May 7, 1935. E. WEHREN 2,000,804

COIN FREED SUBSTATION FOR AUTOMATIC TELEPHONE SYSTEMS

Filed Dec. 16, 1932 3 Sheets-Sheet 2

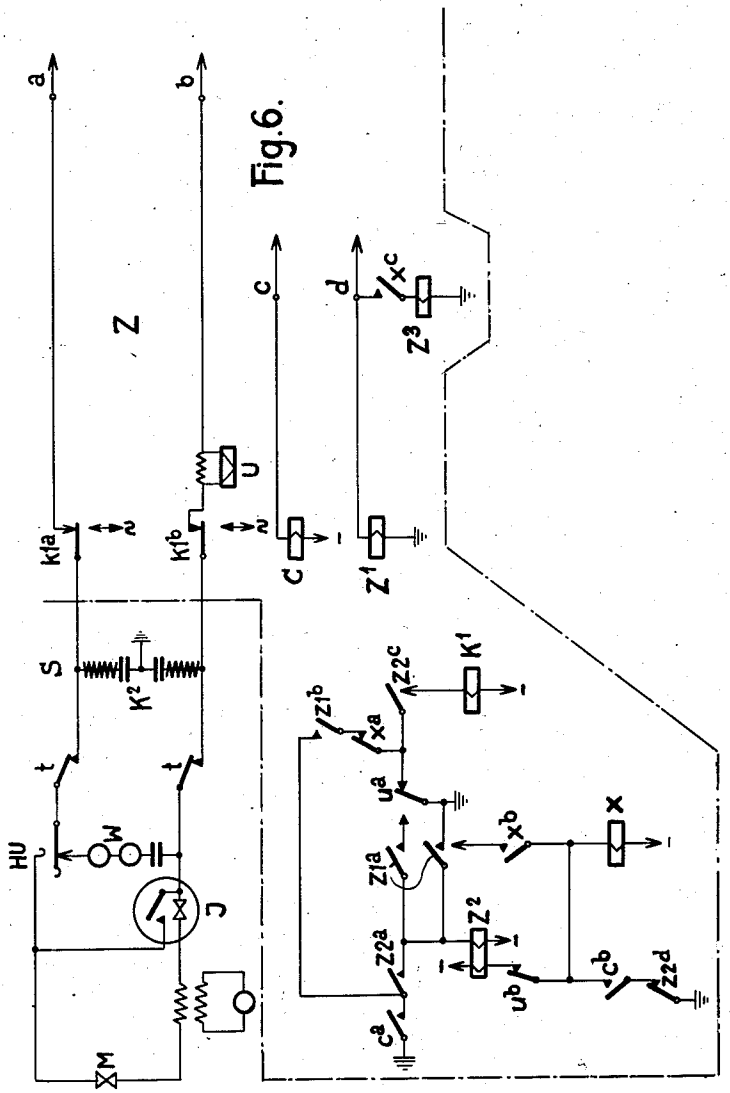

Fig.6.

