

Jan. 30, 1934.

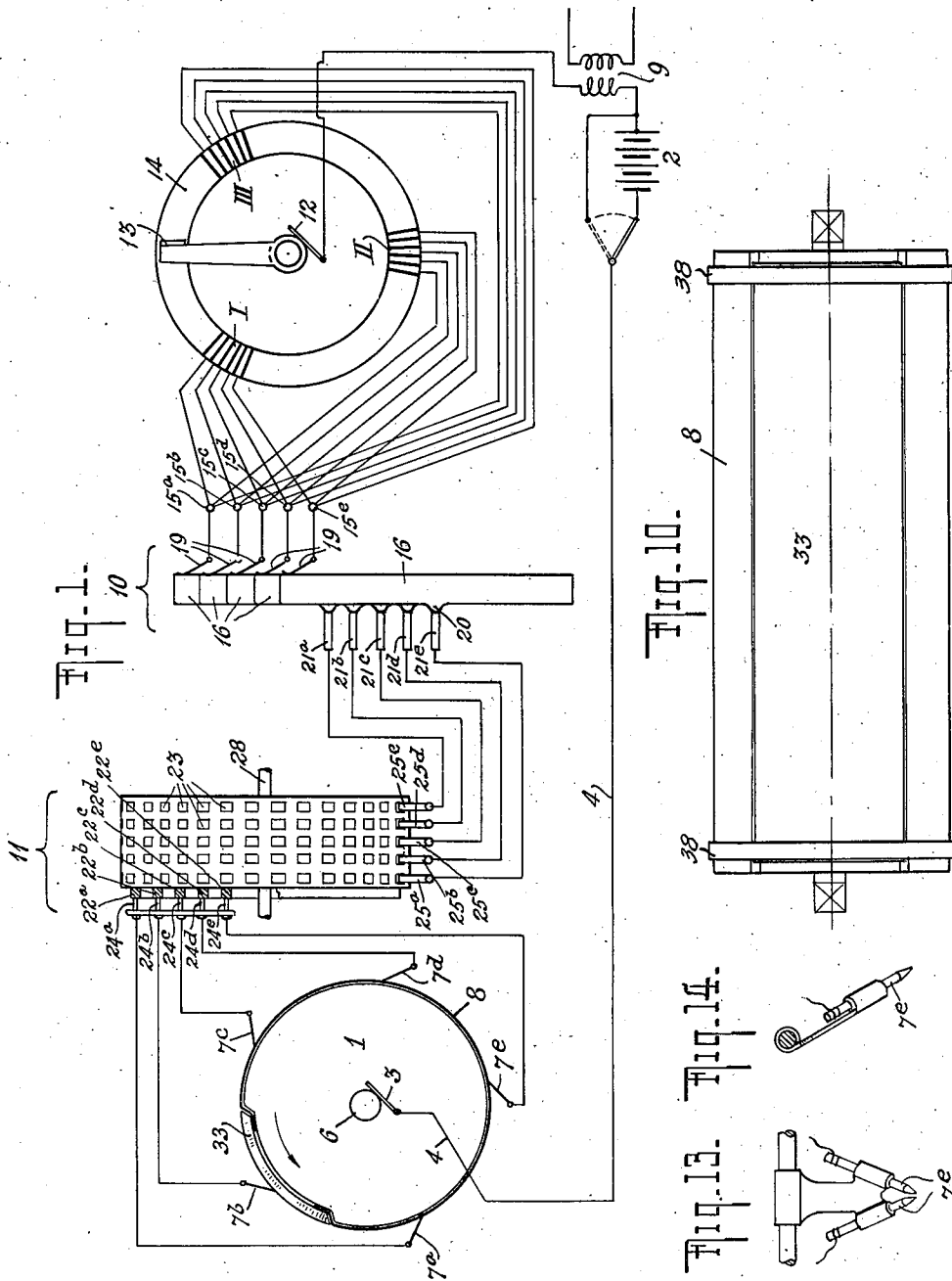
F. WREDE

1,945,014

METHOD AND MEANS FOR ESTABLISHING SECRET COMMUNICATION

Filed March 17, 1932

3 Sheets-Sheet 1



WITNESS

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METHOD AND MEANS FOR ESTABLISHING SECRET COMMUNICATION

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3 Sheets-Sheet 2

Fig. 3.

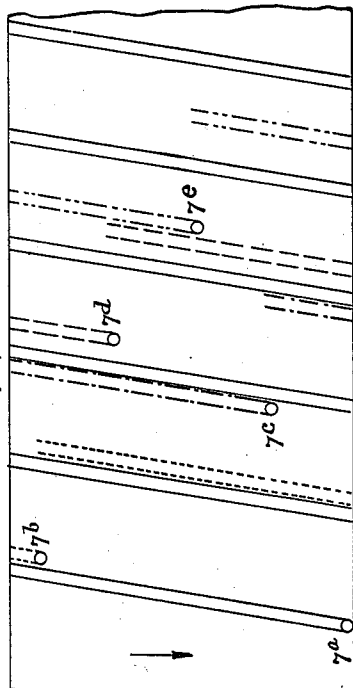


Fig. 2.

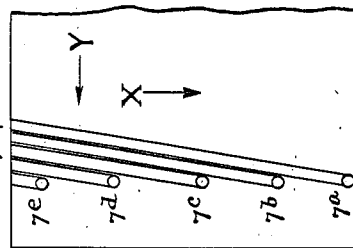


Fig. 4.

