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J. SAVIN ET AL

1,796,402

SWITCH FOR TELEPHONE SYSTEMS

Original Filed Oct. 18, 1926 2 Sheets-Sheet 1

Fig. 1.

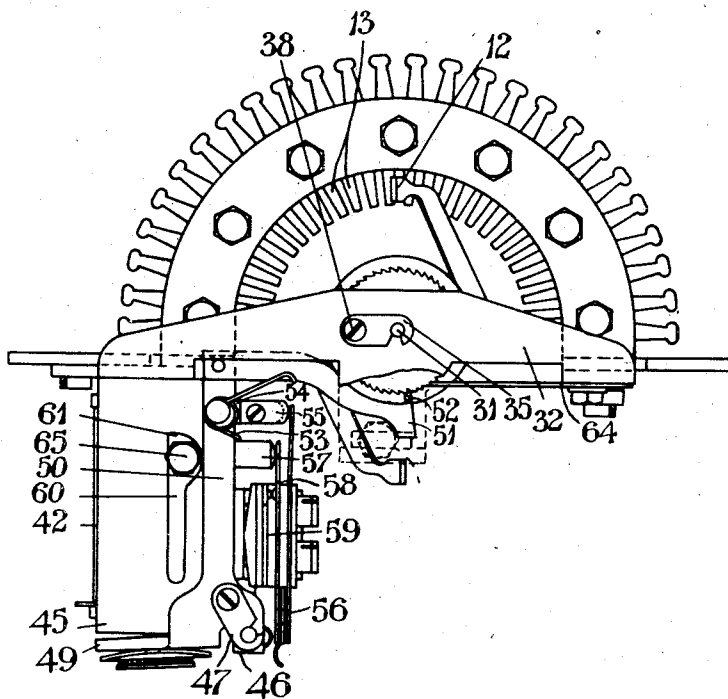
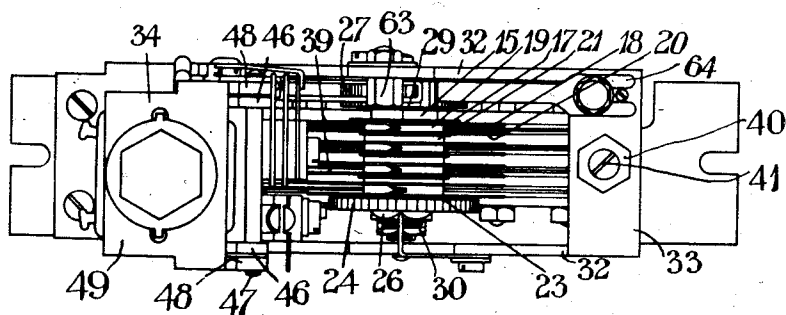


Fig. 2.



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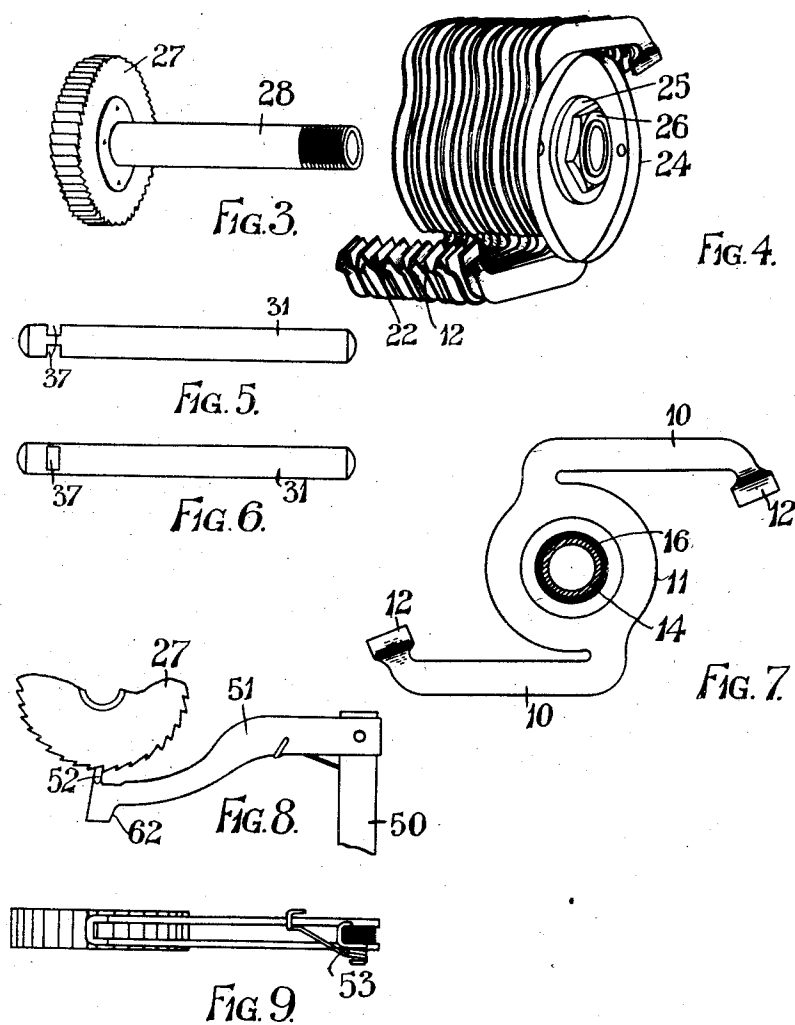
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SWITCH FOR TELEPHONE SYSTEMS

