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A. A. C. DEGEN

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SELECTIVE CIRCUIT ARRANGEMENT

Filed Oct. 15, 1936

3 Sheets-Sheet 1

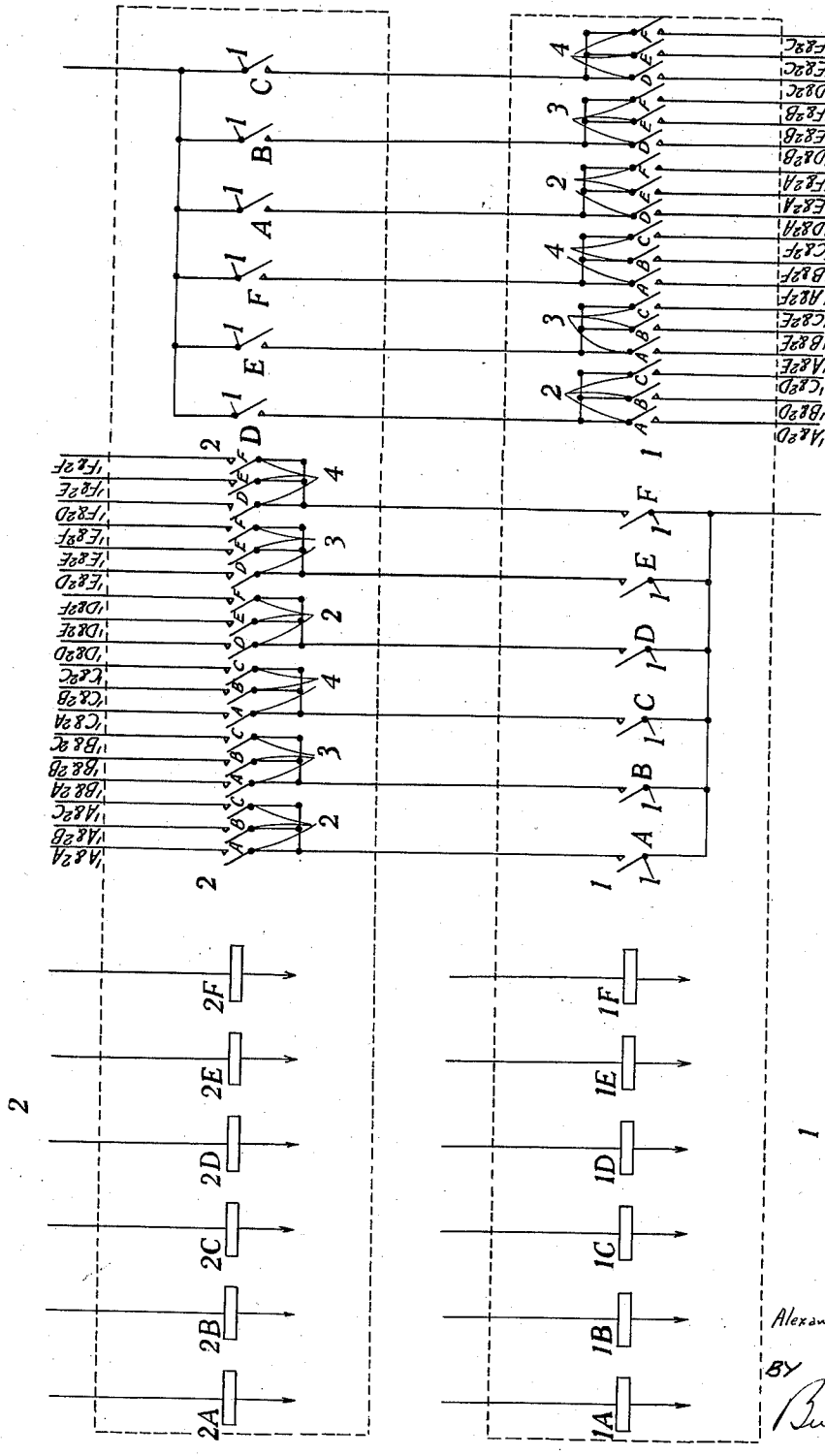


Fig. 1

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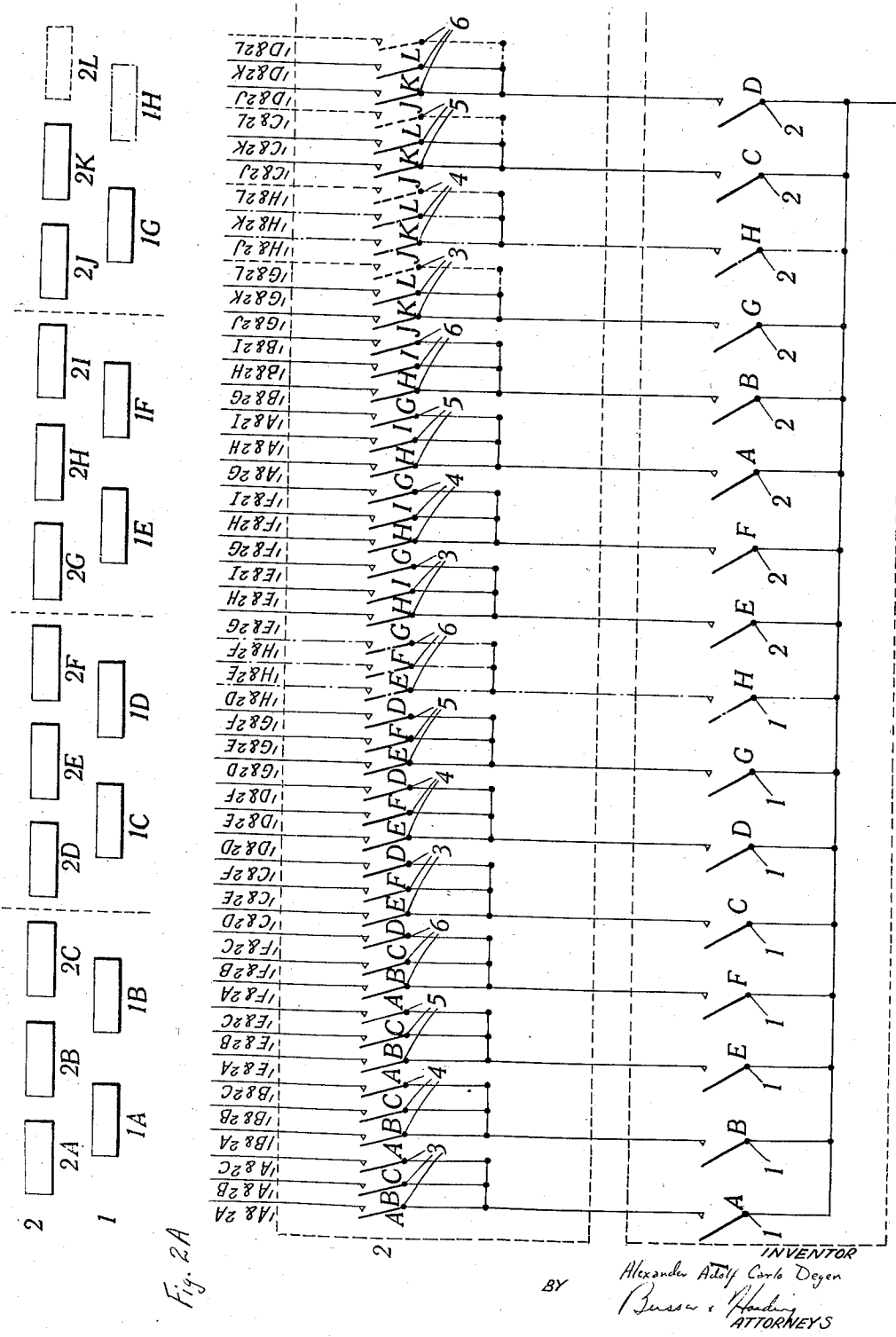
