

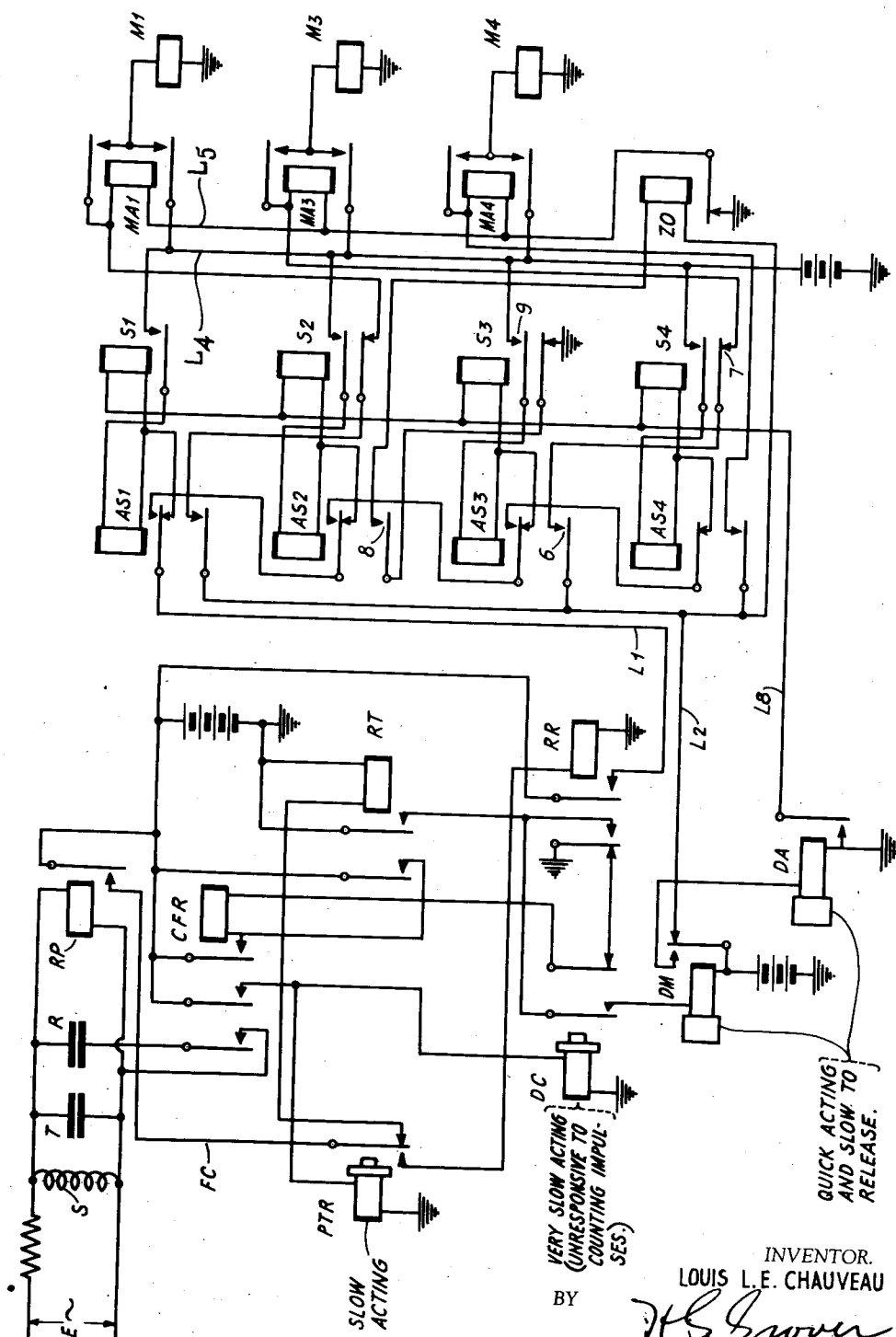
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REMOTE SELECTIVE CONTROL SYSTEM

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REMOTE SELECTIVE CONTROL SYSTEM

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The present invention is concerned with a system of remote selective control by wire or by radio predicated upon the employment of a selector of the stepping type known from automatic or machine telephony, the control of the said selector being particularly insured in such a way that the mechanism is safeguarded from interference or jamming actions either intentional or inadvertent.