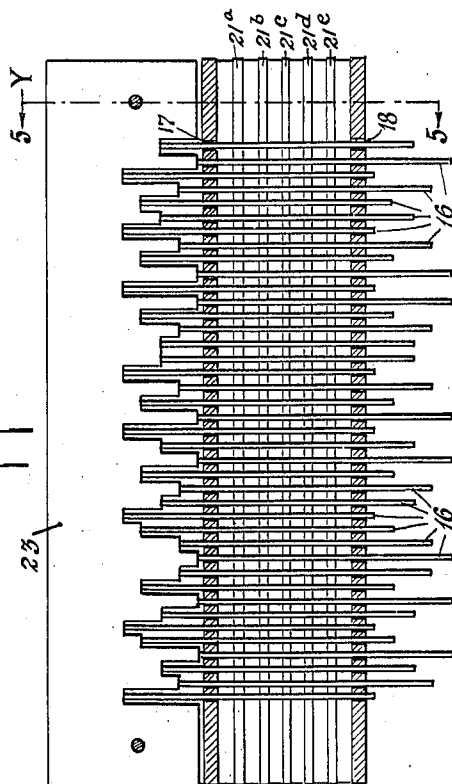
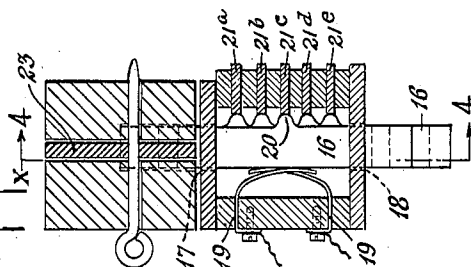


Fig. 5.



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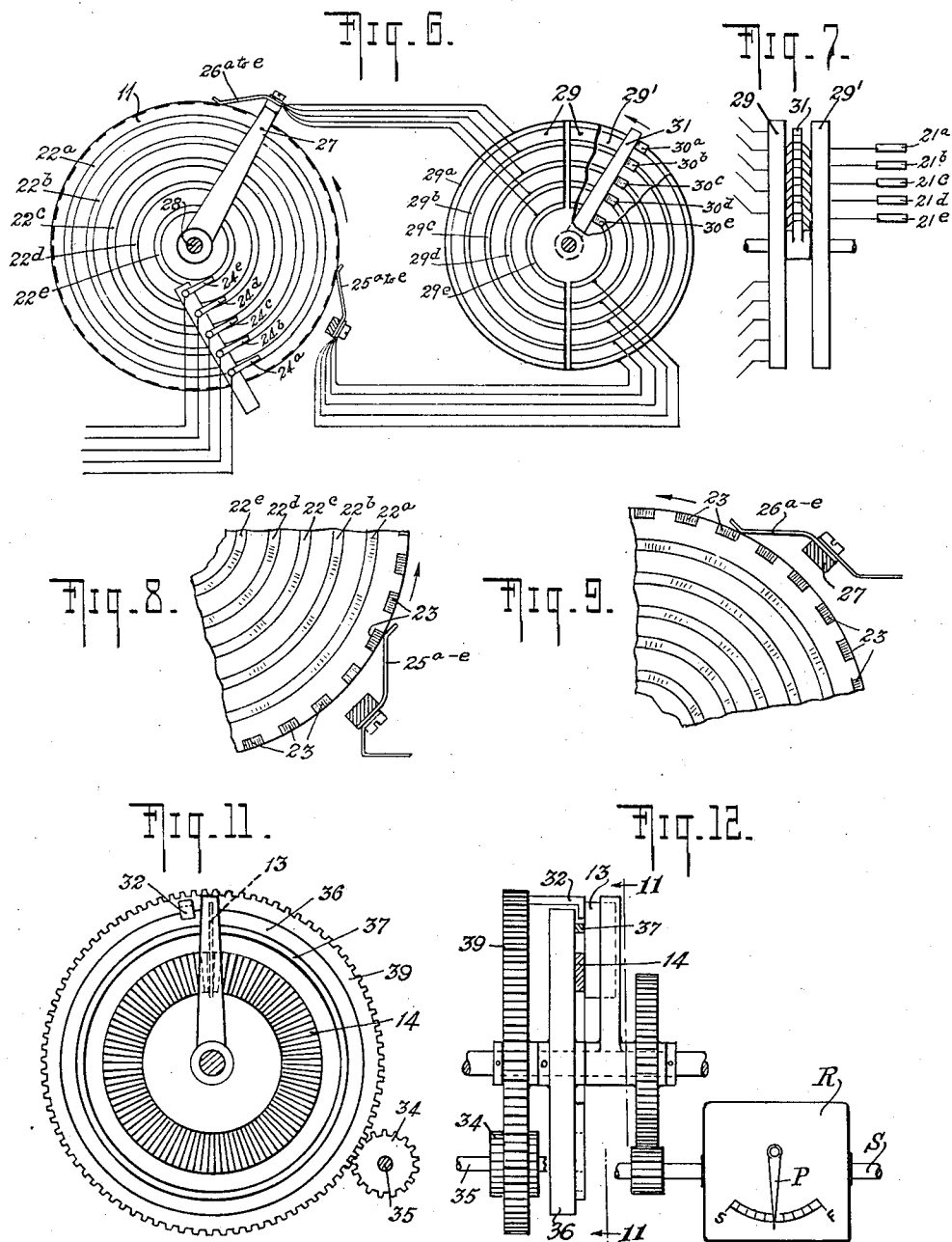
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METHOD AND MEANS FOR ESTABLISHING SECRET COMMUNICATION

Filed March 17, 1932

3 Sheets-Sheet 3



WITNESS

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UNITED STATES PATENT OFFICE

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METHOD AND MEANS FOR ESTABLISHING
SECRET COMMUNICATION

Franz Wrede, Berlin-Charlottenburg, Germany

Application March 17, 1932, Serial No. 599,513,
and in Germany December 16, 1929

25 Claims. (Cl. 178—22)

The invention relates primarily to the art which deals with the transmission and reception of messages, the meaning of which is to be concealed from outsiders even though such outsiders should possess means capable of responding to the several individual impulses or stimuli by which the message is transmitted. The object of the invention is to establish a method of secret communication which will leave the uninitiated recipient of the several individual impulses by means of which the message is conveyed without any clue to the correct deciphering or integrating of whatever record he may obtain.

The method devised by me may be used for the transmission of information or news of all varieties including diagrams, plans, pictures, maps, military and naval information with substantial assurance that no unauthorized person will be able to correctly integrate the message, even though all of the impulses by which the message is sent may be intercepted.

