March 10, 1942. R. E. ZENNER 2,275,669

FREQUENCY CONTROL SYSTEM AND APPARATUS

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FIG. 1

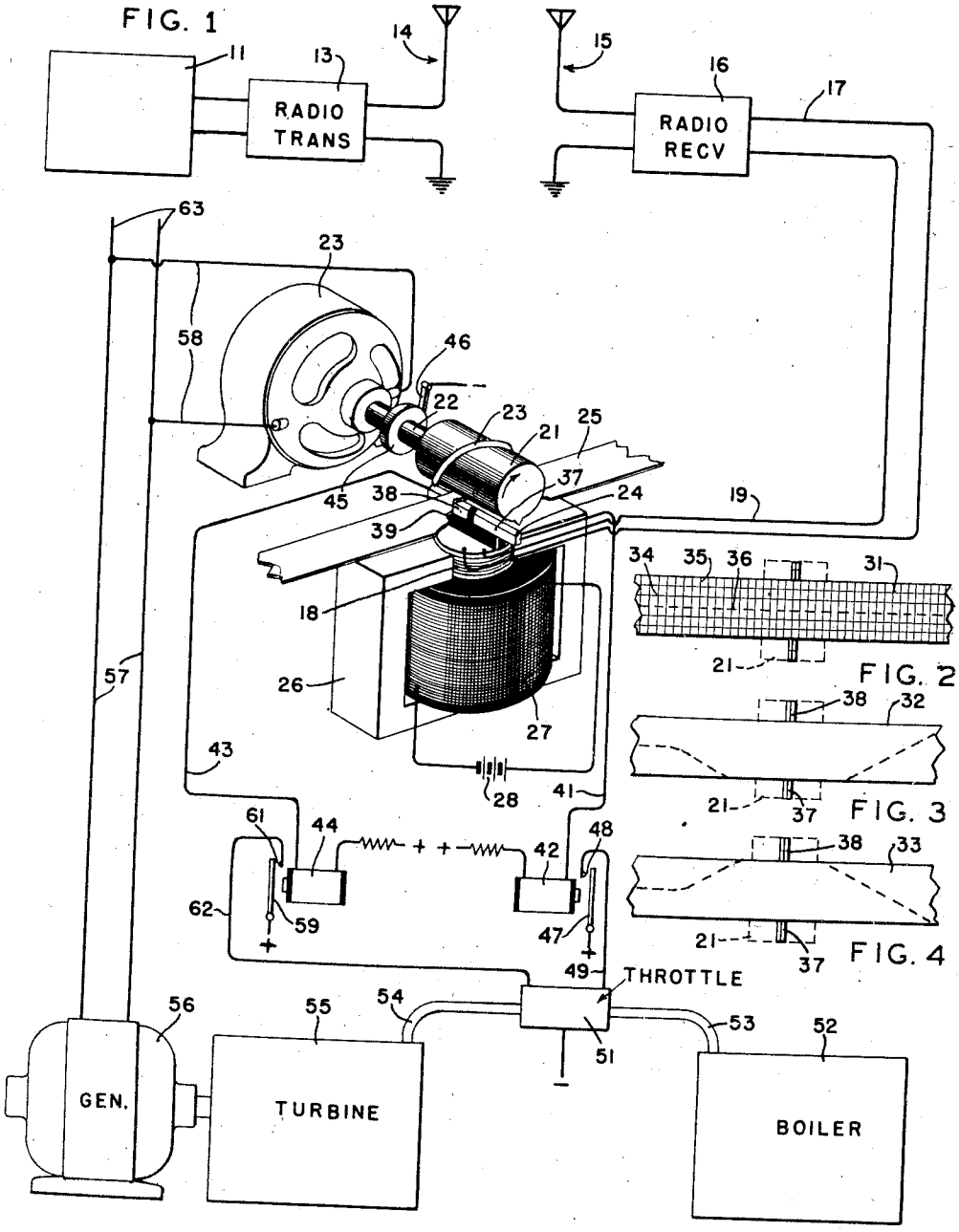

FIG. 2

FIG. 3

FIG. 4

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FREQUENCY CONTROL SYSTEM AND APPARATUS

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4 Claims. (Cl. 171—119)

The present invention relates to remote control systems and more particularly to methods and systems of remote control applied to alternating current frequencies.

The principal object of the invention is to provide means for controlling the frequency of controlled-frequency power stations.

Another object of the invention is to adjust automatically between predetermined limits the frequency of alternating current generated at stations remotely situated from the primary control point.

