

Oct. 17, 1944.

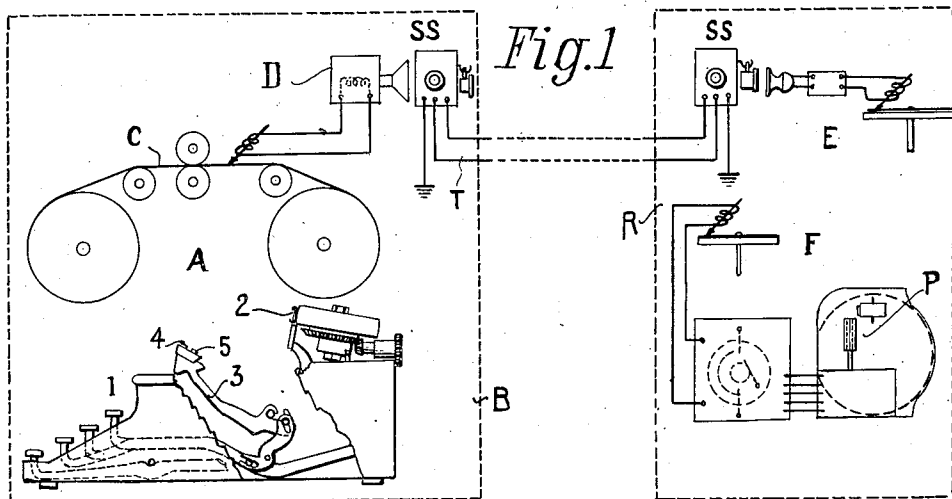
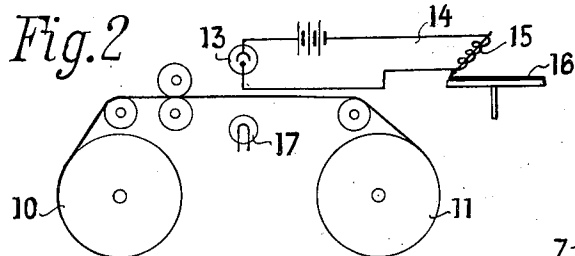
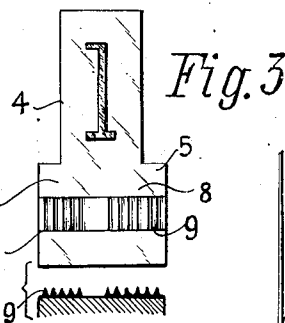
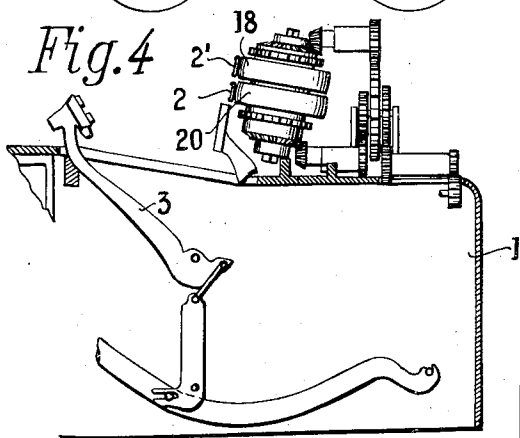
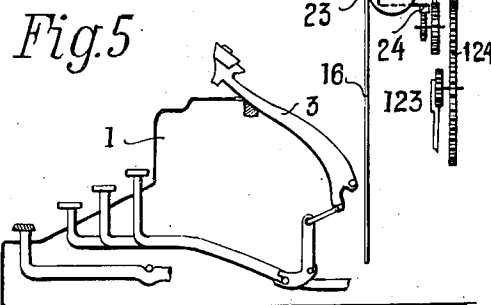
E. REISZ

