

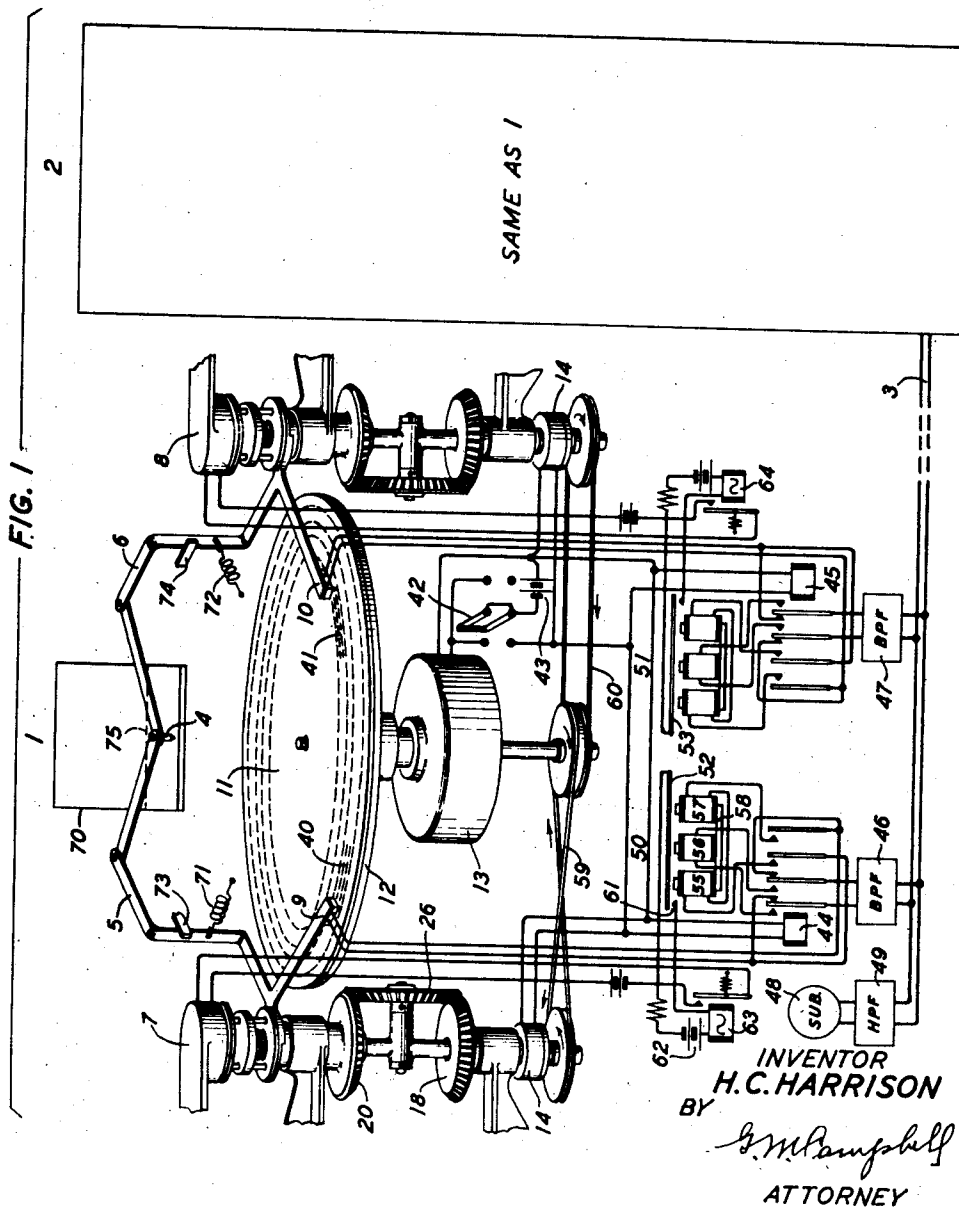
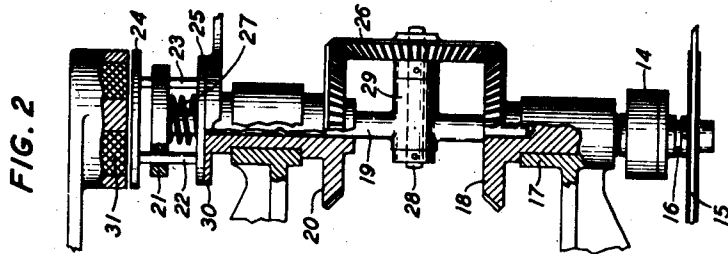
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TELAUTOGRAPH