The present invention contemplates the establishment of a central transmitting station for sending out signals according to some primary or predetermined standard. Specifically, the invention comprehends a system wherein it is desired to provide throughout a wide area, alternating current having a uniform frequency to control time indications. That is, in the widespread use of electric clocks and other electrically controlled chronometric devices, it is highly desirable to operate these instruments uniformly throughout the area, and to render them independent of local conditions. It is known that frequencies vary according to the locally controlled power stations, causing the chronometric instruments in each local area to vary. To prevent this variation from occurring, the present invention contemplates the constant transmission of control signals from a central transmitting point, wherefrom a predetermined signal according to a regulated frequency would be transmitted so that all sixty cycle power stations, for instance, would be maintained at a standard sixty cycle frequency, and not at a locally fluctuating frequency, so that with the present invention even slight time variations or discrepancies would be avoided.

According to one embodiment of the present invention, the standard signals would be received on the tape of a printer of the type shown in U. S. Patent 2,046,328 issued July 7, 1936, to E. E. Kleinschmidt et al. This record would be received in the form of dashes, which, when printed along a longitudinal line parallel to the edges of the tape, would indicate that the frequency of the alternating current power supply to the printer motor is correct. If the printed dashes tend toward the upper or lower edges of the tape, the attendant or operator would visually note the deviation of the signals from synchronism or a predetermined speed relationship and adjust the printer speed without loss of signals by regulating the power generating mechanism. For example, if the printed record tends toward the upper edge of the tape, that is, inclines upwardly, the indication is that the receiver is being driven too fast by the local power station, or that the frequency of the power supply at the controlled station has deviated from the established standard. Likewise, if the record slopes downwardly toward the bottom edge of the tape, the indication is that the receiver is being driven too slow by the local power station, and that the frequency of the alternating current power supply has again deviated from the adopted standard, thus necessitating an adjustment of the power generating machinery thereat.

According to the second embodiment of the invention, the control of the frequency-controlled power station is rendered automatic. To accomplish this result, a tape is used which is narrower than the scanning wheel and print hammer of the type of printer shown in Patent 2,046,328, the print hammer consisting of two sections, each section insulated from the other. With this arrangement, if and when the control record drifts off the tape, either top or bottom, direct contact will be made between the print hammer and scanning wheel, thereby establishing electrical circuits for the correction of the local frequency by regulating automatically the power generating mechanism thereat.

A better understanding of the present invention may be had from the following description taken in conjunction with the accompanying drawing, wherein

Fig. 1 is a schematic arrangement of the system according to the present invention; and

Figs. 2, 3, and 4 are representations of the printed record on a tape, indicating the deviation of the printed record during variations in speed of the printer mechanism.

Having reference to the drawing, in which like reference characters indicate similar parts throughout the several views, the transmitting station comprises, generally, a master signal generator 11 of the type shown in the aforementioned Patent 2,046,328, which comprises scanning discs which are notched peripherally in accordance with the signal to be transmitted. In accordance with the present invention, the transmitting code disc is so notched as to transmit a series of dashes, as indicated on the tape 31 shown in Fig. 2. The signal thus generated in the transmitter 11 is conducted to the input side of the radio frequency transmitter 13.

The signals transmitted from the radio frequency transmitter 13 of the central transmitting

station 14 are received by the radio frequency receiver 15 of any of the radio receiving stations tuned thereto. As indicated in Fig. 1, the signals transmitted are received by the receiving station 15, where they are demodulated and amplified by the radio receiver 16. The demodulated signal is applied to the line coil 18 of a radio or facsimile printing apparatus of the type shown in the aforementioned patent over the output circuit comprising conductors 17 and 19 of the receiver 16.

The receiving printer located at the receiving station 15 comprises a printing wheel 21 mounted on a shaft 22 of a motor 23. In accordance with the present invention, shaft 22 is continuously rotated in synchronism or a fixed speed relationship with the shaft (not shown) of the transmitting apparatus at the station 14, which relation must be preserved and which it is the object of the present invention to preserve. Printing wheel 21 is provided with a single spiral printing edge or ridge 23. A sharp-edged platen 24 is supported, adjacent the printing wheel, on the line coil member 18. A paper tape 25 and an ink ribbon (not shown) are pulled between platen 24 and the printing wheel 21 through suitable guides (not shown) in any appropriate manner.