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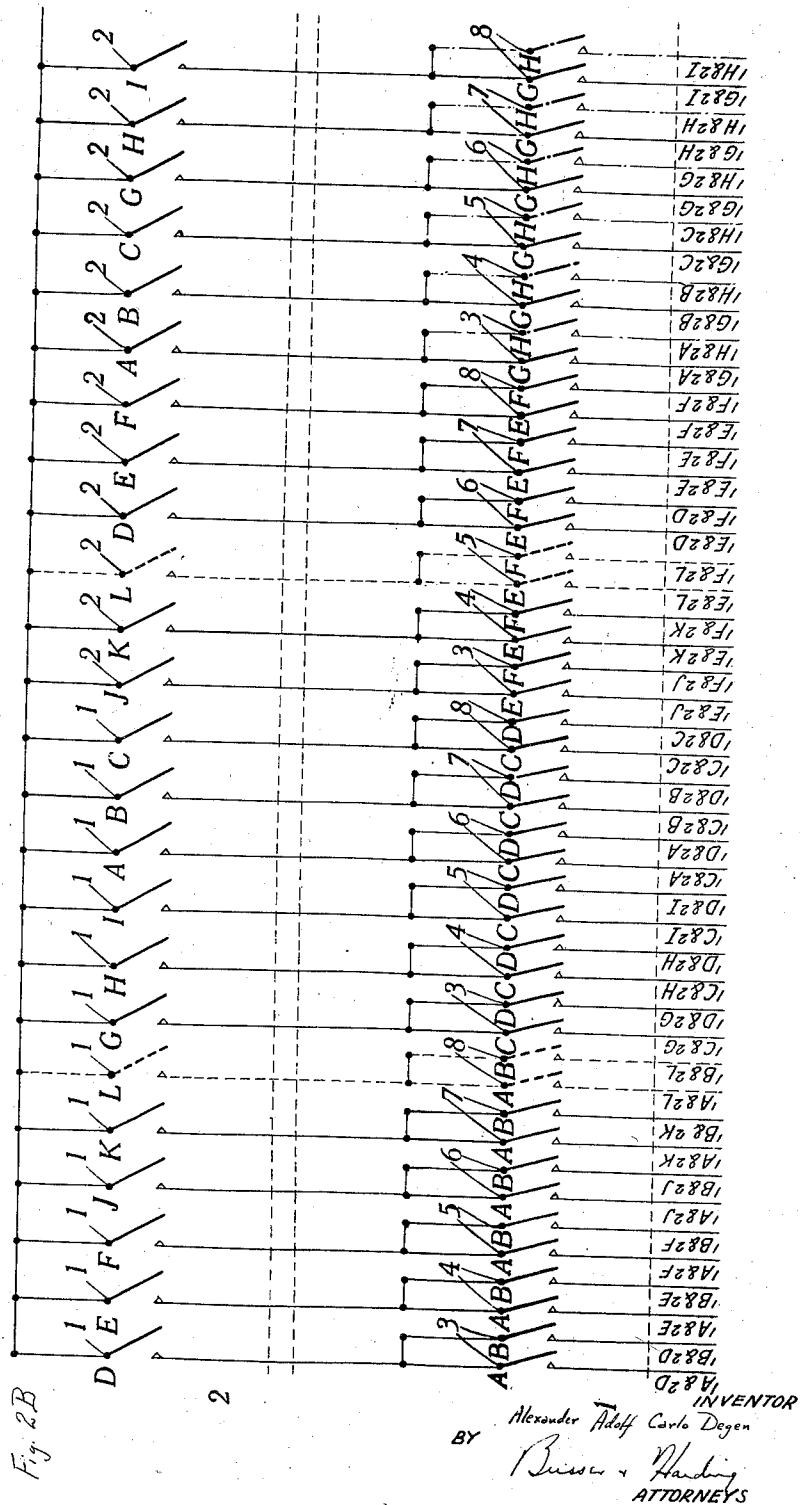
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UNITED STATES PATENT OFFICE

