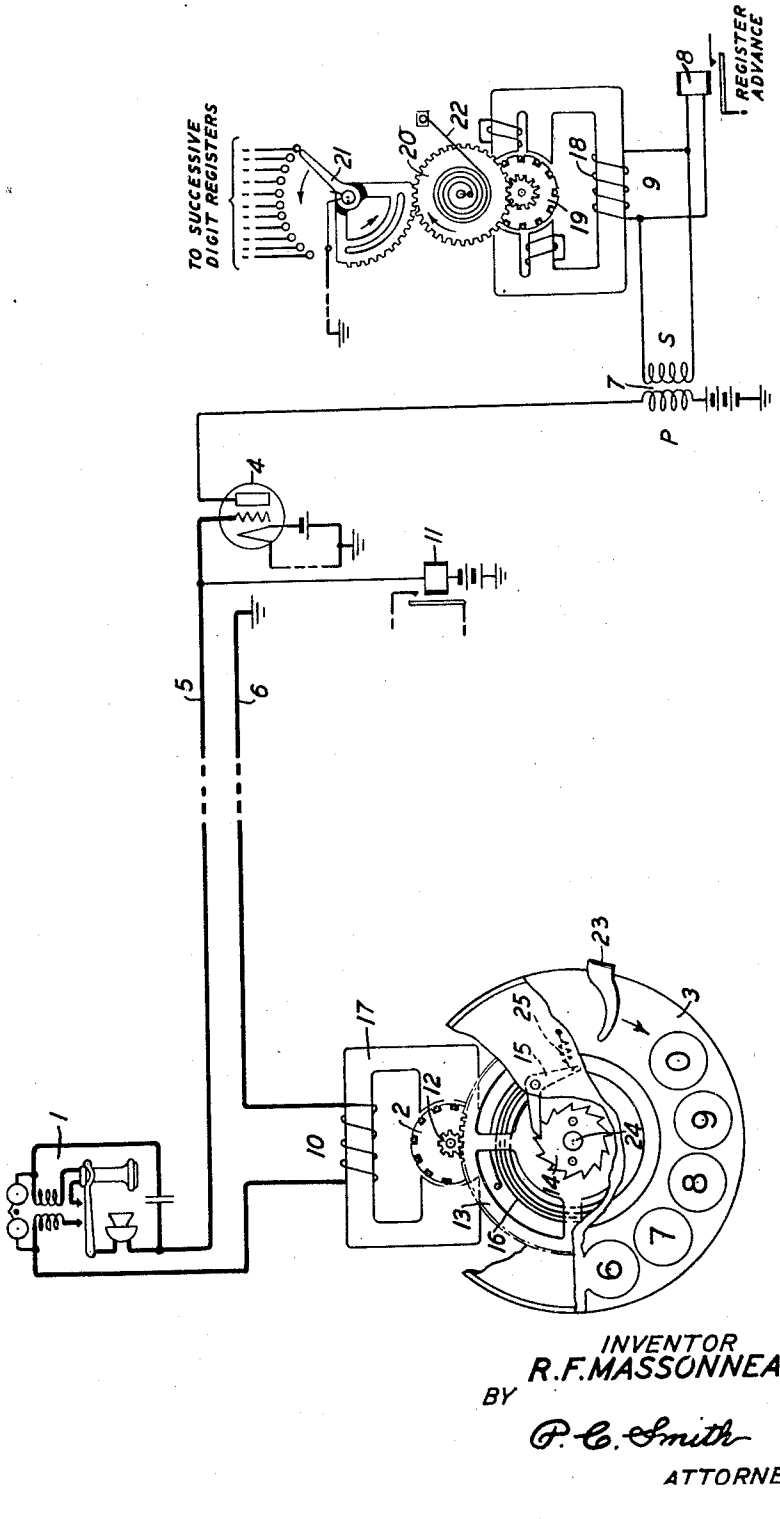
Nov. 15, 1938. R. F. MASSONNEAU 2,136,630

TELEPHONE SYSTEM

Filed Aug. 13, 1935



INVENTOR
R. F. MASSONNEAU
BY
P. C. Smith
ATTORNEY

Patented Nov. 15, 1938

2,136,630

UNITED STATES PATENT OFFICE

2,136,630

TELEPHONE SYSTEM

Robert F. Massonneau, New York, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application August 13, 1935, Serial No. 35,909

5 Claims. (Cl. 179—16)

This invention relates to signaling systems and more particularly to dial control systems in which impulses are produced at one end of a line for transmission to the other end. My invention is specifically directed to the control of an alternating current generator by an impulse dial so that the rotation of the dial back to normal from any digit aperture brought into coincidence with the finger stop, will rotate the armature of the generator to produce a number of alternating current sine waves which is the product of the value of the digit and that of some constant.

