No. 693,530. Patented Feb. 18, 1902.

L. A. McCARTHY.

MULTIPLEX TELEGRAPH CIRCUIT.

(Application filed Apr. 24, 1901.)

(No Model.)

Fig. 1.

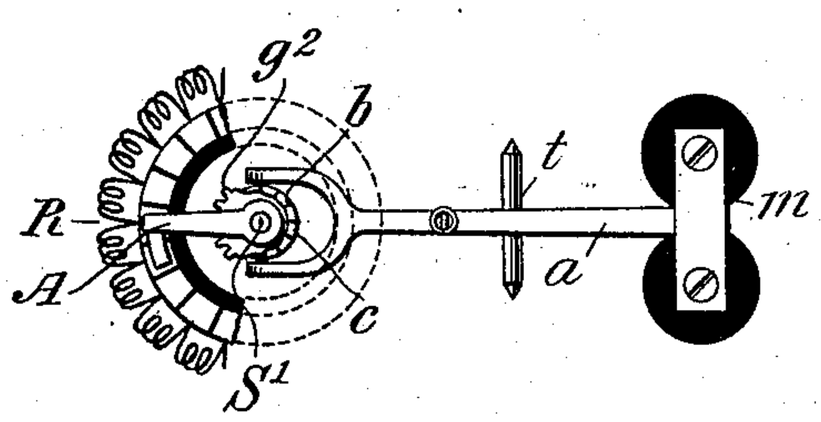


Fig. 4.

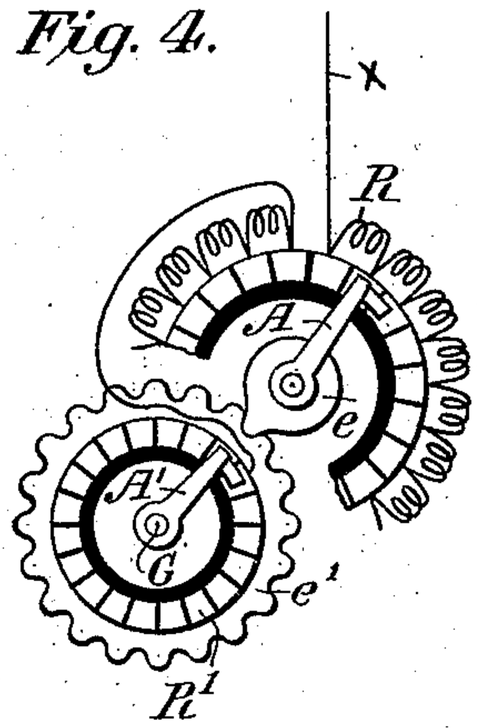


Fig. 2.

