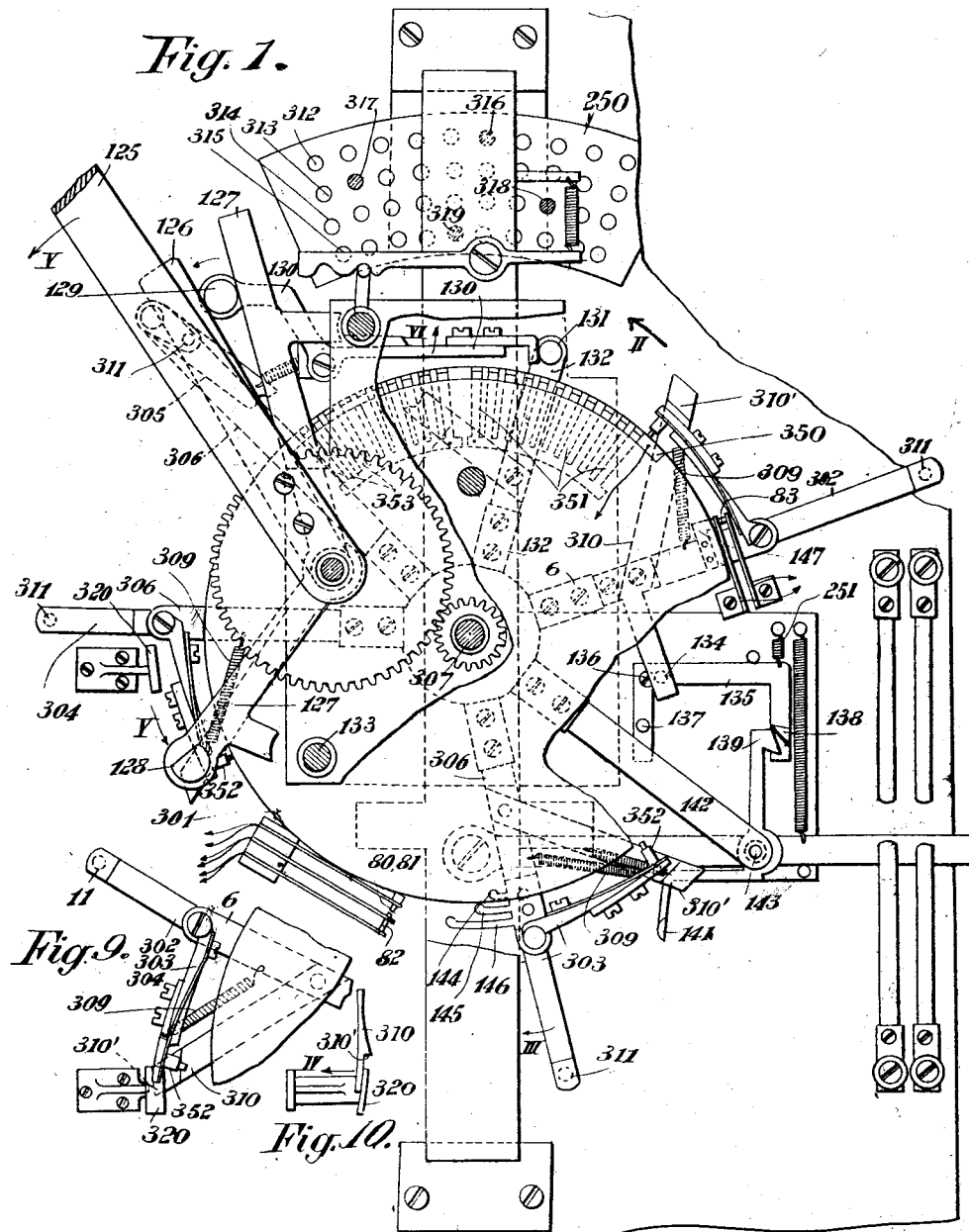


J. PETICKY.
 AUTOMATIC TELEPHONE EXCHANGE SYSTEM.
 APPLICATION FILED JUNE 24, 1909.

1,053,864.

Patented Feb. 18, 1913.

14 SHEETS—SHEET 1.



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1,053,864.

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14 SHEETS—SHEET 2.

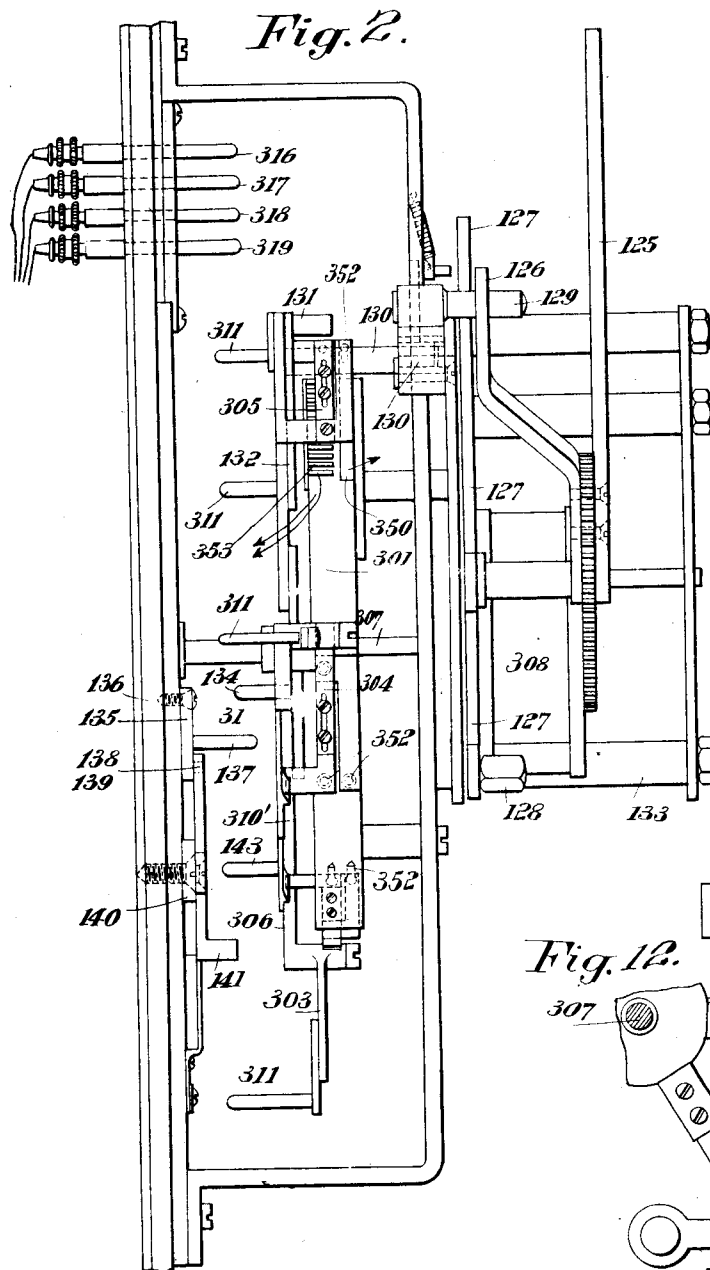


Fig. 4.

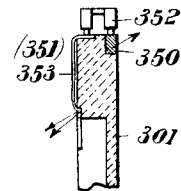


Fig. 22.

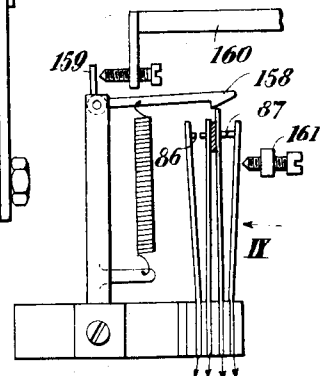
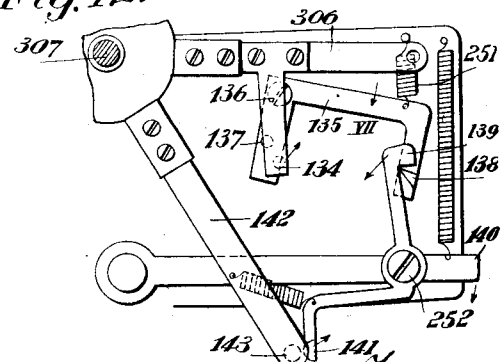


Fig. 12.



Witnesses:
 B. P. Fishburne
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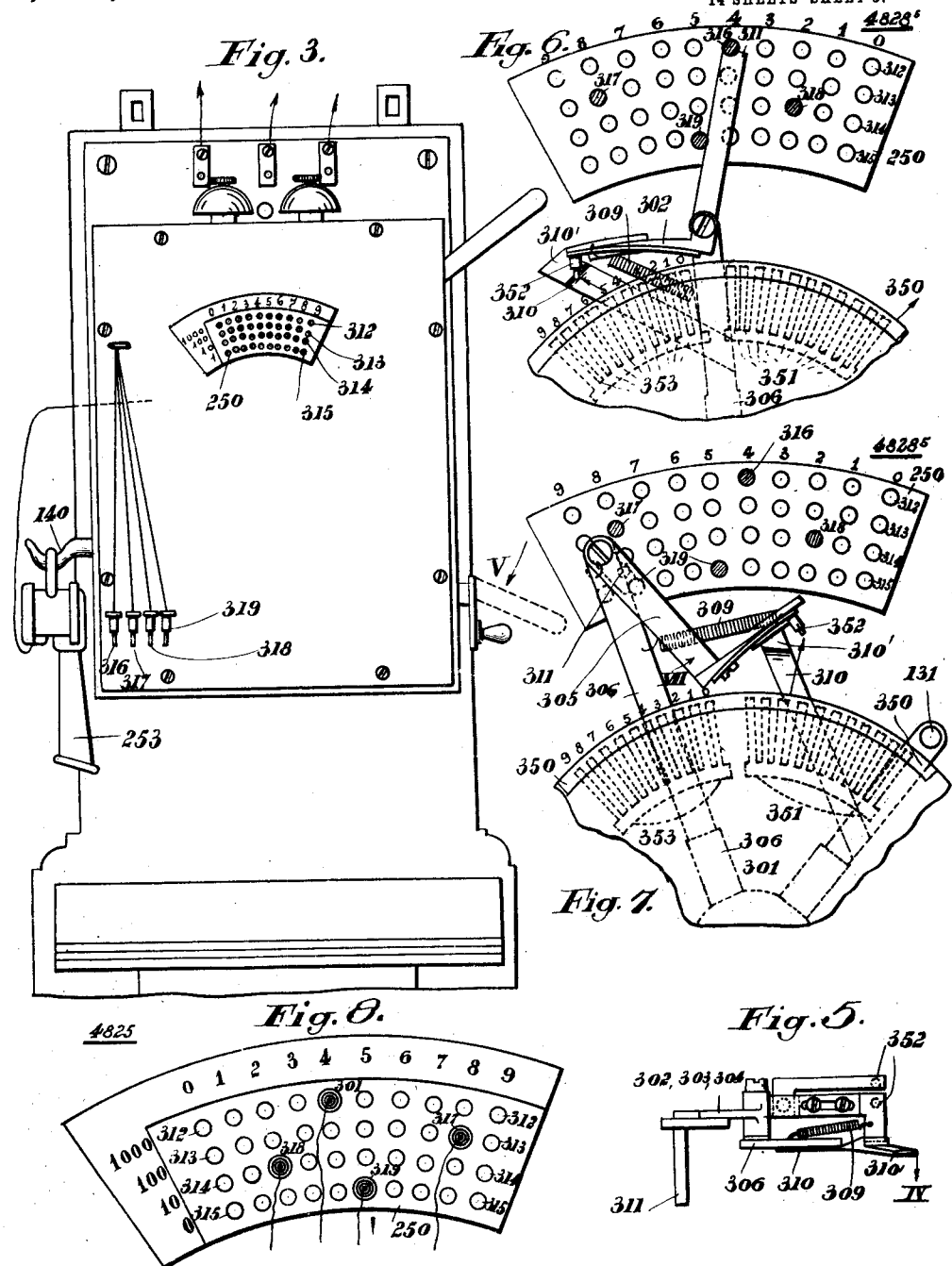
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14 SHEETS—SHEET 3.



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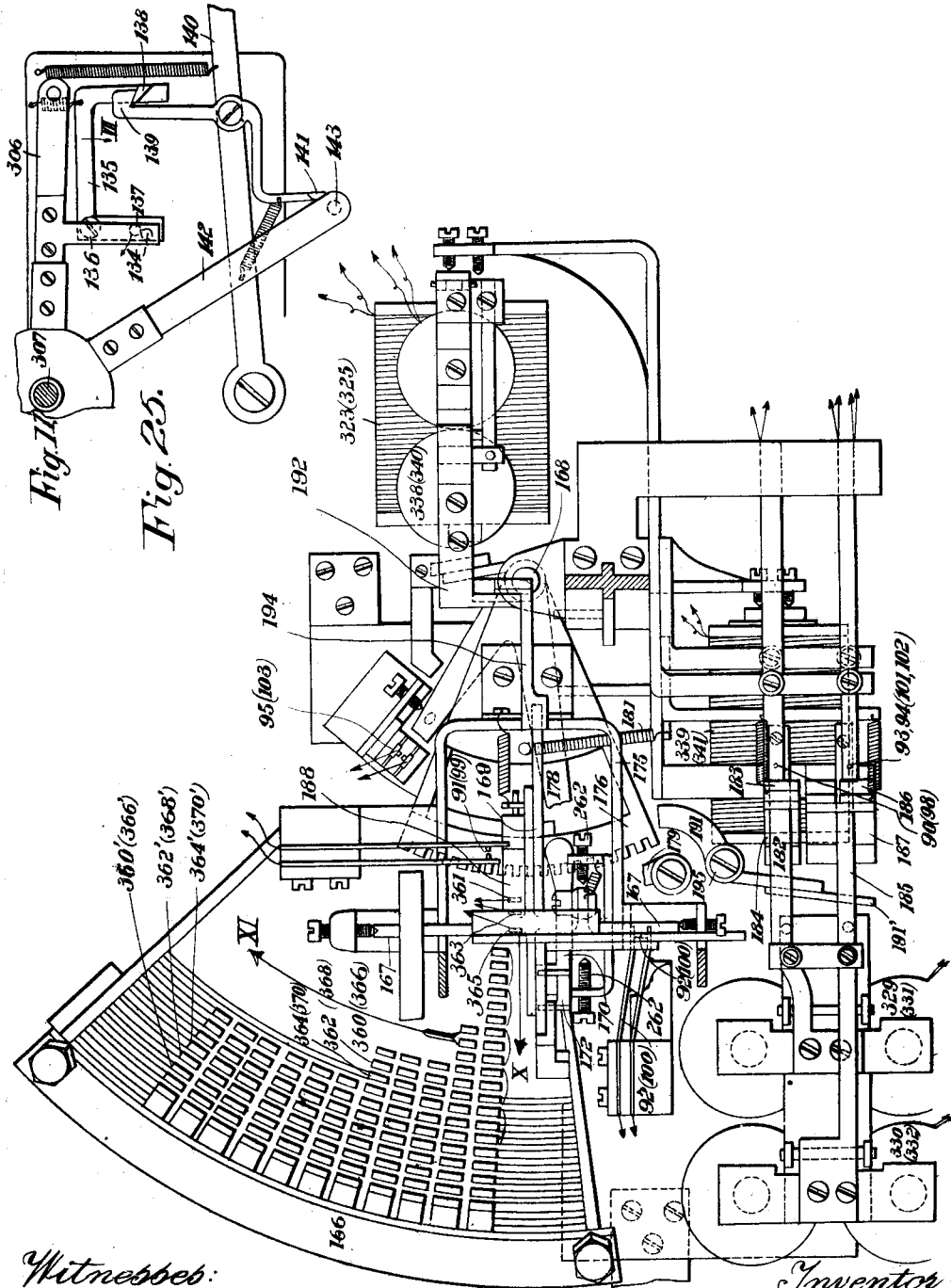
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1,053,864.

