

Jan. 3, 1933.

H. CHIREIX ET AL

1,893,158

HIGH SPEED PRINTING TELEGRAPH

Filed July 18, 1929

4 Sheets-Sheet 1

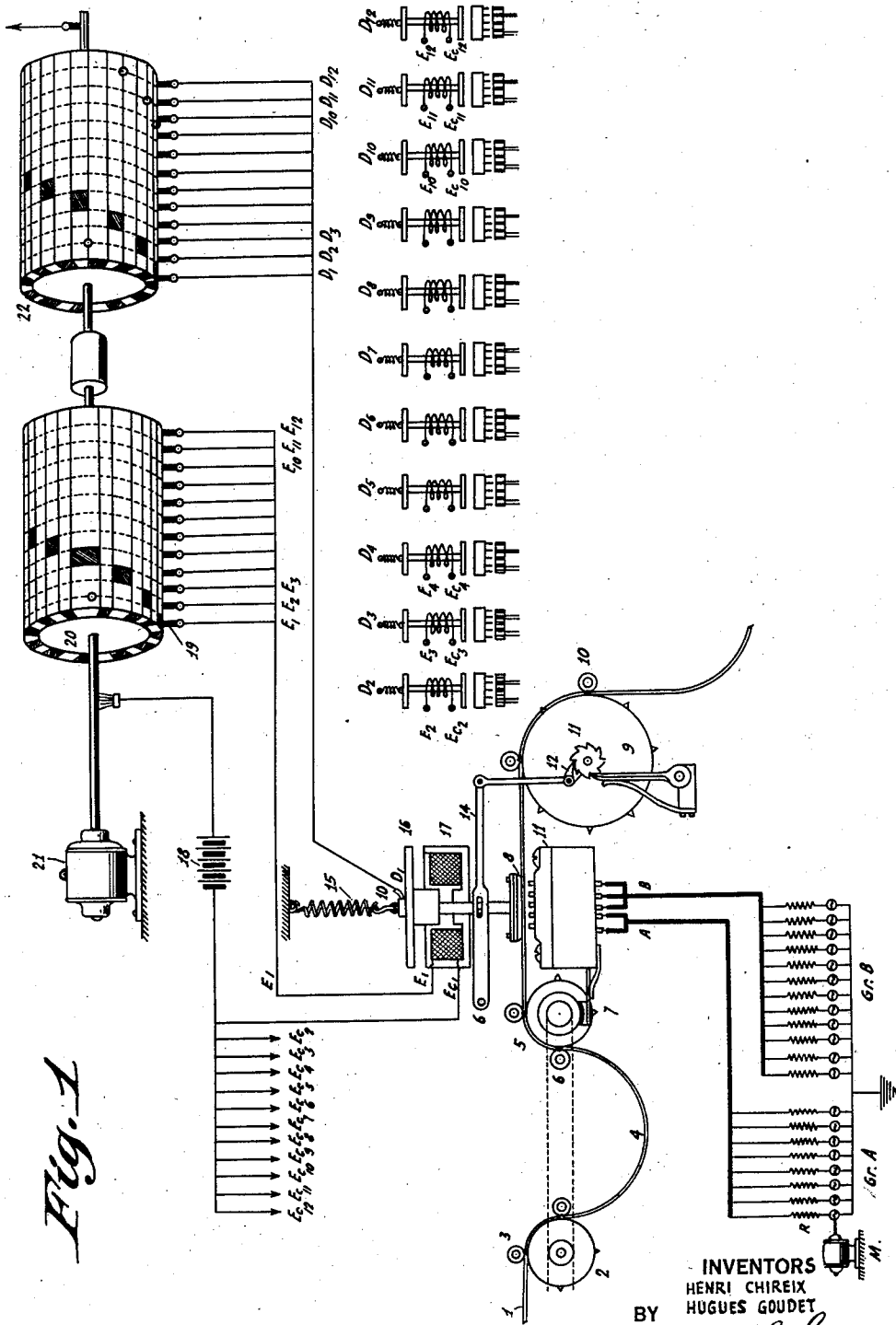


Fig. 1

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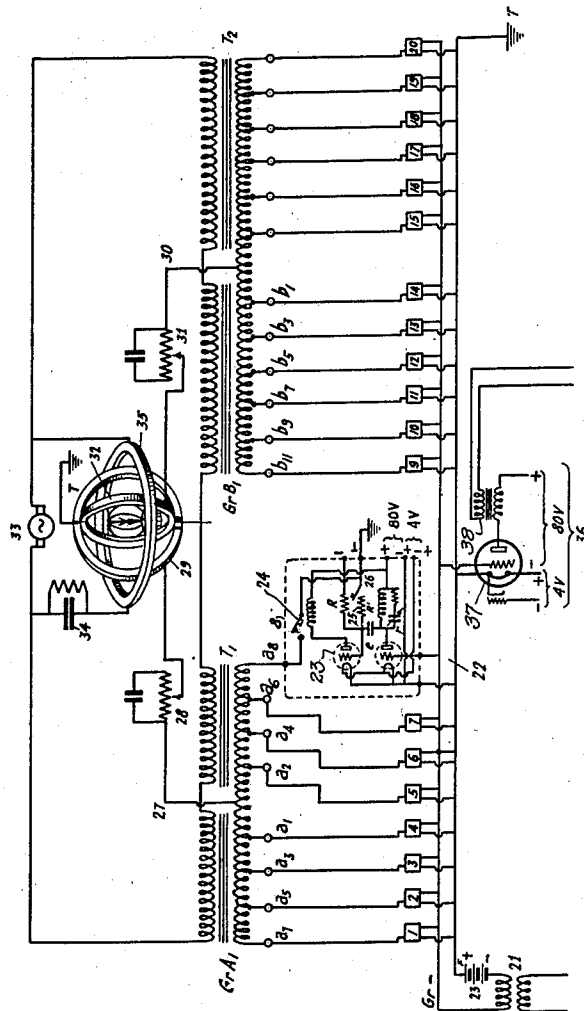
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4 Sheets-Sheet 2