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The present invention relates to improvements in or relating to switches as used in automatic telephone systems and while more particularly the invention is concerned with improvements in a particular type of switch, it should be understood that the various features of the invention where applicable can apply to other types of switch than that mentioned. In British Patent No. 179,157 a type of switch is described and illustrated in which the wipers move in a continuously forwards direction in a single plane under the control of a stepping magnet. A switch of similar type but somewhat different construction is described in British Patent No. 131,716. Usually such switches are provided individual to each subscriber's line and are adapted to operate automatically to select an idle first selector switch when a subscriber lifts his receiver. When utilized in such positions the switches are not used very extensively even on the busiest lines, the motion taking place only at the commencement of a call, particularly if the wipers rest on the contacts last used, if the wipers return to normal the switch makes half a revolution for every call. This switch however is also capable of, and is often used in other cases where it may be in almost continuous rotation; for instance where it is used for controlling the transmission of impulses in a register sender, or in an operator's impulse sender. In such cases in order to avoid excessive replacement it is necessary to design the switch specially, and the object of the present invention is to improve switches of this character so that they will have a much longer "life" than hitherto.

The principal features of the invention consist in the special design of the wipers, provision of a readily replaceable wiper-unit including a ratchet wheel, special hardened steel shoes also replaceable at points of excessive wear, a special construction of pawl from single steel pressing with a hexagonal back stop and the utilization of a specially selected material for the parts found to wear most excessively.

The invention will be better understood by referring to the accompanying drawings and description of one form of carrying the inven-

tion into effect which relates more particularly to a switch having the general features of construction described in British Patent No. 179,157 previously referred to.

In the drawings Fig. 1 shows a side view of the switch and Fig. 2 shows a front view. Figs. 3 and 4 show in perspective view the ratchet wheel on which it is fitted and the wiper assembly unit. Figs. 5 and 6 show the plan and elevation of the wiper shaft. Fig. 7 shows a cross section of the wiper assembly illustrating clearly the shape of the wipers and the arrangement of assembling them on the unit. Figs. 8 and 9 show the construction of the new pawl in plan and elevation.

Referring to Fig. 7 of the drawings it will be noted that the wipers are specially shaped; the object of this shape is to increase the resiliency of the wipers and for that purpose the arms 10 connecting the central part of the wiper 11 to the parts 12 which actually engage with contacts 13 as shown in Fig. 1 are of longer length than the radial distance between the central part 11 and the parts 12. In prior constructions part 10 was usually equal to the radial distance between the centre of the part 12 and the outside of the central part 11. These wipers are formed from a single stamping as previously, except that the shape of the wiper arm is modified. Preferably this shape is in the form shown in the drawing by which the part 12 trails behind the part 10, while the part 10 is in substantially a straight line almost tangential to the circular part 11. The shape of the parts 12 is clearly seen from Fig. 4, the wipers being mounted in pairs and meeting so as to form a V at their points of contact as shown for all the wiper pairs, except the pair at the extreme right is slightly different, the shoes of this pair of wipers meeting on a plane as is also clearly shown in Fig. 4. These wipers are assembled in a single unit as shown in Fig. 4. This unit comprises a metal tube 14 having a fixed hexagonal head 15 (Fig. 2) at one end and threaded at the other end. Fitting over the tube 14 is a tube 16 of insulating material, such as phenol fibre; then there are successively fitted over the tube 16 an insulating washer 17 also of