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COIN FREED SUBSTATION FOR AUTOMATIC TELEPHONE SYSTEMS

Filed Dec. 16, 1932 3 Sheets-Sheet 3

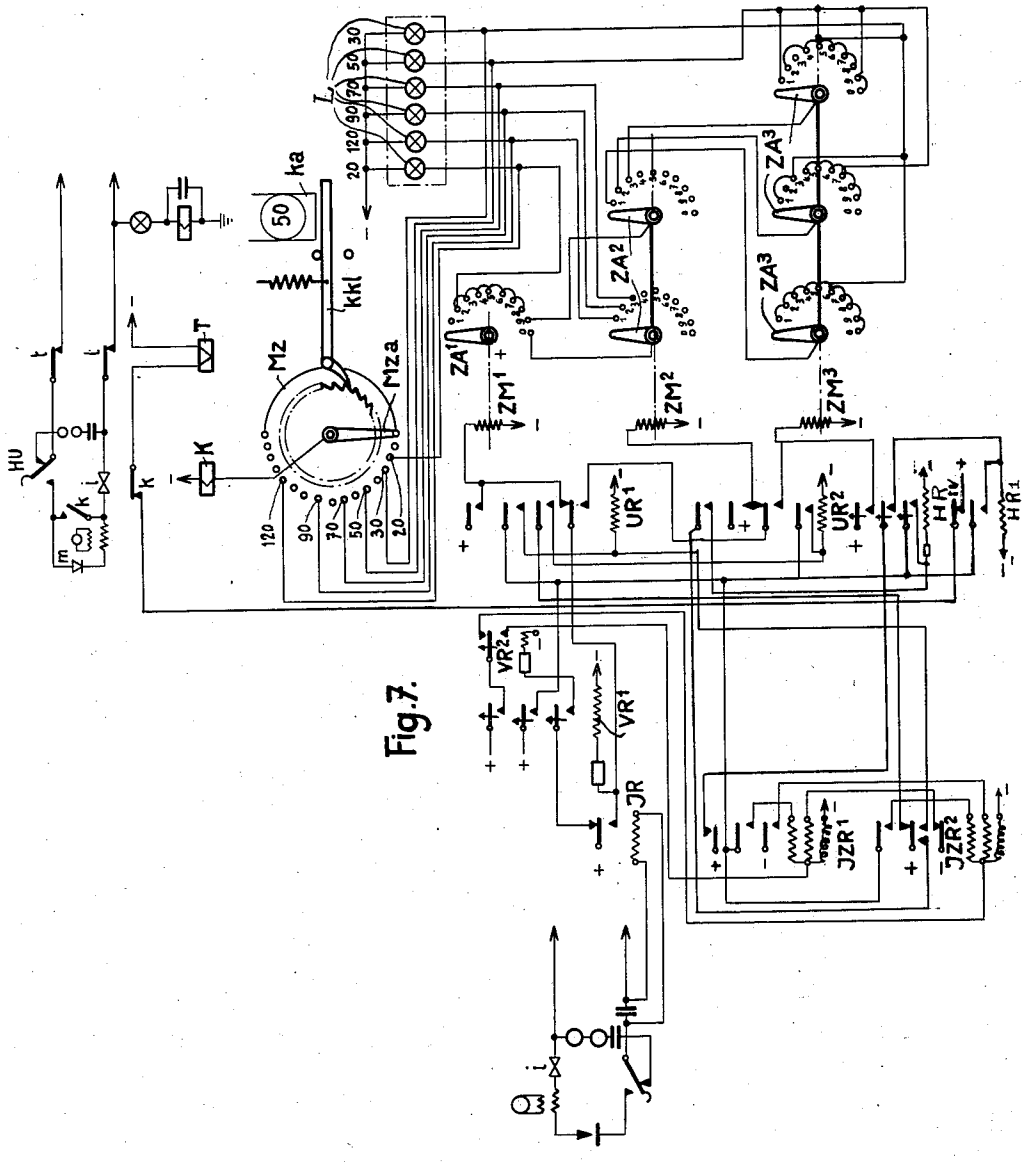

Fig.7.