2,092,412

SELECTIVE CIRCUIT ARRANGEMENT

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5 Claims. (Cl. 177—353)

This invention relates to electrical circuit arrangements for totalizers or other apparatus having similar electrical circuits.

The object of the invention is to provide an improved circuit arrangement for totalizers or other apparatus having similar electrical circuits of the type comprising two groups of relays, the relays of which are operable in pairs, one relay of one group with one relay of the other group, to complete the circuit to a corresponding output channel by means of two contacts connected in series, one operated by one relay and the other by the other relay, for finally operating a selected numerator or other device.

Electrical circuit arrangements of this kind are known by which circuits can be completed for every combination of two relays, using one relay from one group and one relay from the other group. Such circuits have hitherto entailed certain disadvantages, the main disadvantages consisting in the employment of relays having different numbers of contacts and in the assembling of all the output circuits into a single group identified with one only of the groups of relays.

According to the present invention, there is provided a totalizer or similar apparatus of the type specified, wherein all the relays of the respective groups have the same number of contacts which is less than the number of relays in any one group, and the contacts of any relay of each group are so connected that one or each of several (but not all) of the said contacts is connected in series with a parallel arrangement of the contacts of a plurality of relays of the other group, and other contacts of the said relay are each connected in series with one of the contacts of an individual relay (other than one of the said plurality of relays) of the other group the contacts of any one relay of one group being connected only once to the contacts of any one relay of the other group.

Also, according to the invention, there is provided a totalizer or other similar apparatus of the type described comprising two groups of relays, each containing the same number of relays, characterized by the feature that each of the groups of relays is divided into the same number of equal sub-groups, which number is a term of an arithmetical progression the factor of which is two, and the contacts of the relays of the two groups are interconnected in such a manner that a contact of each relay of a sub-group of one group is connected in series with a parallel arrangement of the contacts of all the relays of a sub-group of the other group, the contacts of any

one relay of one group being connected only once to the contacts of any one relay of the other group, whereby a uniform number of contacts, less in number than the number of relays in a group, is employed in each relay and the output circuits controlled by the said relays are grouped into two groups having the same number of output circuits.

Further, according to the invention there is provided a totalizer or other similar apparatus of the type described comprising two groups of relays each containing an even number of relays, characterized by the circuit arrangement interconnecting the contacts of the relays of the two groups being such that the circuits controlled by the said relays are grouped into two similar groups, identified one with each group of relays and each containing the same number of output circuits.

Still further, according to the invention, if at least one of the groups of relays comprises an odd number of relays, the circuits controlled by the two relays are grouped into two groups identified one with each group of relays and one of which groups comprises only one more output circuit than the other group.

The above and further objects of the invention will be more clearly understood from the following specification read in conjunction with the accompanying drawings, in which:

Figure 1 is a diagram the top half of which illustrates the connections of the contacts of the relays of one group, and the bottom half illustrates the connections of the contacts of the relays of another group, there being six relays in each group; and

Figures 2A and 2B, taken together, illustrate similarly the wiring connections of the contacts of two groups of relays, one group containing twelve relays and the other group eight.

With reference to Fig. 1 of the drawings, there is illustrated therein an embodiment of the invention applied to an electrically operated totalizer for use on a greyhound racing track in which the maximum number of greyhounds which can be entered for one race is six. The embodiment of the invention described is applied to the wiring of the relays of the totalizer in such a manner that forecast or "double" bets may be recorded in respect of the winning greyhounds in any two races. To this end, one group of six relays 1A, 1B, 1C, 1D, 1E and 1F, each relay of which corresponds to an individual greyhound in one of the races, is so wired to a second group of six relays 2A, 2B, 2C, 2D, 2E and 2F, each relay of which corresponds

to an individual greyhound in the other race with which the first race is to be coupled, that an individual circuit to a selected numerator can be completed for every combination of two relays, using one relay from one group and one relay from the other group, thereby giving a selection out of thirty-six possible output circuits to be controlled.

The desired object is achieved by first dividing each of the relay groups 1 and 2 into two sub-groups comprising the same equal number of relays. Relay group 1 is therefore divided into two sub-groups, one of which contains the relays 1A, 1B, and 1C and the other of which contains the relays 1D, 1E, and 1F. Relay group 2 is likewise divided into two sub-groups, one of which contains the relays 2A, 2B and 2C and the other of which contains the relays 2D, 2E and 2F. The relays of the respective sub-groups are then connected to one another to produce the required total number of thirty-six output circuits in the following manner:

One half of the required connections is obtained by connecting contacts of each of the relays 1A, 1B and 1C of the first sub-group of relay group 1 with contacts of each of the relays 2A, 2B and 2C of the first sub-group of relay group 2 and by connecting contacts of each of the relays 1D, 1E and 1F of the second sub-group of relay group 1 with each of the relays 2D, 2E and 2F of the second sub-group of relay group 2.

This is effected by connecting a single contact of each of the relays 1A, 1B and 1C of the first sub-group of group 1 in series with a parallel arrangement of corresponding contacts of the relays 2A, 2B and 2C of the first sub-group of group 2. To this end, as shown in the drawings, contact 1 of relay 1A is connected in series with the contacts 2 of relays 2A, 2B and 2C, the said contacts 2 of the three relays being connected in parallel. In like manner contact 1 of relay 1B is connected in series with further contacts 3 of relays 2A, 2B and 2C, also connected in parallel, and contact 1 of relay 1C is connected in series with contacts 4 of relays 2A, 2B and 2C, likewise connected in parallel. This arrangement therefore produces nine output circuits (1A, 2A) . . . (1C, 2C) associated with the first sub-group of relay group 1.

