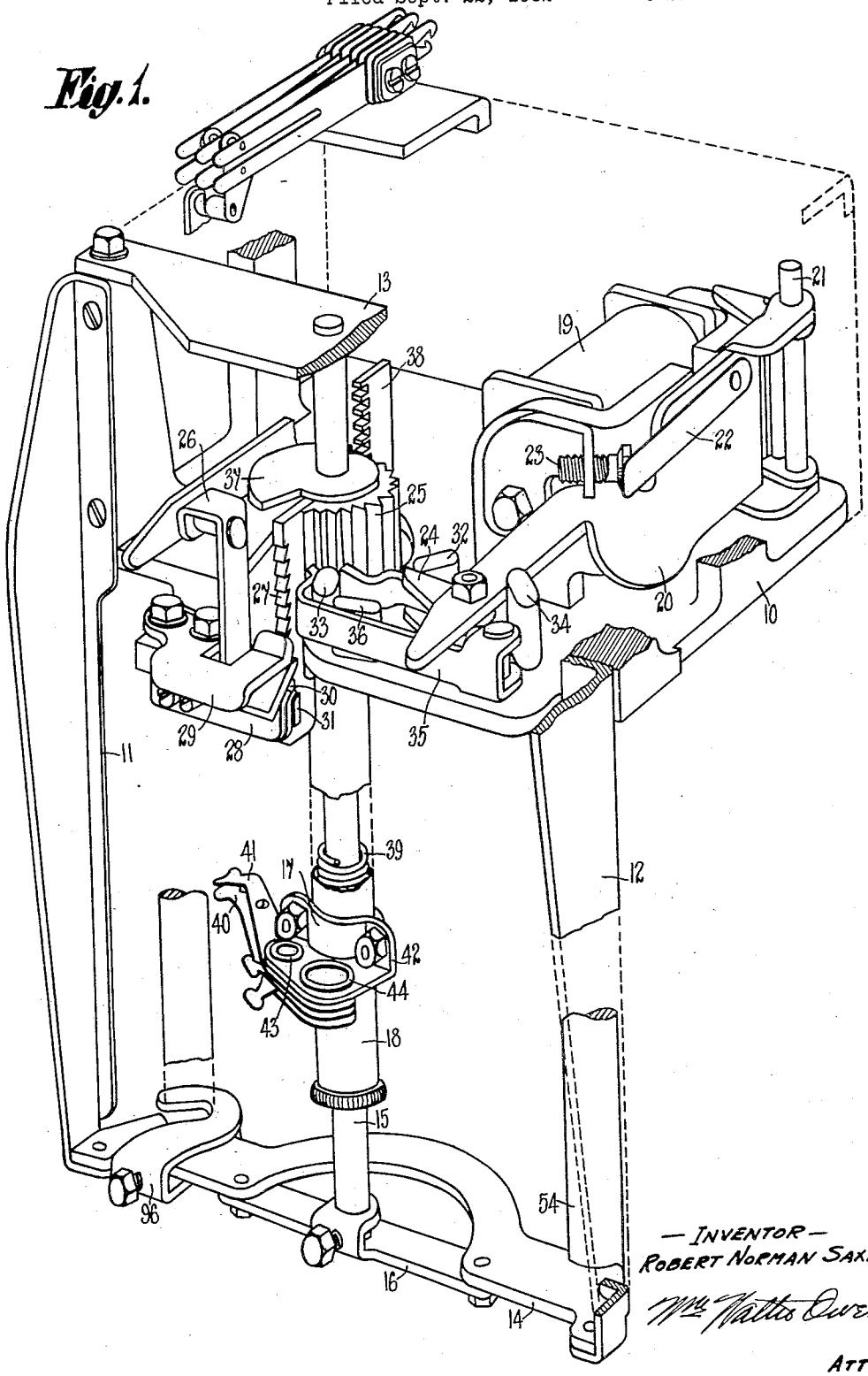
Jan. 21, 1936. R. N. SAXBY 2,028,689

AUTOMATIC SWITCH FOR USE IN TELEPHONE OR LIKE SYSTEMS

Filed Sept. 22, 1932 6 Sheets-Sheet 1

Fig. 1.



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AUTOMATIC SWITCH FOR USE IN TELEPHONE OR LIKE SYSTEMS

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Fig. 2.

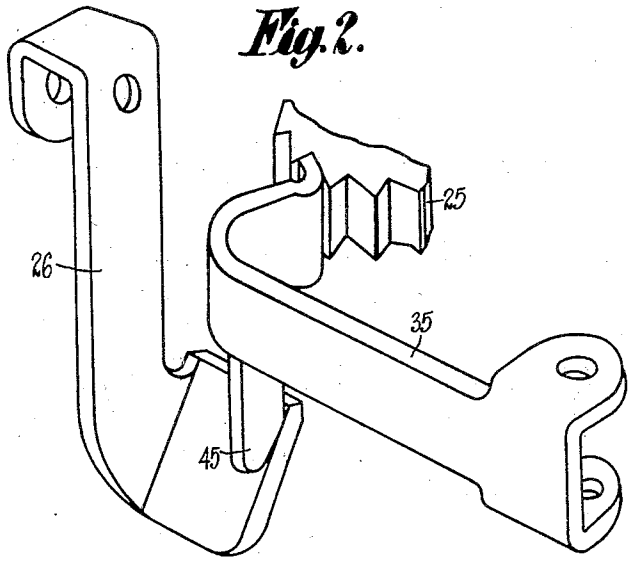


Fig. 3.

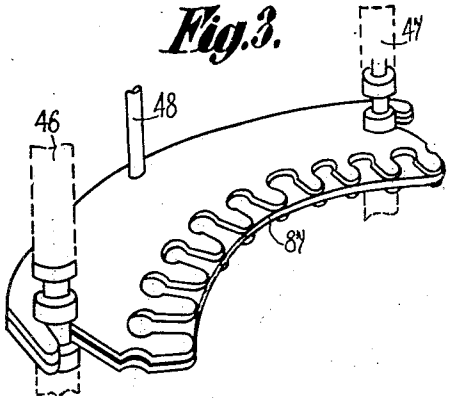
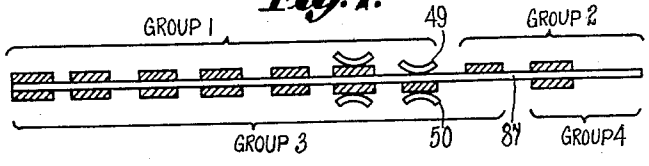


Fig. 4.