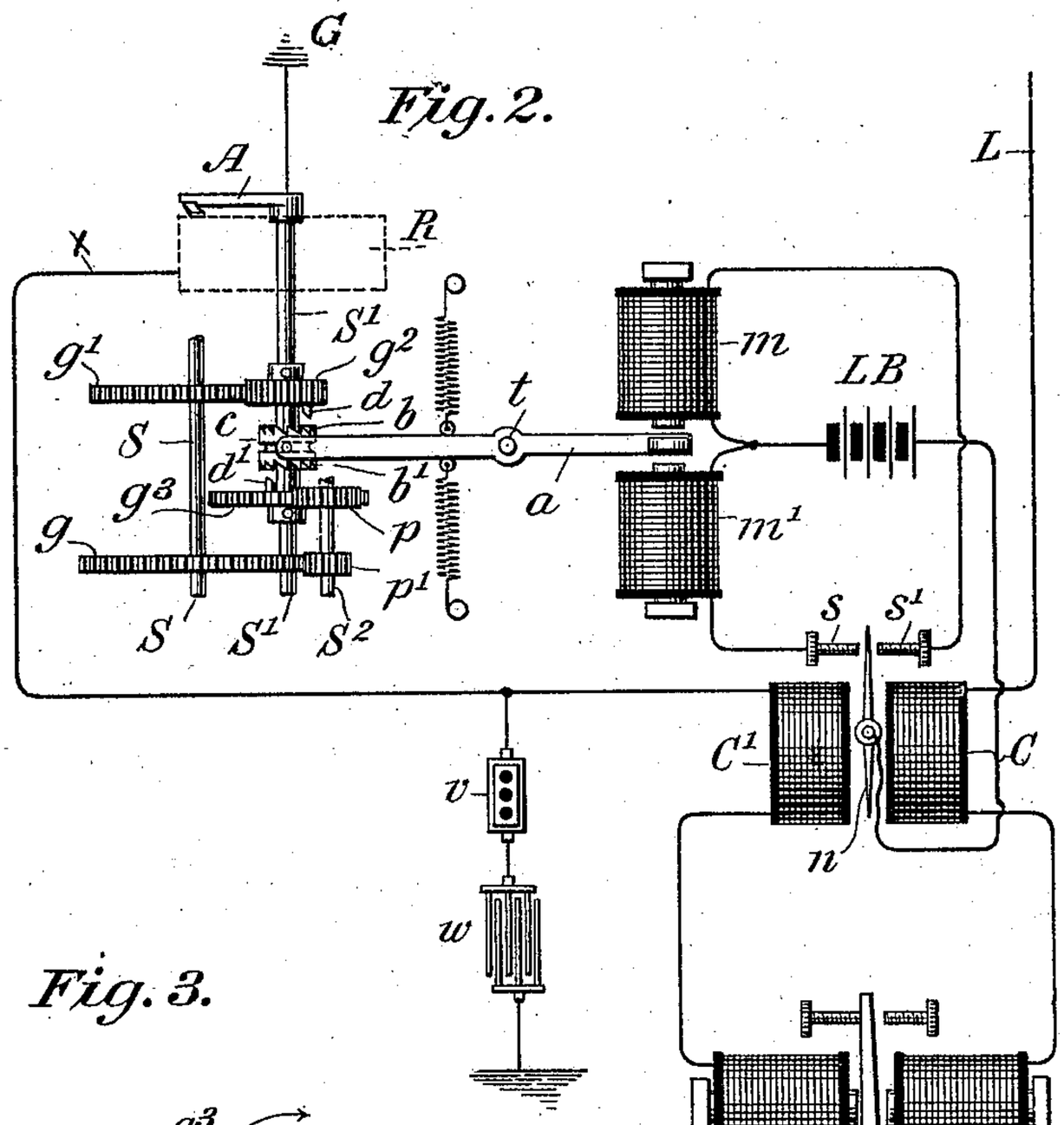
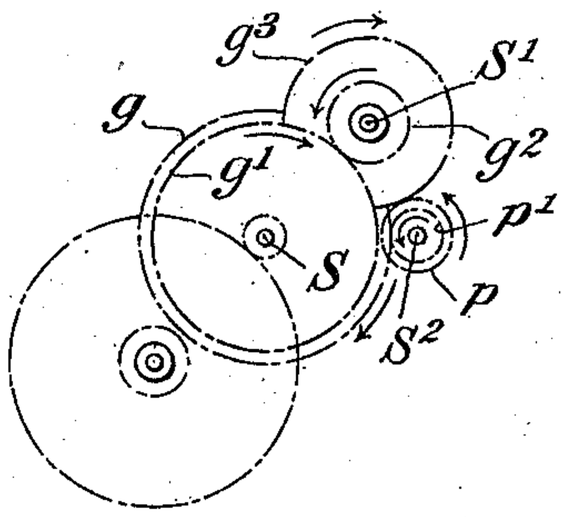


Fig. 3.



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MULTIPLEX-TELEGRAPH CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 693,530, dated February 18, 1902.

Application filed April 24, 1901. Serial No. 57,184. (No model.)

To all whom it may concern:

Be it known that I, LAURENCE A. McCARTHY, a citizen of the United States of America, residing at Brooklyn, Kings county, New York, have invented certain new and useful Improvements in Multiplex-Telegraph Circuits, of which the following is a specification.

My invention relates to that class of electrical circuits in which it is necessary to have a main and an artificial line, the one arranged and kept as near as possible at the exact electrical resistance of the other; and the object of my invention is by means of improved instruments to improve the working of that class of telegraph instruments known as "multiplex" and to increase the working capacity of said class of electrical circuits in which it is necessary that an artificial line be used in combination with the main line in order that more than one signal or message may be sent over a telegraph-wire at one and the same time; and it consists in an improved automatically-actuated rheostat combined with an electrical controlling instrument, the coils of which are connected with the receiving instruments in the main and artificial lines.

I attain the object of my invention by means of the combination of instruments shown in the accompanying drawings, in which—

Figure 1 gives a top view of a rheostat broken away to show the connections between the rotary brush and controlling-lever. Fig. 2 gives a general outline of the connections for the main circuit through a neutral and polar relay and one coil of the controlling instrument to the rheostat on the one side and through the other coil of the controlling instrument to the line on the other side. It also shows a local circuit between the needle and limit-stops of said controlling instrument and through controlling-magnets on the rheostat. Fig. 2 also gives a side view of the mechanism used to rotate the contact-brush or rotary arm of the rheostat forward or backward and the controlling-magnets with their armature arranged to bring the clutch on the brush-arm shaft into contact with and the brush-arm under control of one or the other part of the motor-gearing, as required. Fig. 3 gives a top view of the train of gearing arranged to rotate the contact-brush on the rheostat. Fig. 4 gives a broken top view of a further improvement in the rheostat by dividing the resistance-coils into two sets or banks, the brush of the second or higher set of coils depending for its movement on the movement of the brush of the first or lower set of coils in order to better adapt it to the needs of such a circuit.

