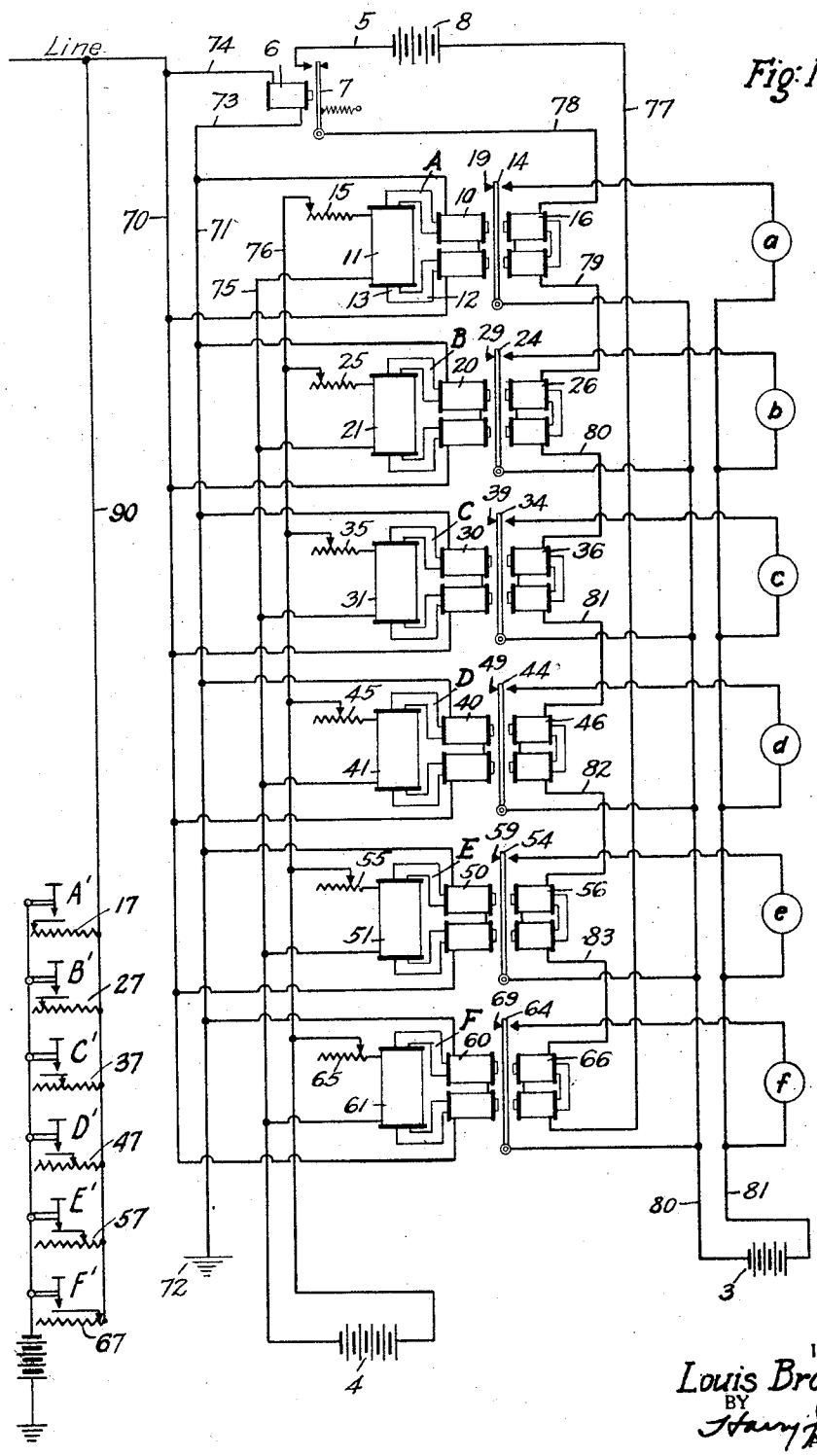
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ONE-WIRE ELECTRICAL SELECTING APPARATUS

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Fig. 1



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ONE-WIRE ELECTRICAL SELECTING APPARATUS