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AUTOMATIC SWITCH FOR USE IN TELEPHONE OR LIKE SYSTEMS

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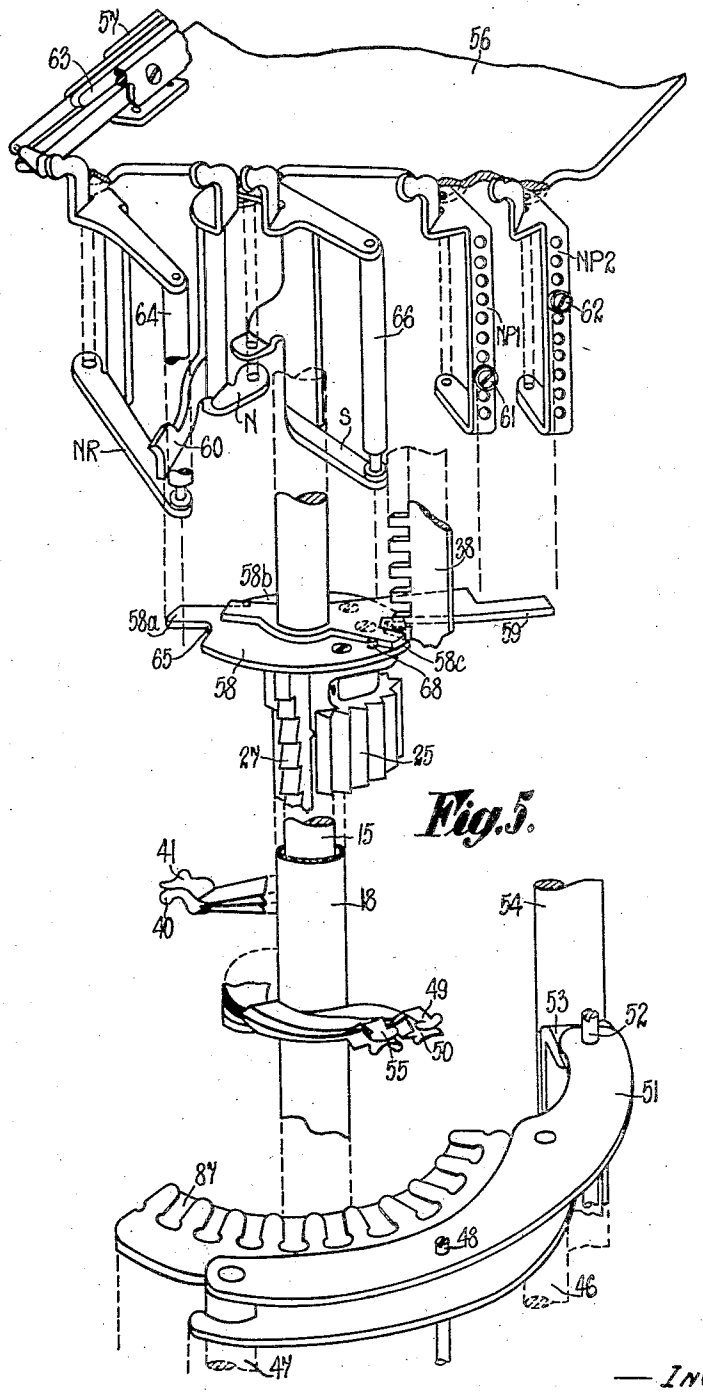


Fig. 5.

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AUTOMATIC SWITCH FOR USE IN TELEPHONE OR LIKE SYSTEMS

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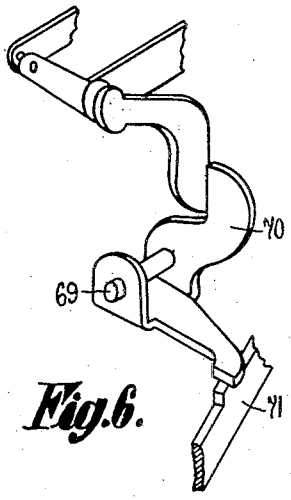


Fig. 6.

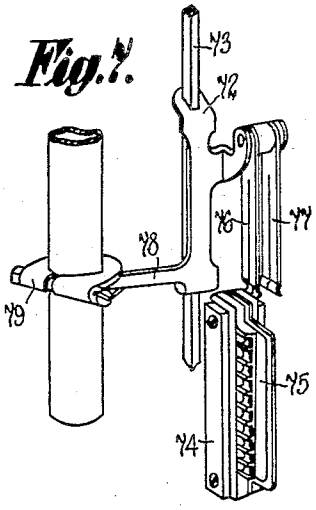
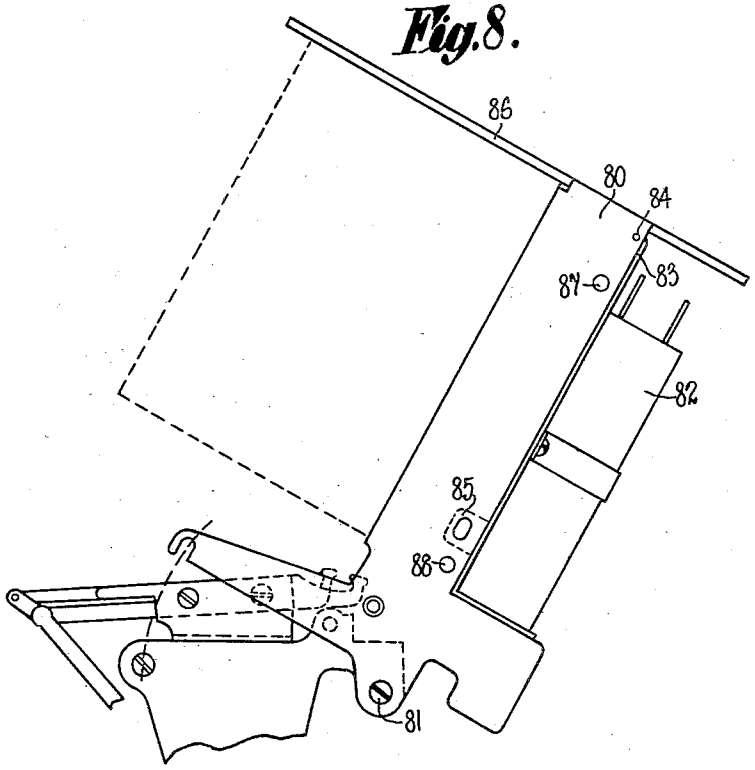


Fig. 7.