10 The general practice in the art of remotely controlled selectors is to control or actuate such a selector device by the intermediary of trains of impulses, each such train comprising one or several impulses, and causing the selector to move forward a number of steps corresponding to the number of impulses that have come in. The signals thus have the form of a certain number of impulses which are separated by spaces.

As a general rule, with a view to avoiding jamming or interference actions in a system of the said sort, the impulses are made of a certain special characteristic. For instance, in the case of radio-telemechanics, independently of the wave length on which the signals have been sent out, these signals are modulated by one or several frequencies (either RF or AF), the receiver being furnished with suitable resonators designed so as not to allow of the transmission or passage of signals except those that have been suitably modulated.

30 The chief characteristic feature of the system forming the object of this invention consists in controlling and actuating the selector by the agency of trains of impulses of a predetermined form, these impulses consisting of signals of another special kind separated by spaces, the latter, in turn, consisting of signals of a predetermined sort being dissimilar from the former; and in using at the receiving end arrangements of such a nature that after reception of a signal of the first kind, the receiver is caused to assume automatically a position that is suited for the reception of a signal of the second kind, and so forth.

Another chief characteristic of the invention consists of causing variations in the kind of the impulses and the spaces after each impulse of one and the same train, in other words, in proportion to the feed or forward motion of the selector, and in equipping the selector with means of such a nature that the receiver will be made to automatically change, in the desired order and sequence, to the particular position that corresponds to the reception of the impulse or the space to follow after the last signal that had come in.

My invention will now be described in detail, reference being had to the accompanying drawing, the sole figure of which shows diagrammatically the circuits for a preferred embodiment.

For the sake of simplifying explanations the supposition will be made that the receiver consists of a circuit tuned to a definite frequency; this circuit comprising the inductance coil S and the condenser T may also be tuned to another certain frequency if the condenser R is added. A relay RP connected across the terminals of the resonant circuit operates only when the signals coming in at E have a frequency corresponding to the tuning of the circuit, the said relay RP then closing its contact I.

The system herein described is designed to be operated by signals sent out by conventional call apparatus. These signals, however, are preferably characterized by different frequencies for spacing and marking pulses. In a train of impulses each marking frequency is followed by a spacing frequency.

The frequency sent out at the time of impulsing is the same to which the circuit ST has been tuned and adjusted; this frequency will hereinafter be called the working or marking frequency T. The frequency sent out during spacing intervals or periods at the termination of the train is the frequency to which the circuit STR has been tuned, and this spacing frequency will hereinafter be called frequency R.

The operating assembly of the selector comprises: A relay RT which is rendered operative by action of the frequency T and driving the relay CFR.

A relay CFR changing the frequency, cutting in circuit the condenser R and driving the relays PTR and DC.

A relay RR which is rendered operative by the frequency R, releasing CFR and driving the selector over line L1.

The operation of the time-lag relay PTR causes relay RT to de-energize and relay RR to operate.

A working relay DC involving a long time-lag releasing CFR.

A relay DM characterized as quick-acting and slow to release. This relay operates under control of relay DC and has for its purpose to render operative a working relay at the end of a selecting operation.

A relay DA, also characterized as quick-acting and slow to release. This relay puts the selector in readiness at the beginning of a train of impulses. At the end of such an impulse train it opens a relay operating circuit.

The selector shown is of the stepping type relay system. It comprises selector relays S1 to S4 associated with auxiliary relays AS1 to AS4 for causing step by step motion according to the number of current impulses transmitted over the line L1. This selector is merely shown by way of example, for it may be replaced by any other kind of stepping selector, either electromagnetic, motor driven, or the like.