Patented Feb. 18, 1913.

14 SHEETS—SHEET 4.

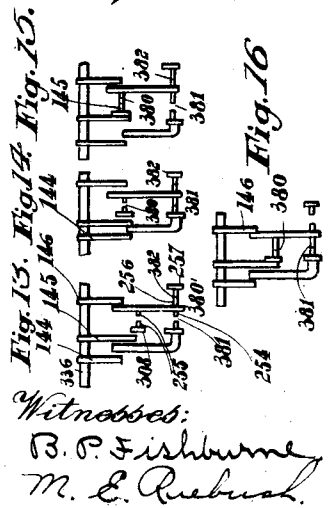


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14 SHEETS—SHEET 5.



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AUTOMATIC TELEPHONE EXCHANGE SYSTEM.
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14 SHEETS—SHEET 6.

Fig. 17.

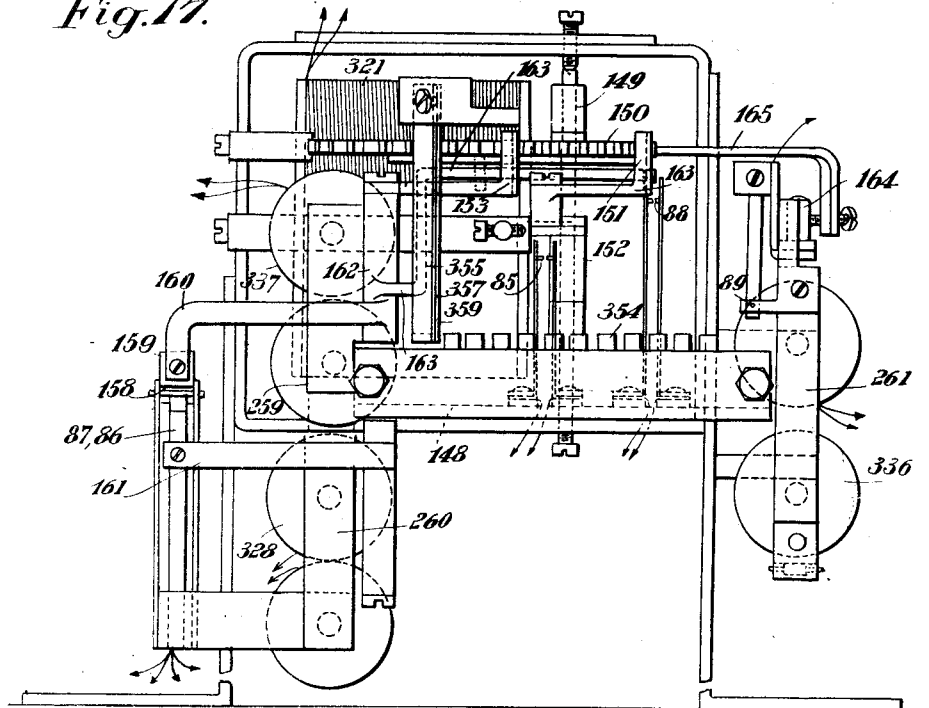
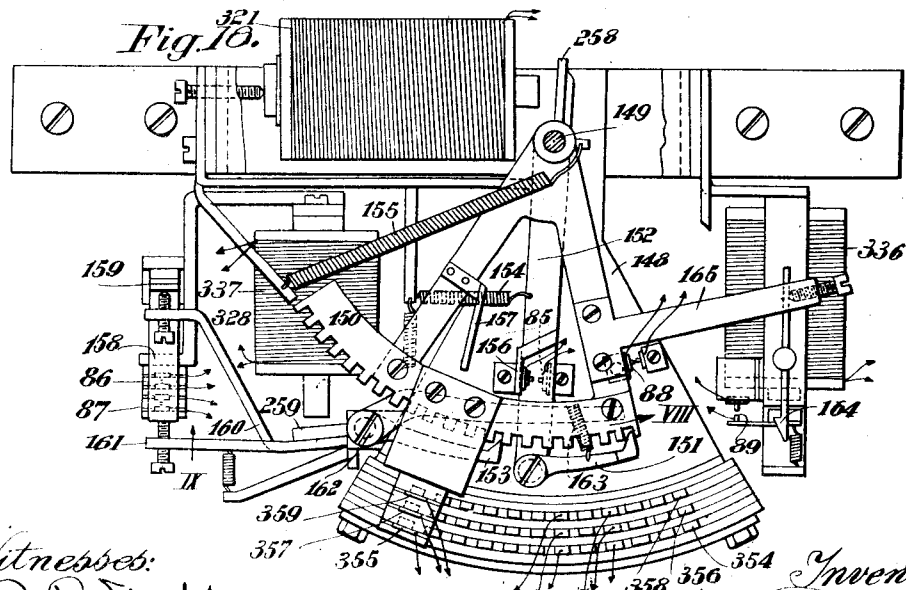


Fig. 18.



Witnesses:
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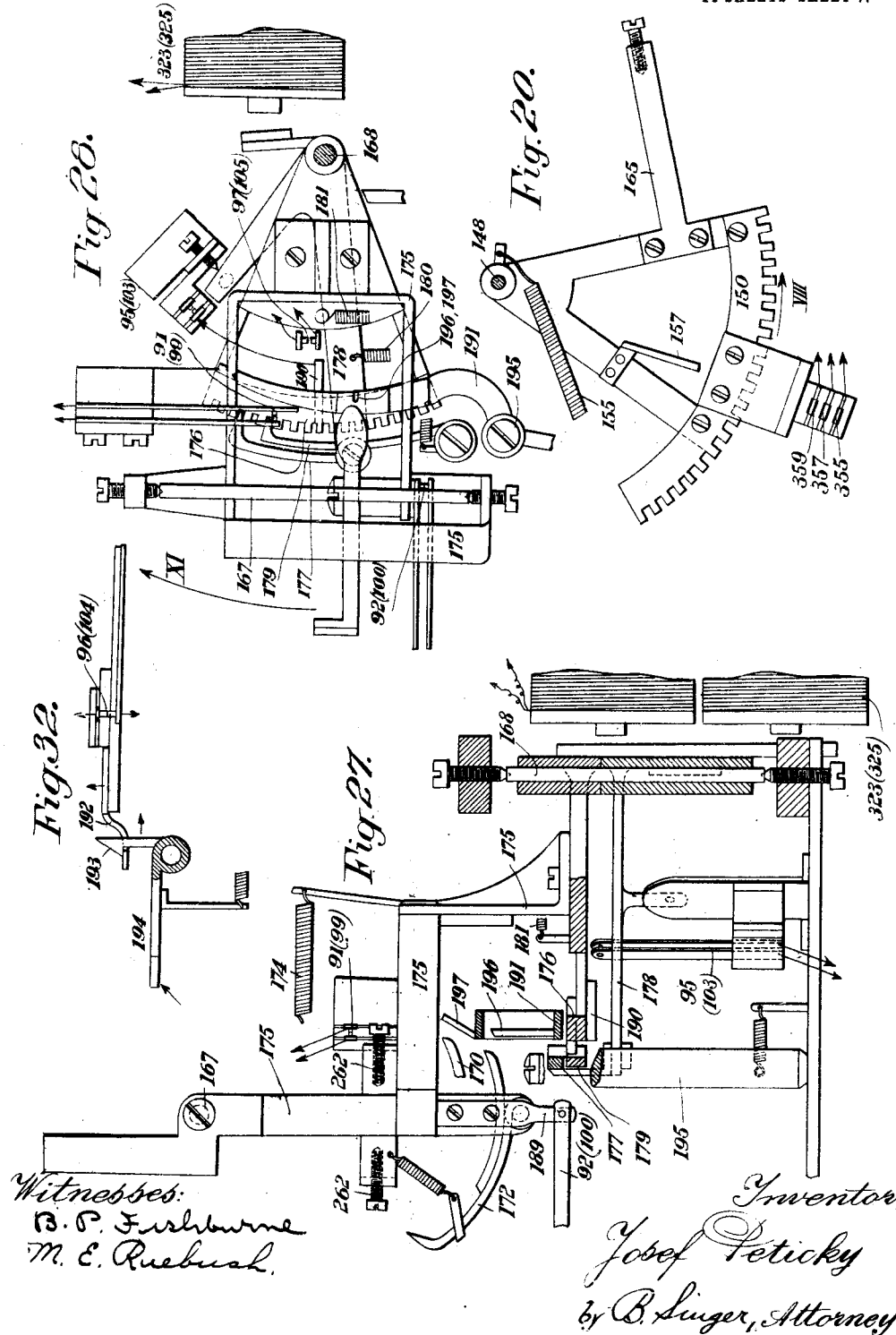
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 APPLICATION FILED JUNE 24, 1909.

1,053,864.

Patented Feb. 18, 1913.

14 SHEETS—SHEET 7.



Witnesses:
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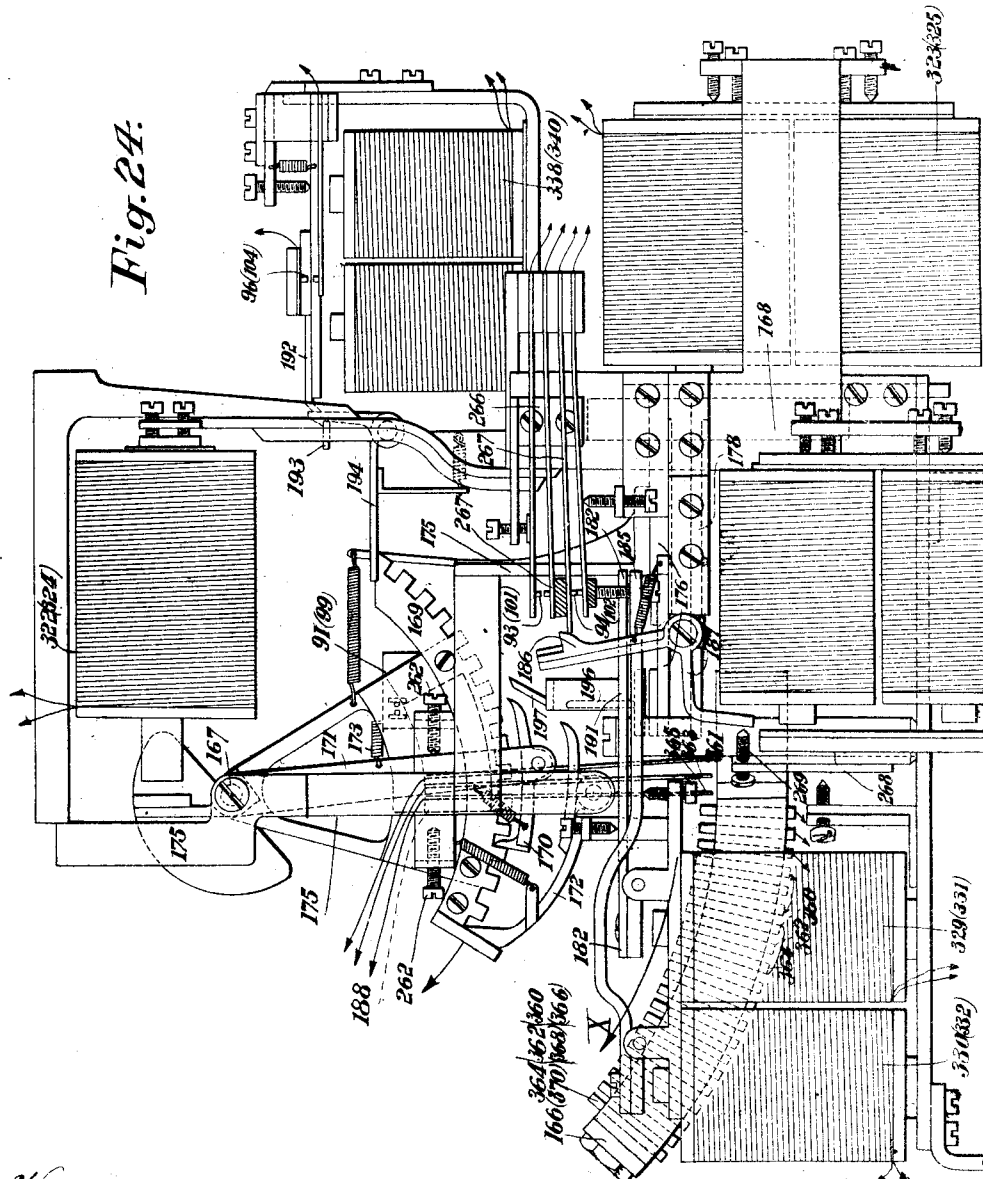
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APPLICATION FILED JUNE 24, 1909.

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14 SHEETS—SHEET 8.



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 APPLICATION FILED JUNE 24, 1909.

1,053,864.

Patented Feb. 18, 1913.

14 SHEETS-SHEET 9.

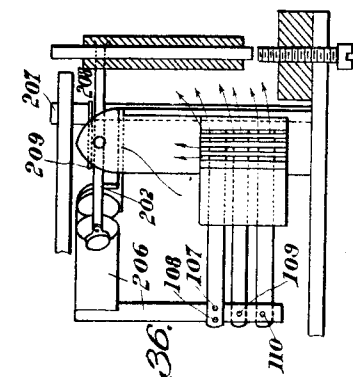


Fig. 36.

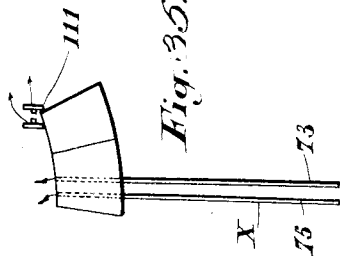


Fig. 35.

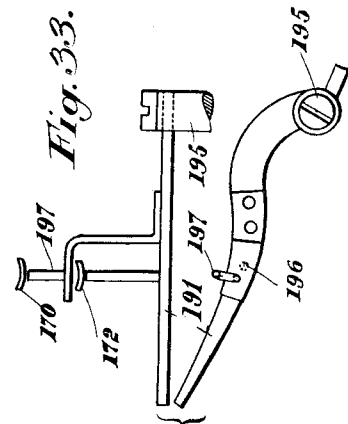


Fig. 33.

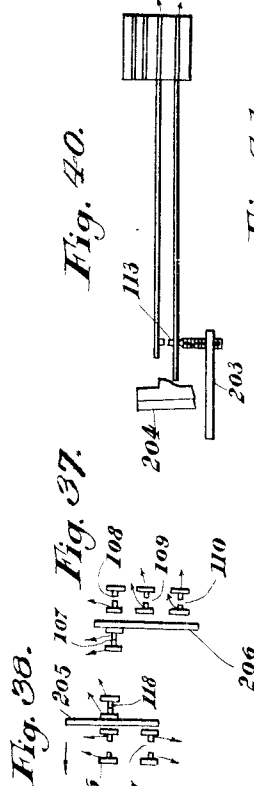


Fig. 38.

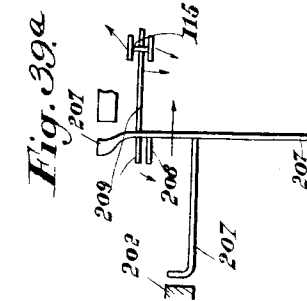


Fig. 39a.

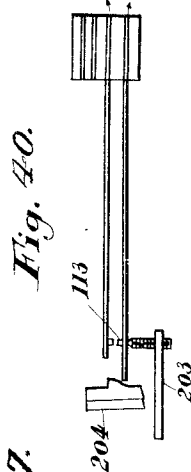


Fig. 40.

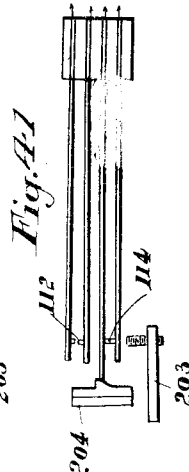


Fig. 41.



Fig. 42.

