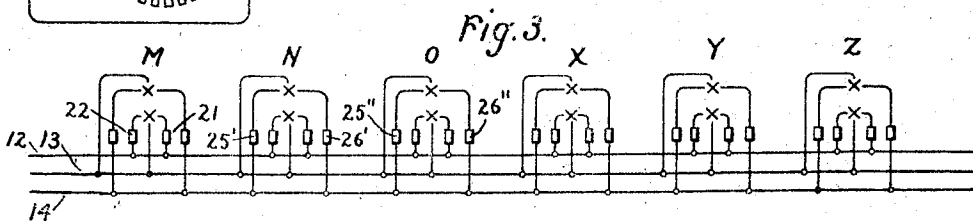
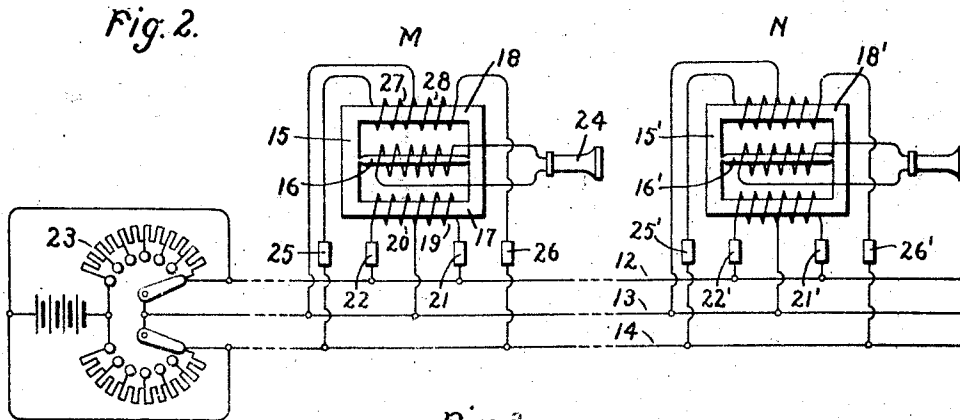
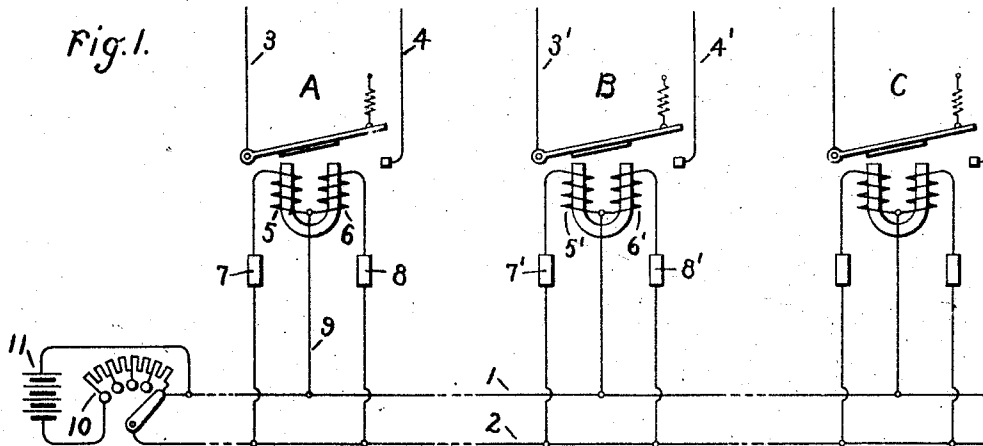


F. W. LYLE.
ELECTRIC SIGNALING.
APPLICATION FILED AUG. 22, 1911.

1,061,960.

Patented May 13, 1913.



Witnesses:

Carl E. Klock
J. Ellis Glen.

Inventor:

Fred W. Lyle,
by *Alfred B. Davis*
His Attorney.

UNITED STATES PATENT OFFICE.

FRED W. LYLE, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC SIGNALING.

1,061,960.

Specification of Letters Patent.

Patented May 13, 1913.

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To all whom it may concern:

Be it known that I, FRED W. LYLE, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Electric Signaling, of which the following is a specification.

My invention is useful in electric signaling and for other purposes, and comprises in particular an arrangement for operating selectively a given signal device, or a given number of devices of a group.

The element boron and, to a lesser extent, the element silicon, possess the characteristic of opposing a high resistance to an electric current up to a certain voltage, this value depending on the purity, shape, size, etc., of the resistor. When the voltage exceeds this value, the resistance breaks down, or falls suddenly in value allowing a comparatively large current to pass. This property is probably due to the heat generated at a given voltage exceeding the heat radiated, whereby the accumulation of heat rapidly lowers the resistance. In accordance with my invention this property of electrical break-down resistance is utilized in a system of signaling in such a manner that an electrical signaling current or impulse may be transmitted simultaneously to a number of receiving points each of which, or any selected group of which, act selectively to respond to currents of a predetermined voltage only. In other words any one station on a line common to a number of selective stations may transmit a signal to any other given station without affecting the other stations.