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This invention relates to electrical selective systems such as are used in printing telegraph receiving apparatus, for automatically selecting and operating any one of a number of different instrumentalities, and is particularly applicable to so-called "marginal" systems in which a single impulse at a time, of predetermined value is sent over a one-wire line for selecting purposes. Such marginal systems as have heretofore been known, as for instance, in connection with printing telegraph systems, have a limited range of selectivity, being usually incapable of selecting any one of more than three devices. They further lack the certainty of operation which is so essential in devices of the character here involved and are more or less inefficient by reason of the danger of selecting more than one device in response to a single impulse. My invention contemplates, among other things, the provision of any number of selecting magnets, each respective magnet being designed to have the intensity of its field neutralized, or reduced substantially to zero, by a different marginal impulse sent over the line from the distant source. The neutralization of the field of one magnet, magnetically releases a selected armature in response to the impulse. My invention contemplates further, the provision of an auxiliary magnet for positively operating the selected armature, on the release of the magnetic pull on that armature, to close a circuit to, or to otherwise actuate a given instrumentality. By means of my invention, I am able to prevent the operation of any armature by an impulse to which said armature is not intended to respond. I am therefore able to insure positive and certain selection, and to obtain a wide range of selectivity. As has been indicated, one of the important uses to which I apply my invention is in the selection of printing characters at the receiving end of a printing telegraph system, in which a one-wire line is used.

It will be understood, however, that my invention may be applied equally as well and with equal facility, and is adapted for use with apparatus other than printing telegraphs such as for instance, telephone party line systems, and other systems in which simple and inexpensive but positive and accurate selection is essential.

The various objects of my invention will be clear from the description which follows and from the drawing, in which

Fig. 1 is a diagram of my new system showing a preferred form and arrangement of the various selecting and operating means and the circuits therefor diagrammatically.

In that practical embodiment of my invention which I have illustrated by way of example, I have shown a series of six selecting magnets. It will be understood, however, that the number of such magnets and the corresponding parts to make up the full units therefor may be very greatly increased, and that by reason of the efficacy of my invention, it becomes possible to use any number which may be needed for practical purposes, without departing from the spirit and scope of the invention.

As has been previously indicated, my apparatus is based on the principle of neutralization of the magnetic force of a selecting magnet having a pair of windings, one of which is energized by a current of predetermined value, and the other of which is energized by a marginal impulse sent over the line to induce a magnetic force opposed to that induced by the first winding. The armature of a given selecting magnet may therefore be magnetically released by a given marginal impulse. Another magnet then becomes operative to throw the released armature into position for causing the operation of the particular instrumentality intended to be responsive to the given impulse. Since the various selecting magnets are each substantially identical in construction, as are each of the various armatures and each of the magnets for moving the armatures into operative position, which magnets I will hereinafter refer to as the "auxiliary" magnets a description of one unit, including a selecting and auxiliary magnet and an armature therefor, will suffice for all.

Each of the selecting magnets such as A preferably consists of a winding 10 hereinafter referred to as the line winding, ener-

gized by the impulse, sent over the line in a manner well known in the art, and as will be briefly described hereinafter, a winding 11 tending to oppose the effect of the winding 10, and a core 12 on which the windings 10 and 11 are preferably wound. The line winding 10 as well as the other similar windings 20, 30, 40, 50 and 60, no matter how many are used, all simultaneously receive from the line the characteristic impulse which may be of greater or lesser predetermined current value, and are wound about the substantially parallel legs of the generally U-shaped core 12. The winding 11, as illustrated, is preferably wound about the continuation or cross bar 13 of the core 12 of the winding 10 and as shown is in spaced relation to and with its axis at right angles to the axis of the windings 10 to minimize possibility of magnetic induction, but regardless of its position is so designed and arranged as to oppose the magnetic effect induced by the winding 10, in a manner which will be obvious to those skilled in the art. It thereby becomes possible to so energize the windings 10 and 11 that there is no resulting magnetic field to attract the armature 14. In other words, the magnetic force of the magnet A may be balanced, neutralized or counteracted to reduce the intensity of the field of the magnet to zero, provided that the proper current values are supplied to said windings simultaneously.

Toward this end, the winding 11 receives its energy from a suitable source of power, such as the field or home battery 4 preferably though not necessarily through the intermediary of the rheostat, or resistance 15, so that said winding 11 is constantly energized to exert a magnetic force on the armature equal but opposite in polarity to that exerted on the armature by the line current impulses in the winding 10. Similarly, the windings 21, 31, 41, 51 and 61 through their respective resistances 25, 35, 45, 55 and 65 or through other suitable means are each energized with current of a predetermined value sufficient to induce a magnetic force upon the armature equal and opposite to that resulting from the various given current impulses which are sent over the line. It will therefore be seen that for any given impulse delivered over the line to the selecting magnets A, B, C, D, E and F, only one of said magnets will be neutralized or in other words, have the intensity of its field nullified to release the magnetic force exerted upon its coacting armature.