In a similar manner a single contact of each of the relays 1D, 1E and 1F of the second sub-group of relay group 1 is connected in series with a parallel arrangement of corresponding contacts of all the relays of the second sub-group of relay group 2. To this end, as shown in the drawings, contact 1 of relay 1D is connected in series with contacts 2 of relays 2D, 2E and 2F of group 2, the said contacts 2 of the three relays being connected in parallel. Likewise, contact 1 of relay 1E is connected in series with further contacts 3 of relays 2D, 2E and 2F, also connected in parallel and contact 1 of relay 1F is connected in series with further contacts 4 of relays 2D, 2E and 2F likewise connected in parallel. This arrangement produces a further nine output circuits (1D, 2D) . . . (1F, 2F) which are identified with relays 1D, 1E and 1F of the second sub-group of relay group 1 and the total number of output circuits identified with relay group 1 is therefore eighteen and constitutes one half the total number of thirty-six output circuits which is required.

In order to complete the wiring of the system, it is necessary to wire contacts of relays 1A, 1B and 1C of the first sub-group of the relay group

1 with the contacts of relays 2D, 2E and 2F of the second sub-group of relay group 2 and to wire the contacts of relays 1D, 1E and 1F of the second sub-group of relay group 1 with those of relays 2A, 2B and 2C of the first sub-group of relay group 2.

This is effected by reversing the method of connection employed for the first part of the wiring above described and by connecting a contact of each of the relays 2D, 2E and 2F of the second sub-group of relay group 2 in series with a parallel arrangement of corresponding contacts of all the relays 1A, 1B and 1C of the first sub-group of relay group 1 and connecting a contact of each of relays 2A, 2B and 2C of the first sub-group of relay group 2 in series with a parallel arrangement of corresponding contacts of all the relays 1D, 1E and 1F of the second sub-group of relay group 1. To this end, as shown in the drawings, relay 2D of the second sub-group of relay group 2 has a single contact 1 connected in series with the contacts 2 of relays 1A, 1B and 1C of the first sub-group of relay group 1, the said contacts 2 of the three relays being connected in parallel. In like manner, relay 2E has a single contact 1 connected in series with further contacts 3 of relays 1A, 1B and 1C connected in parallel, and relay 2F has a single contact 1 connected in series with further contacts 4 of relays 1A, 1B and 1C, likewise connected in parallel. The relays 2A, 2B and 2C of the first sub-group of relay group 2 are connected in a similar manner to relays 1D, 1E and 1F of the second sub-group of relay group 1, each of the said relays 2A, 2B and 2C having a single contact 1 connected in series with contacts 2, 3 and 4 respectively of relays 1D, 1E and 1F of the second sub-group of relay group 1, and all the contacts 2 of the relays 1D, 1E and 1F being connected in parallel, all the contacts 3 of these relays being likewise connected in parallel and all the contacts 4 of these relays being connected in parallel.

By means of the above arrangement, there is provided a further eighteen output circuits (1A, 2D) . . . (1F, 2C) which are identified with the relays 2A, 2B, 2C, 2D, 2E and 2F of relay group 2 and which form a group of output circuits similar to that identified with the relays 1A, 1B, 1C, 1D, 1E and 1F of relay group 1 and which contains the same number of output circuits.

It will furthermore be observed that by connecting the contacts of the two groups of relays in the above manner, the required connections between the relays to produce the thirty-six individual output circuits, each of which can be controlled by the operation of a predetermined two of the relays, one from each group, have been achieved by employing only four contacts on each relay. Each relay has therefore the same number of operative contacts and the system in accordance with the invention provides for the use of a standard type of relay, i. e. one employing four contacts for a totalizer apparatus constructed for operation with a maximum number of six relays in each relay group. In addition, the output circuits to the numerators or other apparatus have been divided into two groups each containing the same number of circuits, thereby permitting the use of a standard multi-core cable for both groups of relays.

