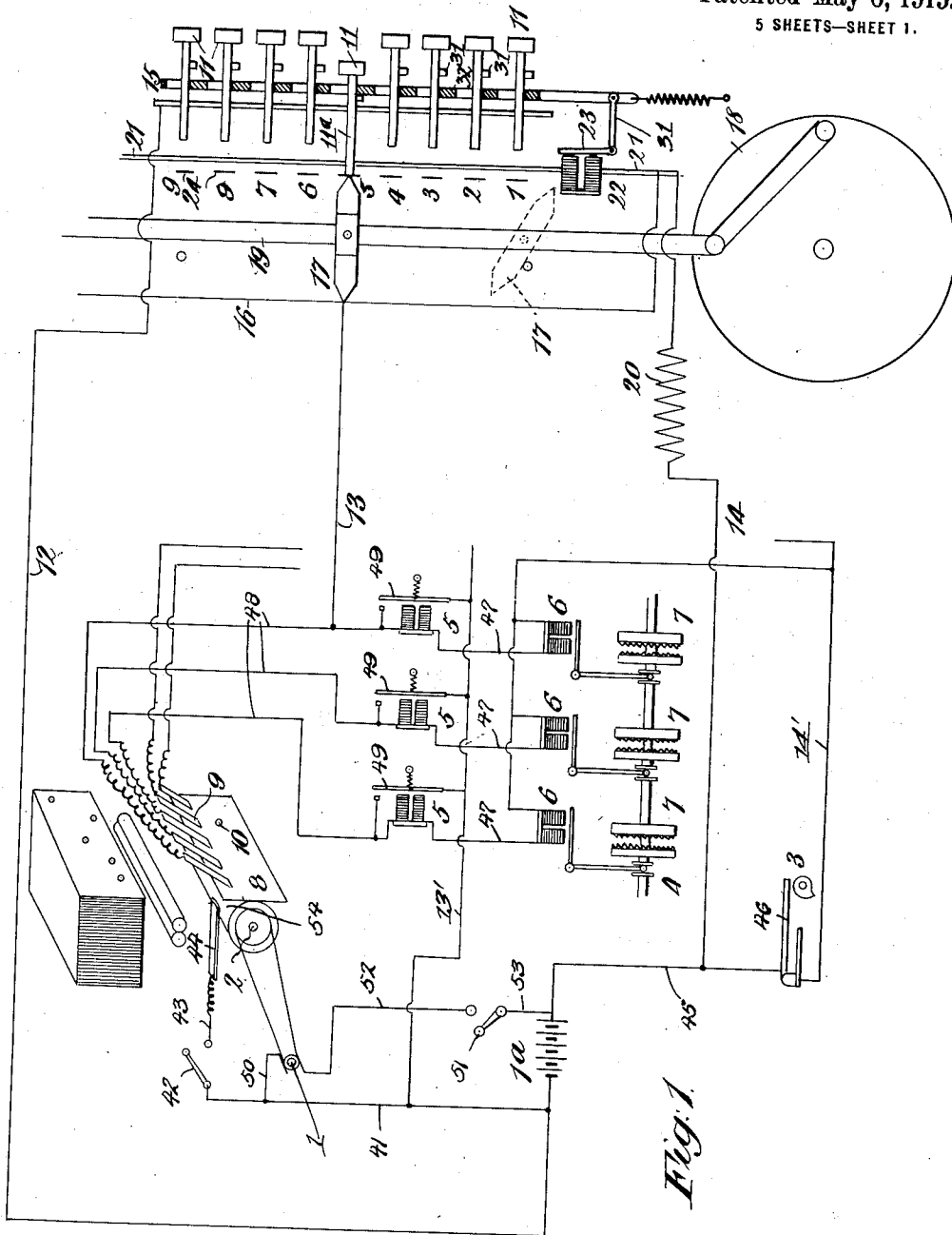


R. N. WILLIAMS.
AUTOMATIC TABULATING MACHINE.
APPLICATION FILED MAY 19, 1915.

1,302,616.