Fig. 2



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HIGH SPEED PRINTING TELEGRAPH

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4 Sheets-Sheet 3

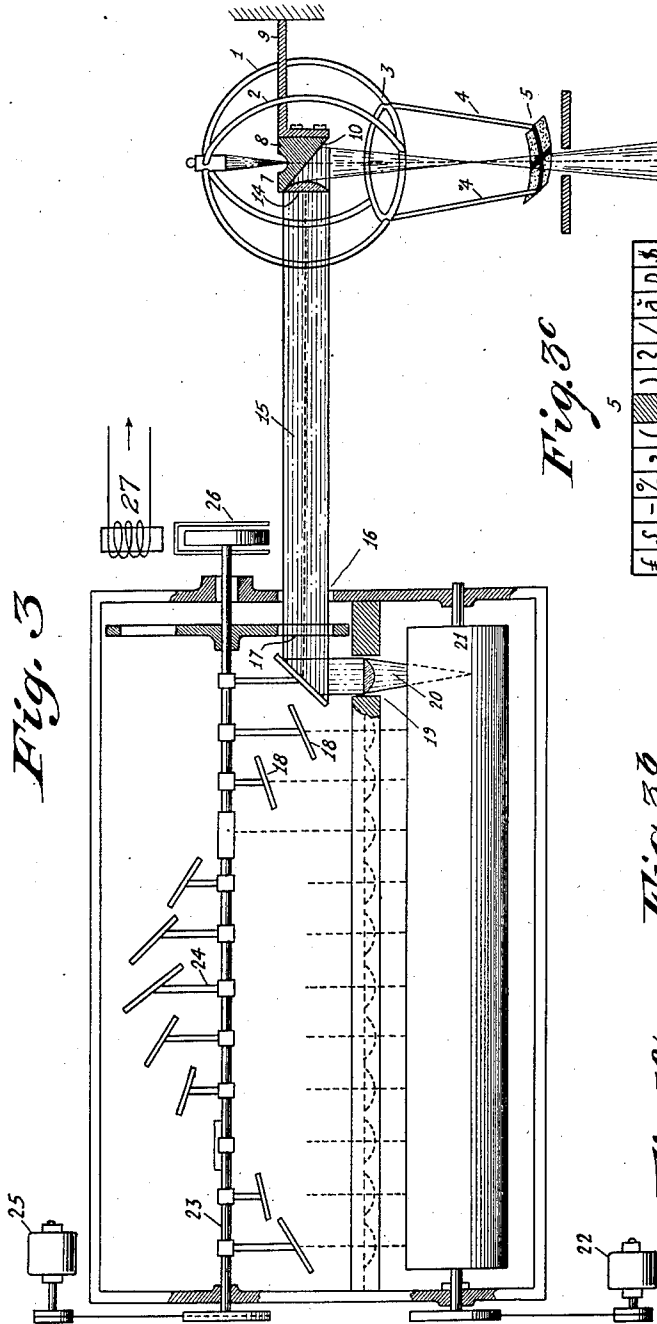


Fig. 3

Fig. 3c

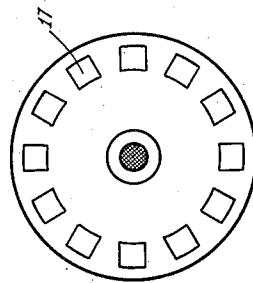


Fig. 3b

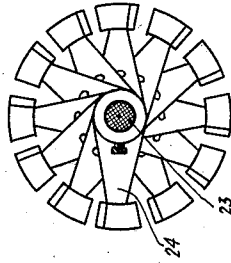


Fig. 3a

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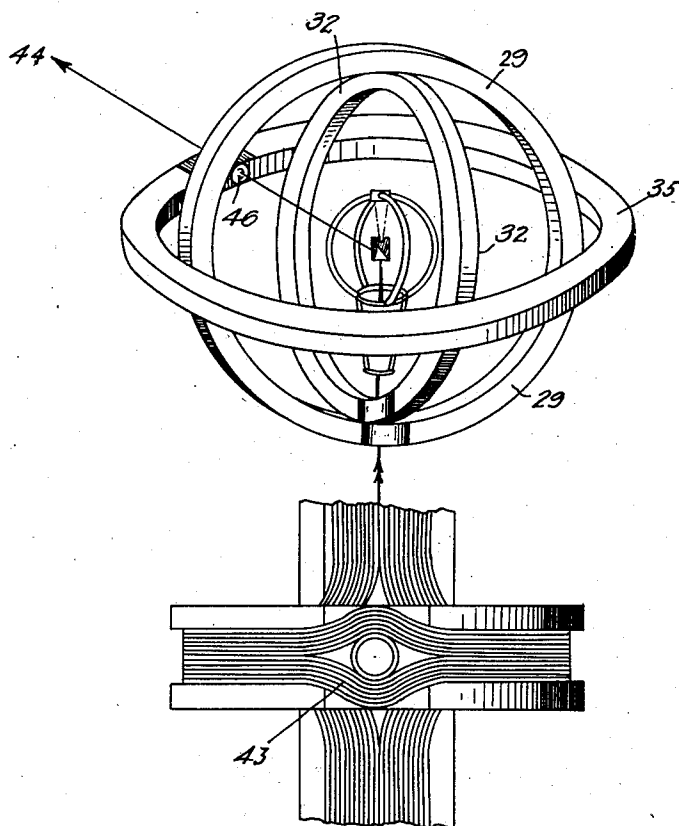
1,893,158

HIGH SPEED PRINTING TELEGRAPH

Filed July 18, 1929

4 Sheets-Sheet 4

Fig. 4



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UNITED STATES PATENT OFFICE

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HIGH-SPEED PRINTING TELEGRAPH

Application filed July 18, 1929, Serial No. 379,095, and in France July 28, 1928.