Since only one armature can be released in response to a given impulse, the particular armature to be operated is thereby selected. The transmitting or sending devices for sending over the line impulses of different current strengths comprises briefly, the conductor 90 connected to the line and to the sending keys A′, B′, C′, D′, E′, and F′, through the intermediary of the respective resistances 17, 27, 37, 47, 57, and 67, the resistance 17 being the greatest so as to send the smallest impulse and the resistance 67 being least to send the greatest impulse.

It will be understood that while I prefer to pivotally support the various armatures such as 14, they are otherwise free of all mechanical restraint except that exerted upon them by their selecting and auxiliary magnets. Any armature is therefore operative by its auxiliary magnet only when it is magnetically released by the neutralization of its selecting magnet so that the armatures tend to remain in the various positions into which they are moved. While all the armatures are biased towards their respective backstops 19, 29, 39, 49, 59 and 69, owing to the constant energization of the windings 11, 21, 31, 41, 51 and 61, the selecting armature, even though released by the neutralization of the magnetic field in which it is located, remains biased towards its selecting magnet, and does not move, unless it is positively moved by suitable means. While it is customary in magnetic armatures to use springs or other similar mechanism for the purpose of operating the armature after it has been released by its magnet, I prefer to avoid the use of springs for that purpose, since, as will be explained hereinafter, the values of the magnetic forces acting on more than one armature may momentarily be reduced to zero and thereby give the spring the opportunity to operate the wrong armature.

If a current impulse of high value is sent over the line, one of the line windings as 10 will develop a field of greater intensity than that developed by the field winding 11, which is constantly energized to induce a magnetic field of lower intensity than those induced by the corresponding field windings 21, 31, 41, 51 and 61. It will be seen that before the impulse is received by the winding 10, the intensity of the field is entirely dependent on the winding 11. On the reception by the winding 10 of the impulse of comparatively high current value, the intensity of the resulting field is first reduced, due to the force induced by the winding 11 being first overcome on the building up of the magnetic force of the winding 10, and for a very small, though hardly appreciable instant of time may be precisely neutralized or reduced to zero, after which the magnetic force, due to the impulse, will reach its full strength of opposite polarity to that exerted by the magnet A when the winding 10 is deenergized, and will again be operative to attract the armature. That is, the instantaneous values of the magnetic forces operating upon more than one armature may become zero in response to a marginal impulse of greater than the lowest predetermined value.

If springs or similar mechanical devices were used, it might be possible that during

the moment in which the intensity of the magnetic field is reduced to zero, the spring would act to move the armature 14 away from the selecting magnet and thereby causing momentary operation of the wrong instrumentality, which it was not intended to select. I provide against this contingency by the use of a series of auxiliary magnets such as 16, 26, 36, 46, 56 and 66, each preferably arranged on the other side of the respective armatures 14, 24, 34, 44, 54 and 64, and each designed to act after the various magnetic fields have reached their respective final intensities. The various auxiliary magnets 16, 26, 36, 46, 56 and 66 are shown connected in series and receive energy from a suitable source of power such as the battery 8, but said magnets may just as well be connected in parallel or in series parallel if desired.

The auxiliary magnets have the further advantage over springs or similar mechanical devices and over gravity operation of the armatures in that the only forces acting upon the armatures are magnetic forces induced in the selecting magnets or in the auxiliary magnets. These forces act upon the selected armature alternately and at different times in a manner impossible with springs which must oppose operation by one set of magnets. If there should be any period when neither the auxiliary nor the selecting magnets are acting upon the armatures, the armatures are free of all forces and it therefore requires but a comparatively small magnetic force to move them in either direction, the armatures remaining or being maintained by inertia in the positions in which they are positively moved by the magnetic forces thereon. It therefore becomes possible to move the selected armature into its initial biased position immediately after its release by the auxiliary magnet after the termination of the impulse since the selecting magnets operate instantaneously owing to their constant energization after the termination of the impulse, and no time is lost as would be the case if the force of the selecting magnets were opposed by a spring or by gravity. It will therefore be seen that my device is possessed of high sensitivity and that the clearing operation can be carried out at high speeds and much greater speed than is possible if springs or gravity were to oppose the movement of the selected armature toward the selecting magnet therefor.

