June 21, 1938. H. C. ROBINSON 2,121,164

TOTALIZING SYSTEM

Filed July 13, 1934 14 Sheets-Sheet 1

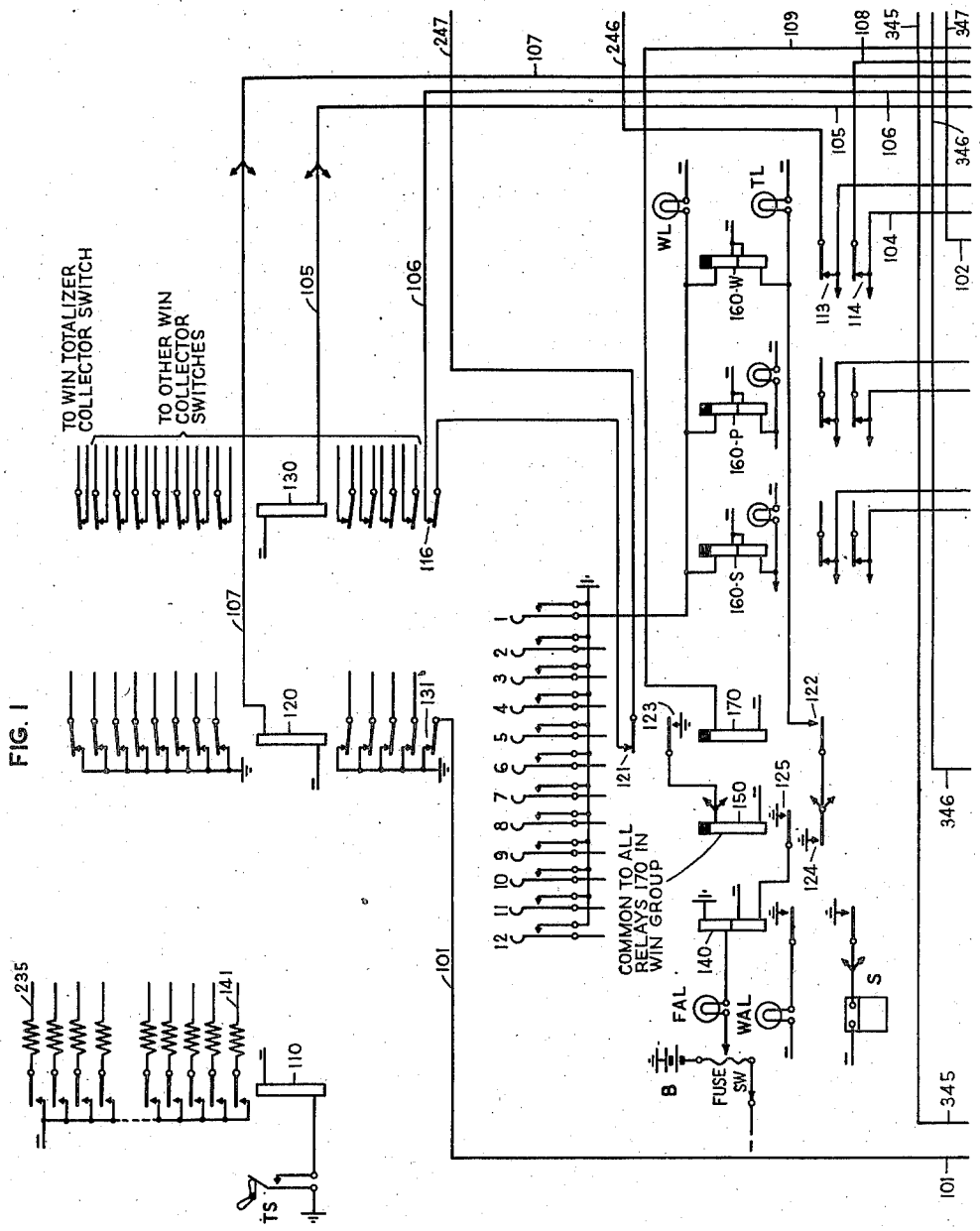


FIG. 1

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Wm Walter Owen ATTY.

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TOTALIZING SYSTEM

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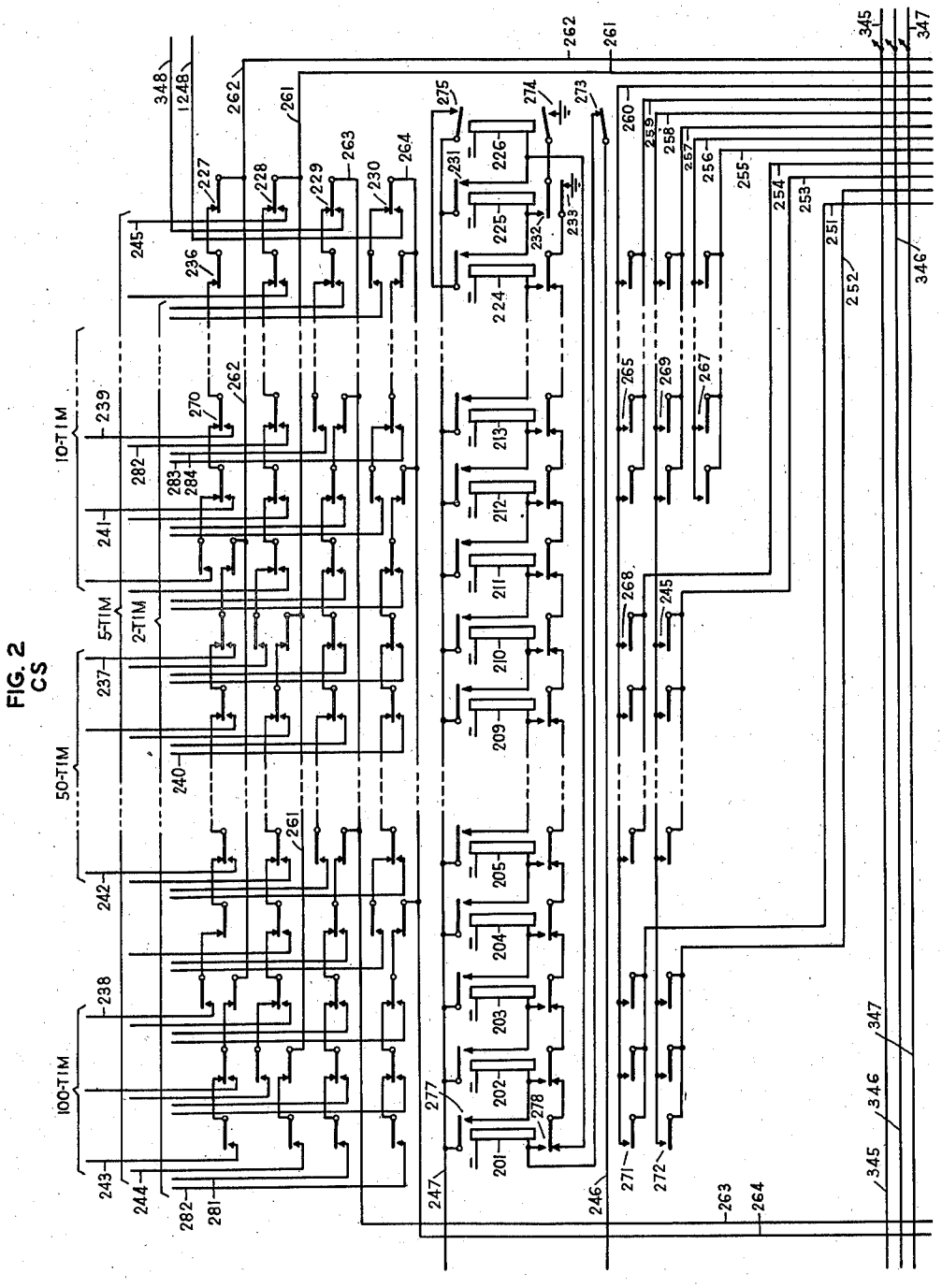


FIG. 2
CS

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McMatter Overall ATTY.

June 21, 1938. H. C. ROBINSON 2,121,164

TOTALIZING SYSTEM

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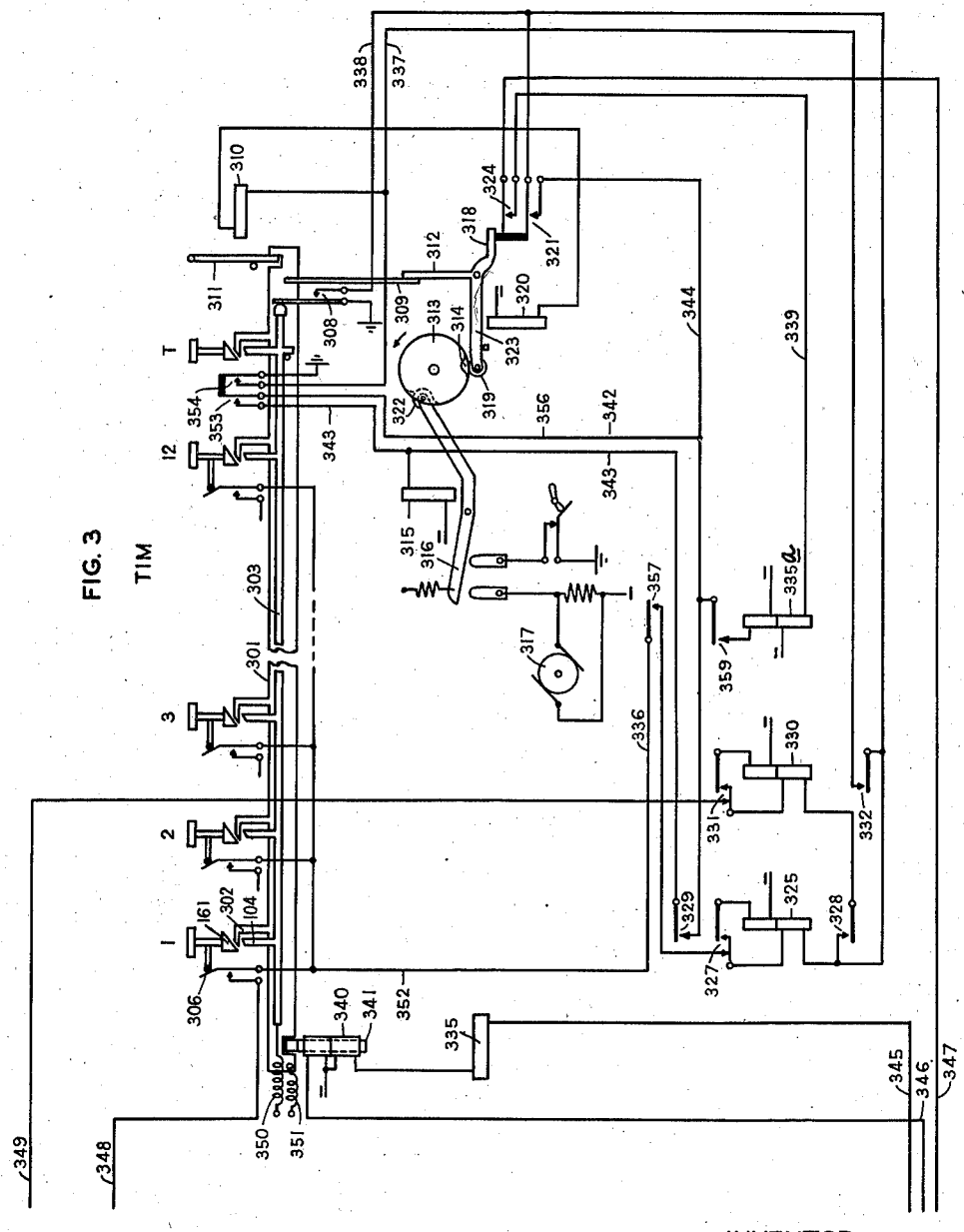


FIG. 3

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June 21, 1938. H. C. ROBINSON 2,121,164

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Filed July 13, 1934 14 Sheets-Sheet 4

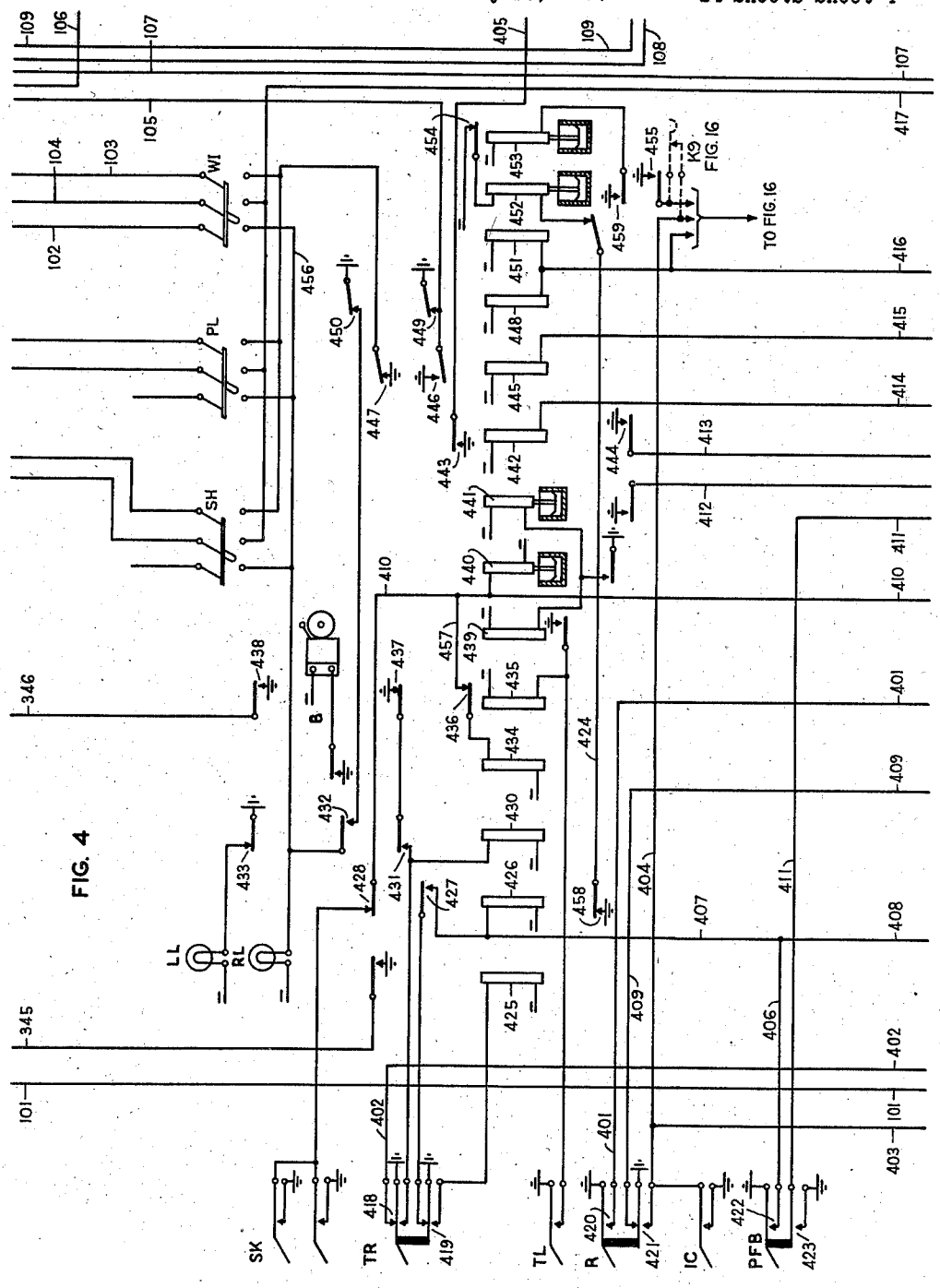


FIG. 4

INVENTOR.
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June 21, 1938. H. C. ROBINSON 2,121,164

TOTALIZING SYSTEM

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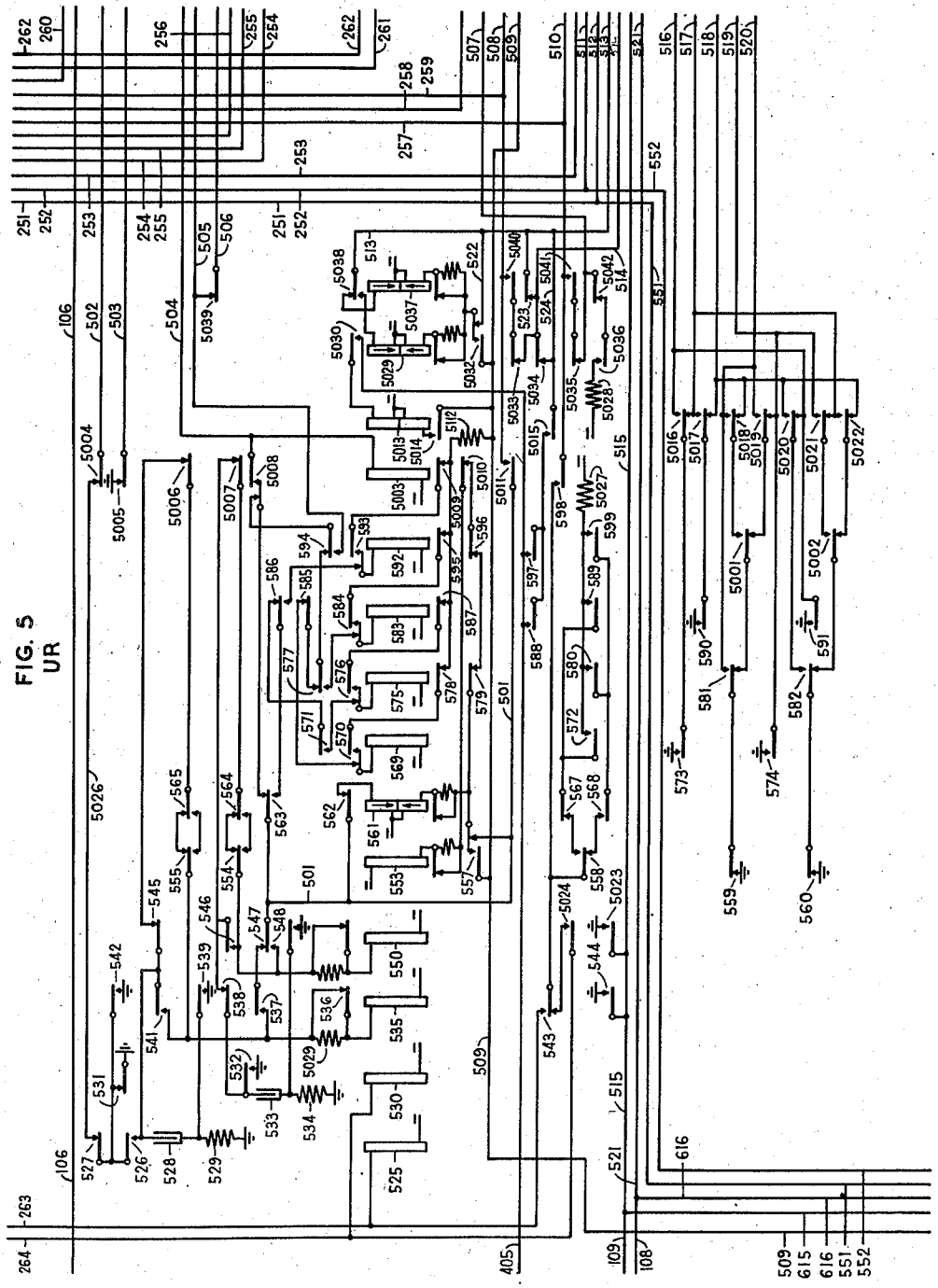


FIG. 5
UR

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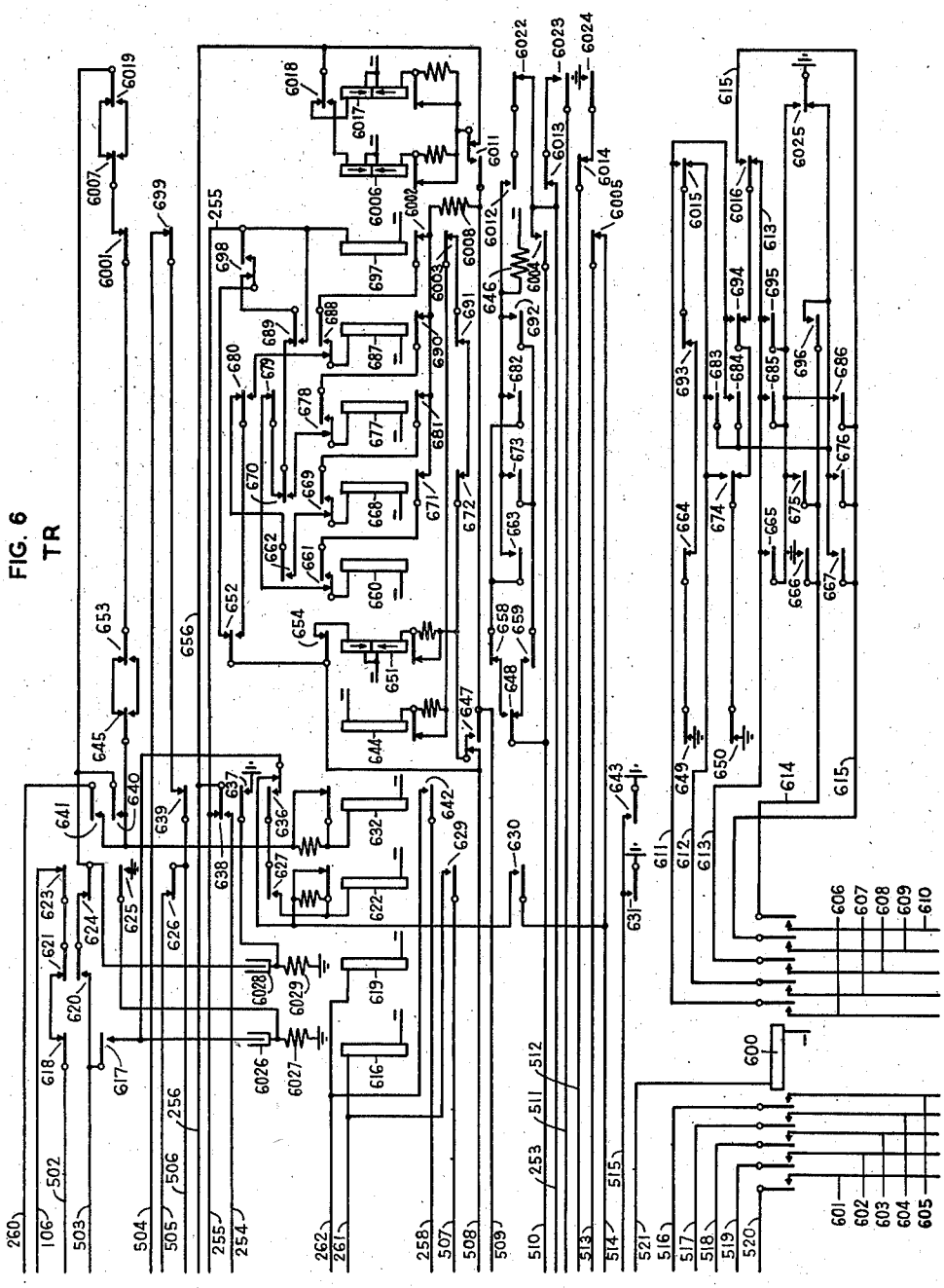
June 21, 1938. H. C. ROBINSON 2,121,164