Fig. 8.



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AUTOMATIC SWITCH FOR USE IN TELEPHONE OR LIKE SYSTEMS

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Fig. 9.

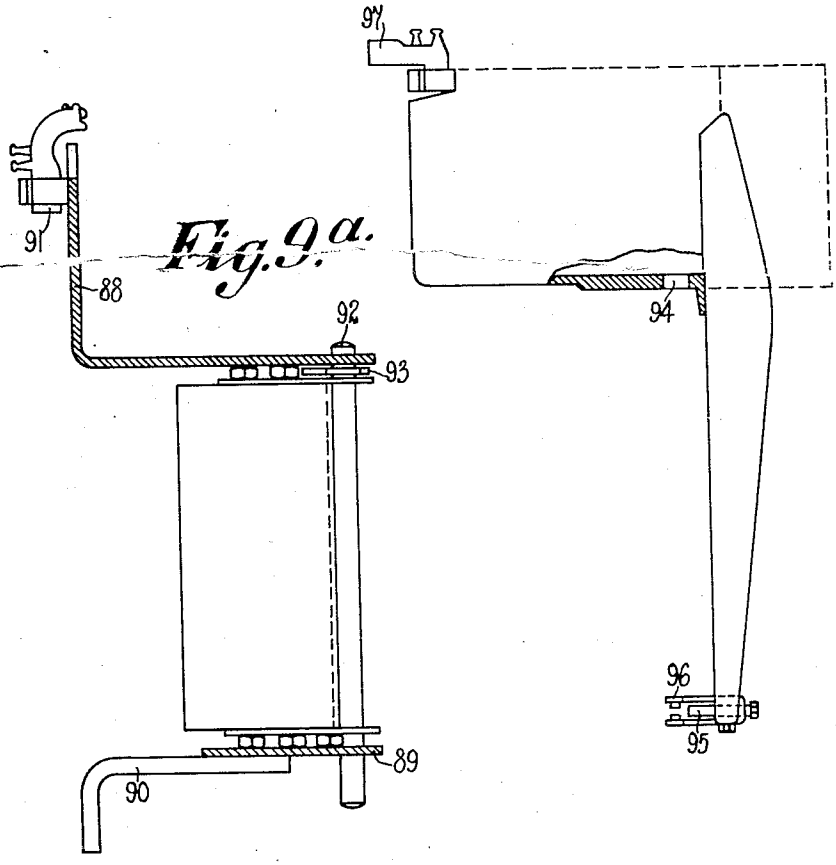


Fig. 9a.

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AUTOMATIC SWITCH FOR USE IN TELEPHONE OR LIKE SYSTEMS

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Fig. 10.

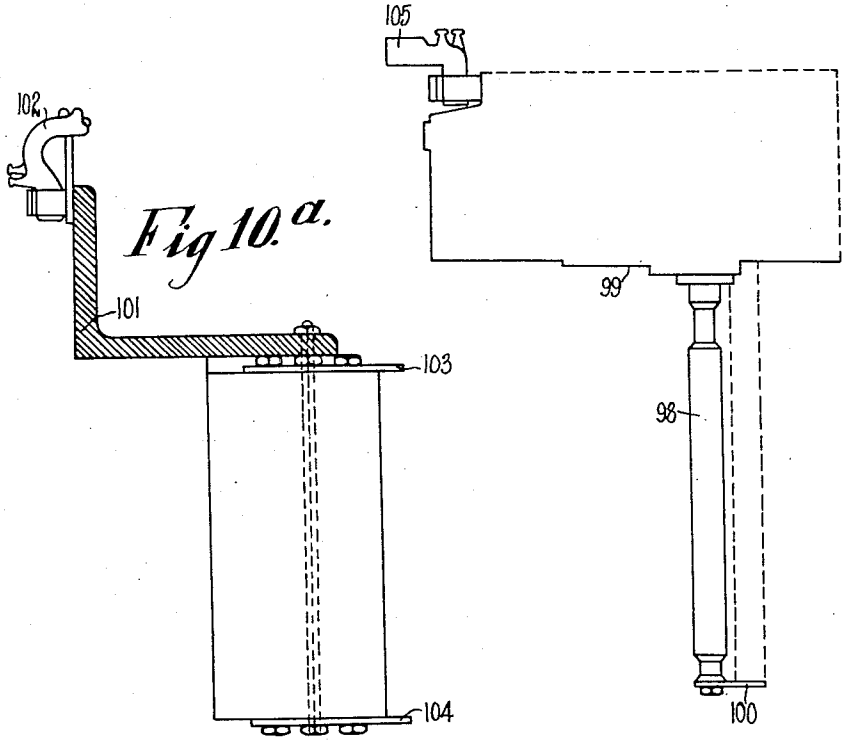
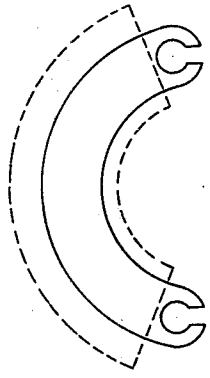


Fig 10.a.

Fig. 11.