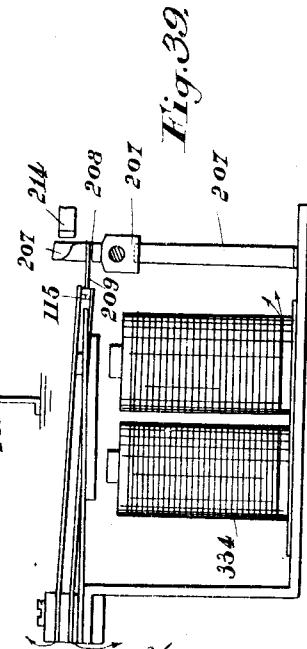


Fig. 39.

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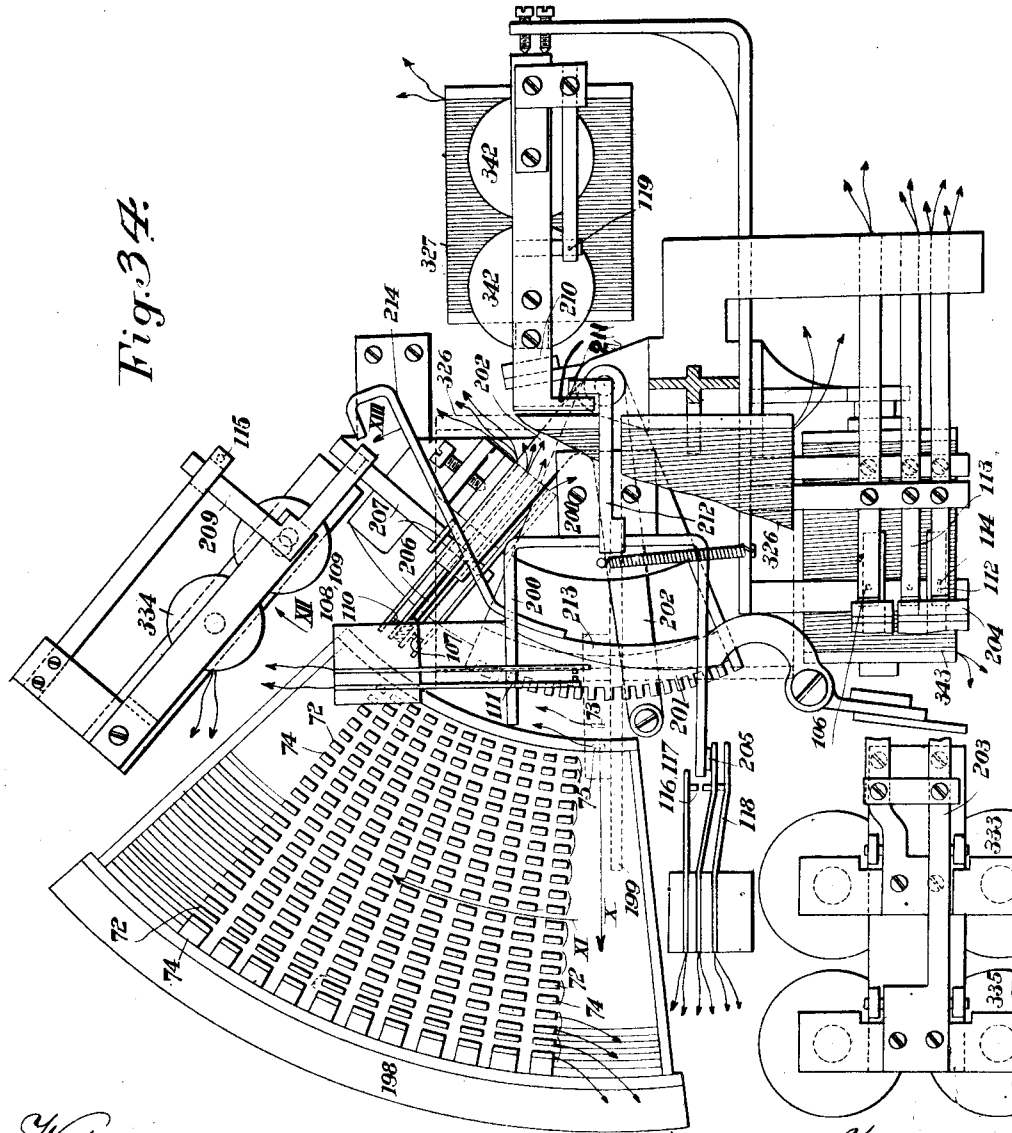
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 AUTOMATIC TELEPHONE EXCHANGE SYSTEM.
 APPLICATION FILED JUNE 24, 1909.

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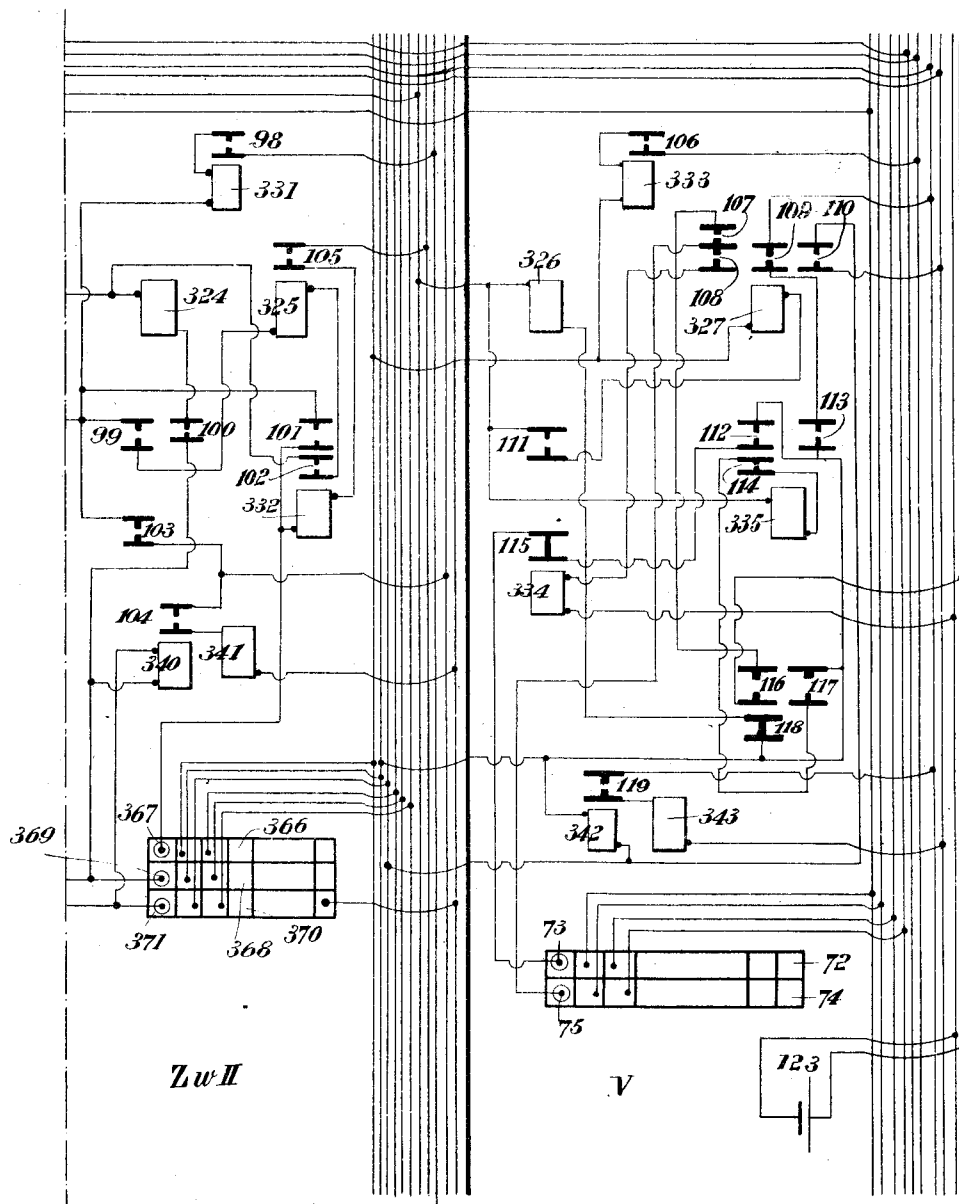
14 SHEETS—SHEET 10.



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Fig. 43.



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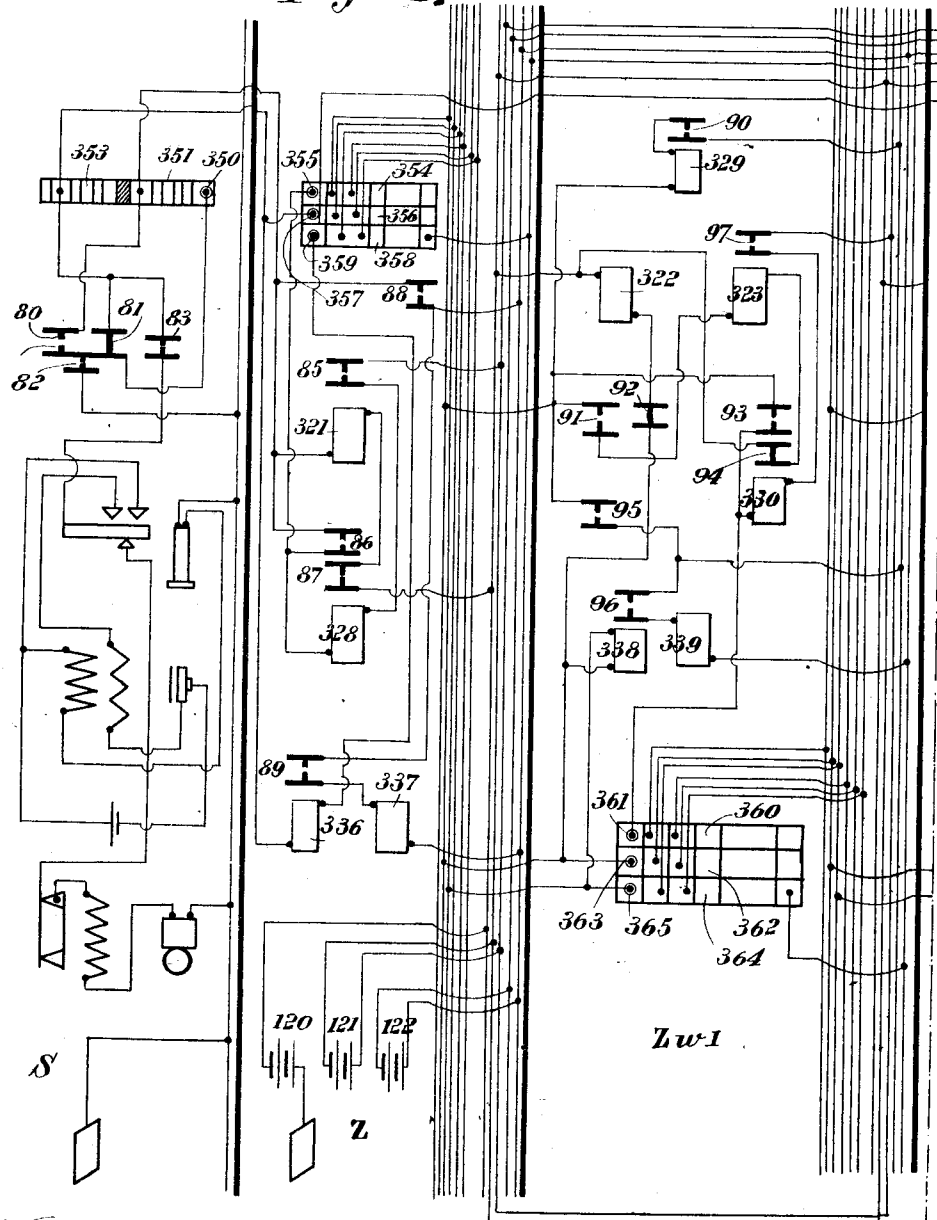
J. PETICKY.
AUTOMATIC TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED JUNE 24, 1909.

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Patented Feb. 18, 1913.

14 SHEETS—SHEET 12.

Fig. 43a



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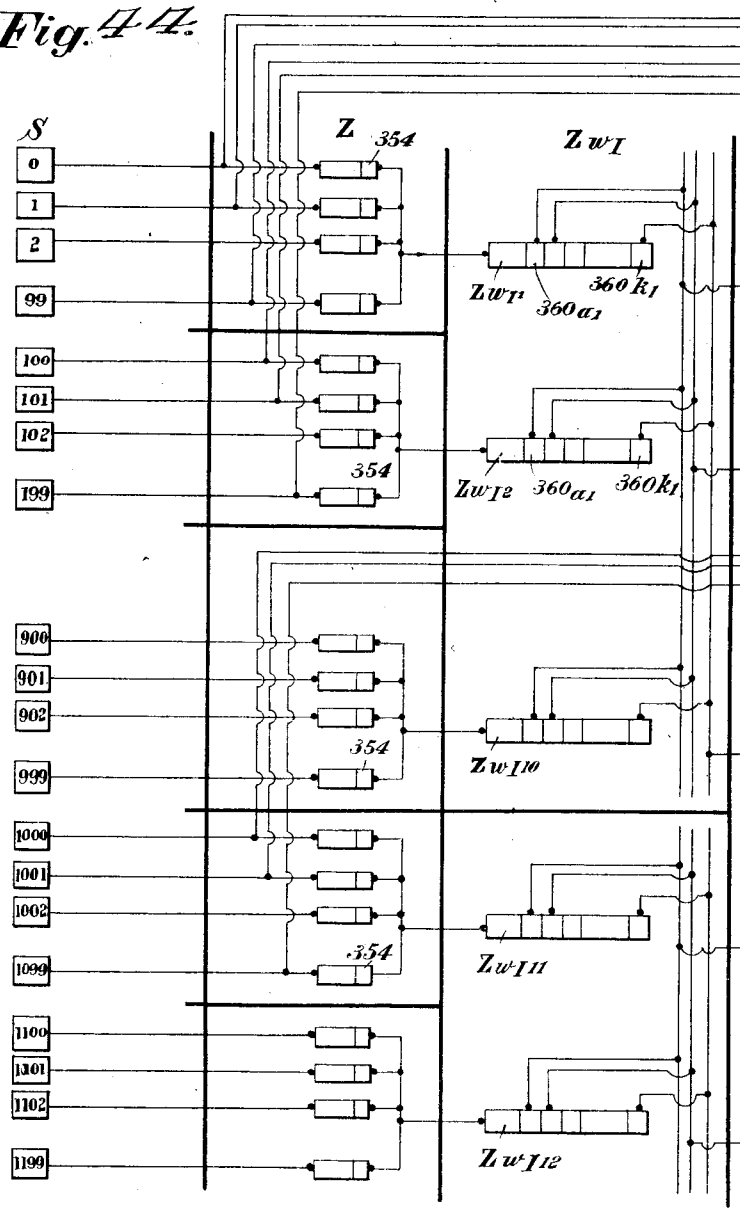
J. PETICKY.
 AUTOMATIC TELEPHONE EXCHANGE SYSTEM.
 APPLICATION FILED JUNE 24, 1909.

1,053,864.

Patented Feb. 18, 1913.

14 SHEETS—SHEET 13.

Fig. 44.