The present invention has as its object an ultra-rapid telegraph system capable of a speed of over 500 words per minute, and is adaptable both for ordinary wire as well as for radio telegraphy.

The principle underlying this system is as follows:

The sending of each letter, cipher or sign is characterized by the simultaneous transmission or emission of two frequencies preferably musical or audio (combination note). When received, these two musical frequencies making up the combination note act upon tuned or resonant relays or upon tuned circuits followed by ordinary relays, and this results in the closing or making and flow of two local currents.

These two currents act simultaneously upon a selector of the type consisting of a special galvanometer having a moving system disposed along several axes carrying as an indication means a light film upon which are photographed (once forever) all of the letters or signs to be reproduced. These two local currents cause displacement of the film along or in the direction of two perpendicular axes so as to place in the path of a fixed luminous pencil the particular letter of the panel which corresponds to the combination of the two currents. The light pencil carrying the letter is thereupon directed upon a photographic emulsion which it impresses and which is unreel in a manner so as to receive the impression of the letters successively transmitted.

These fundamental arrangements are associated with a system whose essential characteristics are as follows:

Assuming that the transmission of capital letters, lower-case letters, ciphers, punctuation signs and the like requires a total number of characters close to 100, provision should be made for the availability of twenty frequencies (furnished, for example, by means of small alternators). These frequencies are divided into two groups A and B, the number of different combinations of pairs of frequencies being obtained by combining each of the frequencies of group A with each of the frequencies comprised in group B.

It would be possible, for instance, to provide 100 combinations of the groups A and B comprising each ten frequencies or a total number of twenty frequencies; or else 96 combinations if of the groups A and B one contains eight frequencies and the other one twelve making also a total of twenty.

The telegrams to be dispatched are divided among as many operators as are required in order to insure the working speed that is desired. Each of these operators has a perforator to transform each of the letters of the text to be transmitted in the shape of perforations produced in a tape of paper or equivalent means. The perforation corresponding to a given letter is effected by two of the punchers of the assembly of twenty punches preferably disposed checkerboard-fashion, the position of these two punches in the assembly characterizing the letter. The tape comprises furthermore one or two uninterrupted rows of holes for its conveyance.

The different bands are thereupon fed simultaneously to a distributor device the purpose of which is to cause upon each passage of a letter consisting of two perforations a transmission of line current peculiar to or characterizing the letter in question, the said device being arranged in such a way that between two consecutive letters of one and the same tape, it insures the transmission of a letter of each of the tapes of the other operators. For this object, the tapes are given an intermittent movement (just like a moving-picture film) in such a way that the two perforations corresponding to a letter are brought to a stop for a brief instant above twenty pistons disposed checkerboard-fashion just like the punching means of the perforators and each thereof being separately connected with one of the twenty alternators of musical frequency. A striker (plunger) electromagnet then is caused to bring its mobile part connected with the line to bear upon the paper. The two pistons positioned opposite the two perforations of the tape are thus made to close the circuit of the two alternators in question so as to connect it with the line, as can be readily understood, one thereof pertaining to group A and the other one to

group B, return of the current being either by way of the other line wire or else through the ground.

This assembly (excepting the alternators) is provided as many times as there are simultaneous tapes, in other words, operators, and the electromagnets are successively operated by the agency of a distributor wheel revolving in synchronism with the sending distributor. The advantages flowing from the said method of operation are as follows:

The operators are not compelled to maintain any definite rhythm or rate or regularity in punching.

A check or control document is kept at the sending end in the form of the perforated tape. The message can be repeated at any desired instant. It is even possible to repeat the tapes systematically two or three times in the following manner:

If the distributor is designed for twelve tapes and twelve operators, then there will be twelve paths (routes) of conveyance. The tape which has left path No. 1 will be directed to paths Nos. 2 and 3, the tape having left path No. 4 will be directed over paths Nos. 5 and 6, and so forth. Only four operators will be necessary instead of a dozen, and three-fold transmission is assured of each of the tapes.

At the receiving end, twenty relays of the resonant type are provided corresponding to the sending frequencies, distributed into two groups A and B. As has already been set forth, each letter will cause the closure of the corresponding relay in group A and of the corresponding relay of group B.

In a preferred form of construction of the invention, the relays of each group control the multiple taps of the secondary of a transformer whose middle is united with the fine winding of the type-selector galvanometer, while the other end of the winding is associated through relays with the multiple taps of the transformer. Just as there are two groups of relays, there are also two transformers and two galvanometer windings. The primaries of these two transformers finally are fed from an alternator which works also permanently upon a third fixed winding of the galvanometer. These three fixed windings of the galvanometer are disposed in three planes at right angles to one another and they present the same time-constant so as to preclude the production of rotating fields. The rotor carrying the mobile film consists only of two short-circuited orthogonal turns mounted upon a single pivot so as to obtain the equivalent of a cardan or universal joint. If none of the resonant relays is closed, the mobile system will be subjected only to the fixed field of the winding fed in a permanent manner, the short-circuited turns will always assume the position of zero cut flux, and this is a position of stable

equilibrium. If a relay of group A and another one of the group B are closed, the general resultant of the field assumes a more or less large angle of inclination in relation to the original position under the action of the perpendicular fields of the two other coils or windings controlled by the relays of groups A and B.

The moving system follows and responds to these shifts, and the short-circuited turns will be repelled until the flux which is cut will be of zero value.

Finally, in the neighborhood of the pivot, a lens and a prism, both stationary, collect a pencil of light and project the same upon the travelling film bearing the characters.

As has been explained, if group A comprises eight relays and the group B twelve, there will be obtainable 96 different positions of balance, and hence 96 characters may be provided upon the mobile film.