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Patented Jan. 21, 1936

2,028,689

UNITED STATES PATENT OFFICE

2,028,689

AUTOMATIC SWITCH FOR USE IN TELEPHONE OR LIKE SYSTEMS

Robert Norman Saxby, Liverpool, England, assignor to Associated Telephone and Telegraph Company, Chicago, Ill., a corporation of Delaware

Application September 22, 1932, Serial No. 634,265
In Great Britain October 14, 1931

11 Claims. (Cl. 179—27.52)

The present invention relates to improvements in automatic switches of the type used in telephone or like systems and is more particularly concerned with switches of the two-directional type arranged to have longitudinal and rotary movement. Such switches as already extensively used in the telephone art are generally mounted with the wiper shaft vertical and have the operating mechanism above the contact banks and the controlling relays above the operating mechanism. Since in a large telephone exchange the number of such switches may run into thousands, the problem of mounting space becomes of considerable importance, and it is desirable that the switches should be arranged to occupy as little space as possible consistent with proper access for maintenance and adjustment. The chief object of the invention is to provide a more compact construction while at the same time reducing the number of component parts and simplifying assembly.

It has already been suggested to reduce the height of such switches by mounting the operating mechanism and controlling relays within the vertical dimension of the banks but this arrangement has certain disadvantages in that switches for different purposes may require different numbers of wipers and corresponding banks and consequently if the mechanism is accommodated within the limits of the minimum bank requirements, when additional banks are needed there will be a certain wastage of space in view of the fact that the increase in the height of the switch applies also to the portion in which the mechanism is accommodated, which space is wasted. Accordingly, the present invention aims at reducing the longitudinal dimension of the complete switch while still keeping the maximum dimensions of the switch in a plane transverse to the switch shaft substantially equal to the dimensions of the banks and wipers.

According to one feature of the invention in an automatic switch of the two-directional type arranged for longitudinal and rotary motion the driving magnets are mounted adjacent one end of the bank with their axes in the same plane transverse to the wiper shaft while the operating mechanism is arranged in close proximity to this plane so as to reduce the longitudinal dimension of the switch without increasing the lateral dimension.

According to another feature of the invention, the contact sets usually provided which are operated by the mechanical movement of the switch such as off-normal and cam springs lie in a plane transverse to the wiper shaft on the other side of the mechanism from the bank.

A further feature of the invention is the arrangement whereby the magnet for producing longitudinal motion effects a release operation if it is again operated after the switch has been rotated.

Still another feature of the invention relates to a mounting arrangement according to which the switch banks are permanently secured to the supporting shelf and arrangements are provided for securing a switch mechanism to the bank together with means for ensuring the accurate centering of the wipers relatively to the bank.

The invention will be better understood from the following description of one method of carrying it into effect which should be taken in conjunction with the accompanying drawings comprising Figs. 1 to 11.

Fig. 1 is a perspective view of the operating mechanism of a switch constructed in accordance with the principles of the invention; Fig. 2 shows the manner in which the vertical magnet may bring about the rotary release of the wipers; Figs. 3 and 4 show constructional details of a P. B. X. bank arc built up of pressed metal plates; Fig. 5 shows the method whereby all mechanically operated springs are actuated through levers which engage with cam plates secured to the wiper carriage; this figure also shows the P. B. X. bank arc mounted in position in the form of a gate which may be hinged away from the switch to give access to the main banks and wipers. Fig. 6 shows the operation of the vertical magnet interrupter springs through the medium of a bell crank lever; Fig. 7 shows a double vertical bank, and associated wiper blades fastened to an auxiliary wiper carriage which is operated from a collar clamped to the main wiper carriage; Fig. 8 shows the manner in which the relay mounting plate is hinged to the rear of the cast frame member; Figs. 9 and 9*a* show one method of securing the contact banks and switch mechanism to the shelf particularly suitable for the construction shown in Fig. 1; Figs. 10 and 10*a* show another method of mounting the contact banks and switch mechanism on the shelf which is somewhat simpler than the previous arrangement, and enables certain components of the switch frame to be dispensed with, with the result that the mechanism is rendered more accessible; while Fig. 11 shows the shape of the bank plates if this method of mounting is used.

As may be seen from Fig. 1 the switch com-

prises an upper die-cast frame member 10 from the front of which are supported two vertical angle members 11 and 12 running parallel to each other and bridged at the top and bottom by metal plates 13 and 14 between which the switch shaft 15 is supported. In the construction shown the shaft is rigidly secured between the bridge pieces, that is to say, the upper end is accommodated in a hole in the bridge piece 13 while the lower end passes through and is clamped to an auxiliary bridge piece 16 which in turn is fastened across the curved portion of the main bridge piece 14. The object of this arrangement is to enable the shaft and wiper carriage it supports to be readily removable from the switch, and as will be appreciated from the drawing this is effected by uncoupling the auxiliary bridge piece 16 so that the shaft and carriage may then be withdrawn downwards away from the switch.

The wipers of which only one set are shown designated 17 are secured to the tubular carriage member 18 which is adapted to slide and rotate on the fixed shaft and also carries at its upper end the vertical and rotary ratchet members. Movement is imparted to the tubular carriage member 18 by means of magnet assemblies of substantially identical construction which are mounted side by side on the die-cast frame 10, and in view of the different movements they are to produce one of the magnet assemblies is turned through an angle of approximately 90° and equipped with a different shaped pawl. In the drawings one magnet assembly only has been shown, that designated 19, which is located on the right-hand side of the cast frame member and is intended to produce rotary movement of the tubular carriage. As is the general practice the magnet assembly comprises a coil across the pole-pieces of which is suspended an armature 20 rotatable about the pivot 21, and arranged to be attracted against the pressure of the flat spring 22, the tension of which is adjustable by means of the screw 23. To the extended arm of the armature is pivoted a pawl 24 adapted to co-operate with the rotary ratchet member 25 fastened to the tubular carriage. In respect of the other magnet assembly which is of substantially identical construction, only the operating pawl 26 is shown and this is pivoted to the extended arm of the armature and co-operates with the vertical ratchet member 27.

Considering now the detailed mechanical operations involved, when the vertical magnet is energized the spring-loaded pawl 26 runs up the lower guide member 28 so as to engage with the vertical ratchet member 27 which is lifted until the pawl becomes locked against the upper pawl stop 29, in which position the tubular carriage and wipers will have been raised to the first level. During vertical stepping the carriage is retained in its operated position by means of a flat spring detent 30 shown below the operating pawl and lying between the lower pawl stop and another stop member 31 which limits the extent of its inward movement.

