

E. H. & K. A. WIDEGREN.
 MEANS FOR CONTROLLING ELECTRIC APPARATUS.
 APPLICATION FILED JUNE 8, 1910.

1,054,811.

Patented Mar. 4, 1913.

3 SHEETS—SHEET 1.

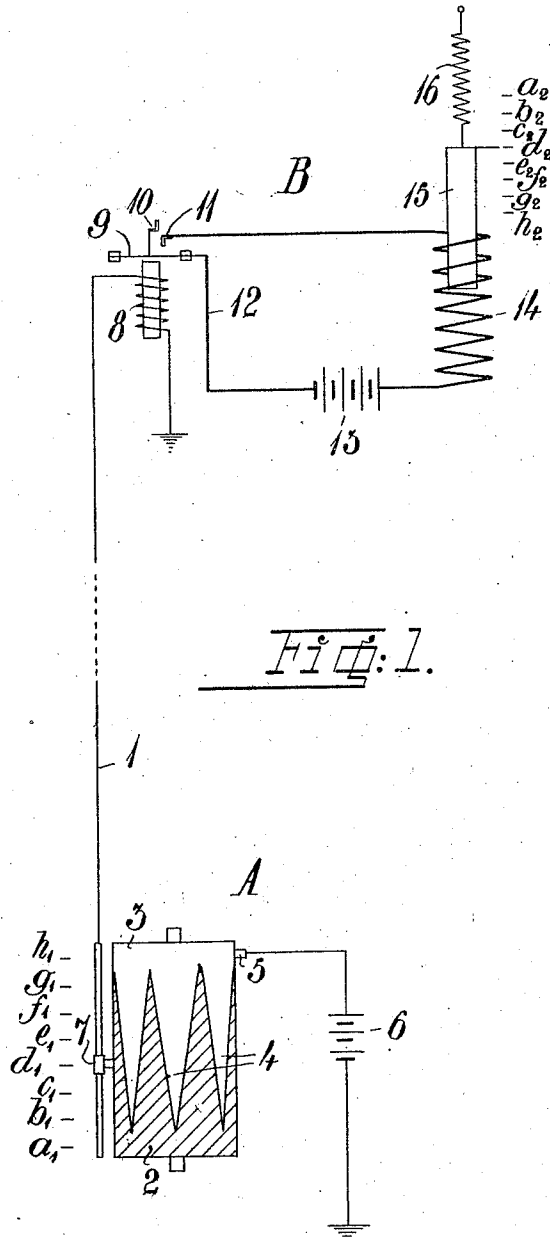


Fig. 1.

