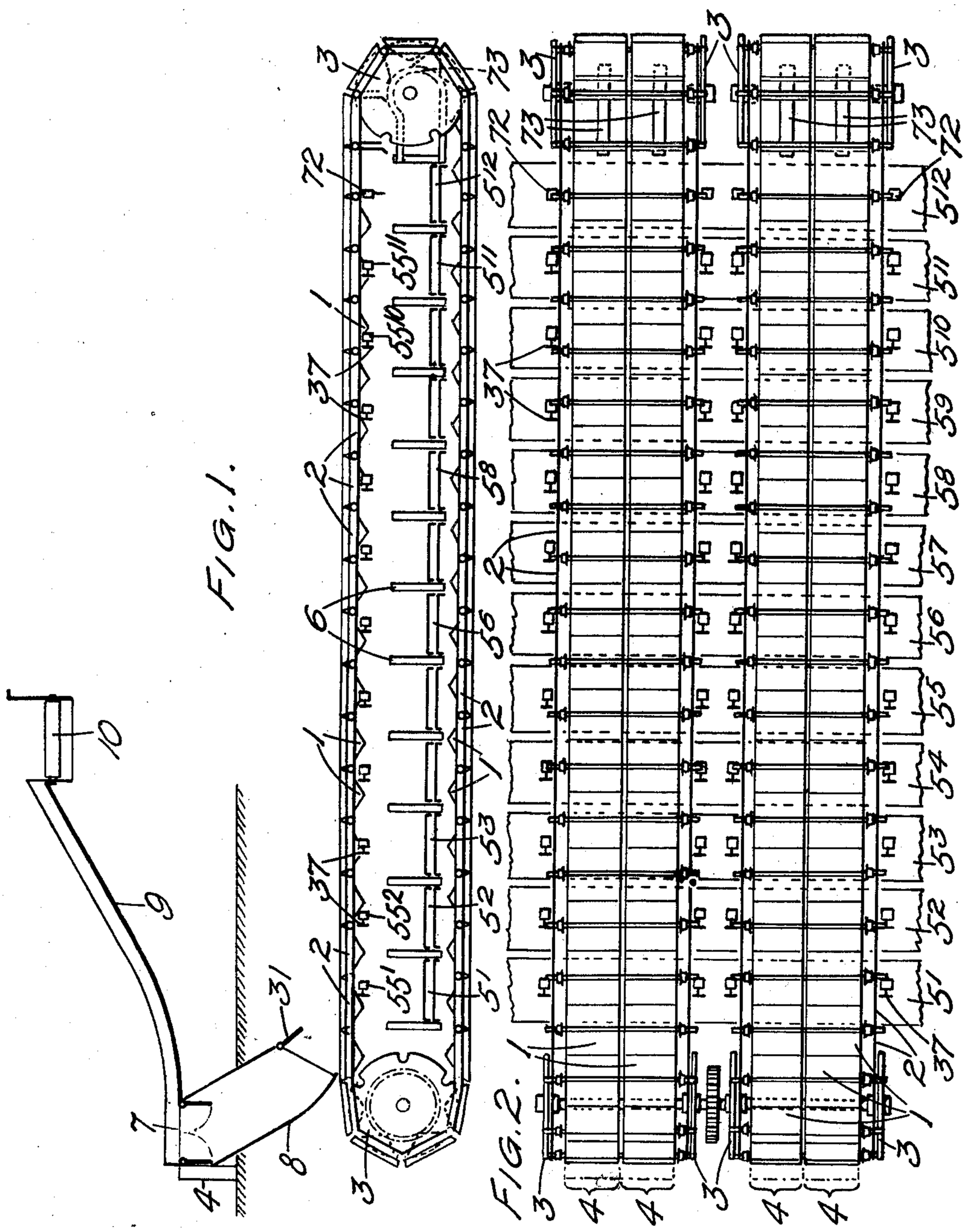
March 19, 1940. H. W. CADMAN 2,194,381

SORTING APPARATUS

Filed Sept. 16, 1937 5 Sheets-Sheet 1



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SORTING