(No Model.)

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APPARATUS FOR SUPPRESSING TELEPHONE DISTURBING CURRENTS.

No. 506,884. Patented Oct. 17, 1893.

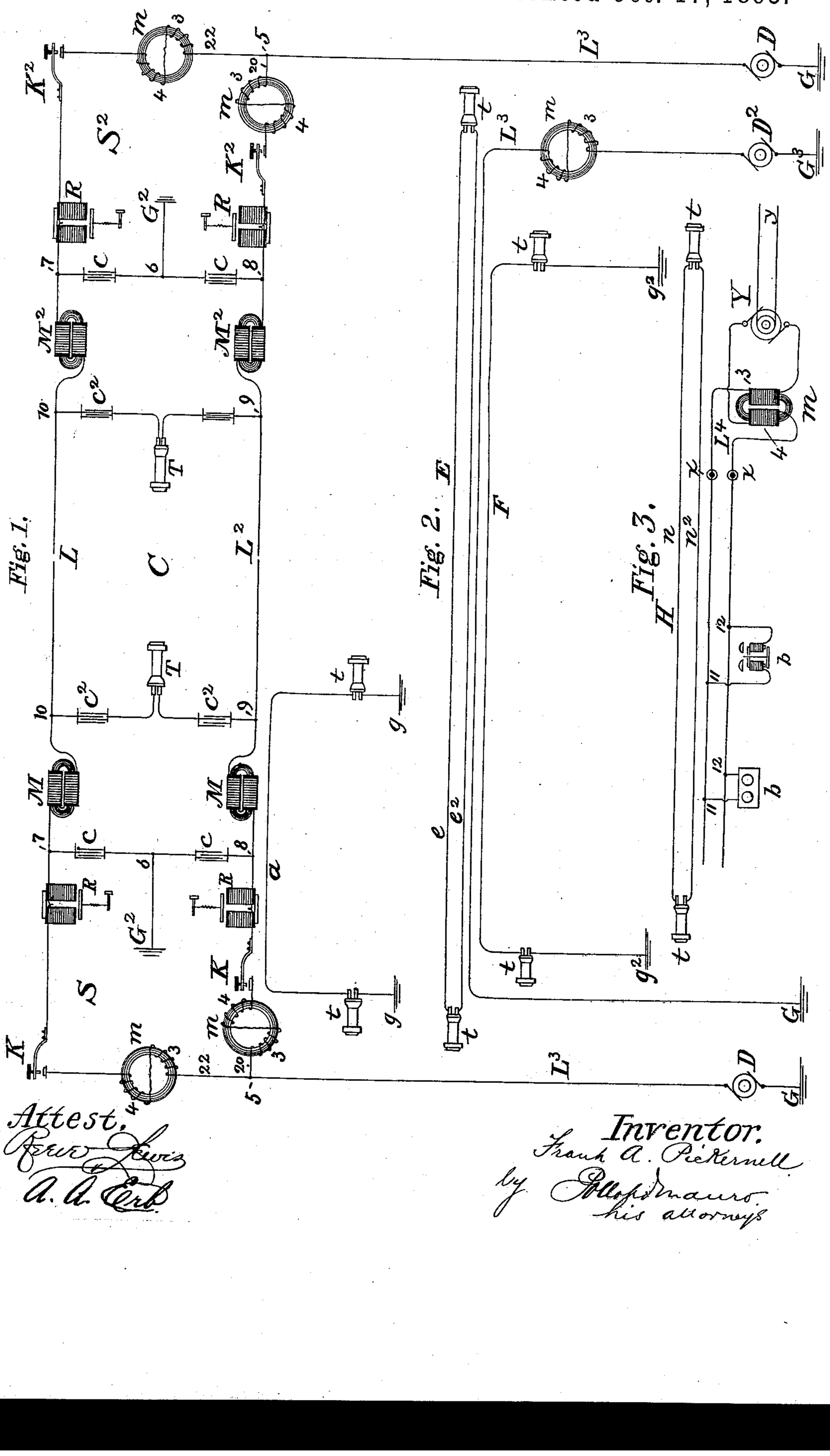

Fig. 1.

Fig. 2.

Fig. 3.