Witnesses
 B. Kommers
 May Ellis

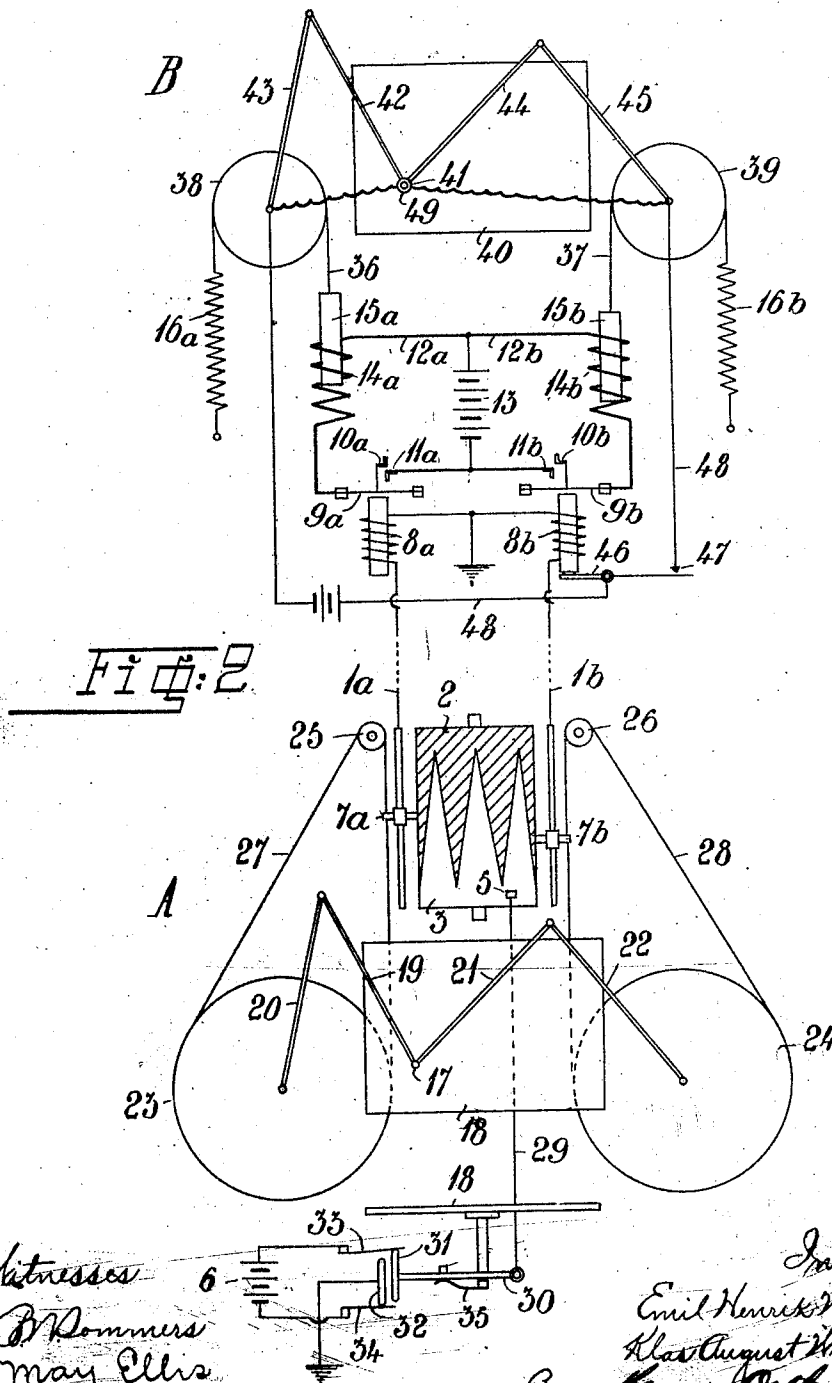
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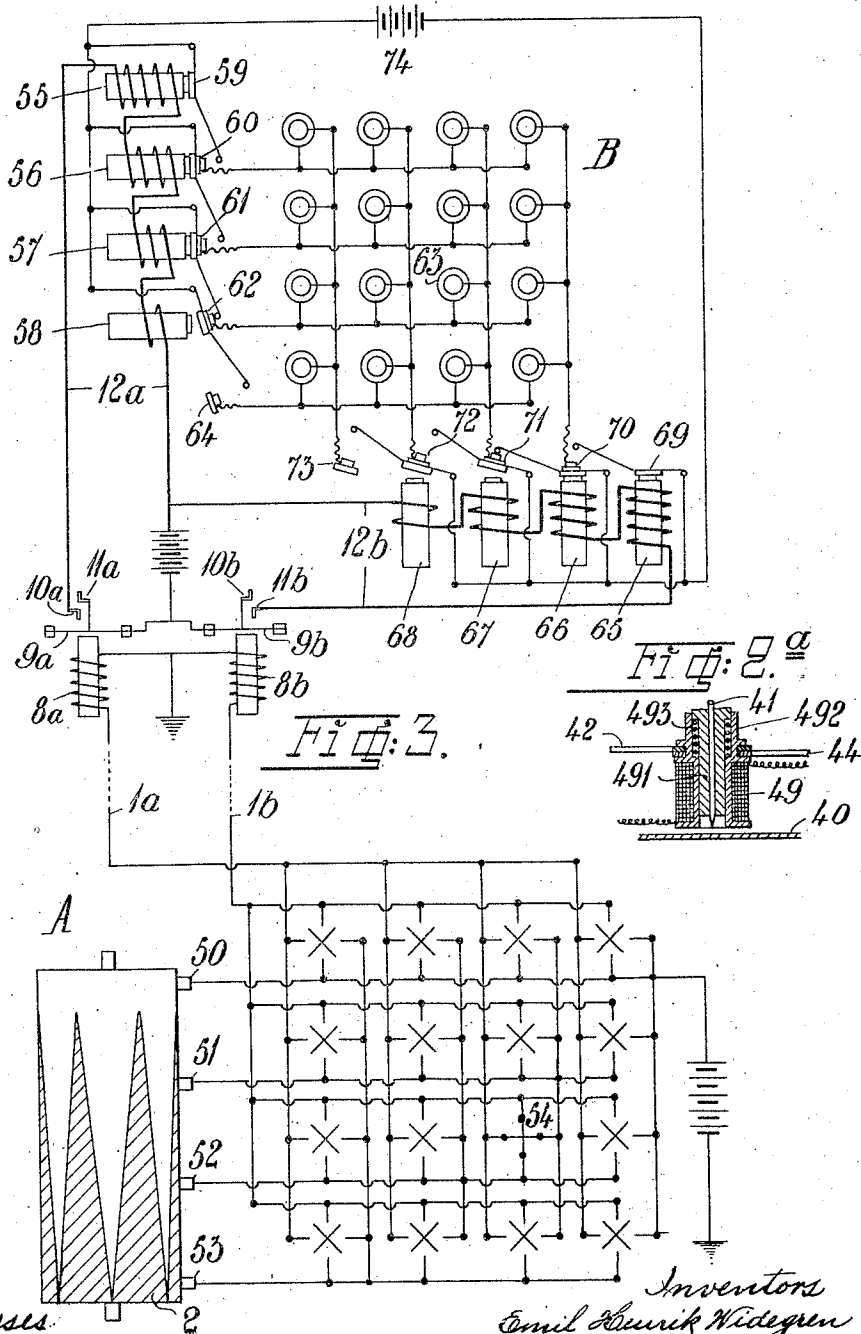
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3 SHEETS-SHEET 3.