In the embodiment of the invention above described, the number of relays is the same in each group. Furthermore, each of the groups of re-

lays is subdivided into two equal sub-groups and the number of contacts required on each relay is equal to the number of relays contained in one sub-group, plus 1, the number of contacts in the embodiment described being equal to four. It will be understood however, that by increasing by similar amounts the number of relays in each group and dividing each group into two equal sub-groups, a uniform number of operative contacts will still be obtained on each relay, which number is equal to one-half the total number of relays provided in a group, plus 1. Thus, with two groups of relays, each containing eight relays, and divided into two sub-groups of four relays, by means of the connection in accordance with the invention each relay will be provided with five operative contacts. If ten relays are provided in each group, each relay will be provided with six operative contacts and so on.

By dividing each group of relays into two equal sub-groups only, a minimum uniform number of contacts will be provided on each relay. However, it will be appreciated that each group of relays may be divided into more than two sub-groups while still retaining the advantages of a standard type relay and a uniform multi-core cable above described, the only effect being to increase the uniform number of contacts provided on the relays. The only requirement is that the two groups of relays must be divided into an equal number of sub-groups, each of which contains the same number of relays as any other sub-group of the same group, and furthermore that this division of the main groups be effected into an even number of sub-groups. Thus, by providing two groups of relays each containing eight relays and subdividing each of the said groups into four sub-groups each containing two relays, and wiring the contacts of the relays of the various sub-groups of the two groups in accordance with the principles described above, a standard type of relay can be employed throughout the system, provided with six operative contacts, and furthermore the output circuits associated with the two groups of relays will be grouped into two similar groups each containing thirty-two output circuits. In the case of two groups of relays each containing twelve relays subdivided into six equal groups of two, by means of the connections according to the invention a standard type of relay may be employed throughout the system, provided with nine operative contacts, and the output circuits associated with the two groups of relays will be grouped into two similar groups each containing seventy-two output circuits.

In the wiring of a system employing two groups of relays which are divided in the manner above described into more than two equal sub-groups, the contacts of any relay in each of the groups will be so connected that each of several but not all of the said contacts is connected in series with a parallel arrangement of the contacts of a plurality of relays of the other group and that other contacts of the said relay are each connected in series with one of the contacts of an individual relay (other than one of the said plurality of relays) of the other group, the contacts of any one relay of one group being connected only once to the contacts of any one relay of the other group. Thus, by developing the circuit connections in accordance with the invention for the case wherein each group comprises eight relays and is subdivided into four groups each containing two relays, it will be seen that any one relay of each

group will have two contacts thereof each of which is connected in series with a parallel arrangement of the contacts of a plurality of relays of the other group, each of the said plurality of relays of the other group comprising relays which are not otherwise connected to the said first-mentioned relay. In like manner, in the case of two groups of relays each containing twelve relays sub-divided into six groups of two, any one relay of each of the groups will comprise three contacts, each of which is connected in series with a parallel arrangement of contacts of a plurality of relays of the other group, each of the said plurality of relays of the other group not being otherwise connected to the said relay.

It will furthermore be understood that where reference is made herein to the two groups of relays containing the same number of relays, the principles of the invention may also be applied in the case wherein the numbers of relays contained in the two groups are unequal. For example, in the case illustrated in the drawings, the runners in one of the races may number only five, so that one of the relays of one of the groups then becomes unnecessary. With the circuit connections indicated, in addition to the said relay being superfluous there would be idle contacts provided on a certain number of the other relays. In cases where such a feature is to be permanent, it may be desired to eliminate the superfluous relay or relays in the initial wiring of the system, while still employing for the other relays the connections in accordance with the principles of the invention, and it will be understood that the statements herein made with regard to groups of relays containing the same number of relays, and which have been referred to solely for convenience of description, must be construed as including also the case wherein the groups of relays contain numbers of relays which are unequal.

The various considerations indicated above, governing the wiring of two groups of relays, will be clear from a study of Figs. 2A and 2B, considered together. In the upper portion of Fig. 2A there are illustrated two groups of relays. One consists of eight relays, 1A, 1B, 1C, 1D, 1E, 1F, 1G and 1H, while the other consists of twelve relays, 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2I, 2J, 2K and 2L. Assuming, initially, that all of the relays are to be used, having their contacts wired together so as to give controlling lines taking care of the ninety-six combinations of the relays, each of the groups may be divided into four sub-groups, as indicated by the dotted lines extending vertically through the groups in the upper portion of Fig. 2A. A systematic arrangement of the wiring may then be made, as indicated in the lower portion of Fig. 2A and in Fig. 2B.