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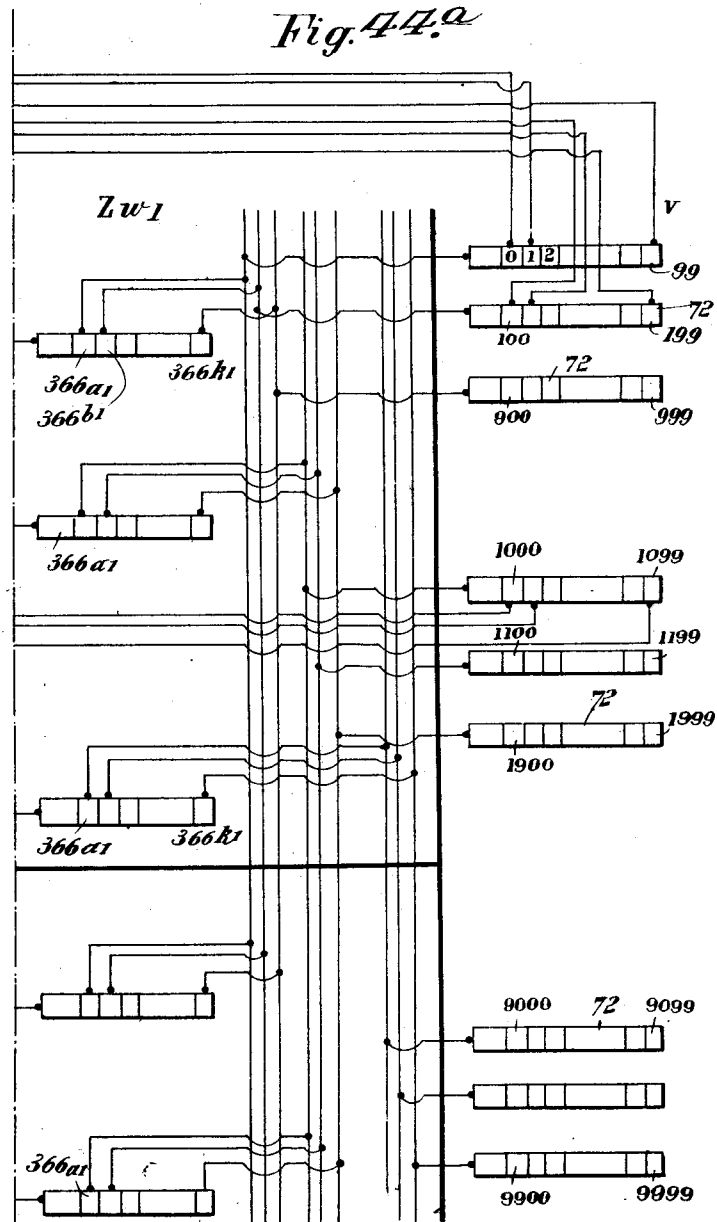
J. PETICKY.
 AUTOMATIC TELEPHONE EXCHANGE SYSTEM.
 APPLICATION FILED JUNE 24, 1909.

1,053,864.

Patented Feb. 18, 1913.

14 SHEETS-SHEET 14.

Fig. 47.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE-EXCHANGE SYSTEM.

1,053,864.

Specification of Letters Patent.

Patented Feb. 18, 1913.

Application filed June 24, 1909. Serial No. 504,178.

To all whom it may concern:

Be it known that I, JOSEF PETICKY, a subject of the Emperor of Austria-Hungary, and resident of Königliche Weinberge, near Prague, Austria-Hungary, have invented certain new and useful Improvements in Automatic Telephone-Exchange Systems, of which the following is a specification.

This invention relates to automatic telephone exchanges, and its principal object is to improve and simplify the same.

In the drawings: Figure 1 shows a view from the back of the subscriber's call apparatus, certain parts to this apparatus being broken away so as to increase the clearness of the figure. Fig. 2 shows a side elevation of Fig. 1. Fig. 3 is a front elevation view of the entire apparatus. Figs. 4 to 16 show details of the subscriber's call apparatus. Fig. 17 is a side elevation of the exchange apparatus. Fig. 18 is the corresponding top plan view. Figs. 19 to 23 show detail views of this apparatus. Fig. 24 shows a side elevation view of one of the intermediary switch apparatus. Fig. 25 is a top plan view of the same, the upper electromagnet being removed. Figs. 26 to 33 show details appertaining thereto. Fig. 34 is a top plan view of the connecting-up apparatus, while Figs. 35 to 42 show details of the same. Fig. 43 shows a scheme for connecting up the various contacts and electromagnets of the automatic telephone system. Fig. 43* shows an extension of circuit diagram shown in Fig. 43. Figs. 44 and 44* together show the repartition of groups.

In the present form of embodiment of this invention the subscriber's call apparatus, the exchange apparatus, the intermediate switch apparatus, and the connecting-up apparatus, are constructed in the following manner: The subscriber's call apparatus (Figs. 1 to 16) comprises the stationary circular disk 301 (Figs. 1, 2, 4, 7) on which are arranged two groups 351, 353, of contacts which are insulated from each other. The first group 351, comprises eleven, the second group, 353, ten contacts; the two groups of contacts are connected with each other by means of electric conductors. Arranged along the groups of contacts and behind the disk 301, is a common contact bar 350 (Fig. 4). The electric connection between the contacts 351 and 353

respectively, and the contact bar 350, is effected by four pairs of sliding contacts 352 (Figs. 1, 4-7), which are arranged on bent levers 302, 303, 304, 305, (Figs. 1, 5, 6, 9, 10), which are rotated in the direction of the arrow II (Fig. 1) by a clock work 308, (Fig. 2) through the medium of the arms 306 and the common shaft 307. Each of the said bent levers 302 to 305, as well as the sliding contacts thereof, 352, are supplied with a helicoidal spring 309 on the circumference of the disk 301. Mounted on the arm 306, and positioned toward the center of the apparatus is a spring 310 which is provided with a tooth 310' (Figs. 9 and 10), and allows at a given moment the desired bent lever 302-305, to keep its retracted position. The radial arms of the bent levers which are provided with the pin 311, are of different length and have such dimensions that each of the pins 11 during the rotation of the arms 306 reaches one of the four rows of holes 312, 313, 314, 315, provided in the plate 250. These holes are intended to receive the contact pegs or plugs 316, 317, 318, 319 (Figs. 1-3; 6-8). They are designated by the numerals 0 to 9 on the outside of the plate (Figs. 3 to 8), the holes 312 being made to correspond to the thousands, the holes 313 to the hundreds, the holes 314 to the tens, and the holes 315 to the units of the number to be called so that the said plate allows of any number being composed between 0 and 9999. Each of said contact plugs or pegs 316 to 319, is intended to cooperate with one row of holes, the pegs 316 being intended for the row 312, the pegs 317 for the row 313, and so on. The four contact pegs are suspended from the apparatus by means of cords (Fig. 3), and their free ends project into the apparatus when they have been introduced into the desired holes. They form in this manner abutments for the pins 311.

If during the rotation of the shaft 307 in the direction of the arrow II, the pin 311 for instance of the longest lever 302, strikes against the pegs 316 which is intended to cooperate therewith, the bent lever 302 controlled by said pin 311 is shifted in the direction of the arrow II, and the slide contacts 352 are removed from the circumference of the disk. By this movement, the

sliding contacts 352 which are arranged on the lower part of the bent lever 302, are raised, and slide along the incline of the tooth 310', consequently pushing aside this tooth as well as the spring 310, which carries it. The spring 310 is thus tensioned and as soon as the sliding contacts 352 have arrived at the upper surface of the tooth 310', the spring 310 suddenly returns into its initial position, as the upper surface of the tooth 310' slides under the surface of the sliding contacts 352. It results, therefrom, that the sliding contacts are held in their raised position and continue their motion in this position.

As shown by Fig. 1, a metal sheet 320 is secured to the framework of the apparatus on the left hand side of the disk 301, and this metal sheet is provided with an incline, that is to say, that the metal sheet 320 is bent so as to form an incline, the lower part of which is directed toward the framework of the apparatus. As soon as the upper part of the spring 310 arrives at this metal plate and on the upper surface of the latter, the spring 310 slides along the aforesaid incline of the metal plate 320 (Fig. 10, the direction indicated by the arrow IV), and is thus held under tension until the tooth 310' leaves the plane of the sliding contacts 352, thus allowing the latter to return suddenly into their starting position or position of rest under the action of the spring 309, and the spring 310 leaves then the incline of the metal sheet 320 (that is to say the lower part thereof according to Fig. 1), and returns into its starting position. The upper peg 316 raises the arm 302, and the peg 317 the arm 303, that is to say that the sliding contacts 352 of the levers 302, 303, slide on the contacts 351 until they are raised by the pegs 316 to 319 inserted into a determined hole of the rows 312, 313, 314, 315. If the peg 316 has been introduced for instance into the first hole designated by 0, the sliding contacts 352 pass over the first contact of the group 353, and are then raised before they have time to come into contact with the following contact 353; they continue afterward their motion in this raised position. If on the contrary, the peg 316 has been inserted in the fifth hole of the row 312, the contacts 352 (Figs. 1, 6, 8) slide only on the five first contacts 353, are therefore raised, and continue their motion in this raised position. The same operation is repeated with the bent levers 303 and 304, and the pegs 317 and 318. The bent lever 305 (Fig. 1), works in a similar manner, and the sole difference existing in its construction consists in that this lever is directed in the opposite direction to the other bent lever, so that its sliding contacts 352 slide exclusively on the contacts 351 (Fig. 7). It is easily seen that the hole which has received one of the pegs cor-

responds to a contact closed in a suitable manner.

The starting of the subscriber's call is carried out by means of a starting lever 125 (Figs. 1, 2, 3) which is connected through the medium of a transmission gear with a clock motion 308, and carries a bent arm 126 (Fig. 2). Mounted on the shaft of said lever 125 is a bent lever 127 (Figs. 1, 2), the shorter arm of which carries at its lower end an abutting tenon 128, one of the sides of which has been flat, by means of a file and against which the arm 126 strikes when the lever 125 is lowered (Fig. 3). Positioned between the arm 126 and the longer arm of lever 127 is the tenon 129 of a bar 130 which oscillates on a pivot and the opposite end of which is bent at right angles and applies itself against the abutment 131 of an arm 132 which is rigidly connected with the shaft 307, and consequently with the arm 306. When the lever 125 is pushed downward in the direction of the arrow V (Figs. 1 and 3), its arm 126 strikes against the tenon 128 and causes the shorter arm of lever 127 to move downward until its extension strikes against the stationary pin 133, secured to the framework of the apparatus. At the same time, the longer arm of the lever 127, and the tenon 129, have caused the bar 130, to oscillate in the direction indicated by the arrow VI so as to set free the abutment 131. Thereafter the apparatus provided at the telephone apparatus of the subscriber is adapted to move under the influence of the clock work 308, and as a matter of fact, begins to move. The rod 125 is then set free and returns into its starting position shown by Fig. 3. When the arms 306 have nearly accomplished an entire revolution, an abutment 134 secured to one of the arms 306 strikes against a stop device, the complete description of which will be given later on, and which is shown by Figs. 2, 11, and 12. When the retarding effect of this stopping device has been removed, the apparatus continues moving on a short distance until it arrives again in its starting or zero position. Once the arm 126 strikes again against the tenon 129, it carries it with it in its motion as well as the arm of the lever 127, and the bar 130 so that the latter arrives again in the path of motion of the abutment 131, and finally stops the arm 132 after an entire revolution has been accomplished. The above mentioned stopping device (Figs. 1, 11, and 12), is intended to give the parts of the apparatus the position which they must have so that the conversation might take place between the subscribers. It comprises a stirrup 135 (Fig. 12) provided on the inner surface of the front covering plate and adapted to move around the pivot 136, this stirrup carrying a pin 137 and projecting hook 138, and being

controlled by a tractional spring 251. When the said members occupy their position of rest, the hook 138 is indicated by a hook 139, which is connected with the lever 140 of the telephone receiver and carries beyond its point of oscillation 252 an abutment 141. The arm 142 keyed on the shaft 307 carries an abutting pin 143.

In the position of zero, or position of rest, all the members described above occupy the position shown by Fig. 1. As soon as the member representing the number of the subscriber to be called has been composed, and after the apparatus annexed to the telephone apparatus of the subscriber has nearly accomplished, as explained above, a complete revolution, the abutment 134 strikes against the pin 137 (Fig. 11), thus causing the momentaneous stopping of the apparatus. In this position, the telephonic conversation can take place.

If at this moment the subscriber who calls upon another one removes the telephone receiver 253 from the hook 140, the latter is caused by the springs controlling it, to rise and thus cause the hooks 139 and 138 (Fig. 11) to engage each other. When at the end of the conversation, the telephone receiver is again put on its hook, its weight causes the lever 140 to be lowered again and causes the stirrup 135 to move again in the direction indicated by the arrow VII, (Fig. 12). The pins 134, 137, are consequently removed from each other and the apparatus is again set free and can continue its radial motion. The pin 143 strikes then against the abutment 141, thus doing away with the mutual engagement between the hooks 138, 139, and producing the liberation of the stirrup 135, so that all the members of the apparatus can return into their position of rest, shown by Fig. 1.

The shaft 307, together with the arms 306, 142, 132, therefore continues still a little its motion until the tenon 131, as already stated, strikes against the end of the balance beam 130.

80, 81, 82, 83, are spring contacts provided in the apparatus annexed to the telephone apparatus of the subscriber (Fig. 1). The contacts 81, 82, 83, are insulated from each other, and secured to the plate of the apparatus. The contacts 80, 81, 82, are formed by three, or rather four, springs, the spring contact 82 being closed in the position of rest, while the contacts 80 and 81 are open. These spring contacts are formed by a central spring 80' (Fig. 13), which is provided on its left side with two pins 254, 255, opposite which are two springs carrying each a pin. Arranged on the right side of the spring 80' in a pin 256 opposite which is the contact spring 257 which in turn carries a pin. As readily seen, these pins form the contacts 80 and 81 which in their nor-

mal position are open and the contact 82 which under normal conditions is closed.

Secured to one of the arms 306 is a certain number of extensions 144, 145, which are bent in a suitable manner, and the object of which is to close or to open at a given moment the spring contacts 81, 82, 83. A moment before the apparatus in the course of its rotary motion stops in the position in which the conversation can take place, the extension 144 touches the springs of the contact 81 and closes this contact for a moment (Fig. 14). A moment later, the said contact is again open and the apparatus stops, (Fig. 11).

When the apparatus after the conclusion of the conversation, has begun its motion, the second extension 145 touches the springs of the contact 80, closes the latter during a moment (Fig. 15), and opens it again an instant later.

During the continuation of the motion of the apparatus, the third extension finally enters into action, closing with its curved surfaces in a suitable manner the contacts 80 and 81 (Fig. 16), and opening at the same time the contact 82, these contacts being again set free a moment later. The apparatus finally stops definitely.

The contacts 83 (Fig. 1) are formed by two contact springs which when occupying their position of rest, are applied against one another by an extension 147 (Fig. 1) which is secured to the arm 306 and are thus closed.

As soon as the apparatus begins to leave this position of rest, the extension 147 leaves the spring 83 which under the influence of its elasticity, produces the opening of the contact, and this opening is maintained until the apparatus after having nearly entirely accomplished its revolution, arrives in the position in which the conversation takes place. At this moment, the extension 147 again engages the spring 83 and thus produces the closing of the contacts. When the conversation is concluded, the apparatus as it has been described above, and with it the extension 147, still perform a short movement until they have attained again their position of zero in which the spring contact 83 remains always closed.

The exchange apparatus (Figs. 17 to 23) is constructed as follows: Arranged on the stationary sector shaped plate 148 (Figs. 17 to 19) are three rows of contacts 354, 356, 358, which are insulated from each other, and on which slide three contact springs 355, 357, 359, which are also insulated from each other. These springs are secured to a tooth segment 150 which is adapted to move around the vertical shaft 149 and to be actuated by the pawl 151 (Figs. 18 to 21) engaging the tooth of the segment to this end, the pawl 151 is mount-

ed in rotary and yielding manner on a lever 152 (Fig. 21) arranged under the tooth segment 150 (Fig. 17), and carrying the armature 258 of the electro-magnet 321, so that the pawl 151 at each energizing of the electro-magnet 321, causes the tooth segment 150 as well as the sliding contacts 355, 357, 359, to advance step by step, and one tooth at a time in the direction of the arrow VIII.

10 A second pawl 153 (Figs. 17, 18), has for its object to lock the segment 150 when the pawl 151 slides backward after its advancing for the segment. The amplitude of motion of the lever 152 and that of the segment 150 is limited by abutments which are arranged in a suitable manner. The return motion of the lever 152 after it has effected the actuation of the segment, and the return motion of the latter after the conclusion of the telephonic conversation, are produced by tractional springs 154 and 155 (Fig. 18).