Since the successive letters transmitted pertain to different tapes and originate therefore from different telegrams, it will be necessary to direct the light pencil after having passed through the mobile film successively upon different bands of photographic paper. For this purpose there are preferably provided small mirrors having an angle of inclination of 45 degrees in reference to the luminous pencil and disposed helix-fashion upon a drum rotating in synchronism with the distributor. Since the shaft of this drum is disposed parallel to the luminous pencil, it will be seen that the different mirrors will intercept the pencil more or less forwards along its path, and reflect it at right angles upon the photographic tapes which are also given a uniform rate of speed. The length of exposure of each photographic tape, as to the rest, will be limited to the very brief time of passage of a mirror in front of the luminous pencil.

By the aid of well-known means it is also possible to insure intermittent conveyance of the recording surface and of the mirrors changing the path of the light pencil, in such a way that the surface and the pencil will be stationary at the instant when an impression of the image is produced.

The adoption of a high-speed telegraph system based upon the foregoing premises presents a certain number of merits which shall hereinafter be enumerated:

(1) For a speed of 600 words per minute, the time interval corresponding to a letter will be roughly 1/60th of one second so that the sending time may be one-hundredth of one second, and this is relatively rather long.

(2) Calculation shows that a constant separation between the frequencies only of 60 to 100 cycles per second is adequate, at this rate of speed. Hence, to prevent inopportune operation of the relays responsive to neighboring frequencies, it would be permissible to

choose the twenty frequencies inside the range of 500 to 2000 or 2500 cycles per second, for instance. Ordinary telephone lines would be entirely suited for such transmission. Calculation furthermore shows that these frequencies should be chosen or spaced apart according to an arithmetic law.

(3) In the case of radio telegraphy, the interference of stray and atmospheric would be greatly diminished on account of the fact that resonance or selectance can be pushed to any desired degree. It may, as to the rest, be mentioned that so far as the Morse or Baudot code is concerned, an appreciable saving in the number of transmitted signals is obtained since a letter requires only a single signal.

(4) Within the operating limit of the relays at the receiving end the amplitude of the signals is immaterial, for the displacements of the galvanometer at the receiving end is independent of this amplitude.

(5) If one of the relays at the receiving station should fail to respond or operate, for instance, as a consequence of what is known as fading, in the case of radio telegraphy, it will be seen that one movement of the moving system of the relay will be skipped. Hence, it would be possible to trace two orthogonal black lines on the film crossing in the middle, and these lines would indicate the positions of equilibrium in case one of the groups of frequency should fail. In this way, the absence of one of the frequencies or of both would result merely in a blank, while under no condition would a wrong letter be produced.

(6) In the case of strong atmospherics in the operation of radio telegraphy, the speed of transmission could be reduced by rotating the distributor at a lower rate and by diminishing the damping of the resonant relays. As the latter consists preferably of a tuned circuit followed by an ordinary type of relay, it will, for instance, be sufficient to remove or cut out a damper resistance connected in the circuit. In this way, also the time required for the current to flow, the tuning of the circuits and the anti-stray qualities of the system will be increased.

(7) The provision of a galvanometric type-selector in a form as hereinbefore indicated by way of preference presents likewise a certain number of advantages:

(a) In a device or instrument of this sort, the retractile couple tending to cause restoration to the position of equilibrium is governed by the amplitude or intensity of the field. Hence, the natural period can be adjusted to the desired value by acting simultaneously upon the intensity of the three fields, that is to say, practically by acting upon the excitation of the alternator producing these fields.

(b) The damping of the moving system

may also be regulated by cutting more or less large resistance in series or in parallel with the field windings. And these resistances, as to the rest, will not affect the high supply frequency of the windings if care be taken so as to shunt them by a condenser when they are connected in series, or to protect them by a choke-coil when they are connected in shunt, this presupposing, as will be readily understood, that the period of movement of the moving system is high compared with the frequency of the supply current.

(c) The use of alternating current for feeding the galvanometer moreover makes it possible to use a particularly simple moving system without any supply leads and of a minimum of weight. Looked at from a theoretical viewpoint it is desirable in designing this device to make the short-circuited turns of highly conducting material and as light as feasible (for instance, of aluminum), and to choose the wire forming the turns of such a cross-sectional area that at the frequency used, the current induced in each turn will be preferably phase-displaced by an angle of 45 degrees with reference to the induced E. M. F. In the presence of this phase value, the natural period will be of a minimum amount. If the said value be exceeded, the inertia is raised too high, while when going below it, the torque is diminished unduly. For the reasons hereinbefore given, it is furthermore desirable to feed the galvanometer with a frequency of several thousand cycles per second, for the higher this frequency, the smaller may the inertia of the mobile system be made.

(8) Synchronism or correction of synchronism may be insured very easily. Inasmuch as the emission of each letter or character takes always the same length of time and recurs at regular intervals, this may be used as fiducial or datum points for insuring synchronism. For instance, if the incoming current is detected by the aid of a triode tube, then, if the rate of sending is 600 words per minute, there is created a current of a frequency around 50 cycles per second, and this current after amplification could be used for synchronizing the mobile means of the receiver, for instance, by driving the same by means of a direct current motor furnished also with rings.

(9) It is possible to follow up letter by letter the transmission of each tape by disposing in the light-ray paths beyond the rotating mirror optical systems adapted to see or observe the letters that are imprinted without incidentally interfering with the printing, as is to be understood. This property is very important from the viewpoint of service.

(10) Instead of providing at the receiving end, say, twelve narrow tape of photographic paper corresponding to a distributor com-

prising 12 contacts, it would also be possible to have recourse to a single wide band subject only to a slow movement of translation, say, travelling two centimeters per second for a rate of sending speed of 600 words per minute. Under these conditions, i. e., when working with a single band subject to a low speed of travel, it will be possible to provide simple automatic means of reduced volume. The wide band, as to the rest, could have perforations so as to separate it into several separate narrow tapes or strips though it could also be cut up by cutting wheels when leaving the drier.

The invention will be better understood as regards its operation by reference to the accompanying drawings showing exemplifications of the invention.