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UNITED STATES PATENT OFFICE.

EMIL HENRIK WIDEGREN AND KLAS AUGUST WIDEGREN, OF ALBY, SWEDEN.

MEANS FOR CONTROLLING ELECTRIC APPARATUS.

1,054,811.

Specification of Letters Patent.

Patented Mar. 4, 1913.

Application filed June 8, 1910. Serial No. 565,840.

To all whom it may concern:

Be it known that we, EMIL HENRIK WIDEGREN, a citizen of the United States of America, and KLAS AUGUST WIDEGREN, a subject of the King of Sweden, both residents of Alby, Sweden, have invented new and useful Means for Controlling Electric Apparatus, of which the following is a specification.

This invention relates to improved means for controlling from a distance electric apparatus and especially telegraph apparatus and the like, which renders it possible by means of a single line wire or a few such wires to put into operation or to regulate the operation of any one of a number of electric apparatus and especially to have such an apparatus, which can take up different positions, to move into the desired position.

The invention is especially applicable for telegraphic transmission of hand writing, drawings, type writing and so on, but it may also be used for other purposes where it is required to effect a selective adjustment or control of an apparatus from a distance.

The construction of the receiver or receivers, which according to the present invention are used at the receiving station, is based upon the well known principle of varying sensibility for varying strengths of current, so that for instance one adjustment is effected by a strength of current of 0.1 ampere, another by a strength of current of 0.4 ampere and so on, said receivers being further of such construction that they are actuated by a pulsating current in accordance with the effective value thereof but are not influenced by the pulsations of the current.

The essential feature of the invention resides in the means by which the effective strength of current at the receiver can be regulated from the transmitting station. For this purpose the receivers working for different strengths of current are inserted in a local circuit with a constant or approximately constant source of current, which by means of a sensitive switching relay is continually broken and closed. Said relay is inserted in a connection circuit between the receiving station and the transmitting station, and at the latter said circuit is provided with devices for transmitting a pulsating current with controllable or determined re-

lation between the length and the intervals of the pulsations.

If the strength of the current flowing through the connection wire under all circumstances is sufficient to actuate the switching relay of the receiving station in full synchronism with its own pulsations, a pulsating current will be obtained in the local circuit of the receiver, the pulsations of which will be analogous with those of the current flowing through the connection wire, but the strength of which will be independent of the strength of the last mentioned current. The switching relay may in being excited close the local circuit and break it when it becomes currentless, or vice versa. If the relation between the length of the pulsations from the transmitting station and the intervals thereof is for instance $=2:5$, the corresponding relation in the local circuit of the receiver will also be $=2:5$ when the relay in being excited closes the local circuit, and $=5:2$, if the relay breaks the said circuit in being excited. If the relation between the length and the intervals of the pulsations transmitted from the transmitting station be changed for instance to $1:5$, the same relation in the local circuit of the receiver will also be changed to $1:5$ or $5:1$. It is thus possible by means of the said devices to effect from the transmitting station arbitrary changes of the relation between the length and the intervals of the pulsations in the local circuit of the receiver, and it is a characteristic feature of the invention that this effect within certain limits is independent of the absolute number of pulsations coming from the transmitting station and also of the frequency thereof, as long as the frequency and the strength of current of the pulsations lie within limits that secure a good function of the switching relay at the receiving station.