The new method is practiced in conjunction with apparatus which is designed generally to be of small compass and relatively little weight so that it may be adapted to fit and be carried in a knapsack worn by a single man. The knapsack itself, after the apparatus is removed and mounted for use, may be filled with stones or earth and be made to serve as the weight which controls the clockwork that governs the moveable parts of the apparatus.

In the following specification the invention will be described as applied to a special type of telautographic apparatus but it will be understood that the invention is not confined to this particular form of apparatus nor to any particular system by which the impulses which convey the message are transmitted or received. The invention, once understood, can readily be adapted and used in connection with other apparatus and other principles of communication than those involved in the particular apparatus in connection with which the invention will be described.

The new method differs from any such methods as involve codes or the like in that whereas all code messages seem to be readily decipherable, in themselves supplying the clue for their deciphering, my new method prevents the unauthorized recipient of the impulses from receiving anything which can possibly serve as the basis of a clue. In all prior methods of secret communication of which I am aware, the outsider is enabled to receive the parts of the message that are being sent at any particular moment exactly as those parts of the message are received by the author-

ized recipient, the remaining problem then only being one of decoding. According to my new method the unauthorized recipient will never be able to receive the parts of the message in the same manner in which those parts are received by the authorized recipient, but he will always obtain either a jumble of meaningless lines or dots or a false interrelation between the several components of the true message.

For convenient description of the invention, reference is made to the accompanying drawings in which Fig. 1 is a diagrammatic assembly of a sender and/or receiving instrument; Figs. 2 and 3 are diagrammatic details of portions of the message carrying and/or receiving cylinder showing different arrangements of the contact organs and the paths thereof; Fig. 4 is a longitudinal section on line 4—4 of Fig. 5 illustrating in greater detail the system shown at 10 in Fig. 1 and Fig. 5 is a section on line 5—5 of Fig. 4; Fig. 6 is a diagrammatic view of a modified form of the system shown at 11 in Fig. 1; Fig. 7 is a diagrammatic side view of the right-hand elements of Fig. 6; Figs. 8 and 9 are enlarged details of the peripheral contacts shown in Fig. 6; Fig. 10 is a detail of the sending and receiving roller or platen 1; Fig. 11 is a section taken along the line 11—11 of Fig. 12 showing a face view of a modified form of the distributor 14 of Fig. 1; Fig. 12 is a side view of the modified distributor, partly in section, showing its connection with the controller; Figs. 13 and 14 are detail views of the contact fingers 7a—e of Fig. 1.

Let us assume that the message to be transmitted is written on a sheet of paper 8. This paper sheet is wrapped around the platen 1 in the manner indicated in Fig. 1, the ends of the paper being preferably retained under the circular metal plate 33 whose outer contour is a continuation of the circular contour of those parts of the platen upon which the paper is stretched. The plate 33 is shown as being removably retained in place for the reception of other message-bearing paper, by the sliding rings 38 shown in Fig. 10. The surface of the plate 33 represents approximately one-fifth of the surface of the platen. The reasons therefor will appear later. The platen 1, as is common with telautographic instruments, rotates continuously on the axle 6 and at the same time moves bodily from right to left or vice versa, so that a stationary finger contact with the surface of the cylinder or platen 1 will necessarily, as the platen rotates, define a continuous spiral line with respect to the outer surface of the platen as indicated in Figs. 2 and 3. Each of the contact

fingers will pursue a spiral path of its own. In Fig. 1 five of such contact fingers are shown at 7a, 7b, 7c, 7d, and 7e respectively and it is to be understood that the number of such contact fingers can be increased or decreased as desired, although five are a convenient number. In Fig. 1 the platen 1 is shown as a metal platen electrically connected to the source of current 2 by means of line 4 and contact 3. The contact fingers 7a to 7e are also electrically associated with the source of current 2 in such manner that when any one of the contact fingers rests upon a portion of the message to be transmitted and the circuit of that contact finger is at that moment closed, an impulse will be sent out through the induction coil 9.

There are several methods available for the initial electric functioning of the contact fingers 7a to 7e with respect to the message. If the message is written in ink and on paper of such character that the ink in the paper serves as a conducting medium, the arrangement will be approximately that shown in Fig. 1 and the contact fingers need have but a single contact point. On the other hand, the message may be written on a conducting base in fatty ink which is non-conducting and in that case the arrangement again will be substantially the one shown in Fig. 1. Preferably however, I employ contact fingers which have double contact points closely adjacent to each other (as shown in Figs. 13 and 14) so that as the two points travel across or along any written part of the message, electrical contact between the two points of the fingers will be established through the graphite of a pencil message on a piece of paper. In that case the electrical communication 4—3 from the source of current to the platen will fall away, the circuits being in that case established from the battery 2 to the two fingers respectively of each contact finger.

The spiral lines pursued by the respective contact fingers are preferably drawn so close to each other as to cover the entire surface of the sheet 8 so that when the platen 1 has completed its travel every part of the written message has been traversed by one of the contact fingers. The contact fingers are, however, preferably so positioned that the respective spirals are not arranged in normal succession as in Fig. 2 but in an entirely irregular arbitrary succession as indicated in Fig. 3 where, for example, the sequence is 7a, 7b, 7d, 7e, 7c. The starting points of the several fingers is also preferably arbitrarily distributed also as indicated in Fig. 3.

Let us now assume that the message contains a dash of such lengths as to correspond exactly to the space between the five spiral lines of the five contact fingers. According to the arrangement of Fig. 3, the first of the fingers to reach that dash will be 7e which will send out the four fifths of the dash. As the cylinder advances, the next finger 7d to reach the dash will send the third fifth of the dash. Then 7c will send the fifth fifth of the dash. Then the finger 7b will send the second fifth of the dash and finally the finger 7a will send the first fifth of the dash. If an interceptor of the impulses has his contacts arranged as shown in Fig. 2, his record will show five impulses positioned in no relation to each other and he can never integrate the five impulses into a dash unless he finds the particular arrangement of Fig. 3. Inasmuch as the possibilities of different arrangements is infinite, it is practically impossible to reconstruct the message.