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COIN FREED SUBSTATION FOR AUTOMATIC TELEPHONE SYSTEMS

Filed Dec. 16, 1932 3 Sheets-Sheet 1

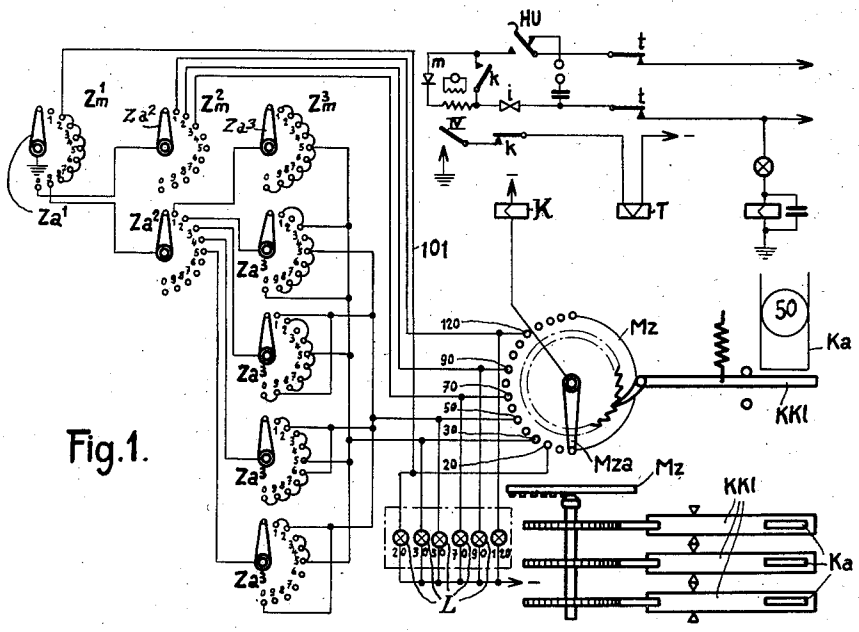

Fig.1.

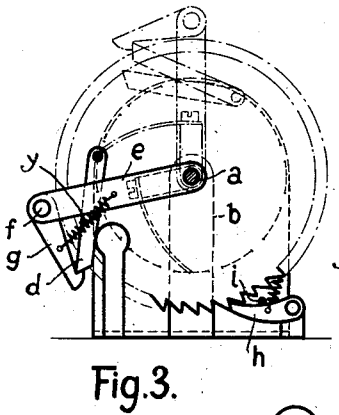

Fig.3.

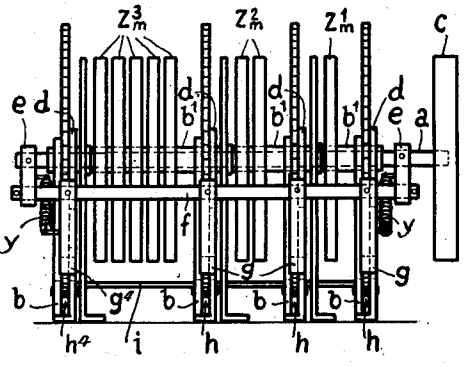

Fig.2.

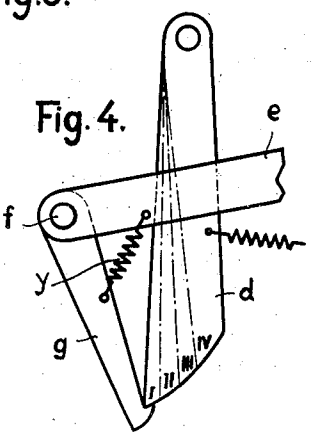

Fig.4.

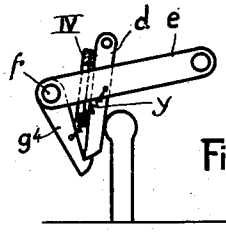

Fig.5.

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Patented May 7, 1935 2,000,804

UNITED STATES PATENT OFFICE

2,000,804

COIN FREED SUBSTATION FOR AUTOMATIC TELEPHONE SYSTEMS

Ernst Wehren, Bern, Switzerland

Application December 16, 1932, Serial No. 647,681
In Germany December 18, 1931

7 Claims. (Cl. 179—6.3)

The present invention relates to coin freed substations for automatic telephone systems of the kind in which a local or a long distance communication may be established, without the assistance of an operator at the central office and after insertion of one or more coins and subsequent selection of the number of the subscriber to be called.

Apparatus of the above stated type have already become known. In these known devices, the verification of the correspondence between the inserted coins and the numerals selected, however, is generally made at the central offices. A great number of selectors and relays are needed there for this purpose, raising not only the purchase costs of the whole system, but endangering also the reliability of the communications. Those arrangements take up a great space which is also a disadvantage.

With the present invention, all apparatus to control the inserted coins and to observe the correspondence between the amount of the communication charge and the inserted coins are located at the substation itself. This system requires an additional arrangement in the central office consisting of six relays by means of which the collecting impulse is given and the connection is opened after the fixed time unit of a call has expired. The respective circuits will be hereinafter described.

The invention consists in a coin freed substation for automatic telephone systems in which the correspondence between the costs of the call and the charge paid by inserting coins at the substation is controlled by a coin counting device operated step by step, characterized by the feature that the contacts of said coin counting devices are connected with the contact banks of selectors which are at least partly connected in series and may be adjusted by the numeral dial.