In the accompanying drawings, Figure 1 illustrates my invention as applied to the operation of a number of signaling stations connected across one pair of conductors, and Figs. 2 and 3 illustrate a modification suitable for operating a large number of stations.

The signaling stations A, B and C, shown in Fig. 1 as connected across lines 1, 2, are represented as having relays suitable for closing the contact in another electrical circuit 3, 4 as indicated, but, of course, any type of signaling device may be employed, the relay devices being illustrative only. Each device is provided with differential or opposing coils 5, 6. In series with a coil 5 is a boron resistor or similar break-down de-

vice 7, connected to the line 2; in series with coil 6 is a resistor 8 also connected to the line 2. The coils 5, 6 are connected in common by conductor 9 to the line 1. Various desired voltages may be impressed across lines 1, 2 by tapping across sections of the resistances 10 connected to a storage battery 11 or other convenient source in a manner similar to that employed in the potentiometer. The resistors 7, 8 of station A break down at slightly different values of voltage, for example, at 4 and 6 volts respectively. The resistors of station B, 7', 8', break down at higher voltages, for example, 8 and 10 volts respectively, and in like manner the resistors of station C break down at successively higher values. The desired break-down voltages may be secured by associating with boron some other modifying element as described in Weintraub U. S. Patents Nos. 1,019,568 and 1,019,569, or by operating the resistor in contact with cooling plates of varying size as disclosed in a copending application No. 507,405, filed July 13, 1909, by E. Thomson. It will be seen that when a signaling current of say five volts is impressed across the lines 1, 2, that the resistor 7 will break down without breaking down the resistance of resistor 8, or any of the other resistors of stations B and C. The armature of the receiving device, therefore, will be attracted at station A only. Should it be desired to operate a signal at station B without affecting the other stations, a voltage of say nine volts is impressed across the lines 1, 2 which, of course, will break down the resistance of both the devices 7 and 8 of station A sending a current through the opposing windings 5 and 6. As the magnetic effects in these windings neutralize each other, the receiver at station A will not be affected. At station B the resistance device 7' will break down but not the resistance device 8'. A current will therefore pass through winding 5' only, thereby operating the signal. Neither of the resistance devices at station C will be broken down as each of them break down at voltages greater than nine volts, therefore, the signal at this station will not be operated. It will thus be seen that a signal can be operated at any one station by impressing a predetermined voltage across the lines 1, 2 and thus passing current through a predetermined combination of resistors. Of

course, if it should be desired to operate a signal at several stations simultaneously, these stations should be provided with resistors which break down at the same voltage. The same idea can be extended to any number of stations by providing sufficient voltage range both in the break-down resistors employed and in the potentiometer or whatever other means is used to furnish the signaling current.

When it is desired to operate a greater number of stations, on a circuit of limited voltage than could be conveniently done in a system such as has just been described without too great refinement of differences in break-down voltage, a system such as illustrated in Figs. 2 and 3 will be found suitable. Three wires 12, 13, 14 are run between the stations. Only two stations M and N have been illustrated in Fig. 2 in detail, but a greater number are indicated in Fig. 3. The signaling devices here illustrated, comprise a magnetic core 15 having a leg 16 which has considerably higher magnetic reluctance than the legs 17, 18. Upon the leg 17 are wound opposing windings 19, 20, each of which is connected across the lines 12, 13 in series with a resistor containing boron, or other material having a sharp break-down voltage characteristic. Desired voltages may be impressed across the lines 12, 13 and 13, 14, by the resistance and battery 23, the signal being received in any well-known way, as by telephone receiver 24. Let it be assumed that the resistors 21 and 22 in series with windings 19 and 20 of station M break down at 20 and 40 volts respectively. In like manner the resistors in series with the coils on the lower leg of the cores of stations N and O break down at the same voltage values. Let it also be assumed that the resistors 25 and 26 in series with the opposing coils 27 and 28 on the upper leg of the core of station M break down at 20 and 40 volts respectively; the resistors 25' and 26' of station N break down at 60 and 80 volts respectively; the resistors 25'' and 26'' of station O break down at 100 and 120 volts respectively. In that case, when a current of 30 volts is impressed across lines 12, 13, one of the coils on the lower leg of the core of each of the receiving devices M, N, and O is energized. However, because of the high reluctance of the middle leg of each core, the magnetic flux will practically all pass through the outer part of the core and no signal will be received at any of these stations. When, however, a current of 30 volts is impressed across lines 13, 14, the coil in series with the resistor 25 which breaks down at 20 volts will be energized thereby generating a magnetic flux in leg 18 which opposes the flux from the lower leg 17 of the core, thereby causing some flux to pass