phenol fibre which abuts against the hexagonal head 15, a wiper 18 (Fig. 2) a metal washer 19, and a second wiper 20; the wipers 18 and 20 are identical in construction, the only difference being that the part which engages the contacts is deflected in opposite directions in the two wipers so that they meet in the form of a V as shown in Figs. 4 and 2. Abutting against the wiper 20 is a metal washer 21, after this comes a piece of insulation 22 which is only shown in Fig. 4. This piece of insulation is exactly the same shape as the wipers, except that it is not deflected at the ends and serves to prevent neighboring wipers coming into contact in case of vibration being set up when the wipers come on and off their contacts. It might be mentioned that in Fig. 4 six pairs of wipers are shown, while in Fig. 2 only four pairs of wipers are shown. This simply illustrates that the number of wipers can be varied at will as will be readily appreciated from the construction of the wiper assembly provided that sufficient space is left on the wiper shaft and on the tubes 14 and 16.

The insulation piece is then followed by another wiper, another metal washer, the complementary wiper of the previous one so as to form a pair and so on as before right up to the last wiper and after which there is another insulating washer 23, Fig. 2, and a number disc 24. This is followed by a metal washer 25 and the whole being secured in position by a nut 26 threaded on to the end of the tube 14. It might be mentioned that the number disc consists of a stamping having a cylindrical edge graduated as shown in Fig. 2, the graduation serving to show the particular contacts in the bank which the wipers are engaging. In order to ensure that the wipers will not rotate relatively to one another, holes are punched in the head 15 of the tube 14, so as to cause the metal to project so that when the nut 26 is tightened up the projecting points penetrate the phenol fibre washer 17, and the compression thereupon exerted if the nut is properly tightened up effectively prevents the relative rotation of the wipers. This unit which is shown in Fig. 4 forms a complete wiper assembly unit which can be readily replaced. The wipers are constructed of a nickel silver alloy of a temper sufficiently hard to cause a minimum amount of wear on the bank contacts, the bank contacts being also constructed of nickel silver alloy, but harder temper is used so that, as the wipers are more easily replaceable than the banks, it is ensured that the replaceable element will be the one which will be first worn. The ratchet wheel 27 is shown in Fig. 3, and has welded into it a tube 28 at the far end. The tube 28 is of a diameter such that it will just fit into the hole of the tube 14. A disc of phenol fibre 29 separates the ratchet wheel 27 from the

head 15 of the tube 14. The ratchet wheel and the head of the nut are indented by a sharp tool so that they both when forced together penetrate into the phenol fibre washer 29 which separates them. A nut 30 is provided for securing the ratchet wheel in position in the wiper assembly thereby forming another replaceable unit. The unit is supported on a shaft 31 of a diameter which just fits inside the tube 28, so that the wiper unit with the ratchet wheel can rotate freely about the shaft. The shaft passes through the holes in each side of the frame 32; this frame is a stamping having connecting bridges 33 and 34 and two parallel side pieces to which the reference 32 is fixed in Fig. 2 of the drawing. The shaft is held in position by a link 35 having a slot adapted to engage with the grooves 37 of the shaft 31. These grooves are shown more clearly in Figs. 5 and 6. This link turns about a screw 38 which acts as a pivot and serves to secure the link in position. It will be at once apparent from the construction that by turning the link the shaft can be removed from the bearings in the frame 32 and when the whole of the wiper assembly including the ratchet wheel can be removed while the wiper assembly and the ratchet wheel can be detached separately so that either part or both parts can be replaced as desired. The wiper contact springs, that is the springs which connect the circuits to the central parts of the rotating wipers are indicated in Fig. 2 by the reference 39. This is not very clear, but it will be sufficient to indicate that they come between the wipers 18 and 20 respectively and are fixed in the contact bank in the same way as the bank contacts but in a special position. Like the bank contacts they consist of stampings and having their ends curled in opposite directions so as to engage the central part of each wiper. These contact springs are also constructed of nickel silver. The switch banks are generally similar in design to those employed in previous constructions, and will not be therefore described further, except to say that the contact bank is secured to the frame at both the bridge pieces 33 and 34, one side of the contact bank is adjustable by means of the nut 40 and screw 41. The electromagnet 42 is supported on the bridge piece 34 and is provided with a U shaped yoke 45, which has extensions 46 through a hole in which a shaft 47 similar in general design to the wiper shaft 31 passes so that it can be secured in position and removed at will by operating a link member 47, which is similar to the link 35. This shaft in addition to sliding through the holes in the extensions 46 passes through extensions 48 of the armature 49. It will thus be appreciated that the armature can be removed as readily as the wiper assembly. The arm 50 which forms an extension of the armature 49 is fitted at its end with a specially shaped pawl 51 shown

in detail in Figs. 8 and 9. From these figures it will be noted that the pawl 51 is formed of a single stamping which is U shaped in plan but is curved in elevation following the curvature of the ratchet wheel, the part for engaging the ratchet wheel is suitably shaped as shown at 52 and forms an extension of the bridge of the two limbs of the U.