The effective value of a pulsating current of the kind that is used at a receiving station with a source of constant current depends only on the relation between the length and the intervals of the pulsations, if only the local circuit is so arranged that its strength of current in closing of the circuit reaches its full value without any perceptible loss of time and is decreased as rapidly to zero in breaking the circuit. If the strength of current at constant closing

of the circuit is $=J$ and the relation between the length and the intervals of the pulsations is for instance 2:3, the effective value of the strength of current in the local circuit will be $0.4J$, and it is obvious that this value is dependent only upon the relation between the length and the intervals of the pulsations coming from the transmitting station, but is fully independent of the strength of current and frequency of said pulsations.

If a pulsating current of the kind that is created in the local circuit of the receiving station by means of the above mentioned devices flows for instance through the winding of an electromagnet the sensibility of which over against the separate pulsations is sufficiently damped, an average magnetization will be reached that is determined only by the said effective value of the pulsating current. The frequency of the pulsations above a certain minimum value which is determined by the damping of the magnet and the armature thereof has no influence on the working of the magnet.

The devices used for the present purpose thus consist at the transmitting station of an apparatus for transmitting pulsating currents with controllable or determined relation between the length and the intervals of the pulsations, and at the receiving station partly of a switching relay without own oscillations and as far as possible undamped, so that it can work fully in accordance with the pulsations coming from the transmitting station, and partly of electromagnets, solenoids, or the like, in a local circuit controlled by the said switching relay, said electromagnets or the like being damped over against the pulsations in such a manner that they are not influenced by the separate pulsations but work only in accordance with the effective value of the exciting current.

In the accompanying drawings we have shown diagrammatically some embodiments of our invention.

Figure 1, which chiefly serves to illustrate the principle of the invention, shows devices for adjusting from a distance the core of a solenoid into different positions. Fig. 2 shows a constructional form of the invention for telegraphic transmission of usual hand writing, drawings, and so on. Fig. 2^a shows a detail of Fig. 2. Fig. 3 shows a device for telegraphic transmission of type writing.

Referring to Fig. 1, A indicates a transmitting station and B a receiving station connected to each other either by a single line wire 1 and the earth or by a double line wire. 2 indicates a commutator of the transmitting station, consisting of a rotating drum of conducting material and having insulations recessed in its surface

which form between them conducting pointed tongues 4 extending from an integral metallic surface 3. Against the latter bears a brush 5 to which one pole of a source of electric current 6 is connected, the other pole of which is connected to earth.

The connection or line wire 1 is connected to a brush 7 bearing against the commutator and being adjustable axially along the same. At the receiving station B the line wire 1 is connected to the winding of the electromagnet 8 of a switching relay the armature of which can follow all pulsations of a current sent from A to B.

It is most suitable to use as an armature a diaphragm 9 of thin sheet iron which is secured in a frame. The diaphragm is arranged in such a manner that the center thereof is in proximity to the pole of the relay magnet. At the center of the diaphragm and on the side thereof opposite the magnet is secured a contact 10 which when the diaphragm is attracted strikes a fixed contact 11. The contacts 10 and 11 constitute a circuit closer or switch in a local circuit 12 comprising a source of electric current 13 and the winding 14 of a solenoid, the iron core 15 of which is damped by the weight of its core and its connected parts.

A spring 16 is arranged in such a manner that it tends to pull the iron core from the solenoid winding 14, while the latter attracts the iron core more or less according to the effective value of the current flowing through the local circuit. In the drawing eight adjusting positions $a_1, b_1, c_1, \dots, h_1$ of the brush 7 at the commutator of the transmitter are indicated, said positions corresponding to eight positions $a_2, b_2, c_2, \dots, h_2$ of the solenoid core 15.