TOTALIZING SYSTEM

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FIG. 6

TR



INVENTOR

HAROLD C. ROBINSON

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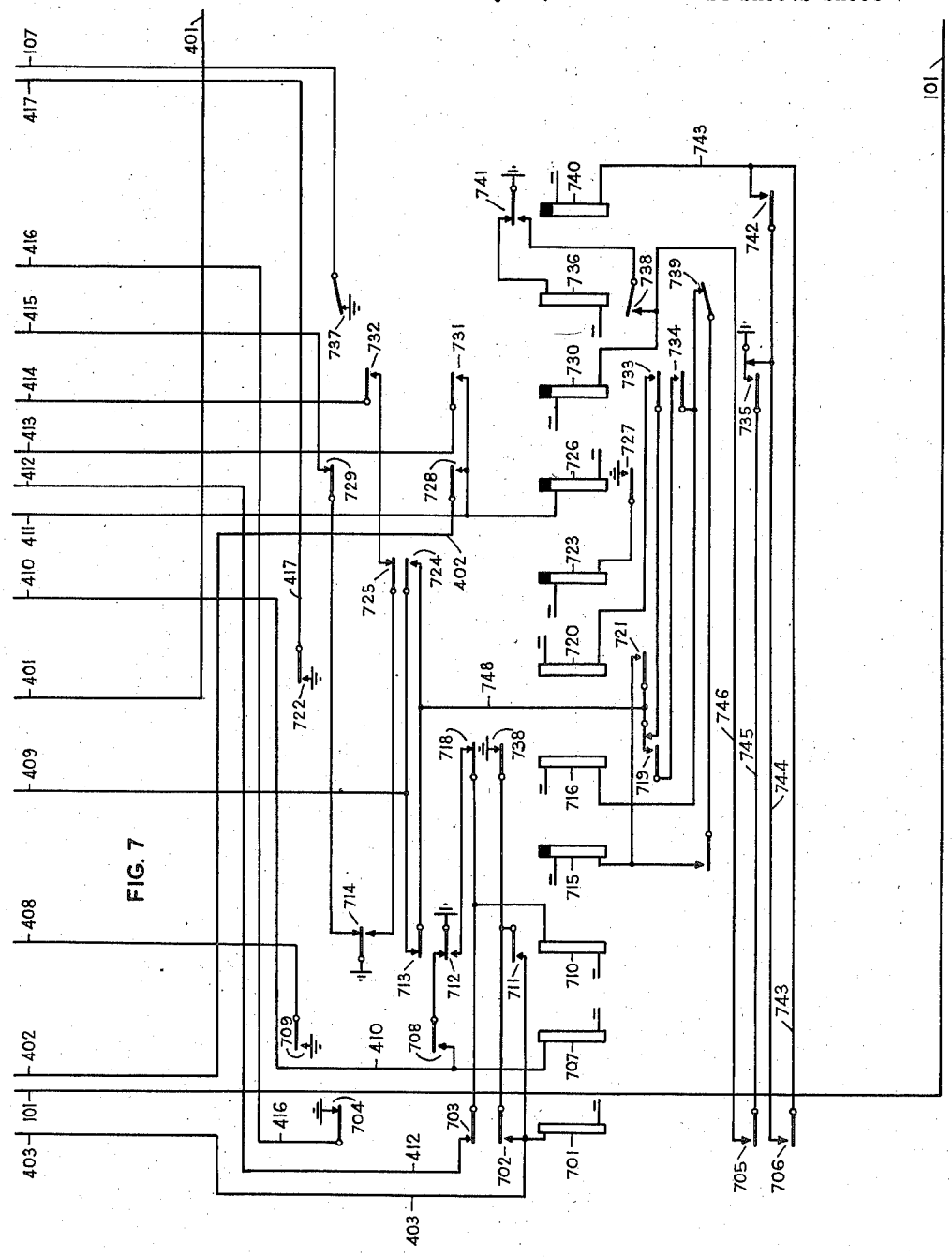


FIG. 7

INVENTOR
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June 21, 1938. H. C. ROBINSON 2,121,164

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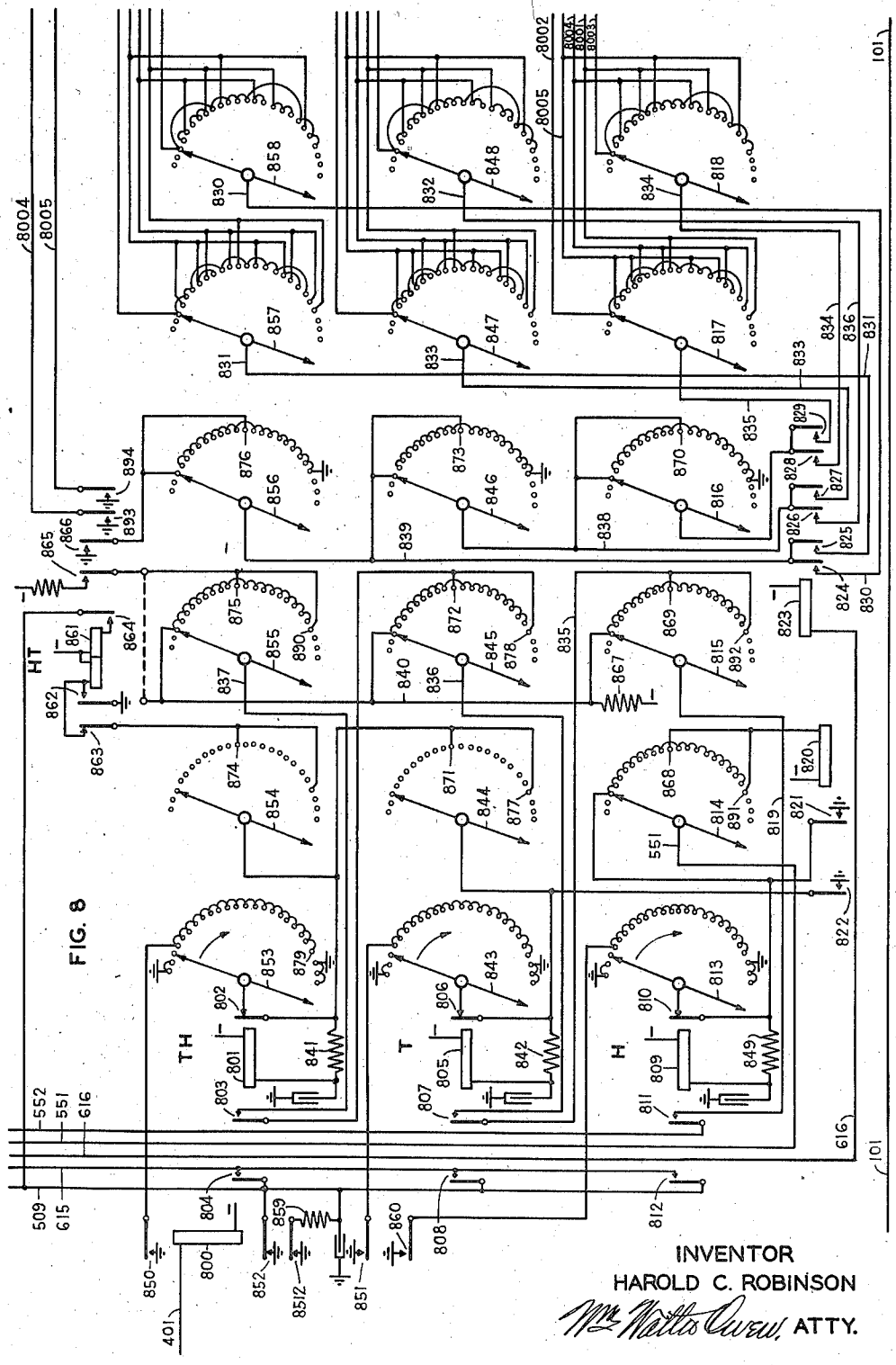


FIG. 8

INVENTOR
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TOTALIZING SYSTEM

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FIG. 10

CODE CHART

DIGIT	RELAYS A	B	C	D	E
1	X				X
2			X		X
3		X	X		
4	X	X			
5		X		X	
6	X			X	
7	X		X		
8				X	X
9		X		X	
0			X		X

FIG. 11

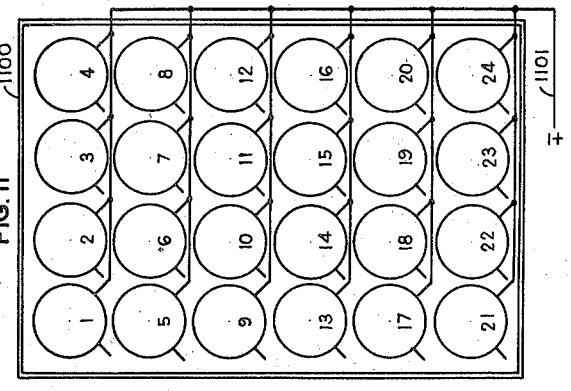
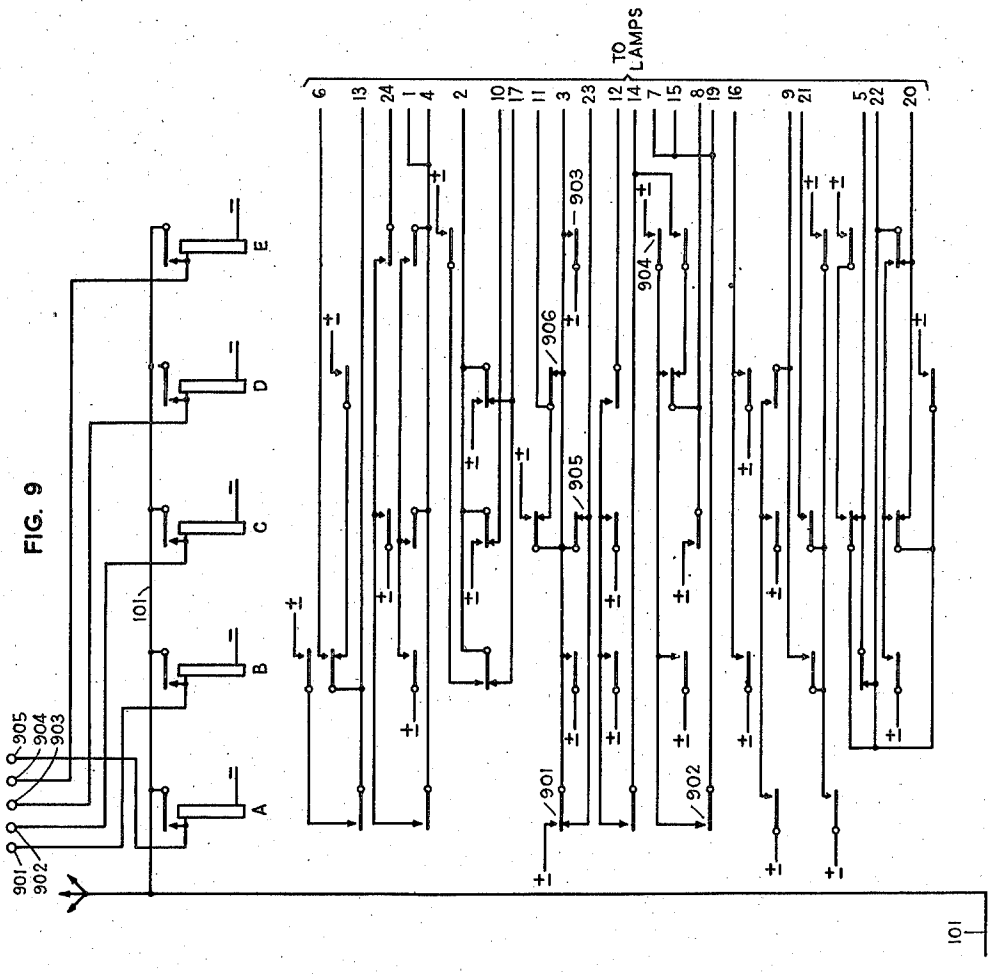


FIG. 9



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June 21, 1938. H. C. ROBINSON 2,121,164

TOTALIZING SYSTEM

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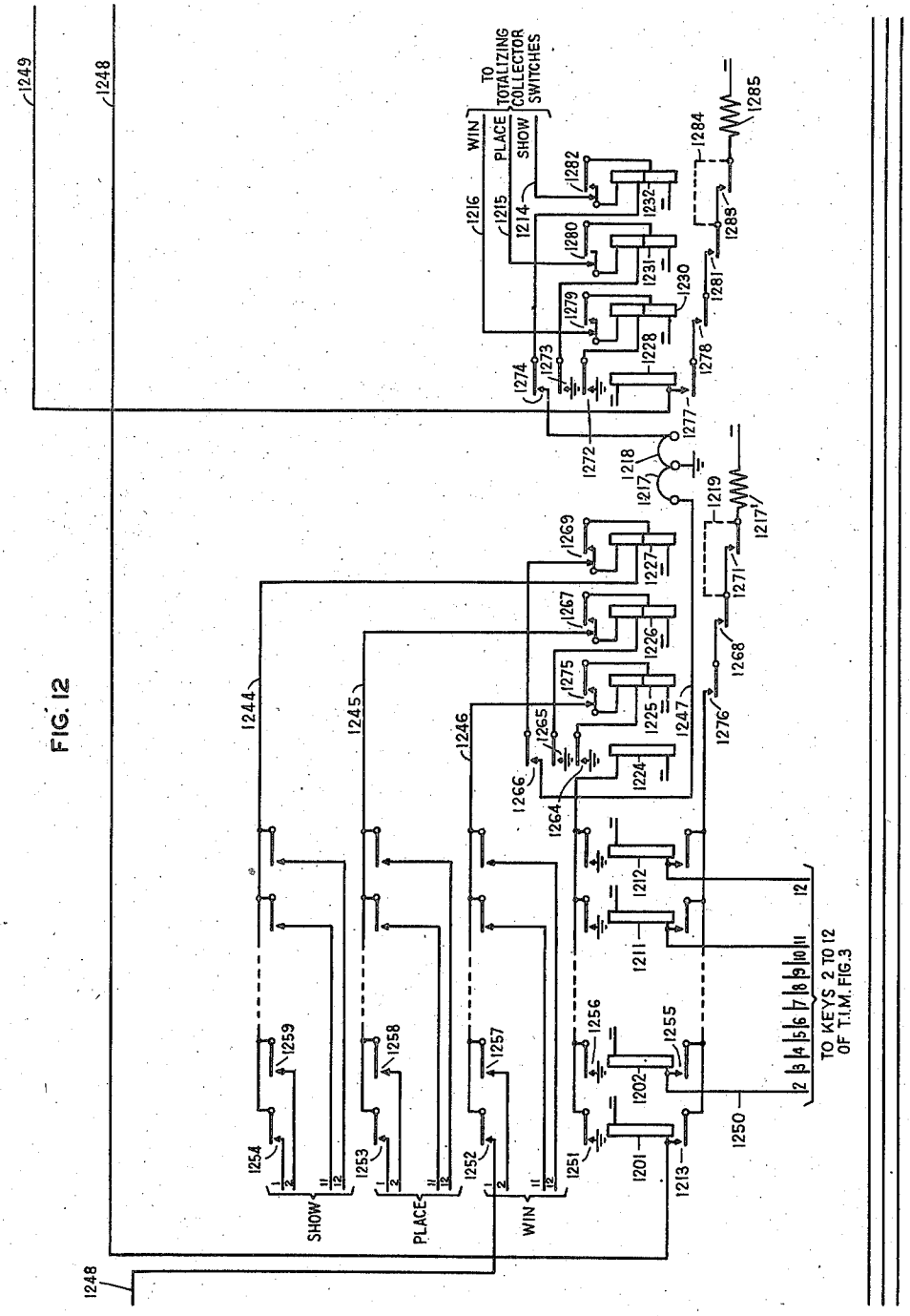


FIG. 12

INVENTOR
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June 21, 1938. H. C. ROBINSON 2,121,164

TOTALIZING SYSTEM

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FIG. 13

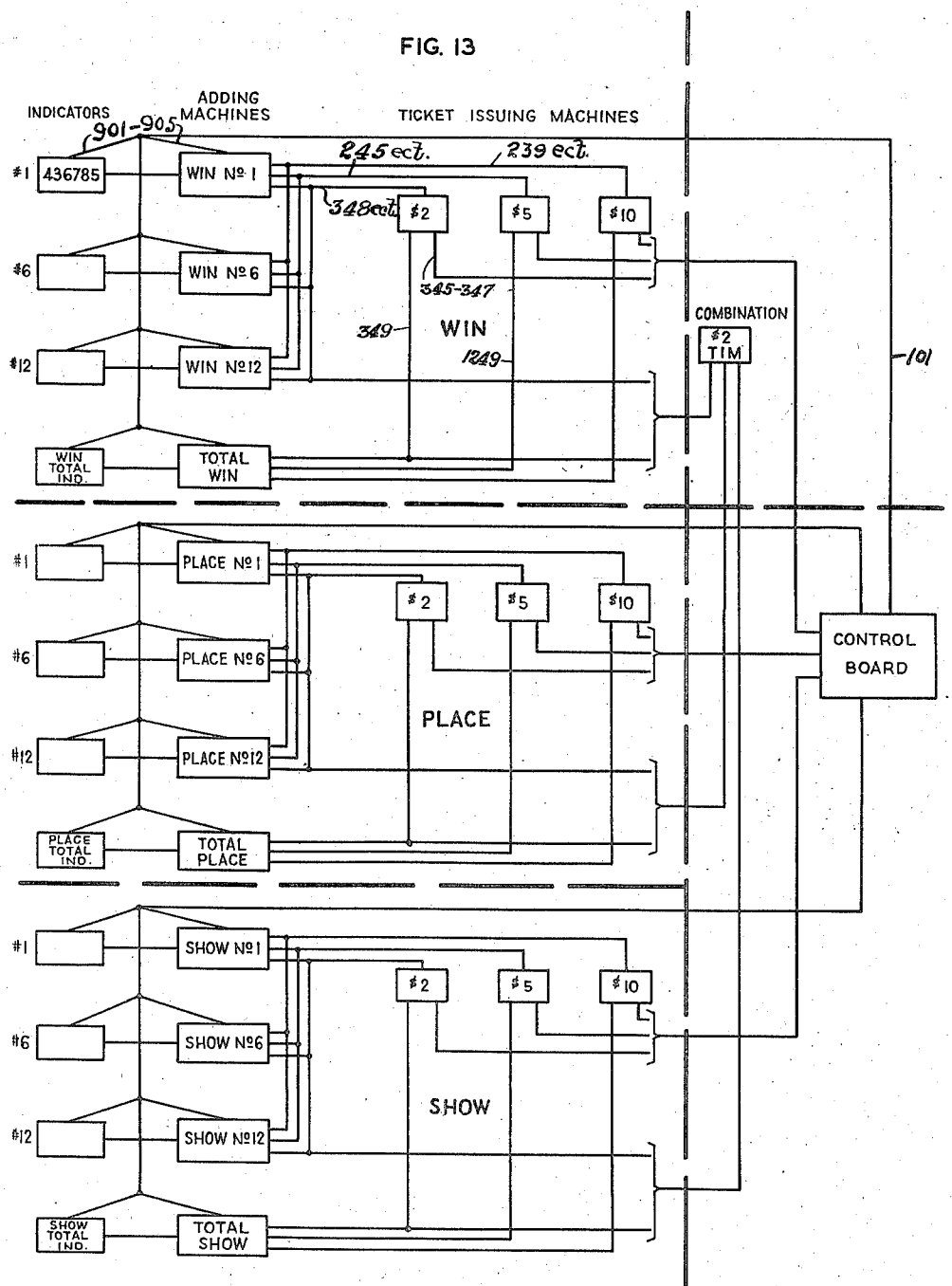


FIG. 14

FIG. 1	FIG. 2	FIG. 3
FIG. 4	FIG. 5	FIG. 6
FIG. 7	FIG. 8	FIG. 9

FIG. 15

FIG. 1	FIG. 2	FIG. 12	FIG. 3
FIG. 4	FIG. 5	FIG. 6	
FIG. 7	FIG. 8	FIG. 9	

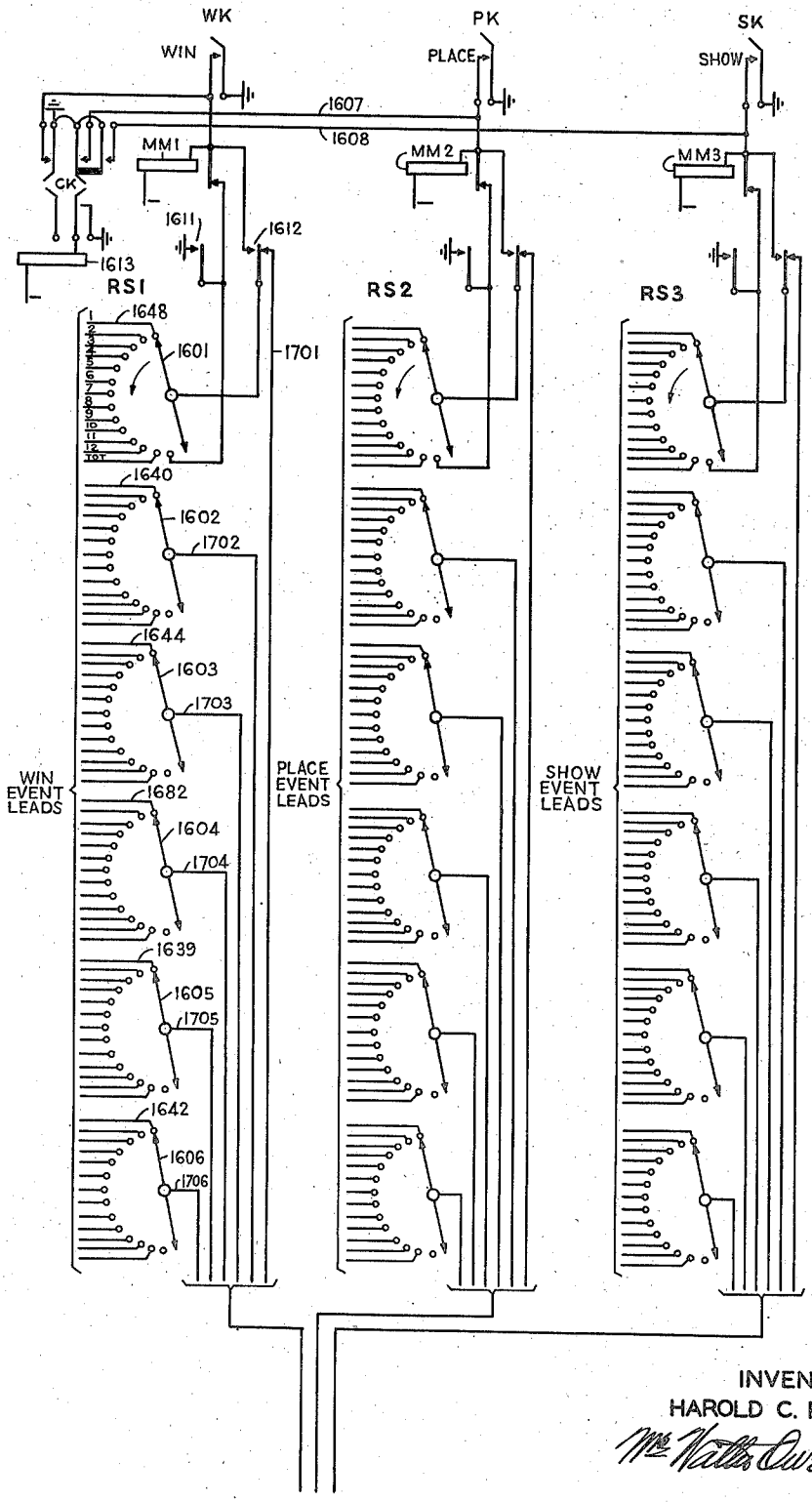
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TOTALIZING SYSTEM

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FIG. 16



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June 21, 1938. H. C. ROBINSON 2,121,164