through the middle leg 16, consequently inducing a signaling current in the coil wound thereon. When a current of say 70 volts is impressed across lines 13, 14, both of the opposing coils on the upper leg of the core of station M are energized, their magnetic fluxes neutralize each other and no opposing flux is therefore generated in the core at station M. However, only the coil in series with resistor 25' breaking down at 60 volts receives current at station N and therefore the opposing fluxes in the lower and upper legs of the core at this station causes a flux to pass through the middle leg 16' and a current to be induced as already explained. Neither of the resistors on the upper leg of the core of the receiving device at station O are broken down and conditions at this station are therefore unchanged. It will, therefore, be seen how a signal may be conveyed to any one of a number of stations in like manner. A second group of stations X, Y, and Z may be provided with resistors in series with the coils on the lower leg of the magnetic core of the signal devices, and designed to break down at 60 and 80 volts respectively. The coils on the upper leg are in series with resistors which break down at graded voltages for example, those of station X at 20 and 40 volts respectively; those at station Y at 60 and 80 volts; those of station Z at 100 and 120 volts respectively. When it is desired to convey a signal to station X, a current of 70 volts is impressed across lines 12, 13 which will cause one of the coils on the lower leg of each of the receiving devices of stations X, Y, and Z to be energized. At the stations M, N, and O, however, both of the opposing coils on the lower leg of each core are energized and their magnetic fluxes neutralize each other. When, therefore, a signaling current of say 30 volts is impressed across lines 13, 14, a signal is received at station X and at none of the other stations as this is the only station where magnetic fluxes oppose each other in such manner as to force the flux through the high reluctance leg of the core. At station M, one coil on the upper leg of the core is energized, but at this station the coils on the lower leg of the core are both energized and their magnetic fluxes neutralize each other. The flux from the upper leg will not be met by an opposing flux and, therefore, will not pass through the middle leg. In a like manner, a signaling current may be sent to any other station of the second group by impressing an appropriate voltage across the lines 13, 14 and causing one coil on the upper leg of the core of the receiving device at one of the stations to be energized. The other stations will have either both their resistors in series with neutralizing coils broken down, or else

neither will break down. It will be seen how by the arrangement shown in Figs. 2 and 3 a great number of stations may be handled on a common line without too great refinements of break down resistance value.

I wish it to be understood that my reference to boron as a material suitable for a resistor having a sharp break-down characteristic is illustrative only. The resistor may contain other elements and may thus be modified.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In a selective electric signaling device, the combination of a plurality of resistors having the property of greatly lowering in resistance when a current having a voltage greater than a predetermined value is impressed thereupon and means responsive to the passage of current through a predetermined combination of said resistors, whereby a signal may be indicated.

2. In a selective electric signaling device, the combination of a plurality of resistors having predetermined differing breakdown resistances and a magnetic indicating device having opposing coils in series respectively with said resistances.

3. In a system of signaling, the combination of selective devices each of which comprises a plurality of boron resistances of unequal resistance break-down characteristic, means for impressing upon said devices a current of desired voltage, and means responsive to a predetermined combination of breakdown condition of the resistors associated with each selective device.

4. The combination of a plurality of signaling stations having paired boron-containing resistors, the members of each pair differing in resistance with respect to each other, means for delivering from any of said stations to the other stations a current of desired voltage, and means at each station responsive to the breakdown of the resistance

of a predetermined combination of said resistors.

5. In a system of signaling, the combination of paired boron resistors differing in break-down resistance, means responsive to the passage of current through a predetermined combination of said resistors only and means distant from said resistors for delivering a current of desired voltage to said paired resistors.

6. The combination of a plurality of circuits, means for impressing currents of desired voltage across said circuits, a plurality of signal-receiving stations on said circuits each having a magnetic core, paired differential coils connected across said circuits and wound on opposite legs of said cores in a direction to generate opposing fluxes, resistors having a definite break-down resistance in series with each coil, the resistors of each pair differing in break-down value, a magnetic path of high reluctance in magnetic shunt to the legs of the core on which said coils are wound, and means for detecting a change in the magnetic flux of said high reluctance path.

7. The combination of a plurality of sets of signaling stations, a magnetic indicating device for each station containing cooperating magnetic members, means for energizing simultaneously one of said members of each device in any set by a current of predetermined voltage, and means for energizing at will a coacting magnetic member of any predetermined station of the same set by a current of predetermined voltage and thereby transmitting the desired signal by the combined action of said members at said station.

In witness whereof, I have hereunto set my hand this 19th day of August 1911.

FRED W. LYLE.

Witnesses:

FRANK G. HATTIE,
ROBERT SHAND.