The device described works as follows: If the brush 7 stands in a certain position for instance that indicated by a_1 , a pulsating current flows when the commutator is rotated through the line wire 1, the pulsations of said current being determined by the width of the conducting portions 4 and the width of the intermediate insulations. The said pulsations excite the magnet 8 so that the latter attracts the diaphragm 9 which in this way is attracted or not attracted during periods of time which practically are equal to the length of the pulsations and the intervals thereof. When the diaphragm 9 is attracted the local circuit is closed at the contacts 10 and 11 and in said circuit is created a pulsating current, the pulsations of which correspond accurately to the pulsations coming from the transmitter. The solenoid 14 attracts its core 15 with a strength that corresponds to the effective value of the current flowing through the local circuit 12, whereby the core is adjusted into a determined position a_2 .

If the brush 7 be displaced from the position d_1 for instance into the position f_1 in which the width of the conducting portions is greater and the width of the insulating portions is smaller, the pulsations sent from the transmitter will be increased and the intervals thereof decreased. Consequently the pulsations in the local circuit 12 will be changed correspondingly resulting in that the pulsating current of the local circuit 12 obtains a greater effective value whereby the core 15 is attracted more strongly and is adjusted into another position f_2 .

Every position of the brush 7 corresponds thus to a determined position of the core 15, and this correspondence is, as is evident from the foregoing, due to the fact that the pulsating current of the local circuit 12 is dependent on the pulsating current of the line wire 1. The working of the device described is however independent on the one hand of the strength of current and the resistance of the line wire 1, and on the other hand within certain limits on the speed of rotation of the commutator. These two facts are of great importance and make an apparatus embodying the present invention more advantageous than the old apparatus of the kind in question. The fact that the working of the device is independent of the strength of current and of the resistance of the line wire is evident already from the foregoing. But said fact is also evident from the circumstance that the switching contacts 10 and 11, which transmit the influence of the circuit 1 to the circuit 12, work independently of the absolute strength of current and the resistance of the wire 1, as long as the strength of current has a value that is sufficient to cause circuit closing at the contacts 10 and 11. Further it is obvious that the working of the device within certain limits is independent of the speed of rotation of the commutator. If the brush 7 has been adjusted into a certain position and the speed of rotation of the commutator for instance is increased, the periods of time during which the brush is in contact with the conducting portions will certainly be decreased but at the same time the periods during which the brush is in contact with the insulating portions will also be decreased in the same proportion, and, as the effective value of pulsating currents of the kind in question, as is already mentioned, depends on the relation between the length and the intervals of the pulsations, the effective value of the current of the local circuit 12 will be unchanged when the speed of rotation of the commutator is changed, provided that the said speed is not decreased so much that the damping of the solenoid core 15 will be insufficient for preventing vibrations, or is not increased so much that the diaphragm 9 and its contact cannot follow the

pulsations of the line wire. The said limits are however so wide that they practically need not be overpassed.

A gradual displacing of the brush 7 along the commutator will obviously effect a similar gradual displacing of the core 15. If it is desired to use only a determined number of fixed adjusting positions one may substitute for the adjustable brush 7 a corresponding number of fixed brushes arranged along the commutator which all can close the circuit through the commutator and on account of their positions cause pulsations of different length and intervals.

Fig. 2 shows a system of telegraphic transmission of hand writing and the like, the working of which is independent of the distance between the stations and the resistance of the connection circuits.

The transmitting station is indicated by A and the receiving station by B. At the transmitting station is provided a pencil 17 which is movable on a plate 18. For the sake of clearness the latter is shown both in plan view and in side view. The said pencil is by means of links 19, 20 and 21, 22 connected to pulleys 23 and 24, the links 20 and 22 and also the pulleys 23 and 24 being rigidly secured to the axles of the latter. Each position of the pencil corresponds always to a certain angular position of the links 20 and 22 and thus also of the pulleys 23 and 24. On the said pulleys and on other pulleys 25 and 26 are placed belts 27 and 28 to which are attached brushes 7^a and 7^b, the latter being adjustable along a commutator 2 of the same construction as that shown in Fig. 1. On the non-slotted portion of the commutator drum 3 slides a brush 5 which by means of a wire 29 is connected to the pivoted arm 30 of a reversing switch 31. The said arm is connected to and actuated by the writing plate 18. The switch 31 further comprises a fixed grounded contact 32 and two contact springs 33 and 34 which are each connected to a pole of a source of electric current 6.