Similar letters refer to similar parts throughout.

Referring to the different lettered parts in Fig. 2, N R represents a neutral relay; P R, a polar relay; C C′, the coils of a galvanometer or needle instrument; *n*, the galvanometer-needle; *s s′*, limit and contact stops for said needle; L B, a local battery; *m m′*, local magnets under control of needle *n*; R, a rheostat or set of resistance-coils; A, a brush or contact arm for said rheostat mounted fast on shaft S′ and arranged to be rotated forward or backward over and in contact with one or the other of the insulated contact-points on the rheostat. *c* is a toothed clutch-wheel having a groove on its periphery and is keyed to shaft S′, so that it can be moved lengthwise on said shaft, but cannot be rotated without turning shaft S′ and brush-arm A with it. *a* is a forked armature-lever under control of magnets *m* and *m′*, is trunnioned at *t*, spanning and connected to clutch *c* by means of pins on said arm projecting into the groove on the periphery of said clutch *c*, and is arranged to and will move clutch *c* lengthwise on shaft S′ when attracted by either magnet *m* or *m′*. g^2 and g^3 are gear-wheels mounted loosely and turning in opposite directions on but having no effect on or control over said shaft S′ unless locked, by means of the teeth *b* or *b′*, on clutch-wheel *c*, being pressed against or in the way of pin *d* or *d′* on said gear-wheels g^2 or g^3. *g* and *g′* are gear-wheels fastened to the main or power shaft S and are arranged to mesh, *g* with pinion *p′* and *g′* with gear-wheel g^2, respectively. Pinions *p* and *p′* are fastened to shaft S^2, and pinion *p* is arranged to mesh with gear-wheel g^3 on shaft S′. *w* represents a condenser attached to the artificial line between the receiving instruments and the rheostat and is for the purpose of neutralizing the static discharge from the main line. *v* represents a set of resist-

ance-coils and is for the purpose of varying the distance between the condenser and the receiving instruments.

Fig. 3 gives a top view of the gear-wheels, marked with darts to indicate the direction they turn, and the action of the main or propelling shaft S on brush-shaft S′ and through it on brush A either rotating it to the left by the action of gear g' on gear g^2 or to the right by the action of gear g on pinion p', shaft S^2, pinion p, and gear-wheel g^3 when either gear g^2 or gear g^3 is locked to shaft S′ by the clutch c.

In Fig. 4 is given a broken top view of a rheostat and intended to represent two sets of resistance-coils, with their contact-brushes, and to show how one set assists or acts on or with the other set. The set marked R is of low-resistance divisions and the other set, R′, is of high-resistance divisions—that is, the resistance of each section in R′ is a fraction larger than the total resistance of the combined sections in R—that is, if the sections in R were, say, twenty-five ohms each and the total resistance in R, say, four hundred and seventy-five ohms each section in R′ would be five hundred ohms. e is a single-toothed wheel fastened on the same shaft as brush A. e' is a gear-wheel fastened on a shaft with brush A′ and has as many teeth as there are sections or divisions of resistance in R′, so that at every complete revolution of brush A and the single-toothed wheel e gear-wheel e' and brush A′ are moved one step or section of R′ and in this way maintaining at all times the same rate of change of resistance—that is, cutting in or out the same amount of resistance—regardless as to whether the total resistance in the circuit is high or low and with the least possible number of resistance-coils or divisions of resistance, and the electrical action is as follows: Starting at B, the current from the house-battery divides through the relays N R and P R and the galvanometer-coils C and C′, one part going to the main line at L, the other part by way of wire x, to and through the rheostat R and brush A to ground at G, and if the resistance of the rheostat is exactly equal to the resistance of the line the current will divide equally through each path and have no detrimental effect on the relays, nor will needle n be attracted by either coil C or C′; but if the resistance of the main line is, say, greater than of the rheostat more current will go through coil C′ than through coil C, attracting needle n against stop s' and closing the local circuit through magnet m, attracting armature a and causing it to press the teeth b' of clutch c against or in the path of pin d' on gear-wheel g^3 and compel brush-arm A to turn to the right and increasing the resistance in the rheostat until it equals the resistance of the line, when the current passing through coils C and C′ again being equal they will have equal effect on needle n, drawing it to a central position and away from stop s', open the local circuit, and allow armature a and clutch c to seek a central position, releasing shaft S′ and brush-arm A from control of gear-wheel g^3, or, on the other hand, if the resistance of the rheostat be greater than the resistance of the line needle n would be attracted by coil C and against stop s, closing the local circuit through magnet m', attracting armature a and causing it to press the teeth b of clutch c against or in the path of pin d on gear-wheel g^2 and cause shaft S′ and brush A to turn to the left and decrease the resistance in the rheostat until it again equals the resistance of the line, when, as before, the current passing through coils C and C′ again being equal they will have equal effect on the needle, drawing it to a central position and away from the limit-stop, open the local circuit, and allow clutch c to again fall back to a central position, releasing shaft S′ and brush A, as before.