A further feature of this invention is the use of an inductor motor relay, described and claimed in my copending application Serial No. 6,787, as a registering device of the groups of alternating current impulses generated by the dial controlled alternator.

As is well known, electrical impulses are usually produced by momentary interruptions of the transmission line. This necessarily reduces the pulsing range to limits determined by the electrical characteristics of the line which very often produce pulse distortion that adversely affects the pulse receiving equipment. Further, direct current pulsing is also limited to the ohmic resistance of the line so that, when said line is very long, repeaters have to be interposed at suitable distances along its length to amplify, or reproduce, the pulses to affect the pulse receiving equipment at the distant end.

By means of my invention, that is, by the use of an alternating current generator as an impulse producer, the pulsing range is greatly extended, the physical characteristics of the pulses are practically undistorted by the line constants and the use of impulse repeaters greatly reduced.

A clearer understanding of the scope and purpose of the invention may be obtained from the following description taken in connection with the accompanying drawing which shows, at one end of a line, a telephone subscriber's station 1 with an inductor alternator 10 whose armature 2 is rotatably geared to a calling dial 3. At the other end of said line there is an alternating pulse receiving arrangement which comprises a thermionic detector 4 having its grid connected to the tip conductor 5 of the line and its plate to a terminal of the primary winding P of transformer 7; the other terminal of said primary winding being connected to a grounded source of battery. The secondary S of said transformer is bridged between the winding of the register advance relay 8 and the field winding 9 of the inductor motor switch, described and claimed in my above-mentioned copending application.

The inductor alternator 10 may be of any suitable type, but I prefer to illustrate the operation of my invention with one having a rotatable armature 2 of the squirrel cage type whose shaft carries a gear 12 with teeth meshing with those of a second gear 13 intermediate gear 12 and the ratchet wheel 14, both of which are rigidly mounted on the dial shaft 24 while the dial wheel 3 is rotatably mounted thereon. A spring 16 is connected to the frame of the dial and to the dial wheel, which spring is wound up when the wheel is rotated in a clockwise direction so that the energy stored in the spring during such an operation will cause the wheel, when released, to restore to its normal condition. On the inner surface of the front plate of the dial wheel 3, pawl 15 is mounted to engage the notched surfaces of the ratchet wheel 14, being firmly held in position within a notch by spring 25, which at one end is attached to the dial plate and the other end to the free end of the pawl. During the time when the dial wheel 3 is being rotated to a position where any one of the digit apertures is directly above the finger stop 23, pawl 15 slides over the teeth of the ratchet 14 and comes into engagement with one of the notches at the "stop" position of the dial wheel. When the wheel is up, the tension stored in the spring will cause said wheel to rotate back to its normal position in a counter-clockwise direction. During this rotation, pawl 15 rotates ratchet 14 and inasmuch as said ratchet is rigidly fixed to the shaft 24 which carries the gear 13, said gear moves with the shaft, rotating gear 12 and armature 2. The ratio of the two gears 12 and 13 shall be such that for each return to normal of the dial from the position to which it may have been pulled from one of the finger apertures, there shall be a number of revolutions of the armature 2 equal in number to the product of the digit indicated in the finger aperture brought into position above the finger stop 23 when the dial wheel is let go and a suitable constant which can be used with each of the digits in the other digit apertures. Thus, if the constant is 10, and the dial wheel is rotated so that the finger aperture which has the digit 1 is just above the finger stop 23 and then released, the armature 2 will make ten revolutions. Since the armature, in rotating, cuts across a magnetic field established through the stator 17, ten sinusoidal current waves will be generated in the line circuit, as explained hereinafter. If, in the same way, digit 6 is dialed, the

armature will revolve sixty times and sixty sinusoidal current waves will be produced in the line.

I will now describe the operating details of my invention. When the subscriber at substation 1 removes his receiver from the hook to initiate a call, the line is extended to an impulse register in the ordinary way well known to the automatic telephone art. As a result, a circuit is completed between the register and the subscriber's line comprising, for example, the grounded battery through line relay 11, conductor 5, through the subscriber's subset, the field winding of stator 17, conductor 6 to ground. Line relay 11 operates to close its contacts, which are effective to operate such parts of the register as control the transmission (not shown) of dial tone to the calling station as an indication that he may proceed to dial. The circuit above described is further effective in producing lines of force in the field magnets of the alternator 10, which lines of force will be cut by the conductors of the armature 2 when said armature rotates under the influence of the dial as above described.