In proportion to the amount of numerals necessary to characterize the communications, a zone marking apparatus composed of a corresponding number of selectors will be provided, said selectors being coupled mechanically or electrically with the numeral dial during the selection of the communication. The contacts of said selectors are mutually connected and also with the contacts of a coin counting device consisting of a step by step selector. In order to establish the communication, a circuit must be closed over the contact of the counting device, which contact corresponds with the selected subscribers' line. If this circuit is not closed, a communication will not be established.

A further advantage of the automatic telephone substation according to the invention consists in the possibility to add a simple arrangement by means of which the calling subscriber may be informed in time of the amount due for the communication wanted. This information is absolutely automatic and may be given without the aid of any operator.

So far as manual long distance offices are concerned where the establishment of the communication is finally done by an operator after she has controlled the inserted coins, the calling subscriber has nothing especially to do about the determination of the charge due, the latter being communicated to him orally. But in such cases where the operator is replaced by automatic arrangements, the calling subscriber usually has to search in indexes which must be made up for every exchange. These indexes or registers are the causes of many mistakes.

With the above-mentioned additional arrangement, all searches in indexes may be avoided for the calling subscriber.

Further advantages and objects will appear in the following specification, reference being had to the accompanying drawings, in which:

Figure 1 shows a general arrangement,

Figures 2, 3, 4 and 5 are different views and details of a form of execution of a mechanical coupling between the selectors of the marking circuit and the numeral dial of the telephone exchange,

Figure 6 shows the additional arrangement in the central office, and

Figure 7 is a diagram of a second form in which the marking selectors are electrically connected with the numeral dial.

The system by means of which the first form of the present invention will be explained is based on a telephone network in which the numbers 200.000 to 899.000 are designated for local communications or suburb communications having the same tax as local calls. The numbers 910.000 to 939.999 are used for the more distant communications, say, for calls with subscribers of the outer network. For long distance calls the characteristic numeral 0 has to be chosen. The tariff charge may be paid in amounts of 20, 30, 50, 70, 90 and 120 cents and with all kinds of coins. For this purpose, the coins are inserted in different channels, as, for instance, K_a in Figure 1, corresponding to their value. After having passed through a coin examining device of any known type (not shown) the coins will operate devices of known construction and which has been shown

in the drawings only diagrammatically such construction causing the pawl lever KK1 to rotate the selector arm Mz*a* for so many steps as there are tens in the inserted coin, i. e. when a 50 cent piece has been inserted, the pawl of the coin counting device will bring the arm Mz*a* on the contact designated with **50** of the contact row of the counting device. For a local communication, the calling subscriber has for instance, to insert two 10 cent pieces which brings the arm Mz*a* on the contact designated with **20**, whereupon the subscriber will select the wanted number of the list of local subscribers. The numeral dial of the substation is, according to the example shown in Figures 2, 3, 4 and 5, mechanically connected with three selectors, the arms of which may be adjusted independently and one after the other in always the same sequence. The first selected numeral causes the adjustment of the zone marking device Zm^1, the second numeral of Zm^2, and the third numeral of Zm^3. The number of contacts of each selector corresponds with the one of the numeral dial, i. e. here two ten contacts are provided. The arms of the selectors are held fast after each selecting movement and are brought back by means of a spring when the call is ended.

By selecting for instance the numeral 2 the first arm Za^1 of the zone marking selector Zm^1 is brought on the second contact thus laying a positive potential on contact **20** of the coin counting device Mz by means of the connection lead **101**. Because the inserted 20 cent piece has caused the arm Mz*a* to be brought on the same contact **20** the circuit for relay K will be closed and the communication will be established. The selecting of further numerals will remain without influence on the described arrangements because there is no connection between the contacts **2** to **8** of selector Zm^1 and the arms of the other selectors. By selecting the fourth numeral contact IV (Figure 1) will be closed in a manner to be later described which means that the circuit of the disconnecting relay T cannot be opened and the line of the call cannot be disconnected. The further selecting operation is registered as usual by the apparatus of the central station.