For example, first, a single contact of each of the relays 1A and 1B may be connected in series with parallel arrangements of contacts of relays 2A, 2B and 2C, as indicated at 3 and 4. Similar connections may then be effected with single contacts of the relays 1E and 1F, as indicated at 5 and 6.

Then similar connections may be arranged involving the relays 1C, 1D, 1G and 1H and the relays 2D, 2E and 2F.

A systematic continuation of this design will be made until half the combinations have been accounted for. Thereafter, a reverse type of connection may be used involving single contacts on the relays of group 2 in series with parallel arrangements of contacts of the relays of group 1, this latter condition being illustrated in Fig. 2B.

It will be obvious that in this fashion, if each group is divided into four sub-groups, a minimum number of contacts will be used to secure the required connections. The system which is followed will be obvious from the figures without further detailed discussion.

So far, in connection with Figs. 2A and 2B, there has been considered the wiring of two groups containing even numbers of relays when the two groups are sub-divisible into an even number of sub-groups greater than two, and when the numbers of relays in the two groups are different. Let it be assumed that the problem is given of connecting only 11 relays of group 2 with eight relays of group 1. The simplest connections involving the use of a minimum number of contacts may then be accomplished by considering the layout described above for groups of twelve and eight relays, and by then eliminating the connections which become unnecessary if one of the relays, say 2L, is omitted. This is illustrated in the figures, in which it will be noted that the relay 2L is indicated in dotted lines, and the connections which may be eliminated if this relay is omitted are also indicated in dotted lines. Consequently, to solve the problem just mentioned, the layout will be the same as that illustrated with the exception that the dotted connections will be omitted.

Suppose, further, that the connection is to be between eleven relays of one group and seven of the other. Again, the design may be effected by contemplating the connections of twelve with eight relays and omitting one of the group of twelve, say 2L, and also one of the group of eight, say 1H. 1H and the connections which may be eliminated by omission of it are indicated in chain lines. Consequently the required connections will be those of the figures with the omission of those indicated in dotted and chain lines.

It may be stated that in any case each group should be divided into an even number of sub-groups containing as nearly as possible equal numbers of relays. This end is achieved for design purposes by first laying out the design with a sufficient larger number of relays to make it possible to secure the same number of relays in each sub-group and by then omitting in the final design the unnecessary connections, as indicated in the procedure outlined above.

It will be noted that from the above systematic arrangement the maximum number of contacts of a relay of either group will be not more than the product of half the number of sub-groups of the other group by one plus the maximum number of relays in any sub-group of said other group.

It has been found that the general considerations which govern the number of contacts to be provided on the relays, whether the two groups contain the same or different numbers of relays are as follows.

When the two groups of relays contain the same even number of relays, the maximum number of contacts required for any one relay exceeds one half of the number of relays in each group by at least one. If each of the groups is divided into two equal sub-groups, as in the case illustrated in Fig. 1 of the drawings, then the maximum number of contacts required for any one relay exceeds one half the number of relays in each group by one.

If one of the groups of relays contains a greater number of relays than the other and yet both numbers are even, the maximum number of

contacts required for at least one relay exceeds one half of the number of relays in the group containing the higher number by at least one. If the two groups of relays are divided into two sub-groups containing an equal number of relays, then the maximum number of contacts required for at least one relay exceeds one half of the number of relays in the group containing the higher number by one.

If one group of relays comprises an even number of relays and the other group an odd number less than the said even number, the maximum number of contacts required for at least one relay exceeds one half of the even number of relays by at least one. If the two groups of relays are each divided into two sub-groups which are as nearly as possible equal, then the maximum number of contacts required for at least one relay exceeds one half the even number by one. On the other hand, if the said odd number is greater than the even number, the maximum number of contacts required for at least one relay exceeds one half of the next higher even number than the said odd number by at least one. If the two groups of relays are each divided into sub-groups which are as nearly as possible equal, then the maximum number of contacts required for at least one relay exceeds one half of the next higher even number than the said odd number by one.

If each group of relays comprises an odd number of relays one number equal to or greater than the other, then the maximum number of contacts required for at least one relay exceeds one half the next higher even number than the said odd number or the higher odd number (as the case may be) by at least one. If the two groups of relays are each divided into two sub-groups containing as nearly as possible an equal number of relays, then the maximum number of contacts required for at least one relay exceeds one half the next higher even number than the said odd number, or one half the next even number above the higher odd number, by one.