Patented May 6, 1919.
5 SHEETS—SHEET 1.



Witnesses:
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Inventor:
Robert Nett Williams

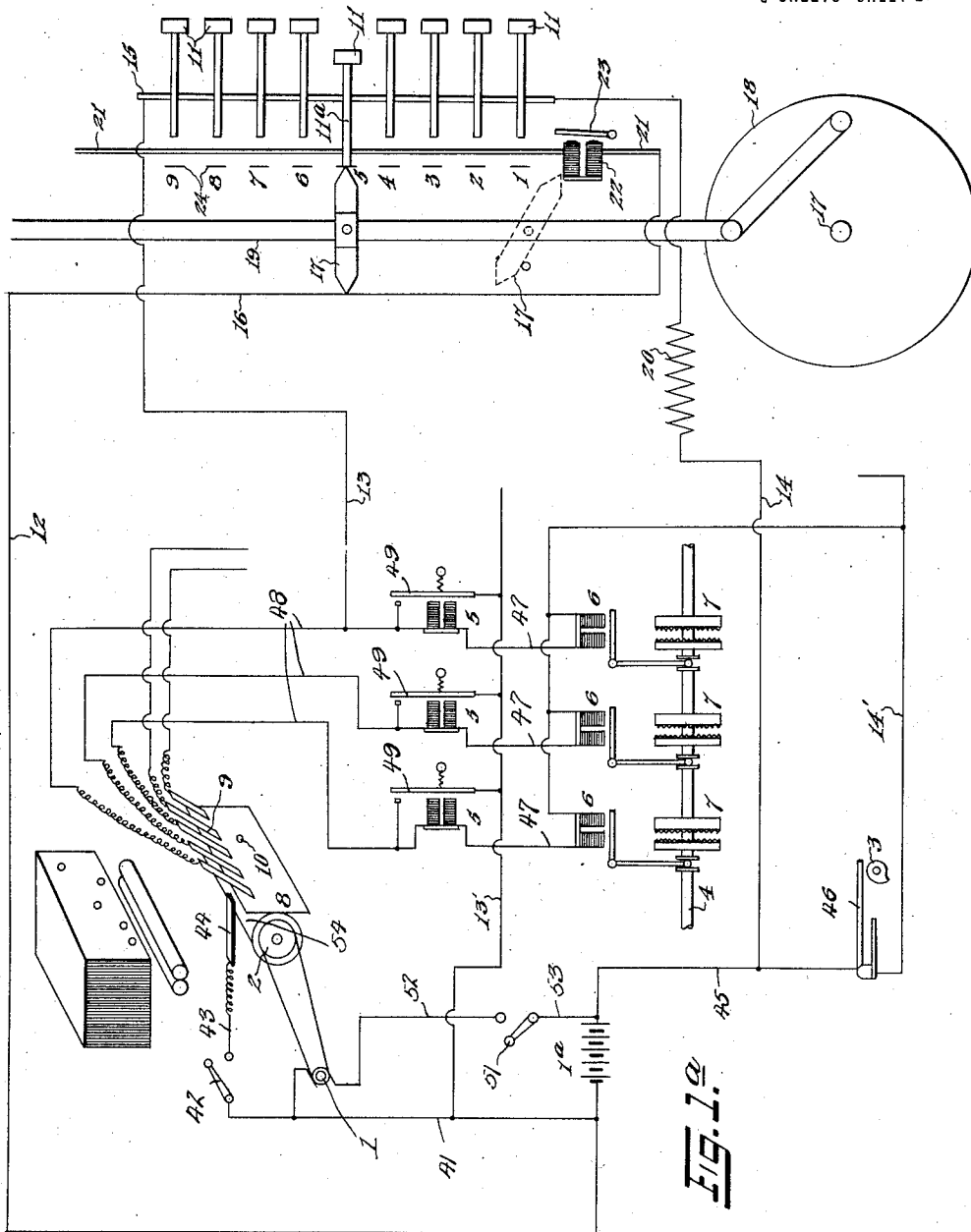
H. D. Penney

By his Atty: *F. H. Richards*

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5 SHEETS—SHEET 2.