To retard the action of said auxiliary magnets as above described, a suitable relay as 6 is arranged in the line, preferably in advance of the selecting magnets. The relay operates upon its armature 7 to close the normally open circuit in the battery line 5 when an impulse is sent over the line. It will be seen that owing to the time element involved in the movement of the relay armature 7 against the action of its spring to close the circuit to the auxiliary magnets, the auxiliary magnets are energized somewhat later than the selecting magnets. It follows that when the instantaneous value of the magnetic forces exerted by any of the magnets A, B, C, D, E and F upon their armatures becomes zero, the auxiliary magnets have not yet been energized. Until the intensity of the magnetic field in which the selected armature is arranged, reaches its limit of intensity or final intensity resulting from the combination of impulse and the home or field current, said armature is not acted upon by its auxiliary magnet. To further assure this result, the auxiliary magnets 16, 26, 36, 46, 56 and 66 are so energized as to create a magnetic field of less intensity than the limiting, or minimum final intensity of any of the fields produced by any of the magnets A, B, C, D, E and F at any time. In other words, the operation of a selected armature by the auxiliary magnets is independent of the instantaneous or intermediate values of the magnetic forces operating upon the armatures, but dependent only on the final values thereof. Operation of the selected armature by its auxiliary magnet closes the circuit to an instrumentality such as *a* of any desired type, such as for instance, a given printing character of a printing telegraph.

It will be understood that when the line impulse ceases, the relay 6 releases the armature 7, thereby cutting off the current received by the auxiliary magnets from the battery 8, and allowing the selecting magnet to draw its armature back against its backstop ready for the reception of another impulse and the selection and operation of another instrumentality.

The various circuits will now be described.

As has been heretofore explained, the various line windings 10, 20, 30, 40, 50 and 60 are connected in parallel to the line as by means of the conductors 70 and 71, the former conductor being connected to one end of each of the line windings and the latter conductor 71 being connected to the other ends of each of the line windings and grounded as at 72. The relay magnet 6 is also connected in parallel to the line as by means of the conductors 73 and 74 so as to become energized simultaneously with the energization of the line windings 10, 20, 30, 40, 50 and 60 by an impulse sent over the line.

The field windings 11, 21, 31, 41, 51 and 61 are connected in parallel with the field or home circuit energized by the battery 4 through the conductors 75 and 76. The conductor 75 is connected to one end of each of the field windings and leads to one side of the battery 4 while the conductor 76 is connected to the other end of each of the field windings and leads to the other side of said battery.

The auxiliary magnets 16, 26, 36, 46, 56 and

66 are energized by the battery 8 through the conductors 77 and 78 and as illustrated, are connected in series to the conductor 78 through the conductors 79, 80, 81, 82, and 83, which are each connected to a terminal of each of the adjacent magnets. The conductor 78 is connected to a suitable terminal on the relay armature 7 and thence through the armature 7 and the line 5, leads to one side of the battery while the conductor 77 leads to the other side of said battery. The circuit is normally opened by the relay armature 7 but is closed when the relay 6 is energized by the impulse sent over the line.

As has been explained, said magnets are energized later than the line windings 10 due to the fact that the operation of the armature 7 of the relay is not instantaneous. As has been heretofore pointed out, the auxiliary magnets, instead of being connected in series as shown, may just as well be connected in parallel to the conductors 77 and 78 or in series parallel, if desired.

The selecting instruments *a*, *b*, *c*, *d*, *e* and *f* indicated diagrammatically, may be of any type such as the printing characters of a printing telegraph and are energized by a suitable battery such as the battery 3 through the conductors 80 and 81 to which they are connected. The circuit to the selecting instruments is normally open due to the normal bias of the armatures 14, 24, 34, 44, 54 and 64 toward the field windings, said armatures normally resting under the influence of the field windings against their respective back-stops 19, 29, 39, 49, 59 and 69. On the neutralization of the proper selecting magnets A, B, C, D, E and F the selected armature is released and is then moved by its auxiliary magnet to close the circuit to the selected instrument *a*, *b*, *c*, *d*, *e* or *f*.

It will be seen that I have devised simple and efficient mechanism capable of a wide range of selection for operating any one of any number of instrumentalities with certainty, that by reason of my invention, it becomes impossible to operate the wrong instrumentality and that I have devised a system well adapted to meet the severe requirements of practical use. I do not wish to be understood as limiting myself to the use of my system for printing telegraphs only, as said system has many other uses, and I further do not wish to be understood as limiting myself to the specific structure and arrangement herein shown and described in detail since I intend to claim my invention as broadly as may be permitted by the state of the prior art and the terms of the appended claims.