The subscriber now pulls the dial around to the finger stop 23 from any digit aperture and, in so doing, winds up the spring 16. In the movement of the dial wheel, ratchet wheel 14 is uninfluenced, but pawl 15 slides over the teeth of said ratchet wheel. When the bottom of the finger aperture comes into coincidence with the top of the finger stop 23, pawl 15 rests in the notch between two successive teeth. When the dial is released, the energy stored in the spring 16 by the clockwise rotation of the dial wheel influences said dial wheel to return to its normal position. Ratchet wheel 14 and gear 13, however, are both rigidly fixed to shaft 24, and since pawl 15 is wedged in the notch of ratchet wheel 14 to which it was advanced, the return movement of the dial wheel will cause the pawl to push the axis assembly of ratchet wheel 14 and gear 13 in a counterclockwise rotation. Inasmuch as gear 13 is meshed with gear 12, and since the ratio between the teeth of these gears is such that for an arcuate displacement of the dial wheel from its normal position to any digit aperture above the finger stop 23, armature 2 will make as many revolutions as the product of the value of the digit designated by the aperture and a constant, it follows that when the dial wheel is rotated to the finger stop position for any digit, said armature 2, on the return of the wheel to normal, will make that many revolutions. With each revolution of the armature, a sinusoidal current wave is generated in the line circuit by the conductors of the armature 2 cutting the lines of force generated by the steady current traversing the generator stator 17, so that there will be as many sinusoidal current waves produced as complete revolutions of the armature.

At the terminating end, the instantaneous value of each sinusoidal current wave serves to alter the potential on the grid of the thermionic device 4, causing thereby a plate current of proportionate intensity to pass through the plate circuit including the primary winding (P) of the transformer 7. A current is further induced in the secondary winding S in the circuit which includes the field winding 18 of the motor relay 9, completely described in my above-mentioned copending application, and the winding of the register advance relay 8 in parallel therewith, causing said relay to operate and hold so long as current flows through the secondary circuit.

So long as the sinusoidal alternating currents are being produced in the line in rapid succession by the continuous rotation of the generator armature 2, the potential of the grid of the detector 4 will continue to be altered correspondingly and cause a flow of current in the plate circuit and an induced alternating current in the secondary circuit (S) of the transformer 7 which will produce an alternating field of proportionate intensity in the stator of the motor relay 9. As a result, armature 19, which is of the squirrel cage type, as described in my above-mentioned copending application, rotates in a counter-clockwise direction and influences gear 20 to step brush 21 over the terminals of its cooperating contact arc, said brush advancing over as many terminals as the number dialed.

When the dial has returned to normal and the potential on the line is restored to the steady current condition, the potential of the grid is reduced, the plate current ceases, and no alternating current is induced in the secondary circuit, whereupon relay 8 releases to control the operation of switches or equivalent structures (not shown) that will advance the conductors on the terminals of the arc accessible to brush 21 to a succeeding register in the manner well known in the telephone switching art. Brush 21, in the meanwhile, is returned to normal through gear 20 by virtue of the energy that was stored in spring 22 when gear 20 rotated under the influence of armature 19.

When the subscriber dials the second digit, the above operations are repeated, and since the terminals of the arc associated with brush 21 are now advanced to another register, the second digit will be registered thereon in accordance to the terminal to which brush 21 will be advanced.

What is claimed is:

1. A signaling system comprising a dial movable from its normal position in accordance with different digital values, means for returning said dial to normal, an alternator and means responsive to the movement of said dial for controlling said alternator to produce a number of alternating current sine waves proportional to the movement of said dial.

2. A signaling system comprising a dial movable from its normal position in accordance with different digital values, means for returning said dial to normal, an alternator, means responsive to the movement of said dial for controlling said alternator to produce a number of alternating current impulses proportional to the movement of said dial, a stepping device, and means responsive to said alternating current impulses for operating said stepping device a number of steps equal to the number of impulses.

3. A signaling system comprising a dial movable from its normal position in accordance with different digital values, means for returning said dial to normal, an alternator, means responsive to the movement of said dial for controlling said alternator to produce a number of alternating current impulses proportional to the movement of said dial, a switching device, and means responsive to said alternating current impulses for operating said switching device for a period of time equal to that of all the impulses.

4. A signaling system comprising a dial movable from its normal position in accordance with different digital values, means for returning said dial to normal, means responsive to the return movement of said dial for producing a current of equal duration to the duration of said return movement and stepping means responsive to said

current for measuring the amount of said displacement.

5. A signaling system comprising a dial movable from its normal position in accordance with different digital values, means for returning said dial to normal, an alternator, means responsive to the movement of said dial for controlling the operation of said alternator to produce a number of alternating current impulses proportional to the movement of said dial, a thermionic detector responsive to said impulses, a stepping device responsive to alternating current, and means responsive to the operation of said thermionic detector for operating said stepping device a number of steps equal to the number of impulses.

ROBERT F. MASSONNEAU.