The writing plate is journaled in such a manner that it moves downward by the pressure exerted on it when writing. As soon as the pencil 17 is lifted from the said plate, the latter will, however, return into its original position by the action of a spring 35. In these movements of the writing plate the reversing switch will be operated in such a manner that it connects either of the poles of the source of electric current to earth and the other pole to the wire 29 whereby the pulsations caused by the commutator will be of different polarity according as they are sent while the pencil is pressed against the writing plate or raised therefrom. The object of this device will be explained more particularly here below.

The brushes 7^a and 7^b of the commutator are each by means of a line wire 1^a and 1^b

respectively connected to the one end of the winding of a magnet 8^a and 8^b respectively at the receiving station while the other ends of said windings are connected to earth or each to one return wire, or eventually both to one and the same return wire.

The magnets 8^a and 8^b are, as the magnet 8 in Fig. 1, each provided with a diaphragm 9^a and 9^b respectively and contacts 10^a, 11^a and 10^b, 11^b respectively. The two pairs of contacts 10^a, 11^a and 10^b, 11^b are each arranged in a local circuit 12^a and 12^b respectively of the receiving station. For both circuits may be used one and the same source of electric current 13. In the said local circuits are provided solenoid coils 14^a and 14^b respectively, having iron cores 15^a and 15^b respectively. The latter are by means of belts 36 and 37 respectively which are placed on pulleys 38 and 39 respectively connected to springs 16^a and 16^b respectively counteracting the attraction of the cores by the coils 14^a and 14^b respectively.

The writing apparatus of the receiving station consists of a writing plate 40 and a pencil 41 which by means of link systems 42, 43 and 44, 45 corresponding to the link systems 19, 20 and 21, 22 of the transmitter is connected to the pulleys 38 and 39. At one of the relay magnets, for instance 8^b, is provided a polarized armature 46 operating a circuit closer 47 in a local circuit 48 of the receiving station. This local circuit comprises a small solenoid 49 the core 491 of which carries the pencil 41 and is movable up and down in a cylinder 492 of non-magnetic material. A spring 493 normally holds the pencil raised from the writing plate 40, while the solenoid 49 when excited attracts its armature and presses down the pencil against the writing plate. The cylinder 492 is hinged to the links 42, 44, (Fig. 2^a). The armature 46 is so arranged that it is not attracted when the direction of current flowing through the line wire 1^a is that obtained by pressing down the writing plate 18 of the transmitter. As long as the armature 46 is not attracted the local circuit 48 remains closed so that the pencil of the receiver is kept pressed against the writing plate 40.

The system now described works as follows: When the pencil 17 of the transmitter is moved over the writing plate 18 producing thereon for instance usual hand writing, the pulleys 23 and 24 will be turned by means of the link systems 19, 20 and 21, 22 respectively, whereby the brushes 7^a and 7^b will be displaced along the commutator 2. The latter being rotated at arbitrary speed during the writing causes the transmission through the line wires 1^a and 1^b of pulsations the length of which in relation to the intervals thereof depends on the temporary positions of the pencil 17 on the writing

plate 18. Said pulsations will cause corresponding pulsations in the local circuits 12^a and 12^b whereby the cores 15^a and 15^b respectively will be attracted more or less into the respective coils 14^a and 14^b and thereby, by means of the pulleys 38, 39 and the link systems 42, 43 and 44, 45 move the pencil 41 of the receiver synchronously with the pencil 17 and in the same path in which the latter is moved.

It is evident that the movements of the pencil 41 of the receiver are independent of the polarity of the pulsations coming from the transmitting station, in as much as the magnets 8^a and 8^b work independently thereof. The polarized armature 46 will however not be attracted by the pulsations sent when the writing plate 18 is pressed down, and consequently the pencil 41 will be kept in contact with the writing plate 40 by means of the solenoid 49, as long as the pencil 17 is kept pressed against the plate 18. When the pencil 17 is raised for instance for producing spaces between the words or for commencing a new line the polarity of the current flowing through the line wires will be reversed by the switch 31 being reversed. On account thereof the polarized armature 46 will be attracted and break the local circuit 48 so that also the pencil 41 will be raised from the plate 40 by its spring 493. Therefore what is written on the plate 18 thus will be accurately copied on the plate 40 independently of the amount of the strength of current that flows through the line wires and independently of the speed of rotation of the commutator within limits which need not be overpassed. The writing is suitably made on usual paper that is placed on the plates 18 and 40.

