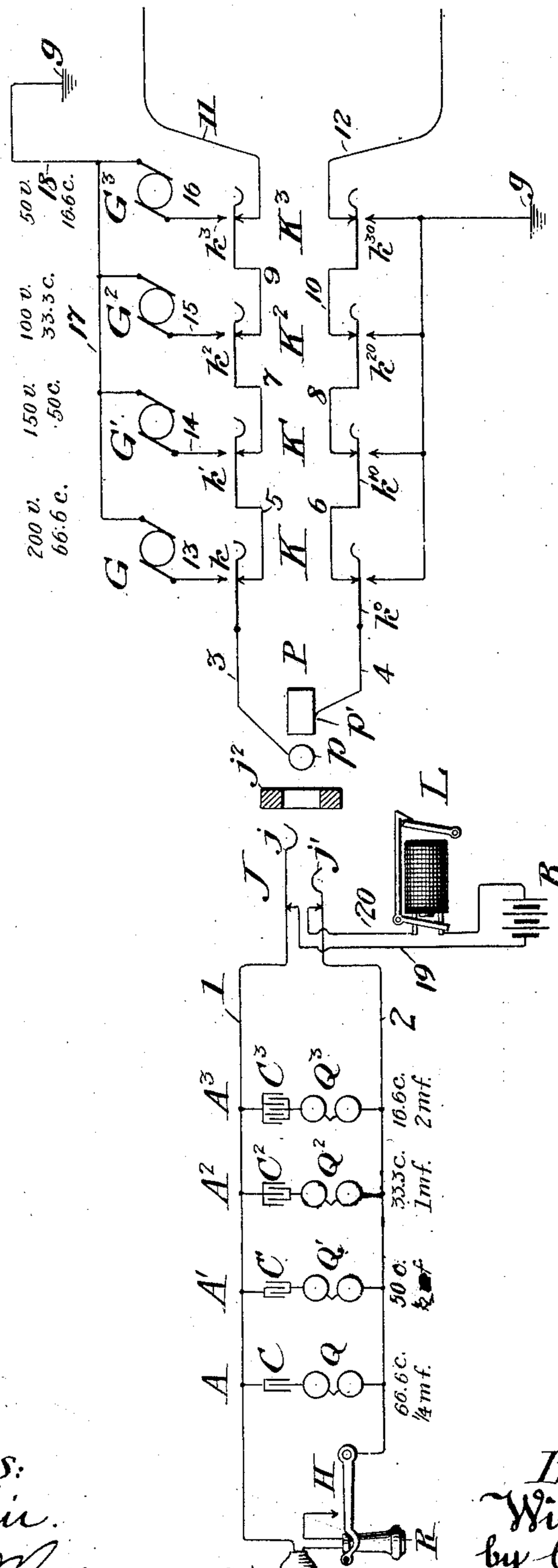
No. 827,087. PATENTED JULY 31, 1906.

W. W. DEAN.

HARMONIC SIGNALING FOR PARTY LINES.

APPLICATION FILED AUG. 9, 1905.



Witnesses:
O. W. Edelin.
James A. Marr.

Inventor:
William W. Dean
by Edward C. Lemert
Atty.

UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF ELYRIA, OHIO, ASSIGNOR TO THE DEAN ELECTRIC COMPANY, OF ELYRIA, OHIO, A CORPORATION OF OHIO.

HARMONIC SIGNALING FOR PARTY-LINES.

No. 827,087. Specification of Letters Patent. Patented July 31, 1906.

Application filed August 9, 1905. Serial No. 273,456.

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Harmonic Signaling for Party-Lines, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to telephone systems, and particularly to what is known as "harmonic signaling for party-lines."

According to methods heretofore employed each of several subscribers' stations connected to the same line has been equipped with a signaling device or ringer adapted to respond to a given frequency only of signaling-current. At the central office several generators have been provided, usually four in number, since the number of stations on one line in practice is generally limited to that number. Of course these generators are not usually built as separate machines, but form parts of one machine, whose speed is rendered fairly constant by means of governing devices which it is unnecessary here to describe. According to some systems the ringer-armatures at the substation, which constitute reeds, are tuned so as to be in exact accord with the several different ringing-currents by which they are to be respectively actuated. According to other systems the ringers are overtuned or undertuned, according to their design and the exigencies of the case; but my present invention is not limited to any of these in particular, but is, in fact, applicable to all of them, since its aim is to correct a defect found in them all.

In all harmonic party-line systems I have found by experiment that while there is practically no tendency for a current of high frequency to affect the bells on the line which are tuned to respond to lower frequencies the reverse is not true, currents of low frequency showing a strong tendency to affect the bells or ringers which are tuned to respond to high frequencies only. I have found it possible to overcome this tendency and to effectively limit each ringing-current to its own tuned bell by winding generators so that their respective outputs shall be of diverse voltages. I find it very effective to make a low-frequency generator of low voltage and a high-frequency generator of high voltage. It is evident that by this method the high-frequency bells, which are always hardest to ring, can be tuned and adjusted more delicately than otherwise would be possible without being affected by the low-frequency currents. In order to still further increase the margin of selection, I also find it expedient to make the condensers of low-frequency bells of larger capacity than the others, those for the highest-frequency bells being, in fact, of very small capacity.