I claim:

1. In an electrical system in which any one of any number of selecting devices is responsive to a single impulse of given current value delivered thereto over a single wire, and the other devices are each responsive respectively to impulses of different current value, a series of selecting magnets receiving said impulses, means for neutralizing the magnetic field of only one of said magnets by said impulse, an armature for each of said magnets normally biased toward its selecting magnet, a series of auxiliary magnets each arranged to operate upon one of said armatures, and means responsive to the impulse for energizing said auxiliary magnets for operating the armature of the neutralized magnet only.

2. In a one-wire line electrical selecting system, a series of electro-magnets, each provided with a line winding and a field winding, means for energizing the field winding of each of said magnets with current of different predetermined value from that of the field windings of the other magnets, the line winding of each magnet being energized by a single impulse sent over the line of such current value as to cause the magnetic field of only a single magnet to be nullified by a given impulse, an armature for each magnet, a set of auxiliary magnets each arranged to operate upon one of the armatures, and a relay in the line operative to close a circuit to the auxiliary magnets in response to the impulse.

3. In a marginal selecting system of the character described, a series of armatures subjected only to magnetic forces, electro-magnets each provided with line and field windings, and normally maintaining the armatures in inoperative position and biased toward the magnet, means for supplying current of predetermined current value to the field winding of each of said magnets to cause each of said field windings to exert a magnetic force differing in intensity from that of the others, means for connecting the line winding of each magnet to the line for delivery thereto of an impulse of predetermined current value sufficient to exert a magnetic force equal to that produced by the corresponding field winding but opposite in direction, for rendering only one of said magnets inoperative in response to the impulse, whereby a selected armature only is magnetically released by that magnet so rendered inoperative, electromagnetic means for moving the armature so released after its release, and means responsive to the impulse for energizing the electromagnetic means after the forces exerted by all of said magnets excepting that rendered inoperative have become greater than zero, and greater than the forces exerted by the energized electromagnetic means.

4. In a marginal selecting system of the character described, a series of armatures, means for normally attracting each of said armatures, means for neutralizing the magnetic force acting on one of said armatures on the delivery to said neutralizing means

of a given current impulse of given current value sent over the line, including means for receiving current impulses of predetermined current value from the line, and means for supplying to said current receiving means, current of the proper value to finally neutralize the magnetic effect of the armature attracting means, and electromagnetic means responsive to the impulse for attracting that armature, the magnetic field of which has been finally neutralized.

5. A marginal selecting system, receiving single selecting impulses of different respective predetermined current values from a one-wire line, comprising a series of switch members, movable from normal and inoperative position to circuit closing position, a series of electro-magnets each arranged to move a selected one of said switch members and each having a magnetic circuit, and a line winding therefor energized by said impulses, and having a field winding energized by a field current of the proper predetermined value to oppose the magnetic forces set up in each of said electro-magnets by said line winding, and thereby reducing the final magnetic force of only a selected one of said electro-magnets substantially to zero in response to a given impulse received by said line windings, and releasing the magnetic force exerted on one of said switch members, means for magnetically operating the released switch member to move it to circuit closing position in response to said impulse, independently of the instanteous values of the magnetic forces operating upon the remaining switch members, and means for pivotally supporting said switch members for the movement mentioned, said switch members being otherwise free of mechanical restraint.

6. A marginal selecting device for an electrical system wherein selecting impulses of predetermined different current values are received singly by the device from a single line, comprising a series of switch members biased to one position and free of forces other than magnetic tending to change the positions thereof, electro-magnetic means, including line windings energized by said impulses, and field windings energized to produce an opposite magnetic effect, for retaining the bias of all but the selected one of said switch members and finally neutralizing the bias of and magnetically releasing said selected switch member in response to the impulse, electromagnetic means for moving only the switch member so selected, independently of the instantaneous values of the magnetic forces operating upon the remaining switch members, and means for energizing said last-mentioned means in response to the impulse only.

7. In a marginal selecting system of the character described, a series of movable circuit closing members pivotally mounted free of mechanical restraint, a series of electro-magnetic elements, each having a line winding receiving one marginal impulse of predetermined current value at a time from the line, and each having a second winding energized by a current of predetermined current value to exert a magnetic force upon one of said members equal and opposite to that exerted by the line winding under the influence of a given impulse, and a magnet for each of said circuit closing members, responsive to the marginal impulse for moving only a selected one of said circuit closing members to circuit closing position when both windings of the electro-magnetic elements acting upon the selected member have been energized to finally neutralize each other, said magnet operating independently of the instantaneous values of the magnetic forces exerted on the remaining elements, and means responsive to the impulse for energizing said magnets after said windings have been neutralized, said magnets and said elements acting at different but closely spaced times in response to the impulse, and the forces exerted thereby being unopposed except by the inertia of the selected member.