It will be noted that the two limbs of the U pass on each side of the extension 50 and rotate about a pivot secured therein. A spring 53 serves to normally press the pawl towards the ratchet teeth. It will be noted that by this construction a central plane in Fig. 9 passes equally through the part 50 and the centre of the ratchet wheel, while the limbs are directly parallel to this line, so that it may be said that the armature and pawl are in a direct line of action. This in contradistinction to constructions where the pawl is offset from the plane of either the ratchet wheel or the extension piece of the armature is a much more satisfactory construction and operates much more efficiently giving a longer life and more reliable action. The part 52 is hardened to reduce wear. On the extension 50 of the armature and integral therewith is a projection 54 carrying a hardened steel shoe 55 for engaging with the steel spring 56 which effects the return motion of the armature and pawl and incidentally, as in this construction of switch the wipers advance on the release of the electromagnet, steps the wipers. A considerable amount of wear is liable to take place at the junction between the parts 55 and 56 and for this purpose part 55 is made detachable so that it can be readily replaced. The second projection is also provided on the part 50 on which is fitted a bush 57 of insulating material, phenol fibre, ebonite or the like, which engages with the interrupter spring 58 to open the magnet circuit by separating the spring 58 from the spring 59 and thereby interrupting the circuit of the electromagnet to permit it to de-energize. The lever 60 is provided with a cam shaped head 61 for the purpose of adjusting the stroke of the pawl and armature. It should be mentioned that the pawl 51 is provided at the end which engages with the ratchet wheel but on the opposite side with a face 62 which is adapted to rest normally against a hexagon headed nut 63 so that the engaging surfaces are sufficiently extensive to ensure that no considerable wear will take place at this point. Springs 54, 56 are constructed of steel, while the ratchet wheel is made of hard Tobin bronze capable of withstanding hard and constant wear. It will be noted that the pawl as designed in addition to being strong and reliable is also light in weight. The action of the ratchet wheel 27, the pawl 51 and the detent spring 64, is designed to give positive and accurate registration of the wipers as they step along the

bank contacts and to operate together with as little absorption of energy as possible, the major portion of the energy of the restoring spring 56 then being available for overcoming the inertia of the wipers and the stepping of one contact to the next. Although there is no restoring spring as the wipers move continuously forward, yet the provision of a detent spring is necessary in order to ensure the correct positioning of the wipers. This detent spring 64 can be seen in Figs. 1 and 2 being provided with a forked end by which its position may be adjusted. This spring is formed of hard nickel sliver and simply consists of a plain stamping with a slight rounding off of the end which engages the teeth, so as to leave an approximately square end for entering between the teeth, and a rounded off end to prevent any rubbing friction against the radial sides of the teeth, as will be obvious to those versed in the art.

By describing briefly the operation of the device note will be made of the particular points on which stress is laid in the present invention with a view to overcoming the wear of the various parts. When the electromagnet is excited it attracts the armature 49 which thereupon turns about the armature shaft and forces back spring 56 by the shoe 55 and forces the pawl 51 forwards, so that the part 52 can engage the next tooth, the spring 54 ensuring this, while the projection 57 forces the spring 58 from engagement with the spring 59. It will be noted that of the parts mentioned the armature shaft, the shoe 55, and the spring 54 are all readily replaceable, while no difficulty would be encountered in replacing any of the springs 56, 57 and 58, which are secured in position by suitable screws and insulations in a manner well known in the art. Again the ratchet wheel is readily replaceable. When the electromagnet de-energizes, whether due to the springs 58 or 59 opening or due to some other part of the magnet circuit being open, the spring 56 forces back the armature and the pawl 51 which thereupon causes the ratchet wheel and the wipers thereon to advance one step, the wipers are liable to wear as they rub over contacts 13 and therefore are constructed in a separate replaceable unit. The detent spring 64 is raised and falls into position behind the next tooth as the ratchet wheel moves round and this is also readily replaceable and adjustable with wear, the lever 60 serves to adjust the armature so as to allow for wear either at its pivot or at the tooth 52 as well as to secure it initially in the best position, the nut 65 being provided for securing the lever 60 in the position to which it is set. Bearing in mind that this operation takes place in any thing up to 80 times per second, when the switch is in operation, and that the switch may be required to make over 1,000,000 steps in a period of six to twelve months, it will be