Rotary motion of the carriage is effected from the other magnet provided with a different shaped pawl 24, the movement of which is guided between the adjusting bollards 32 and 33 each capable of an eccentric movement on its fixing pillar which extends into the cast frame member. The stroke of the rotary magnet armature is regulated by a further adjusting bollard 34 which determines the resting position. At each rotary step the carriage is held in its operated position by means of a detent member 35, shaped as shown, which is spring loaded so as to engage with the ratchet teeth and adjustable as regards its resting position by means of the regulating bollard 36. On the first rotary step a semi-circular plate 37 fixed immediately above the ratchet members on the tubular carriage is arranged to enter a tooth on the comb member 38 fastened to the frame, in order that the carriage and wipers may be supported when the vertical ratchet member rides out of engagement with the holding detent 30.

Restoration of the carriage and wipers is effected in both directions of motion by a single helical spring 39 which encircles the fixed shaft and is contained in the tubular wiper carriage. The spring is secured at one end to the shaft and at the other end to the wiper carriage, so that during the setting operation of the switch it is both compressed and twisted, or alternatively stretched and twisted, depending upon the manner in which it is secured, in order to store up the energy necessary for the restoring movement in both directions.

Conveniently the wipers perform a so-called rectangular movement that is to say, when the switch is to be restored, the circuit is arranged so that the wipers continue their rotation into an extreme position out of engagement with the banks, whereupon the semi-circular plate 37 will leave the comb member 38 and the tubular carriage is then restored by spring 39 to its normal position as regards the vertical movement. In this position the rotary ratchet 25 is lowered clear of the rotary retaining detent 35, and the wipers are then rotated to the normal position below the banks where the vertical ratchet member 27 re-engages with its holding detent 30 and also comes up against a fixed stop (not shown in the drawings) which is secured to the underside of the cast frame member.

The wipers are of a particularly light construction arranged for clamping to the tubular carriage in the manner shown in the drawings, and comprise essentially two flexible metal blades 40 and 41 of the shape shown, which are insulated from each other and the supporting bracket 42 by strips of insulating material and held together by means of soft metal eyelets 43 and 44 the latter of which constitutes a cord hole.

In the case of P. B. X. working where large groups of lines are involved, it is ofen desirable for the wipers to be restored in a rotary direction only in order that they may be raised into engagement with the next level and in the absence of a release magnet particularly designed for this purpose, the mechanism may readily be so arranged that the re-energization of the vertical magnet at this time will bring about the rotary release of the wipers.

The manner in which this may be effected is clearly shown in the detached view, Fig. 2, from which it will be seen that the rotary holding detent 35 is provided with a wedge-shaped extension 45 which lies in the operating path of the vertical pawl 26, and accordingly when the latter is operated it runs up the inclined face of the extension 45 and causes the rotary holding detent 35 to be lifted clear of the rotary ratchet member 25. With this construction the rotary holding detent will be lifted clear of the ratchet teeth during each vertical step but this will not upset the operation of the switch since the detent is without function during this period.

In the case of P. B. X. working where a number

of small groups are involved comprising for example 10 lines or less in each group, the switch will preferably be provided with what is known as a P. B. X. bank arc on which the required grouping is determined. Hitherto such a P. B. X. bank arc has generally been constructed as a substantially semi-circular metal plate carrying rows of screws which serve as the contact points, and are wiped over by one or more auxiliary wipers carried on the switch shaft, the plate itself being connected to earth and the last line in each particular P. B. X. group being marked by the removal of the relevant screw. This construction however is somewhat expensive owing to the necessity of tapping 100 holes and fitting the required screws. In the present construction it is proposed that the bank arc shall be built up of stamped metal plates carrying projecting contacts such as shown in the detached view in Fig. 3, the pairs of plates constituting a single level being separated from each other by an insulating strip **87** of substantially the same shape but without the indentations formed by the projections. The respective pairs of plates comprising the complete bank are assembled between collars turned on the pillars **46** and **47**, and are locked in position by a skewer pin **48** which passes through all the plates. The marking of the last pin in each P. B. X. group is effected by breaking off the particular contact concerned and for this purpose the contacts are suitably reduced in cross section at the point where they join the plate to enable its operation to be carried out in a simple manner.

Although it might appear that this arrangement does not offer the same flexibility as the screwed pin arrangement since when once a contact is broken off it cannot be replaced, it should be explained that the apparent disadvantage is more than offset by the cheapness of the plates, and the ease by which they may be removed and replaced by another set. Removal of a particular pair of plates may be made by withdrawing the skewer pin **48**, after which the plates concerned are slipped out of engagement with the supporting collars without upsetting the arrangement of the other plates in the bank. With this arrangement it will be evident that re-distribution of the P. B. X. groups when desired may be carried out in a simple manner. All plates are electrically connected together through the mounting pillars **46**, **47** and the skewer pin **48** and the insulating strip between the plates of a pair merely serves the purpose of preventing the upper wipers from engaging the same contact as the lower wipers when the last line in a group is encountered. Its function in this respect will be readily apparent from Fig. 4 which shows a typical level of 20 contacts split up into four groups in the manner suggested by the brackets, and determined by breaking off the 7th and 10th contacts in the upper level and the 8th and 10th contacts in the lower level. The wipers are shown diagrammatically as standing on the last line of the first group in the upper level, where it will be seen that the leading wiper blade **49** is prevented from engaging the same contact as the lower wiper blade **50** by the separating strip of insulating material **87**.