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APPARATUS FOR SUPPRESSING TELEPHONE DISTURBING-CURRENTS.

SPECIFICATION forming part of Letters Patent No. 506,884, dated October 17, 1893.

Application filed June 6, 1893. Serial No. 476,735. (No model.)

To all whom it may concern:

Be it known that I, FRANK A. PICKERNELL, residing at Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Apparatus for Suppressing Telephone Disturbing-Currents, of which the following is a specification.

This invention relates to the suppression in telephone circuits, of electrical disturbances manifesting themselves as undesired sounds in the receiving instruments, when such disturbances are due to the fluctuations of the current of a dynamo, operated in connection with circuits adjacent to the telephone circuits, and inductively related thereto.

In composite systems of telephonic and telegraphic simultaneous transmission; in signal bell circuits; and for many analogous purposes, it is convenient and economical to employ dynamo machines or dyna-motors; but it has been found that when a telephone is introduced into a dynamo circuit or in a circuit in the inductive neighborhood of a dynamo circuit, the commutation of the current generated in the armature, causes in the said telephone a humming noise which seriously mars its usefulness.

The object of my invention is to suppress or prevent this humming noise in the telephones without in any sense or degree impairing or interfering with the efficient operation of the telegraph instruments or other translating devices supplied by the dynamo; and I aim to carry out this object by toning down and making more uniform the currents supplied by the said dynamo for the operation of said translating devices.

Prior to my invention attempts have been made to tone down and steady dynamo or other currents in such a way that they would not adversely affect telephones connected with circuits holding an inductive or conductive relationship with the dynamo or supply circuit; and such attempts have sometimes involved the connection in the said supply circuit, of retardation coils or similar electromagnetic resistances. It has always however been a problem how to do this without at the same time adversely affecting the action of the telegraph instruments or other translating devices operated by the supply circuit, which although normally responding to relatively slow changes in current, are made sluggish in their operation by the introduction into the circuit of such devices, and in the case of telegraphic and signaling appliances tend to run their signals together and otherwise to confuse their delivery. But by my invention I am enabled to so subdue and steady the disturbing inequalities of the dynamo current, that interference with adjacent telephone circuits is prevented without adding sluggishness to the dynamo current itself, or in any way impairing the speed or character of operation of the instruments dependent thereon, and worked directly thereby.

To this end, my invention comprises the inclusion in the dynamo circuit whose currents have to be steadied and made uniform, of a differentially wound series connected retardation or choking coil which obstructs the passage of the undesirable noise producing fluctuations of the dynamo current, but which permits the ready passage of the relatively slow variations of Morse signals, or other changes produced by signal manipulation; and it includes also the combination of a composite system of simultaneous transmission in which the telegraphic circuits are supplied by dynamos, with such differentially wound electro magnetic resistances or choking coils which oppose disturbing variations of the dynamo current, but which add no sluggishness, and offer no appreciable opposition to the telegraphic signal transmission.

In the drawings which accompany and form a part of this specification, Figure 1 is a diagram illustrating the application of my invention to a system of composite simultaneous transmission. Fig. 2 is a similar diagram representing its application to any dynamo circuit in the neighborhood of telephone circuits; and Fig. 3 is a diagram of a dyna-motor bell ringing circuit in the vicinity of telephone circuits similarly fitted.

In Fig. 1 which is for a composite system of simultaneous telephonic and telegraphic

transmission, S and S² are the two terminal stations of a double conductor system in which each of the conductors L and L² serve separately as independent telegraphic conductors; while the two taken together constitute an inductively neutral telephone circuit C, forming respectively the direct and return conductors thereof.

The dynamos at the two terminal stations which furnish current for the telegraphic circuits are indicated by the letter D. The two conductors L and L² are furnished with transmitting telegraph keys K and K², and each also at its stations has a receiving relay R. The dynamo D or other source of telegraphic current has one pole connected to earth at G or to an equivalent return conductor and from its other pole a supply conductor L³, leads to the two keys at its own station, and the keys may be either of the normally open or normally closed circuit variety. In the latter case, the sources of supply must of course be so connected that they will reinforce and not oppose each other. If closed circuit keys be employed the usual circuit closer (not shown) in a manner well understood will complete the circuit when the keys are not being used. The supply conductors branch at the points 5, at each station to the fixed key contacts or anvils *k*.