The controlled means may be of any kind at all and they are indicated at M1, M3, M4. They are controlled by the agency of working relays MA1, MA3, MA4, the latter being subject to control actions from the selector.

A cut-off relay Zo corresponding to step 2 of the selector serves to de-energize the working relays and consequently also the driven means when signal No. 2 comes in. This position is evidently chosen merely for the sake of illustration, for it will be evident that relay Zo, according to requirements, could be operated by any other step of the selector.

The selector comprises only four steps by way of example, and it will be understood that the same could comprise any other number of steps according to the number of control actions to be performed; in other words, for instance, the selector could be of the multi-stage type with hundreds, tens, units, so as to allow of the selection of several hundreds. In that case recourse would be had to the conventional methods known from machine telephony associated with such special means as shall hereinafter be described.

Supposing that the device M3 is to be actuated, the impulse train coming in at E will be composed of three impulses of frequency T each followed by a space characterized by the transmission of frequency R.

Upon the first impulse (frequency T) RP and RT will be operated. RT feeds DM which in turn feeds DA. The line L2 is isolated, whereas line L3 is fed, and the selector is thus made ready.

At the same time RT feeds CFR, the latter is "held", cuts in the condenser R and feeds PTR and DC. When the condenser R is connected, the relay RP releases, for at that instant the impulse of frequency T is still proceeding and circuit STR responds to frequency R.

An instant later PTR which is working with time-lag cuts off RT and cuts in operation RR. The relay PTR is so adjusted that the length of its lag will be approximately the same as, or slightly greater than, the length of an impulse of frequency T. As a result the operation of relay RR is delayed until nearly the end of this impulse.

Following the first marking impulse a spacing pulse of frequency R is transmitted. At this time the circuit STR is adjusted to the spacing frequency. Relays RP and RR are caused to operate. Relay RR opens the circuit through relay CFR, releasing the same, and condenser R is thus cut out of circuit. The relays RP, RR and PTR are restored. The relay system is then prepared to receive a succeeding marking impulse of frequency T.

The cycle hereinbefore described recurs in the course of the second impulse of frequency T and the second space with frequency R; and it is repeated, of course, also upon the arrival of the third impulse and the third space.

The part played by the relay DC is explained as follows; this relay has a relatively long time lag in its operation in response to a marking signal and it is not responsive to marking impulses as brief as the ordinary counting impulses to be used.

The relays DM and DA have been working from the very first impulse; they are of the "slow-release" type, that is to say, after having been energized it is necessary that their feed be cut for a certain length of time in order that they may become de-energized. Now, in the course of the reception of the control signal, DM receives current either by RT or by RR and stays energized. The result is that DA also remains excited and feeds a negative potential to the selector by way of line L8.

In the course of the signal, during each space, RR puts an impulse upon the line L1 which controls the selector formed by the relays S1 to S4 and their associated relays AS1 to AS4. Three impulses are thus sent towards the selector, and they cause successive operation of the relays S1, AS1, S2, AS2, S3 and AS3. The first impulse across L1 excites S1 which closes the contact in the circuit of AS1. As soon as the impulse ceases S1 and AS1 become thus excited in series; S1 then holds in order that AS1 switches line A1 on the contact controlled by AS2 and disposed in the circuit of S2. The switching mechanism operates in a similar manner for the succeeding impulses.

At the end of the signals, relays RT and RR stay inoperative and unenergized; hence, at the end of a moment the relay DM releases, line L2 becomes alive and by way of the contacts 6 and 7 the working relay MA3 is energized. This relay is held at (+), line L5 being directly on (-). Relay MA3 through line L4 (+) supplies the driven element M3.

Immediately following the de-energization of DM, the relay DA is likewise rendered inoperative and separates the line L8, and this results in all of the relays of the selector being rendered inoperative. In fact, only MA3 and element M3 remain alive and energized.

The assembly is thus ready for another control action.

It will be seen that this system is adapted to render operative sequentially a plurality of elements such as indicated at M1, M3, and M4, and these stay in working state as long as no zero control action is received.