Preferably in this construction the assembled bank is provided in the form of a gate shown as **51** in Fig. 5 which is hinged on the pin **52** to a bracket **53** fastened to one of the bank rods **54**. Normally the bank will be swung into position and locked by a suitable catch so as to lie concentric with the P. B. X. wipers **49**, **50** and **55**, but when access is required to the main banks and wipers the complete arc is hinged outwards away from the switch. The P. B. X. wipers are secured to the tubular carriage in the same manner as already described for the main switch wipers, and are of similar construction except that two pairs of blades are provided in one assembly and are shaped so that the contact end of both pairs may lie in the same plane and engage with the same level of contacts. All four blades are electrically insulated from one another, and by means of the 200-point bank it is possible to provide P. B. X. facilities over 200 lines, which are split up into any number of groups with the proviso that each group shall contain not less than two or more than ten lines. The complete 200-point bank occupies substantially the same space as the 100-point bank hitherto provided, and as it is built up of separate pairs of plates which are complete in themselves it offers considerable economy in cases where a small number of P. B. X. groups are required since only the levels of contacts which are actually necessary need be provided.

All mechanically-operated springs are mounted at the top of the switch on a common plate which is readily removable as a single unit or alternatively the spring sets themselves may be bodily removable by withdrawing the associated bracket fixing screws. Only one fixing screw need be provided in which case the opposite end of the bracket will be provided with a bumped-up projection which registers with a hole in the plate so as to line up the spring set in its proper position. The common plate which is assumed to bridge the switch frame may be seen in Fig. 5 marked **56** and for convenience in drawing it is shown as carrying only one set of springs designated **57**, although it will be appreciated that actually a number of such sets are provided which are fastened in line across the plate. These springs are arranged to be operated from levers of the various shapes shown which pivot on the pins shown dotted, and are actuated from the plates **58** and **59** carried by the wiper carriage. Actually the plate **58** is a modification of the semi-circular plate **37** shown in Fig. 1 and to this extent Figs. 1 and 5 do not strictly correspond. The plate **58** however performs the same function of supporting the carriage during the rotary movement and also serves for operating various mechanical spring sets. The additional plate **59** lying on top of the plate **58** is provided for the purpose of operating what are known as normal post springs and is supported by the wiper carriage but is free to rotate independently thereof about the shaft, so that it partakes of the vertical movement only but is not influenced by the subsequent rotary movement of the carriage during the normal setting of the wipers on to the desired contacts. For facilitating the understanding of the arrangement, the plates **58** and **59** and associated wiper carriage are shown as withdrawn downwards away from the spring operating levers, and the dotted extension lines are intended to indicate the position taken up by the levers when the assembly is in its normal position.

Considering now the mechanical operations involved, it should be explained that with the wiper carriage in its normal position the end face **58a** of the projection on the plate **58** bears against the extended arm of the off-normal-spring-operating lever N at the point **60**, thereby holding the spring set in its normal position under strain.

When the wiper carriage is raised during the first vertical step, the extension 58*a* of the plate 58 is raised clear of the lever N so that the latter then moves under spring pressure in the direction indicated by the arrow to enable the off-normal spring assembly to take up its operated position.

When a level is attained at which the operation of normal post springs is necessary, one or other of the stepped extensions on the plate 59 will bear against the rollers 61 or 62 fastened to the operating levers NP1 or NP2, either or both of which will then be tilted in the direction indicated by the arrows to operate the respective spring assemblies substantially identical to 57. It will be seen from the drawings that the operating rollers on the levers NP1 and NP2 may be secured in any one of ten positions depending upon the level on which the operation of the normal post springs is desired.

Spring combinations of any well-known type may be employed but those of the anti-bounce type shown in the drawings are preferred. The anti-bounce characteristic of these springs is attained in the present instance by considerably reducing the effective length of the stationary spring arms in the combination. For this purpose the clamping plates at both ends of the assembly and also the separating insulators employed are provided with the extension 63 which serves to hold rigid a certain portion of the stationary springs in the assembly to enable the desired result to be achieved.

When the wipers take their first rotary step into engagement with the banks, the plate 58 makes a clockwise movement and the operating roller 64 of lever NR which is accommodated during the vertical movement in the groove 65 is now caused to ride out on to the circumference of the plate thereby operating the normal rotary set of springs shown.

In case the switch is functioning as a group selector and all the outlets on the level selected prove busy, the wipers will be eventually moved to their 11th position which is unwired as regards a trunk connection, and in order that the condition of the circuit may be altered accordingly, the extension 58*a* of the operating plate is caused to come into contact with the roller 66 of the lever S which thereupon takes a movement in the direction indicated by the arrow to operate the cam springs.

No further changes take place in the condition of the mechanically operated springs until the switch is released in the manner already described, and accordingly when the wipers are moved into their 12th position the point 58*b* on the operating plate will move clear of the supporting comb 38 so that the wiper carriage commences to fall to its vertical normal position. At the same time the movement of the operating plate 58 into its 12th position causes the extension 58*a* to move away from the operating roller 66 on the lever S so that the cam springs are immediately restored, while moreover the slot 58*c* will now be set opposite the operating roller 64 of the lever NR which recedes therein and brings about the restoration of the normal rotary springs.

In order that the normal post springs shall also be released at this time a pin 68 which is let into the plate 58 is arranged to engage the left-hand end of the lever 59 which thereupon moves a short distance in a clockwise direction so that its right-hand end moves clear of the operating rollers 61 and 62 and levers NP1 and NP2 are allowed to recede to restore the respective spring sets.

When the carriage has fallen to its normal position the rotary holding detent is no longer in engagement with the rotary ratchet member and as previously explained the wipers are then rotated back to normal by the restoring spring. In order to ensure that the normal rotary springs are not again operated during the return movement of the wipers below the blanks, the respective operating rollers 66 and 64 are reduced in diameter at their lower ends sufficient to clear the plate 58.

When the wiper carriage arrives in its fully restored position, the extension 58*a* of the operating plate comes into contact with the extension on the lever N and rides along its face for a short distance, during which time the lever is again tilted to restore the off-normal springs to their normal condition. It will be noticed that the operating arm of the lever N is provided with an extended lip which is bent over, and this enables the proper functioning of the lever in relation to the operating plate 58 when the wipers are restored in a vertical direction only without having previously performed their rotary movement as will appear in connection with the digit absorbing feature to be described later.

The vertical and rotary interrupter springs although not shown are mounted at opposite sides of the common plate and operated direct from the magnet armatures. The operation of the rotary interrupter springs will be readily appreciated from reference to Fig. 1 when it is explained that the armature 20 is provided with an arm extending vertically arranged to actuate directly the associated spring set which is preferably mounted at the extreme right-hand side of the common plate.