Placed at each station on each telegraphic conductor, at points outside of the receiving relay, are retardation or choking coils M and M², preferably formed by winding two coils of insulated wire on a closed magnetic circuit iron core and connecting them in series. At each station a bridge connection containing the two condensers *c* unites the two main conductors L and L² at points 7 and 8 between the choking coil M and the relay R, and from a point 6 on the said bridge connection a branch extends to earth G², and a second bridge connection containing two condensers *c*² and the telephone instruments T, also at each station unites the said main conductors L and L² at points 9 and 10 located outside of the choking coils M; and through the last named bridges is formed the inductively neutral double wire telephone circuit. At the terminal stations in the supply circuit branches 20 and 22 leading to the keys, are connected peculiarly constructed regulating retardation or choking appliances *m*. These each consist of two coils 3 and 4 of insulated wire wound differentially upon an iron ring, or magnetically closed iron core, and connected in series. A telephone circuit *a*, is shown as running parallel with the telegraph conductor for a part of its length and the said circuit at its ends is shown as having terminal earth connections *g*, and contains telephones *t*.

In the operation of such a composite system, the keys K or K² are manipulated for the transmission of Morse or similar signals in the usual way, and the circuit of the dynamos D is thereby opened and closed, causing the operation of the relays R. Each time the circuit opens, there is a self induced dynamic discharge of the coils of the relays R which tends to produce a sharp and objectionable snap or click in the telephones T; and the condensers *c* in their bridge, together with the earth branch at 6, is introduced to prevent this; the said discharge thus being enabled to expend its energy in charging the condensers which also aid in toning down and graduating the Morse signaling currents. Furthermore in making and breaking the circuit by means of the keys, there is also a tendency to charge and discharge the condensers *c*² in the telephone bridge through which the metallic telephone circuit is inductively completed, and to thereby interfere to some extent with the operation of the telephones; but this is forestalled and avoided by the introduction of the ordinary choking coils or electro-magnetic resistances M, placed as they are between the keys and relays, and the junction of the telephone branch; for by the use of such coils the telegraphic signals are graduated and toned down to such an extent that they do not produce changes in the telephones abruptly, and the slow changes are not sufficiently rapid to cause an appreciable sound in the telephone. They do in practice cause a vibration of the telephone diaphragm, but it is so slow that it produces no effect which is perceptible to the ear. The coils M also, as well understood, prevent the rapidly varying voice currents of the telephones from propagating themselves in any but the proper direction when in the operation of the composite system a diversity of paths temporarily present themselves; and finally in addition to performing the above functions of damming and choking back the telephone currents, and toning down the telegraphic signals, they steady and flatten out the extremely rapid waves of the fluctuating dynamo current, thereby preventing the passage into the portion of the circuit beyond them of the variations which produce the humming telephonic disturbances. In subserving these functions they unavoidably cause some degree of lag in the dynamo circuit due to the self-induction of the coils, but not sufficient to distort the telegraphic signals.

It will readily be seen that telephones and telegraphic instruments may be simultaneously operated upon the above described plan without reciprocal interference; and when such systems are supplied with current from a battery they do not adversely affect independent parallel telephonic circuits to any material extent. When however dynamos are substituted for batteries their commutation fluctuations act with great strength upon telephone circuits, as *a*, extended parallel to the compound circuit, and produce an annoying and disturbing humming noise in the telephones which distorts and drowns the desired sounds. The same is true with ref-

erence also to the arrangements indicated by Figs. 2 and 3.

In Fig. 2, L^3 is a supply circuit extending between earth or return conductor terminal connections G^3 and connected with a dynamo D^2 whose current may be employed for any desired purpose. E is a two wire and F a single wire telephone circuit both including telephones *t*, and the latter provided with ground connections g^2. If the two wires of E can at all times preserve equidistance to the dynamo circuit L^3, or if neither has loops or resistances which act to prevent a balance of inductive forces in the two sides *e* and e^2 of circuit E, silence will in any event result in the telephones *t* of circuit E; but these conditions cannot always be achieved or maintained, and as a general thing the sharp irregularities of the dynamo commutation will, unless preventive means be applied, set up fac-simile induced currents in the parallel telephone circuits, sometimes producing a disagreeable disturbance in the telephones of circuit E, and always in those of circuit F.