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5 SHEETS—SHEET 3.

Fig. 2.

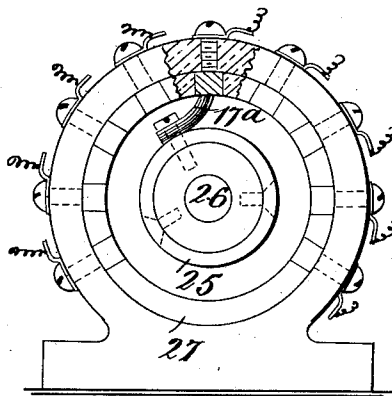
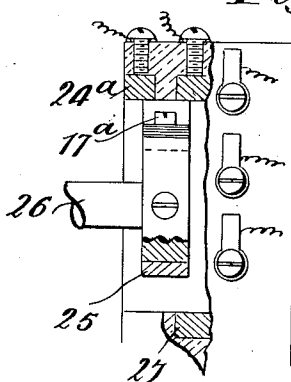


Fig. 3.



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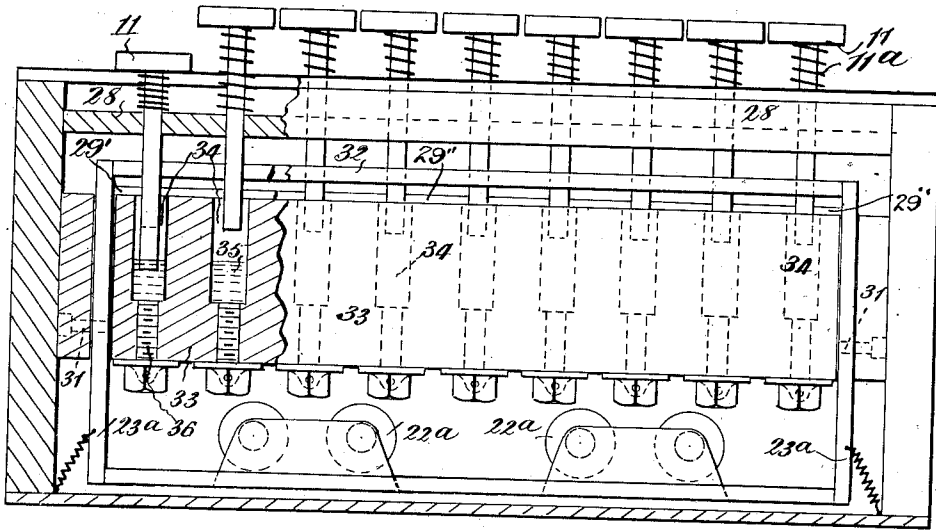