The advancing motion of the segment 150 (Fig. 18) does not take place during the conversation, but before the latter can be carried on, as before the conversation can take place it is necessary to cause the apparatus to move and with it the segment 150. It is only after this motion has been performed that the conversation can take place, as the lever 152 mounted in a rotary manner on shaft 149 is attracted by the electro-magnet 321 wherefrom it follows that the pawl 151 performs an actuating stroke (in the direction of the arrow VIII Fig. 18), and causes the segment 150 to move. As readily seen, this segment 150 moves in the same direction as the pawl 151.

At each to and fro motion of the lever 152 carrying the pawl, an abutment 156 mounted on this lever (Figs. 18, 21) closes and opens the spring contact 85 provided on the stationary plate 148. As soon as the toothed segment 150 with its sliding contacts 55, 57, 59, has arrived at the last contacts 54, 56, 58, arranged on the right side of Fig. 18, it closes through the instrumentality of an abutment 157 carried by it, a spring contact 88 mounted on the plate 148. When the toothed segment 150 returns into its starting position, the contact 88 is again opened.

Mounted on the framework of the apparatus are also two contacts 86 and 87 (Figs. 17, 18, 22), the contact 87 of which is closed and the contact 86 open when the members of the apparatus occupy their position of rest or position of zero, that is to say, when the toothed segment 150 occupies its position at the utmost left (Fig. 18). In fact, above these contacts a hook 158 (Fig. 22) is provided which is adapted to oscillate again a suitable pivot and carries an extension 159 on which the lever 160 of the armature 259 (Fig. 18) of the electro-magnet 337 is adapted to act. On the side of the con-

tacts 86, 87, is a lever 161 which is connected with the armature 260 of the electro-magnet 328. It results from this arrangement that when the electro-magnet 328 is excited, the contact springs 86, 87, are pressed against each other by the lever 161 acting in the direction of the arrow IX (Fig. 18); on the other hand, as soon as the circuit of the electro-magnet 328 is interrupted, the contact 87 is stopped by the hook 158 which produces the opening of the contact 87 and the closing of the contact 86. When the electro-magnet 337 is energized, the contacts 86, 87, again assume their position of rest owing to the raising of the hook 158. Provided on the armature 259 of the electro-magnet 337 is a lever 163 adapted to move around the pivot 162 and arranged opposite the pawls 151 and 153, the object of said lever being to produce the return motion of the toothed segment 150 in its position of rest.

As soon as the electro-magnet 337 is energized, the lever 163 disengages the pawls 151, 153, from the teeth of the toothed segment 150, thus allowing the latter to follow the action of the spring 155 and to return into its position of rest. At the same time, as it has already been stated above, the contacts 86, 87, and 88, are brought back into their respective positions of rest.

The excitation of the electro-magnet 337 is produced by the excitation of the electro-magnet 336 (Figs. 17, 16, 23) and to this end the armature 261 carries one of the springs of the contact 89, the opposite spring being mounted on the framework of the apparatus. Arranged opposite the spring cited in the first instance, is a hook 164 which is adapted to be actuated by the arm 165 secured to the toothed segment 150. When the members of the apparatus occupy their position of rest, the contact 89 is open, while in case of excitation of the electro-magnet 336, this contact is closed and is maintained in its closed position by the hook 164. However, as soon as the segment 150 has returned into its position of rest, or position of zero, the arm 165 causes the hook 164 to oscillate whereby the opening of the contact 89 is produced.

The construction of the two intermediate switches (Figs. 24 to 33) is absolutely identical and it is for this reason that only one of them has been shown and described. However, in order that it might be possible during the explanation of the function of the entire system to refer to both the intermediate switches, the reference numerals of certain members (that is to say of the electro-magnet and the contacts) of the second intermediary switches have been put between parentheses, while the other constitutive members of the intermediate switches (segments, levers, and so on) have

only been designated once in the usual manner in Figs. 24 to 33.

Each of the two intermediary switches (Figs. 24 to 33), comprises a certain number, which may vary according to the requirements of contact rows 360, 362, 364, 366, 368, 370, on which slide sliding contacts 361, 363, 365, 367, 369, 371, (Figs. 24 and 26). By "requirements" the following is to be understood: In the telephone exchange it is necessary to make use of a certain number of identical apparatus (exchange apparatus, intermediate switch apparatus, connecting-up apparatus) in order to allow the subscribers which are connected with these apparatus to select a second, third, and so on, (ordinarily ten per cent. of the number of the subscribers) apparatus in the case where one of the apparatus selected by the subscriber was occupied at his moment. This number is ordinarily ten per cent.; it may, however, be higher (fifteen per cent., etc.) which varies according to the intensity of working of the telephone system.

The sliding contacts are arranged in such a manner that they first advance step by step in the direction of the arrow *x* (Figs. 24 to 26), and it is in such a manner that at each step three rows of contacts can be touched at a time, as this has been indicated in Fig. 25 by the braces. During the first motion in the direction of the arrow X contacts 360, 362, 364, are not touched, but the sliding contacts move at the side of the contact rows.

Only during the second movement in the direction of the arrow XI (horizontal movement) Fig. 25, the three contacts 361, 363, 365, (367, 369, 371) slide at a time along three contact rows, each of the sliding contacts sliding on one row.

During the first movement of the contacts 361, 365, (367, 369, 371) in the direction shown by the arrow X, these contacts are placed on the side of the three lower rows. By performing their horizontal motion, the contacts frictionally engage the three lower contact rows and advance one contact at each step. When the sliding contacts have made two steps in the direction indicated by the arrow X, and afterward perform the horizontal motion XI, they frictionally engage the second of the rows of three contacts and so on during their advancing motion, as it has been said of the one contact at each step. In order to allow these two movements in the directions indicated by the arrows X and IX, the sliding contacts are movable around a horizontal shaft and around a vertical one. The framework 166 intended to carry the stationary contacts 360, 362, 364, (366, 368, 370), has received a corresponding shape and is curved when viewed from the side (Fig. 24) according to the circle which the sliding contacts describe by

moving around the horizontal shaft 167. Viewed from the top, (Fig. 25) the said framework is also curved according to the circle which the sliding contacts describe when performing their horizontal movement in the direction of the arrow XI around the vertical shaft 168.

The sliding contacts 361, 363, 365, (367, 369, 371) are secured to a second toothed segment 169 (Figs. 24, 26), which is adapted to oscillate around the shaft 167. The teeth of this segment are engaged by a pawl 170 adapted to oscillate on the lever 171 and controlled by a spring. The lever 171 is also adapted to move around the shaft 167 and is actuated by an electro-magnet 222, 224, so that the toothed segment and the sliding contacts actuated by the pawl 17 are advanced step by step in the direction indicated by the arrow X. A pawl 172 (Figs. 24, 27) has for its object to stop the segment 169 each time the pawl 170 moves backward. The lever 171 (Figs. 24, 26) moves between two stationary abutments 262 and the return motion after each advancing motion of the pawl is produced by a spring 173. The return motion of the toothed segment 169 after the raising of the pawls 170, 172, is effected by a spring 174.

The shaft 167 is mounted in a framework 175 bent twice at right angles (Figs. 24, 25, 27, and 28) and which is secured on a second toothed horizontal segment 176. The latter is adapted to oscillate on the vertical shaft 168 and is advanced step by step by a pawl 177 (Fig. 28) which is adapted to oscillate on the lever 178 and is controlled by a spring. This lever is also adapted to move around the shaft 168 and to receive an oscillatory motion by an electro-magnet 323 (325) so that through the medium of the pawl 177, the toothed segment 176, the framework 175, and the sliding contacts, are advanced step by step in the direction indicated by the arrow XI, the sliding contacts during these motions engaging those of the contact rows opposite which they have been brought previously by the first advancing movement in an arc to a circle in the direction of the arrow X. The pawl 179 at every receding motion of the pawl 177 serves to stop the segment 176. The amplitude of oscillation of the lever is here, too, limited in a suitable manner and its receding movement after every working is effected by the spring 180. The return motion of the segment 176 and that of the segment 169 which is mounted thereon is produced after the raising of the pawls 177, 179, by the traction of a spring 181. This intermediary switch comprises, besides, a certain number of contacts and electro-magnets, 90 (98) a contact (Figs. 25, 29, 30) which is closed when the members of the apparatus occupy their posi-

tion of rest. Arranged below this contact is a lever 182 which is adapted to be actuated by an electro-magnet 329 (331), while in front of the extreme surface of the contact spring 283, is the tooth 183 of a bent lever 184 adapted to oscillate on a pivot and to be actuated by the electro-magnet 339 (341). As soon as the electro-magnet 329 (331) is energized, the springs 263, 264 of the contact 90 (98) are raised by the armature lever 182 without their mutual contact being interrupted during this raising movement. After the circuit of the electro-magnet 329 (331) has been interrupted, the upper spring 263 comes to rest on the upper surface of the tooth 183, while the lower spring descends, thus producing the interruption of the contact 90 (98). When the electro-magnet 339 (341) is energized, the lever 184 which at the same time forms the armature of this electro-magnet, oscillates and produces by its motion the closing of the contact 90 (98).

The two contacts 93, 94, (101, 102) are each formed by two spring blades constructed in such a manner that in the position of rest, the contact 94 is closed, while the contact 93 is open, (Fig. 31). Below the spring a lever 185 is arranged, the left end of which forms the armature of the electro-magnet 330 (332). As readily seen, when this electro-magnet is energized, the right end of the lever which carries a screw, Fig. 31, oscillates upward and pushes the springs equally upward. As an insulating block 267 is inserted between the springs 265, 266, this block, when the spring 265 moves, presses against the lower spring 266 and raises it until it applies itself against the upper spring of the contact 93. During this movement of the springs, the spring 265 places itself above the upper surface of the tooth 186. Under the action of this spring, the bent lever 187 oscillates toward the springs thus allowing its tooth 186 to place itself under the spring 265 and to stop the latter. As soon as the current circulating in the winding of the electro-magnet 330 (332) is interrupted, the armature lever 185 oscillates downward and the spring 94 which before had been tensioned, follows this motion of the lever. The contact 94 is thus opened. The contact 93 on the contrary remains still open. This state of things lasts until the lever 187 is actuated, that is to say until the electro-magnet 339 is energized. The armature of this electro-magnet is provided with an extension 268 carrying a screw 269 (Fig. 24) which faces toward the lower end of the lever 187. When the electro-magnet 339 is energized, the screw strikes against the lever 187 and thus causes the bent lever 187 to move. The spring 265 is thus free and returns into its prior position, that is to say, into its position of rest in

which the contact 94 is closed and the contact 93 open. The levers 184 and 187 are juxtaposed on the same shaft of oscillation. They move at the same time when the electro-magnet 339 is energized.

The contact 91 is secured to the plate of the framework and is positioned at the right hand behind the toothed segment, Fig. 24. It is composed in turn of two springs forming together a contact.

To the toothed segment 169 an extension 188 is secured in such a manner that it bears in its position of rest against the right hand spring and holds this spring removed from the lefthand spring (Fig. 25). When the toothed segment 169 begins its movement, the extension 188 leaves the right hand spring which under the action of its elasticity presses against the left hand spring. The contact is closed from this moment.

When the segment 169 arrives again in its starting position, the extension 188 again bears against the righthand spring of the contact 91 and thus determines the opening of this contact.

On the side of the framework 175 the contact 92 (100) Figs. 25, 27, 28, is arranged which in its position of rest and during the whole movement of the segment 169 is closed; however, as soon as the horizontal rotary movement begins in the direction indicated by the arrow XI, the extension 189 (Fig. 27) of the framework 175 moves back from the springs of the contact 92 (100). The latter is consequently open. If, on the contrary, the segment arrives again in its position of rest, the aforesaid contact is again closed.

Arranged on the side of the lever 178 is the contact 97 (105), Fig. 28, which is secured to the framework and is open when the members of the apparatus occupy their position of rest, and during the advancing motion of the vertical segment. As soon as the lever 178 begins moving in order to cause the horizontal segment 169 to advance, the contact which has just been mentioned is alternatively opened and closed.

At the side and behind the horizontal segment 176 (Fig. 28), the contact 95 (103). Figs. 25, 27, is arranged which is open in the position of rest. As soon as the segment 176 performing its horizontal motion arrives with the sliding contacts 361, 363, 365, (367, 369, 371) at the last contacts 360', 362', 364', (366', 368', 370'), the contact 95 (103) is closed through the intermediary of an extension 190 (Figs. 27 and 28) secured to the segment 176 and remains closed as long as the segment 176 does not begin its receding motion.

The apparatus just described also comprises a disengaging device, which after the conclusion of the conversation, brings the segments 176, 169, the contacts 90 (98), 93, 13

94, (101, 102), 92 (100), and 91 (99), as well as the contact 95 (103) into their position of rest. This device comprises the electro-magnets 338 (340), 339 (341), Figs. 24, 25, the contacts 96 (104), Figs. 24, 25, 32, and the disengaging lever 191, Figs. 24, 25, 29, 33. The contact 96 (104) is open in its position of rest. One spring of this contact is connected with the armature of the electro-magnet 338 (340) which carries an extension which is directed toward a hook 193 (Fig. 32). The hook has an arm 194 which is directed toward the vertical plane. The disengaging lever 191 (Fig. 32) which is adapted to move around the pivot 195 is connected with the armature of the electro-magnet 339 (341), (Fig. 25 at the bottom and Fig. 28), and is arranged behind the pawls 177, 179, Fig. 28. This disengaging lever also carries secured to it two extensions 196, 197, (Figs. 24, 27, 28, and 33) which are positioned opposite the pawls 170, 172, of the vertical segment 169. When after the conclusion of the conversation, the electro-magnet 338 (340) is energized, the contact 96 (104) is closed, and extension 192 is held stationary by the hook 193 (Fig. 32). However, the closing of the contact 96 (104), reproduces the excitation of the electro-magnet 339, 341, the armature 191 (Fig. 25), of which moves and actuates the disengaging lever 191 which is connected with the armatures 191'. Now, this motion produces a motion of the levers 184, 187, so that the hooks 183, 186, (Figs. 29, 31) will set the contacts 90 (98), 93, 94, (101, 102) free after which these contacts return into their position of rest; at the same time, the pawls 177, 179, are raised (Fig. 28), thus producing the liberation of the horizontal toothed segment 169, which thus is allowed to return into its starting position. By this motion the contact 92 (100) is closed as the extension 189 applies itself against the said contact 92 (100); an instant later the extensions 196, 197, strike against the pawls 170, 172. These pawls 170, 172, carry at one of their ends (at the left end in Fig. 24), a tooth which engages the tooth of the segment 169, and at the opposite end a bevel extension (Fig. 24 at the right).

As soon as the sliding contacts 361, 363, 365, (367, 369, 371) leave the contacts 360, 362, 364, (366, 368, 370), the aforesaid extensions of the pawls 170, 172, strike against the abutments 196, 197 (Fig. 24) which are secured in such a manner to the lever 191 (Fig. 33) that their upper part exactly places itself under the extensions of the pawls 170, 172. The extension is raised by its incline (Fig. 24) while its opposite end is lowered and is thus disengaged from the teeth of the segment 169, which produces the liberation of the segment 169. At the moment when it arrives in the position of zero; the contact 91

(99), (Figs. 24, 26), is open and the arm 194 is raised so that the armature of the electro-magnet 338 (340) is freed, and the contact 96 (104) opened. In this manner, the current circulating in the electro-magnets 339 (341), is interrupted.

The connecting-up apparatus (Figs. 34 to 42) is constructed in a similar manner to the intermediary switch apparatus.