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TELAUTOGRAPH

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This invention relates to telautographs and the object of the invention is a telautograph or facsimile telegraph system which is substantially independent of amplitude variations in the current in the transmitting line and which may be operated over a telephone circuit while speech is being transmitted.

In accordance with the general features of the invention the system utilizes two alternating signal currents each varying in frequency within an assigned frequency band. In general, the area of the writing surface and the degree of accuracy of reproduction required will determine the required width of the bands of signal frequencies. But for a writing pad of moderate size sufficient accuracy for most purposes can be readily obtained by using only frequencies below the range of essential speech frequencies so that telautograph signals may be transmitted simultaneously with speech over the same telephone line. The motion of the transmitting point of the telautograph is resolved into component motions in two coordinates in the usual manner and each component of its motion varies the frequency of one of the signal currents being transmitted over the line. At the receiving station each of these currents of varying frequency reacts with a locally generated current of a frequency determined by the position of a receiving stylus along one coordinate of its motion, and controls the associated receiving stylus driving mechanism.

In the preferred embodiment of the invention this driving mechanism constantly tends to return the receiving stylus to its starting position except when reversed by the received signals. The receiving stylus occupies a position such that the locally generated current for each coordinate differs in frequency from the corresponding current received from the line and the normal or drifting motion of the stylus reduces the difference between the local and the line frequencies. A suitable detector for each coordinate operates when the difference frequency reaches a predetermined value and effects a reversal of the stylus motion. The drifting and reverse motions are ordinarily small and occur in rapid succession with the result that the receiving stylus at any instant is hunting about a position corresponding to the position of the transmitting stylus.

A detector suitable for effecting the reverse motion of the stylus comprises a tuned reed armature unit for each coordinate which is energized by one of the line and one of the locally generated currents and is operated to reverse the driving mechanism whenever the difference be-

tween these frequencies approaches the resonant frequency of the reed.

The reeds of the armature units are preferably tuned to a low frequency such as 50 cycles per second. This frequency may be higher or lower as the case requires but, in order to conserve the frequency range, it is, in general, kept as low as practical from the standpoint of operativeness at the desired maximum writing velocity. As the difference between the line and the receiving station frequency approaches the resonant frequency of the reed it begins to vibrate and a reversing clutch is operated to move the receiving stylus to a position in which the reproducer engages a groove of slightly higher frequency. It will be understood that other devices such as a proper electrical network can be substituted for the tuned reed structure.

The variable frequency generators associated with the stylus linkages may be mechanical or electrical oscillating devices of any known type but a very simple and reliable system comprises phonograph reproducers secured to the writing point linkages and moving laterally across a phonograph record in which the required frequencies are recorded in successive concentric grooves.

The mechanism for driving each stylus linkage and its associated reproducer when signals are being received from the line may consist of a differential driving unit energized by the motor driving the phonograph turntable. This unit has a friction clutch which is normally engaged to impart the drifting motion to the stylus linkage and a magnetic clutch controlled by the detector unit for disengaging the friction clutch and reversing the motion of the linkage.

In the drawing, Fig. 1 shows a telautograph system according to the invention, and

Fig. 2 is a detailed view partly in section of one of the differential drive units for the stylus linkages.

The system shown comprises two stations 1 and 2 connected by a telephone line 3 but since the stations are identical only station 1 has been shown in detail. It will be understood that any desired number of other stations may be added and that they may be associated with telephone subscribers' sets arranged to be interconnected through central offices of any of the usual types.