2,360,719

TELEGRAPH SYSTEM

Filed Dec. 18, 1942

2 Sheets-Sheet 1



EUGEN REISZ

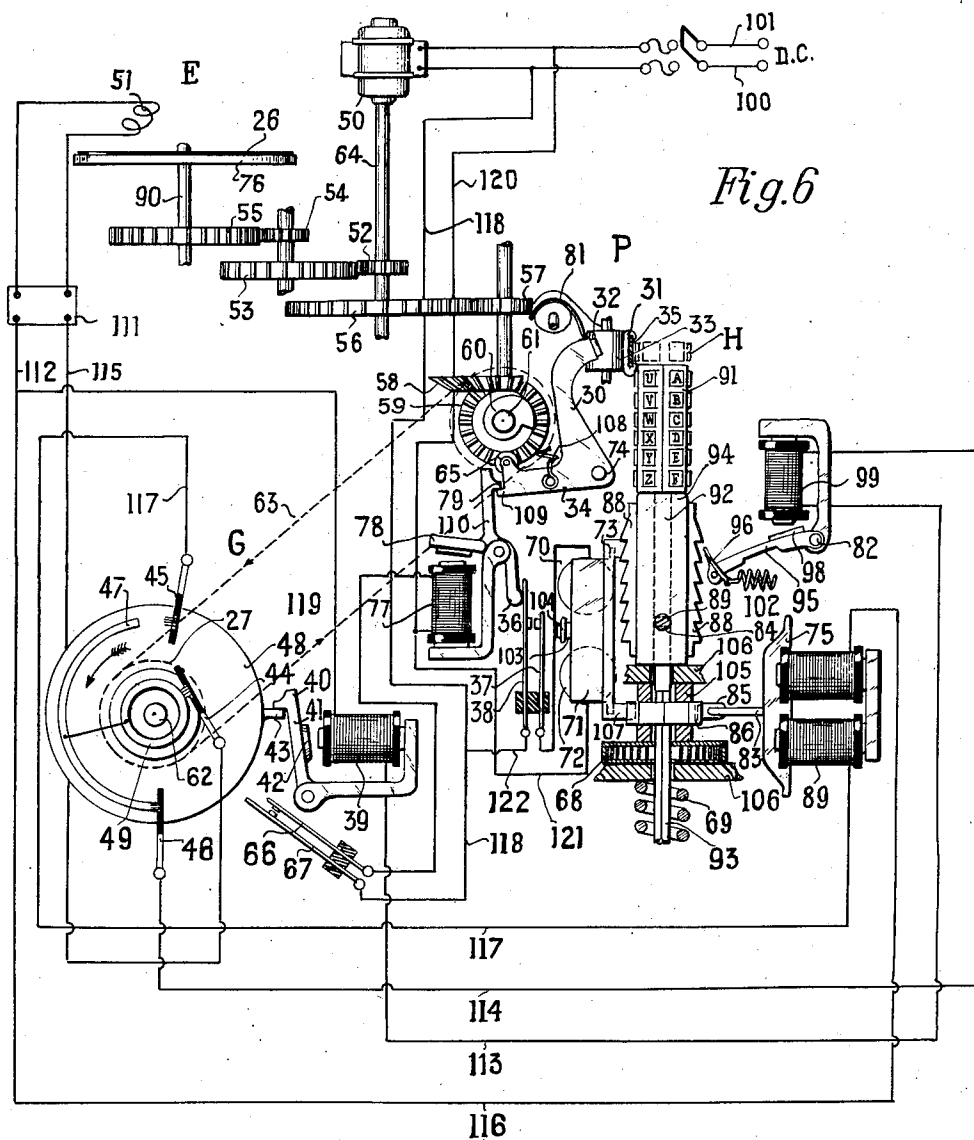
Inventor

per *Geo. P. [Signature]*

**2,360,719**

Filed Dec. 18, 1942

2 Sheets-Sheet 2



per *Goldberger*

## UNITED STATES PATENT OFFICE

2,360,719

## TELEGRAPH SYSTEM

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Application December 18, 1942, Serial No. 469,397

12 Claims. (Cl. 179-4)

This invention relates to printing telegraph systems of the type in which the telegraphic signals to be transmitted over a line are first transformed into signals capable of being recorded on a sound recording surface and are then recorded at low speed in the transmitting station whereupon they are transmitted at high speed from said sound recording surface to a second sound recording surface arranged in a receiving station, the record thus obtained in said station being then reconverted into telegraphic impulses. The present invention consists in the improved method and means which are employed for making the sound record and for reconvertng said sound record into impulses operating a telegraphic printer.

In particular the invention consists in a telegraphic system in which the sound recording surface simultaneously receives a plurality of separate and sound producing records for each character to be transmitted, the said simultaneously produced records being placed on one and the same sound track so that they are successively operative when a sound producing device such as a stylus runs over the track. The electrical impulses thus produced by the sound track are transmitted to the receiving station, in conformity with the system above described, and are converted again into a sound record which is used to generate electric impulses. Among the impulses thus generated those which have been produced simultaneously in the transmitter station and which therefore belong to one character are now made operative on the character selecting and printing mechanisms of the printing arrangement.

The invention further consists in means arranged in the receiving station for differentiating between impulses corresponding to simultaneously made records and impulses corresponding to successively made records. This differentiation is obtained by maintaining a predetermined spaced relationship between the impulse records, the records of the first impulses belonging to different characters being, for instance, arranged at much greater distances than the records of the first impulses of impulse groups belonging to the same character. In the sound record of the receiving station the impulse groups will be spaced proportionally. A distributor coupled with said sound record and moving at a speed exactly proportional to that of said record is thus able to send impulse groups belonging to one character to the character selection devices of the printer and to return all selective devices to their original position in time before the sound record has covered the distance corresponding to that of impulse groups belonging to successive characters.

The invention further consists in providing the

sound recording surface used for recording impulses in the transmitter with a sound track without using a conversion of the telegraphic impulses into sound waves actuating a diaphragm coupled with a needle or into electrical oscillations producing an acoustic record by means of a cutter. Instead of such a transformation direct action of a type bar associated with a character is made use of which produces a direct impression on the surface or so influences the latter that it will produce an audible sound or an oscillation of audio frequency in cooperation with suitable means such as an electric pick-up.

The invention further consists in adapting the well known systems, wherein a number of group signals are sent in succession for each character to be printed, for the present purposes, by producing the group signals for one character simultaneously while sending them through the line in succession. These simultaneously produced but successively transmitted groups of impulses, which are associated with one character, are then made operative in a different way in the receiving apparatus or in the translating arrangement of the receiver, so that they cooperate to select the desired character.

Further objects of the invention will be described in the following specification.

The invention is illustrated in the accompanying drawings by way of example. These drawings show one modification of the system, which embodies the principle that has been adopted and several modifications of the apparatus and arrangements which may be used within said system.