Fig. 1 shows an assembly view of the sending equipment, with the electric circuits and the grouping of different elements, and details of some of the latter;

Fig. 2 shows the same things for the receiving end;

Figs. 3, 3a, 3b and 3c show details of the photographic recorders; and,

Fig. 4 shows details of the galvanometric type-selector apparatus.

I. Transmitter assembly (Fig. 1)

The perforated paper tape (1) conveyed and fed forward from the stock or from the perforator apparatus, is engaged between catch cylinder (2) and the presser rolls (3) subject to a uniform rotational movement thereby feeding a regular amount of paper to the distributor.

A certain amount of slack (4) is allowed before engaging the tape between a second claw cylinder (5) and its presser rolls (6). This cylinder being loose in its movement is retarded by a brake shoe (7). The paper tape then passes into the distributor properly so-called and comprising a selector (11) of 20 mobile contacts of which eight are connected with eight audio-frequency alternators of group A, and twelve with twelve audio-frequency alternators of group B. These two groups of alternators supply the twenty different sending frequencies, and they are simultaneously driven by a single motor M of constant speed. At the delivery or outlet end of the distributor apparatus, the paper tape (1) is engaged between the claw cylinder (9) and the presser rolls (10), and then it is gathered to be incorporated in the records or else it is returned through the same or through another one of the twelve similar distributor apparatus corresponding to the twelve operators.

Cylinder 9 moves through a circular arc equal to the length of tape corresponding to a letter or sign by means of a ratchet (11), for instance, gearing or meshing with a pawl (12) driven by the slender rod (13) actuated

by a lever (14) which in turn is operated by the rod of the plate (8) when the latter reascends under the action of the spring (15) as soon as the magnetic keeper (16) being integral with the plate (8) is relaxed by the electro-magnet (17) whose feed current supplied from a source (18) is interrupted under the brush (19) by the rotation of the control distributor (20) driven by a constant-speed motor (21) simultaneously and synchronously with the sending distributor (22).

It will be understood that any other means adapted to insure the forward feed simultaneously of the tape such as a Maltese cross, gears, springs, cams, etc. may be employed to carry into effect solutions equivalent to the arrangement hereinbefore described and therefore falling inside the scope and spirit of this invention.

Upon the control distributor (20) are disposed contacts which are staggered or displaced helicoidally and are larger than those corresponding to the sending distributor (22) in order that the closing or opening in connection with the sending of each letter or sign may be effected by the latter when the plate (8) is still keeping the tape applied against the selector (11).

II. Receiver outfit (Fig. 2)

(1) *Electric key diagram.*—The incoming signal by way of the transformer (21) is fed to the circuit (22) in which is included a series of polarizer cells (23), whose positive poles are connected with the filament lead and then grounded at T, while their negative poles are connected with the grid lead.

At 1, 2, 3, ... 8 and at 9, 10, 11, 12 20 are indicated the resonant selectors. Details of these selectors are shown in connection with selector 8. It comprises the relays (24) as well as a damping resistance (25) inserted in the circuit, and which may be cut out or in at will by means of a switch (26).

The circuits 1 to 8 constitute the group A1 corresponding to the frequencies of group A of the alternators in the transmitter equipment (Fig. 1); circuits 9 to 20 form the group B1 corresponding to the group B of the alternators in the transmitter apparatus.

Each relay of group A controls an element of transformer T1 whose middle (27) is connected through a damping circuit (28) with the input end of the exciting coil (29) of the selector galvanometer, the output end being grounded.

The two halves, one positive and the other one negative of the secondary of the transformer hereinbefore mentioned correspond to the displacement "left" and "right" of the mobile system of the galvanometer in reference to and out of the balance position. The same thing holds true of the connections of the group B of the transformer T2 and

the vertical exciting coil, orthogonal to the former, of the galvanometer.

The primaries of the transformers T1 and T2 are fed from an alternating current source (33) which feeds also through a damper (34) the directional coil (35).

At (36) is provided a set comprising a tube 37 and a transformer 38 adapted to pick up the fiducial signals of each letter or sign which could be used for synchronizing the rotating mirrors as shall be shown later.

(2) *Moving system and optical recording system.*—The moving system shown in Figs. 3, 3a, etc. consists of two metallic circles or rings (1) and (2) of very low weight disposed orthogonally and being truncated below, though held rigidly by circular or curved pieces (3). Two rigid very light rods (4) support the transparent film (5) upon which are impressed microphotographically letters, signs, ciphers, etc., separated by a dark cross (6). The moving system is suspended by means of a picot (7) upon a bearing (8) fixed to a support (9), and its center of gravity is located below the pivoting point.

At its lower part the said bearing (8) carried a total reflecting prism (10) receiving the enlarged image of a letter of the film illuminated, for instance, by a light source (11) whose rays are reflected by a mirror (12) and concentrated by an optical assembly (13), and projecting it upon a lens (14) which in turn maintains it in parallel rays (15), through the window (16) and mobile slits (17) as far as the revolving mirrors such as (18) which reflect them upon the conjugate lens (19) which in turn concentrates the image received at (20) upon sensitized paper (21) on the desired scale.

Photographic paper (21) is subject to a uniform displacement by the aid of a convenient motor (22) having as constant a speed as possible.

The shaft (23) carrying at the end of arms such as (24) twelve mirrors having an angle of inclination of 45 degrees with reference to the plane of rotation and symmetrically arranged along the helix of revolution is driven by a motor (25) at a regular speed and is maintained in synchronism by any suitable synchronizing means (26) and (27) fed from the receiver (pick-up) (36) Fig. 2.

In order to prevent protraction (drag or lag) of the luminous pencil projected by the revolving mirror upon the sensitized paper which would make the image or outline of the letters or signs less sharp, recourse may be had to a high-speed shutter as in photographic apparatus either operated electrically or mechanically, though in synchronism with the general movement. The light source could also consist of electric sparks which are caused to flash up at the exact instant of coincidence of the axis of the image and the axis of the optical system. This

latter method, in addition to its simpleness and the instantaneousness of illumination, is capable of producing a strong source of light.