In order to prevent the unauthorized inter-

ception of a message still more perfectly and reliably, I have additionally incorporated in my system the procedure indicated at the right hand side of Fig. 1. There is there shown a distributor ring 14 which supports 120 single contacts. Of these contacts only fifteen are shown in order not to make the drawings too confusing. The single contacts are shown as arranged in groups of five, three of such groups being respectively connected with the terminals or junction screws 15a, 15b, 15c, 15d, 15e of the contact finger (7a—7e) circuits. The screws 15a—15e preferably represent a different succession from that used for the succession of the contact fingers 7a—7e.

In addition to the three sets of contacts designated as I, II, and III in Fig. 1, the ring 14 carries seven more of such series of triple groups of five contacts each, so that there will be eight groups of five contacts each from I to II, eight more from II to III, and eight more from III to I. Each contact member of each group of five is in turn connected with one of one series of junction screws 15a to 15e. There are eight such groups of junction screws, the members of each group being in turn electrically connected with one of the contact groups between I and II, II and III, and III and I. The three connections which lead from each of the junction screws to the contacts on 14 preferably lead to different ones of the single contacts making up a group of five as at I, II, and III. Thus 15a may be connected to the first contact of I and to the third contact of II and to the fifth contact of III, and so on with constant diversification of the arrangement with respect to the whole of the one hundred and twenty contacts of 14. Since the five units can be combined in one hundred and twenty different ways, there are one hundred and twenty combinations available out of which one may arbitrarily choose any twenty-four for the connections between the corresponding series of contacts and junction screws.

As a constantly rotating brush 13, electrically associated with the battery 2 and the induction coil 9 through the contact 12, sweeps over the individual contacts of the ring 14, it will open the possibility of the passage of an electric impulse from the fingers 7a—7e according to whether those fingers are passing over a part of the message to be transmitted and whether the brush 13 is on the particular individual contact point on ring 14 which is associated with that particular contact finger.

The brush 13 moves rapidly over the ring 14 at a rate of say four complete revolutions per second. As there are one hundred and twenty contacts on the ring 14, this means four hundred and eighty opportunities for transmitting an electric impulse per second. It is, of course, understood that the several groups of five contacts each on the ring 14 need not be arranged in the same electrical sequence with relation to each other as shown in the drawings, though the arrangement is in each case such that the individual contacts on ring 14 will form a succession of groups representative of the several contact fingers 7a—7e. The platen 1 moves with a peripheral speed of say one inch per second and a longitudinal speed of say 5/100 (0.05) of an inch per second. If therefore the contact fingers 7a—7e are passing over a completely dark part of the message, there will be sent out four hundred and eighty impulses per second representative of the dark spot of a message in the particular region represented by that part of the paper which lies within the

range of the movement of the platen as described.

In the receiving apparatus the arrangement of contacts and connections is exactly the same as in the sender so that Fig. 1 represents a receiver quite as well as a sender with the exception that in the case of the receiver the current impulses are not carried from the fingers 7 to the induction coil 9 but are received at 9 and make a record at the ends of the fingers. In the case of a receiver, moistened electrolytic paper may be employed on the platen 1 so that whenever an impulse passes through any one of the fingers it will leave a dot or colored mark on the paper surface, the current passing from the fingers through the electrolytic moisture, the metal drum 1, the sliding contact 3, the wire 4, and back to the source of current which in this case may be a relay or amplifying device or the like at 9, appropriate to the type of impulse transmission used, e. g. wireless or direct wire connection, and capable of receiving and amplifying the current impulses of the sender.

The motive power required for the operation and timing of the movement of the platen and the brush 13 and other moving parts may, in either or both the sender and receiver, be clockwork or regulating means indicated at R (see Fig. 12) and controllable as by pointer P, the main shaft S being arranged through suitable gearing to impart motion to all moving parts. The motive power may be derived from a pulley (not shown) under the influence of a weight which is made up by filling the knapsack in which the instrument was transported.

The receiver may however be made to operate through the medium of other agencies than electric impulses, for example by a photographic method. In that case the fingers would be replaced by single light beams affecting sensitized paper, one of the light beams becoming effective every time an electric impulse arrives from the distributor. Other methods well known to those skilled in the art may also be employed, as, for instance, the photo-electric cell, which is capable of practical use in connection with the transmitting apparatus. Thus the receiving fingers may be replaced by such cells. For general practice, especially where messages written with lead pencil are to be transmitted, I prefer to use a set of two contact points for each of the fingers 7a, 7b, 7c, etc. as shown in Figs. 13 and 14. In that case whenever the distributor permits of the passage of current between the closely adjacent points of the two contacts of each set and there happens at that moment to be an electrical connection between those two points presented by some graphite or carbon from the lead pencil on the paper, the current will continue its way through this carbon and close the circuit. The gap between the points of the two contacts may be about 1/100 (0.01) of an inch wide and the voltage about 20 to 30 volts, according to the speed of the performing apparatus.

An element which may be introduced in connection or combination with any of the arrangements described may consist in the manner in which the synchronizing and isochronizing of the two or more related apparatus is performed. As a rule signals or current impulses are transmitted from the transmitting apparatus, directly or indirectly controlling and regulating the receiving apparatus. In case these signals are connected with a determined periodical position, as for example whenever the rotating cylinder reaches a

point where the reading organ or finger begins a fresh line on the sheet it is relatively simple to secure isochronism in the receiving apparatus by regulating not only the speed of the rotating cylinder of the receiver in exact accordance with those signals, but also the position of the cylinder in order to have the writing organ begin a fresh line on its sheet simultaneously with that signal. In case, however, the signals are not connected with a determined but with a variable and arbitrarily chosen position, the isochronizing problem alone will introduce an element of such extreme complication as to render the integration of an intercepted message practically hopeless. This feature of the present invention will be further dealt with at a later part of this specification.