The telautograph mechanism at each station includes a writing stylus 4 connected by linkages 5 and 6 to the differential driving units 7 and 8 and to sources of signal frequencies such, for example, as reproducers 9 and 10 engaging a phono-

graph record 11 having concentric reentrant grooves cut at different signal frequencies. The turntable 12 is driven by a motor 13 which, during the reception of telautograph signals, also supplies power for operating the units 7 and 8 which drive the stylus linkages.

The construction of the driving units 7 and 8 will be more clearly understood by referring to Fig. 2. Between pulley 15, which is driven by the motor 13, and the shaft 16 of the stylus linkage driving unit there is interposed a magnetic clutch 14 which is engaged when signals are being received but disengaged when signals are being transmitted so that the stylus may be moved by the operator as explained below. The shaft 16 turns in the bearing 17 and terminates in a bevel gear 18 having a socket for the shaft 19 which extends from its bearing in the gear 18 through the gear 20 and terminates in a disc 21 keyed by pins 22 and 23 to the upper and lower clutch plates 24 and 25.

The gear 26 is mounted on a horizontal shaft 28 projecting from the vertical shaft 19 and engages the gears 18 and 20 which are preferably of the same size as shown. The clutch plate 25 is normally held in frictional contact with a flange 30 which is integral with the gear 20 so that the gear is locked to the shaft 19. Under this condition the gear 26 cannot rotate on its shaft 28 so that shaft 19 is driven at the same speed as shaft 16 and the associated reproducer drifts toward the center of the record. When the winding 31 of the magnetic clutch is energized in a manner to be described, the clutch plate 24 is attracted and held against the stationary structure of the clutch thereby disengaging the friction clutch and locking the shaft 19 against rotation. The gear 26 then turns on its shaft 28 and drives the gear 20 in the opposite direction at the same speed as before to move the associated reproducer towards the periphery of the record.

The grooves of the record 11 at each station are cut in two bands 40 and 41 preferably with the lower frequencies nearer the center of the record. For a system capable of simultaneous telautograph transmission and telephone conversation the outer band 40 may consist of two hundred grooves ranging in frequency from 575 to 375 cycles per second and the inner band 41 of two hundred grooves ranging from 350 to 150 cycles per second.

When station 1 is to be used for transmitting, switch 42 is closed to the right to connect the current source 43 to the motor 13. The relays 44 and 45 are unoperated as shown and the frequencies generated by the reproducers 9 and 10 are sent over the line through the band-pass filters 46 and 47 each of which is designed to pass only the range of frequencies generated by the associated reproducer. As the stylus 4 is moved in accordance with the matter to be transmitted, the linkages 5 and 6 resolve its motion into two components and move the reproducers across the associated bands of grooves in the record to vary the frequencies sent over the line according to the motion of the stylus in two coordinates. During transmission the clutches 14 and 31 of each of the driving units 7 and 8 are open and the friction clutches are engaged so that the shafts 19 are free to turn on their socket bearings in the gears 18 as the transmitting stylus is moved over the writing pad. While these units for purposes of illustration are shown as relatively large and rugged, in practice they can be made so small and light that their inertia does not unduly re-

tard the stylus motion but it tends to prevent faulty operation of the receiving mechanism by limiting the velocity of the transmitting stylus to reasonable values.

The telephone set 48 at each station is connected to the line through a high-pass filter 49 which excludes the frequencies used for telautograph transmission. Before beginning to write the operator at station 1 requests the subscriber at station 2 to set his apparatus for receiving or means may be provided at the transmitting station to effect this result at the receiving station. Since the switch 42 is normally left open the stylus at this time will have already been returned to the bottom of the writing pad 70, as shown, by the springs 71 and 72 which hold the linkages 5 and 6 against the stops 73 and 74 so that the reproducers are engaging the outer or highest frequency grooves of their respective bands. The transmitting operator before closing his switch 42 will move his stylus to the upper portion of the pad so that his reproducers will be engaging grooves of much lower frequency than the reproducers at the receiving station at the beginning of the message.