TOTALIZING SYSTEM

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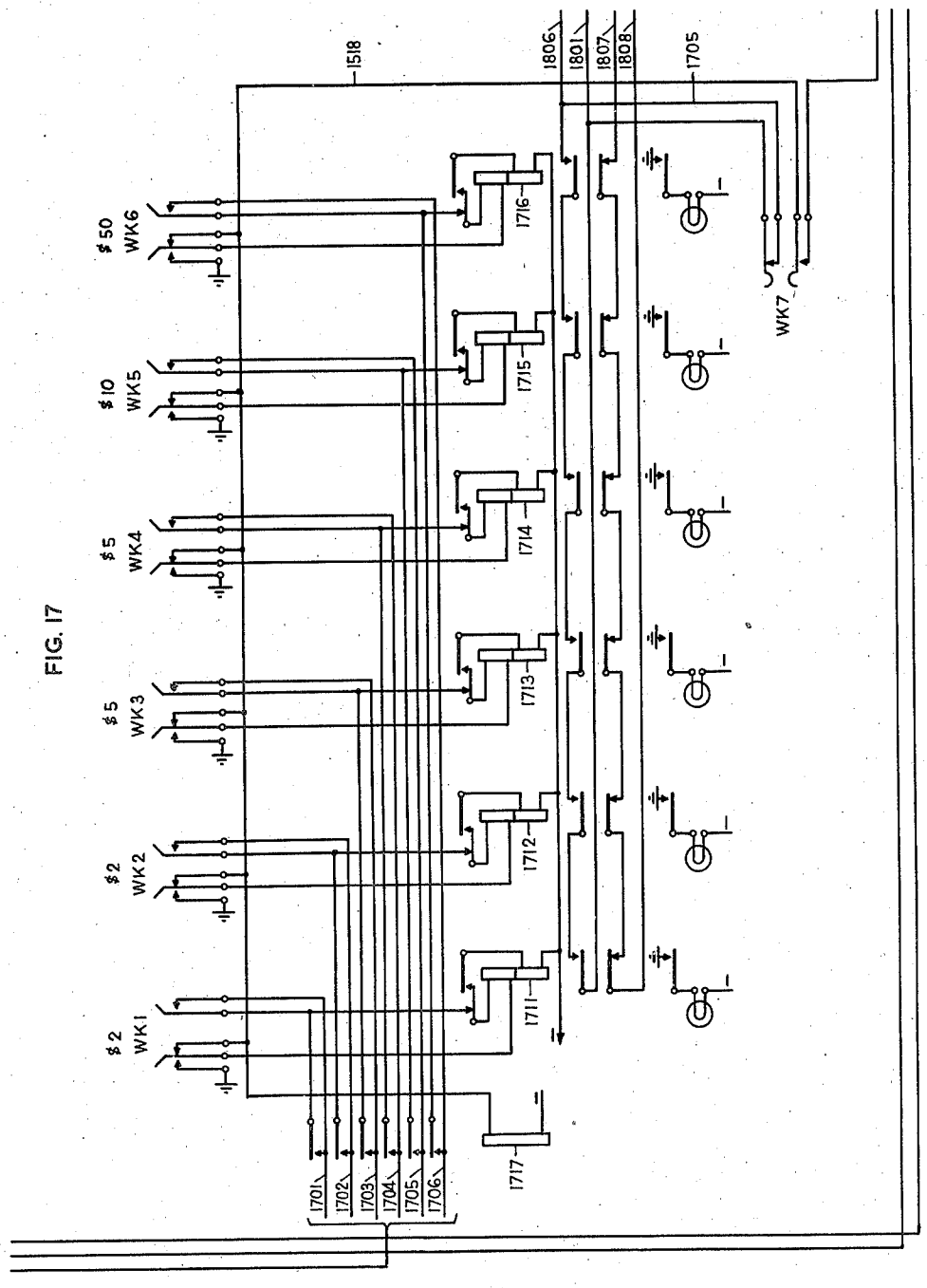


FIG. 17

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June 21, 1938. H. C. ROBINSON 2,121,164

TOTALIZING SYSTEM

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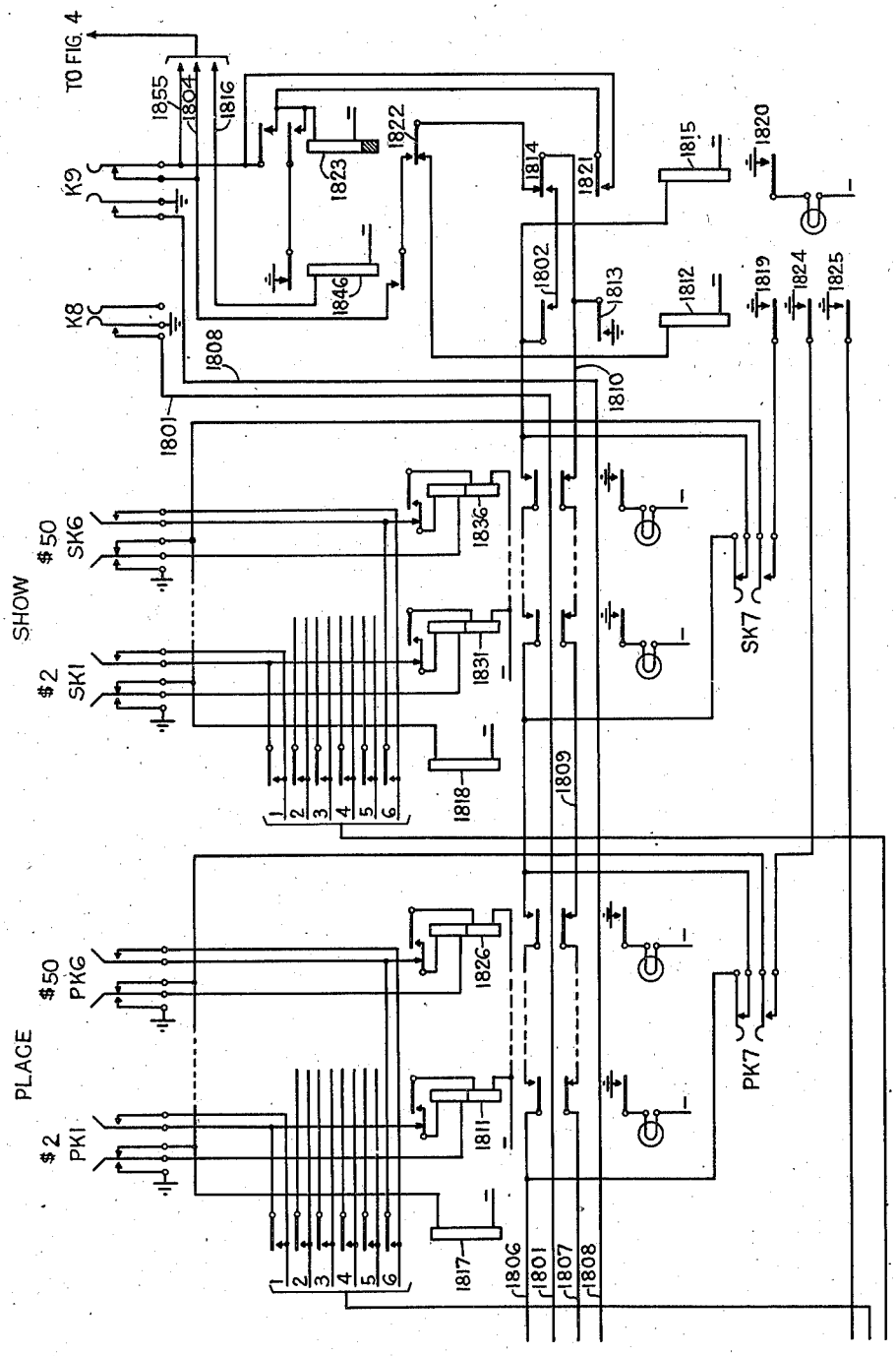


FIG. 18

INVENTOR
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Patented June 21, 1938 2,121,164

UNITED STATES PATENT OFFICE

2,121,164

TOTALIZING SYSTEM

Harold C. Robinson, Chicago, Ill., assignor to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Application July 13, 1934, Serial No. 734,940

14 Claims. (Cl. 235—92)

The present invention relates in general to totalizing systems, but is particularly concerned with the provision of a totalizing system wherein a large number of ticket issuing machines are employed in the sale of tickets of different values, for a number of events, and for different classes of such events; and wherein the total amount of sales for each class of the event as well as the separate sale of tickets for each event are periodically indicated during the sale of such tickets, and wherein when the sale of tickets is discontinued, an indication is given of the final total value of ticket sales for each event and the total amount in sales of each of the classes of such events.

One of the many objects of the invention, is to provide a system wherein the likelihood or chance of inaccuracy is very remote.

Another object is to provide a system which is made up entirely of relays and other apparatus of long proven qualities of endurance and dependability.

A still further object is to provide a system of the foregoing character in which the issuance of a ticket occurs only after registration in one adding machine has resulted from actuation of a key of a ticket issuing machine, and in which the actuated key is held locked in its actuated position until a second adding machine has registered the issuance of the ticket.

An additional feature is concerned with the provision of equipment for routining the adding machine circuits of the system.

There are many other features and objects of the invention not specifically mentioned, but which will appear from time to time as the description of the invention progresses.

The invention is disclosed in fourteen sheets of drawings comprising Figs. 1 to 18, inclusive, which diagrammatically show sufficient of the circuits and apparatus of the system to enable the invention to be readily made clear by the accompanying specification describing the circuits and apparatus disclosed.

Fig. 1 shows a part of the supervisory control equipment of the totalizing system.

Fig. 2 shows the relay collector switch for connecting the leads of the various ticket-issuing machines to the register.

Fig. 3 shows the essential parts of one ticket-issuing machine.

Fig. 4 shows certain keys and relays of the supervisory control equipment.

Fig. 5 shows the units registering relays of the adding machine.

Fig. 6 shows the hundreds registering relays of the adding machine.

Fig. 7 shows further relays of the supervisory control equipment.

Fig. 8 shows the switches of the adding machine cooperating with the register relays of Figures 5 and 6 to register the hundreds, thousands, etc.

Fig. 9 shows the relays for controlling the indicating equipment.

Fig. 10 shows a code chart indicating which of the relays of Figure 9 are operated to register a particular digit.

Fig. 11 shows one bank or frame of lamps for displaying a digit.

Fig. 12 shows the circuits for connecting a combination ticket-issuing machine to the collecting means.

Fig. 13 is a schematic layout of the various machines in the system.

Figs. 14 and 15 show the arrangement of the various sheets of drawings.

Figs. 16, 17, and 18 show a distinct arrangement for checking the circuits of the adding machines of the system.

The first nine sheets of drawings should be first arranged as indicated in the layout Fig. 14. Figs. 1, 4 and 7 of these sheets disclose control and supervisory equipment which, for the most part, is common to the entire calculating system, and which employs ordinary and well known forms of relays.

Fig. 3 diagrammatically shows only the parts of a ticket issuing machine necessary to describe the invention. This ticket-issuing machine is arranged to deliver a ticket for any of twelve events, depending on which of twelve keys is actuated, and with a test key T. In the entire system there are four groups of these ticket-issuing machines. In one group the tickets issued are labeled "Win", designating the one class of the twelve events for which the ticket-issuing machines of this group may issue tickets. The second group is like the first except that the tickets employed are labeled "Place". The third group is also like the first and second, but the tickets employed are labeled "Show". The fourth group of ticket-issuing machines may be labeled "Combination" or in some other manner to designate that they have characteristics in common with the tickets issued by the ticket-issuing machines of the first three groups or of at least two of the first three groups.

Each ticket-issuing machine of the first group has control conductors extending to twelve dif-

ferent collecting switch and adding machine units individual to the twelve events of the class for which such ticket-issuing machine issues tickets, and they each also have a thirteenth conductor extending to a thirteenth collector switch and adding machine employed to collect and totalize the amount in ticket sales of its particular class of the twelve events.

In like manner, each of the ticket-issuing machines of the second and third groups has control conductors extending to twelve other different collector switches and adding machines individual to their class of the twelve events for which they issue tickets and a thirteenth conductor extending to a collector switch and adding machine employed to totalize all ticket sales of their respective classes of the twelve events.

Each of the ticket issuing machines of the fourth or "Combination" group have control conductors extending to each of the thirteen collector switches and adding machines of each of the other three groups so that when a ticket is issued by the ticket issuing machine of the fourth group one of the twelve adding machines of each class of events will be modified by it as well as the totalizing adding machine of each class of events. It will be obvious that the particular event and therefore the particular adding machine of the three respective classes influenced will depend on the key of the combination ticket issuing machine which is actuated. For example, the actuation of the No. 6 key of a ticket issuing machine of the fourth group will ordinarily be the equivalent of the actuation of the No. 6 key of a ticket issuing machine in each of the first three groups, so far as the calculating system is concerned. The ticket issuing machines of the fourth group are identical to those employed in the other groups, which are identical to the one diagrammatically shown in Fig. 3. However, the association of the ticket issuing machine of the fourth group with the three groups of collector switches and adding machine previously mentioned, rather than with a fourth group of collector switches and adding machines requires the introduction of additional circuits between it and the collecting switches of these groups. Such circuits are shown in Fig. 12.

Since, as previously brought out, tickets are issued to twelve different events and to three classes of such events, there will be required thirty-six collecting switches and adding machines for the proper registration individually of these events and their respective classes. Three additional adding machines will also be required to totalize the sales of the three respective classes, making a grand total of thirty-nine collector switches and associated adding machines in the whole system. These collector switches and adding machines are all identical to each other and for this reason it will only be necessary to disclose one of them. Fig. 2 comprises one of the thirty-nine collector switch portions CS of the system, and is the one which is individual to an adding machine, disclosed in Figs. 5, 6, and 8, and to indicating equipment some of which is disclosed in Fig. 9. The collector switch CS, as shown, comprises twenty-six relays. Relays **206** to **208** of these have not been shown since they are identical to relays **205** and **209** of the chain. For like reasons relays **214** to **223**, inclusive, have not been shown since they are identical to relay **213** of the chain. It will be observed from the bracketed conductors, however, that it is arranged to connect with a large group of ticket issuing machines designated **2**—TIM, a smaller group designated **5**—TIM, and progressively smaller groups designated **10**—TIM, **50**—TIM and **100**—TIM, respectively. The group of ticket issuing machines served may be readily increased if necessary by merely increasing the number of relays in the chain.

Each of the thirty-nine adding machines employed and one of which is illustrated in Figs. 5, 6, and 8, comprises a group of units registering relays UR, a group of tens registering relays TR, three simple rotary switches H, T, and TH, comprising hundreds, thousands, and ten-thousand registering equipment, and a hundred-thousands registering relay, HT. The rotary switches here employed are of the well known type such as shown in U. S. Patent No. 1,693,027.

The indicating equipment for each adding machine comprises six frames of twenty-four lights each, one for each order such as units, tens, etc., controlled in various combinations by the respective portions of the adding machine to display the digits registered therein by the operations of the ticket issuing machines. Fig. 9 shows the relays and circuits for controlling one frame of twenty-four lamps for the units digit and which is merely duplicated for each of the other orders required. The numbers of the conductors extending to the bracket labelled "To lamps" designates to which lamps of the frame these conductors extend. Fig. 11 shows a typical frame of twenty-four lamps, such as employed, while Fig. 10 shows a code chart which enables one to readily determine which of the relays of Fig. 9 must be operated to light appropriate lamps in the frame to display any digit.

The calculating portion of the system is more clearly visualized as a whole by the schematic layout disclosed by Fig. 13. This schematic layout shows the first, sixth and twelfth event adding machines of the three classes, and their respective totalizing machines designated "Win", "Place", and "Show", respectively. Each of the twelve adding machines, such as those designated "Win", as previously explained, is associated with a different one of the twelve keys of each of all of the ticket issuing machines of the group equipped to sell tickets designated "Win". The rectangles under the label "Indicators" represent the indicators associated with the diagrammatically disclosed event adding and totalizing adding machines.

As previously stated, each of the ticket issuing machines may issue tickets to any of twelve events. When a sale to event No. 1 is made, for example, by a "Win" ticket issuing machine, the No. 1 "Win" adding machine will function to register the sale on the associated indicator of that adding machine. The adding machine designated "Win total" will also be operated and cause its associated indicator to register the sale of a ticket designated "Win". Likewise if any "Win" ticket issuing machine issues a ticket for event No. 6 the No. 6 "Win" adding machine will function to register the sale on its associated indicator. At the same time, the adding machine designated "Win total" will also function to cause its associated indicator to indicate the total of the "Win" ticket sales. A few numerals have been applied to Fig. 13 which correspond to the numerals applied to like lead lines in the other figures so as to show the relation of this layout to the detailed drawings. It should be understood, however, that many of the lines shown in Fig. 13 represent a group of leads.

Rectangles are shown representing $2, $5 and

$10 ticket issuing machines under the headings "Win", "Place" and "Show", respectively. These machines differ only in that the printing on their tickets is in accordance with the class or group to which they belong.

One ticket issuing machine of the previously mentioned group of "Combination" ticket issuing machines is also illustrated and is designated by a rectangle labeled "Combination". As previously explained to some extent, when a ticket is issued by a machine of this character it causes one of the adding machines and the totalizing adding machine of the classes "Win", "Place", and "Show", to actuate and their indicators to indicate the sale on each of the indicators in accordance with the key actuated or event for which the ticket issuing machine issued a ticket.

The control and supervision of operation of the ticket issuing machines, the adding machines, and the indicating equipment is centralized at a control board represented by a rectangle in Fig. 13, and designed "Control board". The conductors extending from the control board to each of the respective ticket issuing machines are employed, as will subsequently be described, to lock and unlock the ticket issuing machines, as required to insure their operation only when such operation is authorized. The conductors extending between the control board and each of the adding machines and between the control board and the indicating equipment are for exercising various control functions, as will be subsequently made clear. As previously stated, this equipment is disclosed in Figs. 1, 4 and 7, to which attention is now directed.

The keys 1 to 12 of Fig. 1 correspond to the keys 1 to 12 of the ticket issuing machines and are provided to optionally prevent the issuance of tickets for a particular event, as will be described subsequently.

The relay 110 and its associated toggle switch TS is one of three such units which may be employed to prevent a defective totalizing adding machine of any of the three classes from preventing the proper operation of the adding machines of their associated class as will be described subsequently.

The switches SH, PL, and WI are employed to cut out of service the ticket issuing machines and the associated adding machines of any of the three classes of events. For example, if only "Win" and "Show" tickets are to be issued the switch PL will be left open.

When the system is to be put into operation the switches WI, PL, and SH, are all usually closed and current is supplied to the system from any appropriate D. C. source herein shown as a battery B in Fig. 1, having one side grounded and supplying the current thereof through an appropriate fuse and main switch SW. The closure of this switch causes the immediate operation of relays 445, 448, 451, and 736, respectively.

The relay 445 is operated over a circuit extending from ground supplied through the armature 714 and resting contact of relay 710, contacts 729, conductor 415, and the winding of relay 445 to negative battery. The relay 445, at contacts 446 opens a point in the operating circuit of relay 130 and at its contacts 447 closes a point in the operating circuit of the relay 201 of the collector switch CS.

The relays 448 and 451 are operated over a common circuit which extends from negative battery through the windings of these relays in multiple, conductor 416 and through the contacts 704 of relay 701 to ground. The relay 448, at its contacts 450 closes a point in a circuit employed to supply ground potential to all ticket issuing machines as will be described later, and at its contacts 449 applies ground potential to conductor 105 extending direct to the winding of relay 130 and negative battery. The relay 130 accordingly energizes and at its contacts closes a point in the operating circuit of the collector switch CS at springs 116 and corresponding points in the operating circuits of the other twelve collector switches of the "Win" group. Two other relays like the relay 130, but not shown, are also tied to conductor 105 and operate to prepare like circuits for the collector switches of the "Place" and "Show" groups, respectively.

The relay 451 closes an obvious circuit through the timing dash-pot relay 452 which, after an apreciable interval, at contacts 459 closes a circuit through its companion dash-pot relay 453, and at its contacts 455 applies ground potential to the conductors 404 and 403 and through the winding of relay 701 to battery. The operation of this relay and the circuits controlled by it will be gone into later.

The relay 736 is operated over an obvious circuit and at its contacts 737 applies ground to conductor 107 and through the winding of relay 120 to negative battery. This latter relay accordingly operates and at its contacts 131 applies ground potential to a locking conductor 101 extending to the locking armatures of all indicator relays such as A to E of Fig. 9 of the sets of such relays employed to control indicators of the "Win" adding machines and the "Win" totalizing machine. Two other relays like the relay 120, but not shown, are also tied to conductor 107 and operate to apply ground potential to the locking leads of the indicator relays of the "Place" and "Show" adding machines and of their respective totalizing adding machines. The relay 736 also, at contacts 738 opens a point in the operating circuit of relay 730 and at contacts 739 closes a point in the operating circuit of relay 716.

The relay 226 of the collector switch CS and a corresponding relay of each of the other collector switches of the system not shown, are operated over obvious circuits like the one shown for relay 226, which includes the chain of serially connected contacts of the other twenty-five relays of the collector switch CS. The relay 226, at its contacts 274 opens a point in the locking circuit of relay 225, at its contacts 275 opens a point in the operating circuit of this latter relay, and at its contacts 273 completes the operating circuit of relay 201 of the collector switch.

This circuit extends from ground supplied through the contacts 447 of relay 445, the right blade of switch WI, conductor 103, contacts 113, conductor 246, contacts 273, and through the winding of relay 201 to negative battery. The relay 201 operates to associate the conductors 281, 282, 243 and 244 with its associated adding machine, at its contacts 271 and 272 closes points in control circuits which will be described later, at its armature 278 interrupts the circuit of relay 226 and completes a locking circuit for itself, and at contacts 277 completes the operating circuit of relay 202 of switch CS. This latter circuit extends from negative battery through the winding of relay 202 and the contacts 277, conductor 247, through contacts 121 of relay 170, contacts 116 closed by relay 130, conductor 106, through contacts 623, 621, 618,

conductor 502, contacts 5004, conductor 5026 and contacts 527 and 531 to ground. The relay 226, upon restoring, at contacts 273 interrupts the circuit of relay 201, at its contacts 274 prepares a circuit for relay 225, and at its contacts 275 closes a point in the operating circuit of relay 225. It will be appreciated that so long as conductor 247 has ground potential thereon the relays 201, 202, 203, etc. will operate in rapid sequence each interrupting the prior operated one until the relay 226 is again actuated thereby. When this occurs the relay 226 at its contacts 273, again closes the circuit of relay 201 and therefore these relays rapidly operate in the order of a rotary switch to sequentially connect with marked conductors of the various ticket issuing machines of a particular class as will subsequently be more thoroughly gone into.

The attendant at the control board desiring to prepare the circuits for the actual selling of tickets does so by momentarily operating the key PFB and thereafter operates the ticket issuing machine release key TR. The key PFB at contacts 422 closes an obvious circuit for the relay 426 and at its contacts 423 applies ground potential out over conductor 411 to the slow to operate relay 726. The relay 426 at contacts 427 completes a locking circuit for itself including the normal contact and spring 419 of the ticket issuing machine release key TR, at contacts 428 opens a point in a control circuit ordinarily under the influence of a steward's key SK, and at contacts 458 interrupts the operating circuit of timing dash-pot relay 452.

The relay 726 at its contacts 728 completes a locking circuit for itself extending over the conductor 402 and through the normal contact and spring 418 to ground at key TR, at its contact 729 interrupts the normally closed circuit of relay 445, and at contact 727 closes an obvious operating circuit to slow to operate relay 723. The relay 445 restores and at its contacts 446 applies ground potential to conductor 105 in multiple with that already applied thereto by the contacts 449 of relay 448 and at contacts 447 removes ground potential from the circuit of the collector relay 226, thereby stopping its operation as soon as relay 225 thereof pulls up.

The relay 723 operates and at contacts 725 interrupts one point in the operating circuit of relay 442, and at its contacts 724 connects conductors 409 and 748 together independent of the normally closed contacts of relay 710.