Fig. 4

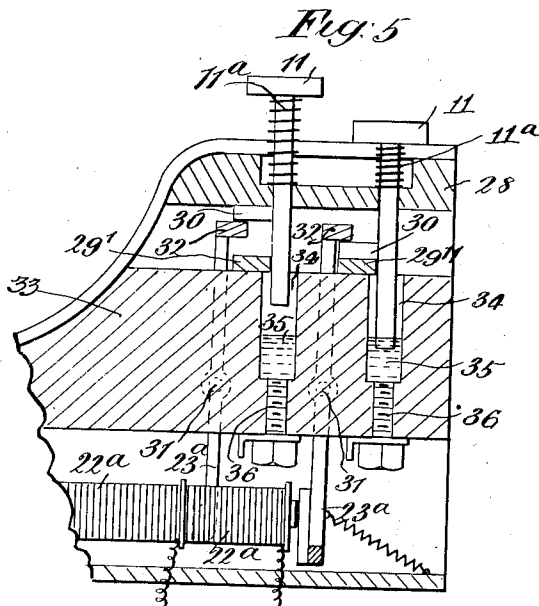


Fig. 5

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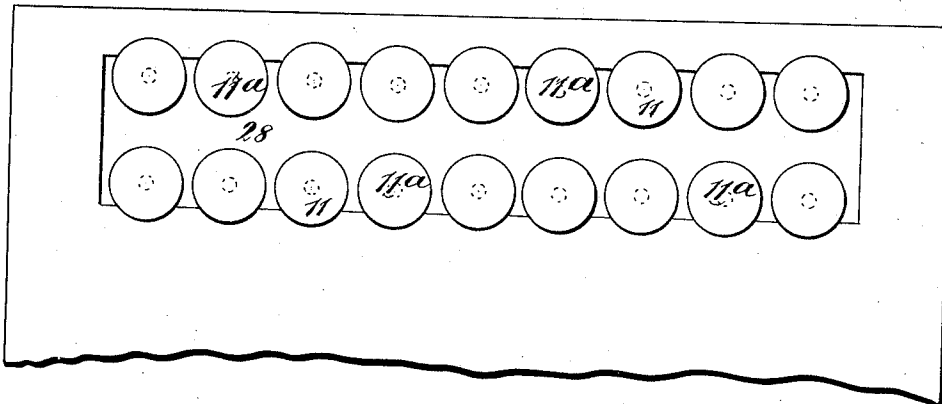
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5 SHEETS—SHEET 5.

Fig. 6.



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UNITED STATES PATENT OFFICE.

ROBERT NEIL WILLIAMS, OF LONDON, ENGLAND, ASSIGNOR TO POWERS ACCOUNTING MACHINE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

AUTOMATIC TABULATING-MACHINE.

1,302,616.

Specification of Letters Patent.

Patented May 6, 1919.

Application filed May 19, 1915. Serial No. 29,244.

To all whom it may concern:

Be it known that I, ROBERT NEIL WILLIAMS, a citizen of the United States of America, residing in London, England, have invented certain new and useful Improvements in Automatic Tabulating-Machines, of which the following is a specification.

This invention relates to improvements in and relating to automatic tabulating machines in which adding mechanism is employed operated by perforated cards. With tabulating installations it is sometimes required either in order to check the totals indicated by the machine or to ascertain a grand total, that a hand-operated machine be employed.

The present invention has for its object to provide means whereby the adding portion of an automatic tabulator may be set by hand so that it may be employed for the purposes for which a separate hand-operated adding machine would otherwise be required. Adding mechanism according to this invention, moreover, presents the advantage that the action is much more rapid than with an ordinary hand operated adding machine, inasmuch as the actual operation of the adding units is effected by the power driving the mechanism of the main machine.

Broadly defined, the invention comprises a key board having keys, one row of keys for each adding unit, and which keys control the setting of the said adding units.

The invention may be applied to either electrical non-listing and non-printing tabulating machines of which that known as the "Hollerith" machine may be taken as an example, or mechanical listing and printing tabulator machines, of which the "Powers" may be instanced.

As applied to an electrical machine, the arrangement is such that upon a key being depressed, at the moment of time corresponding to that at which an electrical impulse would ordinarily be given to the corresponding unit due to the passage of an appropriately perforated card through the machine, an impulse will be given to the particular adding unit or counter the circuit for which, however, is controlled from the key-board.

Provision is preferably made whereby

both the actuated and unactuated keys are locked after setting.

In order that the invention may be the better understood drawings are appended illustrating an example of the application of the invention in which:—

Figure 1 is a diagrammatic view showing the arrangement of the keyboard as applied to an electrically operating tabulating machine.

Fig. 1^a is a similar view of a modified form of the invention.

Fig. 2 is a side view of a modification of a form of circuit closing device for the keys.

Fig. 3 a cross section of Fig. 2.

Fig. 4 is a front view of the keyboard partly in section.

Fig. 5 is a cross section of Fig. 4.

Fig. 6 is a plan.

As applied to an electrical machine of the aforementioned Hollerith type, and in which a driving shaft 2 is employed which is driven by motive power 1, causing the cards to be fed through the machine, a shaft carries a cam 3 which closes a contact at the beginning of each cycle of operation and disconnects it at the end of the same, and at the same time effects the synchronous movement of an adding unit shaft 4.