In the system shown in Fig. 3 which serves to transmit type writing a commutator 2 is used at the transmitting station A having a number of brushes 50, 51, 52 and 53 placed in fixed positions. The construction of said commutator in other parts is the same as that of the commutator shown in Figs. 1 and 2. A difference resides, however, in that the local circuit of the receiving station B comprises a number of relays or electromagnets which will be operative for different effective strengths of current of the local circuit. This system is based upon the principle that if the current is led through the one or the other of the brushes, a determined effective value of the current in the local circuit of the receiving station will be obtained for each brush.

The electromagnets of the local circuit are similar to each other except that their windings have a different number of turns. The springs of all armatures are of one and the same strength. The windings of the electromagnets are so proportioned that for a certain effective value of the current of the

local circuit a certain number of the armatures are attracted and the armatures are so arranged with relation to each other that a contact will be obtained between the last attracted armature and the following non-attracted armature. In this way such a contact will always correspond to a certain brush of the commutator, and the number of such contacts corresponds also to the number of brushes. By providing the commutator for instance with seven brushes it is thus possible to control seven contacts at the receiving station. If a further connecting circuit be provided, having seven brushes on the commutator or being connected up to the same brushes as the first-mentioned connection circuit it will be possible to control a further set of seven contacts at the receiving station. In this case it is suitable to combine the local circuits of the receiving station in such a manner that each local circuit is led through one contact in each of the two groups and closes the two connecting circuits each through one brush of the commutator or both through one and the same brush. In as much as here 49 combinations are possible, 49 local circuits or a corresponding number of electromagnets at the receiving station may be operated in this way by means of seven brushes at the transmitter and fourteen electromagnets at the receiver.

For the sake of clearness only four brushes are shown at the commutator in Fig. 3. The transmitter may be provided with a usual key board of a type writing machine having depressible keys. These keys which are not shown in the drawing serve each to operate one circuit-closer which when closed connects the two connection or line wires 1^a and 1^b to two of the brushes 50—53 or to one and the same brush. In the drawing it is assumed that the key above the circuit-closer 54 is depressed so that this circuit-closer is closed, while the other circuit-closers are open. The circuit-closer 54 serves to connect the commutator brush 51 to the wire 1^a and the brush 52 to the wire 1^b . In similar way all circuit closers are arranged to connect the two connection or line wires to two brushes or to one brush of the commutator.

In each of the two line wires is provided a sensitive electromagnet 8^a and 8^b respectively at the receiving station, each magnet having an armature in the shape of a diaphragm 9^a and 9^b respectively which serves to close contacts 10^a , 11^a and 10^b , 11^b respectively in the local circuits 12^a and 12^b respectively. In the local circuit 12^a are arranged four relays 55, 56, 57 and 58 the armatures of which 59, 60, 61 and 62 are arranged closely to each other and are connected up in the circuits of a corresponding number of electromagnets corresponding to

the circuit-closers operated by the keys at the transmitting station. Of these electromagnets that one corresponding to the circuit-closer 54 is indicated by 63 while the others have no reference characters.

The armatures 59, 60, 61 and 62 are arranged in such a manner that an attracted armature is in contact with the contact piece of an adjacent armature not attracted, but when also the latter is attracted, the said contact will be broken.

64 indicates a contact piece with which the armature 62 makes contact when attracted.

In the local circuit 12^b are in a similar way provided four relays 65, 66, 67 and 68 having armatures 69, 70, 71 and 72 arranged in similar way as the armatures 59, 60, 61 and 62.

73 indicates a contact piece with which the last armature 72 makes contact when attracted. All relays 55 to 58 and 65 to 68 are similar to each other except that their windings have a different number of turns so that they work for different minimum strength of current.

74 indicates a source of electric current at the receiving station supplying current to the electromagnets 63. These electromagnets are arranged in well known manner to operate the keys of a usual type writing machine. For the sake of clearness the type writing machine proper is not shown.