Fig. 1 of the drawings illustrates in a purely diagrammatic way the main features of the system,

Fig. 2 shows a modification of the translating arrangement of the transmitter,

Fig. 3 shows the enlarged head of a type bar with the type slugs and illustrates the production of signal groups for each character,

Fig. 4 shows a modification of the typewriter used at the transmitting end with two endless tapes receiving the record of the message to be sent over the line; one tape receiving the printed record, while the other receives impressed corrugations to be utilised for signal producing purposes,

Fig. 5 illustrates diagrammatically the use of another typewriter in which a disc is provided with the corrugations or indentations to be utilised for signal producing purposes,

Fig. 6 illustrates diagrammatically a modification of the translating apparatus in the receiver.

The system employed is based on the making of records in the transmitter station as above explained according to the invention recording

of the message is effected by making for each character of the message a number of indentations or corrugations so that an undulating or sinusoidal surface results which is capable in its turn to generate sound vibrations. This translation of the character signals into sound vibrations may be performed either directly by producing the undulating surface in a mechanical way or indirectly by using an electrical or electro-optical device for the production of the record. Alternatively a sound record may be made by printing lines of variable transparency which are then used to produce a sound record in the manner well known from the production of such records from cinematographic films.

The second part of the translation consists in producing a sound, preferably a tone, by means of the record in any approved phonographic apparatus. This sound or tone is then transmitted over the telephone lines to a receiving station, either in the same way in which speech is transmitted through the diaphragms of the microphones and telephones or by transmitting the electrical current oscillations engendered in the circuit of an electric pick-up, cooperating with the sound record, over the telephone lines. The sound vibrations or currents thus produced and transmitted are then recorded at the receiving station on a gramophone disc.

The record thus made at the receiving end is now retranslated into electrical current oscillations utilized to operate a telegraphic receiving apparatus. The translating means employed contain identification or distribution members for distributing the groups of signals in such a way that they act on the selecting members operating the type wheels or bars in the prescribed fashion.

The telegraphic system therefore essentially consists in a translation system A (Fig. 1) in the transmitter B translating printed signals or impressed signals into a sound record C, in a sound producer D and in a transmission line T, preferably a telephone line, for transmitting the sound oscillations inscribed on the record to a receiver R, in a sound recording mechanism E in the receiving station and in a translating apparatus F for translating the sounds inscribed on the record of the receiving station into impulses operating a printer or a typewriter P.

As will be clear from the above description the system is capable of high speed transmission over telephone lines. Moreover, as solely sounds are transmitted, the telephone equipment can be utilized as it is, without alteration or addition. Even if the currents from a pick-up are directly sent through the line to operate a cutter in the receiving station, the changes which have to be made to connect the pick-up or cutter circuits with the line are insignificant. Nevertheless the speed of transmission, especially when the highest frequencies which can be transmitted through a microphone or telephone are utilized, is very high.

The frequency of the electric currents, corresponding to the pitch of the tone to be transmitted is best selected in such a manner that it is above that range which is used for the transmission of speech. The frequencies due to the transmission of speech do not exceed a limit of about 4500 osc./sec. as a rule. If, therefore, a frequency between 6000 and 10,000 is selected for the tone to be transmitted interference between the signals for telegraphic purposes and

the transmission of speech is practically excluded.

The method for carrying the invention into effect is illustrated in Fig. 1. A typewriter 1, printing on tape 2 is used, said tape being advanced for one step upon actuation of a type bar 3. Said type bar may carry two type slugs 4 and 5, one of them being provided with the character (letter, numeral, stop, conventional abbreviation), while the other contains a suitable matrix which will produce a certain number of sinusoidal corrugations, as described later in detail. Both slugs strike simultaneously so that two impressions are produced on the tape 2 when a type bar is operated.

The printed record produced by impression of the characters is, of course, not necessary for transmission purposes, but serves as a permanent record to be retained in the transmitting station.

It is of advantage to use two (or more) signal groups for each character, each group, as shall be described later in connection with the translating apparatus of the receiving station, actuating different members capable of selecting the proper character on a type wheel or cylinder. As shown in Fig. 3 two juxtaposed groups of corrugations 7 and 8 are therefore arranged on a type slug corresponding to one character. Each group contains a definite number of corrugations 9, 5 and 6 corrugations respectively being shown in the figure. This number is however arbitrarily selected for the sake of clear representation.

The corrugations 9 are of sinusoidal shape in cross section, as indicated, and they constitute a matrix pressing against the tape 2 when a type bar is operated.

The slug containing the corrugations may be wider than slug 4 as the space between two adjacent groups of corrugations may be much smaller than that left between two characters.

The impression is made on the surface of the tape where a suitable material is available for this purpose; alternatively a prepared surface coating covering part of the tape surface may be used. The tape which has been corrugated by the impressions may be directly used as a record actuating a talking machine, if necessary after having undergone a stiffening or hardening process.

In some cases it may be of advantage to dispense with the impression of corrugations and to make printed impressions. In this case the group signals consist of black or shaded and white lines printed in the usual way. This method admits correction of the record in the same way in which such correction is made in a typewritten script.

The tape or that part of the tape on which the lines have to be printed is preferably transparent or translucent. A sound record is produced from it in the same way in which a sound record is produced from cinematographic sound tracks on a motion picture film. The method is diagrammatically illustrated in Fig. 2.