If the calling subscriber wants, for example, a subscriber of the 50 cent zone, he has to select for the three first numerals for instance the characteristic number 925, in accordance with the distribution of the above specified example. During this operation, the arm of the zone marking device Zm^1 will be set on its contact **9** and remains there during the whole call. Thus, the positive potential of Zm^1 is transmitted to the second arm Za^2 of the zone marking device. When the second characteristic numeral 2 is selected, both arms of selector Zm^2 are brought on their second contact. The second arm Za^2 of Zm^2 is connected with the second arm Za^3 of the marking device Zm^3 and according to the third numeral bringing the latter arm on **1**, **3** or **4** to **9** the positive potential is transmitted to the contact **30** of the coin counting device Mz or to its contact **50**. After inserting of the correct amount of money the arm Mz*a* of the counting device is brought on the corresponding contact and the communication will be established as stated above.

The contacts **70**, **90** and **120** of the coin counting device can be reached over the first arm of the zone marking selector Zm^2 which is electrically connected with the 0 contact of the zone marking selector Zm^1.

It may be seen from the diagram shown in Figure 1, that it is not absolutely necessary to adjust the coin counting device by inserting the necessary amount of money before the selecting operation. It is early enough when the coins are inserted between the selection of the third and fourth numeral, because only after the selection of the latter one contact IV is closed. This circumstance may be used to inform the calling subscriber automatically of the amount to be pair after having dialed the characteristic numerals of the wanted number.

The arrangement shown in Figures 2, 3, 4 and 5 will be explained in the following passages. Figure 2 is a side elevation, Figure 3 a lateral view, and Figures 4 and 5 are details of this mechanism.

The general shaft of all rotative parts of the arrangement is designated with *a*. It is supported by several bearings *b* and is rigidly connected with the numeral dial *c*. Between the different bearings the contact rows represented in Figure 1 of the selectors Zm^1, Zm^2 and Zm^3 serving as zone marking devices with one, two and five contact arms Za^1, Za^2 and Za^3, not shown in this Figure 2, are arranged. These contact arms are all provided with the necessary insulation and connection leads and are mounted on a hollow shaft b^1. They have for each selector a finger *d* by means of which one selector at the time may be coupled with the numeral dial.

For this purpose two drivers or arms *e* are fixed on the shaft *a*. These arms *e* carry a rotatably mounted arbor *f* on which four hooks *g* are fixed, corresponding with the fingers *d* of the selectors 2^1m, 2^2m and 2^3m and the fourth finger of the switch IV (see Figure 5.) The hooks *g* or the arbor *f* can thus only be moved all together. These hooks are exactly adjusted and lie in the same plane of the fingers *d* co-operating with them.

The fingers *d* have not the same length, which may be seen in Figure 4 where they are numbered I, II, III and IV. It is evident that all other hooks *g* will not co-operate with the fingers *d* II, II and IV when the first hook *g* is in engagement with the finger *d*I. When the first numeral is selected by operating the numeral dial the arm Za^1 of the selector Z^1m (see Figure 1) only will be adjusted and the other selectors remain in their position of rest. After the first selector is adjusted and held fast by its corresponding stop pawl *h* and the numeral dial has returned in its position of rest during which return it has operated its impulse contact, the second operation of the dial when selecting the second numeral will cause the adjusting of arms Za^2 of selector Z^2m. This has become possible because the hooks *g* have advanced for one step by means of the springs *y*, so that now the second hook *g* is in engagement with the finger *d*II and the fingers *d*I, III and IV are free from their respective hooks. After the second selector Z^2m is adjusted, the third selector Z^3m is adjusted. When the fourth numeral is selected, contact IV will be closed for the time of the call by the last hook g^4 (see Figure 5). This contact IV is latched in a way, not shown, by the last stop pawl h^4.

The holding pawls *h* are controlled by a rod *i* which is operated by a mechanism of the hook switch so that when the telephone receiver is hung up all pawls *h* are disengaged and all selectors return in their position of rest.

The described coin freed telephone substation may be connected with the central station by means of the usual outfit of the subscriber sta-

tion according to the respective system. The collecting of the coins must of course be done by an additional device and in different ways if a local communication of unlimited duration or if a communication with a netgroup subscriber which is to be disconnected after three minutes is to be dealt with. Such additional device for the above stated purpose is schematically shown in Figure 6.