The actuation of the vertical interrupter springs presents rather more difficulty since if they are to be mounted at the extreme left-hand side of the common plate it is necessary that the vertical movement of the vertical magnet armature shall be converted into a horizontal movement in order that the springs may be operated in a manner similar to the others mounted on the plate. For this purpose it is proposed to employ a small bell-crank lever 70 of the shape shown in the detached view, Fig. 6, which will be pivoted on the pin 69 screwed into a convenient position in the switch frame. One arm of the bell-crank lever 70 is arranged to bear on a small projection 71 on the vertical magnet armature while the other arm is provided with an insulated buffer and is arranged to bear against the spring set to be operated. At each movement of the vertical magnet armature, the bell-crank lever is rocked and the associated spring set is therefore operated with a horizontal movement in a manner appropriate to its fastening.

If the switch is to be used in circumstances where absorption of one or more of the setting digits is desirable, it will be preferable to arrange for the release of the carriage and wipers in a vertical direction only, in order that they may be restored to their normal position in the minimum amount of time so as to be ready for the next train of impulses. It will be realised that under these conditions the releasing time must always be less than the pause provided between successive trains of impulses, and the rectangular release operation employed in ordinary working would seriously reduce the margin of safety

in this respect. In order to obtain direct vertical release the switch is provided with an auxiliary magnet of small dimensions as compared with the main driving magnets, which is preferably mounted below the cast frame and is arranged upon operation to move the vertical holding detent **30** out of engagement with the vertical ratchet member so that the carriage and wipers immediately fall to the normal position. The necessity for the turned over lip on the off-normal-spring-operating lever N as shown in Fig. 5 will now become apparent, since when the projection **58***a* of the operating plate falls against the end of the lever N it will ride over the inclined portion, so as to bring about the movement of the lever which is necessary to restore the off-normal spring sets to their normal condition.

Vertical wipers and banks when required will be provided in the manner shown in Fig. 7 and comprise essentially a vertical wiper carriage **72** arranged to slide on the guide bar **73** which is preferably secured between the underside of the frame casting and the lower bridge piece shown in Fig. 1. Two sets of wipers and banks are provided which are insulated from each other so that **20** separate contact points may be closed in pairs. The vertical bank **74** which is double-sided is fastened to one of the bank rods or alternatively to one of the side angle members such as **12** in Fig. 1, and comprises two rows of ten contacts and two metal plates such as **75** arranged back to back. Fastened to the vertical wiper carriage are the wiper blades **76** and **77** arranged to slide vertically over the bank so as to connect the respective contacts in turn to the metal plates, thereby completing the electrical connection. The vertical wiper carriage is coupled by means of an extended limb **78** to a channelled ring **79** clamped to the main wiper carriage in the manner shown, and it will be appreciated from this arrangement that the vertical carriage will be caused to take the vertical setting of the main wiper carriage but is not influenced by the subsequent rotary movement.

The controlling relays are secured to a mounting plate of the well-known tray-shaped construction designated **80** in Fig. 8 in which the relays are not shown in detail but the position they occupy is indicated by dotted lines. As illustrated the mounting plate is arranged to pivot on the screws **81** one on each side of the cast frame and is locked in position by the screws. With this arrangement when the switch is removed from the shelf the relay plate may be hinged backwards in the manner shown to give access to the mechanically operated springs mounted immediately below. This feature of hinging the relay mounting plate is not absolutely essential but it is a facility which is easily provided with the present construction. The condensers **82** are mounted at the back of the relay plate in the manner shown on a second plate **83** which is L-shaped and pivoted at the point **84**, and is arranged to clip into position by means of bumped-up portions on the lugs **85** which spring into slots cut in the sides of the relay mounting plate. Access to the wiring at the rear of the relay mounting plate may be had by pulling the plate **83** from the bottom so that it hinges at the point **84** outwardly. It will be appreciated therefore that the plate **83** in addition to supporting the condensers also completely encloses the rear of the relay mounting plate and therefore acts as a dust cover. The main dust cover (not shown) which is fitted over the front of the switch is arranged to envelop both the relays and the switch mechanism, and is supported on the guide plate **86** riveted to the top of the relay plate, and clipped in position behind the pins **87** and **88**. Preferably the spring connecting jack will be mounted on the back of the plate which carries the mechanically operated springs and as the relay mounting plate is arranged to be removable therewith it will be appreciated that all electrical wiring may be made quite apart from the mechanical movement.

One arrangement of mounting the contact bank and switch mechanism on the shelf is shown in Figs. 9 and 9*a* this arrangement being particularly suitable for the construction illustrated in Fig 1. The shelf is shown in Fig. 9*a* and is arranged as a two-piece construction comprising at the top a pressed plate **89** bent at right angles and below a flat plate **89** supported at its ends by substantial bracket members **90**. The upper shelf member **88** supports along its vertical side the shelf jacks **91**, while the lower shelf member **89** is movable so as to be suitable for one, two or three banks depending upon the capacity of the switch. In the drawings the banks are shown as clamped together in a single unit and although this is not absolutely necessary an appreciable saving is effected in the vertical dimension by the elimination of intervening clamping nuts. As is the general practice the banks are threaded on to rods such as **92** the ends of which extend above and below the mounting shelf to provide a locating means for the mechanism and controlling relays. Conveniently a groove is turned in the upper ends of these rods to accommodate a spring clip **93** of hairpin shape which is inserted between the upper bank plate and shelf member **88** to hold the rods in position. If the banks are required to be additionally secured to the shelf this may be effected by extending certain of the clamping bolts through holes in the shelf members. The mechanism shown diagrammatically in Fig. 9 is provided with two holes in the base of the cast frame member which accommodate the upper ends of the bank rods, while the lower ends are clamped into recesses in the lower bridge piece **95**, corresponding to **14**, Fig. 1, by means of the hooked clamping members **96**, in a manner which may be more readily appreciated from the perspective view, Fig. 1. With this arrangement the switch is readily removable from the shelf and no inconvenience is caused in lining up when it is replaced since the clamping means are self-centering.