The tape is stretched between two spools 10 and 11 and is advanced at a slow but regular speed. It passes between a source of light 17 and a photo-electric cell 13. The light falling from the source of light to the cell 13 is intercepted by the black or shaded lines and electrical pulsations are set up in the circuit 14 of the cell which are actuating a cutter 15 making a sound track in a gramophone disc 16. The

sound track record made on the disc thus comprises a number of oscillations equal to the number of black or shaded lines printed on the tape.

According to a further modification shown in Fig. 4 two tapes one above the other, 2 and 2' respectively, moved by independent feeding rollers 18, and 20, respectively may receive the impressions. The top most tape 2' is corrugated while the second tape 2 receives the letterpress impression. The arrangement of separate tapes for the two kinds of impression is of advantage in many cases as the surfaces which are best suited for printing letterpress characters by means of a ribbon are different from those required for receiving and preserving a permanent corrugation. Different materials may be used in this case for the two tapes. Moreover the speed with which the tape travels or the distance for which it is shifted at each depression of a key may be better adjusted for the purpose in view.

In Fig. 5 a modification is shown, wherein the typewriter used in the translating arrangement of the transmitting station is modified so as to be able to make direct impressions on a disc. Said disc 16 is mounted on an axle which is slowly rotated and at the same time is moved towards the printing point. The mechanism which is used for rotating the axle 23 and for shifting the frame 24 in which it is journaled is practically identical with the well known arrangements for advancing the tape feeding rollers or for effecting the carriage advance in tickers or typewriters and is indicated merely in a diagrammatic way at 123 and 124. This mechanism advances each point of the disc 16 along a spiral. The corrugations are thus placed in spiral grooves and the disc 16 may be used directly in a talking machine to produce a sound or tone.

After having made the sound record either on a tape 2 or on a disc 16 in one of the ways above described at slow speed the tap 2 or disc 16 is placed in position in a talking machine 25. The speed with which the disc or tape is moved is however much lighter than that with which the sound record has been produced. It corresponds to the frequency of the highest tone that may be transmitted through a microphone or telephone or sent over telephone lines and which is consistent with a perfect sound reproduction at the receiving end.

Assuming, for instance, that 360 characters (60 words) can be printed per minute, each character together with the blank space between adjacent characters occupying about  $\frac{1}{4}$  in. then the total length of tape printed in one minute will be equal to 90 in. or to  $5\frac{3}{4}$  ft. The speed with which a stylus can run over a sound track, reproducing perfectly the tone or sound that has been recorded may be assumed to be about 3 ft./sec. The speed of transmission in this case can therefore be about 48 times that of printing the message. Assuming further that one corrugation in the example above given will occupy .01 in. the frequency of the tone thus produced will be merely 3600 osc./sec., a frequency which is far below the limit of approximately 10,000 osc./sec. that can be negotiated. The number of characters transmitted per minute in this case over the line is 17,500 per minute or approximately 3000 words per minute. This speed exceeds the highest transmission speed obtained by multiplex systems and by so called machine telegraphs using perforated tapes. No

such speed was obtainable hitherto in the case of telegraphy over telephone lines, where the slowing down of the signal current variations reduces the transmission speed to a mere fraction of the above mentioned value.

The above indicated speed is by no means the speed limit. The type slug usually occupies far less than an  $\frac{1}{8}$  in. with known teletypewriters so that a notable reduction of the width of the impression below the rather large value above mentioned is possible. This is not only of advantage as regards the speed obtainable but also with respect to the frequency of the tone selected, which should be very high as above explained. When selected above 7500 osc./sec. it will be inaudible to most persons and in any case it will be entirely dissociated from sounds produced by the human voice.

The transmission of the message is completed when the sound waves transmitted over the line have been recorded on a disc 26 in the receiving station R. The record is then inserted at the proper place in the arrangement E translating the sound track record into impulses operating a printing arrangement.

Translation arrangement E consists of an impulse generator 51, of a distributor G and of a printing mechanism P. The impulse generator comprises the rotating gramophone table 76 driven by a motor 50 by means of a shaft 64 and a transmission gear 52, 53, 54, 55; this transmission is so designed that the disc 26 will move at low speed with respect to the stylus or needle of the electric pick-up 51, a speed which will permit the printing of about 360 characters per minute. The arrangement may be designed for a somewhat higher or for a lower speed without much change.

The motor shaft 64 also drives shaft 61 by means of a gearing 56, 57, 58, 59. The ratio of the two transmissions is so selected that shaft 61 performs one revolution when disc 26 is advanced for a distance corresponding to one character.

Shaft 61 drives shaft 62 of the distributor G by means of a friction belt or cable 63. The belt may constitute a frictional coupling between the two shafts and for this purpose it may be adjusted in such a way that gliding of the belt can take place when shaft 62 is arrested, while there is sufficient friction to drive the shaft when it is free to move. Instead of this arrangement which has been shown for the sake of simplicity a friction coupling (not shown) may be provided, consisting of friction discs, one of which is fixed on shaft 62 while the other is loosely mounted thereon and carries the pulley 27 for belt 63.