The zero or clearing control action is characterized by a train comprising two impulses which causes operation in the selector of the relays S1, AS1, S2, AS2. What results after this control action is that when on the line L2 a current is caused to flow, the relay Zo is made to operate and cut the line L5, and this restores the working relays MA to inoperation.

It will thus be seen that this arrangement allows of preparing an operation or action beforehand, to release it by a brief signal, to arrest it by a new signal of brief duration, and to repeat it at will. All that is necessary for that purpose is to provide between each one of these control actions time sufficient to restore to inaction the time-lag devices DM and DA and this happens generally in practice.

The restoration to inaction of the working relays MA is insured, as in the preceding case, by action of the relay Zo responsive to control action 2. It will also be noted that the assembly thus designed makes it feasible to control simultaneously a plurality of operations.

The action of the system will now be considered when subjected to an intentional or accidental jamming effect or interference.

(1) Continuous jam on frequency T in the absence of signalling: the relays RP, RT, DM, DA, and CFR operate, condenser R is cut in circuit.

The tuned circuit is no longer influenced by jamming, the energized relays are successively caused to be restored to inactivity with the exception of CFR.

Now relay CFR controls relays PTR and DC. Relay DC is quick acting, but slow to release after it is de-energized. The opening of contacts of relay DC causes relays CFR, DC and PTR to be restored. If the jamming action persists, the cycle before described is repeated.

It will thus be seen that continued jamming on frequency T will leave the selector unresponsive. To prevent the action of DC from vitiating or disturbing correct signal reception, DC may be given a sufficient time-lag so that it will not open its contact for a length of time equal to the duration of an impulse T followed by a space of frequency R.

(2) Continued jamming on frequency R in the absence of signals. This jamming will produce no effect since the input resonant circuit is tuned to frequency T.

(3) Jamming on frequency T prior to and during signaling. Before the signal, the situation is the same as in case (1), and if, at the instant of the first impulse of frequency T, DC has not opened its contacts, this first impulse falls together with the jamming and will be ineffective, for the resonant circuit will then be tuned to the frequency R. But during the first space this frequency R is transmitted, and this becomes causative of the operation of the relays RP and RR. The selector receives the first impulse. At the same time, however, relay CFR releases and the resonant circuit becomes tuned to the frequency T. As this wave is sent out from the jamming source, relays RP and RR stay energized. But at the instant when relay PTR is released relay RT is energized in lieu of relay RR. Relay CFR operates and the resonant circuit is again tuned to the frequency R. Relays RP and RT become de-energized at an instant corresponding practically to the transmission of the second impulse of frequency T. The relay PTR pulls up only an instant after the action of relay CFR due to its time-lag so that nothing happens as a result of the transmission of frequency T which occurs together with the jamming; but upon the transmission of the second space signal by frequency R, relay RR becomes energized so as to render the selector responsive to an ensuing impulse.

(4) Jamming on frequency R prior to and during a signal. Before the signal, conditions are the same as in case (2). During the signal, upon the first impulse on frequency T, the relays RP, RT and CFR operate, the resonant circuit becomes tuned to frequency R, this being the wave sent out from the jamming station, RP and RT stay energized. However, an instant after the actuation of CFR, relay PTR is operated. The latter is adjusted so as to act only after expiration of a delay interval equal to, or slightly greater than, the duration of an impulse on frequency T. Thus relay RR will become subject to the control of relay RP only at the instant when the space frequency R is transmitted. The relay RR releases relay CFR; the resonant circuit is tuned again to frequency T; relay RP is restored, and relay RT is then prepared for response only to a second impulse of frequency T.

It will be seen from the preceding description of the invention that the system is insensitive or non-responsive to intentional or accidental jamming sent out on one of the frequencies, either during space periods or during control-action

periods. In fact, jamming in this latter instance merely means an extension of the time of action of the relays RT or RR.