This preliminary operation is necessary to insure an initial difference frequency between corresponding reproducers at the transmitting and receiving stations at least equal to the resonant frequency of the detector unit so that the receiving mechanism will be operative to reproduce subsequent motions of the transmitting stylus. For the same reason it is necessary during transmission to avoid moving the stylus to the extreme lower part of the pad. This is conveniently prevented in various ways such for example as by providing a hinged metal piece (not shown) which may be thrown forward to mask the lower part of the pad up to some line such as 75 and thereby restrict the space available for transmitting to the area over which the receiving mechanism is operative. The manner in which the line signals operate the receiving mechanism will be clearly understood from the following description of the operation of station 1 when receiving signals from the line.

In this case the switch 42 is closed to the left thereby connecting the current source 43 to the motor 13, to the clutches 14 and to the relays 44 and 45. The operation of relay 44 disconnects the reproducer 9 from the line and connects it to the windings 55 and 57 of the tuned reed armature unit 50 and connects the winding 56 of the unit to the line through the filter 46 which selects the signal frequencies sent out from station 2 by the reproducer corresponding to reproducer 9 at station 1. The windings 55, 56 and 57 are disposed on a 3-pole core 58 having a tuned reed armature 52 which is solicited by magnetic forces which are alternating at the sum and difference frequencies of the currents in the windings as in the well-known magnetic modulator. The armature 52 is tuned to some low frequency, such as 50 cycles and will therefore begin to vibrate whenever the difference frequency approaches this value. The unit 51, which is identical with unit 50, is connected to the line and to reproducer 10 in a similar manner by the operation of relay 45 and its armature 53 also begins to vibrate when the difference frequency approaches 50 cycles.

Upon the engagement of clutches 14 the gears 18 of the units 7 and 8 are driven by the belts 59 and 60 in opposite directions as indicated by the arrows on the pulleys 15. Assume that at some instant reproducer 9 is engaging the 575-cycle

groove and that at that instant the corresponding reproducer at the transmitting station is engaging the 375-cycle groove (or any other groove of a frequency less than 525 cycles per second). Under this condition the armature 52 of the unit 50 will be at rest. The magnetic clutch 31 of the driving unit 7 will be disengaged and the friction clutch will be engaged so that the reproducer 9 is drifting in a contra-clockwise direction toward lower frequencies. As the reproducer approaches the 425-cycle groove the difference frequency in the unit 50 approaches 50 cycles and the armature 52 begins to vibrate.

The vibration of the armature intermittently closes the contact 61 and a pulsating current flows from the battery 62 through the alternating current relay 63 which attracts its armature and completes a circuit for the magnetic clutch of the driving unit 7. As previously explained, when the clutch is energized the reproducer 9 reverses its motion and moves clockwise to engage a groove of higher frequency. As soon as this reverse motion produces a difference frequency in the unit 50 in excess of 50 cycles the armature 52 ceases its vibration, relay 62 releases, the magnetic clutch is deenergized and the reproducer 9 resumes its drift toward lower frequencies.

While the armatures are tuned to 50 cycles they will begin to vibrate before the difference frequency actually reaches this value and the closing of contact 61 will occur at some difference frequency greater than 50 cycles by an amount depending on the damping of the armature and the adjustment of the contact 61. It is recognized that if the transmitting stylus is moved so suddenly that the difference frequency becomes considerably less than 50 cycles before the contact 61 closes the system becomes inoperative until the receiving stylus is moved back to an operative position. This condition will not be encountered in ordinary use, however, since the receiving mechanism can be readily made sensitive enough that the receiving stylus will follow the transmitting stylus for any reasonable velocities. Moreover, when necessary, the relay units can be adjusted to close their contacts at a difference frequency high enough above resonance to keep the system operative for the highest stylus point velocity likely to be used.

The apparatus for the other coordinate of motion operates in a similar manner. Relay 47 selects the frequencies sent over the line by the reproducer 10 at the transmitting station and passes them to the outer windings of the relay 57. The central winding of the relay is energized by the frequencies generated by the receiving reproducer 10 which is normally drifting toward lower frequencies as already explained. Whenever the difference frequency in the unit 51 approaches 50 cycles the armature 53 closes its contact and operates the alternating current relay 54 which in turn energizes the magnetic clutch of the driving unit 8. The motion of reproducer 10 is thereupon reversed and the reproducer moves toward higher frequencies until the difference frequency in the unit 51 again becomes more than 50 cycles when the magnetic clutch will be released and the reproducer will resume its drifting toward lower frequencies.