Line coil 18 is supported, as disclosed in U. S. Patent No. 2,046,328, in a radial magnetic field produced by the electr magnet 26, having winding 27 through which a current thus is passed by battery 28 over an obvious circuit. Coil 18 is connected to the output of the radio receiver 16, as previously mentioned, so that it moves upwardly to carry the platen 24 toward the printing wheel 21 when a positive impulse is applied to said channel at the sending station 14. When coil 18 thus moves platen 24 towards printing wheel 21 so that the ink ribbon and the tape 25 are compressed between platen 24 and printing wheel 15, a mark will be made on the tape 24, as indicated in Figs. 2 to 4, depending upon the phase relation between the sending and receiving stations. Therefore, by sending appropriate positive impulses over the broadcast channel from station 13, the platen 24 will force the ink ribbon and tape 25 against printing wheel 21 in accordance with said impulses and thus print the symbol represented by said impulses. Manifestly, the symbols thus printed may be either character symbols or only marks as indicated in Figs. 2 to 4. The manner in which the impulses are generated which represent various symbols to be recorded is fully described in the aforesaid Patent No. 2,046,328. Instead of employing an ink ribbon to produce the markings on the tape 25, said tape may be coated with wax so that the symbols will then be scratched on the waxed surface of the tape.

As fully disclosed in the aforementioned Patent No. 2,046,328, the printer shown in Fig. 1 is of the facsimile or similar record type. Specifically, the recorder exemplified by said patent permits variation in receiver and transmitter speeds without loss of signals, and hence permits the use of methods of speed control in accordance with the present invention. This is due to the fact that at least one complete character is always received, and the position of the characters on the receiving record indicates the synchronous or asynchronous condition of the apparatus and an operator can, without interruption of signaling, visually note deviations of the receiver from synchronism, and can adjust the receiver speeds, as will presently appear, without loss of signals.

Thus, a salient feature of the invention resides in utilizing the recording attributes of a facsimile or radio printer, variations in the speed of which cause the recorded message to tend to drift off the tape (top or bottom), for controlling the frequency of controlled-frequency power stations. If the speed of rotation of printing wheel 21 is maintained at a fixed ratio to the speed of rotation of the transmitting code disc, the record will be received as shown upon tape 31 (Fig. 2) as a succession of marks aligned between and parallel to the edges of the receiving tape. Should the ratio change due to deceleration of the printing wheel 21, the record will be received as shown on the tape 32 (Fig. 3), wherein the alignment of marks tends to drift off the bottom of the tape. Conversely, should the ratio change in the opposite sense, due to acceleration of the printing wheel 21, the resultant record will be as shown on tape 33 (Fig. 4), wherein the alignment of marks tends to drift toward or off the upper edge of the tape.

According to one form of the invention, the tapes 31, 32, and 33 are calibrated, so that the horizontal lines 34 (longitudinal of the tape); Fig. 2, indicate cycles deviation from the adopted standard, and the transverse lines 35 indicate time in seconds (or other unit of time). Therefore, the slope of the dash line indicates error in cycles per second. Thus, when the attendant notices that the line of dashes deviates from the normal longitudinal line 36 (Fig. 2), he proceeds to operate the controls for the power generating machinery to speed up or slow down the power generator.

According to another form of the invention, the generation of power and the frequency of the alternating current at the receiving station is controlled automatically. To effect this control, the width of the tape is less than the span of the spiral ridge on the printing wheel such that as the record drifts off the tape, the platen and printing wheel come into direct contact, whereby control circuits are completed. With this arrangement the platen 24 comprises two metallic or conducting portions 37 and 38 insulatably mounted by means of insulation 39 on the line coil 18. The portions 37 and 38 are further insulated from each other by a projection on insulation 39. Portion 37 is connected by conductor 41 to the coil of a relay 42, which in turn is connected to positive battery. Similarly, portion 38 is connected by conductor 43 to a relay 44 which is connected to positive battery. Printing wheel 21 is of conducting material and is conductively connected to shaft 22 which in turn is connected conductively to a metallic disc 45. A brush 46 constantly bears on disc 45 and is connected to negative battery.

As previously alluded to, this form of the invention utilizes the attributes of facsimile printing and permits the knife edge or ridge 23 to come into direct contact with the metallic portions 37 or 38 of the platen 24. For example, if the record tends to drift off the tape, as shown in Fig. 3, the ridge 23 will contact the portion 37 of the platen 24 to complete an electrical circuit from negative battery, through brush 46, disc 45, shaft 22, wheel 21, ridge 23, portion 37 of platen 24, over conductor 41 through relay 42 to positive battery. Correction impulses will thereupon be transmitted to relay 42 which will become energized to cause its

armature 47 to close a contact 48 to complete a circuit from positive battery, through armature 47, contact 48, thence over conductor 49 to a suitable electrically controlled valve mechanism (not shown) in the throttle 51, thence to negative battery. The throttle 51 will thus operate to open its valve to increase the flow of steam from boiler 52, through conduits 53 and 54 to a steam turbine 55, thereby causing the turbine 55 to operate at a greater speed to thus increase the number of revolutions per minute of the electric generator 56. Alternating current of increased frequency is thus supplied over conductors 57 and 58 to the motor 23, thus causing the speed of the motor to be increased.