8. In a marginal selecting system, a series of circuit closing members, magnetic means adapted to have the magnetic effect thereof finally neutralized for freeing one of said members in response to a given impulse of given current value received by said means, electro-magnetic means for operating the freed member to close a selected circuit independently of the instantaneous values of the magnetic forces exerted on the remaining members, and a circuit for energizing said electro-magnetic means in response to the impulse and after the impulse has had its full effect on the first-mentioned magnetic means including a normally opened relay in the circuit adapted to close the circuit on the reception by the relay of the impulse.

9. In a marginal selecting system of the character described, a series of circuit-closing armatures, electromagnetic means for attracting said armatures to move them in one direction, electro-magnetic means energized by an impulse of given current value delivered thereto for freeing a given armature of the attraction of said attracting means and of all forces acting thereon in response to a given impulse, and operative at a different time to free any selected one of the other armatures respectively in response respectively to other single given impulses of different current value, and electromagnetic means responsive to the impulse for moving the selected armature in the other direction immediately after it has been freed.

10. In a marginal selecting system of the character described, a series of armatures normally biased to circuit opening position, means for magnetically releasing any one of said armatures in response to respective im-

pulses of different current value delivered to said means, and a series of magnets each acting on one of the armatures for moving only the released armature to close a circuit, each of said magnets exerting a magnetic force upon its respective armature in response to the given impulse, said force being of less intensity than the final strength of the minimum magnetic force acting on any but the selected armature at any time.

11. In a marginal selecting system of the character described, a series of armatures, normally magnetically biased to circuit opening position, and acted upon by magnetic forces only, a series of instrumentalities to be operated, means for freeing different selected armatures of the bias thereof in response respectively, to impulses of different current value delivered to said means, and magnetic means responsive to the impulse for moving the selected freed armature to close a circuit to a given instrumentality, said magnetic means operating only after the magnetic forces on all but the freed armature have reached their maximum value and for releasing the the freed armature to become unopposedly biased into its initial position immediately on the termination of the impulse.

12. In a marginal selecting system of the character described, a series of pivoted circuit closing members, otherwise free of mechanical restraint and magnetically biased to circuit opening position, means responsive to an impulse of given current value for freeing any number of the bias thereof by the neutralization of the magnetic force acting on the selected member, including magnetic means exerting predetermined magnetic forces on one side of said members and magnetic means energized by impulses of predetermined value sufficient to produce a final magnetic force of such intensity and direction as to precisely balance the effect of said predetermined magnetic means with respect to only a selected one of said members, magnetic means on the other side of said members for moving the selected member to circuit closing position, responsive to the impulse and inoperative to move any unselected member irrespective of the intermediate value of the magnetic forces acting on the unselected members, and releasing the selected member immediately on the termination of the impulse to permit said member to be unopposedly biased to its initial position, and a relay responsive to the impulse for energizing the last-mentioned magnetic means only after the final values of the magnetic forces on all but the selected members have been reached to create a magnetic field of less intensity than the minimum of said final values, said members being maintained by inertia in the positions into which they are moved until subjected to magnetic force.

13. The method of selecting a device to be operated from a number of such devices in a marginal selecting system wherein selecting impulses of different current values are received singly by the devices from a single line comprising subjecting the devices to electromagnetic force only, the force acting on any of the devices being of different intensity from the force acting on any other of the devices, neutralizing the electromagnetic force acting on the device to be selected in response to an impulse to free the device from all force including the electromagnetic force, then by means of the impulse exerting, electromagnetic force on the device to be selected in the opposite direction to operate the device in response to said impulse and only after the device has been completely released by the neutralization step mentioned, and again releasing the device after its operation immediately on the termination of the impulse to subject it to the original electromagnetic force to again free it for movement back to its initial position under the influence of electromagnetic force only unopposed by any other force.

14. In a marginal selecting system, a series of movable circuit-closing pivoted members otherwise free of mechanical restraint, means for normally exerting magnetic force upon said members, means for neutralizing the force exerted upon any selected member in response to a given impulse, delivered to said neutralizing means, electromagnets arranged adjacent said members for moving the selected member, and means for energizing said electromagnets in response to the impulse to create a magnetic field of less intensity than the minimum final intensity exerted by said first-mentioned means in response to the impulse.

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