Suppose now, that the transmitting and the receiving apparatus, both built alike—with exception of the form of fingers 7a—e employed—are synchronized and the connections between the eight series of junction screws and the twenty-four series of contacts are alike in the two apparatus, then the current impulses would go through the corresponding fingers in both apparatus in exact correspondence and relation, provided they were connected with the corresponding junction screws respectively. If finger 7a is connected with junction screw 15a in the same way in each apparatus, each apparatus in turn will react alike to current impulses responsive to that particular arrangement. But of course both apparatus may have been arranged to connect 7a with some other one of the junction screws in each of the other seven series of junction screws. So 7a may be connected in the second series of junction screws (which may be designated 15'a—e) with 15'c, and in the third series with 15''e and so forth, without any trouble arising in the communication, provided that the same screw has been used in both apparatus alike. This may readily be done by means of five universal bars 21a—e, which may be directly connected with the fingers 7a—e respectively and to which connection wires from the eight series of junction screws may also be directly attached. But in the described apparatus a different and more advantageous construction has been employed.

Suppose a mistake should occur, one of these connections being interchanged with another one in one of those two corresponding apparatus, then of course each of these two junction screws would lead the current impulses coming over its three contacts respectively at wrong moments and to wrong fingers; e. g. in the copied picture or writing in the receiving apparatus there may be missing six dots and these six dots may appear somewhere at wrong places. In fact the number of adulterated elements equals twice the number of contacts on the distributor ring connected with the respective junction screws, multiplied by the number of wrong connections. Thus it may be understood how essential the agreement in both apparatus of every single connection is for obtaining a recognizable reproduction of the picture transmitted, and how important it is on the other hand to be able to interchange all those connections without any mistakes and in some practical and time-saving way.

One device for doing this is shown diagrammatically in Fig. 1 in the form of a multiple-switch 10 and more fully in Figs. 4 and 5, but of course some other kind or form of switch may also be used for the same purpose. Fig. 4 shows a view of the cross-section 4—4 of Fig. 5, seen

in the direction of the arrow *x*, and Fig. 5 shows the view of the cross-section 5—5 of Fig. 4 seen in the direction of the arrow *y*. As in a Yale lock there are a number—in this case forty—of parallel metal bars 16 arranged in a row and movable longitudinally in two slits or guides 17, 18 held in position by and slidably movable on springs 19 which are connected with the above-mentioned junction screws 15*a—e*, 15'*a—e*, 15''*a—e*, etc. on one side and on the other side having a nose 20, which is brought into any selected position according to any shifting of the bar, thereby making contact with one of the five universal bars 21*a—e*, which are connected directly or indirectly with the five fingers 7*a—e* respectively.

The forty bars may be adjusted by shifting them all up to the top position and then depressing them by means of a key or comb 23 (Figs. 4 and 5) and locking the comb in the proper position. The bars are then held in their position and in contact with their universal bars by means of the springs 19. The comb 23 may be exchanged with another one and thereby a very great number of different combinations of ways for the current is provided and quickly interchangeable.

The receiver of the messages may easily carry with him a set of different combs 23, and replace one comb for another at prearranged times, intervals, or other arrangements previously made, but always so that the identical combs will be simultaneously used by the sender and receiver. In this way all of the interrelated electrical connections will be periodically completely rearranged into a new arbitrary network so that whatever false picture may have been received by an unauthorized interceptor, may from that moment become false in an entirely new way, either of the intercepted records supplying any information containing any clue, which could possibly lead to a proper integration of the true message.

The same kind of a multiple-switch, previously described or some other equivalent may be used for interchanging the connections between the contacts on the distributor 14 and the junction screws, in which case the latter would be replaced by universal bars or the like.

All those means hereinbefore described for interchanging the different ways of the current may be regarded as rigid means, since they are set before the message is sent and remain in their set position during the sending of the message, but when desired, I also provide means capable of interchanging the combinations during the sending period, one of which I shall here describe, and which is represented diagrammatically in Fig. 1.

The main part of this device is also a multiple-switch, adapted to interchange the five connections between the five fingers 7*a—e* and their universal bars 21*a—e*. This switch consists of a rotor 11 provided with concentric metal contact rings 22*a—e* on one of its flat sides and of a large number of series of five metal contacts 23 arranged in rows parallel to the axis of the rotor on its cylindrical surface. Wires from the fingers 7*a—e* lead to the sliding contact springs 24*a—e* which contact with the metal rings 22*a—e* and another series of contact springs 25*a—e* glides on the contacts 23 and is connected with the universal bars 21*a—e* by means of wires. The contacts 23 are connected with the metal rings 22*a—e*, each series 23 showing a different and

arbitrarily chosen combination of its connections with the rings 22*a—e*. Therefore the connections between the fingers 7*a—e* and their universal bars 21*a—e* may be changed as often as desired by turning the rotor 11 to any arbitrarily selected position.

The commuting switch or rotor 11 may be rotated by hand, either while the apparatus is not in use or during a pause or stop which may be inserted by previous agreement, for instance for controlling the synchronism of the apparatus. But the rotor may also be rotated automatically, for instance by means of the gearing and by the power employed to drive the rest of the moving parts of the apparatus. Such gearing means are well known and therefore need not be described here.

Fig. 6 shows an example of an automatically performing device of this kind. The rotor 11 is shown from its left side with the contact rings 22*a—e* and the sliding contacts 24*a—e*. On the circumference of rotor 11 glide the contact series 25*a—e*, as described above and shown in Fig. 1. In the case of Fig. 6 there is provided one or more series of sliding contacts 26*a—e*, fastened on a bar 27 which is pivotally mounted on the axle 28 of the rotor 11 and may be rotated around the rotor 11 and thereby be adjusted to any desired position where the contact springs 26*a—e* are in contact with one of the series 23. The connections from contact springs 25*a—e* to the universal bars 21*a—e* are exchanged with those from contact springs 26 by means of a distributor 29 consisting of two systems 29 and 29' of five contact rings each 29*a—e*, each ring of 29 being cut in half, the one half being connected with the series of contact spring 25*a—e* and the other half with contact spring 26*a—e*. The system 29' communicates with the universal bars 21*a—e*, and five brushes 30*a—e*, mounted on a rotating arm 31, connect corresponding parts of both systems while rotating.