1^a indicates a source of electrical energy having one pole thereof connected to the conductor 41 which is connected to one end of the switch 42, the other end of the switch being electrically connected by the conductor 43 to the brush 44 electrically connected to the conductive surface 54 on the shaft 2. The other pole of the source of electrical energy 1^a is connected by the conductor 45 with the switch 46 operated by the cam 3, which switch is electrically connected by the conductor 14' with the magnets 6 which are in turn electrically connected by the conductors 47 with the relays 5 that are electrically connected by the conductors 48 with the brushes 9 coöperating with perforated cards 8 in the manner well-known with the Hollerith type of accounting machine. To co-operate with the relays 5, the armatures 49 are provided which are electrically connected by the conductor 13' to the conductor 41. For energizing the motive power 1, in the present instance, one pole of the same is electrically connected to the conductor 41 by the conductor 50 while the other pole is

electrically connected to one end of the switch 51 by the conductor 52 while the other end of the switch 51 is connected to the source of electrical energy 1^a by the conductor 53.

The operation of the foregoing is substantially as follows:

After the switches 42 and 51 have been closed, and one of the brushes registers with an index point 10, the cam 3 having closed the switch 46 in the meantime, current will be caused to flow through the relay 5 connected thereto and thereby attract its armature 49 whereupon a circuit will be established through conductor 47, relay 5, armature 49, conductor 13', conductor 41; source 1^a, conductor 45, switch 46, conductor 14', through the magnet 6 connected to such relay 5, whereupon the counter 7 operatively connected to such magnet 6 will commence and continue to accumulate until the switch 46 is again opened by the cam 3.

As is well-known with the Hollerith type of accounting machines, the greater intervals of current flow will be initiated by the index points designating the greater amounts which is accomplished by disposing such index points near that end of the card which first engages the brushes 9 according to the amount to be registered.

In accordance with this invention the adding units are operated by means of the keyboard in the same manner as by index cards, so that each adding unit will be advanced by an amount corresponding to the key 11 which is depressed. In the example illustrated in Fig. 1 three adding units 7 are shown and for each of the adding units 7 a special row of keys would be provided. The connection of the keys to the circuits of the tabulating machine is made through three conductors 12, 13 and 14, one of which, 12, ends in a rail or bar 15 through which pass the shafts 11^a of the keys. Another conductor 13 ends in a conductor rail 16 which is not connected to any source of supply and acts as a contact for a movable contact 17 which moves synchronously with the driving shaft 2 of the machine and the cam shaft 3 thereof for closing the main circuit of the machine. The conductor 16 also acts as a shunt circuit for an electromagnet 22, hereafter referred to, when the contact 17 passes under the depressed key. Driving mechanism for the moving contact 17 may consist of a crank disk 18 whereby the contact piece which is mounted on a rod 19 is given an oscillating motion. The third conductor 14 is connected to a rail 21 through a resistance 20, which, when a key 11 is depressed, is in conducting connection with the shaft of the key. Normally in series with the aforesaid resistance 20 there is a spring controlled electromagnet 22 provided with an armature 23. The armature 23 serves,

when attracted by the magnet, to shift the lever 31 and the locking bar 32 under or over one of the projections 30 of the keys 11 to lock the keys 11 so that in this position they cannot be moved. An arrangement for locking the keys is shown in Figs. 4 and 5 and will be hereafter more fully described.

A number of contact pieces 24 are electrically connected with the aforesaid movable contact 17 as the latter is moved past them.

