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RELAY CHAINS COMPRISING MAGNETIC COUNTING OR STORING RELAYS

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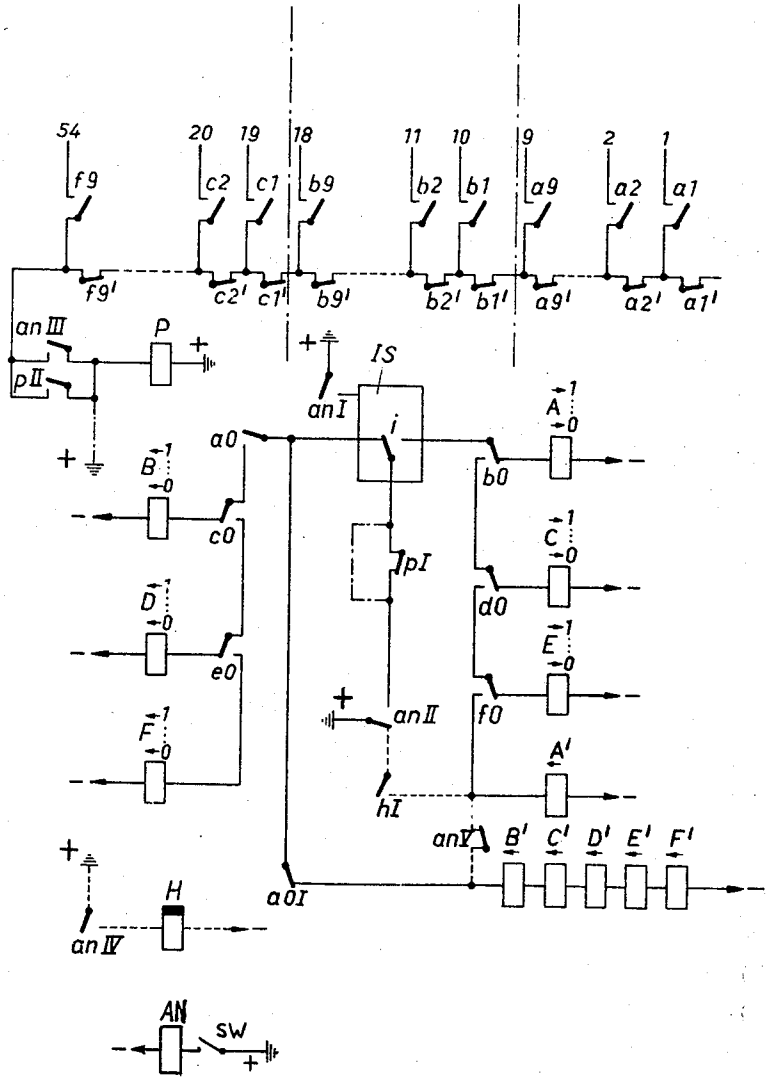

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RELAY CHAINS COMPRISING MAGNETIC COUNTING OR STORING RELAYS

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This invention relates to impulse counting systems and more particularly to a counting chain made up of a plurality of electromagnetic impulse counting devices of the type having multiple armatures associated with a common energizing system and separate contact means associated with each armature. The invention is particularly directed to an arrangement whereby a plurality of electromagnetic devices of the type above-mentioned operate in succession to count more than the number of impulses which is the limit of each.

The type of counting device utilized may be of the type for instance disclosed in the copending application of U. Hubner, filed June 23, 1954, bearing Serial No. 438,713 and entitled "Electromagnetic Impulse Counter," or similar to reissue Patent No. 23,089 to Bellamy.

Relay counting chains are known and serve as test distributors, test selectors, or key senders, etc. in communications applications and are either controlled by impulses or when started, continue their progress automatically. In the normal system, a separate distributor is required to switch successive counters into circuit. This invention eliminates the necessity for any distributing means. Accordingly, it is an object of this invention to provide an impulse counting circuit utilizing a plurality of counting devices of the type above mentioned so interconnecting said devices that they are formed into a chain and operate in succession.