When the attendant subsequently operates the ticket issuing machine release key TR the relay 425 is operated over an obvious circuit and at its contacts supplies ground potential out over conductor 345 extending direct to the ticket issuing machine, through the magnet 335 thereof, and through the lower winding of the magnet 340 to battery. The magnet 340 upon operating shifts its core 341 clear of the slot in the locking bar 301 of the ticket issuing machine freeing it for operation by the ticket salesman. Branches of the conductor 345 also extend to corresponding equipment of all other ticket issuing machines of the system. The ticket salesman may now proceed in the sale of tickets. The ticket issuing machine release key TR at its spring 418 removes ground potential from conductor 402 thereby interrupting the locking circuit of relay 726. This relay accordingly restores, and at its contacts 727 opens the circuit of relay 723, while at its contacts 729 it again closes the circuit of relay 445. This latter relay accordingly again closes its contacts 447, thereby completing the previously traced operating circuit for the collector switch which immediately starts operating. The relay 723 restores but without any particular effect at this time. The key TR at its spring 418 and its working contact completes an obvious circuit for the relay 430. This relay operates and at its contacts 431 completes an obvious locking circuit for itself. The relay 430 also at its contacts 433 interrupts the circuit of the lamp LL which becomes extinguished and indicates that the ticket issuing machines are no longer locked up; and at its contacts 432 connects ground potential to conductor 456, included in the pick-up circuit of all relays such as 335*a* of the ticket issuing machine TIM, and to the lamp RL which lights up to definitely indicate to the attendant that the ticket issuing machines have been released for operation. The key TR at its spring 419 and its resting contact interrupts the locking circuit of relay 426 which accordingly restores and at its contacts 428 again closes a point in the control circuit extending to the key SK. The relay 426 also at its contacts 458 completes the operating circuit extending over conductor 424 to the timing dash-pot relay 452. The restoration of the key TR is without effect.

A predetermined time after the closure of contacts 458 the dash-pot relay 452 operates and at its contacts 455 applies ground potential to conductor 404, and at its contacts 459 completes the circuit of dash-pot relay 453. This latter relay after a predetermined interval of time at its contacts interrupts the circuit of dash-pot relay 452 which accordingly restores and again opens the circuit of relay 453 and again removes ground from conductor 404. It will be obvious that these relays operate intermittently so long as relay 451 remains operated and relay 426 remains restored. Each time ground is applied to conductor 404 the relay 701 is operated by the extension of this ground over conductor 403, and through the winding of relay 701 to battery.

The relay 701 operates and, at its contacts 702 completes an obvious circuit for itself including the armature and grounded resting contact 738 of relay 716. The relay 701, also at contacts 704 interrupts the circuit of relays 448 and 451 and at contacts 703 interrupts a point in the operating circuit of relay 710. The relay 448, upon restoring, at its contacts 450 disconnects ground from conductors 456 to prevent any ticket issuing machine from operating its relay 325 at this time and from the lamp RL causing it to become extinguished, and at contacts 449 removes the remaining one of the two ground multiple connections from conductor 105, thereby causing the relay 130 to restore and stop the operation of the associated collector switches, to momentarily prevent the adding machine from attempting to record ticket sales. The relay 451 restores, and at its contacts interrupts the circuit to the timing dash-pot relay 452 to stop its operation until an indication is given of the ticket sales which may have been made and registered up to this time. The relay 701, in operating, also, at its contacts 706 completes an operating circuit for slow to operate relay 740. This circuit extends from negative battery through the winding of relay 740, conductor 743, contacts 706, and contacts controlled by armature 735 of relay 730 to ground.

The relay 740, upon operating, at its contacts 742 completes an obvious locking circuit for itself

excluding contacts 706 of relay 701, at its armature 741 interrupts the normally closed operating circuit of relay 736 and completes an obvious operating circuit to the relay 730 as soon as relay 736 restores. The relay 736 also, upon restoring at contacts 737 removes ground from conductor 107 extending to the winding of relay 120 and battery, and at its contacts 739 opens a point in the operating circuit of relay 716. The relay 120 restores, and at its contacts removes ground potential from the indicator locking conductor 101 and similar conductors extending to the locking armatures of relays A, B, C, D, and E, of the indicating equipment of the associated adding machine, and from conductors extending from other contacts of the relay 120 to the indicating equipment relays such as A to E of other adding machines of the "Win" group and from the totalizing machine serving the other events of the "Win" group. This is done so that the existing or last set up sales indication is erased in preparation for the display of up to date information as to the amount in ticket sales which have been made.

The relay 730, upon operating, at its contacts 735 interrupts the locking circuit of relay 740, at its contacts 734 closes a point in the locking circuit of relay 716, at contacts 731 closes a point in an operating circuit of relay 726, at contacts 732 closes a point in the operating circuit of relay 442, and at its contacts 733 completes the operating circuit of relay 720. This latter circuit extends from battery, through the winding of relay 720, contacts 733, contacts controlled by armature 719 of relay 716, conductor 748, through contacts 713 of relay 710, to conductor 409 which is grounded by the contacts 421 of key R.

The relay 720, upon operating, at its contacts 721 extends the ground potential on conductor 748 to the winding of relay 715 and battery, and at its contact 722 applies ground potential to conductor 417 to the "Win" indicating control relays 823 and 600, respectively, and to other indicating relays corresponding to these of all "Win" event adding machines and the totalizing adding machines belonging to the "Win" class. The operating circuit to the relays 823 and 600 of the adding machine shown may be traced as follows: from ground applied to conductor 417 through the center blade of knife switch WI, conductor 104, contacts 114, conductor 108, to the junction of conductors 521 and 616, respectively. The ground potential applied to conductor 616 extends directly to the winding of relay 823 to battery, while the ground potential applied to conductor 521 extends directly to the relay 600 and battery. These relays and the corresponding other relays, operated over branch circuits including contacts of other relays such as 160 not shown, accordingly energize to apply operating potential to the proper indicator control relays such as A to E of the various indicators to cause them to display digits in accordance with the amount of ticket sales which have been registered up to this time.

The relay 740, upon restoring, again completes the circuit of relay 736, the relay 736 accordingly again operates, again closes its contacts 737 so that relay 120 will again operate to ground the locking conductors 101 and similar ones extending to the indicator relays such as A to E, to maintain the newly displayed indications independent of relay 720. The relay 736 at this time at its contacts 739 completes an operating circuit for relay 716. This circuit extends from the grounded conductor 748, through contacts 721, contacts of relay 715, contacts 739, and the windings of relay 716 to negative battery. The relay 716, upon operating, at armature 719 interrupts the circuit of relay 720, at its contacts 718 opens a point in the locking circuit of relay 710, and at its contact 738 opens the locking circuit of relay 701.

The relay 720, upon restoring, again interrupts the circuits extending to the relays 600 and 823 and to the other corresponding relays of the system, and at its contacts 721 opens the circuits of relays 715 and 716 which restore without any immediate consequences. The relay 701, upon restoring, at contacts 704 reestablishes the circuit of relays 448 and 451, and at its contacts 705 interrupts the locking circuit of relay 730.

Relay 448, upon operating again, at its contact 449 recloses the circuit of relay 130, and at its contacts 450 again applies ground potential to the lamp LL and to the pick-up circuits extending to the relays, such as 325, of the ticket machines. The relay 130 now operates to reestablish the operating circuits of the collector switches to enable them to again proceed to pick up marking potential on the conductors extending to the ticket issuing machines. The relay 451 operates to again close the circuit of timing dash-pot relay 452. After a predetermined interval the dash-pot relay 452 again becomes effective to initiate the operations just described to effect the erasure of the indications last locked in on the indicators and to replace such indications with up to date information as to the value of tickets sold.

If for any reason the steward desires to obtain an up to the instant indication of the ticket sales registered without waiting for the timing relay 452 to complete the circuit of indication control cycle relay 701 he may obtain the operation of such relay by momentarily operating the indication cycle key IC. Obviously the results are the same as when relay 452 actuates.

$2 Ticket sales

The attendant having performed the necessary operations preceding the commencement of the ticket selling procedure, a description of the operations occurring consequent to the issuance of tickets at various machines will now be gone into. For this purpose it will be first assumed that a salesman having the $2 "Win" ticket issuing machine TIM of Fig. 3 at his disposal sells a ticket for event No. 1 and accordingly actuates the No. 1 key of the ticket issuing machine.

When the No. 1 key is actuated the locking bar 301 and the off normal bar 303 are shifted to the right against the tension of their associated springs 351 and 350, respectively. With the key fully depressed its triangle portion 161 becomes locked under the portion 302 of the locking bar 301 and the off normal bar 303 remains moved to the right sufficiently to close the off normal contacts 308. The locking bar 301 in moving to the right moves with it a spring member 309 which in turn rotates the arms 312, 323 and 318 in a clockwise direction sufficiently to fully actuate the contacts 321 and 324. The distance of rotation of the arm 318 through the medium of its arm 312 and spring 309 is, however, limited by the roller 319 on arm 323, which enters a detent in the cam 313.

Upon the operation of the contacts 324 a circuit is completed for the relays 335*a*. This circuit extends from negative battery through the

lower winding of relay 335a, conductor 338, contacts 324, conductor 347, conductor 102, the left blade of switch WI, conductor 456, contacts 432 and 450 to ground. The relay 335a, upon operating, at contacts 359 completes a locking circuit for itself including its upper winding, conductor 344, contacts 321, conductor 338 now grounded by the operated off normal contacts 308. The relay 335a also at contacts 357 applies marking potential to the conductor 348 over a circuit extending from ground on conductor 338, through the lower winding of relay 325, contacts controlled by the armature 327 of this relay, contacts 357, and the contacts 306 of key No. 1 of the ticket issuing machine. The ground potential applied to the conductor 348 over the traced circuit is connected with the lead terminating in the front contact of armature 229 of the relay 225 of the collector switch CS.

Owing to the previously described operating circuit of the collector switch CS the relay 225 upon its next operation will extend the ground potential on conductor 348 through the front contact and armature 229 to conductor 263 and over the conductor 263 to the winding of the relay 525 of the unit register relay group of the adding machine to battery. The resistance of the lower winding of relay 325 is very low compared to that of relay 525 and the latter relay therefore does not permit sufficient current flow in the traced circuit to enable relay 325 to operate. The relay 525, however, operates and at its contacts 527 interrupts the traced operating circuit of the collector switch CS, and at its contacts 526 completes an operating circuit through its slave relay 535. This latter circuit extends through the grounded contacts 531, contacts 526, 545, 5006, the armature 565 and its resting contact, and resting contact and armature 555, through contacts 536 and the associated resistance in multiple, and the winding of relay 535 to battery.

The relay 535 operates over the traced circuit and at its contacts 536 removes the shunt from about the associated resistance 5029 so as to include the resistance in its locking circuit which it completes at its contacts 541, and which circuit is the same as the one traced except that it excludes contacts 545, 5006, and armatures 555 and 565. It may be well to mention at this time that in order to make the relay 535 quick operating it is designed to draw quite an amount of current and that the low resistance is then introduced in the locking circuit of the relay to cut down this current flow to the amount required to hold the relay operated. This same arrangement is provided on other relays of the system, as will be obvious. The relay 535 also, at its contacts 542 applies ground potential to contacts 526, thereby preventing the operation of terrupts a point in the operating circuit of relay 535. The relay 535 also at its contacts 538 interrupts a point in the operating circuit of relay 550, at armature 543 and its front contact closes a point in an operating circuit for the relay 325, at its contacts 544 applies ground potential to an alarm conductor 109 and at its contacts 537 extends ground potential by way of the resting contact and armature 547, conductor 501 and contacts 562, to the upper winding of control relay 561; by way of another branch of the conductor 501 and contacts controlled by armature 557 to the lower winding of control relay 561 and battery; and also by way of contacts 578, 596, 5010 to the winding of control relay 553 and battery.

The relay 535 finally, at its contacts 537, also extends ground potential by way of armature 563 and its resting contact, contacts controlled by armature 5008, armature 594 and its resting contact, armature 577 and its resting contact, contacts 585, contacts controlled by armature 576, and the winding of register relay 569 to battery.

The relay 569 operates over the traced circuit, at its armature 570 interrupts the traced operating circuit for itself, and completes a locking circuit for itself which extends by way of contacts 578, the resistance 5112, and hold conductor 509 and through the contacts 852 of relay 806 to ground. The relay 569 also, at its contacts 571 closes a point in the operating circuit of register relay 575, at its contacts 572 closes another point in the operating circuit of relay 325 of the ticket issuing machine, and at contacts 573 and 574 applies ground potential to the conductors of the circuits employed in indicating the unit digit of the number representing the value of the tickets sold by the ticket issuing machines of the group to which the disclosed adding machine belongs. The control relay 561 is of the differential type and does not operate when ground potential is connected to both of its windings. The relay 553, however, operates and at its armature 557 completes a locking circuit from the grounded conductor 509 and over the previously traced circuit through its winding to battery. The relay 553, at its armature 555, opens a point in the traced operating circuit of relay 535 and prepares a point in an alternative operating circuit for this relay, and at armature 554 opens a point in an operating circuit for relay 550 and closes a point in an alternate operating circuit of that relay. The relay 553 also, at its contacts 559 and 560 removes ground potential from conductors associated with the indicating equipment, the purpose of which will be gone into later, and at its armature 558, interrupts one point in one operating circuit for the ticket issuing machine relay 325, and at the front contact of this armature completes another operating circuit of this relay. This circuit extends from the negative terminal of the battery, through the low resistance 5027, contacts 572 and 567, through the front contact and armature 558, armature 543 and its working contact, to conductor 263 and over the previously traced circuit to the relay 325 to ground.

In the ticket issuing machine, the relay 325 now operates, and at its armature 327 disassociates itself from the adding machine and therefore interrupts the circuit of relay 525 and completes a locking circuit for itself extending from battery through its upper winding, its armature 327 and its working contact, its lower winding, conductor 338, and through contacts 308 to ground. Relay 325 also, at contacts 329 completes the circuit of the motor start magnet 315 of the ticket issuing machine. This latter circuit extends from battery, through the winding of magnet 315, conductor 343, contacts 329 and 321, and over the previously traced circuit to ground at contacts 308. The magnet 315, upon operating, moves the knife switch blade 316 into engagement with its contacts to complete the obvious operating circuit to the motor 317 of the ticket issuing machine and clears the roller 322 from the detent in the cam 314, which, with the cam 313, is driven by the motor 317. As soon as the motor 317 moves the cams 313 and 314 a short distance the cam 313 engages the roller 319 and through the medium of the arm 319 rotates the arms 312 and 318 in a counterclockwise direction

into their normal positions in which they are shown against the tension of the spring member 309 to enable the contacts 321 and 324 to again open. The contacts 321 in opening interrupt the traced circuit of the magnet 315, but without effect since the cam 314 is now effective to hold the switch blade 316 in its operated position to maintain the motor circuit closed until the cams 313 and 314 have completed one revolution. The contacts 324 in restoring also interrupt the circuit of relay 335a which accordingly restores. The relay 325 finally, at contacts 328 connects the grounded conductor 338 to the lower winding of relay 330. The relay 330 has the upper terminal of its lower winding connected through its make before break contacts to conductor 349. This conductor extends to one of the leads 2—TIM of the collector switch associated with the adding machine employed to totalize the ticket sales made by the ticket issuing machines in the group to which the ticket issuing machine TIM belongs; and since, as previously explained, this collector switch and adding machine are identical to the collector switch and adding machine shown in the drawings, they have been omitted from the present disclosure. It will be obvious, however, that as soon as ground potential is connected to the lower terminal of the relay 330 through the winding of this relay to the conductor 349 the collector switch with which this conductor is associated will have marking potential therein and will be effective to influence its adding machine in the same manner that the collector switch and adding machine which are disclosed were influenced by the application of potential to the conductor 348. It will be appreciated, therefore, that almost immediately following the energization of relay 325 the relay 330 operates. This latter relay at its armature 331 disassociates itself from its adding machine and locks itself up to the grounded conductor 338, and at its contacts 332 completes the operating circuit of magnets 310 and 320. This circuit extends from battery, through the winding of magnets 320 and 310 in series, conductor 337, contacts 332, to the grounded conductor 338.

The magnet 310 operates and through the medium of its armature 311 moves the locking bar 301 to the right sufficiently to permit the operated key of the ticket issuing machine to restore to normal. The restoration of the key also brings about the restoration by the spring 350 of the off-normal bar 303 and the consequent opening of contacts 308. The opening of these contacts obviously interrupts the traced locking circuit of relays 325 and 330 as well as the operating circuits of magnets 310 and 320, and these relays and magnets accordingly restore to their normal position. Upon the deenergization of magnet 310 the spring 351 of the locking bar 301 restores this bar to its normal position in readiness to perform the locking operation upon depression of the next key. Ordinarily the magnet 310 will be operated before the ticket issuing machine has completed its cycle of operations and therefore before the cam 313 has its detent opposite the roller 319 and under such circumstances the energization of the magnet 320 is without effect. If, however, the ticket issuing machine has completed its cycle of operation prior to the completion of the circuit of the magnets 310 and 320 the magnet 320 functions to hold the arm 323 in its normal position to insure its associated contacts remaining open until after the off normal contacts 308 are separated, as, otherwise, a false operation of the ticket issuing machine might result. It will be obvious that when the ticket issuing machine completes its cycle of operations roller 322 again enters the detent on cam 314 and lifts the blade 316 on the armature of magnet 315 to open the circuit of the motor 317.

The relays 325 and 330, in restoring, again place the ticket issuing machine in its normal condition in readiness for reoperation.

In the adding machine, the relay 525, upon restoring, at its contacts 527 reestablishes the operating circuit of the collector switch and at its contacts 526 interrupts the circuit of its slave relay 535 and removes the ground potential heretofore traced to the conductor 501, and to the upper winding of control relay 561. The relay 561 now operates and at its contacts 567 interrupts another point in the operating circuit of relay 325, and at its contacts 568 closes a point in an alternative operating circuit for this relay. The relay 561, also, at armatures 564 and 565 opens points in the normal operating circuits of relays 535 and 550, and closes points in alternative operating circuits of these relays. Finally, the relay 561 at armature 563 interrupts a second point in the original operating circuit of register relay 569 and closes a point in the operating circuit of register relay 575.

The relay 535, upon restoring, at contacts 541 interrupts another point in its holding circuit, at contacts 542 also removes ground from a point in its holding and operating circuit. The relay 535, also, at contacts 539, removes the shunt from about the resistance 529, at contacts 538 recloses a point in the common branch of the operating circuit of relay 550, and at its contacts 537 interrupts another point in the circuit formerly supplying ground to conductor 501. The relay 535 finally at the armature 543 opens another point in the circuit to conductor 263 formerly employed in operating the relay 325 of the ticket issuing machine, at its back contacts closes a point in a similar circuit which will be referred to later, and at contacts 544 removes ground potential from the alarm conductor 515.

It is believed advisable at this time to briefly describe the purpose of the condenser 528 and its associated resistance 529, and the like condenser and resistance arrangement associated with similar circuits of the system. As previously explained, in order to make the relays 535 and 550 to operate at the highest possible speed they are made of comparatively low resistance and then, upon operation, cut in additional resistance in series with themselves. When the circuit of one of these relays, take the relay 535, for example, is closed by the contacts 526, the condenser 528 and the associated resistance 529 connected to ground provide an ideal arrangement for cutting down the arcing at contacts 526. On the other hand, however, when the relay 525 is once operated and has its associated resistance cut in series with it its impedance is changed to such an extent that if the condenser 528 still has its discharge path through the resistance 529 it will be of little effect in preventing arcing at the contacts 526 when these contacts interrupt the circuit of relay 535. For this reason the direct path from condenser 528 to ground at contacts 539 is provided and serves to reduce the spark occurring at contacts 526 to a minimum when the circuit of relay 535 is broken.

It will now be assumed that a key of another ticket issuing machine of the group to which

the ticket issuing machine TIM belongs is actuated and that such machine applies marking potential to conductor 240 of the collector switch CS. When the relay 209 of the collector switch operates it extends the marking potential on conductor 240 through a series of resting contacts and armatures of relays 210, 211, and 212 to the conductor 264, and thence through the winding of relay 530 to negative battery. The relay 530, upon operating, at its contacts 531 removes ground potential from the previously traced operating circuit of relay 535, and at its contacts 532 completes a circuit for its slave relay 550. This circuit extends from the grounded contacts 532, through contacts 538, 5007, the armature 564, through contacts 554, and the winding of relay 550 to negative battery. The relay 550 accordingly operates, and at its contacts 546 completes a locking circuit for itself excluding the armatures 554, 564, and the contacts 5007. The relay 550, also, at contacts 545 interrupts a second point in the operating circuit of relay 535, and at its armature 548 opens a point in the circuit previously traced for applying ground potential to conductor 501, and connects this conductor to the grounded lead now extending to the winding of relay 550. Since the control relay 561 is at this time in operated condition the ground potential on conductor 501 extends by way of armature 563 and its working contact, the resting contact and armature 586, contacts 571, and by way of contacts controlled by armature 576 to the winding of register relay 575 and battery. The relay 550, finally, at contacts 5024 closes a point in the operating circuit of the relay of the ticket issuing machine corresponding to the relay 325 of the ticket issuing machine TIM, and at its contacts 5023 applies ground potential to the alarm conductor 515.

The relay 575 operates over the traced circuit and at its armature 576 completes a locking circuit for itself including the contacts 587, the resistance 5112 and the grounded conductor 509, and opens its own operating circuit. The relay 575, at its armature 577, opens a second point in the operating circuit of relay 569 and closes a point in the operating circuit of relay 583, at its contacts 578 interrupts the locking circuit of relay 569, and at its contacts 579 interrupts the holding circuit of relay 553. The relay 575 also at its contacts 580 closes a point in the operating circuit of the relay in the connected ticket issuing machine corresponding to relay 325 of the ticket issuing machine shown, and at its contacts 581 and 582 modifies the indicator control circuits as required to indicate thereon the amount of the ticket sales which have been made.

The relay 569, upon restoring, at its armature 570 again closes a point in its own operating circuit and opens a point in its locking circuit, and at its contacts 571 opens a second point in the operating circuit of relay 575. The relay 569 also, at its contacts 572, opens a point in the previously traced circuit for operating the relay 325 of the ticket issuing machine TIM, and at contacts 573 and 574 removes ground potential from conductors previously grounded to influence the indicator in accordance with the previously recorded sale by the ticket issuing machine TIM.

The relay 553, upon restoring, at armatures 554 and 555 interrupts points in the alternate operating circuits of relays 535 and 550 and closes points in the normal operating circuits of these relays, and at armature 557 disconnects the grounded hold conductor 509 from the lower winding of relay 561 and substitutes the grounded conductor 501 therefor. The relay 553 also, at armature 558 completes the low resistance circuit from negative potential to the conductor 264 required to operate the relay of the connected ticket issuing machine corresponding to relay 325. This circuit extends from negative potential through the resistance 5027, contacts 580, 568, the contact and armature 558, armature 543 and its resting contact, and contacts 5024, to conductor 264. The operation of the relay in the connected ticket issuing machine brings about the deenergization of relay 530 in the same manner as the deenergization of relay 525 was brought about. The relay 530, upon restoring, at contacts 531 again closes a point in the operating circuit of relay 535 and again supplies ground potential by way of contacts 527 to the collector switch operating circuit, and at its contacts 532 interrupts the formerly traced circuit of relay 550, and removes ground potential from the conductor 501, thereby causing the restoration of the relays 550 and 561, respectively.

The relay 561, upon restoring, at armatures 565 and 564 opens points in the alternate operating circuits of relays 535 and 550, respectively, and close points in the normal operating circuits of these relays. The relay 561 also at armature 563 opens a second point in the operating circuit of relay 575 and closes a point in the operating circuit of relay 583. The relay 561 finally, at contacts 567 closes a point in a control circuit similar to that traced to conductors 263 and 264 to operate the ticket issuing machine relays such as 325, and at its contacts 568 opens another point in the operating circuit last employed to operate the relay in the connected ticket issuing machine corresponding to relay 325 of the ticket issuing machine shown.

The relay 550, upon restoring, at contacts 545 closes a point in the operating circuit for relay 535, at contacts 546 interrupts another point in its own locking circuit and at armature 547 disconnects the conductor 501 from its upper winding and reconnects this conductor to the armature 537 of relay 535. The relay 550 also at contacts 5024 opens another point in the low resistance path traced to conductor 264, and at contacts 5023 removes ground potential from the alarm conductor 515.

It will be quite obvious that the only reason for extending two control conductors 263 and 264 between the collector switch and the adding machine or calculating equipment is that provisions are made for the sale of a great many tickets of the $2 value compared to the tickets of greater values. It will be readily observed, however, that the conductors 263 and 264 are associated at times simultaneously with ticket issuing machines and that if two simultaneously connected $2 ticket issuing machines are in the process of issuing tickets during such time, both conductors 263 and 264 will have potential thereon, and consequently both of the relays 525 and 530 of the calculating equipment will operate. Under these circumstances the collector switch will have its operating circuit interrupted until both of the ticket sales have been properly registered. In order to further explain this phase of the invention it will now be assumed that the ticket issuing machine TIM of Fig. 3 applies a marking potential to its conductor 348, and that at the same time a ticket issuing machine of this same group applies marking potential to the conductor 1248 of the

collector switch. Upon operation of the relay 225 of the collector switch CS marking potential will be applied to the conductors 263 and 264 in the manner and over circuits as previously described, thereby effecting the operation of relays 525 and 530 of the calculating equipment.