In Fig. 3, a dynamotor Y fed from a dynamo supply circuit *y*, supplies alternating currents to a ringing circuit L^4, for the purpose of ringing by means of keys or buttons *x*, or otherwise, bells *b* connected with the supply circuit in any desired way at certain points 11 and 12; and the ringing circuit or portions thereof, extends in proximity to and parallel with a telephone circuit H, whose direct and return conductors *n* and n^2 unite in metallic circuit the telephones *t*. When a dynamotor is used on a circuit for work of this or similar character, the rapid pulsations or variations of the initiatory dynamo current are superimposed on the much slower and more gradual alterations of the call current generated by the dynamotor, and set up induced currents in all telephone circuits within the sphere of inductive influence, making the objectionable noise to which reference has been made in the telephones connected with such circuits. To prevent or suppress the objectionable effects to which I have called attention, I introduce into the dynamo or dynamotor circuit (as is indicated in each of the cases described) the differential choking coils or electromagnetic resistances *m*. These each consist of two independent helices 3 and 4 of insulated wire of suitable size, wound differentially upon an iron ring core, or in other words upon an iron core whose magnetic circuit is complete in itself, and connected in series. When placed in an electric circuit, a current at any given instant traversing such circuit acting through the two helices 3 and 4 respectively, tends to develop equal and opposing magnetic forces in the two halves of the ring core, which neutralizing one another, result in a magnetic zero, and therefore in little or no counter electro motive force of self induction induced in the magnetizing coils.

In Fig. 1 the differential electromagnetic resistance coil *m* is placed as shown in the branches 20 and 22 leading to the fixed key contacts, and the two helices 3 and 4 are united directly in series; and in Fig. 2 also this mode of connection is adopted. But in Fig. 3 while the general mode of connection is the same, the two helices 3 and 4 are in opposite sides of the circuit. The operation of such coils in accordance with my invention and under the conditions under consideration, tones down or flattens out the fluctuations of the dynamo or dynamotor current, and steadies the current generally beyond the coils, and the humming noise in the telephones of the previously disturbed circuits is no longer heard; while the desired signals in every case remain unimpaired. If the coils were not wound differentially, and connected to develop opposing magnetic effects, they would, it is true, still act to quell the disturbing humming effect; but they would also tend to increase the lag in the dynamo circuit, and this increased lag in organizations similar to that illustrated in Fig. 1, added to the lag of the graduating coils would cause the telegraphic signals to run together and become confused. The differential winding of the coils upon the iron ring core permits the slow variations of the Morse signals to pass through them without impedence, owing to the fact the counter electro-motive force of each of the two coils neutralizes that of the other; while such counter electro-motive forces as are developed in the said coils by the induced rapid pulsations or wave currents of the dynamo, and which are superimposed on the slower variations are not neutralized by the said differential windings. They react upon themselves and tend to neutralize each other, but this tendency is opposed and rendered futile by the magnetic inertia of the iron core. Therefore while the action of the coils removes from the circuit the element which disturbs adjacent telephone lines, it has no deteriorating effect on the perfection of the telegraphic or other desired signals.

Having now fully and clearly described my invention, I claim—

1. The combination of a dynamo; and a working circuit supplied thereby, and including translating devices; of a differentially wound, series connected electro-magnetic resistance included in the said circuit; substantially as and for the purposes described herein.

2. In combination with a composite system of simultaneous telegraphic and telephonic transmission; a dynamo supplying the working current thereof; and a differentially wound and series connected electro-magnetic resistance included in the circuit of, and near to the said dynamo, and organized to oppose and suppress the disturbance producing variations of the dynamo itself, but to offer no appreciable opposition or impedence to the

transmission of the telegraphic signals, substantially as specified.

3. The hereinbefore described inductive or electro-magnetic resistance appliance, consisting of a ring or endless iron core; and two magnetizing coils of equal magnetizing power wound differentially thereon and connected in series.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 1st day of June, 1893.

FRANK A. PICKERNELL.

Witnesses:
H. E. HAYES,
W. H. FREEMAN.