The arm 31 rotates once only as a distributor brush 13 (Fig. 1) rotates twice, e. g. during one rotation of brush 13 the universal bars 21*a—e* are connected with the fingers through contacts 25*a—e* and during the next rotation of brush 13 with contacts 26*a—e*. Meanwhile the rotor 11 is also rotating, but only one-half of a full step from one contact series 23 to the next series during one complete rotation of brush 13. As shown in Figs. 8 and 9 the contact series 25*a—e* and 26*a—e* are so positioned in relation to one another that as contacts 25*a—e* begin to make contact with one of the series 23, contacts 26*a—e* will be out of contact with their contact series 23. When brush 13 will have finished one more rotation series 25*a—e* will leave their contact series 23 and contacts 26*a—e* will have passed over the interval between two series 23 and will just have reached its next series 23. Thus the connections between the universal bars and the fingers will be commuted continually. Suitable means are used for adjusting the rotational speed of the different axes through appropriate gearing but such means being known are not illustrated and need not be specially described.

By having the two series of contact springs 25*a* and 26*a* working on two individual rotors 11, each rotor being rotated by means of an appropriate alternating and change gear system to the extent of either one or more steps, e. g. from one series of contacts 23 to any other of the series 23, this commuting device may be made still more effective.

As previously described, the drum 1 in Fig. 1 is covered with the paper 8 which is held in position by the part 33. In Fig. 10 this part 33 is shown as being held by two rings 38 movable on the ends of the drum 1. The part 33 is made of metal and therefore will let a current impulse pass whenever current comes through that one of the fingers 7a-e which touches the surface of part 33, and since the latter occupies one-fifth of the circumference of drum 1 there will always be one of the fingers in contact with part 33 and therefore in the transmitting apparatus one out of five impulses from the source of current 2 over the distributor 14 will reach the other pole through the surface 33, thereby transmitting a signal impulse to the receiving apparatus. In case both apparatus are properly adjusted, those impulses will, of course, in the receiving apparatus meet the part 33, but not have any effect on the electrolytic paper. But in case there should be some mistake in the adjustments or interception by a non-corresponding system, these impulses will, of course, go through some other finger and mark a wrong spot. Thus these impulses will entirely ruin the communication by covering the sheet with wrong dots and so avert any interception by an unauthorized person in case this person is experimenting with an apparatus not adjusted absolutely correctly.

Fig. 11 shows a device for arbitrarily changing the isochronizing position of this kind of apparatus. Outside of the distributor ring 14 there is another ring-shaped contact 37 electrically connected with the source of current 2 and replacing the sliding contact 12. The brush 13 glides over the distributor ring 14 and also over the ring 37, thereby connecting the latter with whatever contact on the ring 14 it happens to touch. Both rings 14 and 37 are fastened on a disc 36 (Figs. 11 and 12) and on the protruding edge of this disc a single contact 32, connected with the other pole of the source of current 2, is movably attached and adapted to be shifted around the edge of the disc 36. Each time the brush 13 connects the contact 32 with the contact ring 37 there will be a current impulse allowed to flow along this connection, thereby transmitting a signal (such as an audible signal or its equivalent) for synchronizing and isochronizing purposes.

The position of contact 32 may be chosen arbitrarily and remain unaltered, but of course may be also continually shifted during the performance by connecting it by suitable gearing means with the source of power actuating the other moving parts of the apparatus as shown for example in Figs. 11 and 12. The contact 32 is attached to a gear wheel 39, which meshes with another wheel 34 of suitable diameter, the axle 35 of which is rotated by gearing from the main shaft of the source of power.

This arrangement will enable the receiver to start receiving with a pre-agreed or signalled relation between the brush 13 and a particular contact of the series 14 and distance between the brush 13 and the contact 32. Thereafter the contact 32 will move in harmony with the corresponding element in the sender but the position of the contact 32 at the time of its engagement with 13 will not be exactly equal to one revolution of the brush 13 but may be varied and by these means an interceptor may find himself still more hopelessly deprived of all possibility of correctly receiving and much less, integrating the message.

In ordinary telautographic, picture telegraphic or similar apparatus two similar synchronized apparatus function in unison and some organ which may be a pencil or a beam of light permits the two sheets to be written and read or received line by line from top to bottom, the lines running parallel and close to each other in order to cover the entire surface of the sheet. In the apparatus which constitutes the subject matter of the present invention the transmitting current is not continuous but intermittent and the picture as drawn at the receiving apparatus is broken up into single elements or units of area comparable to a certain extent to those which are the product of the use of screen in photo-printing and those units are thereupon not transmitted one after the other as they succeed each other in their respective lines but in an arbitrary arrangement and sequence and if that arbitrary arrangement is not known and cannot be found, the picture can never be intercepted as sent and nothing but a meaningless jumble of dots all spaced in improper relation to all the other dots will be received. Suppose for example that there is an element or organ functioning at the end of the fifth line, and succeeded by one at the beginning of the second line, and then one out of the middle of the fourth line, and then one from somewhere in the first line, and so on, as in the case where a multiplicity of organs or contact fingers is used, each one of which works exclusively on the elements or units of area in its own line, as shown in Fig. 3. Then a receiver which has its fingers differently arranged or grouped from the arbitrary arrangement of the authorized sender and receiver cannot possibly succeed in recording the message in its proper integrated condition.

Although it is not advisable to increase the number of organs or fingers beyond a certain limit, there may also without exceeding practical conditions be more than one organ for each line, the two organs being, for example, arranged to take successively every alternate space unit of the line.