(3) *Inductor system (Fig. 4).*—The inductor system comprises two concentric orthogonal coils 32 and 29 the winding of which is spaced apart below as indicated at 43 so as to allow of the passage of light rays 44 to the moving system. These two coils set up two exciting fields corresponding individually to groups A1 and B1 of transformers T1 and T2, Fig. 2.

A third fixed coil 35 disposed perpendicularly to the former two windings furnishes the directional field. Its winding is spaced apart at 46, just as at 43 for the others, so as to allow of the passage of the luminous pencil from the fixed prism (10), Fig. 3.

It will be understood that, in order to insure the passage of the light rays through the windings of the source in the direction of the moving system and thence to the recording means, recourse may be had to any other optical means, or else each winding could be divided into two spaced a little distance apart so as to provide sufficient space for the passage of the luminous pencil.

After having thus described a particular embodiment of the invention, it will be understood that there are a great number of other solutions conceivable. For instance, at the transmitting end it is not necessary to proceed by way of or work with a perforated tape; indeed, the keys of the operators could directly control the transmission of musical frequencies, though this solution is not quite so good, because it compels the operators to keep up a certain pace.

To remedy this inconvenience, the keyboards of the operators could control the sending out of musical frequencies which would be recorded upon a magnetic wire (apparatus of the kind known as telegraphones). Instead of passing perforated tapes under the distributor, magnetized wires would then be passed.

The galvanometric type selector which forms an essential part of the system could also be constructed in different ways. For instance, the fixed directional field could be orientated in a sense other than the vertical.

It could also be constructed in the form of direct current apparatus, the mobile part being constituted by a coil to which a fixed direct current is supplied, or else, more simply, by a small magnetized bar. As a matter of fact, in an instrument of this kind the mobile system would always orientate itself along the resultant of the induced field (compass).

It could also be designed like an ammeter with two mobile orthogonal coils subject to permanent perpendicular fields, the currents

of each of the coils being controlled in this case by the relays of the groups A and B.

Instead of using a luminous ray pencil passing through a transparent film, it would also be possible to utilize light reflected from an opaque film.

The luminous pencil having traversed the film could be divided into several parallel rays corresponding to the different tapes by other methods and means than hereinbefore suggested by way of example.

It could also be thought to raise the speed of transmission beyond the limitations imposed by the inertia of the galvanometer and the sensitiveness of the photographic paper.

One solution in this direction would consist in providing at the receiving end two identical and complete outfits, and to insure "commutation" or changing-over in such a way that the first tape will be conveyed to the first outfit, the second towards the second, the third again to the first outfit, and so on. From Fig. 2 it can be seen that the line current excites the grids of twenty tubes corresponding to the twenty selective circuits. Hence, in order to insure commutation or changing-over to another outfit terminating likewise in twenty tubes, all that would be required is to polarize negatively the grids of the first twenty tubes, when it is desired to change over to the second set of twenty tubes; and, inversely, polarize negatively the grids of the second set of twenty tubes when it is desired to go back to the first set. This condition can be readily insured by applying in series to the grid circuits, by means of a transformer, for instance, an alternating current potential being preferably of rectangular form. A potential having such a wave-shape could be easily obtained from a small alternator furnished with a special kind of teeth so as to produce directly the desired harmonics or else by two or three alternators disposed in series and resulting respectively in the fundamental wave and overtones of desired proportions. These alternators, as will be understood, would have to be driven in synchronism with other revolving parts of the high-speed telegraph system.

Another solution adapted to increase the speed of traffic is as follows:

If there are provided both at the sending and the receiving ends two identical and complete equipments, they could be operated simultaneously by transposing all of the frequencies of one thereof. For instance, if the equipments are designed to transmit a frequency range between 500 and 2000 cycles per second, then one equipment for sending and receiving would be designed to handle this range of frequencies. The second equipment of identical design as the first would then be employed in the following manner: Before sending over the line the frequencies of the second equipment, they are transposed

in a known manner, for instance, by modulating them by the aid of a local generator of 2500 cycles per second. Disposing the film tape at the output end of the modulator, the range of frequencies 500-2000 will have been transposed into a range 3000-4500 which could likewise be passed over the line or to the radio telegraph station. At the receiving end there will have to be mounted a band filter of identical design. After this operation has been completed, the frequency range or spectrum is restored to the original limits, and the second equipment is operated independently of the first. It will be noted that by proceeding in a way as stated, there are generally on the line four frequencies simultaneously, two in the first spectrum 500-2000 and two in the other 3000-4500.

It must finally be noted that when recourse is had to this solution it would also be possible to replace the transmission of the first equipment inside the range of frequencies between 500 and 2000 by an ordinary telephone transmission so that there are passed simultaneously over one and the same line or over the same radio circuit a telephonic communication and high-speed telegraph transmissions.

The same solution likewise furnishes according to the disclosure of the present invention a method of secret transmission. For this purpose there are changed simultaneously the frequency transpositions at the sending and at the receiving end by modifying synchronously the regulation of the local generators that are used. For this purpose, recourse may be had to advantage to the synchronizing device existing between the two ends of the transmission, for example, by means of mechanical control means such as cams, and the like, thereby modifying periodically and synchronously one of the elements governing the frequency of the local generators.

While we have shown only one embodiment of carrying out our invention in the foregoing drawings, it is capable of various modifications therefrom without departing from the spirit thereof and it is desired therefore that only such limitations shall be imposed thereon as are required by the prior art or indicated by the appended claims.