My invention is illustrated in the accompanying drawing, which is a diagram of a polystation-line and the central office apparatus through and by which any station on the line can be selected and rung.

In the drawing, A, A′, A^2, and A^3 are subscribers' stations all connected to the same pair of line-wires 1 2. At each subscriber's station I provide the usual transmitter T, receiver R, switch-hook H, and whatever other apparatus may be required in addition to the ringer Q and the condenser C. I have shown the telephone set and switch-hook at station A only, their inclusion at each of the other stations being understood.

At the central office the line-wires terminate, respectively, in the springs *j j′* of the jack J, which may be a single line-jack of a simple or transverse board or may be taken as the type of multiple jacks on a multiple switchboard. In the latter case a test-thimble j^2 would be required for each jack, and I have illustrated it for that reason. The line-signal L is shown as a drop-annunciator, connected to the line through cut-off contacts in the jack, its circuit 19 20 including a source of signaling-current B.

Coöperating with the jack and intended to establish connection between the subscriber's line and other lines or circuits is the plug P, which is here supposed to be the calling-plug of a pair whose corresponding contacts are connected together through cord conductors 3 to 11 and 4 to 12. I have shown the plug P with a tap-contact *p* connected to the conductor 3 and the sleeve-contact *p′* connected to the conductor 4. The conductors 11 and 12 are therefore supposed to be similarly connected to the tap and sleeve of the twin or answering plug of the pair. As my invention relates only to the calling appara-

tus and circuits, I have not illustrated the answering end of the plug-cord, its arrangement being familiar to all those skilled in the art.

In the calling end of the cord which I have illustrated I provide four selective ringing-keys K, K′, K², and K³, each adapted when actuated to connect to the cord and thence to the line one of the four ringing-generators G, G′, G², and G³, and thereby throw out current of the proper character to ring the bell at any particular one of the four stations A A′ A² A³. Each of these ringing-keys has a pair of springs with front and back contacts. Those of the key K are marked *k* and k^0, and in their normal condition of disuse they rest upon their front contacts connected to the conductors 5 and 6, which pass thence to the springs *k′* and k^{10} of the key K′, these in turn normally resting upon front contacts connected through wires 7 and 8 to the springs k^2 and k^{20} of the key K², which normally rests upon contacts connected through wires 9 and 10 to the springs k^3 and k^{30}, the normal resting contacts of these springs being connected to the conductors 11 and 12. Each of the keys is provided with an actuating button or lever with a cam, which upon actuation of the button or lever acts to spread apart the springs, breaking the connection between conductors 3 4 and 11 12 and establishing a connection from the conductors 3 4 to one of the generators. Thus upon actuating the button or lever of key K the springs *k* and k^0 are carried from the terminals of wires 5 and 6 and close the circuit for generator G, which may be traced as follows: on the one side from the tip *p* through conductor 3 to the spring *k*, thence to the generator G and by wires 17 and 18 to the ground at *g;* on the other side from the sleeve *p′* through conductor 4 to the spring k^0 and thence direct to the ground. The plug having been inserted in the jack J when the key K is thus actuated, current from the generator G will pass out from the line-wires 1 2 to actuate the bell at the corresponding station.

The ringers Q, Q′, Q², and Q³ at the stations A A′ A² A³, respectively, are designed to respond to and be actuated by currents of the following frequencies: for ringer Q, current at 66.6 cycles; for ringer Q′, current at fifty cycles; for ringer Q², current at 33.3 cycles, and for ringer Q³ current at 16.6 cycles per second. The generators G, G′, G², and G³ are wound and run so as to produce currents of the four frequencies mentioned—that is, generator G gives current at 66.6 cycles, G′ current at fifty cycles, G² current at 33.3 cycles, and G³ current at 16.6 cycles.

There is nothing essentially novel in the system thus far described. With some slight modifications it might be taken as a type of that class of systems familiar to telephone engineers under the name of "harmonic selective systems." My present invention, however, may now be understood and will be described as applied to the foregoing. It consists, essentially, in giving the generators G, G′, G², and G³ such peculiarities of speed or winding, or both, that they will produce their respective current at diverse voltages as well as of diverse frequencies. Thus the generator G, I design to produce current at a voltage of two hundred, generator G′ at one hundred and fifty, generator G² at one hundred, and generator G³ at fifty. In other words, I make the high-frequcncy generators also high-voltage machines, relatively speaking, and the low-frequency generators I make low-voltage machines. Correspondingly I may wind the ringers Q Q′ Q² Q³ of different resistance, or, as I have shown in the drawing, I preferably make the condensers in the ringer branches of diverse capacities. The ringer Q at station A being tuned to respond to current at a frequency of 66.6 cycles per second, which is the maximum employed in the system, I include in this ringer branch the minimum capacity of one-fourth of a microfarad. The ringer Q′ being tuned to respond to current at fifty cycles, I double the capacity, making it one-half of a microfarad. For ringer Q², I again double the capacity, making it one microfarad, and for ringer Q³, I provide two microfarads. The condensers C, C′, C², and C³ have progressively-increasing capacities, therefore, the largest capacity C³ corresponding to the lowest frequency and the lowest-voltage current which is thrown out by the generator G³.