The distributor G comprises moreover a disc 48 carrying an approximately semicircular contact segment 47 which covers an arc somewhat smaller than  $180^\circ$ . This segment is connected with a collector ring 49 with which the contact brush 44 is in permanent contact. Two further brushes 45 and 46 cooperate with contact segment 47. As will be gathered from the drawings they are placed on opposite sides of disc 48 so that only one of the brushes may be in contact with the segment 47 at a time. Their position is moreover such that when contact segment 47 leaves one of the two brushes during rotation of shaft 62 it will engage the other brush only after a short interval of time.

Disc 48 is moreover provided with an outwardly projecting stop 43 which may be held by the hooked end of a finger 41 fixed on the armature

42 of start magnet 39. This stop also cooperates with a set of contact springs 66, 67 which control the circuit of the printing magnet 77. The springs are closed when the stop passes over them. They are arranged close to the position of rest of the disc but ahead of this position so that the stop will engage the springs shortly before reaching its position of rest where it is held by the hooked end 40 of finger 41.

The printing arrangement P consists of a type wheel or type cylinder 91 which comprises a number of discs, rows or levels. In the example shown 6 discs, rows or levels are arranged and each disc or row carries 6 types on its circumference. The type cylinder is mounted on a type shaft 92 and may be shifted and rotated with it. This shaft is held in suitable bearings (not shown) permitting axial and rotational movement of the same.

Shaft 92 is provided with a lower extension 93 forming a square shaft. It is under the tension of a clockwork spring 68 which attempts to return it to its original position whenever the shaft 92 is rotated. A spring 69 returns said shaft when it is moved axially.

Below the printing cylinder 91 a sleeve 94 is arranged which is secured to shaft 92 in such a way that axial displacement is transmitted while both parts are free to rotate within each other. To secure axial connection between the parts set screws 84 may be provided which enter circular grooves 89 provided in shaft 92. The sleeve carries two racks 87 and 88, the former cooperating with a spring pawl 96 of vertical or disc shifting magnet 99 while the latter is engaged by a detent 73 carried by the arm 70 of release magnet 72. Magnet 99 is provided with an armature 98 fixed to an arm 95 which is pivoted at 82. Spring pawl 96 is pivotally connected with said arm and is held at one end by a spring 102 which is without tension when the arm 95 is in its position of rest. The spring 102 holds pawl 96 in such a position that it is free from contact with the teeth of the rack 87 so that it may be moved in either direction without interference from the pawl.

When magnet 99 is energized and arm 95 is lifted, pawl 96 will not only be lifted with the arm, but it is also rocked to a certain extent by spring 102 which becomes tensioned and it is thus tilted towards the rack. It will therefore engage the teeth of the rack shortly after the starting of the upward movement, and it will advance the rack for one tooth during the movement imparted to the arm 95 by one energization of the magnet 99.

Advancing the rack for one tooth will bring the topmost disc or row of the type wheel or cylinder 91 into the printing position H indicated in dotted lines. If the magnet is energized repeatedly by a number of impulses each energization will advance the rack for one tooth and it depends on the number of impulses which disc or row of the type wheel 91 will ultimately have reached the position H.

When, upon de-energization of magnet 99 arm 95 and pawl 96 fall back the type cylinder 91 on shaft 92 and sleeve 94 are held in the position to which they have been brought by the pawl, by means of detent 73 engaging rack 88. This detent is held in its place by a spring 104 acting on a lug 103 projecting from armature 71 of release magnet 72 which is solidary with arm 70 carrying the detent 73.

Rotation of shaft 92 and of type cylinder 91 is performed by means of the square shaft 93 which engages a ratchet wheel 86. It will be understood that shaft 93 may be moved in axial direction without impairing the rotational engagement between the square shaft and the square bore in the hub of the ratchet wheel which is held in its position without moving with the shaft by washers 105 and suitable parts of the frame 106. The ratchet wheel, moreover, is engaged by a pawl 85 pivotally mounted on the arm 83 fixed to armature 75 of rotary magnet 80. The construction and arrangement of pawl 85 is identical with that of pawl 96 operated by the vertical magnet 99. When the rotary magnet is energized the pawl is rapidly moved into engagement with the ratchet wheel 86 and advances it for one step (which in this case is  $\frac{1}{6}$  of the circumference) while the pawl 85, when in its position of rest, keeps clear of the teeth of the ratchet wheel and permits free movement of the same.

To hold the ratchet wheel 86 in the position to which it is advanced by pawl 85 against the tension of the clockwork spring which tends to return it to its original position, a detent 107 is arranged on the arm 70 of release magnet 72.

The printing arrangement moreover comprises a printing hammer 30 which has the form of a bell crank lever and is pivoted at 74. One part of the hammer is arranged opposite the printing position of type wheel or cylinder 91 and this part carries the striking block 32, striking from behind against the tape 35 after the selected type of type cylinder 91 has been moved to the printing position H, and thus causing an impression to be made on the tape. The second part 34 of the printing lever 30 carries a roller 65 acting as a follower and cooperating with cam 60 on shaft 61. This portion is moreover urged upwardly by a strong spring 108 attached to it. Its end is provided with a projecting nose 109 which may be engaged by the hooked end 79 of an extension 110 mounted on armature lever 78 of printing magnet 77. The armature lever 78 carries a second arm 36 which controls the contact springs 37, 38 which in their turn control the energizing circuit of the release magnet 72.