Now while I show a train of wheels to represent the motive power to rotate the brush on the rheostat it is plain that different kinds of small motors, either mechanical or electrical, might be used to accomplish the desired result. I therefore do not confine myself to any particular kind of motor as a means of rotating the brush-arm of the rheostat; also, that sensitive electromagnets might be used instead of the needle instrument described without departing from my invention; but,

What I claim as new, and desire to protect by Letters Patent, is—

1. In a multiplex-telegraph circuit having a main and an artificial line, the combination of a controlling instrument, the coils of which are inserted in said main and artificial lines, a local circuit, and magnets, in said local circuit, with a rheostat having an automatically-rotated brush-arm, said rheostat forming the artificial line, all substantially as and for the purpose set forth.

2. In a multiplex-telegraph circuit having a main and an artificial line, the combination of a controlling instrument, the coils of which are inserted in the main and artificial lines, a needle, responsive to an unequal strength of current passing through said coils, and limit-stops to said needle, with a local circuit, the local magnets in said local circuit, an armature responsive to a current passing through either of said local magnets, and the automatically-rotated contact-brush and resistance-coils, said brush and coils forming said artificial line, all substantially as and for the purpose set forth.

3. In a multiplex-telegraph circuit having a main and an artificial line, the combination of a controlling instrument, the coils of which are inserted in said main and artificial lines, a needle, responsive to an unequal strength of current passing through said coils, limit-stops to said needle, and a local circuit, with local magnets, an armature for said local magnets, and the automatically-rotated brush-arms and

stationary resistance-coils, said brush-arms and stationary coils forming said artificial line, all substantially as and for the purpose set forth.

4. In a multiplex-telegraph circuit, the combination of the automatically-rotated brush-arms, with the stationary resistance-coils, said brush-arms and coils forming the artificial line, the local magnets and forked armature, and a controlling instrument, for said local magnets, the coils of said controlling instrument being inserted in the main and artificial lines, all substantially as and for the purpose set forth.

5. In a multiplex-telegraph circuit, the combination of stationary resistance-coils, and the automatically-rotated brushes for said coils in the artificial line, with an automatically-rotated brush-arm, local magnets and armature, a local circuit, and a controlling instrument, the coils of which are inserted in the main and artificial lines, all substantially as and for the purpose set forth.

6. In a multiplex-telegraph circuit, the combination of the resistance-coils, the rotary shaft and the contact-brushes, for said coils, said coils and brushes forming the artificial line, the gear-wheels, mounted loose on said rotary shaft, the clutch-wheel, keyed to said rotary shaft, the local magnets and forked armature, said armature to coöperate with and move said clutch-wheel lengthwise and against either one or the other of said gear-wheels, with the local battery and the controlling instrument, the coils of which are inserted in the main and artificial lines, all substantially as and for the purpose set forth.

7. In a multiplex-telegraph circuit, the combination of an automatic rheostat, having a contact-arm capable of being rotated by a motor, and controlled by electromagnets in a local circuit, said rheostat forming the artificial line, with a controlling instrument the coils of which are connected in the main and artificial lines, and the needle of which is responsive to an unequal strength of current passing through said coils, all substantially as and for the purpose set forth.

8. In a multiplex-telegraph circuit, the combination of resistance-coils R, rotary brush-arm A, shaft S′, single-toothed wheel *e*, and resistance-coils R′, brush-arm A′, said resistance-coils and brush-arms forming the artificial line, and toothed wheel *e′* with armature *a*, local magnets *m m′*, needle *n*, and coils C, and C′, all substantially as and for the purpose set forth.

9. In a multiplex-telegraph circuit, the combination of an automatic rheostat, having contact-arms capable of being rotated by a motor, and controlled by electromagnets in a local circuit, with the controlling instrument, the coils of which are connected in the main and artificial lines and the needle of which is responsive to an unequal strength of current passing through said coils, the receiving instruments and the condensers, all substantially as and for the purpose set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 22d day of April, 1901.

L. A. McCARTHY.

Witnesses:
DANIEL E. PIKE,
C. R. DANFORTH.