The relay 530, upon operating, at its contacts 531 interrupts the operating circuit of the collector switch CS and at its contacts 532 completes an operating circuit for its slave relay 550 which is the same as the circuit previously traced.

The relay 525, upon operating, at its contacts 527 opens a second point in the collector switch operating circuit and at its contacts 526 closes a point in the operating circuit of its relay 535. The closure of contacts 526 is without effect at this time because of the removal of ground potential from the operating circuit of relay 535 by the actuation of contacts 531 of relay 530.

The relay 550, upon operating, at its armature 547 and its working contact extends ground potential to conductor 501, to armature 563 and its resting contact, the contacts controlled by armature 5008, armature 594 and its resting contact, armature 577 and its working contact, through contacts controlled by armature 584 and the winding of relay 583 to battery.

The relay 583 now operates and at its armature 584 completes a locking circuit for itself through the contacts 595, resistance 5112, and the grounded hold conductor 509, and interrupts its own operating circuit. The relay 583 also, at contacts 585, opens another point in the operating circuit of relay 569, and at contacts 587 interrupts the holding circuit of relay 575. The relay 583 also at armature 586 opens a second point in the operating circuit of relay 575 and closes a point in the operating circuit of relay 592, and at contacts 589 closes a point in the operating circuit of the relay, corresponding to relay 325, in the connected ticket issuing machine. The relay 583 finally, at its contacts 590 and 591 applies ground potential to the conductors of the indicator control circuit, as required to bring about the display of digits in accordance with the newly registered ticket sale.

The relay 575, upon restoring, makes circuit changes similar to those made upon the deenergization of relay 569 and in addition at contacts 579 closes the operating circuit of relay 553. This latter relay now operates and performs the same circuit changes as those previously performed by it, except that at this time it, at its contacts 558, completes the low resistance path from negative potential through resistance 5027, contacts 589, contacts 567, front contact and armature 558, armature 543 and its resting contact, contacts 5024, to conductor 264.

Upon the operation of the relay in the connected ticket issuing machine the relay 530 restores and at its contacts 531 closes one point in the operating circuit of the collector switch CS. This relay also, at contacts 531 completes the prepared operating circuit of relay 535, and at its contacts 532 interrupts the circuits extending through relay 550 and the upper winding of relay 561, respectively.

The relay 561 now operates and makes its usual circuit changes including the interruption of the low resistance path traced to conductor 264.

The relay 550, upon restoring, accomplishes the usual circuit changes as previously described except that since relay 525 is now operated the relay 550, at contacts 545 now completes the circuit of relay 535.

The ground potential supplied to conductor 501 at this time extends via armature 563 and its front contact, armature 586 and its front contact through the winding of relay 592, to battery.

Relay 592 now operates and at its armature 593 completes a locking circuit for itself including the contacts 5009, resistance 5112, and the grounded hold conductor 509, and interrupts a point in its own operating circuit. The relay 592 also at contacts 596 interrupts the circuit of relay 553 and at its contacts 599 closes a point in the low resistance path from negative potential to conductor 263 required to operate the relay of the ticket issuing machine and to bring about the deenergization of relay 525, all as previously described. Finally the relay 592 at contacts 5001 and 5002 modifies the indicator control circuits as required to bring about the display of an indication in accordance with the registration of the additional ticket sale.

The relay 583, upon restoring, makes circuit changes generally similar to those made upon the restoration of the similar relay 569.

Relay 553 restores and makes the usual circuit changes as previously described, and at its contacts 558 completes the prepared low resistance path from negative potential to the conductor 263. This circuit extends from negative potential through resistance 5027, contacts 599, contacts 568, the resting contact and armature 558, and the armature 543 and its working contact to the conductor 263.

Upon the consequent operation of the relay in the connected ticket issuing machine relay 525 now restores and at its contacts 527 again completes the operating circuit of the collector switch CS, and at its contacts 526 again interrupts the circuit of relays 535 and 561. These relays accordingly again restore to normal.

Units indications

With the units registering relays of the adding machine in normal position operating circuits are prepared for the energization of the C and D relays of their associated units digit indicating equipment. The circuits of Fig. 9 show circuits including a set of indicator control relays A to E which may be employed to control digit indicating lamps of any indicating order of the system. If these circuits are employed as the units indicating control circuits, the prepared circuit for the relay D extends from ground supplied through contacts 560 of relay 553, through armatures 582, 5002, and 5022 and their resting contacts, conductor 518, through contacts of the relay 600, conductor 603, to the terminal 903 of the indicating equipment shown in Fig. 9 and the winding of relay D to battery. The circuit prepared for relay C extends from the grounded contacts 559, through the armatures 581, 5001, 5019, and their resting contacts, conductors 519, through contacts of relay 600, conductor 602, terminal 902, and through the winding of relay C to negative battery. It will be recalled that the relay 600 is intermittently operated during the ticket selling period and therefore with the units registering relays in the normal condition relays C and D will operate and, as observed by the chart, complete circuits for lamps as required to display the digit "0".

As previously described, the relays 553 and 569 of the units registering group will be in operated condition consequent to the sale of one $2 ticket. Under these circumstances, when the timing equipment at the control board functions and

brings about the operation of relay 600 the prepared circuits of relays C and E of the equipment shown in Fig. 9 will be completed to cause the digit 2 to be displayed in the units indicating frame.

If two ticket sales have been made the relay 575 will be actuated to prepare for the closure of circuits of relays A and B of the indicator control group, consequent to the operation of relay 600. As indicated by the chart, when these two relays are actuated the digit 4 will be displayed in the indicator frame. The circuit for relay A extends from ground supplied through the contacts 560, the armature 582 and its working contact, armature 5020 and its resting contact, conductor 516, through contacts of relay 600, conductor 605, the terminal 905, and the winding of relay A to negative battery. The circuit for relay B extends from the grounded contacts 559 through the armature 581 and its working contact, conductor 520, contacts of relay 600, conductor 601, terminal 901 and the winding of relay B to negative battery.

In case three ticket sales have been made the relays 583 and 553 will be operated. Under these circumstances circuits are prepared by the relay 583 for the operation of relays A and D, consequent to the operation of relay 600. The circuit for relay A under this condition extends from the ground through contacts 590, armature 5017 and its resting contact, to conductor 518, contacts of relay 600, conductor 603, the terminal 903 and through the relay D to negative battery. The circuit for relay A extends from ground supplied through contacts 591 to conductor 516 and over the previously traced circuit to the relay A.

If four ticket sales have been made the relay 592 will be in operated condition, and at its contacts 5001 and 5002 will prepare circuits for the operation of relays D and E, consequent to the energization of relay 600. The circuit for relay D at this time extends from ground through contacts 560, armature 582 and its resting contact, armature 5002 and its working contact, armature 5021 and its resting contact, to conductor 517 and over the previously traced circuit through relay E and battery. The circuit for the relay D extends from ground supplied through contacts 559, the armature 581 and its resting contact, armature 5001 and its working contact, armature 5018 and its resting contact, to conductor 518, and over the previously traced circuit to the relay D and negative battery.

In the operation of any adding machine the units registering relays UR function to bring in the units indication of the first four of a series of five $2 ticket sales, as already shown. The receipt of a fifth $2 ticket sale causes the units registering relays to again prepare the units indicator control circuits for the display of the digit 0 in its units indicating frame and the tens registering relays to prepare the tens indicator control circuits for displaying a digit one point higher than previously displayed, thereby to account for the five $2 ticket sales which have been made.

As a result of the making of the fifth $2 ticket sale the relay 592 is restored to its normal position and the previously described circuits for bringing about the display of 0 in the units digit initiating frame are again prepared.

In the tens relay group the registration in its tens indicating frame of a single $5 ticket sale does not immediately occur, but on each second $5 ticket sale it functions to raise the indication in the tens indicator frame one point. Obviously, relays of the tens group function consequent to each $10 ticket sale made to cause the tens indication to be raised one point.

Upon a $50 ticket sale being made, relays of the tens group function to control the tens indicating circuits as required to raise the displayed number therein five points. In case any fifth $2 ticket sale, any second $5 ticket sale, any $10 ticket sale, or any $50 ticket sale raises the total ticket sales to $100 or over, the tens digit relays perform carry-over functions so that the tens indicator frame will indicate any tens which are in addition to the $100 in ticket sales, and the digit 1 will be made to appear in the hundreds indicating frame.

Fifth $2 ticket sale

It will now be assumed that a fifth $2 ticket sale is made and as a consequence thereof marking potential is applied to conductor 264. The relay 530, accordingly, again operates and as in the previous instances stops the operation of the collector switch and completes an operating circuit to its slave relay 550.

The relay 550, upon operating, makes the previously described circuit changes excluding the completion of the operating circuit of relay 553 since its circuit is now open at contacts 596, and extends ground potential by way of armature 563 and its resting contact, contacts controlled by armature 5008, armature 594 and its working contact, conductor 505, contacts 626, 639, 699, and conductor 504 through the winding of relay 5003 to negative battery.

The relay 5003 accordingly operates and at its armature 5008 completes a locking circuit for itself excluding conductors 504 and 505 and opens a point in its traced operating circuit. The relay 5003 also at contacts 5004 opens another point in the operating circuit of the collector switch, and at contacts 5006 and 5007 opens common points in the operating circuits of relays 535 and 550, respectively. The relay 5003 also at contacts 5005 removes ground potential from conductor 503 to prevent the operation of either of the slave relays 622 or 632 of the tens registering relay group from being controlled by a $10 ticket sale while a registration is being made therein consequent to the fifth $2 ticket sale. The relay 5003 also, at contacts 5010, interrupts a second point in the operating circuit of relay 553, and at contacts 5011 extends the grounded conductor 501 to the conductor 508 extending to the tens registering relay group. The relay 5003 finally, at its contacts 598, closes a point in a circuit employed an instant later to control the connected $2 ticket issuing machine and at contacts 5009 interrupts the locking circuit of relay 592.

The relay 592, upon restoring, at contacts 5001 and 5002 again closes points in the indicator control circuits as required to bring about the display of the digit 0.

The now grounded conductor 508 extends to relays 644, 651 and 660 of Fig. 6. These latter relays are employed to receive and register each two $5 ticket sales in the tens indicator equipment and for also receiving and registering each aggregate five $2 ticket sales therein.

The ground potential applied to conductor 508 extends to the upper winding of relay 651 by way of its contacts 654 and to the lower winding of this relay by way of its contacts controlled by armature 647.

Relay 644 now operates, at contacts 645 opens a point in one of the operating circuits of relay

632, at contacts 647 substitutes the grounded hold conductor 509 for conductor 508 so far as the circuits to the relay 644 and through the lower winding relay 651 are concerned, and at contacts 648 prepares a point in the low resistance path from negative potential required to operate the relay in the connected ticket issuing machine. The relay 644 at contacts 649 and 650 removes ground potential from certain of the indicator control circuits as did the corresponding relay 553 of the units register relay group.

The ground potential applied to conductor 508 also extends by way of armature 652 and its resting contact, through contacts controlled by armature 698, armatures 689 and 670 and their resting contacts, contacts 679 and through contacts controlled by armature 661 to the winding of relay 660 to battery.

The relay 660, upon operating, at contacts 662 closes a point in an operating circuit for relay 668 and at armature 661 completes a locking circuit for itself including contacts 671 and resistance 6008, and the grounded hold conductor 509, and interrupts a point in its own operating circuit. The relay 660, also at contacts 663 completes the required low resistance path from negative potential to conductor 264 which is required to operate the relay in the ticket issuing machine and to bring about the restoration of the relay 530 of the units registering relay group. This circuit extends from negative potential through the resistance 6004, contacts 663, 658, the front contact and armature 648, conductor 510, contacts 598, armature 543 and its resting contact, through contacts 5024 to conductor 264 and over the previously traced circuit to the relay in the ticket issuing machine.

The relay 660 finally, at its contacts 664, 666 and 667 makes circuit changes in the indicator control circuits as required to cause the digit 1 to be displayed on its indicating equipment upon operation of the relay 600.

The relay 530, as in previous instances, now restores and at its contacts 531 again applies ground potential to the conductor 5026 to again start the collector switch, but without effect at this time, since the circuit is now open at contacts 5004, and at contacts 532 opens the circuit of its slave relay 550 and removes ground from conductor 501, and consequently from the holding circuit of relay 5003 and from the conductor 508 extending to the upper winding of relay 651.

Relay 550 restores and makes the usual circuit changes. It may be well to note that in this instance the relay 550 at contacts 5024 interrupts the traced low resistance path to the ticket issuing machine.

Relay 5003, upon restoring, at contacts 5004 recloses the operating circuit of the collector switch CS, at contacts 5005 reconnects ground potential to conductor 503 to enable the tens registering relay group to be again operated consequent to the occurrence of $10 ticket sales, and at contacts 5006 and 5007 again closes points in the operating circuits of relays 535 and 550. The relay 5003, also, at contacts 5008, opens a second point in its own locking circuit and again prepares a point in the operating circuit of relay 569, and at contacts 5009 closes a point in the locking circuit of relay 592.

The relay 5003, finally, at contacts 5010 recloses a point in the operating circuit of relay 553, at contacts 5011 again separates conductors 501 and 508 and at contacts 598 opens another point in the traced low resistance path from negative battery in the operating circuit of the relay in the ticket issuing machine.

Relay 651 operates consequent to the removal of ground potential from conductors 501 and 508 and at its contacts 658 opens another point in the low resistance path previously referred to, and at its contacts 659 prepares another such path for subsequent use. The relay 651 also, at its armature 653, opens a point in the normal operating circuit of relay 632 and closes a point in the alternate operating circuit of this relay, and at armature 652 interrupts a second point in the operating circuit of relay 660 and closes a point in the operating circuit of relay 668.

$5 ticket sales

When a $5 ticket sale is made the collector switch CS picks up and extends marking potential over conductor 261 extending to the winding of relay 616 and battery.

The relay 616, upon operating, at contacts 618 opens the operating circuit of the collector switch CS and at its contacts 617 connects the grounded conductor 503 to the upper terminal of its slave relay 622 by way of the contacts controlled by armature 636. The relay 622, upon operating, at contacts 623 opens a second point in the operating circuit of the collector switch CS, at contacts 624 opens a point in the operating circuit of slave relay 632, at contacts 626 opens one of two multiple paths including the operating circuit of relay 5003, and at contacts 627 closes a point in an auxiliary locking circuit for itself. The relay 622 also at contacts 629 closes a point in a low resistance path subsequently established between the adding machine and the connected ticket issuing machine by way of lead 261, at contacts 630 extends ground potential to conductors 514 and 513 to the relays 5029 and 5037 by way of contacts 523 of the latter relay and 6005 of relay 697 in multiple. The relay 622 also at its contacts 631 applies ground potential to the alarm conductor 515.

The ground potential applied to conductor 513 extends by way of contacts 5038 to the upper winding of relay 5037 and by way of branch conductor 522 and contacts controlled by armature 5032 to the lower windings of relays 5029 and 5037, respectively. The relay 5037 being differential does not operate at this time.

The relay 5029 operates and at its contacts 5032 completes a locking circuit for itself by substituting the grounded hold conductor 509 for the branch 522 of conductor 513. The relay 5029 at contacts 5030 closes a point in the operating circuit of relay 5013, at contacts 5033 opens a point in a possible path between conductors 508 and 514, at contacts 5034 opens one of the three multiple paths between conductors 514 and 513, the other paths being through contacts 6005 of relay 697 and through contacts 523 of relay 5037. The relay 5029 in addition, at contacts 5035, opens a point in a low resistance operating circuit for a ticket issuing machine subsequently connected to conductor 261 by way of conductor 507 and contacts 629, and at contacts 5036 closes a low resistance path from negative potential through resistance 5028 to conductor 261 and to the connected ticket issuing machine by way of contacts 5042, conductor 507, and contacts 629 of relay 622.

Upon operation of the relay in the ticket issuing machine the relay 616 restores and at its contacts 618 closes another point in the operating circuit of the collector switch CS, and at its con-

tacts 617 opens the circuit of relay 622 and removes ground potential from the path extending by way of contacts 630 to conductor 513, and to the upper winding of the differential relay 5037.

Relay 622 at contacts 623 recloses the operating circuit of the collector switch CS, at contacts 624 closes a point in the operating circuit of relay 632, and at contacts 626 connects conductors 505 and 506 together in multiple with contacts 5039 of relay 5037. Relay 622 also at contacts 627 opens a point in the auxiliary locking circuit for itself, at contacts 629 opens a point in the low resistance path from negative potential to the conductor 261, at contacts 630 opens a second point in the circuit traced through the upper winding of relay 5037, and at contacts 631 removes ground potential from the alarm conductor 515.

Relay 5037 now operates and at armature 5038 transfers the conductor 513 from its upper winding into connection with the upper winding of differential relay 5029, and at contacts 5039 separates conductors 505 and 506 at this point, but without effect since contacts 626 in multiple with 5039 are now closed. The relay 5037 at contacts 5041 closes a point in an alternative low resistance control path, and at contacts 5042 opens the traced low resistance path to conductor 261. The energized condition of relays 5029 and 5037 constitutes the storage of one $5 ticket sale in the calculating equipment.

Consequent to a second $5 ticket sale, marking potential is again applied to conductor 261 and through the winding of relay 616 to battery. The relay 616 accordingly again operates and at its contacts 618 interrupts the operating circuit of the collector switch CS and again at contacts 617 closes the operating circuit of relay 622.

Relay 622, upon operating, at contacts 626, electrically separates conductors 505 and 506 because of the operated condition of contacts 5039 of relay 5037, at contacts 630 extends ground potential to conductor 514 and by way of contacts 6005 to conductor 513 as before. Since the relay 5037 is now operated, however, the ground potential now extends to the upper winding of the differential relay 5029 to battery, causing this latter relay to restore.

The relay 5029, upon restoring, at contacts 5032 reconnects its lower winding and the lower winding of relay 5037 to conductor 513, at contacts 5034 connects the grounded conductor 514 to the branch 524 of conductor 513, so that conductor 513 is now grounded independent of contacts 6005. The relay 5029 also, at contacts 5035, connects conductor 510 to 507 to prepare a point in the low resistance path of negative potential back to the connected ticket issuing machine, and at contacts 5036 closes a point in a low resistance path to the ticket issuing machine subsequently connected to conductor 261. The relay 5029 finally, at contacts 5033, connects grounded conductor 514 to conductor 508, and since relays 644 and 651 at this time are in operated position, ground on conductor 508 now extends by way of the armature 652 and its front contact, armature 680 and its back contact, and contacts 662 to the winding of relay 668 and negative battery.

The relay 668, upon operating, at armature 670 opens a second point in the operating circuit of relay 660 and closes a point in the operating circuit of relay 677, and at contact 669 locks up through contacts 681 and resistance 6008 to the grounded conductor 509. The relay 668 also at contacts 673 closes a point in the low resistance path being prepared from negative potential to the connected ticket issuing machine, and at its contact 672 interrupts the circuit of relay 644. The relay 668 finally at contacts 671 interrupts the locking circuit of relay 660, which accordingly restores, and at contacts 674, 675, and 676 modifies the indicator control circuits as required to properly prepare for an indication of the additional $10 in ticket sales in the tens indicator frame.

The relay 644, upon restoring, at contacts 645 opens a point in the alternative operating circuit of relay 632 and recloses a point in its normal operating circuit, and at contacts 647 reconnects its winding and the lower winding of relay 651 to the conductor 508 which, it will be recalled, now has ground potential applied to it from contacts 5005 over conductor 503, contacts 617, contacts controlled by armature 635, contacts 630, conductor 514, contacts 5033, and 5040 to conductor 508. The relay 644 finally, at contacts 649 and 650, reconnects ground potential to the conductors of the tens indicating control group, and at its contacts 648 completes the low resistance path required to operate the relay in the connected ticket issuing machine. This circuit extends from the negative potential through the resistances 6004, contacts 673, 659, the resting contact and armature 648, conductor 510, contacts 5041, 5035, conductor 507, contacts 629, to conductor 261 and to the connected ticket issuing machine.

The relay 616, upon subsequently restoring, at contacts 618 closes a point in the collector switch operating circuit and at contacts 617 removes ground potential from its slave relay 622 and, of course, from the traced circuit to the upper and lower windings of relay 5029 and to the lower winding of relay 651. The relay 5037 accordingly now restores.

Relay 622 now restores, and in addition to reestablishing the usual circuit conditions, at contacts 623 finally closes the collector switch operating circuit.

Relay 651, upon restoring, at contacts 653 again completes the preparation of the normal operating circuit of relay 632, at contact 652 opens a second point in the operating circuit of relay 668, and prepares a point in the operating circuit of relay 677. The relay 651, also, at contacts 658 closes a point in the low resistance path to the next connected ticket issuing machine, and at contacts 659 opens the last completed low resistance path to the last connected ticket issuing machine.

$10 ticket sales

When the collector switch picks up marking potential on a lead extending from a ticket issuing machine selling $10 tickets, for example from conductor 239, of the collector switch CS, relay 213, which connects such lead to conductor 262, extends the marking potential on this latter conductor through the winding of relay 619 to battery. Relay 619 accordingly operates and at its contacts 621 opens the operating circuit of the collector switch, and at its contacts 620 completes a circuit for its associated slave relay 632. This circuit extends from ground on conductor 503, through contacts 620 and 624, the armatures 6019 and 6007 and their resting contacts, contacts 6001, the armatures 653 and 645 and their resting contacts, the winding of relay 632 to battery. The relay 632 at its contacts 639 opens a point in the operating circuit of relay 5003, at

contacts of armature 636 opens a point in the operating circuit of relay 622 and closes a point in an auxiliary locking circuit for that relay; and at contacts 638 separates conductors 255 and 256 from each other, but without effect as they are now connected together by the contacts 267 of the collector switch relay 213 and connects conductor 256 to conductor 254, but without effect at this time as conductor 254 is open at contacts 268 of the collector switch. The relay 632 also at contacts 642 closes a point in a low resistance path being prepared from negative potential to the connected ticket issuing machine, and at its contacts 640 completes a locking circuit for itself independent of contacts 6019, 6007, 6001, 653, 645, and extends its operating ground to control conductor 508 by way of contacts 641, conductor 260, contacts 265, conductor 259, and conductor 508 to relays 644 and 651 as in the previous case when conductor 508 became grounded. This ground potential also extends by way of the armature 652 and its resting contact, contacts controlled by armature 698, armature 689 and its back contact, armature 670 and its front contact, contacts controlled by armature 678, and through the winding of relay 677 to battery.

The relay 677, upon operating, at contacts 680 opens a second point in the operating circuit of relay 668 and closes a point in the operating circuit of relay 687, at contacts 679 opens a point in the operating circuit of relay 660, and at contacts 678 locks up by way of contacts 690, resistance 6008 and the grounded hold conductor 509. The relay 677 also at contacts 681 interrupts the locking circuit of relay 668, and at its contacts 682 prepares a point in a low resistance path to the ticket issuing machine. The relay 677 finally, at its contacts 683, 684, 685 and 686, modifies the condition of the indicator control circuits as required to prepare for a display of digits in accordance with the newly registered $10 ticket sale.

The relay 668, upon restoring, at contacts 672 now completes the previously traced circuit for relay 644. This relay accordingly operates and at its armature 648 completes a low resistance path to the connected ticket issuing machine, by way of contacts 682 and 658, front contact and armature 648, conductors 510 and 257, contacts 269, conductor 258, contacts 642, to the conductor 262 and to the connected ticket issuing machine.

Relay 619 now restores and at contacts 621 again closes the collector switch operating circuit and at its contacts 620 removes ground potential from relays 632 and conductor 508 thereby permitting the relay 651 to operate and 632 to restore.

The relay 651, at this time at contacts 652, prepares an operating circuit for relay 687, and at its contacts 659 closes a point in the next low resistance path to be employed for control of the subsequently connected ticket issuing machine.