We claim:

1. In a printing telegraphy system in which the symbol to be transmitted comprises the superposition of a plurality of frequencies, a receiving station including a series of resonant selector devices each thereof being singly responsive to one of the individual transmitter frequencies, a galvanometric selector, an exciting coil therefor and means controlled by said incoming signals for connecting said coil to a source of constant potential, said galvanometric selector comprising means adapted to be energized by said

resonant selector devices, a transparent film carrying opaque characters operatively associated with said galvanometric selector and means controlled by said selector upon receipt of an incoming signal for displacing said film in accordance with the signal, a recording device and means controlled thereby for recording the particular signal transmitted.

2. In a printing telegraphy system means for transmitting a signal character formed from a plurality of simultaneously emitted frequencies and means for transmitting a synchronizing frequency, a plurality of resonant receiving circuits each being singly responsive to one of the individual transmitted frequencies, a selector device adapted to oscillate simultaneously about several axes of rotation, a film having corresponding signal characters impressed thereon associated with said selector, a luminous pencil, means controlled by said plurality of transmitted frequencies for displacing said film so as to place a portion thereof corresponding to the transmitted signal character in the path of said luminous pencil, means controlled thereby for recording the particular signal character transmitted, means for receiving the synchronizing frequency and means controlled thereby for operating said recording apparatus in synchronism with the transmitting apparatus.

3. In a printing telegraph system, means for transmitting a signal character formed from a plurality of simultaneously emitted frequencies, a plurality of resonant receiving circuits each being singly responsive to one of the individual transmitted frequencies, a selector device adapted to oscillate simultaneously about several axes of rotation, a film having corresponding signal characters impressed thereon associated with said selector, a luminous pencil, means controlled by said plurality of transmitted frequencies for displacing said film so as to place a portion thereof corresponding to the transmitted signal character in the path of said luminous pencil and means controlled thereby for photographing the particular character transmitted upon a photographic film.

4. An ultra rapid telegraphy method including the steps of converting each sign or impulse to be transmitted into energy impulses representative of the superposition of several simple characteristic frequencies sent out simultaneously, each of said frequencies belonging to a separate group of frequencies and transmitting said energy impulses.

5. A rapid telegraphy method which includes the steps of converting each sign or impulse to be transmitted into energy impulses obtained by the superposition of several simple characteristic frequencies sent out simultaneously, each of said frequencies

pertaining to a separate group of frequencies, the frequencies of each group increasing progressively in an arithmetic series and transmitting said energy impulses.

6. A method, as claimed in claim 5, including the steps of receiving said impulses and separately resonating the frequencies in the groups.

7. A method, as claimed in claim 4, including the step of receiving said impulses, resonating energy at the frequencies in each group of frequencies, setting up a magnetic field representative of the resultant of the resonated energy and producing indications representative of said field.

8. In a transmitter for high speed telegraphy by means of a perforated tape, a plurality of contacts, means for connecting each of said contacts with an alternator supplying a distinct frequency for each contact, means for passing the perforated tape adjacent said contacts, a single transmission line, a resiliently mounted contact plate located adjacent said tape and a distributor connecting said plate to said transmission line.

9. An arrangement, as claimed in claim 8, including intermittent means for causing said plate to move said tape against the contacts of the transmitter and automatic means to control the movement of said plate.

10. Keying apparatus for a transmitter system including a plurality of contacts, each adapted to be connected in a separate circuit, and a perforated tape adapted to be moved adjacent said contacts, means for closing said circuits including a movable plate, magnetic means for moving said plate in a direction perpendicular to the line of travel of said tape and means for controlling the movement of said tape.

11. A telegraphy system for transmitting signal impulses, each composed of a plurality of superimposed frequencies, each frequency belonging to one of a pair of groups of frequencies, comprising a plurality of assemblies, common alternators for supplying transmission frequencies to all of the assemblies, a plurality of contacts in each assembly connected to said alternator, keying means including a perforated tape for each assembly and means for passing said tape past said contacts and a plate for moving said tape in contact with said contacts, a signal transmission line and an interrupter adapted to connect in sequence the movable plates of each assembly to the transmission line.

12. An arrangement, as claimed in claim 11, including magnetic means for actuating the plates to move the tapes against the contacts and in which said tape feeding means comprises a pawl and ratchet actuated by the motion of said plate to feed forward the tapes by equal steps or stages, and in which the

rotary interrupter in the form of a distributor unites in turn and sequence to the line each of the plates corresponding to the individual telegraph assemblies, whereby the line transmits successively a signal of each band in such a way that between two consecutive signals of a tape there is transmitted a signal of another tape.

13. Multiplex telegraph system comprising transmitters, tapes, ratchet devices for feeding said tapes to said transmitters, and mobile plates for pushing the tapes against the transmitters, the movements of the mobile plates being combined with the ratchet devices feeding the tapes forward by equal steps, common alternators supplying the transmission frequencies to all of the assemblies, each one of which transmits the signals of one tape, a rotary interrupter in the form of a distributor uniting in turn and sequence with the line each of the mobile plates or disks corresponding to the individual telegraph assemblies and conducting the signal currents, the line transmitting thus successively a signal of each tape in such a way that between two consecutive signals of a tape there is transmitted a signal of each of the other tapes, and a rotary distributor revolving in synchronism with the preceding distributor and exciting in turn and sequence the electromagnets of the plates of the individual assemblies.

14. Apparatus for receiving telegraphy signals composed of a series of impulses, each consisting of superimposed alternating currents of different frequencies including a plurality of groups of signal resonate relays, a tapped inductance, a galvanometer including an exciter coil, a connection between the midpoint of said inductance and said exciter coil and a connection between each of said relays and a tap on said inductance.

15. An arrangement, as claimed in claim 14, in which the relays are divided into two groups, the relays of each group being connected to points on different portions of the tapped inductance connected with the exciter coil, the portions of said winding forming the secondary windings of transformers whose primary windings are fed from an alternating current source and means for energizing the directive field windings of said galvanometer from said source.

16. An arrangement, as claimed in claim 14, in which the relays are divided into two groups, the relays of each group being connected with taps disposed on a winding having its middle point connected with an exciter coil of the galvanometer, the two portions of the winding forming the secondary windings of transformers whose primaries are fed from an alternating current source, which supplies at the same time the exciter coil of the said galvanometer.