This invention permits the realization of a relay chain which is simple and which may serve as a test distributor or test selector having a large number of outlets.

The electromagnetic impulse counting device utilized in this invention is of the type having a plurality of armatures associated with a common energizing winding and the operation of the first armature of the device prepares the next succeeding armature for operation upon the receipt of the impulse. These devices are decadic and have a separate recycling or release windings which releases all of the armatures at the conclusion of the tenth impulse and movement of the tenth armature in response thereto.

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying schematic drawing.

In the drawing there are shown two groups of three relays A, C and E which will be called the odd numbered impulse counters and B, D and F which will be called the even numbered impulse counters.

The arrows shown above the relay windings indicate the direction of the flux in the energizing winding necessary to attract armatures **1** to **0** sequentially. The windings marked A' . . . F' represent the recycling or release windings associated with each of the impulse counters A . . . F and the arrow over the winding indicates the direction of the magnetic flux necessary to cause release of the associated counting device. There is

also shown an impulse sender IS which essentially consists of transfer contact *i* which has its movable contact connected to ground through break contact *p***1** which is associated with test relay P and the front contact of transfer contact set *an***2** associated with starting relay AN. At the top of the drawing there are a series of 54 lines numbered accordingly and which may represent subscriber test leads or leads in a telephone system and which are usually marked by a negative potential when free. Thus, in hunting for a free line, it is customary to scan a group of test leads and seize the first one which is marked with a negative potential. The series of lines **1** . . . **54** are each coupled to a make contact *a***1** . . . *f***9** and which contacts are associated with the several armatures of the counting devices A . . . F. The break contacts *a***1'** . . . *f***9'** are also associated with the several devices A . . . F. The relay H is a slow release relay and its purpose will be explained later in connection with the description of the operation of the circuit.

The ultimate contact of each counting device (*a***0** . . . *f***0**) serves to transfer impulses from one device to the next in the chain upon the receipt of the tenth impulse to that device.

The operation of the circuit in response to impulses is as follows:

Starting relay AN is closed by a suitable means and which for the purposes of this description is shown as switch SW. Contact *an***1** completes a circuit to operate impulse sender IS and which impulse sender may be of a known form. Transfer contact *an***2** is now in its make position and completes a path from ground to the movable contact *i* of the impulse sender via normally closed contact *p***1**. When the impulse contact *i* moves to its right-hand position, a path for the energization and the operation of device A is completed via: +, *an***2** front *p***1**, *i* front, *b***0** back, winding A, —. Counting device A will respond to the next 9 impulses, pulling up a different one of its armatures upon the receipt of each impulse from impulse sender IS. Upon the receipt of the tenth impulse, contact *a***0** closes and prepares a path for the energization of the energizing winding of counting device B via: —, winding of device B, back contact *c***0**, *a***0** make, back contact of impulse sender IS. Thus, upon the next excursion of the movable contact *i* to its operating back contact, an energizing circuit for winding B, will be completed via: +, *an***2** front, *p***1** make, *i* back, *a***0** make, *c***0** back, energizing winding of device B, —. Upon each excursion of the movable contact *i* to its front contact, an impulse will be applied to the energizing winding of counter A, but since counter A has responded to the tenth impulse and all its armatures are attracted to its core, these further impulses will have no effect and will continually be applied until contact *b***0** changes its position, as will now be explained. Upon the receipt of the 19th impulse the contact *b***0** moves to its make position and completes a circuit for the energization of device C which operates in a similar manner to that described with respect to device B. The devices D, E and F operate sequentially upon receipt of the 27th to 35th impulse, 36th to 44th impulse, 45th to 54th impulse, respectively. Upon receipt of the 54th impulse, transfer contact *f***0** moves to its make position and completes a circuit for the energizing of the recycling or resetting winding A' via: negative, winding A', *f***0** front, *d***0** front, *b***0** front, through impulse sender contact *i* to positive via contacts *p***1** and *an***2** to positive. It will be readily seen that upon the next excursion of the transfer contacts *i* to its make position that the winding A' will be energized. The device A will thereby release and its contact *a***01** will close and prepare a circuit for the windings B' to F' which are serially connected therewith and which will be energized upon the next excursion of the