The bottom of the framework 198 (Fig. 34) which on the one end is curved according to the arc of a circle, and on the other hand is shaped like a part of an annulus, carries mounted thereon a certain number of contact rows 72, 74, above which two sliding contacts 73, 75, (Fig. 35) are adapted to move which, as in the intermediary switch apparatus, are secured to a vertical segment 199 which in the figure is shown in dotted lines and which through the instrumentality of a lever and pawl, is moved step by step by the electro-magnet 326 (shown in dotted lines in Fig. 34). The ascending motion in the direction of the arrow X only takes place here each time through a distance of two contact rows, as indicated by the braces in Fig. 34. The toothed segment 199 is arranged in a kind of stirrup 200, which is secured to the horizontal toothed segment 201. The latter is actuated as in the intermediary switch device, by means of pawls and a bent lever 202 by the electro-magnet 327 and this in the direction of the arrow XI, while the contacts 73 and 75 slide on the two rows of contacts 72, 74.

The contact 106 (Figs. 34, 42) is closed in the position of zero, or position of rest, and is actuated like the contacts 90 (98) of the intermediary switch apparatus by the electro-magnets 338 and 343. Arranged parallel to these contacts are contacts 112, 113, 114 (Figs. 34, 40, 41) which are actuated by the electro-magnets 335, 343, by means of the levers 203, and 204. The contact 113 is positioned between the contacts 112, 114. The contact 114 (Fig. 41) is closed in its position of rest. The contacts 112, 113, are open. These contacts are actuated like the contacts 93, 94, of the intermediary switch apparatus, the only difference consisting in that the springs and the parts pertaining thereto have been designated by other signs of reference. In the place of the contacts 90, 93, 94, (Figs. 29 to 31) we have here the contacts 106, 112, 113, 114, (Figs. 40, 41, 42); in the place of the levers 182, 185 the levers 203 and in the place of the lever 183, 184, and 186 and 187, the levers 204. The construction and the working of these members are besides the same as those described above.

As soon as the electro-magnet 335 is excited, the lower contact springs of the contacts 112, 113, 114, are raised and the contacts 112, 113, are closed. After the inter-

ruption of the circuit of the electro-magnet 335, the contact springs are stopped by the hooked levers 204 in such a manner that the contacts 112, 113, remain closed while the contact 114 is open. When the electro-magnet 343 is energized, the contacts return into their position of rest through the intermediary of the lever 204.

The contact 111 (Fig. 34) is constructed in the same manner as the contact 91 (99), Fig. 25, and is controlled by the vertical segment 199.

On the side of the extension 205 of the stirrup 200, or of the horizontal segment 201, contacts 116, 117, 118, (Figs. 34, 42) are arranged, which are formed of three double springs (Fig. 42). The contacts 116 and 117 are positioned one below the other; the contact 118 is to be found on the right end side of the contact 116 (as this has been shown by Fig. 42). All the contacts are mounted on an insulating member secured to the framework (Fig. 34) and extended with their ends to the extension 205 so that the left hand spring (Fig. 36) of the contact 118 bears against this extension 205 and is thus held closed while the contacts 116 and 117 remain open as they do not come into contact with the extension 205.

The rising motion of the segment 199 does not change its position, as the extension 205 is not shifted, but as soon as the segment 201 begins its horizontal motion, the extension 205 secured to its segment 201 moves with the latter away from the contact 118 (Fig. 42, direction of the arrow) whereby the opening of the contact 118 is produced and the closing of the contact 116, 117. When the segment 201 arrives in its position of rest, the contacts 116, 117, 118, again return into their original position.

Secured to the bent lever 202 is an extension 206 (Figs. 34, 36), at both sides of which are the contacts 107-110, secured to the framework. These contacts are formed by four double springs (Fig. 37) one 107, of which is positioned on the left hand side (Fig. 37) of the extension 206, while the other double springs 108, 109, 110, are positioned on the right hand side of same. The extension 206 applies itself against one of the halves of the double springs 107 and holds this contact closed, while the contacts 108, 109, and 110 remain open as the extension 206 does not touch them in the position of rest.

At the moment when the electro-magnet 327 actuating the bent lever 202 is excited, this bent lever 202 and its extension 206 move toward the right hand side (Fig. 37) so that this extension 206 applies itself against the contacts 108, 109, 110, and moves at the same time back from the contact 107.

It follows therefrom, the closing of the contacts 108, 109, and 110, and the opening

of the contact 107. If, thereafter, the circuit of the electro-magnet 327 is interrupted the extension again returns to its starting position and brings the contacts into their position of rest (contact 107, closed, contacts 108, 109, 110, open). Arranged at the side of the bent lever 202 is also the contact 115 and an electro-magnet 334 (Figs. 34, 39, 39^a). The contact 115 is closed when it occupies its position of rest. Opposite the bent lever 202, is the spring 207, which at each motion of the lever receives a reciprocating motion. This spring has a horizontal extension 208 above which a square 209 is arranged which is connected with the armature of the electro-magnet 334, and with the lower spring of the contact 115. The movement of the lever 202, causes the extension 208 to advance in the direction of the arrow (Fig. 39^a). When the electro-magnet 334 is energized, it attracts its armature and as the latter is secured to the square 209, the latter is also drawn downward; it results therefrom that its upper part (Fig. 39) also causes the lower spring of the contact 115 to move downward and thus produces the opening of the contact of this spring 115. In the meanwhile, the bent lever 202 has achieved its forward movement and begins its backward movement. The electro-magnet 334 loses its current. The square 209, as above explained, having been drawn downward, has consequently arrived under the horizontal lower surface of the extension 208 (Fig. 39^a). If later on the bent lever 202 moves backward, the spring 209 and its extension 208 also perform a movement in the same direction as the lever 202, (toward the left hand side in Fig. 39^a), the extension 208 having slipped over the square 209 (extension 208 above, square 209 below, springs 115 open). All the members remain in this position until the bent lever 202 begins its second forward motion, producing the energizing of the electro-magnet 327. At this moment, two alternatives are present. In fact, if the bent lever 202 performs its forward motion, it is necessary to cause, as above described, the spring 207 to advance again toward the right in Fig. 39^a and thus cause the extension 208 to be removed in the same direction so that said extension is no longer placed above the square 209. At this moment the bent lever 202 has performed its advancing motion. If afterward the electro-magnet 334 is energized, it attracts once for all its armature, and with it the square 209 which is connected thereto so that the removal of the extension 208 has no action on the square 209 and that the latter always remains in the same position. As soon as the electro-magnet loses its current, it is evident that it no longer attracts its armature, and the square. When the extension 208 has been removed,

the square 209 readily moves forward and arrives above the upper surface of the extension 208. The springs 115 are in this manner again put into contact with each other, and the contact is closed. When the bent lever has begun its return motion, the spring 207 performs the same motion and the extension 208 again places itself below the square 209, that is to say, in its original position.

As long as the bent lever 202, after its first forward and backward motion does not move a second time, all the members evidently remain in the same position (extension 209 above, square 208 below, spring contact 115 open) and it is up to the moment when the entire apparatus and consequently the device described above have been brought back into their position of zero.

This apparatus is also provided with a disengaging device which is constructed in about the same manner as that of the intermediary switch apparatus, and works in the same manner. This device comprises two electro-magnets 342 and 342' (Fig. 34), the contact 119, the extension 210, the hook 211, with the extension 212, and the disengaging lever 213 and its extensions intended to actuate the pawls of the horizontal and vertical segments, that is to say that these extensions work like those of the intermediary switch apparatus. However, in this apparatus, the disengaging lever carries secured thereto still another extension 214; the hooked upper end (Fig. 34) extends to the spring 207. The latter is curved in such a manner that the extension 214, when the disengaging lever is actuated moves toward the springs 207 (toward the left hand side in Fig. 34) until it arrives at the obliquely bent surface of the spring 207, and removes this spring by pushing it backward. In the above described case, that is to say, when the square 209 is positioned under the extension 208, the extension has removed toward the righthand side in Fig. 39^a, which allows the square 209 to move suddenly upward in its original position.

It will be readily seen that the disengaging device described above, brings back into their position of rest all the members which during the working of the apparatus have been removed from this position of rest. These members are the following: the contacts 106, 112, 113, 114; the segment 201; the contacts 116, 118, 115; the segment 199; and the contact 111, thereafter, thanks to the intervention of the arm 212, and the hook 211; the contact 119 is interrupted and it is in a manner which is similar to that described for the intermediary switch apparatus.

The intermediary switch apparatus and the connecting-up apparatus described

above, are united by groups and this in such a manner that each of these groups comprises ten identical apparatus, having for their object to allow of the selection of a non-engaged apparatus. The horizontal rows of contacts 354, 356, 358, and 360, 362, 264, (366, 368, 370) serve to allow this selection of a non-engaged apparatus and with each of these rows the ten identical apparatus are connected. This division into groups is shown by Fig. 44. It may be stated with reference to this figure, that in order to simplify matters, instead of the ten identical apparatus, one only of those apparatus, and in each of the latter instead of the ten identical contacts, only one of these contacts, have been shown.

From each subscriber, two lines lead to the exchange. Fig. 44 only shows one of these conductors so as to not complicate the figures of the drawing. The lines end in the exchange apparatus of the corresponding subscriber (Fig. 43^a, contacts 365, 388, and the electro-magnet 321, first line, contact 357; and electro-magnet 336, second line).

In the exchange apparatus the horizontal rows of contacts 354, 356, 358, are connected with conductors which lead from the exchange apparatus to the various intermediary switch apparatus I. The same arrangement is repeated in the intermediary switch apparatus I and II in which the horizontal contact rows are likewise connected with conductors, and in the intermediary switch apparatus I the conductors starting from the contact rows 360, 362, 364, lead to the intermediate switch apparatus II and in the latter from the contact rows 366, 368, 370, to the connecting-up apparatus. In the latter, the various subscribers are directly connected with the contact rows 72, 74, and this in the following manner: The connecting-up apparatus are divided into groups in such a manner that there be a group of connecting-up apparatus for each thousand of subscribers. In fact, in each of the connecting-up apparatus a hundred subscribers are connected with the rows of contacts 72, 74, (ten times ten rows of contacts). Now for these hundred subscribers there is not a single well determined connecting-up apparatus, as in this case the free selection would not be possible, but there are ten identical apparatus, that is to say, that the contacts 72, 74, are repeated in all the connecting-up apparatus, and all the respective contacts 72 and 74, of all the ten apparatus are connected between each other. It results from this arrangement that a conductor with ten branch lines appertains to each of the respective contacts 72 and 74. These conductors 100 are directly connected with the corresponding subscribers, that is to say, that the first

conductor is connected with the first subscriber and so on (Fig. 44 right hand side of the top).

As readily seen, the first hundred of the subscribers (0-99) is connected with the first ten identical connecting-up apparatus. The second hundred (100 to 199) also has its ten identical apparatus. The contacts 72 and 74 are connected between each other in the same manner and lead also to the connected subscribers (second hundred). The same arrangement is repeated for the other hundreds, that is to say, the third, fourth, and so on hundred, up to the tenth hundred. One obtains in this manner the first group which, as will be easily understood, is intended for the first thousand of subscribers (0 to 999), (Fig. 44, at the top and on the right hand) and comprises one hundred connecting up apparatus (ten times ten identical apparatus).

The second group for the second thousand (1000 to 1999) and the third group (2000 to 2999) and so on, are arranged in the same manner. If, consequently, there are ten groups 10,000 subscribers will be connected therewith (1000 for each group). The connecting up apparatus are connected besides by means of conductors with the intermediate switch apparatus II and this in the following manner:—There are ten first identical aforesaid connecting-up apparatus for the subscribers 0 to 99 conductors, the first of which starts from the electro-magnets 327, and 333, the second from the contacts 112, 113, 117, 118, and from the electro-magnet 342 (Fig. 43) leading to the horizontal contact rows 366, 368, 370, of the intermediate switch apparatus II, and this to the first row 366 *et al.*, Fig. 44. Each of these rows is formed of three rows of ten individual contacts (Fig. 25); the aforesaid contacts of the first of the ten connecting-up apparatus leading to the first three contacts of this row. These three contacts are designated in the Fig. 25 by *a'''*. Those of the second, etc., connecting-up apparatus leading to the second, third, etc., contacts and those of the tenth to the tenth contacts. It is easily seen that the ten first identical connecting-up apparatus are connected with the first row of contacts.

From the ten second identical connecting-up apparatus (subscribers 100 to 199), the conductors lead in the same manner to the second contact row of the same intermediary switch apparatus II, from the third connecting-up apparatus etc., to the third etc. row, and finally from the tenth apparatus to the tenth row. It is readily seen that 100 connecting-up apparatus (first group of subscribers 999) are connected with these ten rows. Just as for the connecting-up apparatus, there are also ten identical intermediary switch apparatus II, that is to say,

that the three hundred (100 times 3) contacts, 366, 368, 370, are repeated in the ten intermediary switch apparatus II, in the same manner as described for the connecting-up apparatus. It follows from the foregoing that for the 100 aforesaid connecting-up apparatus, there are ten identical intermediary switch apparatus II, (first group subscribers No. 0 to 999).

In the second group of subscribers No. 1000 to 1999 the conductors lead also from the 100 connecting-up apparatus intended for this group to the ten other identical intermediary switch apparatus II, and in an analogous manner from the third to the tenth group. As readily seen, there are ten times ten, or one hundred intermediary switch apparatus II. Now, the intermediary switch apparatus II are connected by conductors with the intermediary switch apparatus I, and this in the following manner: The conductors of the ten aforesaid identical intermediary switch apparatus II (subscribers No. 0 to 999) lead to the contacts of the horizontal contact row 360, 362, 364, of the intermediary switch apparatus I, the first conductor 360 starting from the contacts 99, 101, 103, and from the electro-magnet 331 the second conductor 362 from the contacts 101, 103 and from the electromagnet 331 and the third conductor 364, from the contact 71, and from the electro-magnet 340 (Fig. 43) and lead to the first row of contacts 360, 362, 364, that is to say, that the conductors of the first intermediary switch apparatus II, lead to the three first contacts of the row and the conductors of the second, etc., intermediary switch apparatus to the second contacts. It is readily seen that the ten first identical intermediary switch apparatus are connected with the first row of contacts.

The ten second identical intermediary switch apparatus II (subscribers No. 1000 to 1999) are connected with the second row of contacts and so on, that is to say, that the tenth intermediary switch apparatus are connected with the tenth row. There are consequently ten intermediary switch apparatus I with the contact rows of which the hundred intermediary switch apparatus II are connected. However, as one must take into account the necessity of the selection of the apparatus, these apparatus are repeated, that is to say instead of ten intermediary switch apparatus I, a hundred have been provided by groups of ten identical apparatus. The contacts 360, 362, 364, are repeated in these ten identical intermediary switch apparatus I in the same manner as the contacts 366, 368, 370, in the intermediary switch apparatus II. As readily seen, there are one hundred intermediary switch apparatus I. Now, these interme-

diary switch apparatus I are connected in the following manner with the exchange apparatus:—The exchange apparatus only comprises three rows of contacts 354, 356, 358, or one row of contacts comprising three rows at the contacts of which end three conductors (the first of which comes from the contacts 91, 93, 95, and from the electro-magnet 329, the second from the contacts 363, 92, and from the electro-magnet 338, and the third from the contact 363 and from the electro-magnet 338 (Fig. 43). Every one hundred of the exchange apparatus forms a group, that is to say, their contacts 354, 356, 358, are connected between each other by means of conductors just as in the intermediary switch apparatus. There are three conductors comprising each 100 branch conductors, there are consequently 10 times 3, or 30, conductors which lead to the group of 100 exchange apparatus. Now, of these aforesaid intermediary switch apparatus I, ten are associated with this group. These are the ten first identical intermediary switch apparatus I. The three aforesaid conductors carry first contacts 354, 356, 358, leading to the first intermediary switch apparatus I (Fig. 44), the conductors starting from the second contacts 354, 356, 358, leading to the second intermediary switch apparatus I, and so on; those starting from the tenth contacts 354, 356, 358, lead to the tenth intermediary switch apparatus I.