When the switch (Fig. 9) is in its mounted position on the shelf (Fig. 9*a*), the base of the cast frame member seats itself on the shelf plate **88** and the switch jack **97** comes into register with the springs of the shelf jack **91**, to complete the electrical connections.

Another method of mounting the contact banks and mechanism on the shelf is shown in Figs. 10 and 10*a*, from which it will be seen that the vertical angle plates (Fig. 10) extending from the front of the switch are now dispensed with, and the bank rods **98** are threaded directly into the base of the cast frame member **99**, and carry at their lower ends the bridge piece **100** which serves as the lower support for the fixed shaft and wiper carriage indicated by the dotted lines. The light shelf members used in the previous arrangement are replaced by a single sturdy member **101** (Fig. 10*a*), preferably a length of angle iron of suitable cross connection, arranged to carry along its vertical side the shelf jacks **102**. The con-

tact banks are constructed as a single unit and are provided with extended clamping bolts so that they may fasten directly to the shelf.

To provide a means for correctly locating the mechanism when it is mounted in position on the shelf, the holes in the upper and lower bank plates 103 and 104 are slotted in the manner shown in Fig. 11 sufficient to pass the turned-down portion of the bank rods. With this arrangement the mechanism will be positioned over the shelf by a horizontal movement and then lowered until the base of the cast frame member 99 seats itself on the shelf 101. In this position the switch jack 105 registers with the shelf jack 102, and the large diameter portions of the bank rods enter the holes in the bank plates thereby lining up the wipers with the banks.

In case the switches are to be transported from one place to another in position on the racks they may be definitely locked in place by means of a securing screw which passes through a hole in the switch frame and is threaded into the mounting shelf 101.

The second arrangement of mounting is to be preferred in that the front angle plates 11 and 12 shown in Fig. 1 are dispensed with, and it is therefore possible to remove the vertical members on the cast frame to which they were secured, thereby considerably opening up the switch mechanism and facilitating adjustment. When this is done the upper bridge plate 13 will also disappear in the form shown, and will be replaced by an auxiliary bracket member secured to the top of a pillar extending upwards from the cast frame in substantially the position occupied by the comb member 38 for which it will also serve as a support.

In order to effect a still further increase in the speed of operation, the vertical and rotary movements may be arranged as separate units and quite distinct from each other, so that in operation the vertical movement will not be burdened by the weight and parts having a purely rotary function, while similarly the rotary movement will not be burdened by parts having a purely vertical function. The reduction in inertia thus obtained should enable higher hunting speeds to be obtained.

According to the invention therefore, an improved switch is provided, of particularly compact design and constructed of a plurality of units which are complete in themselves thereby offering distinct manufacturing advantage over similar type switches hitherto constructed.

I claim:

1. An automatic switch having a wiper shaft and mechanism for moving the same in a vertical and rotary direction, a plurality of contact spring sets, means for operating said springs by the mechanical movement of the shaft, said spring sets mounted in a plane transverse to the plane of the wiper shaft, and means for operating said sets at different positions of the wiper shaft.

2. An automatic switch having a wiper shaft movable in vertical and rotary directions, a magnet having means for moving the shaft in a vertical direction, and means operated by said magnet after the shaft has been moved in its rotary direction for releasing the shaft.

3. An automatic switch having a bank of contacts, a wiper shaft, means for moving the shaft in a longitudinal and rotary direction, means for releasing the shaft, said means effective to cause a forward rotary movement, a longitudinal movement and a return rotary movement if release is initiated after a rotary movement of the shaft has taken place, and to cause the shaft to release over the same path over which it was operated in case release is initiated before rotary movement thereof has taken place.

4. An automatic switch having a bank of contacts, a shaft carrying wipers cooperating therewith, means for operating said shaft in a vertical and rotary direction to bring said wipers into engagement with certain contacts of said bank, an auxiliary wiper, an auxiliary bank of contacts therefor mounted on the front of the switch, said auxiliary bank pivotally mounted and adapted to swing out to permit access to the first bank and wipers.

5. An automatic switch as claimed in claim 4 in which the auxiliary bank comprises a plate for each longitudinal step of the switch, each plate having projections corresponding to each rotary step of the switch, each projection having a weakened portion permitting breaking off of projections readily.

6. An automatic switch having contacts, a wiper shaft, a tubular carriage slidably mounted on said shaft and also movable in a rotary direction thereon, wipers mounted on the carriage, and a single helical spring for restoring the carriage in both directions of movement.

7. An automatic switch as claimed in claim 6 in which the wipers are secured to the carriage by soft metal eyelets, one of said eyelets of sufficient diameter to form a cord hole through which wires leading to the wipers may pass.

8. An automatic switch having a switch shaft carrying wipers, means for moving said shaft in longitudinal and rotary directions, a spring set operated when the shaft moves off normal, another spring set operated when the shaft takes its first rotary motion, other spring sets operated in different positions of the shaft, and a single member for operating all of said sets.

9. An automatic switch having contacts arranged in levels, a shaft carrying wipers co-operating with the contacts, means for raising the shaft step by step to different levels and means for rotating the shaft to carry the wipers over the contacts of a level, means controlled by said first means for releasing the shaft in its rotary movement only without releasing the shaft in its vertical movement, said first means thereafter operable to raise the shaft to bring the wipers to the next level.

10. An automatic switch having contacts, a wiper shaft carrying wipers for engagement with any of said contacts, a magnet having a pawl for raising the shaft, a magnet for rotating the shaft, a rack of ratchet teeth engaged by the pawl of the first magnet to raise the shaft, said rack being attached to the shaft in such a manner that it is moved out of range of the pawl when the shaft is moved in its first rotary movement.

11. An automatic switch having contacts arranged in levels, a shaft carrying wipers, means for operating the shaft to a level and rotating the same to step the wipers over the contacts of a level, auxiliary wipers, a pair of toothed plates for each level, a strip of insulation separating each pair, said insulation preventing the auxiliary wipers from both engaging the remaining tooth when another tooth is broken off in a particular position.

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