By increasing the number of contacts on the distributor ring and connecting the series of organs repeatedly and with different series of contacts respectively, thereby arbitrarily varying the succession of the connections within the single series, the resulting "total combination" will be sufficiently complicated to avert possibility of deciphering in practically all cases.

Means are also provided to permit of periodic interchange or commutation of the connections between the different parts whereby the "total combination" is rendered still more intricate to an extent sufficient to avert a proper reception of a message by an interceptor.

The several means described will result in the following effect: Each time one of the sending fingers of the transmitter running across the white sheet meets a dark spot in its line, an electric impulse will cause one of the writing organs or fingers in the receiver to produce a dark spot on its sheet. This dot will stand at exactly the same place of its sheet as the corresponding dark spot occupied on the original and in this way every part of the original will be produced on the copy dot for dot, each dot in its proper place, thereby resulting in an accurate and faithful copy of the original picture or writing. On the other hand, if one of the fingers has not been positioned at its proper place as in the case of an unauthorized intercepting apparatus, the dots will appear shifted to other places and will

in consequence be missing at the proper places. A third person without knowledge of the accurate arrangement of the fingers or of the "combination" or interrelation between the connections and distribution system must therefore fail to find more than a few of these several details by accident or repeated trials. Should he undertake to intercept such messages even by means of a properly synchronized apparatus, he would still receive merely a multitude of dots mixed up and shifted to mock places with no clue for shifting them to their proper places. This difficulty is made entirely hopeless if there are other dots added which do not belong to the message or picture. Some meaningless lines or scratches between or beside the writing on the original will accomplish this end but it can be done automatically more effectively by using a purposely confusing element in the apparatus such as the plate 33 shown in Figs. 1 and 10. Such a plate 33 is, of course, to be regarded merely as one example of a device utilizing the method which underlies the present invention.

It will be apparent that numerous changes, modifications and developments can be made and it is my object to include all such modifications, etc. as may be within the purview of the present invention, within the scope of the appended claims.

I claim:

1. Apparatus for establishing secret communication comprising a sender and a receiver, means to divide each element of a message into a multiplicity of units meaningless per se, means in said sender adapted to transmit impulses corresponding to said units, said means being adapted to diversify said impulses into a plurality of sequences and means in said receiver adapted to receive said impulses, said means being in synchronous agreement with said transmitting means with respect to the timing and sequence of said impulses.

2. Apparatus for establishing secret communication comprising a sender and a receiver, means adapted to divide each element of a message into a multiplicity of units meaningless per se, means in said sender and receiver, adapted to transmit impulses corresponding to said units, means in said receiver adapted to receive said impulses, said transmitting and receiving means being in synchronous agreement with respect to the timing and sequence of said impulses, and means in both to establish the relation between the individual impulses according to an arbitrary arrangement.

3. Apparatus for establishing secret communication comprising a sender and a receiver, means adapted to divide each element of a message into a multiplicity of units meaningless per se, means in said sender to transmit impulses corresponding to said units, said means being adapted to diversify said impulses into a plurality of sequences and means in said receiver adapted to receive said impulses in synchronous agreement with said transmitting means, said transmitting and receiving means being adjustable.

4. Apparatus for establishing secret communication comprising a sender and a receiver, means in said sender to divide each element of a message into a multiplicity of units meaningless per se, means to transmit impulses corresponding to said units, said means being adapted to diversify said impulses into a plurality of sequences and means in said receiver in synchronous agreement with said transmitting means with respect to the

timing and sequences of said impulses, and means to re-establish every unit of the message in its original order, sequence and arrangements.

5. Apparatus for establishing secret communication comprising a sender and a receiver, means adapted to divide each element of a message into a multiplicity of units meaningless per se, means in said sender adapted to transmit impulses corresponding to said units, means in said receiver adapted to receive said impulses, means in both to establish the relation between the individual impulses according to an arbitrary arrangement, said transmitting and receiving means being in synchronous agreement with respect to the timing and sequence of said impulses and means for shifting the order of said impulses in mutual agreement between said sender and receiver during the progress of the transmission of the message.

6. Apparatus for establishing secret communication comprising a sender and a receiver, means adapted to divide each element of a message into a multiplicity of units meaningless per se, means in said sender adapted to transmit impulses corresponding to said units, means in said receiver adapted to receive said impulses, means in both to establish the relation between the individual impulses according to an arbitrary arrangement, said transmitting and receiving means being in synchronous agreement with respect to the timing and sequence of said impulses and means in both comprising a distributor adapted to direct and control the reception of impulses according to an arbitrary succession in the electrical connections of the distributor.

7. Apparatus for establishing secret communication comprising a sender and a receiver, means adapted to divide each element of a message into a multiplicity of units meaningless per se, means in said sender adapted to transmit impulses corresponding to said units, means in said receiver adapted to receive said impulses, said transmitting and receiving means being in synchronous agreement with respect to the timing and sequence of said impulses, means in both to establish the relation between the individual impulses according to an arbitrary arrangement, means comprising a contact plate adapted for the transmission of a multiplicity of impulses having no relation to the message and means in said receiver for rendering said impulses nugatory by the correspondence between the respective systems of receiver and sender.

8. Apparatus for establishing secret communication comprising a sender and a receiver, means adapted to divide each element of a message into a multiplicity of units meaningless per se, means comprising a plurality of paths associated with said dividing means through which successive impulses corresponding to said units are transmittable in arbitrarily arranged sequence and means in said sender adapted to transmit said impulses, means in said receiver adapted to receive said impulses, said transmitting and receiving means being in synchronous agreement with respect to the timing and sequence of said impulses.

9. Apparatus for establishing secret communication comprising a sender and a receiver, means adapted to divide each element of a message into a multiplicity of units meaningless per se, means in said sender adapted to transmit impulses corresponding to said units, means in said receiver adapted to receive said impulses, said transmitting and receiving means being in synchro-

nous agreement with respect to the timing and sequence of said impulses, and means in both to establish the relation between the individual impulses according to an arbitrary arrangement, said means comprising universal bars, contact plates adjustable in reference to said bars, and a plurality of arbitrarily diverse adjusting members for controllably positioning the contact plates to a plurality of diverse positions with respect to said bars.