The above may be generalized by stating that each group should be divided into an even number of sub-groups containing as nearly as possible equal numbers of relays. Then the maximum number of contacts of a relay of either group will be not more than the product of half the number of sub-groups of the other group by one plus the maximum number of relays in any sub-group of said other group.

It will be further understood that in the case where two groups of relays are employed which contain unequal numbers of relays, the number of operative contacts which will be necessary on each relay will not be the same throughout the system, but nevertheless an advantage will be obtained by employing the method in accordance with the invention, in that the output circuits leading to the numerators or other devices will be divided into two groups, each of which is identified with one of the groups of relays, thereby simplifying the electrical connections from the groups of relays to the numerators or other devices.

I claim:—

1. A circuit arrangement of the type described for use in a totalizer or like apparatus, comprising two groups of operators, each of said groups being sub-divided into an even number of sub-groups, a plurality of circuit closing contacts arranged to be closed by each of said operators, and electrical connections joining a single circuit closing contact of each of the

operators of half the sub-groups of each group in series with a parallel connection of circuit closing contacts of the operators of a sub-group of the other group, and similar connections for other combinations of sub-groups of the two groups, the circuit closing contacts of each operator of one group being connected at least once, but only once, in series with a circuit closing contact of every operator of the other group, the circuit closing contacts of any one operator of either group numbering not more than the product of half the number of sub-groups of the other group by one plus the maximum number of operators in any sub-group of said other group.

2. A circuit arrangement of the type described for use in a totalizator or like apparatus, comprising two groups of operators, each of said groups being sub-divided into an even number of sub-groups, with no sub-groups of a group containing a number of operators differing from the number in another sub-group of the same group by more than one, a plurality of circuit closing contacts arranged to be closed by each of said operators, and electrical connections joining a single circuit closing contact of each of the operators of half the sub-groups of each group in series with a parallel connection of circuit closing contacts of the operators of a sub-group of the other group, and similar connections for other combinations of sub-groups of the two groups, the circuit closing contacts of each operator of one group being connected at least once, but only once, in series with a circuit closing contact of every operator of the other group, the circuit closing contacts of any one operator of either group numbering not more than the product of half the number of sub-groups of the other group by one plus the maximum number of operators in any sub-group of said other group.

3. A circuit arrangement of the type described for use in a totalizator or like apparatus, comprising two groups of operators, each of said groups being divided into two sub-groups containing as nearly as possible the same number of operators, a plurality of circuit closing contacts arranged to be closed by each of said operators, and electrical connections joining a single circuit closing contact of each of the operators of one sub-group of each group in series with a parallel connection of circuit closing contacts of the operators of one sub-group of the other group, and similar connections for the other sub-group

of each group, the circuit closing contacts of each operator of one group being connected at least once, but only once, in series with a circuit closing contact of every operator of the other group, the circuit closing contacts of any one operator of either group numbering not more than one plus the maximum number of operators in either sub-group of the other group.

4. A circuit arrangement of the type described for use in a totalizator or like apparatus, comprising two groups of operators containing the same even number of operators, each of said group being sub-divided into an even number of similar sub-groups, a plurality of circuit closing contacts arranged to be closed by each of said operators, and electrical connections joining a single circuit closing contact of each of the operators of half the sub-groups of each group in series with a parallel connection of circuit closing contacts of the operators of a sub-group of the other group, and similar connections for other combinations of sub-groups of the two groups, the circuit closing contacts of each operator of one group being connected at least once, but only once, in series with a circuit closing contact of every operator of the other group, the circuit closing contacts of any one operator of either group numbering not more than the product of half the number of sub-groups of either group by one plus the number of operators in any sub-group.

5. A circuit arrangement of the type described for use in a totalizator or like apparatus, comprising two groups of operators containing the same even number of operators, each of said groups being sub-divided into two similar sub-groups, a plurality of circuit closing contacts arranged to be closed by each of said operators, and electrical connections joining a single circuit closing contact of each of the operators of one sub-group of each group in series with a parallel connection of circuit closing contacts of the operators of one sub-group of the other group, and similar connections for the other sub-group of each group, the circuit closing contacts of each operator of one group being connected at least once, but only once, in series with a circuit closing contact of every operator of the other group, the circuit closing contacts of any one operator of either group numbering not more than one plus the number of operators in any sub-group.

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