It will be apparent from the foregoing description that there will be little or no chance for leakage and consequent interference by low-frequency current through the high-frequency branches at stations A A′. The high-frequency bells are the hardest to ring for mechanical as well as electrical reasons, and since I have cut down the capacity a small fraction and the voltage or pressure of the current also to a small fraction of the maximum, the frequency being already a small fraction thereof, the amount of leakage transmitted through the high-frequency branch is negligible. Moreover, it will be noticed in going down the scale from station to station as the capacities and voltages increase the tendency to interference decreases. Thus the system is perfectly symmetrical.

I believe I am the first person to combine the factors by which energy transmission has heretofore been separately limited. I shall therefore claim the same broadly and wish it to be distinctly understood that all applications of this broad idea, whatever be their specific form, and all the modifications which may be made therein are contemplated by me as within the scope and purview of my invention.

Having thus described my invention, what I claim, and desire to obtain by Letters Patent, is—

1. In a telephone system, the combination of a plurality of signal-receiving devices tuned to respond to periodic impulses at different frequencies, and means to supply current impulses to any desired frequency at a voltage approximately proportionate to the frequency.

2. In a telephone system, the combination of a line-circuit and a plurality of signal-receiving devices connected thereto each of said signal-receiving devices being tuned to respond to a current of a particular frequency, with sources of current, and means to connect one or more of said sources to said circuit, the current from said sources varying not only as to its frequency but as to its voltage.

3. In a telephone-exchange system, a party-line and a plurality of differently-tuned ringers connected thereto, a corresponding plurality of periodic current-generators, each furnishing current of a given frequency and at a voltage approximately proportional to the frequency.

4. In a telephone-exchange system, a subscriber's line and a plurality of differently-tuned ringers connected thereto, a corresponding plurality of ringing-generators at the central station, adapted to furnish ringing-currents of high and low frequencies, and of high and low voltages, and switching means whereby any one of said generators may be connected to said line.

5. In a telephone-exchange system, a subscriber's circuit and a plurality of stations connected thereto, a ringer at each station connected to the circuit and tuned to respond either to high or low frequency currents only, central-office switching means and a plurality of selective ringing-generators adapted to be connected thereby to the subscriber's circuit, one of said generators being adapted to furnish current of low frequency and at a relatively low voltage, and another of said generators being adapted to furnish current of high frequency and at a relatively high voltage, whereby the low-frequency current will be unable to objectionably affect the high-frequency ringers.

6. In a telephone-exchange system, a party-line with a plurality of subscribers' ringers connected thereto, said ringers being progressively tuned to respond to currents of progressively-increasing frequencies, a plurality of sources of ringing-current of progressively-increasing frequencies corresponding to those of the ringers, and means to prevent current of one frequency from passing through the ringer tuned for another frequency, to an objectionable degree.

7. In a telephone-exchange system, a plurality of tuned bells, ranging from high to low pitch, a plurality of generators adapted to furnish ringing-currents ranging from high to low in frequency and means to regulate the output of one or more of the low-frequency generators by limiting the effective electromotive force impressed on the line thereby.

8. In a telephone-exchange system, a plurality of tuned bells, ranging from high to low pitch, a plurality of generators adapted to furnish ringing-currents ranging from high to low in frequency, and means to regulate the output of the generators according to their frequencies by limiting the effective electromotive force impressed on the line thereby.

9. In a telephone-exchange system, a plurality of tuned bells, ranging from high to low pitch, a plurality of generators adapted to furnish ringing-currents ranging from high to low in frequency, and means for regulating the amount of effective current from any one generator which shall pass through each ringer by limiting the effective electromotive force impressed on the line thereby.

10. In a telephone-exchange system, a subscriber's line and a plurality of harmonic ringers connected thereto, means for furnishing selective current for said ringers, a condenser in circuit with each ringer, the capacities of the condensers being inversely proportionate to the frequency to which their corresponding ringers are tuned and means to limit the output of current for each ringer by limiting the effective electromotive force at the ringer-terminals.

11. In a telephone-exchange system, a party-line and a plurality of subscribers' stations having ringers tuned to progressively-increasing frequencies connected to said line, central-office switching apparatus for said line, and a plurality of ringing-generators furnishing current of progressively-increasing frequencies at progressively-increasing voltages.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM W. DEAN.

Witnesses:

A. D. THIBBY,

GEO. A. SCOVILLE.