10. Apparatus for establishing secret communication comprising a sender and a receiver, means in said sender to divide each element of a message into a multiplicity of units meaningless per se, means adapted to vary the order, sequence and arrangement of impulses corresponding to said units, means to emit said varied impulses and means in said receiver adapted to receive said impulses said means being in synchronous agreement with said impulse emitting means with respect to the timing and sequence of said impulses.

11. Apparatus for establishing secret communication comprising a sender and a receiver, means in said sender to divide each element of a message into a multiplicity of units meaningless per se, means in both to establish a relation between the individual impulses corresponding to said units according to an arbitrary arrangement, means in said sender adapted to transmit said impulses, means in said receiver adapted to receive said impulses, said transmitting and receiving means being in synchronous agreement with respect to the timing and sequence of said impulses and means for causing the synchronism between said sender and receiver to be maintained, said means adapted at the same time to function asynchronously with relation to other parts of the sending and receiving apparatus.

12. Apparatus for establishing secret communication comprising a sender and a receiver, means in said sender adapted to divide each element of a message into a multiplicity of units meaningless per se, means in both to establish a relation between individual impulses corresponding to said units according to an arbitrary arrangement, means in said sender adapted to transmit said impulses, means in said receiver adapted to receive said impulses, said transmitting and receiving means being in synchronous agreement with respect to the timing and sequence of said impulses, and means for altering the timing and for setting the respective mechanism of the sender and receiver to maintain said timing in the two equipments.

13. Method of secret communication which comprises dividing each element of the message into a multiplicity of units meaningless per se, varying the order of impulses corresponding to said units and transmitting said impulses to a receiving instrument adapted for the reception of the impulses in the same order as transmitted.

14. Method of transmitting messages in secret from a sending station to a receiving station which comprises greatly diversifying the sequence of current impulses representing units of a message sending said diversified current impulses to a receiving station adapted for the reception of the impulses in the same order and diversification as transmitted and re-arranging said impulses to their original sequence.

15. Method of transmitting messages in secret from a sending station to a receiving station which comprises varying the order or sequence of current impulses representing units of a mes-

sage by an arbitrary arrangement, re-arranging said succession of impulses during the course of the transmission of the message, and transmitting said impulses to a receiving station adapted for the reception of the impulses in the same order or sequence as transmitted.

16. Method of secret communication which comprises diversifying the order or sequence of single current impulses representing units of a message by an arbitrary arrangement of the succession of the single current impulses, repeatedly re-arranging said succession during the course of the transmission of the message and transmitting said impulses to a receiving station adapted for the reception of the impulses in the same order and sequence as transmitted.

17. Method of secret communication which comprises sending current impulses representing units of a message greatly diversified with a multiplicity of impulses not a part of the transmitted message to a receiving station adapted for the reception of the impulses in the same order and diversification as transmitted.

18. The method of transmitting messages in secret from a sending station to a receiving station, said message comprising a multiplicity of individual characters having a predetermined order, which consists in impressing the individual characters in said predetermined order upon a carrying medium located at the sending station, breaking up said characters into meaningless units, transmitting impulses corresponding to said units out of said predetermined order toward the receiving station, intercepting said impulses at the receiving station and automatically rearranging the impulses to their original sequence at the receiving station.

19. Apparatus for establishing secret communication comprising a sender and a receiver, means in said sender to divide each element of a message into a multiplicity of units meaningless per se, means comprising a plurality of paths associated with said dividing means through which successive impulses corresponding to said units are transmittable in an arbitrarily arranged sequence, means for repeatedly rearranging said sequence during the course of transmission of the message and means in said sender and receiver, respectively, to transmit and receive said impulses, said means being in synchronous agreement with respect to the timing and sequence of said impulses.

20. Apparatus for establishing secret communication comprising a sender and a receiver, means to divide each element of a message into a multiplicity of units meaningless per se, means in said sender adapted to transmit current impulses corresponding to said units, means to greatly intermingle said message current impulses with a multiplicity of impulses not a part of the transmitted message, means to greatly diversify the sequence of said intermingled impulses according to an arbitrary arrangement, and means in said receiver adapted to receive said impulses, said means being in synchronous agreement with said transmitting means with respect to the timing and sequence of said impulses.

21. Apparatus for establishing secret communication comprising a sender and a receiver, means to divide each element of a message into a multiplicity of units meaningless per se, means in said sender and receiver, respectively, to transmit and receive impulses corresponding to said units, means in both to diversify said im-

pulses into a plurality of sequences according to an arbitrary arrangement, and means in both to change such arbitrary arrangement at any time and in mutual agreement, said transmitting and receiving means being in synchronous agreement with respect to the timing and sequence of said impulses.

22. Apparatus for establishing secret communication comprising a sender and a receiver, means adapted to divide each element of a message into a multiplicity of units meaningless per se, means in said sender and receiver, respectively, to transmit and receive impulses corresponding to said units, said means being in synchronous agreement with respect to the timing and sequence of said impulses, and means in both to continuously diversify the sequence of said impulses during the transmission of the message, and in mutual agreement.

23. Apparatus for establishing secret communication comprising a sender and a receiver, means adapted to divide each element of a mes-

sage into a multiplicity of units meaningless per se, means in said sender and receiver, respectively, to transmit and receive impulses corresponding to said units, said means being in synchronous agreement with respect to the timing and sequence of said impulses, stationary means in each to diversify said impulses according to an arbitrary arrangement, and movable means in each to further diversify the arrangement of said impulses into a plurality of different sequences.

24. Apparatus as set forth in claim 23 in which the movable diversifying means in said sender and receiver move at a predetermined rate and in synchronism with each other.

25. Apparatus as set forth in claim 23 in which the stationary and movable means in said sender and receiver are so connected that the transmission of said impulses is maintained uninterrupted while said movable means is continuously diversifying the sequence of said impulses.

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