The receiving stylus 4 will of course be driven in accordance with the motion of the reproducers 9 and 10 and will hunt about a position in each coordinate corresponding to a reproducer position slightly less than 50 cycles above the transmitting station frequency for that coordinate.

While this results in a constant distances displacement of the stylus at the two stations, it does not affect the accuracy of the reproduction at the receiving station. This displacement may, of course, be reduced by tuning the armatures 52 and 53 to a lower frequency but if tuned to a very low frequency the natural period of the armatures will be so high that the accuracy of reproduction will be impaired.

What is claimed is:

1. In a telautograph system, a writing point, a plurality of adjacent recordings of different frequencies, two reproducers, and means for moving each of the reproducers into operative relation to successive recordings in accordance with the motion of the transmitting point in one of two coordinates.

2. In a telautograph system, a transmitting station, a receiving station, a line connecting the stations, a transmitting stylus, and means at the transmitting station for setting up in the line two alternating currents each varying in frequency in accordance with the changes in position of the stylus in one of two coordinates, a reproducing stylus, and means at the receiving station for driving the reproducing stylus in accordance with the motion of the transmitting stylus comprising means for driving the reproducing stylus in one direction in each of two coordinates, and means selectively responsive to the currents in the line for reversing the direction of motion of the receiving stylus in each of the coordinates.

3. A telautograph receiver comprising a stylus, linkages for driving the stylus in two coordinates, a source of current for each linkage varying in frequency in accordance with the motion of the linkage, means for imparting a normal motion to the linkage, means for reversing the motion of the linkage, and means for operating the reversing means comprising a detector unit responsive to a predetermined difference in frequency between a received signal and one of said currents.

4. In a telautograph system, a transmitting station, a receiving station, a line connecting the stations, a transmitting stylus, and means at the transmitting station for impressing on the line two signal currents each varying in frequency in accordance with the motion of the stylus in one of two coordinates, a receiving stylus, and means at the receiving station for driving the stylus in accordance with the motion of the transmitting stylus comprising two stylus driving members each normally moving the stylus in one direction in one of the coordinates, two sources of current each alternating at a frequency differing from one of the line frequencies but normally approaching the frequency of the line current in accordance with the normal motion of one of the stylus driving members, detecting means for each coordinate motion of the stylus energized by one of the line currents and a current from one of the sources, and means operated by each detecting means when the energizing currents differ by a predetermined frequency for reversing the normal motion of one of the stylus driving members.

5. Telautograph apparatus comprising a stylus, linkages connected to the stylus, a phonograph record having two bands of concentric grooves cut at different frequencies, a reproducer for each band of grooves adapted to move across the grooves in accordance with the motion of one of the linkages, means for driving each linkage, a detector unit for each linkage connected to the associated reproducer and to a source of signal

frequency, and means responsive to a predetermined frequency in the unit for reversing the driving means.

6. In a telautograph receiver, a stylus, linkages
5 for driving the stylus in two coordinates, a source
of current varying in frequency in accordance
with the motion of the linkages, operating means
for each linkage comprising a driving gear, a
shaft, a driven gear connected to the linkage,
10 a connecting gear on the shaft having an axis of
rotation normal to the axis of the shaft, means
for locking the shaft against rotation to drive
the linkage in one direction, means for unlock-
ing the shaft and locking the driven gear to the
15 shaft to drive the linkage in the opposite direction,
and means responsive to a predetermined
difference between the frequencies of received

signal currents and currents from the source for
controlling the operation of the locking and un-
locking means.

7. A telautograph transmitter comprising a
transmitting stylus, means for generating a cur-
5 rent having a single predominant frequency with-
in a certain range of frequencies, means for vary-
ing the frequency of said current in accordance
with the position of said stylus along one of its
coordinates, means for generating a second cur-
10 rent having a single predominant frequency with-
in a different range of frequencies, and means for
varying the frequency of said second current in
accordance with the position of said stylus along
the other of its coordinates.

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