The system described with reference to Fig. 3 works as follows: If a key, for instance that corresponding to the circuit-closer 54 of the transmitting station be depressed, this circuit-closer will connect the two line wires 1^a and 1^b to the commutator brushes 51 and 52, so that pulsating currents with a determined relation between their length and the intervals thereof will be sent through the line wires. These pulsations act at the receiving station on the two electromagnets which in their turn cause corresponding pulsations in the local circuits 12^a and 12^b . The pulsations in the local circuit 12^a , which are caused by the brush 51, obtain such an effective value that the magnets 55, 56 and 57 attract their armatures, while the armature 58 remains in idle position. The pulsations in the circuit 12^b , which are caused by the brush 52, obtain a somewhat smaller effective value so that only the magnets 65 and 66 attract their armatures.

The result of the attraction of the armatures will be that a local circuit through the type writing magnet 63 is closed in the following way: From one pole of the battery 74 through armature 61, the insulated contact piece of the armature 62, the electromagnet 63, the insulated contact piece of the armature 71, and the armature 70 to the other pole of the battery 74. The electro-

magnet 63 thus is excited and operates its key so that the corresponding type is written. The working when closing the other circuit-closers of the key at the transmitting station is substantially the same as that now described.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In a system for operating electric apparatus from a distance, the combination of a transmitter having means for generating pulsating electric currents and manually operated means for adjusting the relation between the lengths and intervals of pulsations, a receiver consisting of a switching relay actuated by the pulsating currents from the transmitter, a local circuit controlled by said switching relay, and a receiving apparatus operated in accordance to the effective value of the pulsating currents excited in the local circuit by the said switching relay.

2. In a system for operating electric apparatus from a distance, the combination of an electric source, a rotary commutator connected to said electric source, means for leading off from the commutator pulsating electric currents, manually operated means for adjusting the relation between the lengths and intervals of pulsation, a line circuit, a receiver consisting of a switching relay connected to the line circuit, a local circuit controlled by said switching relay, and a receiving apparatus in said local circuit operated in accordance to the effective value of the pulsating currents excited in the local circuit by the said switching relay.

3. In a system of operating electric apparatus from a distance, the combination of a transmitter having means for generating pulsating electric currents and manually operated means for adjusting the relation between the lengths and intervals of pulsation, a line circuit, a receiver consisting of a diaphragm relay interrupter connected to the line circuit, a local circuit controlled by said interrupter, and receiving apparatus operated in accordance to the effective value of the pulsating currents excited in the local circuit by the said interrupter.

4. Apparatus for telegraphic transmission of writings and drawings, consisting of a transmitter having means for generating two sets of pulsating electric currents, hand operated devices for varying the relation between the lengths and the intervals of the pulsations, a receiver consisting of

switching relays connecting to said line circuits, local circuits controlled by said switching relays, a pencil, and electromagnetic means in the said local circuits for moving said pencil in accordance with the effective value of the pulsating currents excited in said local circuits.

5. Apparatus for telegraphic transmission of writings and drawings, consisting of a transmitter having an electric source, a rotary commutator for generating pulsating electric currents of different relations between the lengths and intervals of pulsations, two line circuits, a receiver having two switching relays connected to said line circuits, local circuits controlled by said switching relays, a pencil, and coils connected to said local circuit for moving the pencil in accordance to the effective value of the pulsating currents excited in the said local circuits.

6. In an apparatus for telegraphic transmission of writings and drawings, the combination of a transmitter consisting of hand operative writing means, means for generating two sets of pulsating currents having a variable relation between the lengths and intervals of the pulsations, a receiver consisting of two switching relays, local circuits controlled by said switching relays, writing means and electromagnetic coils connected to said local circuits for moving the writing means of the receiver in accordance with the effective value of the pulsating currents of the said local currents.

7. In an apparatus for telegraphic transmission of writings and drawings, the combination of a transmitter consisting of an electric source, hand operative writing means, a rotary commutator for generating pulsating currents having a controllable relation between the lengths and the intervals of the pulsations, movable brushes on said commutator in operative connection with said writing means, line circuits, and a receiver, consisting of diaphragm relays, local circuits controlled by said relays, writing means, and coils for operating said writing means in accordance with the effective value of the pulsating currents of said local circuits.

In testimony that we claim the foregoing as our invention, we have signed our names in presence of two subscribing witnesses.

EMIL HENRIK WIDEGREN.
KLAS AUGUST WIDEGREN.

Witnesses:

ERNST DELMAR,
JOHN DELMAR.