If the speed of the motor 23 should increase beyond a predetermined limit, the printed record on the tape will tend to drift off the upper edge, as shown in Fig. 4, in which event the portion 38 of platen 24 will contact the ridge 23 of printing wheel 21, thus completing a circuit for the transmission of correction impulses from negative battery through brush 46, disc 45, shaft 22, wheel 21, ridge 23, portion 38 of platen 24, thence over conductor 43 and through relay 44 to positive battery, thus energizing relay 44 to cause it to pull its armature 59 and close contact 61. Closure of contact 61 completes a circuit from positive battery, through armature 59, contact 61, over conductor 62 to the electrically controlled valve mechanism in the throttle 51, then to negative battery. The throttle 51 will then operate to close its valve to decrease the flow of steam from boiler 52, through conduits 53 and 54 to turbine 55, thus reducing the speed of the turbine and correspondingly diminishing the revolutions per minute of the electric generator 56. Alternating current of diminished frequency is then supplied over conductors 57 and 58 to the motor 23, thereby decreasing the speed of the motor. Accordingly, a balancing of the speed of the motor within predetermined limits is maintained to thereby hold the frequency of the alternating current generated by controlled-frequency power stations within corresponding limits.

The narrower the tape is with respect to the width of the printing or scanning wheel, the greater is the time allotted to the correction of the speed relationship between the transmitter and receiver. In other words, as the tape becomes narrower with respect to the width of the printing or scanning wheel, the correction time increases. Thus, the relation between the tape width and the scanning wheel and platen widths may be varied in accordance with the time required to effect the correction of the frequency at the controlled receiving station. The number of correction impulses generated at the receiving station, and hence the correction time, is directly proportional to the difference between the widths of the tape and scanning wheel.

The terminals 63 are connected to supply lines for supplying current of a regulated or controlled frequency determined, not according to a local determinant, but by a remotely situated station broadcasting a frequency-control signal according to a universally accepted standard.

It is, of course, understood that the foregoing embodiments of the present invention are to be considered illustrative and not restrictive, and are to be accorded a breadth of application or construction commensurate with the scope of the appended claims.

What is claimed is:

1. In a system for controlling the frequency of controlled-frequency power stations, a source of frequency controlling signals, a receiving recorder responsive to said signals, a printing wheel in said recorder having a single helical ridge, a knife-edged platen adapted to co-operate with said ridge in response to said signals, said printing wheel and platen adapted to co-operate directly with each other and with a control strip, and electrical circuits established upon the direct co-operation of said printing wheel and said platen resulting from a deviation of said receiving means from synchronism with said source for adjusting the frequency generating apparatus at said receiving station in accordance with said signals.

2. In a system for controlling the frequency of controlled-frequency power stations, means for transmitting frequency controlling signals, a receiving recorder responsive to said signals, said transmitting means and said recorder operating at predetermined relative speeds, a printing wheel in said recorder having a single helical ridge, a knife-edged platen adapted to co-operate with said ridge in response to said signals, said printing wheel and platen adapted to co-operate directly with each other and with a control strip, and electrical circuits established upon the direct co-operation of said printing wheel and said platen resulting from a deviation of said receiving means from said predetermined relative speed for adjusting the frequency generating apparatus at said receiving station in accordance with said signals.

3. In a system for controlling the frequency of controlled-frequency power stations, means for transmitting frequency controlling signals, a receiving recorder responsive to said signals, said transmitting means and said recorder operating at predetermined relative speeds, a printing wheel in said recorder having a single helical ridge, a knife-edged platen adapted to co-operate with said ridge in response to said signals, said printing wheel and said platen adapted to co-operate directly with each other and with a control strip, frequency generating apparatus for controlling the operation of said recorder, adjusting means for said apparatus, and electrical circuits established upon the direct co-operation of said printing wheel and said platen resulting from a deviation of said receiving means from said predetermined relative speed for operating said adjusting means to control said frequency generating apparatus in accordance with said signals.

4. In a system for controlling the frequency of controlled-frequency power stations, a source of frequency controlling signals, a receiving recorder responsive to said signals, a printing wheel in said recorder having a single helical ridge, a control strip, a pair of insulatedly separated knife-edged platens adapted to co-operate with said ridge in response to said signals, said printing wheel adapted to co-operate directly with either platen and said control strip, and electrical circuits established upon the direct co-operation between said printing wheel and either of said platens, resulting from a deviation of said receiving means from synchronism with said source, for adjusting the frequency generating apparatus at said receiving station according to the platen with which the printing wheel co-operates.

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