If the jamming persists after a signal it will likewise be without effect, for if it is of frequency T it will not act upon RR, and if of form R, it merely will cause extension of the end of the signal at the moment when the resonant circuit becomes tuned to frequency T.

The only disturbing jam would be the one resulting from a continued and simultaneous transmission of the two frequencies T and R. But in this case the selector works step by step as far as its last step, and all that is then necessary is that this last step should not cause any working actions in order that the jamming may not conduce to an undesired control action.

The above description has been given merely by way of example, and it will be evident that the different parts described may be employed combinedly or separately in whole or in part.

The step-type selector could consist of any desired kind of automatic switch, a relay selector, electromagnetic selector, motor selector, and the like.

Each of the elementary signals (impulse or space) making up the control-action sequence or train may be characterized by one or several frequencies, either RF or AF, or else by any other measurable phenomenon or physical action such as duration, phase, power, etc.

The arrangements here disclosed may be used not only in connection with systems predicated for their practical operation on trains of impulses of the kind utilized in automatic telephone work, but also with system controlled by code signals of the Baudot, Morse, or similar kind.

The input relay or relays RP may be of any desired sort, provided that they satisfy the conditions laid down in this specification. The invention is useful in all kinds of remote-control or tele-mechanical schemes worked over a wire or by radio.

The scope of the invention is such that the signaling code to be employed may be widely varied in its characterization. That is to say, the impulses and the spaces between impulses may be differentiated, for example, by the use of different frequencies as disclosed in this application, or by other means known in the art.

I claim:

1. In a selective signaling and impulse counting system, a signal responsive means including a resonant circuit normally tuned to a marking signal frequency and at times tunable to a spacing signal frequency, means operable after the reception of a marking signal of predetermined duration while said responsive means is adjusted to its normal tuning condition for shifting the frequency response thereof, means operable after the reception of a spacing signal of predetermined duration while said responsive means is adjusted to the spacing signal frequency for restoring said responsive means to its normal tuning condition, and means including a plurality of individually responsive electro-magnetic units each selectively actuable by the signal responsive means in cooperation with the other said means, for counting the number of recurrences of marking and spacing signals of predetermined duration.

2. Controlling apparatus including a system of counting relays and means for successively operating said counting relays including a receiver-circuit responsive to signals of different predetermined frequency and duration characteristics

by which so-called "marking" and "spacing" impulses are distinguished, relay means for shifting the response of said receiver-circuit to accept a spacing impulse following a marking impulse, and vice versa provided marking and spacing impulses are alternately received at a predetermined cadence, and means for disabling the system of counting relays and for restoring said controlling apparatus to its initial condition for accepting a marking impulse, the last said means being operable upon reception of an impulse of excessively long duration.

3. In a selective system responsive to signals composed of current impulses of two different predetermined characteristics, a receiver-circuit adjustable alternatively to either of two resonant conditions, a relay in the receiver-circuit responsive to impulses of either characteristic, a plurality of ordinally numbered relays of which the first and second are alternatively operable by the receiver-circuit relay, the third relay is operable by the first and is self-locking and constitutes means for shifting the receiver-circuit resonance adjustment from a normal to an alternative condition, the fourth relay is slow acting in response to the actuation of the third relay, and constitutes

means for switching the control by the receiver-circuit relay from the first to the second relay, the fifth relay is very slow acting under control of the third relay and constitutes means for unlocking said third relay after receipt of a succession of impulses of both characteristics, the sixth relay is operable by the first, provided the fifth relay is not in the actuated position, and the seventh relay is operable by the sixth, and selective means operable to count the number of impulses of predetermined duration to which said second relay is responsive while the seventh relay remains energized.

4. A system in accordance with claim 3 and having means operable by said second relay for unlocking the third relay.

5. A system in accordance with claim 3 and further characterized in that the time constants of the different relays are suitably adjusted for enabling said second relay to be intermittently actuated only in response to alternate actuations of the receiver-circuit relay and provided said alternate actuations synchronize with the cadence of the signals.

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