The operation of the device is as follows:—

The control by means of the cards 8 is cut out either by removing the brushes 9 from their working position or interrupting the circuit supplying the brushes. Electrical connection is next established between the tabulating machine and the keyboard. Assuming a key 11 has been depressed this produces a contact between the shaft 11^a of the said key and the rail 21 in the circuit with which is the aforesaid magnet 22. The result of establishing this contact, is that a current passes through the winding of the electro-magnet 22 owing to the fact that the rail 15, which is electrically connected to the shaft 11^a of the key 11 is connected by the conductor 12 with one pole of a battery 1^a or other source of energy, and the second rail 21 through the aforesaid magnet 22, in series therewith, and the resistance 20 and the conductor 14 with the other pole of the battery. Whenever a key 11 is depressed, therefore, the armature 23 of magnet 22 will be attracted and the key locked until the said armature 23 releases the said key. The shaft of the depressed key not only makes contact with the second rail 21 but also with a contact piece 24. This contact is ineffective until the moving contact 17 reaches the corresponding contact piece 24. As soon as this occurs by reason of the movement of rod 19 there is a direct electric circuit between the depressed key 11 and the contact piece 17 and the second contact rail 21. By this means there is a short circuit from one side of the magnet 22 through contact bar 16 sliding contact 17, contact 24 to rail 21 on the other side of magnet 22. The resistance of this shunt circuit is negligible compared with the resistance of the magnet. Consequently only the small current will flow through the magnet and the armature 23 is released by its spring from the said magnet. A circuit is also closed with the pole of the battery 1^a through the aforesaid resistance 20 by way of the second contact rail 21 over the circuit 13, the winding of the relay electromagnet 5, the adding unit at the end of said electromagnet 6 and the circuit connected thereto. When current passes through the circuit 13 and the electromagnets of the relays 5, the armatures of such relays are drawn and permit current to pass through the conduc-

tor 13', said armatures and electromagnets of the relays 5, thence to the electromagnets 6 and then through the conductor 14', the cam 3 to the battery. This causes the armatures of the relays to remain drawn and the electromagnets 6 to be energized so long as the current can pass through the path just described, and until the circuit is broken by the cam 3. The adding unit 7 operates as long as the electromagnet 6 is energized. At the moment, therefore, that the contact piece 17 passes its contact 24, which is depressed by one of the keys into the path of said moving contact, there is an operation of the corresponding adding unit 7 which continues from the time the contact piece contacts the contact 24 until the cam 3 interrupts the main circuit 14' of the machine, consequently, when one of the keys has been depressed the coördinating adding unit is controlled in the same manner as it would be if a card were to pass through the tabulating machine so that the actuation of the adding units according to the value of the key depressed is effected by reason of the timed relation of the rotation of the cam 3 and the movement of the contact 17. By this means there is provided an adding machine using adding units of the tabulating machine by the simple addition of a keyboard.

Instead of the rail 15 through which the key shafts pass and which is in continuous metallic connection with all of the key shafts, being connected directly to one pole of the battery and providing for the connection of the second rail 16 with the other pole by means of a conductor in which the relay and an adding unit electromagnet are inserted, the inverse method could be followed, as shown in Fig. 1^a, and the second rail 16 be connected directly through the conductor 12 with one pole of the battery and the first rail or key shaft rail 15 connected through a conductor 13 with the relay 5 and the adding unit operating electromagnet 6. This arrangement has the advantage that where a number of rows of keys are employed, a single moving contact 17 and its corresponding conductor rail 16 would be sufficient. The only requirement is that the electro-magnet 22 for locking the keys shall be so supplied with current that the key lock armature 23 thereof operates properly. This requirement is met as in Fig. 1, since in Fig. 1^a, the resistance 20 is connected to the rail 15. When the key 11 is depressed, current passes through conductors 12 and 16, electromagnet 22, rail 21, shaft 11^a, rail 15, resistance 20 and conductor 14. When the contact 17 engages contact piece 24, current passes through conductors 12 and 16, contact 17, rail 15, and conductor 13, thus completely shortcircuiting the electromagnet 22 and releasing the key. In practice, instead of the oscillating