It will be obvious from the foregoing description that the relays 644 and 651 are controlled by the $10 ticket issuing machines to register $10 ticket sales and are also controlled by circuits completed consequent to each fifth $2 ticket sale. It will be obvious, therefore, that upon the next $10 ticket sale, or alternatively, upon the last of the next five $2 ticket sales relay 687 will be operated to prepare the tens indicating control circuits as required to display the digit 4. In order to save equipment the registration for indication of the fifth to ninth tens digits the circuits are arranged so that each fifth $10 registration effects the actuation of the $50 register relays 6006 and 6017, and the $10 registering relays 660, 668, 677, and 687 are then used over again to register the sixth to ninth tens digits.

To illustrate further, it will now be assumed that the relay 687 has been operated and that, consequent to a $10 ticket sale by a ticket issuing machine connected to the collector switch conductor 239, the relays 619 and 632 again operate. The relay 632 in operating again extends ground potential over the previously traced circuit to relays 644 and 651 and to the armature 652 of the latter relay. The ground potential on armature 652 extends via its back contact, contacts controlled by armature 698 and armature 689 and its front contact to the winding of relay 697 and negative battery. A branch of this circuit also extends back over conductor 255, through contacts 267, and conductors 256 and 656 to the $50 registering relays 6006 and 6017, respectively.

The relay 697, upon operating, at contacts 6001 opens a point in the operating circuit of relay 632, at contacts 699 opens a point in the operating circuit of relay 5003, and at armature 698 completes a locking circuit for itself excluding contacts of relay 687. The relay 697 also, at contacts 6002 interrupts the locking circuit of relay 687 permitting that relay to restore. In addition the relay 697, at contacts 6003 prevents the closure of the circuit of relay 644, consequent to the closure of contacts 691. The relay 697 finally, at contacts 6004 closes a point in the low resistance path which must be completed to the connected ticket issuing machine, and at contacts 6005 opens one of three multiple connections between conductors 513 and 514.

The ground potential applied to conductor 656 extends by way of armature 6018 and its resting contact to the upper winding of relay 6017, and by way of contacts controlled by armature 6011 to the lower winding of relays 6006 and 6017.

The relay 6006, upon operating, at its armature 6011 completes a locking circuit for itself and for the lower winding of relay 6017, including the grounded hold conductor 509 in substitution for the ground potential originally supplied to it via conductor 656. The relay 6006 also at contacts 6007 opens one point in the normal operating circuit of relay 632 and closes a point in the alternative operating circuit of this relay, at contacts 6012 closes a low resistance path from negative potential to the conductor 262 and to the connected ticket issuing machine. This circuit extends from negative potential through resistance 646, contacts 6012, 6022, contacts 6004, conductors 510 and 257, contacts 269, conductor 258, and contacts 642 to conductor 262 and to the connected $10 ticket issuing machine. The relay 6006 also, at contacts 6013, opens a point in an alternative low resistance path to conductor 262. Finally, the relay 6006 at armatures 6015 and 6016 modifies the tens indicator control conductors as required to bring about the registration for display of the digit 5 in the tens indicating frame.

The relays 619 and 622 now restore as in the previous examples and ground potential is accordingly removed from the conductor 656. This results in the operation of relay 6017, which, at armature 6019 opens a point in the normal operating circuit of relay 632 and closes a point in its alternate operating circuit. The relay 6017 also at contacts 6018 disconnects its upper winding from conductor 656 and connects the upper

winding of relay 6006 thereto. The relay 6017 also, at contacts 6022, opens a point in the traced low resistance path to the last connected ticket issuing machine, at contacts 6023 prepares a similar circuit for the next low resistance path to be completed by the $50 register relays, at contacts 6024 closes a point in an operating circuit for the hundreds register switch magnet 809, and at armature 6025 further modifies the indicator control circuits, but without effect in this particular instance.

$50 ticket sales

If now the collector switch CS picks up marking potential from a conductor such as 237 extending from a $50 ticket issuing machine, the collector switch relay 210, upon operating, will extend this marking potential to the conductor 262 and accordingly relays 619 and 632 will operate as previously described. This time, however, due to the energization of relay 210, the relay 632, at contacts 641 extends ground potential out over conductor 260, through contacts 268, conductor 254, the front contact and armature 638 to conductor 656. This ground potential now extends via armature 6018 and its front contact to the upper winding of relay 6006 and negative battery.. The differential relay 6006, accordingly restores and at its contacts controlled by armature 6011 connects the grounded conductor 656 to the lower windings of relays 6006 and 6017 in substitution for the grounded hold conductor 509. The relay 6006 also, at contacts 6007 opens a point in the alternate operating circuit of relay 632 and recloses a point in its normal repeating circuit, at contacts 6012 opens another point in one of the low resistance paths previously employed, at contacts 6013 closes a point in the low resistance path about to be completed to the connected ticket issuing machine. The relay 6006 finally, at contacts 6014, completes an operating circuit to the magnet 809 of the hundreds digit register switch H, and at its armatures 6015 and 6016 modifies the tens indicator control circuit as required to prepare for the indication of the digits 1 to 4 or 0 in the tens indicator frame as determined by the operated one of the relays 660, 668, 677 or 687, or by the non-operated condition of all these relays. The operating circuit to the magnet 809 extends from ground potential supplied through contacts 6024 and 6014 to conductors 512 and 551 through the wiper 814 and one of its bank contacts, the resistance 849, to the winding of magnet 809 and negative battery, or alternatively via wiper 814 and one of its bank contacts 868 or 891 to relay 820. In any case the magnet 809 of the hundreds switch H is operated in a manner which will subsequently be described and extends negative potential back to the connected ticket issuing machine. This negative potential extends over conductors 552 and 511, through contacts 6023 and 6013, to conductor 253, through contacts 245 of relay 210, conductor 258, contacts 642 to conductor 262 and to the connected ticket issuing machine.

The relays 619 and 632 now, as in previous examples, restore and ground potential is accordingly removed from conductor 656. Upon the removal of ground potential from this conductor ground potential is removed from both windings of relay 6006 which therefore remains restored, and from the lower winding of relay 6017 which accordingly now restores. The relay 6017, at its contacts 6019 opens a point in the alternate operating circuit of relay 632 and recloses a point in its normal operating circuit, and at armature 6018 reestablishes the normal circuit connections of the upper windings of relays 6006 and 6017. The relay 6017 also, at contacts 6023, opens a point in the last traced low resistance path to conductor 262, and at contacts 6024 opens the circuit traced to the hundreds register H. The relay 6017 finally, at armature 6025, modifies the tens indicator control circuits as required to complete the preparation for the display of a tens digit depending on the condition of the tens register relays at this time.

If a $50 ticket sale is made at a time when any one of the tens register relays 660, 668, 677 or 687 is in operated position and at a time when relay 6017 is in its normal position, the relay 6017 will be operated to prepare for the display of the digit 6, 7, 8, or 9 in the tens indicator frame. In such operation when the collector switch picks up marking potential from a conductor such as 237 extending from the ticket issuing machine of the $50 group 50—TIM the collector switch extends this potential to the conductor 262 and accordingly relay 619 will operate as in the previous examples.

The relay 632 will accordingly also operate as previously except that it now, at contacts 641, extends ground potential to relays 6006 and 6017, via conductor 260, contacts 268, conductor 254, the front contact and armature 638, the conductor 656 and to the relays 6006 and 6017.

The relay 6006 accordingly operates and completes circuits such as previously closed by it except that the low resistance path back to the connected $50 ticket issuing machine extends through resistance 646, contacts 6012, 6022, conductor 253, contacts 245, conductor 258, and contacts 642 to conductor 262.

$100 ticket sales

Ticket issuing machines which issue tickets of $100 valuation are connected to conductors of the collector switch grouped under the bracket 100—TIM. In order to describe the operations which follow a $100 ticket sale it will be assumed that such a sale has resulted in the placing of marking potential on conductor 243 of the collector switch CS. Upon the next operation of the relay 201 of the collector switch, marking potential is extended to the conductor 262 to again bring about the energization of the relay 619 of the tens group.

At this time following the operation of relay 619 the relay 632 operates and makes the usual circuit changes except that this time contacts 641 extend to ground potential, connected to the upper terminal of the relay 632, to the motor magnet 809 of the hundred register switch H. This circuit extends over the conductor 260, through contacts 271 of relay 201, conductors 251 and 551, the wiper 814 of switch H, and its bank contact, through the resistance 849 and the winding of the magnet 809 to negative battery.

The magnet 809, upon operating, at its contacts 810 opens a point in a self restoring circuit for the switch H, and at its contacts 812 connects the grounded hold conductor 509 to conductor 615 comprising a branch of alarm conductors 109 and 515, and at its contacts 811 completes the required low resistance path from negative potential to the conductor 262 and to the connected ticket issuing machine. This circuit extends from the negative battery through the resistance 867, the bank contact and wiper 815, conductor 819, contacts 811, conductor 552, to the junction

of conductors 252 and 511, respectively. The circuit extends by way of conductor 252, contacts 272, conductor 258, contacts 642, and then to the conductor 262 and the connected ticket issuing machine.

Relay 619 now restores and at its contacts 620 interrupts the circuits of relays 632 and of the magnet 809. The relay 632, upon restoring, at its contacts 642 opens the traced low resistance circuit to the conductor 262.

The magnet 809, upon restoring, advances its wipers 813 to 818, inclusive, one step. The function of the various wipers of the switch H are briefly as follows: 813 is employed to bring about the restoration of the switch H at the conclusion of a ticket selling period; 814 to carry over each accumulation of ten hundreds to the switch T; 815 to bring about the establishment of the required low resistance path to the ticket issuing machine from switch H and at times from switches T and TH, respectively; 816 is employed to determine to which of the indicator control wipers operating current will be applied on operation of the associated indicator control relay 823; while wipers 817 and 818 jointly feed potential to their associated indicator control conductors to prepare for the display of the appropriate indications in the hundreds digit indicating frame.

It will be quite clear that on each subsequent $100 ticket sale the relays 619, 632, and the operating magnet 809 will go through the cycle of operations just described resulting in the advancement of the wipers of the hundreds switch H one step for each $100 ticket sale. And, as heretofore shown, will advance one step whenever the accumulation of the $2, $5, $10 and $50 ticket sales comprise a total of $100 in ticket sales.

In order to explain the carry-over from the hundreds switch H to the thousands switch T and from the thousands switch to the ten-thousands switch TH, and finally the operation of the hundred-thousands relay HT, it will first be assumed that the wipers of the hundreds switch H have been advanced nine steps consequent to nine energizations and deenergizations of its operating magnet 809 resulting from ticket sales amounting to $900, and that an additional $100 ticket sale is made. This time the relay 632, upon operating and closing its contacts 641 extends ground potential out over the conductor 260 and over the previously traced circuit to the conductor 551. Since, however, the wiper 814 of the switch H is now in engagement with its contact 868 this ground potential extends to the winding of hundreds carry-over relay 820 and to battery instead of directly to the operating magnet 809 of the switch H as formerly.

The relay 820, upon operating, at contacts 821 completes an obvious operating circuit for the magnet 809 of the switch H and at its contacts 822 completes an obvious operating circuit to the magnet 805 of the thousands switch T. The magnets 805 and 809 now jointly complete the required low resistance path from negative potential to the conductor 552 and over the previously traced circuit extending back to the connected ticket issuing machine. The circuit over which negative potential is connected to the conductor 552 extends through the resistance 867, conductor 840, the bank contact and wiper 845, conductor 836, contacts 807, the bank contact 869 and wiper 815, conductor 819, contacts 811, to the conductor 552.

As in former instances the connection of the low resistance path from negative potential to the conductor 552 results in the deenergization of relay 619 and 632 and in the resulting deenergization of the hundreds carry-over relay 820. This latter relay, upon restoring, interrupts the operating circuit of magnets 805 and 809 thereby permitting them to deenergize and opens points in the low resistance path traced and to advance their wipers one step. The second series of ten bank contacts of switch H and also of switches T and TH are in multiple with the first employed series and therefore consequent to the advancement of wipers such as 817 and 818 of switch H following the recording of $100 ticket sales, the wipers 817 and 818 will be associated with the proper indicator conductors to again prepare for the display of the digit 0 in the hundred indicating frame. The wipers 814 and 815 in advancing one step following the registration of the tenth $100 in ticket sales opens a second point in the operating path to the hundreds carry-over relay 820 and in the second path traced from the low resistance 867 and again prepare the direct operating circuit for magnet 809 and the initially employed low resistance path. Accordingly, subsequent $100 sales will be effective to operate the magnet 809 of the switch H until $900 in ticket sales have been made following which the wiper 814 will again prepare an operating circuit for the hundreds digit carry-over relay 820. When ground potential is applied to conductor 551 as a result of the twentieth $100 in ticket sales, the relay 820 will be operated a second time and will bring about the operation of magnets 805 and 809 as previously. These magnets upon operating will again complete the low resistance path from negative potential back to conductor 552 to bring about the restoration of the relay 619 and of relay 632 in case the changes are occurring consequent to the sale of a $10, $50, or $100 ticket, in the restoration of relays 616 and 622 if the changes are occurring consequent to the sale of a $5 ticket, or in the restoration of relays 525 and 535 or 530 and 550 if the changes are occurring consequent to the sale of a $2 ticket.

Following the deenergization of the relay affected, the relay 820 again restores and in turn interrupts the circuit of magnets 805 and 809. These magnets, upon restoring, again advance their wipers one step and interrupt the established low resistance path back to the connected ticket issuing machine.

The wiper 813 of the switch H is now brought into engagement with its grounded bank contacts and the magnet is accordingly energized over a self interrupting circuit including its break contacts 810, and it accordingly advances its wipers into the position in which they are shown.

It will be appreciated from the foregoing that the hundreds digit registering switch will consecutively register each hundred dollars in ticket sale and that on each tenth hundred dollar accumulation it will be operated in multiple with the thousands registering switch T to effect the registration of the $1000 accumulation therein. In a similar manner when nine thousand dollars in ticket sales have been made the switch T will have its wipers 844 and 845 in engagement with their bank contacts 871 and 872, respectively. With the wipers of the switch T in this position, and with the wipers of the hundreds switch in engagement with their contacts 868 and 869 and ground potential on conductor 551 consequent to the additional ticket sales amounting to $100

ground potential will be extended over the previously traced circuit to magnets 809 and 805 and also over wiper 844, its bank contact 871 and to the winding of magnet 801 of the ten thousands switch TH to battery. The magnets 801, 805 and 809 now jointly function to apply negative potential to the conductor 552. The circuit in this instance extends through resistance 867, the bank contact and wiper 855, conductor 837, contacts 803, the bank contact 872 and wiper 845, conductor 836, contacts 807, the bank contact 869 and wiper 815, conductor 819, and contacts 811 to the conductor 552.

As soon as ground potential is again removed from conductor 551 the magnets 801, 805 and 809 will advance their wipers one step. In the present instance, the magnet 809 will bring its controlling wiper 813 into engagement with the first of the last three grounded bank contacts and will accordingly proceed to step the wipers into the position shown. The wipers 817 and 818 are accordingly again positioned as required to produce the 0 indication in its indicating frame.

The wipers of the switch T will be advanced to their eleventh position so that the wipers 847 and 848 will be in their eleventh or second normal position and will accordingly prepare circuits for displaying the digit 0 in the frame of the thousands digits indicator frame. Since the wipers of the switch TH have under the present assumption been advanced one step the wipers 857 and 858 will have prepared circuits for the display of the digit 1 in the indicator frame of the ten thousands indicator frame.

With the wiper 854 of the switch TH in engagement with its bank contacts 874 and with the remaining wipers of switch TH in a corresponding position this switch is prepared for the display of the digit 9 in its indicating frame. In the switch T with its wipers 844 in engagement with its bank contact 877 and with the remaining wipers in a corresponding position this switch has prepared for the display of the digit 9 in its indicating frame. Likewise when the wiper 814 of the switch H is in engagement with its contact 891 and with its other wipers in a corresponding position it has prepared to display the digit 9 in its indicating frame. Under these circumstances, if another $100 ticket sale occurs or an accumulation of $100 in ticket sales occurs the consequent application of ground potential to conductor 551 will result in the operation of magnets 801, 805 and 809 over the previously traced circuits and in addition, the hundred-thousands relay 861 is operated by ground supplied through wiper 854, bank contact 874, contacts 863 and the left winding of relay 861 to battery. The relay 861, upon operating, at its contacts 864 completes a locking circuit for itself, at its contacts 866 applies ground potential to the normal position bank contacts of the wipers 856 and 816, respectively, to prepare their circuits for the display of 0 in their indicating frames if their wipers are in normal position, and at its contacts 893 and 894 applies a ground potential to its indicator control conductors 8004 and 8005 extending to relays on its indicating frame corresponding to the relays A and E of Fig. 9, to bring about the display of the digit 1, in the one-hundred thousands digit indicating frame.

It has already been explained that the relays 600 and 823 periodically operate under control of timing equipment during the period of ticket sales to bring about the display of digits representing the sum total of ticket sales from time to time, and of the particular classes of such sales. The specific manner in which the $2 ticket sales effect the display in the units digit indicating frames, as well as the manner in which display of the tens digits in the tens digit indicating frame, is accomplished has already been explained.

For the purpose of describing the manner in which the hundreds switch H completes a circuit for controlling the lamps in the hundred digit indicating frame, it will be assumed that the indicator control circuits of Fig. 9 are the control circuits of the hundreds registering switch, and that accordingly the terminals 901 to 905 are connected with the conductors 8001 to 8005, extending from the banks of the switch H.

With the wipers of the switches H, T and TH in the position shown, there is no ground potential connected to the various contacts of relay 823, therefore the operation of this relay during ticket sales which have not yet reached a total of $100 will be without effect. If, however, $1000 in ticket sales have been registered and an additional $100 in ticket sales have not yet been registered, the thousands switch wiper 846 will have advanced one step from the position shown, whereas the wipers of switch H will be in one of its two normal positions. Under these circumstances the relay 823, upon operating, applies ground potential through the bank contacts and wipers 846, to the bank contact and wiper 816, and through contacts 828 and 829 of relay 823 to the wipers 817 and 818 of the hundreds indicating switch. The ground potential on wiper 817 extends by way of conductor 8002 to terminal 902 of the indicator control circuit, and through the winding of the associated relay C to negative battery. The ground potential on wiper 818 will extend by way of conductor 8003 and the terminal 903 to the winding of relay D and negative battery. As was previously brought out and as shown by the chart in Fig. 10, the energization of these two relays completes circuits to the appropriate lamps of the indicating frame to display the digit 0 therein. With the wipers 817 and 818 advanced one step, irrespective of the condition of switches T and TH, and upon operation of relay 823 circuits are completed to the indicator control relays A and E, so that appropriate lamps of the frame will be lighted to display the digit 1. The circuit for the relay A extends from ground supplied through a bank contact and associated wiper 816, through the contacts 828 and 829 to the wipers 817 and 818, through the conductor 8005 to the terminal 905 and the winding of relay A to negative battery, and from wiper 818 through conductor 8004 and terminal 904 to the winding of relay E and negative battery. As the wipers 817 and 818 are progressively advanced the circuit combinations necessary to produce the display of the digits 3 to 9, inclusive, are obviously completed. Likewise, it will be obvious that when the wipers 817 and 818 are moved into engagement with their bank contacts corresponding to the bank contact 870 associated with wiper 816 that the same circuits to the indicator control conductors are completed as when wipers 817 and 818 are in their first normal position, and accordingly if the wiper 846 of the thousands digit register T, or 856 of the ten-thousands digit registers are off normal or if the hundred-thousands relay 861 is actuated and wipers of switches TH, T and H are in either of their normal positions, relays C and D of the indicating equipment will be operated to display the digit 0 consequent to the operation of the re-

lay 823. Since the circuit connections made by wipers 817 and 818 in their movement in the next ten steps are the same as in the first ten steps it will be seen that the indicator equipment will be controlled in like manner during the second ten steps of the switch H. The bank wiring of the indicator banks of switches T and TH is identical to that of the indicator banks of switch H. In view of this it will be obvious that the wipers associated with the indicator banks of switches T and TH will influence connected indicating equipment in the same manner as do the wipers 817 and 818 of the switch H.

It is not contemplated that occasion will ever be required for the indication of more than the digit 1 in the hundred-thousands indicator frame, and for this reason the relay 861 can be employed to apply ground potential to the indicating relays such as A and E of this frame to display the indication 1, this being a much more economical arrangement than to provide an additional switch such as TH for this purpose.

It has heretofore been shown that when a relay of the collector switch picks up marking potential from two $2 ticket issuing machines that the collector switch operating circuit is held open until the two $2 sales have been accounted for by the units register relay group.

If there is also marking potential on the other marking conductors of the operated collector switch relay; irrespective of whether such conditions are from $5 and $10, $5 and $50, or from $5 and $100 ticket issuing machines; all such marking potentials are disposed of by the affected registers of the adding machine before the operating circuit of the collector switch can be again completed. Furthermore, the registrations consequent to the sale of $5, $10, $50 or $100 tickets, as the case may be, will occur concurrently with those occurring in the units register group.

The circuits are so arranged, however, that when carry-over operations are occurring from one register to the next, the operation of such next register, consequent to the receipt of marking potential from a ticket issuing machine is prevented until such carry-over operations have been completed.

In order to explain these operations it will now be assumed that the hundreds, tens and units registers are set as required to display the number 888, that an odd $5 registration has also been made, and that the collector switch CS upon operating its relay 213 picks up marking potential on conductors 239, 282, and on conductors 283 and 284 extending from $10, $5 and $2 ticket issuing machines, respectively.

Under the circumstances assumed in the tens register relay group TR register relays 651, 677, 6006 and 6017 will be in operated position. In the units register relay group relays 592, 5037 and 5029 will be operated.

As will be obvious from the foregoing description relay 213 on operating extends marking potential to conductors 261 to 264, inclusive, and accordingly the connected register control relays 616, 619, 525, and 530 immediately become energized. Furthermore, since each of these relays opens a point in the collector switch operating circuit and further, since each of these relays remains operated until it has brought about the registration and a consequent operation in the connected ticket issuing machine, it will be obvious that the two $2, the $5 and the $10 ticket sales must be registered before the collector switch is enabled to again operate.

In the units relay group relay 530 at its contacts 531 prevents the relay 525 from causing the operation of its slave relay 535, and at its contacts 532 completes the circuit of its slave relay 550 in the usual manner. The relay 550 upon operating extends ground potential to conductor 501, effecting the immediate operation of relay 644.

At this same time the relays 616 and 619 of the tens relay group are operating to complete the circuits of their slaves 622 and 632, respectively. The relay 622 closes an auxiliary locking circuit for itself at its contacts 627 before the armature 636 of relay 632 has had time to break the operating circuit of relay 622 and, accordingly, relay 622 fully operates and at contact 624 interrupts the circuit of relay 632, preventing its operation at this time. The relay 622 at its contacts 626 opens a point in the operating circuit of relay 5003 of the units register group, thereby preventing its operation consequent to the grounding of conductor 501 by operation of relay 530, and at its other contacts controls the relays of the tens register in the usual manner to register the $5 ticket sale. Since it is assumed that one $5 sale is already registered the ground potential applied to the upper terminal of relay 622 now extends through contacts 630 over conductor 514 through contacts 6005, conductor 513 to armature 5038 and its front contact and through the upper winding of the operated differential relay 5029 to battery. The relay 5029 accordingly restores and at its contact 5033 extends the ground potential on conductor 514, through contacts 5040 to conductor 508. This ground potential now extends over armature 652 and its front contact over the previously traced circuit to relay 687 and negative battery. The relay 687 performs the usual circuit changes including the interruption of the circuits of relays 677 and 644 which accordingly restore and at its contacts 692 completes the usual low resistance path back to the connected $5 ticket issuing machine. This circuit extends from negative battery through resistance 646, contacts 692 and 659, the back contact and armature 648, conductor 510, contacts 5041 and 5035, conductor 507, contacts 629 to conductor 261 and the connected $5 ticket issuing machine. It will be obvious that the relay 687 has now prepared the tens indicator for the display of the digit 9 instead of the digit 8.