The first group of 100 exchange apparatus comprises connections with the subscribers 0 to 99. The second group of 100 exchange apparatus (subscribers No. 100 to 199) is constructed in the same manner as the first group. Its conductors lead to the second ten identical intermediate switch apparatuses I. The same remark can be made for the third etc. to the tenth group (subscribers 200 to 299, 900 to 999); the respective conductors lead to the third etc. to the tenth identical intermediate switch apparatus. These ten groups form the first main group (subscribers No. 0 to 999). The second main group (subscribers No. 1000 to 1999) and the third etc. up to the tenth group are constructed in exactly the same manner as the first main group. Each of them is divided into ten groups, the conductors of which lead to ten identical intermediate switch apparatus, but which naturally are not those of the first main group (Fig. 44, intermediate switch apparatus I, 1st, 1st, and so on).

The conductors leading to the connecting-up apparatus (and coming from the intermediary switch apparatus II, contact 366 a—b) lead through all the ten main groups, (Fig. 44). They are constructed in each main group identically in the same manner as above described for the connecting-up apparatus.

The working of the entire plan is as follows: When a subscriber desires to ask the communication with another subscriber having for instance the number 4825, he engages the pins 316, 319 into the openings 312, 313, 314, 315, of the apparatus annexed to his telephone apparatus. These pins, in the example chosen, must be introduced in the first row 312 (thousands) under the Fig. 4 (Fig. 8) in the second row 313 (hundreds) under the Fig. 8, in the third row 314 (tens) under the Fig. 2 and in the fourth row 315 (units) under the Fig. 5. The subscriber thereafter lowers the lever 125 (in the direction of the arrow V) and hereafter releases it again. The balance beam 130 then oscillates in the manner described above, thus freeing the arm 132 and allowing the apparatus to start, the shaft 307 carrying the bent levers 302, 303, 304, 305, therefore rotates in the direction of the arrow III. The bent levers 302, 303, 304, carrying the contacts 352, slide over the contacts 351 and 353, the lever 302 entering into action first, then the lever 303, finally the lever 304. The aforesaid levers slide on all the contacts 351, while the levers 302, 303, 304, only slide on the contacts 353 until their extensions 311 come into contact with the corresponding pins (316—318). At this moment, the lever 302 is raised and received by the spring tooth 310¹. As readily seen, this lever from this moment continues its motion without sliding on the contacts 353. The lever 305 by reason of its bent direction in an opposite direction, rubs with this contact exclusively on the contacts 351 and this only until its extension strikes against the pin 319 of the fourth row 315. The contacts 353 are arranged with reference to the figures designating the openings 312, 313, 314, 315, (Fig. 7) in such a relation that each of these figures 0 to 9 correspond to contact 353. One consequently obtains always an impulse of current, that is to say, even when the pins 316 to 319 are engaged into the openings 312 to 315, which are designated by 0, it is readily seen there is one impulse of current more than indicated by the figure of the opening into which the pin has been inserted.

The aforesaid contacts act in the following manner on the apparatus arranged at the exchange office, that is to say, on the apparatus Z, ZwI, ZwII, and V, (Fig. 43). The lever 302 first rubs on all the contacts 351. It thus produces in the exchange apparatus belonging to the calling subscriber (Fig. 17), the excitation of the electro-magnet 321 (circuit 120—87—321 line of the calling subscriber 351, 350, 82—earth—120). In this manner the toothed segment of the exchange apparatus is actuated. The contacts 355, 357, 359 (Fig. 18) rub on the contacts 354, 356, 358, until they arrive at the contacts of those rows which are connected with

a non-engaged intermediary switch apparatus *ZwI*, the contact 90 (Fig. 25) of which is closed, and the electro-magnet 329 of which has not yet been energized; in fact, if as above stated, the said excitation has already taken place, the contact 90 is open and the circuit of this intermediate switch apparatus *ZwI* is interrupted. This means that the considered intermediary switch apparatus is "engaged". It is therefore not possible as long as the contact 90 is interrupted that an exchange apparatus connects itself up with it. The excitation of the electro-magnet 329 (Fig. 25) takes place when the contact 355 (Fig. 18) arrives at the contact 354 (Fig. 18), which is connected with the said free, or not engaged, intermediary switch apparatus *ZwI*. In fact, each excitation of the electro-magnet 321 (Figs. 17, 18) produces the closing of the contact 85 (Fig. 18) and from this moment the current finds a free way through the electro-magnet 328 (Figs. 17, 18) of the exchange apparatus of the calling subscriber and the electro-magnet 329 (Fig. 25) of the disengaged intermediary switch apparatus *ZwI* (circuit 121, 85 (Fig. 18) 328 (Figs. 17, 18) 355, 354, conductor leading to the disengaged intermediary switch apparatus *ZwI* (Figs. 24, 25), 329, 90, (Fig. 25) 121. The electromagnets 328 (Fig. 17) and 329 (Fig. 25) are energized so that the armature of the electro-magnet 328 causes the contacts 86 and 87 to move while the electromagnet 329 actuates the contact 90 without producing, however, during this motion the opening of the contacts 87 and 90. When the lever 302 of the apparatus annexed to the telephone of the subscriber (Fig. 1) arrives at an insulating layer separating the contacts 351, the circuit of the electromagnet 321 is interrupted, its armature suddenly returns into its starting position and thus produces the interruption of the contact 85, and consequently also that of the circuit of the electro-magnets 328 and 329 (Figs. 17, 25), the spring contacts 87 and 90 are opened, and contact 86 closed. (The manner in which this closing takes place has been explained in the course of the description of the apparatus.) The lever 302 then slides over the remaining contacts 351 without causing the passage of any current, as the circuit controlling the electro-magnet 321 is opened at the contact 87, which at this moment is open. The lever 302 then arrives at the contacts 353, thus producing the closure of the circuit of the electro-magnet 322 (Fig. 24) of the selected disengaged intermediary switch apparatus *ZwI*. (Circuit: 120 (Fig. 43) 322 (Fig. 24), 92 (Fig. 25), 356, 357, (Figs. 17, 18), 353, 350 (Fig. 6), 82 (Figs. 1, 13, 16), 120). The electro-magnet 322 attracts its armature and causes the segment 169 (Figs. 24, 25, 26), as well as the sliding contacts 361, 363, 365

(Figs. 24, 25) to move in the direction of the arrow *x* on the side of the contact rows 360, 362, 364, (Figs. 24, 25). At the moment when the first excitation takes place, the contact 91 (Fig. 24) is closed. The number of the excitations of the electro-magnet 322 (Fig. 24) depends upon the number of contacts 353 (Fig. 1) on which the lever 302 slides.

As it has already been stated above, the said number is determined by the position of the pin 316 in the row 312, that is to say by the number of thousands contained in the number of the subscriber called. Consequently, if, as this has been supposed by way of example, the pin 316 is positioned according to the Fig. 6, the springs 361, 363, 365, slide over five contacts 353, and send five current impulses into the electro-magnet 322. If, at this moment, the lever 302 is raised by the pin 316, the contacts 353 are no longer engaged, and the sliding contacts 361, 363, 365, (Figs. 25, 26) stop at the side of the fifth row of three contacts 360, 362, 364. As readily seen in this manner the desired number of thousands has been called. The lever 302 then continues its motion in its raised position until it arrives at the inclined metal sheet 320 (Fig. 1) which lowers the lower spring 310 so that the lever 302 is brought back into its position of starting.

The contacts 361, 363, 365, have been brought in front of the row of contacts 360, 362, 364, of the intermediary switch apparatus *ZwI* which are connected with the ten intermediate switch apparatus *ZwII*, corresponding to the number of thousands in the number of the subscriber called. The lever 303 enters into action when the raised lever 302 has passed the last contact 353 and first slides over the contacts 351 and afterward over the contacts 353, like the lever 302. The effect of the current impulses thus produced is also the same as for the lever 302, with this difference, however, that when the lever 303 slides over the contacts 351, the electro-magnet 323 (24, 25, 27, 28) of the intermediary switch apparatus *ZwI* is energized (circuit: 120, 94 (Figs. 24, 30), 323, 91 (Figs. 24, 25), 354 (Figs. 17, 18), 355, 86 (Figs. 17, 18), 351 (Figs. 1 to 16), 350, 82, (Fig. 1), 120) with the result that the horizontal segment 176 (Figs. 24 and 25) is moved over the horizontal rows of contacts. At the first step the contact 92 (Figs. 25, 28) is interrupted. Now, if the contacts 361, 363, 365 (Figs. 24, 26) arrive at the contacts of the rows 360, 362, 364, which correspond to a disengaged switch apparatus *ZwII*, the electro-magnets 330 (Figs. 24, 25) of the intermediate switch apparatus *ZwI* and 331 (Figs. 24, 25) of the disengaged intermediate switch apparatus *ZwII* are energized (circuit: 121 (Fig. 130

43), 97 (Figs. 28, 30), 61 (Fig. 24), 360 (Figs. 24, 25), 331, 98, (Fig. 25) 121). The circuit of the electromagnet 323 and afterward that of the electro-magnets 330 and 331, are then interrupted just as this was the case for the electro-magnets 321, 328, 329, and the horizontal segment 176 of the intermediate switch apparatus *ZwI* stops at the contacts 360, 362, 364, which correspond to the disengaged intermediate switch apparatus *ZwII*. When afterward, the lever 303 (Fig. 1) slides over the contacts 353, the vertical segment 169 (Fig. 24) of the intermediate switch apparatus *ZwII* moves upward. The following circuit is then closed for the electro-magnet 324; 120, 324 (Figs. 24, 26), 100 (Figs. 25, 26), 362, 363, 356, 357 (Figs. 17 and 18), 353, 350, 82 (Fig. 1), 120 wherefrom it follows that the subscriber calls the desired number of hundreds, that is to say, that he brings the contacts 367, 369, 371, (Fig. 26) in front of that row of contacts 366, 368, 370 (Fig. 24) which are connected with the ten connecting-up apparatus V (Figs. 43, 34, to 42) of the hundred contained in the number of the called subscriber. The first movement of the segment 169 produces the closure of the contact 99 (Figs. 25, 27). After this the third lever 304 enters into action and this again when the lever 303 has passed the last contact 353. It slides over the same contacts 351, 353, and produces the same effects as the first, and the second levers 302 and 303, with this difference, however, that this time it is the horizontal segment 176 of the intermediate switch apparatus *ZwII* which is caused to move. A circuit 120 (Fig. 43), 102 (Figs. 24, 25), 325 (Fig. 24), 99 (Fig. 25), 360, 361 (Fig. 24), 93 (Figs. 31, 24), 354, 355 (Fig. 18), 86, 351 (Figs. 1, 7) 350, 82 (Fig. 1), 120 is closed which allows of a non-engaged connecting-up apparatus being selected, the electromagnets 330 (Fig. 25) and 333 (Fig. 34) being excited to this end. The circuit allowing of this selection being performed, is the following one: 121, 105 (Fig. 28), 332 (Fig. 25), 367, 366, (Figs. 24, 25, 26), 333, 106 (Fig. 4), 121. The first movement of the segment 176 produces the opening of the contact 100 (Figs. 25, 28). During the motion of the lever 304 over the contacts 353, it energizes the electro-magnet 326 of the disengaged connecting-up apparatus whereby the number of tens contained in the number of the subscriber to be called can be called. As readily seen, the vertical segment 199 (Fig. 34) is thereby brought with the contacts 73, 75, in front of that row of contacts with which the tens of the number of the subscriber to be called are connected. The first movement of the segment 199 produces the closure of the contact 111. Finally, the lever 305 enters into action. This lever unlocks

the levers 302, 303, 304, only slides over the contacts 351. According to the position of the opening of the row 315 in which the pin 319 has been inserted a corresponding number of contacts of the row 351 is closed. The lever 305 is raised at the contact carrying the pin 319, and consequently does not at all come into contact with the contacts 353. It results therefrom that the electro-magnet 327 of the connecting-up apparatus (Fig. 34) is energized (circuit: 120, 111, (Fig. 34), 327, 366, (Figs. 24, 25), 367, 101, (Fig. 31), 360, 361, 93, 354, 355 (Figs. 17, 18), 86, 351, 350, 82, (Fig. 1), 120) and thus as many times as indicated by the figure under which the opening of the row of contacts 315 in which the pin 319 has been engaged is situated. In this manner the horizontal segment 201 of the connecting-up apparatus is moved and this over the horizontal rows in the direction of the arrow XI, thus establishing in this row the connection with the units comprised in the number of the subscriber called. The first movement of the horizontal segment 201 produces the closure of the contacts 116, 117, and the opening of the contacts 118 (Fig. 34).

When the fourth lever 305 has passed in front of the row of contacts 351, the extension 144 secured to the arm 306 of the bent lever 303, engages the contact 81 (Fig. 1) and closes this contact (Fig. 14), thus producing the excitation of the electro-magnet 335 of the connecting-up apparatus. The circuit closed in this manner is the following: 120, 335, 114, 117, (Fig. 43) 368, 369, 362, 363, (Figs. 25, 26), 356, 357, (Fig. 17), 81, 82, (Fig. 1), 120. In this manner the contacts 112, 113, 114, (Fig. 34) are actuated without the spring contact 114 being open. Furthermore, the extension 134 (Fig. 1) arrives at the extension 137 (Fig. 11) and the apparatus annexed to the telephone apparatus of the calling subscriber comes to a standstill; the contacts 83 (Fig. 1) of the subscribers call apparatus are again closed. At this moment, a conductive connection is existing between the calling subscriber and the subscriber called up, and the conversation again takes place after the usual calls by means of the magneto electric inductor, and the bell coöperating with the latter. The conversation circuit starting from the earth lead of the telephonic apparatus of the calling apparatus is as follows: 83 (Fig. 1), 357, 356, (Figs. 17, 18) 363, 362, 369, 368, (Figs. 24, 25, 26), 112, 115, 73, 72 (Fig. 34) to the called subscriber, 356, 357, (Figs. 17, 18) 83, (Fig. 1) and back to the earth after having passed through the telephonic apparatus of the subscriber called. The ringing circuit is the same as the foregoing, except that this circuit includes the contacts closed by the removal of the receiver from

the hook 140, the line controlled thereby, and the bell, as shown in Fig. 43^a.

If, after the subscriber A has been connected-up with the subscriber B, a third subscriber C calls the same number as the first subscriber A, the speaking circuit of this third subscriber is cut, thanks to the presence of the electromagnet 334 (Figs. 34, 39), and thanks also to the connection between all the contacts 74 (Figs. 34, 39, 39^a, 43), belonging to a called subscriber.

The contacts 74 of the connecting-up apparatus with which, as above described, each time a pair of a given hundred subscribers (No. 0 to 99) are connected between each other, by means of conductors in such a manner that these conductors 74 are successively connected between each other by means of conductors when the connecting-up apparatus belonging to these hundred subscribers, that is to say, that the first contact 74 of the first connecting-up apparatus (subscriber No. 0) is connected by means of conductors with all the first contacts 74 of the remaining nine connecting-up apparatus. As readily seen, there is one line with ten branch lines. The same remarks apply to the second, third, and so on, subscriber.

In the connecting-up apparatus with which the second hundred of subscribers is connected, the same arrangement is to be found again as well as for the third, fourth, and so on, hundreds.

When the contact 75 of the vertical segment 199 (Fig. 34) of the connecting up apparatus intended to establish the connection for the subscriber No. 0, arrives at a contact 74 which is equivalent, that is to say, which belongs to the same subscriber B and on which the contact 75 is already placed in another connecting-up apparatus, the following happens: Each excitation of the electro-magnet 327 (Figs. 34, 39) produced by the lever 305, produces the opening of the spring contact 107 and the closing of the contacts 108, 109, 110, (Figs. 34, 36). During the return motion of the lever 206, (Figs. 34, 36) actuating this contact the aforesaid contacts again arrive in their position of rest. Now, when the horizontal segment of the connecting-up apparatus which is intended to make this connection has arrived at a contact 74 which is already occupied by the first subscriber A, the contact 108 is closed, whereby the current finds its way to the electro-magnet 334 (Fig. 34) of the third subscriber C circuit (Fig. 43). 123, 334, 108, 75, 74, to the first subscriber A; that is to say, to the contact 74 of the latter, 75, 107 (closed) 116, 123. The electro-magnet 334 of the subscriber C, is energized and presses downward the lower spring of the contact 115 thereby causing its interruption as it has been described above. In this manner, the speaking circuit

going from the third subscriber C, to the second one is interrupted at 115 (Figs. 34, 39).