contact 17 a rotating switch would be employed, around which the various contacts connected to the individual keys would be grouped. Such an arrangement is shown in Figs. 2 and 3 and comprises a circular commutator for which a rotary contact 17^a is provided. This contact 17^a is located on a revolving support 25 mounted on and suitably insulated from a shaft 26, which shaft is moved synchronously with the main controlling cam shaft 3. 24^a indicates the contact pieces of the commutator. For each keyboard there is a special commutator ring, the contact pieces 24^a of which are in metallic connection with the keys. A metal ring 27 is located to one side of the commutator contacts and insulated from them. This ring 27 is in permanent connection with the brush 17^a and corresponding to the conductor 16, is in permanent connection with the circuit 13 leading to the relay magnets, see Fig. 1. The brush 17^a bridges over from the contacts to this ring passing one after another of the same so that a current is caused to flow in the same manner as already described with reference to Fig. 1, whenever a key is depressed. The shaft 11^a of the keys are in permanent metallic connection with a metal plate 28 which corresponds to the perforated rail 15 of Fig. 11 for the said key shafts, before referred to. Each row of keys is provided with a metal rail indicated respectively by 29' and 29'', Figs. 4 and 5 which correspond to the second rail 21 of the first described arrangement shown in Fig. 1, and are connected through a corresponding circuit 14 to the resistance 20 with one pole of the battery. Each key shaft has a projection 30 which comes in contact with one of the aforesaid rails 29' or 29'' when the appropriate key is depressed. The electromagnets 22^a corresponding to the magnets 22 of the aforesaid arrangement have their coils in the circuit between the rails 29' 29'' just referred to and one pole of the battery 1^a. Each of these electromagnets has an armature 23^a pivoted in a bearing 31 and has a hook-shaped projection 32 at its free end. This hook-shaped projection as long as the armature is not attracted is out of the path of motion of the projection 30 on the key shaft. When, however, the armature is attracted, the hook-shaped projection 32 passes under the projections 30 of the keys that have not been depressed and over the projection 30 or projections as the case may be on the key which has been depressed. Each time a key is depressed the contact 30 connects it to the rail 29' or 29'' and an electromagnet 22^a is energized whereupon the armature 23^a of the same is attracted. Consequently the depression of one key causes all keys of the keyboard to be locked by the projection 32, and remain locked until the armature 23^a of

the locking magnet is released by its electro-magnet. The support for the keys comprises a block 33 of insulating material provided with holes 34 into which the shafts 11^a of the keys 11 penetrate, and which holes contain mercury 35 contact with which is established by the screws 36, the heads of these screws being connected with the contact pieces 24^a of the commutator. When a key 11^a is depressed the end of its shaft enters the mercury 35 and in this way causes a current to flow to the commutator contact piece. This connection corresponds to the contact of the shaft of the depressed key 11 with the contact piece 24 in Fig. 1 of the drawing. When the brush 17^a revolves therefore the same actions take place, as in the arrangement shown in the diagrammatic Fig. 1, so that a further explanation of the action of mechanism shown in Figs. 2-6 in detail is not required.

The key board comprises a number of rows of keys each row controlling the stops for one sector of the adding mechanism. This sector advances until its further movement is checked by a raised stop and in doing so it advances from the naught to the nine, or any other point between these positions according to the key depressed. In order, however, that the sector shall not move to the nine position when no stop has been raised in any column, provision is made whereby the naught stop shall always be raised, except when some other stop has been raised in the same column. Provision is made for locking each row of keys when one of the keys has been depressed.

Claims.

1. In an electrically operating tabulating machine having adding units, relays and magnets for the adding units, keys, a movable contact for controlling the circuit to the relays for the magnets of the adding units, and a series of contacts closed by the keys and arranged in the path of the said moving contact.

2. In an electrically operating tabulating machine having adding units, relays and magnets for the adding units, keys, a movable contact for controlling the circuit to the relays for the magnets of the adding units, and a series of contacts closed by the keys and arranged in the path of the said moving contact, means for locking all the keys when the selected keys have been depressed to effect the setting, and means for releasing the keys when the adding units have been operated.

3. In an electrically operating tabulating machine having adding units, relays and magnets for the adding units, a series of keys, a rotary member, a brush upon said member, a fixed member carrying the contacts for the relays for the magnets of the adding units, and contacts closed by the keys

whereby the circuit of the relays for the adding units may be closed by the brush upon the rotary member.