The relay 616 now restores and in the usual manner interrupts the supply of current to relay 622 and that extended to relays 5029 and 5037. The relays 622 and 5037 accordingly now restore.

Relay 622, at contacts 624 now completes the operating circuit of slave relay 632, and at its contacts completes an operating circuit for relay 5003. This latter circuit extends from the ground potential placed on conductor 501, consequent to the prior operation of relay 550, via armature 563 and its back contact, contacts controlled by armature 5008, armature 594 and its front contact, conductor 505, contacts 626, 639 and 699, the conductor 504 and winding of relay 5003 to negative battery.

From the foregoing it will be observed that the common portion of the operating and locking circuits of relay 632 includes the break contacts 5005 of relay 5003 and that the operating circuit of relay 5003 includes the break contacts 639 of relay 632, but that the locking circuit of relay 5003 is independent of relay 632. It is immaterial so far as the registration is concerned which

of these relays fully operates and remains operated, and their order of operation may be readily changed by a variation in their contact spring adjustments.

For the present it will be assumed that the armature **5008** of relay **5003** operates sufficiently to engage its front contact and that this relay therefore fully energizes and prevents the partial or momentary operation of relay **632** from effecting a registration at this time of the $10 ticket sale.

The relay **5003**, upon operating, also at contacts **5004** opens another point in the operating circuit of the collector switch, at contacts **5006** and **5007** opens common points in the operating circuits of relays **535** and **550**, respectively. The relay **5003** also at contacts **5010** interrupts a second point in the operating circuit of relay **553**, and at contacts **5011** extends the grounded conductor **501** to the conductor **508** extending to the tens registering relay group. The relay **5003** finally, at its contacts **598** closes a point in a circuit employed an instant later to control the connected $2 ticket issuing machine, and at contacts **5009** interrupts the locking circuit of relay **592**.

The relay **592**, upon restoring, at contacts **5001** and **5002** again closes points in the indicator control circuits as required to bring about the display of the digit 0.

The grounded conductor **508** now extends to the upper and lower windings of relay **651**, through armature **652** and its back contact, contacts controlled by its armature **698**, armature **689** and its front contact, and the winding of relay **697** to negative battery. This ground potential is also extended from the upper terminal of relay **697** back over conductor **255**, through contacts **267**, conductors **256** and **656**, and through the armature **6018** and its front contact and the upper winding of relay **6006** to negative battery, forcing the relay **6006** to restore.

The relay **6006**, upon restoring, makes circuit changes eventually resulting in the operation of the magnets **809** of the hundreds switch as described under the heading "$50 ticket sales". In this instance, however, the negative potential extended back over conductors **552** and **511** extends via contacts **6023**, **6013** and **6004**, conductor **510**, contacts **598**, armature **543** and its back contact, and through contacts **5024** to conductor **264** and the connected $2 ticket issuing machine.

The relay **530** will now restore and in so doing remove ground potential from its slave relay and from the windings of relays **6017** and **5003** and these relays accordingly restore.

The relay **6017**, upon restoring, removes ground potential from the operating magnet of the hundreds register switch magnet **809** to enable it to advance its wipers as required to prepare for the indication of the digit 9 in its indicating frame, and prepares the tens indicator control circuits for the display of the digit 0 therein.

The relay **5003**, upon restoring, now at contacts **5005** completes the previously traced circuit of relay **632** which accordingly now operates in the usual manner to modify the tens indicator control circuits as required to prepare it for the display of the digit 1 in a manner which will be clear in view of the preceding description under the heading "$10 ticket sales". The relay **5003** also, at contacts **5006**, completes the circuit of slave relay **535** which accordingly influences the units relay group in the usual manner to modify the units indicator control circuits as required to prepare it for the display of the digit 2, in a manner which will be clear in view of the preceding description under the heading "$2 ticket sales".

When the last two registrations have been made the last of the relays **525** or **619** to restore will complete the reestablishment of the operating circuit of the collector switch which will accordingly again start its hunting operation.

When the time during which tickets may be sold expires the steward at the control board momentarily operates the ticket issuing machine locking key TL to momentarily energize the associated relay **435**. This relay, during its operation at its contacts **437** interrupts the locking circuit of relay **430** and at its contacts **438** applies ground potential over the conductor **346** to the upper winding of the ticket issuing machine lock magnet **340** of all the ticket issuing machines, thereby locking these machines against further operation.

The relay **430**, upon restoring, at contacts **431** opens a second point in its locking circuit, at its contacts **432** opens the circuit to the lamp RL, and removes the ground supply from the conductor **456** included in the operating circuit of the relay **325***a* of each ticket issuing machine of the system.

The steward now operates the key SK momentarily and in so doing connects ground potential by way of contacts **428** and conductor **410** to the winding of relay **707** and negative battery, and by way of conductor **457** and contacts **436** through the winding of relay **434** to negative battery. The relay **707** operates and at its contacts **708** completes a locking circuit for itself including the resting contact and grounded armature **712** of relay **710**. The ground potential from this source maintains the conductor **410** grounded after restoration of the key SK.

The relay **434** operates and at its contacts completes an obvious circuit for the bell B which operates to notify the public that the event for which they have purchased tickets has started. After a short interval of time the dash-pot relay **440**, which is also connected to the grounded conductor **410**, operates and completes an obvious operating circuit for the dash-pot relay **441** and for the relay **439**, respectively. The relay **439** now operates and completes an obvious operating circuit for relay **435**. This latter relay in operating at contacts **436** interrupts the circuit of relay **434** which accordingly restores and silences the bell B.

The relay **441** now operates and applies ground potential over conductor **412** and through contacts **703** to the winding of relay **710** and negative battery.

The relay **710**, upon operating, at armature **714** interrupts the circuit of relay **445**. The relay **445** accordingly restores and at its contacts **446** applies ground potential to the conductor **105** independently of that supplied through contacts **449** and at its contacts **447** opens the traced operating circuit of the collector switch CS so as to stop its operation. The relay **710**, at contacts **712** interrupts the locking circuit of relay **707** and of the dash-pot relay **440** and completes a locking circuit for itself including the contacts **718** of relay **716**, and at its contacts **711** connects the ground supplied through contacts **738** to the winding of relay **701** and negative battery. Responsive to the removal of ground potential from conductor **410** the dash-pot relay **440** restores and interrupts the circuits of relay **439**

and of dash-pot relay 441, respectively, and these relays accordingly restore. Upon the restoration of relay 439, relay 435 also restores.

The relay 701, upon operating, at its contacts 704 removes ground potential from conductor 416 and from the associated relays 448 and 451. The relay 448 restores but without effect at this time, since the conductor 105 is at this time grounded by contacts 446. The ground potential normally supplied through contacts 450 is, however, disconnected from conductor 456 at this time at contacts 432 of relay 430. The relay 451, upon restoring, interrupts the circuit to the dash-pot timing relay 452, so that further impulses will not be transmitted out over conductors 404 and 403 to the relay 701 from this source. The relay 701 also at its contacts 702 completes a locking circuit for itself independent of the contacts 711 of relay 710, and at contacts 703 removes the relay 710 from control of the dash-pot relay 441. Finally, the relay 701 at its contacts 705 closes a point in the locking circuit for the relay 730 and at its contacts 706 completes the previously traced operating circuit of relay 740.

The relay 740, upon operating, at contacts 742 completes a locking circuit for itself including the contacts controlled by armature 735 of relay 730, and at armature 741 interrupts the circuit of relay 736 and closes a point in the operating circuit of relay 730. The relay 736, upon restoring, at contacts 737 again removes ground potential from conductor 107 extending through the winding of relay 120, at its contacts 738 again completes the circuit of slow to operate relay 730, and at its contacts 739 opens a point in the operating circuit of relay 716.

The relay 120 now restores and at its various contacts removes ground potential from the locking conductor 101 and the similar conductors extending to the indicating relays A to E of each of the indicating frames of all twelve "Win" adding machines and of the totalizing adding machine of this group in order to enable the final ticket sale to be registered on the respective indicators.

The relay 730, upon operating, at contacts 731 closes a point in a second operating circuit of relay 726, and at contacts 732 now completes an operating circuit for relay 442. This circuit extends from the grounded armature 714 and its front contact, contact 725, contacts 732, conductor 414, and the winding of relay 442 to negative battery. The relay 442 now operates and at its contacts 444 completes an obvious circuit for the slow to operate relay 726 and at its contacts 443 applies ground potential to the conductor 405. The relay 730 also at its contacts 733 completes the previously traced operating circuit of relay 720, and at contacts 734 closes a point in the locking circuit of relay 716, and at its armature 735 opens the locking circuit of relay 740 and again completes its own locking circuit. The relay 726, upon operating, at contacts 728 again locks up to grounded conductor 402, at contacts 729 opens a second point in the circuit of relay 445, and at contacts 727 again completes the circuit of relay 723. The relay 723, upon operating, at contacts 724 again connects the grounded conductor 409 to conductor 748 and at contacts 725 interrupts the circuit of relay 442. The relay 442 in restoring at contacts 444 opens the operating circuit of relay 726 and at contacts 443 again removes ground potential from conductor 405.

The relay 720 now operates as previously described to complete the operating circuits to all of the indicator display control relays 823 and 880 and to effect the operation of relay 715. The relay 715 operates as previously described to prepare the operating circuit of relay 716.

Upon the restoration of relay 740 relay 736 operates, as previously described, and again completes the circuit of relay 716. The relay 716, upon operating, again interrupts the locking circuits of relays 701 and 720 and in addition interrupts the locking circuit of relay 710. The relays 701 and 720 restore as in the usual indicating cycle of operation. The relay 720, upon restoring, in the usual indicating cycle, effects the restoration of relays 715 and 716.

The relay 701, upon restoring, as in the usual indicating cycle, interrupts the locking circuit of relay 730 which accordingly also restores.

The application of ground potential to conductor 405 during the time of operation of relay 442 has an effect dependent on the registrations which have been set up in the units and tens register relay groups. If only a $2, $4, $6, or $8 ticket sale is registered and no odd $5 sale has been registered, the application of ground potential to conductor 405 is without effect.

If, however, a $2 or $4 ticket sale is set up and an odd $5 ticket sale is stored, or in case only a $5 ticket sale is stored, ground applied to conductor 405 will extend by way of contacts 5030 to the upper winding of relay 5013 and negative battery. The relay 5013 at its contacts 5014 completes a locking circuit for itself including its lower winding and the grounded hold conductor 509, and at its contacts 5016 to 5022 modifies the indicator control circuits as required to cause the units indicator to change from zero to five or from two to seven or from four to nine, depending on the condition of the units registering relays.

If no $2 ticket sales are at the time registered circuits for displaying the digit five in the units indicating frame are prepared. Under such circumstances ground potential extends through contacts 559 of relay 553, armature 581 and its resting contact, armature 5001 and its resting contact, armature 5019 and its working contact, to conductor 520, through contacts of relay 600, conductor 601, terminal 901, and the winding of relay B to battery. The circuit for relay E extends from ground supplied through contacts 560, armatures 582 and 5002 and their resting contacts, armature 5022 and its working contact, conductor 517, through the contacts of relay 600, conductor 604, terminal 904 and the winding of relay E to negative battery. As will appear from the code chart shown in Fig. 10, the energization of the relays B and E are the ones required for producing the display of the digit 5.

If a $2 ticket sale is set up on the relay group UR the relay 569 will be in operated condition and the relay 553 will also be operated. Under these circumstances the relay 569 completes a circuit to the relays A and C of the digit indicator to cause the digit 7 to be displayed thereon.

On the other hand, if the registering relays have been set in response to two $2 ticket sales the relays 575 will be the one operated and relays 553 will be in restored condition, with the result that circuits are prepared for the relays B and D of the indicator, and accordingly the digit 9 will be displayed.

In case three $2 ticket sales are set up, the relays 583 and 553 will be the ones which are operated and the relay 583 will complete the

preparation of circuits for the operation of relays A and E of the indicator control group, so that the digit 1 will be displayed. Similarly, if $8 of ticket sales are registered the relay 592 will be operated instead of relay 583 and circuits will be prepared for the operation of relays D and C to prepare for the display of the digit 3.

In the latter two instances the addition to the registration of the $5 ticket sale to the $6 or $8 ticket sale required a carry-over operation to the tens registers. The manner of accomplishing this carry-over will now be gone into. Under these circumstances the relay 5013, upon operating, extends the ground potential applied to conductor 405 by way of contacts 588 or 597 to the conductors 524 and 513, and through the armature 5038 and its working contact to the upper winding of relay 5029, thereby causing this differential relay to restore.

The relay 5029, upon restoring, at its contacts 5030 interrupts the operating circuit of 5013 and at its contacts 5032 again connects the grounded conductor 509 to the lower winding of relay 5037 in substitution for the now grounded conductors 513 and 522, and at its contacts 5033 and 5034 now applies the grounded potential extended over conductor 405 through contacts 5040 to the conductor 508 and over the previously traced circuit extending to the upper and lower windings of relay 651 and through the winding of relay 644 to battery. This ground potential also extends by way of armature 652, to the winding of one of the relays 660, 668, 677, 687, or 697, depending on the condition of the register relay group TR at this time. In the present example it will be assumed that $90 in ticket sales have already been registered in the tens registering relay group, and that, accordingly, relays 687 and 6006 are operated at the time ground potential is extended to conductor 508 and to armature 652. This ground potential accordingly extends through the contacts controlled by armature 698, the armature 689 and its working contact, and the winding of relay 697 to negative battery.

The relay 697, upon operating, at its armature 698 completes a locking circuit for itself back to armature 652, but excluding contacts of relay 687, at its contacts 6001 opens a point in the collector switch operating circuit, but without effect at this time since the collector switch has been stopped, at its contacts 699 opens a point in the operating circuit of relay 5003 and at its contacts 6003 interrupts a second point in the circuit of relay 644. The relay 697 also, at contacts 6004 and 6005 modifies circuits only of utility when the relay 697 is being operated consequent to a registration initiated by the operation of a ticket issuing machine.

The relay 697 finally at its armature 698 extends the ground potential applied to its upper terminal through armature 652 to the back contact and armature 638, the conductor 656, and through the armature 6018 and its working contact and the upper winding of differential relay 6006 to negative battery.

The relay 6006 accordingly restores to normal and at contacts controlled by its armature 6011 connects the ground potential now supplied to its upper winding also to its lower winding in substitution for the ground previously supplied to the lower winding by the hold conductor 509; and at its contacts 6015 and 6016 restores the tens register relay indicator control circuits to normal, so that the connected tens indicator instead of indicating the digit 9 will now indicate the digit 0 upon operation of relay 600. The relay 6006, upon restoring, in addition to performing the functions previously described, at its contacts 6014 completes an operating circuit for the magnet 809 of the hundreds switch H. This circuit extends through the grounded contacts 6024, contacts 6014, conductor 512, conductor 551, wiper 814 and associated bank contacts, the resistance 849, the winding of magnet 809 to negative battery. Accordingly the switch H subsequently operates in the manner previously described to change its indicator control circuits. Obviously the effect of applying ground potential to conductor 551 also effects the operation of switches T, TH and of relay HT in case the switches H, T and TH are each in position at the time to register the digit 9.

It will be seen therefore, that prior to the display of the final registration, any odd $5 ticket sale will be accounted for by the registering equipment.

Release

When there is no further use for the display indications representing various ticket sales the steward releases all of the registering and indicating equipment by actuating the reset key R. This key, at its contacts 421, removes ground potential from conductor 409 to release any of the relays 701, 715, 716 or 720 which may be in their operated stage, at its working contact applies ground potential to conductors 404 and 403, and thereby causes the relay 701 to again operate and again lock up through contacts 738 of relay 716. The relay 701 also at its contacts 704 again removes ground potential from conductor 416. Relays 448 and 451 accordingly become deenergized. The relay 451 at its contacts interrupts the operating circuit of timing relay 452 to prevent its making further attempts at controlling relay 701 to display the amount of ticket sales. The relay 448, upon restoring, removes ground potential from conductor 105 and from the relay 130 which accordingly restores and opens the operating circuit of all collector switches of the "Win" group of adding machines and of the totalizing collector switch of this group. The relay 448 also at its contacts 450 removes ground potential from a point in a circuit already open at this time at contacts 432.

The relay 701 in operating also completes the circuit of 740, as previously described, which again operates and locks up through its contacts 742 independently of relay 701.

The relay 736 now restores and at its contacts 737 interrupts the circuit of relay 120. The relay 120 accordingly restores to open the locking circuits of all indicator relays such as A to E of all of the "Win" adding machines and of the corresponding indicator relays of the associated totalizing adding machine, so that all of the associated indicating lamps will be extinguished.

An instant later the relay 730 operates, but relay 720 does not operate at this time since ground is removed from conductor 409 owing to the operated condition of the release key R.

The key R also at its contacts 420 applies ground potential to conductor 401 extending to the release relay 800 and negative potential. The release relay 800 is accordingly held operated and at its contacts 850, 851 and 860 applies ground potential to the bank contacts associated with wipers 853, 843 and 813 of the respective ten-thousands switch TH, thousands switch T, and hundreds switch H, enabling the magnets

of these switches to operate in self interrupted circuits and restore their respective wipers into their normal position, as shown. The relay 800 at its contacts 852 prevents the application of ground potential to conductor 615 by contacts 804, 808 and 812 of magnets 801, 805 and 809, during the restoring operation of the hundreds, thousands, and ten-thousands switches, H, T and TH, and at its contacts 8512 removes the multiple ground from the discharge circuit normally extending through resistance 859 from connection with conductor 509. The steward can readily hear the registering switches in their restoring movement and when they stop operating restores the reset key R to normal position.

Following the restoration of key R relay 800 restores owing to the interruption of its circuit at contacts 420, the spring 421 now engages its resting contact and again applies ground potential to the conductor 409, as a result of this the relay 720 now operates and at its contacts 722 again applies ground potential to conductor 417 and through the switch WI to conductor 104 and contacts 114 to conductor 108, and its branch conductors 521 and 616 to again operate the associated relays 600 and 823 which will be effective to light the indicator lamp of any of the ticket indicators in case for some reason or other certain of the equipment has not been properly restored, and at its contacts 721 applies ground potential from the now grounded conductor 409, through contacts 713 and conductor 748 to the relay 715. Relay 715, upon operating, extends ground potential through its contacts and to contacts 739, through the winding of relay 716 which operates to open the circuit of relay 720 and the locking circuit of relay 701, permitting these relays to restore.

Relay 701, upon restoring, again completes the operating circuit of relays 448 and 451. The relay 448 accordingly operates and at its contacts 450 again closes one point in the circuit employed in applying ground potential to the ticket issuing machines, and at its contacts 449 again completes the operating circuit of relay 130 to permit the collector switches to be again set into operation upon the energization of relay 445. The relay 451 again starts the operation of the solenoid timing relays 452 and 453. The relay 701 at its contacts 705 interrupts the locking circuit of relay 730 and this relay now restores and at its contacts 733 interrupts a second point in the circuit of relay 720.

The relay 720, upon restoring, removes ground potential from the traced circuit to relays 600 and 823 and to the corresponding relays of the other adding machines, these relays accordingly all restore.

The operations preliminary to the commencement of ticket selling for a subsequent group of events are substantially the same as described as occurring preceding the sale of tickets to the first events. It will be recalled, however, that when a final display indication was obtained at the end of a ticket selling period the relay 726 was locked up through contacts of the key TR. With relay 726 operated relay 445 remains deenergized and relay 723 remains operated. With the relay 445 deenergized ground potential is now held off the start conductors 246 of the collector switches. When the steward again operates key TR, however, ground potential is removed from relay 726. This relay accordingly restores, again opens the circuit of relay 723 permitting it to restore, and again closes the circuit of relay 445. The relay 445, accordingly, operates to again close the operating circuits of the collector switches.

Combination ticket issuing machines

In the prior description it has been assumed that the ticket issuing machine of Fig. 3 was being employed as one of a group of $2 ticket issuing machines associated with the group of "Win" adding machines of the system. By introducing the circuits of Fig. 12 between Figs. 2 and 3, as shown in the layout comprising Fig. 15, and by employing an appropriate roll of tickets, the ticket issuing machine becomes a combination machine.

The operation of the ticket issuing machine under these circumstances is substantially the same as when it is employed as a "Win" ticket issuing machine. However, instead of its controlling any one of twelve "Win" adding machines, depending on the key actuated, and the totalizing adding machine of the "Win" group may, as a combination machine, control one each of twelve "Win", "Place", and "Show" groups of adding machines depending upon the key operated and also the totalizing adding machine of each of these three groups. For example, if the key 1 is operated marking potential will be applied to conductors 348 and 349 as previously described. This marking potential, however, instead of extending to a conductor of the collector switch CS, and to a conductor terminating in a corresponding collector switch of the "Win" totalizing adding machine, is extended via conductors 1248 and 1249 to relays 1201 and 1228 of the combination relay group.

The relay 1201, upon operating, at contacts 1213 prepares a locking circuit for itself, and at its contacts 1252, 1253 and 1254 closes points in the operating circuits of marking relays 1225, 1226 and 1227, respectively. The relay 1201 also at its contacts 1251 completes an obvious operating circuit for relay 1224.

The relay 1224, upon operating, at its contacts 1264, 1265 and 1266 supplies ground potential to one terminal of the upper winding of each of the relays 1225, 1226 and 1227, respectively. The other terminal of the upper winding of relay 1225 is connected with conductor 1246 and through contacts 1252 to conductor 1248, and to the collector switch CS, whereas conductors 1245 and 1244, respectively, are extended through contacts 1253 and 1254, to collector switches CS associated with the "Place" and "Show" adding machines, respectively.

The relay 1228, upon operating, at its contacts 1277 closes a point in the low resistance path from negative battery necessary to obtain the operation of relay 325 of the ticket issuing machine. The relay 1228 also, at its contacts 1272, 1273, and 1274 connects ground potential to the upper windings of relays 1230, 1231 and 1232 and through the upper windings of these relays to conductors 1216, 1215 and 1214, extending to the respective collector switches of the totalizing adding machines, of the "Win", "Place" and "Show" groups. As the respective adding machines with which conductors 1244, 1245, 1246, 1214, 1215 and 1216 connect negative potential via low resistances such as those previously traced to conductors 348 and 349 to conductors 1244, 1245, 1246, 1214, 1215 and 1216, their associated relays 1227, 1226, 1225, 1232, 1231, and 1230, will operate and lock up in series with their lower windings and disconnect themselves from the as-

sociated conductors extending to the collector switches of their respective adding machines, in the same manner as did the relays 325 and 330 of the ticket issuing machine when employed in the issuance of $2 "Win" tickets.

When the relays 1225 to 1227 have actuated a circuit is completed from negative potential through the low resistance 1217, contacts 1271, 1268, 1276 and 1213 to and back over conductor 1248 to the conductor 348 and over the previously traced circuit including the relay 325 and ground.

In a similar manner, upon operation of relays 1230, 1231 and 1232, negative potential is supplied through the low resistance 1285 and through contacts 1283, 1281, 1278, and 1277, to conductors 1249 and over conductors 349 and the previously traced circuit including the relay 330 to ground.

The relays 325 and 330, accordingly, operate to control the ticket issuing machine TIM in the same manner as when this machine is employed in the issuance of tickets to one adding machine group.

There may be occasions when it is desired to employ the combination machine in the sale of tickets designating "Win" and "Place" only. In such an instance, the circuits of relays 1227 and 1232 employed in controlling the "Show" adding and totalizing machines, are cut out of service by interruption of jumpers 1217 and 1218, and by placing a bridge around their contacts 1271 and 1283, respectively, as indicated by the dotted conductors 1219 and 1284.

Event lockout control

There may be times when certain of the possible events may be cancelled and therefore no tickets should be sold covering such events. To prevent the issuance of a ticket under these circumstances the control board is equipped with a group of keys 1 to 12, corresponding to the keys 1 to 12 of the ticket issuing machines. Each of these keys is employed to operate "Win", "Place" and "Show" event lockout relays such as 160—W, 160—P, and 160—S, respectively, to light an associated warning lamp WL, before the steward.