Cam 60 is so adjusted that the cam surface presses against roller 65 during the first part of the revolution of shaft 61. When lever arm 34 of printing hammer 30 is moved to its lowermost position in which it is under tension of spring 108, hook 79 will engage nose 109 and lever arm 34 is thereby held in this position. Upon actuation of the printing magnet, however, nose 109 is disengaged from the hooked end of extension 110 and the printing hammer will be urged to strike toward the printing position.

The tape 35 on which impressions have to be made is stretched between rollers 33 arranged on both sides of the printing position. These rollers are advanced for one step at each stroke of the printing hammer 30 by a mechanism, which is not shown in the figure. It comprises a ratchet wheel mounted on the axle carrying roller 33 and a pawl driven by shaft 74 of the printing hammer 30.

Between the rollers 33 which are located close to the printing position a bridge piece 31 supporting and guiding the tape may be arranged. The bridge piece is provided with a cut through which printing block 32 strikes the tape during the forward movement of the hammer 30. The rollers from which the tape is unwound and on

which it is wound in the course of the printing process are not shown as they are located at the outside as usual. Merely the small guiding rollers leading the tape towards these rollers or spools are indicated at 81.

The tape may be covered with carbon paper to produce printed impressions. Preferably however an inking mechanism consisting of an inking roller and a distribution roller in arranged beneath the printing point H. The tape feeding mechanism and the inking mechanism are completely identical with the mechanisms as used in the prior art and no detailed description and illustration appears to be necessary.

The operation of the translating mechanism 15 is the following:

The driving motor 50 is connected with the mains 100, 101 and is started. It rotates at a constant and predetermined speed. Shafts 90 and 61 are both driven from shaft 64 and are therefore maintained at a constant speed relation with respect to each other. When operation starts all parts are in the position shown in the drawings.

Shaft 90 and gramophone table 97 are rotated at a speed which approximately corresponds to the speed of 360 characters per minute. This speed is therefore a fraction only of the speed with which the sound record was made. A series of impulses succeeding each other at relatively slow speed is generated in the pick-up 51, their number corresponding exactly to the number of corrugations which were produced in the transmitting station B during the recording of the message. These electrical impulses which may be amplified or relayed before being sent into the translating mechanism, as indicated at 111, pass through line 112, start magnet 39, line 113, vertical magnet 99, line 114, brush 46, segment 47, collector 49, brush 44, and return by means of line 115. Disc 48 and segment 47 are held in their position of rest when operation starts. With the first impulse the start magnet 39 and the vertical magnet 99 are energized simultaneously and the former will move finger 41 out of engagement with stop 43. Belt 63 will therefore be able to drive shaft 62 which is no longer arrested and disc 48 will therefore begin to rotate, in the direction of the arrow. Segment 47 will rotate with the disc, but contact between it and brush 46 is maintained during a half revolution of the shaft approximately. During this interval the impulses generated in the pick-up 51 are transmitted to the vertical magnet.

It has been assumed for the sake of simplicity that the number of impulses delivered to the vertical magnet is equal to the number of steps through which the printing cylinder has to be advanced. When the vertical magnet receives these impulses, 5 impulses for example, it will upon each energization, actuate armature 98, which will fall back upon each deenergization. Arm 95 and pawl 96 will therefore be moved upwardly. Each movement of pawl 96 will advance rack 87 for one tooth, as already explained. The rack together with sleeve 94 to which the rack is fixed is held during the intervals of deenergization of the magnet 99 by detent 73 engaging the second rack 88. The sleeve is thus raised for 5 steps and with it the printing cylinder 91 is lifted and the 5th disc or row of the cylinder is brought to the printing position H.

During the delivery of the printing impulses start magnet 39 was energized, too, but after the first impulse this energization was without

effect. Contact segment 47 has been rotated during this interval to such an extent that at the end of the interval it will leave contact brush 46. After a short pause during which it is not in contact with a brush, it then engages contact brush 45. It will be remembered that two groups of impressions were made, arranged at a suitable distance from each other. When segment 47 engages brush 45 the second group of impulses becomes operative. The rotary magnet is now connected with lines 112 and 115 over lines 116, magnet winding 80, line 117, brush 45, segment 47, now in contact with this brush, collector 49, brush 44. The impulses will therefore energize the rotary magnet 80 which will move armature 75, and arm 83 with pawl 85. The pawl will advance the ratchet wheel 86 for a number of steps corresponding to the number of impulses received. The ratchet wheel 86 in its turn rotates square shaft 93 and with it the type cylinder 91. Thereby the special character in the selected level or row of the type cylinder 91 will be brought into its operative position facing the tape 35.

The ratchet wheel 86 is held between the impulses by detent 71 on lever 70 which is solidary with the armature of release magnet 72.

