of said structure, and conductors electrically connecting said terminals and jacks.

7. An automatic telephone switch structure comprising a frame, bank contacts arranged in a plurality of rows, a coöperating wiper, means for advancing said wiper by a primary motion to the different rows of bank contacts, means for subsequently advancing said wiper by a secondary motion to the contacts of a selected row, means for releasing said wiper and restoring it to normal, three electromagnets for controlling respectively said primary and secondary advancing and said releasing means, individually detachably secured to said frame and having their terminals all exposed for connection at one and the same side of the switch structure, a row of jacks on the same side of said structure, and conductors electrically connecting said terminals and jacks

8. An automatic telephone switch structure comprising a frame, bank contacts arranged in a plurality of rows and having their connecting ends exposed for connection at one side of the switch structure, a coöperating wiper, means for advancing said wiper by a primary motion to the different rows of said contacts, means for advancing said wiper by a secondary motion to the contacts of a selected row, means for releasing said wiper and restoring it to normal, three electromagnets for controlling respectively said primary and secondary advancing and said releasing means, individually detachably secured to said frame and having their terminals all exposed for connection at the same side of said frame as the connecting ends of said bank contacts, a row of jacks on the same side of said structure, and conductors electrically connecting said terminals and jacks.

9. An automatic telephone switch structure comprising a frame, a bank of contacts detachably connected with said frame, a cooperating wiper, an actuating shaft for said wiper movably mounted in said frame, and advancing and release magnets secured in said frame at substantially right angles to said shaft, said magnets constituting all the advancing and releasing magnets of said wiper.

10. An automatic telephone switch structure comprising a frame, a bank of contacts detachably connected with said frame, a cooperating wiper, an actuating shaft for said wiper movably mounted in said frame, and advancing and release magnets secured in said frame at substantially right angles to said shaft and the general direction of said contact-bank, said magnets constituting all the advancing and releasing magnets of said wiper.

11. An automatic telephone switch structure comprising a frame, a contact-bank detachably secured to said frame and having its contacts arranged in rows, a coöperating wiper movable primarily to the different rows and secondarily to the contacts in the rows, an actuating shaft for said wiper movably mounted in said frame, a primary magnet and mechanism for actuating said shaft to give said wiper its primary movement, a secondary magnet and mechanism for giving said wiper its secondary movement, a release magnet for freeing said parts, and a spring for returning the parts to normal when freed, said primary, secondary and release magnets being secured in said frame at substantially right angles to said shaft.

12. An automatic telephone switch structure comprising a frame, a contact-bank detachably secured to said frame and having its contacts arranged in rows, a coöperating wiper movable primarily to the different rows and secondarily to the contacts in the rows, an actuating shaft for said wiper movably mounted in said frame, a primary magnet and mechanism for actuating said shaft to give said wiper its primary movement, a secondary magnet and mechanism for giving said wiper its secondary movement, a release magnet for freeing said parts, and a spring for returning the parts to normal when freed, said primary, secondary and release magnets being secured in said frame at substantially right angles to said shaft and the general direction of said contact-bank.

13. An automatic telephone switch structure comprising a frame, a contact-bank detachably secured to said frame and having its contacts arranged in rows, a coöperating wiper movable primarily to the different rows and secondarily to the contacts in the rows, an actuating shaft for said wiper movably mounted in said frame, primary and secondary magnets and mechanism coöperating with said shaft to give said wiper its primary and secondary movements, a release

magnet for freeing said parts, and a spring for returning said parts to normal, said primary, secondary and release magnets being secured in said frame at substantially right angles to said shaft.

14. An automatic telephone switch structure comprising a frame, a contact-bank detachably secured to said frame and having its contacts arranged in rows, a coöperating wiper movable primarily to the different rows and secondarily to the contacts in the rows, an actuating shaft for said wiper movably mounted in said frame, primary and secondary magnets and mechanism coöperating with said shaft to give said wiper its primary and secondary movements, a release magnet for freeing said parts, and a spring for returning said parts to normal, said primary, secondary and release magnets being secured in said frame at substantially right angles to said shaft and the general direction of said contact-bank.

15. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame, a coöperating wiper, a shaft for said wiper movably mounted in said frame, ratchet teeth upon said shaft, and electrically operated pawl mechanism for engaging said teeth to advance said shaft step by step, said mechanism comprising an electromagnet, an armature extending lengthwise in said electromagnet, a pawl secured to said armature and extending at right angles thereto, stops and springs all arranged as a unitary structure detachably secured to the switch frame.

16. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame and having its contacts arranged in rows, a coöperating wiper movable primarily to the different rows and secondarily to the contacts in the rows, an actuating shaft for said wiper longitudinally movable in said frame, ratchet teeth upon said shaft, and electrically operated pawl mechanism for engaging said teeth to advance said shaft step by step, said mechanism comprising an electromagnet, armature, pawl, stops and springs all arranged as a unitary structure detachably secured to the switch frame.

17. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame, a coöperating wiper, a shaft for said wiper movably mounted in said frame, ratchet teeth upon said shaft, and electrically operated pawl mechanism for engaging said teeth to advance said shaft step by step, said mechanism comprising an electromagnet, an armature extending lengthwise in said electromagnet, a pawl secured to said armature and extending at right angles thereto, stops and springs all arranged as a unitary structure detachably secured to the switch frame with the axis of the electromagnet at right angles to said shaft.

18. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame and having its contacts arranged in rows, a coöperating wiper movable primarily to the different rows and secondarily to the contacts in the rows, an actuating shaft for said wiper longitudinally movable in said frame, ratchet teeth upon said shaft, and electrically operated pawl mechanism for engaging said teeth to advance said shaft step by step, said mechanism comprising an electromagnet, armature, pawl, stops and springs all arranged as a unitary structure detachably secured to the switch frame with the axis of the electromagnet at right angles to said shaft.

19. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame, a coöperating wiper, an actuating shaft for said wiper longitudinally movable in said frame, means for longitudinally moving said shaft to advance said wiper, means for releasing said shaft, a dash pot secured to said frame with its walls about said shaft, and a piston on said shaft positioned so as to enter said pot at the end of the return stroke of said shaft and thereby cushion its return.

20. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame and having its contacts arranged in rows, a coöperating wiper, a primary shaft for moving said wiper to different rows, a secondary shaft for moving said wiper to contacts in said rows, teeth on said primary shaft, a locking pawl for engaging said teeth to lock said shaft against movement, a lever for actuating said pawl, and a projection on said secondary shaft positioned so as to cause said lever to throw said pawl into locking position upon the first advance step of said secondary shaft and to withdraw said pawl upon the return of said secondary shaft to normal.

21. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame and having its contacts arranged in rows, a coöperating wiper, a primary shaft for moving said wiper to different rows, a secondary shaft for moving said wiper to contacts in said rows, teeth on said primary shaft, a driving pawl to engage said teeth to actuate said shaft, a locking pawl to engage said teeth to lock said shaft against movement, a lever for actuating said pawl, and a projection on said secondary shaft positioned so as to cause said lever to throw said pawl into locking position upon the first advance step of said secondary shaft and to withdraw said pawl upon the return of said secondary shaft to normal.

22. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame and having its contacts arranged in rows, a coöperating wiper, a rotatable primary shaft for moving said wiper to different rows, a longitudinally movable shaft for moving said wiper to contacts in said rows, primary magnet mechanism for rotating said primary shaft, secondary magnet mechanism for moving said shaft longitudinally, teeth on said primary shaft, a locking pawl for engaging said teeth to lock said shaft against movement, a lever for actuating said pawl, and a projection on said secondary shaft positioned so as to cause said lever to throw said pawl into locking position upon the first advance step of said secondary shaft and to withdraw said pawl upon the return of said secondary shaft to normal.

23. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame and having its contacts arranged in rows, a coöperating wiper, a primary shaft for moving said wiper to different rows, a secondary shaft for moving said wiper to contacts in said rows, primary magnet mechanism including driving and retaining pawls for actuating said primary shaft, secondary magnet mechanism including driving and retaining pawls for actuating said secondary shaft, said primary and secondary shafts lying in proximity to and substantially parallel to each other and said retaining pawls engaging each other so that when the one is moved to non-changing position the other will also be moved to its non-engaging position, a release magnet and mechanism for moving the former retaining pawl to its non-engaging position, and means for restoring said shafts to normal when said retaining pawls are in non-engaging position.

24. An automatic telephone switch structure comprising a frame having two main supporting plates connected together at substantially right angles to each other, a contact-bank secured at the line of union of said plates and lying substantially in the plane of one of them, a coöperating wiper, substantially parallel primary and secondary actuating shafts extending through the other of said plates, primary and secondary magnet mechanism including driving and retaining pawls for actuating said primary and secondary shafts respectively, said retaining pawls engaging each other so that when one is moved to non-engaging position the other will also be moved to non-engaging position, a release magnet and mechanism for moving the former retaining pawl to its non-engaging position, and means for restoring said shafts to normal when said retaining pawls are in non-engaging position.

25. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame, a hollow actuating shaft movably supported in said frame, a coöperating wiper mechanically connected to one end of said shaft and movable into engagement with the contacts in said bank, a terminal contact on said frame, and a flexible conductor extending through said hollow shaft and electrically uniting said wiper and terminal contact.

26. An automatic telephone switch structure comprising a frame, a contact-bank secured to said frame, a coöperating wiper movable into engagement with contacts in said bank, primary and secondary shafts for moving said wiper, step-by-step mechanism for rotating one of said shafts and longitudinally moving the other, means for releasing said shafts, a spiral restoring spring for said rotating shaft closely coiled about it and suitably secured at its ends, a lever pivoted to the frame and secured at one end to the longitudinally movable shaft, and a tension restoring spring for said shaft connected between said frame and said lever.

27. An automatic telephone switch structure comprising a frame, a contact bank secured to said frame and having its contacts arranged in rows, a coöperating wiper movable primarily to the different rows and secondarily to the contacts in the rows, substantially parallel rotary and longitudinally movable shafts for bringing about these movements of the wiper, a pivot uniting said wiper at an intermediate point in its length to the rotary shaft, and a guide secured to the longitudinally movable shaft and comprising parallel plates extending substantially at right angles to the latter shaft and lying on opposite sides of the non-contacting end of the wiper in all operative positions of the rotary shaft.

28. An automatic telephone switch structure comprising a frame having substantially parallel frame members, bank-contacts, a coöperating wiper, a rotary shaft for moving said wiper and lying substantially parallel to said frame members, an actuating magnet secured to one of said members and extending toward the other, a pivoted armature for said magnet having its free end lying near said other frame member, a ratchet on said shaft, a coöperating pawl pivoted to said armature, and a return spring for said armature adjustably secured to said other frame member.

29. An automatic telephone switch structure comprising a frame having a member provided with a long narrow slot, bank-contacts, a coöperating wiper, a longitudinally movable shaft for actuating said wiper lying in proximity to and in substantial parallelism with said slotted frame member, a guide pin extending from said shaft into said slot, means for advancing said shaft step by step.

ratchet teeth on said shaft, a retaining pawl pivoted adjacent to said member and extending substantially parallel thereto, and a spring for yieldingly holding said pawl in position to engage said teeth.

30. An automatic telephone switch structure comprising a frame having two plates united at right angles to each other and a slotted member at right angles to the first plate and parallel to the second plate, a contact-bank secured to said plates in line with the second plate, primary and secondary shafts extending through said first plate at right angles thereto with the secondary shaft lying adjacent to said slotted member, a wiper coöperating with the contacts in said bank and pivoted to said primary shaft and having its non-contacting end actuated by said secondary shaft, a guide pin extending from said secondary shaft into the slot of said slotted member, primary and secondary magnets secured to said second plate and extending toward said slotted member, ratchet teeth on said primary and secondary shafts, primary armature and pawl mechanism movable at right angles to said primary shaft for advancing it, a primary retaining pawl pivotally mounted upon said first plate, secondary armature and pawl mechanism movable in the direction of said secondary shaft to advance it, a secondary retaining pawl pivoted adjacent to said slotted member in a position to engage said primary retaining pawl in their movements, restoring springs for said primary and secondary shafts, a release magnet secured at one end to said second plate, and an armature for said release magnet to throw said retaining pawls to their non-engaging positions.