The arrangements of the subscribers station S are separated from those of the central office Z by dots and lines.

In the central station the following relays are provided:

The impulse time relay U which is excited by the feeding current of the subscribers substation,

The relay C which is excited by the usual subscribers' outfit in a manner, not represented,

The counting relay Z^1 which receives also impulses by the usual subscribers' outfit at the end or at the beginning of a call if a local or netgroup communication is to be dealt with, which conditions are determined by the system of the central station and are not necessary for the operation of the subscribers' substation,

The counting relay Z^3 registering the number of tax units which are collected by the exchange.

The other relays of the central exchange will be mentioned while describing the functions of the arrangement.

The hook switch HU is provided with a retarding device so that the hooking on of the telephone does not cause the immediate connection of the alarm W. The hooking off instead causes the instantaneous switching on of the microphone M in the feeding circuit of the battery of the central office. By this operation the relay U at the station is excited.

The switch contact u^a is shifted and the back contact u^b is opened. The relay C is excited hereupon by the central office in a way, not shown, and closes its circuit contacts c^a and c^b. This causes the closing of the circuit for relay X:

Battery, relay X, contacts c^b and $Z2^d$, ground.

Contact x^a opens and contacts x^b and x^c close.

When a local communication is to be dealt with, relay U is de-energized at the end of the call and the counting relay Z^1 receives current from the central office. Relay Z^2 is excited over contact z^{1a} and keeps itself energized over the contacts c^a and z^{2a}.

Battery, relay Z^2, contacts Za^2 and ca, ground.

Contact Zc^2 closes the circuit for relay K^1:

Battery, relay K^1, contacts z^2c and u^a, ground.

By means of the two switch contacts $K1^a$, $K1^b$, the collecting relay K^2 being in bridge connection is excited.

Contacts $K1^a$ and $K1^b$, leads a and b of the communication line, both windings of relay K^2 and its condensers, ground.

The latter operates the collecting device of the subscribers' station. At the same time, the call counting relay Z^3 is excited by the usual relays of the central office over lead d, contact x^c, relay Z^3, and ground.

After the counting operation, the relays Z^1 and C are de-energized by the usual relay combinations at the central office.

If a netgroup communication is to be dealt with, the counting operation takes place at the beginning of the call. The collecting operation is only prepared. The connecting operations are the following:

Relays U and C are excited as already set forth and their contacts are operated. By means of contact c^b relay X is excited.

As soon as the called subscriber answers, the counting operation is initiated by the arrangements at the central office and relay Z^1 and the counting relay Z^3 is excited. Contact $Z1^a$ will excite relay Z^2. The latter holds itself by means of the circuit:

Battery, relay Z^2, contacts $Z2^a$ and c^a, ground.

Relay K^1 cannot be excited because contact u^a is in its working (left) position. On the other hand, the circuit of relay K^1 is prepared by contact $Z2^c$. Because $Z2^d$ has opened the circuit of time relay X the latter will hold itself only during the duration of the counting impulses coming from the central station:

Battery, relay X, contacts x^b and $Z1^a$, ground.

Relay X is therefore a retarded time relay. This relay will be de-energized as soon as relay Z^1 comes to rest and contact $Z1^a$ will remain open. The circuit of relay K^1 will be prepared by contact x^a and the counting device Z^3 will be disconnected by contact x^c. This latter operation avoids the counting impulses of the second call unit operating the counting device Z^3 because the communication is to be disconnected after three minutes.

The disconnection is effected by contact $Z1^b$ which closes the circuit of relay K^1 already with the first counting impulse:

Battery, relay K^1, contacts $Z2^c$, x^a, $Z1^b$, c^a, ground.

Now, relay K^1 will send the collecting impulses over the a—b line and collecting relay K^2 will be energized. At the same time the call line will be opened by the contacts $K1^a$ and $K1^b$, and the communication is disconnected.

The described telephone exchange is provided with an arrangement which informs the calling subscriber of the amount due when the respective characteristic numeral or numerals is or are selected. The contact rows of the selectors Zm^1, Zm^2 and Zm^3 (Figure 1) are connected with lamps L announcing the tax to be paid.