It has been explained that the timing of the rotational speeds of shafts 51, 61 and 62 is such that disc 26 is advanced through a distance corresponding to the recording of one character, while shafts 61 and 62 are performing one revolution exactly. When all impulses have been delivered disc 48 and shaft 61 have completed almost one revolution. At the beginning of this revolution cam 60 has pressed down lever arm 34 of the printing hammer 30 by means of follower 65. Spring 108 has thereby been tensioned and nose 109 was moved into engagement with hook 79 which holds the printing hammer in this position, while the cam moves away from the follower 65 during the second half of the revolution of shaft 61. Shortly before completion of the revolution of shafts 62 and 61 stop 43 on disc 48 strikes contact spring 66 and establishes contact between this spring and spring 67. An energizing circuit for the printing magnet 77 is thereby closed which runs from main line 100 over connection 118, contact springs 66, 67, connection 119, magnet 77, and connection 120 to main line 101. Printing magnet 77 is energized and its armature will disengage the hooked end 79 on finger 110 from nose 109. The printing hammer 30 is thereby released and spring 108 will thrust the hammer towards the tape 35. Striking block 32 will strike the tape with great force and causes an impression of the character on the type cylinder, facing the tape, to be made. As has been described the movement of the hammer 30 and of the axle 74 advances the tape for one step, so that it is ready for the next impression.

When the printing magnet is energized its armature 78 will rock extension 36 which closes the contact springs 37 and 38. Thereby the circuit of the release magnet 72 will be closed. This circuit branches off from connection 118 and includes connections 122 and 121, release magnet 72 and the contact springs 37 and 38. Release magnet 72 is thereby energized and its armature 71 moves arm 70 to the left against the tension of spring 103 thereby releasing simultaneously rack 88 and ratchet wheel 86, as detents 73 and 107 are disengaged from these members. If necessary armature 71 may be weighted so as to move at a slower speed than printing hammer 30.

When rack 88 and ratchet wheel 86 has been released springs 68 and 69 will immediately return the shafts 92, 93 and type cylinder to their original position. These members are now ready for being set for the next impression. Printing hammer 30 is returned, as described, during the first part of the next revolution of shaft 61.

At least one impulse has to be delivered to start operation and this impulse, in the example illustrated, is a "vertical" impulse. Should no impulse be delivered to the rotary magnet 80 the operation is exactly the same. In this case the first character in the row that has been lifted to the printing position is printed. During pauses in which no impulses are delivered the printing hammer is held by the hooked end 79 and the cam rotates without moving the follower 65.

It will be clear from the above description that short intervals between the signal groups are of advantage, as they will exclude the possibility of confusion between signal groups. There is sufficient time in such a case for the releasing and returning of the type cylinder. A misadjustment of one of the shafts, discs, cams or the like causes a permanent error in the reproduction of the message which is therefore detected immediately by the observer. Therefore the system is self correcting in the same way in which systems transmitting the difference between successive impulses are self-correcting.

The details of the transmitting, translating and printing arrangements may be modified without departing from the invention.

Other systems of telegraphy may be adapted in analogous manner for the purpose set forth. The principle governing this adaptation consists in delivering a number of impulses for each character to be typed which are capable of being translated into an equal number of surface undulations and to arrange the separately formed series of impulses belonging to one group into a continuous series in which they are so located that they can be identified thereafter. The surface is then ready to act as a tone producing record at high speed.

By using the above stated principle a number of well known telegraph systems may be so modified that they will admit transmission over the lines in the form of high pitched sound oscillations according to this invention.

The system according to the invention has many special advantages besides those mentioned in the foregoing specification. It admits correction of errors made in typing the message before transmission or translation. Where the characters and the signals are both printed correction does not differ from that of a typewritten script. In other cases the faulty part of the tape may be cut out and a corrected part may be inserted before using the tape for transmission purposes.

The record made in the receiving station may be driven with constant speed and no difficulty will arise on account of the decrease of circumferential speed at different points of the spiral, as the same record is used which has been received and as neither frequency nor number of impulses is affected.

I claim:

1. In a telegraphic system in which telegraphic impulses are recorded on a recording surface at low speed in a transmitting station, are then transmitted over a line from said recording surface at high speed to a receiving station, and are again recorded in said station on a second recording surface, the impulses thus recorded be-

ing utilized to operate a printing telegraph, the method which consists in making simultaneously a plurality of separate and independent sound producing impulse records for each character to

5 be transmitted on the sound recording surface, in such positions that these impulse records are successively operative when a sound producing device runs over the sound track of the said surface, these records being reproduced on the second recording surface in the receiver station in accordance with the above mentioned system, in reconverting the second record into electrical impulses and in making the impulse records associated with one character operative on different mechanisms of the printing arrangement.

2. In a transmitting station of a printing telegraph, a translator arrangement, comprising members associated with the characters, each provided with means for making a plurality of separate impressions simultaneously on a recording surface, means for converting said impressions into sound oscillations and said sound oscillations into electrical oscillations of audio frequency, said means including a sound recording surface with a sound track consisting of record portions derived from the impressions made by the aforesaid members, with the records corresponding to simultaneously made sound tracks arranged in succession and the records made by different members also arranged in succession, but at different distances from each other, on the sound tracks of the recording surface, an oscillation generator, whose operative member is the aforesaid sound recording surface, driven at a speed which is a multiple of the speed at which the record was made, and means for translating the sound record into electrical oscillations.

3. In a printing telegraph system a transmitting station containing a translation arrangement with members associated with the characters to be selected, each member being provided with means for making simultaneously a plurality of separate impressions, means comprising a sound recording surface with an operative sound track produced by the impression means, simultaneously made impressions being located on successively operative portions of the sound track, a line and a receiving station, a recorder containing a further sound recording surface in said receiving station, a translation and printing arrangement, the former comprising an impulse generator formed by an electric pick-up in operative connection with the aforementioned sound recording surface and a distributor in positive speed relation with said surface, the latter containing a plurality of control units, operated by different impulse series for selecting the character to be printed, said distributor by virtue of the speed connection with the impulse generating recording surface distributing successive impulses, which were derived from simultaneously made impressions in the transmitting station among the control units of the printing arrangement.