31. An automatic telephone switch structure comprising a contact bank, and a wiper adapted for adjustment relatively thereto, a movable shaft for adjusting said wiper, a retaining pawl for said shaft, a lever normally holding said pawl withdrawn from said shaft, a second lever and a magnet armature for actuating the same, a projection upon said second lever adapted to actuate said first lever to free said pawl, said first lever including means adapted to interlock with said second lever and hold it in actuated position, a switch contact adapted to be forced to an alternate position by said second lever and held while said interlock exists, and a release magnet armature adapted to actuate the first lever to destroy said interlock, whereby said second lever and said spring restore, said release magnet armature also controlling said first lever to withdraw said retaining pawl.

32. An automatic telephone switch structure comprising a contact bank, and a wiper adapted for adjustment relatively thereto, a movable shaft for adjusting said wiper, a retaining pawl for said shaft, a lever normally holding said pawl withdrawn from said shaft, a second lever and a magnet armature for actuating the same, a projection upon said second lever adapted to actuate said first lever to free said pawl, said first lever including means adapted to interlock with said second lever and hold it in actuated position, a switch contact adapted to be forced to an alternate position by said second lever and held while said interlock exists, and a release magnet armature adapted on attraction to actuate said first lever to destroy said interlock, said armature, when retracted, operating said first lever to withdraw said retaining pawl.

33. An automatic telephone switch structure comprising a contact bank, and a wiper adapted for adjustment relatively thereto, a movable shaft for adjusting said wiper, a retaining pawl for said ratchet, a lever normally holding said pawl withdrawn from said shaft, a second lever and a magnet armature for actuating the same, a projection upon said second lever adapted to actuate said first lever to free said pawl, said first lever including means adapted to interlock with said second lever and hold it in actuated position, a switch contact adapted to be forced to an alternate position by said second lever and held while said interlock exists, a set of switch springs mounted on the switch structure, a third lever for actuating said springs, a magnet having an armature member adapted on energization to engage said lever and on deënergization to actuate the same to shift said springs, a release magnet armature adapted to be moved in one direction to destroy said interlock to free said second lever, said armature then serving to also free said third lever from said actuating member, a device actuated by said armature when moved in said direction to interlock with said third lever to prevent its restoration when so freed, and means for thereon moving said armature in the opposite direction to actuate said first lever to withdraw said retaining pawl, said device then breaking its interlock with said third lever, whereby the latter is restored and said springs shifted to normal.

34. An automatic telephone switch structure comprising a frame, a bank of contacts detachably connected with said frame and having its contacts arranged in groups, a coöperating wiper movable in one direction to a desired group and then in a different direction to a desired contact in that group, an actuating shaft for said wiper movably mounted in said frame, and advancing and release magnets for advancing said wiper in said two directions and releasing it, said magnets being secured in said frame at substantially right angles to said shaft.

35. An automatic telephone switch structure comprising a frame, a bank of contacts detachably connected with said frame and having its contacts arranged in groups, a coöperating wiper movable in one direction to a desired group and then in a different direction to a desired contact in that group, an actuating shaft for said wiper movably mounted in said frame, and advancing and release magnets for advancing said wiper in said two directions and releasing it, said magnets being secured in said frame at substantially right angles to said shaft and the general direction of said contact bank.

In witness whereof, I hereunto subscribe my name this 15th day of February, 1909.

WILLIAM KAISLING.

Witnesses:

JAMES G. KELLOGG,

CAROLYN WEBER.