When the conversation is concluded, the calling subscriber hangs his telephonic receiver on the hook (Fig. 1), thereby producing the lowering of the lever 140 (Figs. 1, 2, 12), the shifting of the lever 135, the separation of the connection 134, 137, so that the apparatus annexed to the telephonic apparatus of the calling subscriber can continue its rotary motion in the manner described. During this rotary motion, the extension 145 (Fig. 1) closes the contact 80 (Fig. 15), thus determining the actuation of the disengaged devices. In fact, the closing of the contact 80 produces the excitation of the electro-magnet 327 (Fig. 34) of the connecting-up apparatus (circuit 120 (Fig. 43), 111, 327 (Fig. 34), 366, 367 (Figs. 20-25), 101, 360, 361, 93, (Fig. 31), 354, 355, 86, (Figs. 17-18), 80, 82 (Fig. 1) 120), thus causing the contacts 109, 110 (Fig. 34) actuated by the lever 206 of the electro-magnet 327 to be closed. The disengaged current thus finds the following way open: 122, 109, 113 (Fig. 34). From here the current is divided and one part of it goes to the electro-magnet 342 (Fig. 34) and the contacts 110, 122, while the main part of the current 368, 369, contacts its way and again divides itself in order to flow afterward to 340, 371, 370 (Figs. 34, 25), 110 (Fig. 43), 122 and to continue toward 338, 365, 364, 71, 370, (Fig. 25), 110, (Fig. 34), 122; and finally to 356, 357, 336, 359, 358 (Figs. 17, 18) 365, 364, 371, 370, (Fig. 25), 110 (Fig. 34) 122. In this manner, the electro-magnets 342 (Fig. 34), 340, 338, (Fig. 25) and 336 (Figs. 17, 18), are energized at the same time, thus producing the closing of the contacts 119, (Fig. 34), 104, 96 (Fig. 24) and 89 (Figs. 17, 18, 23). Thus the current can arrive at the electro-magnets 343 (Fig. 34) 341, 339 (Fig. 24) and 337 (Figs. 17, 18) according to the following circuits: 122, 119, 343 (Fig. 34) 122; 122, 104, 341 (Fig. 24) 122; 122, 96, 339, (Fig. 24) 122; 122, 89, 37 (Figs. 17, 18) 122. The disengaging magnets 343, 341, 339, and 337, thus attract their armatures and successively bring all the parts of the apparatus which have been moved, back into their positions of rest, as this has already been described; thus the contacts 119 (334) 104, 96, (Fig. 24), 89, (Figs. 17, 18) are opened. After the close of the contacts 80, 81 (Fig. 1) of which mention will be made later on, the apparatus annexed to the telephone of the calling subscriber (Figs. 1 to 17) comes to a standstill as it is stopped by the balance beam 130, and the abutment 131. It is from this moment possible to call another subscriber.

It may happen that none of the ten co-

operating intermediate switch apparatus *ZwI*, or none of the intermediate switch apparatus *ZwII*, or finally, none of the connecting-up apparatus, be disengaged, that is to say, that all the apparatus with which the calling subscriber would connect himself up, are engaged. For this case, the following device has been provided in the apparatus:

1. If all the ten intermediate switch apparatus *ZwI* of the group of hundred subscribers attributed to the exchange apparatus are engaged, so that the calling exchange apparatus, that is to say, the eleventh exchange apparatus (as already ten exchange apparatus have called before) does not find a disengaged intermediate apparatus, the contacts 355, 357, 359, (Figs. 17, 18) of the exchange apparatus pass over all the contacts of the contact rows 354, 356, 358, without any current impulse adapted to actuate the electromagnets 328, (Figs. 17, 18) and 329 (Figs. 24, 25) being produced, as precisely all the ten intermediary switch apparatus *ZwI* are "engaged," that is to say, that their spring contacts 90 (Fig. 29) are open. In this case, the contacts 355, 357, 359 (Figs. 17, 18) arrive at the last contacts of the rows 354, 356, 358, (Fig. 18) where the tooth segment 150 is stopped by an extension and is prevented from continuing its movement. By this motion, the contact 88 is closed by means of the extension 157 (Fig. 18) as this has been described above. When the lever 302 on the subscriber's call apparatus continues its motion and slides over the contacts 353, it does not produce any effect; nor do the levers 303, 304, 305, sliding over the contacts 351, and 353. The toothed segment 150 (Fig. 18), remains still in this final position on the contact 88. When the subscriber's call apparatus comes to a standstill (speaking position), the calling subscriber has evidently not been connected up with the subscriber calling, therefore, when the calling subscriber hangs his telephonic receiver on the hook, his call apparatus again resumes its movement and produces as above described, the closing of the contacts 80 and 81 (Fig. 1) while at the same time opening the contact 82 (Fig. 16). In this manner, the contacts 80 and 81 are closed, and the disengaging current finds the circuit 122, 88 (Figs. 24, 25) 80, 81 (Fig. 1) 336, 359 (Figs. 17, 18) last contact 358, 122, whereby the electro-magnet 336 is energized. This electromagnet by closing the contact 89 (Figs. 18, 23) energizes the electro-magnet 337 (Figs. 17, 18) circuit: 122; 89, 337 (Figs. 17, 18, 23), 122, and brings the exchange apparatus (Figs. 17 to 23) back into its position of rest.

2. When one of the ten intermediate switch apparatus *ZwI* (Figs. 21 to 33) is disengaged, and thus can be employed for

connecting up purposes, while on the other hand all the intermediate switch apparatus *ZwII* belonging thereto, are occupied, it is still impossible to obtain the telephonic connection with the subscriber called. In fact, the electro-magnet 321 (Figs. 17, 18), and the electro-magnets 328 (Figs. 1, 7, 18), and 329 (Figs. 24, 25, for selection of a disengaged intermediate switch apparatus *ZwI*) as well as the electro-magnets 322, and 323 (Figs. 24 and 25) are energized in the manner already described. It is easily seen that the contacts 361, 363, 365, (Figs. 24, 25) just as in case 1, place themselves on the last contact of rows 360, 362, 364, where the segment 176 (Fig. 25) stops and where the contact 95 (Fig. 25) is closed, the other contacts of the levers 303, 304, 305, do not produce any effect. As readily seen, there has been no connection allowing of the conversation being carried out, and after the setting free of the subscriber's call apparatus (Figs. 1 to 16) by the hanging up of the telephonic receiver, the contacts 80, 81, are again closed. In this manner, the disengaging electro-magnets 336 (Figs. 17, 18) and 338 (Figs. 24, 25) are energized (circuit 122, 95 (Figs. 25, 28), 354, 355, 386 (Figs. 17, 18) 80, 81: from here the current is split up, a part thereof flowing to 336, 339, 358 (Figs. 17, 18), 365 (Figs. 24, 25) last contact 364, while the second part of the current contacts its way toward 357, 356, (Figs. 17, 18) 338, 363, (Figs. 24, 25) last contact 364, 122). The contacts 96 (Fig. 32) and 89 (Figs. 17, 18) are closed and the electromagnets 337, and 338 (Figs. 24, 25) are energized, thus bringing the apparatus back into their starting position, as above described.

3. When the calling subscriber succeeds in connecting himself up with the intermediate switch apparatus *ZwI* and *ZwII*, but does not find a disengaged connecting up apparatus (Figs. 34 to 42) matters take place in the following manner: The electro-magnets 321 and 328 (Figs. 17, 18) and 329 (Figs. 24, 25) of disengaged intermediate switch apparatus *ZwI* are energized first, afterward the electromagnets 322, 323, 330, and 331 (Figs. 24, 25) of disengaged intermediate switch apparatus *ZwII*, and finally the electro-magnets 324 and 325 (Figs. 24 and 25). The circuits of these electro-magnets have been described above. The contacts 367, 369, 371, arrive at the last contacts of the rows 366, 368, 370, (Fig. 24); the toothed segment 176 is then stopped and the contact 103 (Fig. 28) is closed, while the other contacts of the levers 304 and 305 do not produce any effect. After the subscriber's call apparatus (Figs. 1 to 16) has been released from the speaking position (Fig. 12) the contacts 80 and 81 (Fig. 1) (cited in case 1 and 2) are again closed. This closing produces the excitation of the disengaged mag-

nets 336 (Figs. 17, 18) 338 and 340 (Figs. 24, 25), circuits; 122, 103 (Fig. 27), 360, 361, (Fig. 25), 93 (Fig. 31), 354, 355, 86, (Figs. 17, 18), 80, 81 (Fig. 1). From here the current is divided, one part of which flowing to 336, 359, 358, (Figs. 17, 18) 365, 364, 371 (Figs. 24, 25) the last contact 70, 122, the second part of the current flowing to 357, 356 (Figs. 17, 18), 338, 365, 364, 371 (Figs. 24, 25) last contact 370, 122, while the third part of the current which starts from 356 (Figs. 17, 18) flows to 363, 362, 340, 371, last contact 370; (Figs. 24, 25) 122. The contacts 89 (Figs. 17, 23) 96 and 104 (Fig. 22) are closed and consequently allow the excitation of the free electro-magnets 337 (Figs. 17, 18) 339 (Figs. 24, 25) and 341 (Figs. 24, 25), whereby the apparatus are brought back into their position of rest.

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

1. In a device of the kind described for automatically connecting up the subscribers of a telephone exchange a plurality of intermediate switch apparatuses (ZwI) comprising each in combination a toothed segment (169) rotatably mounted on a horizontal shaft, an electro-magnet (322) adapted to actuate the said toothed segment, a lever (171) and pawls (170, 172) adapted to co-operate with the said electromagnet (322) for actuating the said toothed segment, three sliding contacts (361, 363, 365) carried by the said toothed segment, a frame (175) carrying the said shaft as well as the said toothed segment and sliding contacts, a toothed segment (176) having secured to it the said frame (175) and rotatably mounted on a vertical shaft, an electro-magnet (323) adapted to actuate the said toothed segment (176), two pawls (177, 179) and a lever (178) adapted to coöperate with the said electro-magnet (323) for actuating the said toothed segment (176), a frame (180) curved so as to suit the movements of the said sliding contacts, a plurality of contact rows (360, 362, 364) inserted in the said curved frame so that at every excitation of the electro-magnet 322 the sliding contacts are moved step by step over three rows (in one direction X) and then at every excitation of the electro-magnet (323) slide step by step on those three rows in front of which they have been brought by the first motion substantially as and for the purpose set forth.

2. In a device of the kind described for automatically connecting up the subscribers of a telephone exchange, a plurality of intermediate switch apparatuses comprising each in combination a horizontal toothed segment, a vertical toothed segment, means comprising pawls for causing the said toothed segments to move forward, contacts

90, 93, and 94 and a disengaging device for said pawls comprising a contact 96, an electro-magnet 338 adapted to actuate the said contact, a hook 193 coöperating with said vertical toothed segment and adapted to actuate the said contact 96 an electro-magnet 339, levers 184, 187 and 191 adapted to be actuated by the said electro-magnet 339, the lever 191 being directed toward the pawls of two toothed segments, the arrangement being such that when the electro-magnet 338 is excited the contact 96 and thereby the circuit of the electromagnet 339 are closed whereby the contacts 90, 93, 94, the horizontal toothed segment together with the contacts 92 and thereafter the vertical toothed segment together with the contact 91 and thereby also the contact 96 after the disengagement of arm 194 are adapted to be brought back into their starting position and means for operating the said backward motion of said members, substantially as and for the purpose set forth.

3. In a device of the kind described for automatically connecting up the subscribers of a telephone exchange a plurality of connecting up apparatuses comprising each in combination a toothed segment rotatably mounted on a vertical shaft, a toothed segment rotatably mounted on a horizontal shaft and all carried by the vertical shaft an electro-magnet (326) adapted to actuate the segment adapted to rotate around the said vertical shaft, an electro-magnet (327) adapted to actuate the segment which is rotatably mounted on said horizontal shaft, contact rows 72 and 74 two sliding contacts (73 and 75) carried by the said vertical toothed segment, a framing curved according to the path of motion of said two contacts, these contacts (73 and 75) being adapted to move step by step in two different directions at the side and between a plurality of contact rows (72, 74) mounted in the said curved framing the said step by step movement of said contacts (73, 75) at the side of said contact rows taking place each time over two rows, substantially as and for the purpose set forth.

4. In a device of the kind described for automatically connecting up the subscribers of a telephone exchange a plurality of connecting up apparatuses comprising each a fixed contact a vertical toothed segment carrying sliding contacts and means for controlling it, a horizontal toothed segment supporting the vertical segment and means for controlling it, a contact (106) which is closed when the said members occupy their position of zero and an electro-magnet (333) adapted to open the said contact 106 when it is energized, a line leading to each connecting up apparatus, a circuit for said magnet including said contact and said line substantially as and for the purpose set forth.

5. In a device of the kind described for automatically connecting up the subscribers of a telephone exchange, a plurality of connecting up apparatuses comprising each in combination a fixed contact a vertical toothed segment carrying sliding contacts and means for controlling it a horizontal toothed segment supporting the vertical segment and means for controlling it, contacts (112, 113, 114), the contact 114 of which is closed when the members of said connecting up apparatus occupy their position of zero and an electro-magnet (335) adapted when energized to close the contacts 112 and 113 and to open the contact 114, a calling line circuit leading to each apparatus, and a circuit for said magnet including said contact 114 and the calling line circuit, substantially as and for the purpose set forth.

6. In a device of the kind described for automatically connecting up the subscribers lines of a telephone exchange to form a talking circuit a plurality of connecting up apparatuses comprising each in combination fixed contacts for the lines a vertical toothed segment, sliding contacts thereon and means for controlling it, a horizontal segment supporting the vertical segment, a pawl lever adapted to cause the said horizontal segment to advance step by step, an electro-magnet (334), a contact (115) controlling the talking circuit which is closed when the members of said connecting up apparatus occupy their position of zero and is adapted to be actuated by the said electro-magnet (334) and the said pawl lever of the horizontal segment, means whereby the said pawl lever each time it performs its forward stroke allows the said electro-magnet (334) to open the said contact (115) and when this takes place, means whereby the said pawl lever owing to its backward movement maintains the opened condition of said contact even in

the case when the circuit of said electro-magnet be interrupted and this until the said pawl lever continues its movement whereby the said contact (115) is closed while this contact remains open when the circuit of the said electro-magnet (334) is closed, and means responsive to the engaged or busy condition of a called line for energizing said electro-magnet substantially as and for the purpose set forth.

7. In a device of the kind described for automatically connecting up the subscribers of a telephone exchange a plurality of connecting up apparatuses comprising each in combination fixed contacts for the lines a vertical toothed segment, sliding contacts thereon a pawl mechanism adapted to actuate the said vertical toothed segment, a horizontal segment, supporting the vertical segment the contacts 106, 112, 113, 114, 116, 117, 118, 111, 115 and 119, a pawl mechanism adapted to actuate this horizontal segment, a disengaging mechanism comprising an electro-magnet (342) a line circuit therefor, a contact 119 adapted to be actuated by the said electro-magnet and by the said vertical toothed segment, the electromagnet (343), the disengaging lever 213, means whereby the closing of the contact 119 energizes the electro-magnet 343 to bring the said contacts 106, 112, 113, 114, the horizontal segment and the said contacts 116, 117, 118, thereafter the said vertical segment and the said contact 111 and finally the contacts 115 and 119 back into their position of zero, substantially as and for the purpose set forth.

In testimony whereof I have hereunto set my hand in presence of two witnesses.

JOSEF PETICKY.

Witnesses:

TRANT PETICKY,
ADOLPHE FISCHER.