4. In the transmitting station of a printing telegraph, a translation arrangement comprising a sound recording surface and means for producing a sound record, said means consisting in impression making members with matrices making direct impressions on the sound recording surface in the form of corrugations capable of producing sounds when forming part of the sound track.

5. A transmitting arrangement of a printing

telegraph according to claim 4, with a translating arrangement wherein each of the impression making members is provided with a matrix into which a plurality of groups of sinusoidal undulations are cut, said groups being arranged side by side at a predetermined distance from each other, the number of undulations in different groups differing from each other for different characters, the member carrying said matrix being adapted to make a direct impression on the sound recording surface with the various groups of impressions located in one sound track, one behind the other at the above mentioned predetermined distance.

6. In the transmitting station of a printing telegraph system according to claim 2, a translating arrangement, wherein the impression members are provided with types, printing a number of units for each character, and wherein a recording surface is provided, on which an intermediate record consisting of the printed impressions from the above mentioned types can be printed, the said translation arrangement further comprising a photo-electric arrangement with a photo-cell and a source of light, between which the printed record is scanned and in which electrical impulses are produced, corresponding to the number of dark units, printed on the record and further comprising an electric cutter, cooperating with the sound recording surface of the translating device, operated by the impulses generated in the photo-electric arrangement and cutting sinusoidal grooves into said surface exactly corresponding to the number of units printed on the intermediate record.

7. In a printing telegraph system according to claim 3, a translation arrangement in which groups of impressions are made on a record, the impressions made simultaneously being arranged at one predetermined distance from each other, and in which means are provided for advancing the said record over another predetermined distance after the making of an impression, so as to align successively made impressions on said record, a receiving arrangement comprising sound recording means for making a record, corresponding exactly to the record made in the transmitter, a translating arrangement with an impulse generator operated by the record made in the receiver, with driving means for said record and with a rotating distributor coupled during rotation with the driving means of the impulse generator, contact members in said distributor, adapted to establish various connections during its rotation, a printing device with a type carrier, means for selecting a type on said carrier and for moving the selected type into an operative position, said means being operated by a plurality of independent, electromagnetically controlled selector mechanisms, each mechanism provided with an energizing circuit and operated by a series of impulses, the said distributor, after a predetermined advance of the record corresponding to the distance between simultaneously made groups of impressions in the transmitter, changing the connections of the impulse generator with the operating circuits of the selector mechanisms, thus operating a plurality of co-operating type selecting means in the printing device.

8. In the receiving arrangement of a printing telegraph system according to claim 3, a translating and printing arrangement, comprising an impulse generator, operated by the record made in the receiving station, means to drive

said record at low speed, a distributor and means to drive said distributor with a speed which is in a certain fixed relation to the speed with which the record is driven, means to arrest said distributor and to hold it in its arrested position, said arresting means being operative after delivery of the last impulse associated with one character, while release of said distributor is effected together with the sending of the first impulse for each character.

9. In the receiving arrangement of a printing telegraph system according to claim 3, a translating and printing arrangement comprising an impulse generator actuated by the sound record made in the receiving station, an impulse distributor, a type selecting mechanism and a type carrier, the latter being adapted to be moved in two directions to select the desired type and to bring it into operative printing position, the type selecting mechanism comprising two different electromagnetically operated means for imparting the two kinds of motion, each containing an actuating magnet, energizing circuits for said magnets connected with the distributor, a release magnet holding said type carrier in the position to which it has been moved and a local impulse circuit, controlled by said distributor for operating the release magnet and for restoring the mechanisms to their original position shortly before the record has been advanced for a distance corresponding to that existing between successively made impressions in the transmitter.

10. In the receiving arrangement of a printing telegraph according to claim 3, a translating and printing arrangement comprising an impulse generator, operated by the record made in the receiving station, means to drive said record at low speed, a distributor, and means to drive said distributor with a speed which is in a fixed speed relation to the speed at which the record is driven, means to arrest said distributor and to hold it in its arrested position, said means being controlled and released by a start magnet, type selecting mechanisms and a type carrier, electromagnets operating the aforesaid mechanisms, operative circuits for said electromagnets controlled by the distributor, the start magnet being included in the circuit of the magnet which is operating the type carrier first during the operation for each type to be selected, and releasing the distributor with the first impulse delivered to the type selecting mechanisms for each type, the said distributor being thus kept in permanent correct space relation with respect to the various groups of impulses appearing on the record.

11. In the transmitting arrangement of a printing telegraph system according to claim 2, impression members consisting of type bars, with impression producing slugs arranged in several lines, two independent tapes for receiving the impressions, the said tapes being provided with independent means for feeding them past the printing position, when an impression is made, thus aligning the impressions made on different tapes at different distances.

12. In the transmitting arrangement of a printing telegraph according to claim 4, a sound recording surface consisting of a record disc, into which impressions are made directly by a matrix on impression members and means for simultaneously shifting and rotating said disc through a given angle after each impression.

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