If a local communication is wanted, the arm Za^1 comes to stand on contact 2 and the lamp for 20 cents flashes up. The adjustment of the other selector arms remains without influence upon the other signalling lamps.

If the calling subscriber has selected the numeral 0 or 9, according to a long distance or an outer network call, one of the arms Za^2 will receive a potential which will cause the lamp for 70, 90 or 120 cents to flash up or one of the arms Za^3 after the selecting of the third numeral will cause the transmission of the potential to one of the lamps for 30 or 50 cents.

For the second form of execution shown in Figure 7, a network has been chosen in which the three first numerals of each subscriber number are characteristic numerals. The subscribers directly connected with the central office have the numbers 200.000 to 899.999. The outer network subscribers have the numbers 910.000 to 939.999. For long distance calls 0 has to be selected as first characteristic numeral.

For the determination of the taxes and to control the amount of inserted coins, three selectors connected in series and each provided with an automatic return mechanism are utilized, the switch magnets ZM^1, ZM^2 and ZM^3 of said selectors being operated one after the other by means of impulses emitted by an impulse relay JR.

The mutual combinations of these selectors are

connected on the one hand with determined lamps which flash up during or after selection of the three characteristic numerals and on the other hand with a coin counting device corresponding with the one represented in Figure 1 the same parts being provided with the same signs of reference as in said figure.

The proceedings are as follows:

When the calling subscriber removes his receiver, besides the usual circuits to the central station, an impulse emitting circuit receiving the selection impulses is closed over the impulse relay JR which attracts its armature and energizes over its switch contact, the slow-acting relay VR^1 and the selection of the number can begin.

When the impulse relay JR attracted its armature, the selector ZM^1 has been prepared to receive the impulses because the positive pole of the battery has been connected with the selector magnet ZM^1 over the switch contact of relay JR and switch contact of the switch relay UR^1.

As soon as the calling subscriber selects the first numeral, the impulse relay JR will, during the return of the numeral dial, be de-energized as many times as the numeral has units. In this time the current passing through the selector magnet ZM^1 will, say for instance four times, shortly be interrupted and the contact arm of the selector will be moved from its position of rest in its position 4. At the beginning of the selection of the first numeral the time relay VR^2 has been energized because VR^1 (provided with a copper cap as retarding arrangement) will not be de-energized during the duration of the selection of the first numeral.

When the slow-acting relay VR^2 attracts its armature the relay JZR^1 will be energized over the lowest contact of relay JZR^2. After the selection of the first numeral the impulse relay JR will be energized for a longer period so that relay VR^2 will drop its armature, causing relay JZR^2 to be energized over the lowest contact of relay JZR^1, this relay having created for itself a maintenance circuit comprising its resistance, its upper winding, its upper contact and the middle contact of relay VR^1. Relay JZR^2 puts switch relay UR^1 in circuit by means of its own switch contact. This relay UR^1 attracts its armature, closes a maintenance circuit for the selector magnet ZM^1 and transmits the impulse emitting current over its lowest contact and the switch contact of relay UR^2 to the selector magnet ZM^2.

When the calling subscriber selects the second numeral, the impulse relay JR drops its armature according to the intervals between impulses. The slow-acting relay VR^2 will be energized, so that the still excited relay JZR^1 will be de-energized by short-circuiting its maintenance circuit over the two upper contacts of relay VR^1 and selector ZA^2 is adjusted by its magnet ZM^2. After the series of impulses emitted after the selection of the second numeral is ended impulse relay JR remains again energized for a longer period. Relay VR^2 drops its armature and short-circuits now the maintenance circuit of relay JZR^2 which has been closed over its resistance, its upper winding, its upper contact and the middle contact of relay VR^1 in accordance with the maintenance circuit of relay JZR^1. Relay JZR^2 thus drops its armature also.

When the armature of JZR^2 drops off, the switch relay UR^2 is put in circuit which relay closes a maintenance circuit for the selector magnet ZM^2 over its second contact from the top and closes the impulse emitting circuit for selector magnet ZM^3 and tht latter goes in its working position.