movable contact *i* to its left or back position. Assuming that it is desired to test lines **1** . . . **54** for an idle connection which as stated before is characterized by a negative potential at the end of the line and assume further that the first free line is line number **9**, upon closure of the starting relay AN, the impulse sender IS will cause counting device A to sequentially pull up its cooperating armatures until the armature *a***9** completes a circuit between line **9** and the bus interconnecting the break contacts *a***1′** . . . *f***9′**. A path is thereby created over contact *a***9**, break contact *b***1′** . . . *f***9′**, make contact *an***3**, winding of relay P, positive. The test relay P thereupon energizes and contact *p***1** breaks. It will now be seen that positive potential is removed from the movable contact *i* of the impulse sender and consequently the counting device A will move no further and will remain energized due to remnant magnetization. At the conclusion of the use of line **9**, the negative potential at the end thereof will be removed and relay P will deenergize. The pulse source is again thereby completed and the count may proceed as before.

Where the counting chain is to be used as a test distributor both relay P and contact *p***1** will be shorted and which short is indicated in the drawing by dot-dash lines. The chain is disconnected by deenergization of the starting relay AN through whose contact *an***2** the application of positive potential to the impulse sender controls the sequential operation of the several counting devices. Release of relay AN results in the energization of slow-release relay H via back contact *an*IV. The slow release relay H will maintain its contact *h***1** closed during the release time of relay AN and a path for the energization of the restoring windings of the counters would be completed via: plus, back transfer contact *an*/II, front contact *h***1**, restorting winding A′ and a parallel circuit via back contact *an*V and a series connection among the restoring windings B′ . . . F′, minus. However, should the starting relay AN not be deenergized during the release time of relay H, a circuit will be completed for the recycling coil A′, as first above traced. As explained before the release of device A will thereupon cause the energization by means of the contact *a***01** and the consequent release of counter B . . . F.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

I claim:

1. An electrical impulse counting circuit comprising a plurality of electromagnetic impulse counters, each being of the type having a common energizing winding, a common restoring winding, a series of multiple armatures associated with said windings and separate electrical contacts associated with each of said armatures, said armatures successively operated in response to successive pulses, respectively, said counters arranged in a chain of odd and even groups, a source of operating impulses, an energizing circuit for the energizing winding of the first counter in the odd group extending to said source over a back contact of the first counter in said even group, an energizing circuit for the energizing winding of the first counter in said even group extending to said source over a front contact of the first counter in said odd group and a back contact of the second counter in said odd group, each succeeding counter in each group having an energizing circuit which includes the closed ultimate contacts of all previously operated counters in the opposite group of the chain, and a restoring circuit for connecting the restoring winding of the first counter in one of said groups to said source, said restoring circuit including the ultimate contact of the ultimate counter in said chain.

2. An impulse counting circuit as claimed in claim 1, further comprising an additional restoring circuit for connecting the restoring windings of the balance of the counters in said chain, said additional restoring circuit under control of a restoring contact under control of the first counter in the odd group of said chain.

3. An impulse counting circuit as claimed in claim 2, wherein said additional restoring circuit comprises a series connection among said restoring contact and the restoring windings of the balance of the counters of said chain.

4. An impulse counting circuit as claimed in claim 2, further comprising a delayed release relay, switch means for controlling operation of said source of impulses, said restoring circuit comprising a series connection among the restoring winding of the first counter of said odd group and contacts under control of said delayed release relay and said switch means, respectively.

5. An impulse counting circuit as claimed in claim 1, further comprising a delayed release relay, switch means for controlling operation of said source of impulses, said additional restoring circuit comprising a series connection among the restoring windings of the balance of said counters, contacts under control of said switch means and said delayed release relay.

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