4. In an electrically operating tabulating machine having adding units, relays and magnets for the adding units, a series of keys, a rotary member, a brush upon said member, a fixed member carrying the contacts for the relays for the magnets of the adding units, and contacts closed by the keys whereby the circuit of the relays for the adding units may be closed by the brush upon the rotary member, and means for locking all the keys when the selected keys have been depressed, and means for releasing the keys when the adding units have been operated.

5. In an electrically operating tabulating machine having adding units, relays and magnets for the adding units, a series of keys, a rotary member, a brush upon said member, a fixed member carrying the contacts for the relays for the magnets of the adding units, and contacts closed by the keys whereby the circuit of the relays for the adding units may be closed by the brush upon the rotary member, means for locking all the keys when the selected keys have been depressed, and means for releasing the keys when the adding units have been operated, comprising an electro-magnet, the circuit of which is closed by the depression of the keys, an armature for said magnet, a projection on said armature, projections on the keys adapted to engage the projections on the armatures, a contact closed by the keys and means for releasing the armature when the adding units have been operated.

6. In a tabulating machine having adding units, relays and magnets for the adding units, and keys whereby the adding units may be controlled by hand, means for locking all the keys when the selected keys have been depressed, and means for releasing said keys when the adding units have been actuated.

7. In an apparatus of the character described, the combination of a plurality of keys; electric means for locking the keys; a movable means adapted to contact a depressed key and to short circuit said electric means; an adding means; a source of current; conductors connecting said source, said keys, said movable means, and said adding means in a circuit; and means for breaking said circuit; said adding means being adapted to operate when the movable means contacts the depressed key and to cease when said circuit is broken.

8. In an apparatus of the character described, the combination of a plurality of keys; electric means for locking the keys; a movable means adapted to contact a depressed key and to short circuit said electric means; an adding means; a source of current

rent; conductors connecting said source, said keys, said movable means, and said adding means in a circuit; and means for breaking said circuit.

5 9. In an apparatus of the character described, the combination of a plurality of keys; a contact rail adapted to be contacted by a depressed key; a resistance; an electrically operated key locking means disposed
10 between said resistance and said contact rail; a uniformly moving contact adapted to engage any depressed key and electrically to the connection between said locking means and resistance; an adding unit electrically
15 connected to said moving contact; a source of current having one pole connected to said keys and its other to said resistance and unit; and means for breaking the connection between said other pole and said unit.

20 10. In an apparatus of the character described, the combination of a bar; a two part rail; keys adapted when depressed to electrically connect said bar and one part of said rail; a conductor rail and a resistance electrically
25 connected to the other part of said rail; an electrically operated locking means interposed between said parts and adapted to lock said keys; a uniformly moving contact adapted to electrically connect the conductor rail with the depressed key; an adding
30 unit electrically connected to said conductor rail adapted when electrically operated to move when the movable contact contacts with the depressed key; a source of
35 current having one pole connected to said bar and its other pole to said resistance and said adding unit; and means for breaking the electric connection between said unit

and said other pole after the movable contact has moved forward past all of the keys. 40

11. In an apparatus of the character described, the combination of a series of longitudinally movable key shafts provided with keys; a bar and a rail associated with said series and adapted to be, by the said shafts, 45 electrically connected together when a key is depressed; a conductor rail; a plurality of contact pieces, one for each key shaft, adapted to be put in electrical connection with the key shaft when the key thereof is depressed; 50 a movable contact adapted to successively engage said contact pieces and electrically connect them to said conductor rail; means for moving said movable contact past said pieces at equal time intervals; a resistance; an electro-magnet of high resistance; an adding 55 unit comprising relays and operating magnets and adapted when operated to move when the movable contact contacts with the depressed key; a cam operated switch; a source of current; a conductor connecting one pole of said source to said bar and to said relays conductors connecting the other pole of said source to said switch, said operating magnets and said resistance; conductors connecting said rail, said resistance and said electro-magnet in series; and a conductor 60 connecting said relay to the movable contact. 65

In witness whereof I have hereunto affixed my signature in the presence of the undersigned witnesses. 70

ROBERT NEIL WILLIAMS.

Witnesses:

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H. B. WARD.