The relay 160—W, upon operating, at its contacts 113 interrupts a point in the operating circuit of the collector switch CS associated with the No. 1 "Win" event adding machine, and at its contact 114 interrupts a point in the circuit over which ground potential is supplied to conductor 108 having branches 116 and 521 extending to the No. 1 event indicating display control relays 823 and 600, respectively, so that the display condition of the No. 1 event indicators will remain dark while the described condition prevails. The relays 160—P and 160—S make corresponding circuit changes in the No. 1 event "Place" and "Show" circuits.

For each of the twelve adding machines of a group there is also provided an alarm relay 170 and a pair of alarm relays 140 and 150 controlled by any relay 170 of the associated group. The alarm relay 170 is of the slow to operate type and is operated over conductor 109 from branch alarm conductors 515 and 516, when ground is connected to conductor 109 for a period longer than it should be by any one of the slave relays such as 535 and 500 or by the operating magnet of any of the switches H, T or TH. If, due to some fault in the operation, the conductor 108 becomes grounded for an abnormal period, relay 170 operates, and at its contacts 121 opens the operating circuit of the collector switch CS to prevent its operation and the possible loss of registration of such ticket sales, and at its contacts 122 closes a point in an operating circuit including the lower winding of event lock-out relay 160—W and the trouble lamp TL. The relay 170 also, at its contacts 123, completes an obvious circuit for the slow to operate relay 150. After a slight interval if the ground has not been removed from conductor 109 the relay 150 will operate and complete the circuit to the lamp TL and through the lower winding of relay 160—W and will also, at its contacts 125 complete an obvious operating circuit for the alarm relay 140. The relay 160 operates to perform the same function as when operated by operation of its associated key, while the lamp TL serves to advise the attendant that there is trouble in the No. 1 event "Win" adding machine, which must be cleared before any further tickets can be sold for this event.

The relay 140 completes the circuit of the "Win" alarm relay lamp WAL and of audible signal S to advise the steward of the existence of trouble. The steward upon hearing the signal S operate observes by the lighted lamp WAL that the trouble is in an adding machine of the "Win" group. He then can tell which adding machine of this group is in trouble by noting which of the tell-tale lamps TL of this group is lighted.

The totalizing adding machines for the various events are not considered to be of sufficient importance to warrant the holding up of ticket sales should the totalizing adding machine of any event become defective. In order to provide a ready means of supplying negative potential back through the conductor 349, which is normally supplied thereto upon completion of operation or registration of a ticket sale in the totalizing machine, conductors 141 and 235 are tied to the respective conductors 349 extending between the various ticket issuing machines of a group and the collector switch of their associated totalizing adding machine. When any totalizing adding machine becomes defective negative potential is supplied to the conductors 349 by energizing the relay 110 of such group, it being understood that there is one such relay for each totalizing machine.

It will be obvious that the conductors extending from the switches PL and SH extend to conductors of the "Place" and "Show" adding machine equipment in the identical manner in which the conductors 102, 103 and 104 extend to the "Win" adding machine circuit. Any of these switches may be accordingly opened to disassociate and render inactive any of the three groups of ticket issuing machines and their associated adding machine equipment.

It will be appreciated that the success of a comprehensive system such as described in the foregoing is dependent directly upon its absolute accuracy in registering and displaying of digits indicative of the amounts of ticket sales. To provide a ready means of quickly checking up on the accuracy of operation, the circuits and apparatus shown in Figs. 16, 17 and 18 are provided. These figures should be arranged with Fig. 16 above Fig. 17, and with Fig. 18 to the right of Fig. 17.

Fig. 16 shows three rotary switches RS1, RS2, and RS3, which advance their wipers one step upon the deenergization of their associated motor magnets. The switch RS1 is provided with six sets of bank contacts and associated wipers through the medium of which the equipment of

Figs. 17 and 18 may be selectively associated with the collector switches of the "Win" adding machine group.

In the present example it is assumed that the conductor extending from the first bank contact of switch RS1, with which the wipers 1601 and 1602 are associated, are connected with conductors such as 348 and 1248 of the 2—TIM group, that the first bank contact with which the wipers 1603 and 1604 are associated have conductors 1644 and 1682 extended to conductors such as 244 and 282 of the 5—TIM group, that the first bank contact with which wiper 1605 is associated has a conductor 1639 extending to a conductor such as 239 of the 10—TIM group, and that the first bank contact with which wiper 1606 is associated has a conductor 1642 connecting it with a conductor such as 242 of the 50—TIM group, all terminating in the collector switch CS which has heretofore been assumed to be the "Win" collector switch associated with the adding machine of the No. 1 event group.

The equipment in Fig. 17 comprises six value keys WK1–WK6 so arranged that when operated they will simulate the selling of $2, $5, $10 and $50 tickets, as indicated. These keys have associated with them relays 1711 to 1716 which operate following registrations resulting from the operation of their associated keys and control associated lamps which light up and advise the attendant that registrations have occurred consequent to the operation of the associated keys.

In Fig. 18 are shown the first and last of two other groups of keys PK1–PK6 and SK1–SK6, and associated relays and lamps which are identical to the complete set shown in Fig. 17, but which are employed to exercise control over the "Place" and "Show" adding machines of the system by way of switches RS2 and RS3 in the same manner as control is exercised by keys WK1–WK6 through the medium of its associated switch RS1.

The purposes of the various keys and relays and circuits not heretofore specifically referred to will be clearly brought out in the more detailed explanation.

Before going into the detailed explanation it is suggested that Fig. 4 be placed immediately above Fig. 18, for the reason that certain of the conductors in the lower right-hand corner of Fig. 4 are arranged for connection with conductors extending from the upper right-hand corner of Fig. 18. It is further suggested that the collector switch CS, Fig. 2, be placed to the immediate left of Fig. 16, since, as previously explained, conductors extending from the bank contacts of the switch RS1 connect with conductors of the switch CS.

The circuits shown for testing the "Win", "Place", and "Show" adding machine groups are so arranged that with the wipers of the switches RS1, RS2, and RS3 in the normal position, as shown, operation of any one of the keys WK1–WK6 will bring about the registration of a digit in the No. 1 event "Win" adding machine in accordance with the value of the key actuated. In like manner, if keys of the groups PK1–PK6 or alternatively SK1–SK6 are actuated, the No. 1 event adding machines in the respective "Place" and "Show" groups will operate in identically the same manner as does the No. 1 event adding machine of the "Win" group.

In order to further explain the operation it will now be assumed that an attendant operates key WK1. Upon operation of this key ground potential is extended through contacts of this key, the upper winding of relay 1711, the break contacts of the make before break spring combination of this relay, other contacts of key WK1, conductor 1701, wiper 1601, and conductor 1648 to a conductor such as 348 or 1248 or to any other selected conductor of the 2—TIM group of the collector switch CS. It will be obvious that this is the identical condition set up by the operation of the No. 1 key of the ticket issuing machine TIM and that accordingly the "Win" adding machine will function to register digits in accordance with those registered when a $2 ticket sale is made. The connected adding machine upon performing its registering operation effects the operation of relay 1711 in the same manner as it does relay 325 of the ticket issuing machine. The relay 1711, upon operating, disconnects itself from the adding machine and completes a locking circuit for itself including the lower and upper windings in series and ground supplied through the operated contacts of key WK1, and at its lower contacts completes a circuit through its associated lamp to advise the attendant that the registration has been made and that he can, accordingly, release the key. Upon release of the key the relay 1711 again restores. In an identical manner other of the keys WK2–WK6 may be actuated to place marking potential on other conductors of the collector switch CS by way of wipers 1602–1606 and the associated conductors of their first bank contacts.

If the attendant desires to effect registrations in the connected adding machine equivalent to the operation of all keys WK1–WK6 he may do this by actuating the locking type keys WK7 and K9. With these keys operated ground potential is extended from the contacts of key K9, over conductor 1808, through the lower chain of break contacts of the relays 1711–1716, conductor 1807, the lower chain of break contacts of relays 1811–1826, conductor 1809, the chain of lower break contacts of relays 1831–1836, conductor 1810, armatures 1814 and 1822 and their resting contacts, and the winding of relay 1812 to negative battery. The relay 1812 accordingly operates and at its contacts 1825 supplies ground potential through the lower contacts of the operated key WK7, conductor 1518 and through the winding of connecting relay 1817 to negative battery. The relay 1812 also at its contacts 1813 completes a locking circuit for itself which is the same as the operating circuit except that it excludes the traced circuit passing through the lower row of break contacts of the respective relay groups, and at its contacts 1802 closes a point in a locking circuit for relay 1815.

The connecting relay 1717, upon operating, at its upper contacts connects the upper terminal of the winding of relay 1711 to conductor 1701 and accordingly marking potential is now supplied from the grounded conductor 1518, through the normal contacts of relay WK1, the upper winding of relay 1711, the break contacts of the make before break combination of this relay, the upper contacts of relay 1717 to conductor 1701 and over the previously described circuit to the collector switch CS.

It will be obvious that the relay 1717 at the remainder of its contacts in like manner applies the marking potential to conductors 1702–1706 and that accordingly the connected collector switch CS and its associated adding machine will

function to register two $2 ticket sales, two $5 ticket sales, a $10 ticket sale, and a $50 ticket sale. As the registering operations occur the relay 1711–1716 will operate and complete circuits for their associated indicating lamps which serve to advise the attendant of the progress of the registering operation.

When the key K9 was actuated the normally existing circuit between contacts 455 of the timer dash pot relay 452 and conductor 404 was interrupted and therefore the indicating equipment associated with the connected "Win" adding machine was prevented from setting up any new indications while the adding machine was operating to register digits resulting from the actuation of keys WK7 and K9, and therefore if the attendant desires to obtain an indication without further operation of the adding machine and thus ascertain if the registrations made consequent to the operation of keys WK7 and K9 are correct, he can do so by restoring key WK7 and actuating key K8. Upon restoration of the key WK7 the circuit to relay 1717 is interrupted as is the obvious locking circuit of each of the respective marking relays 1711–1716 and accordingly all of these relays restore. Now, upon operation of key K8 ground potential is supplied over conductor 1801 through the upper contacts of key WK7, conductors 1705 and 1806, the upper contacts of keys PK7 and SK7 in series, and the winding of relay 1815 to negative battery. The relay 1815, upon operating, at armature 1814 opens the locking circuit of relay 1812, which accordingly restores; and at contacts 1821 now prepares an operating circuit to the slow release relay 1823. This circuit extends from negative battery through the winding of relay 1823, contacts 1821, conductor 1855, to contacts 455, which, upon their subsequent operation, supply ground potential for operating the relay 1823. This relay, upon operating, at its inner upper contacts completes an obvious locking circuit for itself, and at armature 1822 interrupts a second point in the circuit of relay 1812 and prepares a point in a circuit employed in extending ground potential to conductor 1804 and to conductor 404 as required to bring about the display of the newly registered digits in the adding machine, which occurs in the manner well known in view of the previous description of operation and control of the indicating equipment. In the course of this operation it will be recalled that relay 701 operates and removes ground potential from the conductor 416 until the indication cycle is completed and during this removal the relay 1846 restores and closes the locking circuit of slow release relay 1823. The latter relay accordingly remains energized until the indication cycle has been completed and then restores to again prepare the operating circuit of relay 1812.

If the attendant desires to make a more comprehensive test of the connected "Win" adding machine and its associated display equipment he can do so by operating keys WK7, WK8, and WK9. Under these circumstances the operations are the same as just described except that with the key WK7 left in operated position and key K8 in operated position, the relay 1823 upon restoring immediately again completes the circuit of relay 1812 which accordingly operates again to complete the circuit of relay 1717 and to feed marking potential to the conductor 1518, through the associated keys WK1–WK6 and through the associated relays 1711–1716 to conductors 1701–1706. Accordingly the registering operations heretofore described will be repeated. It will be obvious that upon the completion of each registering cycle an operating circuit including the upper series contacts of relays 1711–1716 and contacts of keys WK8 and WK9 will be completed for relay 1815 which will operate and at its contacts 1820 complete the circuit of its associated lamp which serves to advise the attendant of the completion of a cycle. Also at this time relay 1812 restores and at its contacts 1825 interrupts the circuits of the operated relays 1711–1716, permitting them to again restore, and at its contacts 1802 opens the locking circuit of relay 1815 which now also restores. After permitting the registering operation to proceed a desired period of time the attendant can stop the operation by restoring key K8, and when the last initiated cycle of registration has been completed as indicated by the lighted condition of all lamps associated with relays 1711–1716, the attendant may restore key WK7 and reoperate relay K8. The operation of this latter key under these circumstances effects the operation of relay 1815 in the manner previously described so that upon the subsequent operation of contacts 455 a final display indication will be given. The attendant may check the accuracy of the registrations by dividing the number displayed by a number arrived at by adding the total value of registration resulting from the actuation of keys WK1–WK6, in this instance 74, and will obtain a dividend which is an exact multiple of 74 providing the registrations have been accurately made. The attendant may, by actuating the key WK momentarily, effect the energization and deenergization of motor magnet MM1 to advance the associated wipers of switch RS1 one step into engagement with conductors of the collector switch associated with the No. 2 adding machine of the "Win" group, and can then test the No. 2 adding machine in the same manner that No. 1 was tested. It will be obvious that by repeating this process the event adding machines and totalizing adding machine of the "Win" group may be sequentially connected with and tested for their accuracy of operation. The testing for accuracy of operation of the "Place" and "Show" groups of adding machines is obviously accomplished in the same manner that the testing operation of the "Win" group is accomplished except that the associated key PK7 or SK7 is operated under these circumstances and their associated switches RS2 and RS3 are advanced by operation of their associated advance keys PK and SK, respectively.

If the attendant desires to perform testing operations in adding machines of all groups simultaneously he may do so by simply actuating keys WK7 PK7 and SK7, and by then actuating keys K8 and K9. Under these circumstances it will be obvious that the relay 1815 will become operated only when all of the marking relays of each group of keys have actuated and therefore under these circumstances indications of the digits registered will occur following the completion of registration of, in the example shown, $74 in each of the associated adding machines.

If after performing the required testing operation of the connected No. 1 "Win", "Place" and "Show" adding machines the attendant desires to perform the same testing operations on the No. 2 "Win", "Place" and "Show" adding machines he may advance all of the switches RS1, RS2 and RS3, by a single actuation of key CK upward and by then restoring this key. It will be obvious that upon operation of the key CK in

an upward direction ground potential will be applied directly to the winding of motor magnet MM1 and over conductors 1607 and 1608 to the motor magnets MM2 and MM3, respectively. Upon restoration of this key the respective magnets become deenergized and advance their wipers one step in a well known manner.

After all testing operations have been completed the attendant may desire to restore the switches RS1, RS2, and RS3 to their normal position. To do this he operates the key CK downward and holds the key in this operated position until operation of the switches RS1, RS2 and RS3 cease, and then restores the key to normal. Upon operation of the key CK downward the associated relay 1613 operates and at its contacts 1611 applies ground potential to its last bank contact. The relay 1613 also at armature 1612 disconnects the conductor 1701 from the wiper 1601 and connects the wiper 1601 to the winding of the associated motor magnet MM1. The ground potential applied through contacts 1611 in addition to extending to the last bank contact of wiper 1601 extends through the interrupter contacts of motor magnet MM1 to negative battery and this magnet accordingly operates in a buzzer-like manner to advance its wipers. When the wiper 1601 reaches its last contact it extends ground potential directly through contact 1612 to the winding of motor magnet MM1 and therefore this magnet can no longer interrupt its own circuit and accordingly remains energized. It will be obvious that the relay 1613 at its other contacts and armatures exercises a like control over the motor magnets of switches RS2 and RS3 and that accordingly the wipers of each of these three switches will be advanced into engagement with their last contacts. Upon restoration of the key CK relay 1613 becomes deenergized and ground potential is accordingly removed from the wiper 1601 and from the corresponding wipers of switches RS2 and RS3. The respective motor magnets MM1, MM2 and MM3 accordingly become deenergized and in so doing permit the advancement of their associated wipers into engagement with their normal contacts in readiness for a repetition of the cycle of testing operations hereinbefore described.

Having described the invention, what is considered to be new and is desired to be protected by Letters Patent will be set forth in the following claims.

What is claimed is:

1. In a totalizing system, a plurality of groups of marking conductors each conductor of which has one end terminating in a different ticket issuing machine arranged to place marking potential thereon when actuated to issue a ticket, an adding machine, means for sequentially associating said groups of conductors with said adding machine one complete group at a time, and means in said adding machine arranged to simultaneously test all of said conductors of a group and consecutively set up registrations in said machine in accordance with the accumulated value of the tickets to be issued by the ticket issuing machines of such group as determined by the conductors thereof having marking potential thereon.

2. In a totalizing system, a collector switch comprising a group of relays, a plurality of conductors incoming to said switch, means for applying marking potential to said conductors, an adding machine associated with said collector switch, means in said collector switch for successively operating the relays thereof to associate groups of said conductors into operative relation with said adding machine, each relay simultaneously connecting a group of said conductors to the adding machine, means in said adding machine for preventing said relay from disassociating a group of said conductors from said adding machine so long as any conductor of such group has marking potential thereon, means in the adding machine for setting up a registration depending upon the conductors of the associated group which have marking potential thereof, means for then removing marking potential from such conductors, and means for then enabling said collector switch to operate a second one of said relays to associate a second group of such conductors with said adding machines.

3. In a totalizing system, a multi-relay collector switch operated sequentially, a plurality of conductors extending from each relay of said switch and terminating in ticket issuing machines arranged to issue tickets of different values, an adding machine connected to said collector switch and having register control conductors, means for always sequentially operating the relays of said collector switch to successively connect said register control conductors with different groups of said plurality of conductors, leading to more than one ticket-issuing machine means in the connected ticket issuing machines for placing marking potential on combinations of said plurality of conductors in accordance with the machines employed as determined by the value of the tickets to be issued, and means in said collector switch enabling the registration of different value ticket sales over the same control conductor and fixed value ticket sales over the other of said control conductors while one of the relays is energized.

4. In a totalizing system, a chain of register relays, means for sequentially operating the relays of said chain and for sequentially restoring the previously operated ones to sequentially register a series of digits of a uniform unit value, a carry-over relay responsive to said means to effect the restoration of the last operated register relay, a second chain of register relays, a second means for sequentially operating the relays of said second chain and for sequentially restoring the previously operated ones thereof to register a series of digits of a greater uniform unit value, contacts on said carry-over relay for temporarily preventing the operation of said second means from being effective and for extending the influence of said first means to said second chain to effect a unit value of registration thereby to account for the accumulated values erased by the restoration of the last register relay of said first chain and for the additional unit of value represented by the operation of said carry-over relay by said first means.

5. In a totalizing system, a set of register relays, a pair of sequence relays, a control relay for controlling said register relays having an operating circuit including normally closed contacts of each of said sequence relays and having a locking circuit excluding such contacts, means for actuating said control relay and, through it, one of said pair of sequence relays and one of said register relays, means actuated consequent to the actuation of such register relay to interrupt the locking circuit of said control relay and to effect the actuation of the other relay of said sequence pair, and an alternate operating

circuit for said control relay including normally open contacts of each of said pair of sequence relays.

6. In combination, a ticket issuing machine, an event adding machine, a grand total adding machine, conductors extending between said ticket machine and said adding machines, means responsive to the actuation of a key on said ticket issuing machine for placing marking potential on both of said conductors, means in each of said adding machines responsive to the marking potential on one of said conductors to register the operation of such key, means in each of said adding machines operated in the course of the registering operation therein for modifying the potential on one of said conductors, and means in said ticket issuing machine responsive only to the modified potential on both conductors to operate the ticket issuing machine to issue a ticket and prepare the machine for its second operation.

7. In combination a ticket issuing machine, an adding machine, a conductor extending between said machines, means responsive to the actuation of a key on said ticket issuing machine for placing marking potential on said conductor, means in said adding machine responsive to such marking potential to register the operation of such key, means in said adding machine operated in the course of the registering operation therein for modifying the potential on said conductor, means in said ticket issuing machine responsive to the modified potential to operate the ticket issuing machine to issue a ticket, a second adding machine, a second conductor extending between said ticket issuing machine and said second adding machine, means in said ticket issuing machine responsive to said modified potential to apply marking potential to said second conductor, means in said second adding machine responsive to such marking potential to register the operation of such key therein, means in said second adding machine operated in the course of its registering operation to modify the potential on said second conductor, and means in said ticket issuing machine responsive to the modified potential over said conductor to control the release of the last actuated key of said ticket issuing machine, whereby the ticket issuing machine is only completely released after the modification of the potential on both conductors.

8. In a totalizing system, a plurality of ticket issuing machines each adapted to issue tickets of different value for any one of a plurality of events, marking leads extending from each machine, register mechanism, a series of sequentially operating relays in which a lead from each machine of any value terminates, means for operating each machine to mark its lead, each relay when operated connecting a plurality of said leads extending from machines representing different values, to the registering mechanism, and means in the register mechanism for registering the values represented by each marked lead each time a relay operates.

9. In a totalizing system, denominational registers including a units register, a tens register and a hundreds register, a plurality of ticket issuing machines each having means for issuing a ticket of a different value, a sequentially operated relay chain, leads from certain of said machines of different value all terminating in one of said relays, leads from others of said machines of different value terminating in another relay, means in each machine for marking its lead whenever the machine is operated to issue a ticket, each relay when operated connecting its leads to the proper one of said denominational registers, and means for maintaining each relay operated until all of its marked leads have been registered in the proper register according to the value thereof.

10. In a totalizing system, a plurality of ticket issuing machines each having means for issuing tickets of different values, a collector switch including a sequentially operated chain of relays, leads from a plurality of ticket machines to each relay, means in each machine for marking its lead when operated to issue a ticket, registering means, means responsive to the operation of each relay of the chain to connect its plurality of leads to the registering means, means in the registering means operated whenever any lead of the relay is marked for stopping the sequential operation of said relay chain and making a registration for each lead from the relay which is marked, and means in the registering means for causing all operated ticket machines connected to the registering means by a relay to issue tickets in sequence, and then permit continued operation of the relay chain.

11. In a totalizing system, a plurality of ticket issuing machines, a collector switch consisting of a chain of sequentially operated relays, leads from said switch to each ticket machine, means in each machine for marking its lead when operated to issue a ticket, register relays, each relay of the chain having means for connecting two or more of said machines simultaneously to said register relays, said register relays sequentially registering the values represented by each machine connected thereto and sequentially causing the complete operation of each machine over the marked leads to issue its ticket.

12. In a totalizing system, a plurality of ticket issuing machines having means for issuing tickets on different events, keys for each machine, a plurality of event registers, a total register, means responsive to the operation of the key of any machine for locking the key and for registering that operation in an event register corresponding to the pressed key and also in the total register, means controlled from the event register for operating the machine to issue a ticket while maintaining the key locked, and means controlled from the total register for unlocking the key.

13. In a totalizing system, a plurality of ticket issuing machines, a collector switch, leads connecting the machines to the switch, units register relays, a units indicator controlled by said relays, tens register relays, a tens indicator controlled directly by said tens relays, a rotary step-by-step switch, a hundreds indicator controlled directly from wipers of said switch, means in said ticket issuing machines for marking leads to the collector switch, said collector switch successively connecting said leads in groups to said register relays, means responsive to the connection of marked leads from certain machines to operate a units relay to directly control the units indicator to register the ticket sale, means responsive to the connection of a marked lead from another machine to the relays to operate one of the tens relays to directly control the tens indicator, and means responsive to the connection of marked leads from other of said machines for directly operating said step-by-step switch to control the hundreds indicator therefrom.

14. In a totalizing system, ticket issuing machines for issuing $2, $5, $10, $50, and $100 tickets

having leads marked when a machine is operated, registering mechanism, a collector switch comprising a series of relays, means for operating said relays in sequence to connect the leads from said machines to the register mechanism, means controlled by the operation of the first relay for simultaneously connecting the leads from a plurality of $2 machines a $5 machine and a $100 machine to the register, means controlled by the energization of others of said relays for simultaneously connecting leads from a plurality of $2 machines, a $5 and a $50 machine to the register, means controlled by the energization of others of said relays for simultaneously connecting leads from a plurality of $2 machines a $5 machine and a $10 machine to the register, and means in the register responsive to the connection of said leads thereto, when the corresponding ticket machine has been operated, for registering values corresponding to each lead successively.

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