17. In a system of telegraphic transmis-

sion wherein the signals transmitted at regular intervals are constituted by the superposition of several characteristic frequencies sent out simultaneously, means for receiving said signal impulses, means for detecting said received impulses to obtain alternating components of the detected current, of a frequency equal to that of the signals, and utilizing this current for synchronizing the receiving means with the signal transmitting means.

18. A system, as claimed in claim 14, wherein the tuned relays under the action of currents of suitable frequency cause the closing of circuits producing displacement of the moving system of the translator galvanometer comprising as its stator three orthogonal concentric coils, two of which furnish exciting fields, and the third the directive field, and as the rotor two orthogonal short circuited spires or turns of such a section that at the feed frequency of the galvanometer the phase angle between the current and the electromotive force induced in each spire amounts to approximately 45 degrees, the assembly being controlled by alternating current.

19. A system, as claimed in claim 14, wherein the galvanometer includes a stator having three orthogonal concentric coils, two of which furnish the exciting fields and the third the directive field, and a rotor having two short-circuited orthogonal turns, the assembly being driven by alternating current, the said galvanometer supporting the film upon which are disposed the characters, and in which the relays are tuned and are actuated by signal currents of suitable frequency to complete circuits causing displacement of the mobile system of the translator galvanometer.

20. Device for recording, by means of a luminous ray and a photographic band, signals coming in at regular intervals, each thereof constituted by the superposition of several characteristic frequencies and successively pertaining to another message, comprising means actuated by the picked-up signals for displacing the luminous-ray pencil impressing the photographic band perpendicularly to the lines of printed messages.

21. Device for recording signals coming in at regular intervals, each constituted by the superposition of several characteristic frequencies and pertaining successively each to another message, comprising a light ray, and a photographic band, a system of mirrors disposed along a helix around an axis or spindle whose rotation is synchronized by the transmission signals, these mirrors reflecting the light-ray pencil before it impresses or acts upon the band in such a way that it is displaced perpendicularly to the lines of printed messages.

22. A method of recording signals pro-

duced by the superposition of several characteristic frequencies by means of a photographic band and a movable film having signal symbols thereon and portions intended to preclude the passage of light including the step of passing said pencil ray of light through said film and on to said band and moving said film in a manner characteristic of the signal to be recorded.

23. Means for recording signals composed of a plurality of simple frequencies superimposed to obtain a compound frequency characteristic of a signal character including a source of light, a galvanometer having a fixed system adapted to be energized by the signal frequencies and a movable system mounted therein, a film carried by said movable system and located in the path of said light, said film comprising symbols representative of the characters in the signals to be transmitted and a black band adapted to be in the path of said ray when the film is at rest, and a photographic band, said film being interposed between said band and said light source.

24. In a transmission system adapted to transmit signals by means of current impulses, each composed of superimposed frequencies, the combination of means for transposing to use frequencies, means for sending successively non-transposed and transposed frequencies, means for receiving said frequencies, means to restore the transposed frequencies, and a plurality of independent receivers, each reporting a distinct message.

25. In apparatus for signalling, in accordance with the method set forth in claim 4, the combination of, means for transposing the used frequencies, means of sending in line successively non-transposed messages constituted by the voice and transposed messages, means for the restoration of transposed frequencies upon arrival, and several independent and identical receivers recording each one message.

26. In apparatus for signalling, in accordance with the method set forth in claim 4, the combination of, means for transposing the used frequencies, means for sending in line successively non-transposed and transposed messages, means for restoring transposed frequencies upon arrival, and several independent and identical receivers recording each one message, means being provided at the sending and the receiving end to vary the transposition simultaneously and synchronously.

27. In apparatus for signalling, in accordance with the method set forth in claim 4, the combination of, means for transposition of used frequencies, means for sending in line successively non-transposed and transposed messages, means for restoring transposed frequencies at arrival, and several independent and identical receivers recording

each one message, means controlled by the synchronizing device provided at the sending and the receiving ends or outfits, adapted to vary the transposition simultaneously and in synchronism.

28. An ultra rapid telegraphy method including the steps of converting each symbol or impulse to be transmitted into energy impulses representative of the superposition of several characteristic frequencies sent out simultaneously, each of said frequencies belonging to a separate group of frequencies, transmitting said energy impulses, receiving said impulses, resonating signal energy representative of each signal impulse received, and producing indications representative of the resonated signal energy.

29. A rapid telegraphy method which includes the steps of converting each signal or impulse to be transmitted into energy impulses obtained by the superposition of several simple characteristic frequencies sent out simultaneously, each of said frequencies pertaining to a separate group of frequencies, the frequencies of each group increasing progressively in an arithmetic series, transmitting said energy impulses, receiving said energy impulses, producing magnetic fields with the energy of each impulse, and producing indications representative of each field.

30. An ultra rapid telegraph system of the type adapted to convert individual impulses to be transmitted into energy impulses representative of the superposition of several simple characteristic frequencies, each of the frequencies belonging to a separate group of frequencies, having, in combination, a plurality of relays each tuned to one of the frequencies in the signal impulses, a galvanometer including a fixed system and a moving system, a plurality of energizing circuits, each including a switch connected with the fixed system of said galvanometer, and means connecting each of said relays to the switch in one of said energizing circuits.

31. An ultra rapid telegraph system of the type adapted to convert individual impulses to be transmitted into energy impulses representative of the superposition of several simple characteristic frequencies, each of the frequencies belonging to a separate group of frequencies, having, in combination, a plurality of relays each tuned to one of the superimposed frequencies, a translating galvanometer having a movable system comprising two short circuited orthogonal spires, and a fixed system comprising three concentric orthogonal coils, of which two furnish the exciting fields and a third the directive field, energizing circuits for said fixed system and means actuated by said relays for closing said energizing circuits.

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