clear that the arrangements provided by the invention enable this switch to last very much longer than would be possible in prior constructions where the replaceability of wearing parts was not made possible in such a satisfactory manner as in the present case. Also it would be appreciated that as materials have been specially selected by numbers of experiments the present invention is designed to give a much longer life to the switch before any replacement whatever is necessary than has hitherto been possible, particularly where switches are manufactured as they must be in large quantities.

15 What we claim as new and desire to secure by Letters Patent is:—

1. A wiper assembly for use in automatic telephone switches having rotatable wipers comprising a tube on which the wipers are fitted as a separate and distinct unit, a second tube fitting inside said first tube to which a ratchet wheel is secured, said second tube and ratchet wheel being detachably secured to the wiper unit so as to make another larger unit which is readily removed and replaced in the switch.

2. A wiper assembly as claimed in claim 1 in which a non-rotatable readily removable shaft is provided as a support permitting the wipers to rotate freely, the shaft being supported in fixed bearings and secured in position by a link device engaging a slot or slots near one end.

3. A switch for use in automatic telephone systems having rotatable wipers in which the pawl for operating the ratchet wheel is constructed from a single piece of sheet metal bent in the shape of a U with one edge of the base of the U hardened and suitably shaped to engage with the teeth of the ratchet wheel, and forming a continuation of a radial line extending from the center of the ratchet wheel.

4. In an automatic switch for use in telephone systems, a set of bank contacts arranged concentric to a hub, a set of wipers integrally formed on said hub and adapted to rotate over said bank contacts, said wipers having arms arranged in a plane parallel to said bank contacts and extending from each side of said hub towards said bank contacts in a direction tangent to said hub, and a portion of each arm engaging said contacts bent at an angle from said arm but in the same plane and arranged in a radial line with each other and said hub.

5. In an automatic switch for telephone systems, a set of bank contacts, a set of wipers concentric to said contacts and adapted to rotate over them, an enlarged circular central portion of said wipers mounted on a hub, and a pair of arms on each wiper extending from each side of said circular portion in a direction tangent thereto, the ends of said arms being bent to conform to the shape of said contacts

and the whole forming an approximate S-shaped structure.

6. In an automatic switch for telephone systems, a set of bank contacts, a set of wipers arranged concentric to said bank contacts and in the same plane thereof, a circular central portion on said wipers, two arms extending tangentially from said circular portion towards said contacts, contact making portions on the ends of said arms bent at an angle but in the same plane therefrom to conform to the shape of said contacts, said arms being greater in length than the radial distance between said contact making portion and the center of said circular portion of the wipers.

7. In an automatic switch for telephone systems, a set of bank contacts, a set of wipers adapted to rotate over said contacts in a forward direction, a circular central portion of said wipers mounted on an insulated axis, wiper arms on said circular portion extending on opposite sides and in opposite directions and tangent thereto, contact making portions on the ends of said arms bent at an angle therefrom to conform to the shape of said bank contacts and in a plane parallel thereto, the length of said wiper arms being greater than the radial distance from the bank contacts to the edge of said circular portion of the wipers.

8. In an automatic switch for telephone systems, a set of bank contacts, a set of wipers having access to said contacts, a motor magnet having an armature adapted to operate a pawl and ratchet wheel to rotate said wipers over said bank contacts, said pawl comprising a single U-shaped sheet of metal having the two open ends pivoted to the end of said armature and one edge of the base of the U flattened out and lying in a plane parallel to the radius of the ratchet wheel to engage with the teeth of said ratchet wheel.

9. In an automatic switch for telephone systems having rotatable wipers in which the pawl for operating the ratchet wheel comprises a U-shaped member in which an extension of the base of the U forms a pawl, and in which the free ends of the member extend separately from the pawl to the point at which they are pivoted.

10. In a pawl and ratchet mechanism a U-shaped member having a pawl formed at the base of the U to engage with the teeth of the ratchet wheel and pivot points on said member comprising extensions of the arc forming the U.

In testimony whereof we have signed our names at Liverpool, England, this 30th day of September, 1926.

JOHN SAVIN.

ROBERT EDWARD BOYD.