As soon as the calling subscriber begins with the third impulse series by dialing, the third numeral impulse relay JR accordingly becomes de-energized. The relay VR^2 becomes excited and the impulse emitting relay JZR^1 is put in circuit again. At the same time the selector magnet ZM^3 is advanced by the impulse relay JR and its arm is brought in a position corresponding with the third numeral. After the thousand unit is selected JR keeps its armature perpetually attracted, VR^2 is de-energized and energizes JZR^2 on again. When JZR^2 attracts its armature the slow-acting holding relay HR is energized over the switch contact of JZR^2 and the uppermost contact of UR^2, whereupon HR closes a maintenance circuit for selector ZM^3 over its uppermost contact.

When the calling subscriber dials the fourth numeral, the relay JZR^1 will be deenergized in the same manner than by the dialing of the second numeral. The closing of the uppermost contact of relay JZR^1 will complete the circuit over the middle contact of relay HR for relay HR^1, which will close the contact IV (uppermost contact of relay HR^1).

By the continual closing of its uppermost contact the relay HR being held over its lower contact will cause a further working of relay JR (by the dialing of the other numerals) remaining without effect.

The arm ZA^1 of selector ZM^1 is connected with the positive pole of the battery. Its contact row is, the contacts 1, 9 and 0 excepted, connected with the lamp for twenty cents. The result is that when, for instance, the calling subscriber wants to have a communication with a subscriber which is directly connected with the main office the lamp for twenty cents will flash up already after the selection of the first numeral. The adjusting of the arms ZA^2 and ZA^3 remains without further influence.

If the calling subscriber wants a long distance call he has selected first of all the numeral 0. The arm ZA^1 has been adjusted accordingly and has connected the first arm of ZA^2 with the positive pole of the battery. After the further selection this second arm ZA^2 comes to rest on contacts 1, 2 or 3 which are directly connected with the lamps for 120, 90 and 70 cents. At the end of the second series of impulses the calling subscriber already knew about the tax to be paid. The third series of impulses has caused also the adjustment of arm ZA^3 but without any lamp being influenced because the second arm ZA^2 of selector ZM^2 is connected with contact 9 of selector ZM^1.

If the calling subscriber wanted a communication with a subscriber of the outer network he has selected first of all the numeral 9. By this selection the second arm ZA^2 of selector ZM^2 has been connected with the positive pole of the battery. According to the second numeral this potential has been transmitted to the one or the other of the arms of the selector ZM^3 which causes the flashing up of the lamps for 50 or 30 cents respectively in accordance with the series of impulses emitted.

The above description concerns principally the arrangements for indicating the amount to be paid. The further apparatus shown as, for instance, the coin counting device MZ and the selectors connected with this device are exactly the same as those shown in and explained in connection with Figure 1. The description of these parts therefore is unnecessary.

What I claim is:

1. A coin freed substation for automatic telephone systems comprising a numeral dial, selectors having contact banks, a coin counting device operated step by step including contacts connected with the contact banks of said selectors which contact banks are at least partly connected in series and adjustable by the numeral dial.

2. A coin freed substation for automatic telephone systems as claimed in claim 1, characterized in that the selectors are mechanically coupled one after the other with the numeral dial.

3. A coin freed substation as claimed in claim 1 characterized by the provision of a relay and devices, the selector arms being adjustable by means of said relay influenced by the selecting impulses of the numeral dial and said devices controlling the subsequent operation of the selectors.

4. A coin freed substation as claimed in claim 1 characterized in that the selector arms are adjusted in a predetermined sequence and according to the subsequent operations of the numeral dial and brought on the contacts corresponding with the numerals of the selected number.

5. A coin freed substation as claimed in claim 1 characterized in that the selector arms are adjusted in a predetermined sequence and according to the subsequent operations of the numeral dial and brought on the contacts corresponding with the numerals of the selected number, said selectors being arranged on the arbor of the numeral dial and the selector arms being taken along one after the other by said arbor.

6. A coin freed substation as claimed in claim 1 characterized by the provision of a device controlled by the numeral dial to announce the charge corresponding with the characteristic numeral or numerals selected.

7. A coin freed substation as claimed in claim 1, characterized by the provision of a device controlled by the numeral dial to announce the charge corresponding with the characteristic numeral or numerals selected, said announcing device being controlled by the selectors adjusted by the numeral dial.

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