APPARATUS

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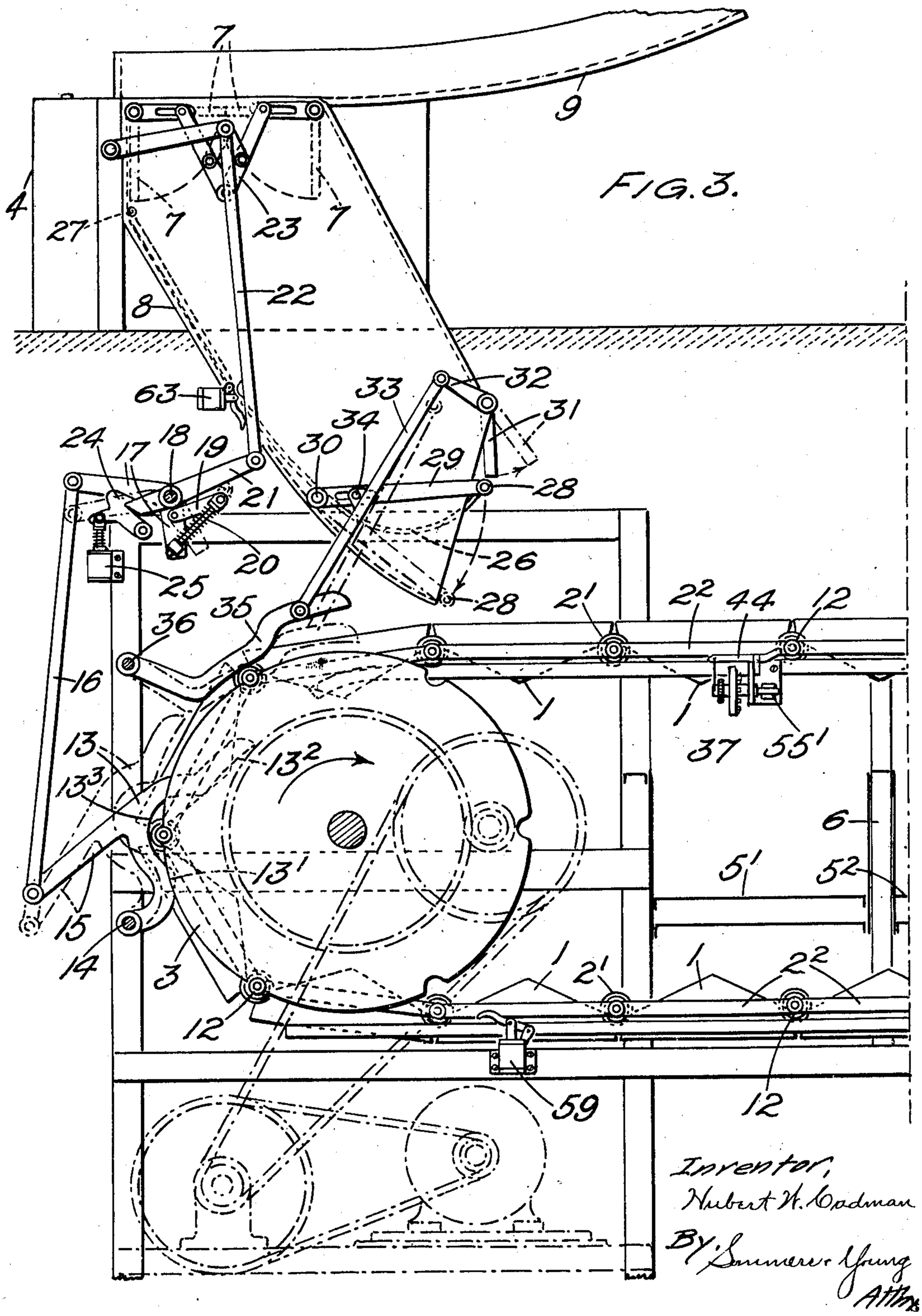

FIG. 3.

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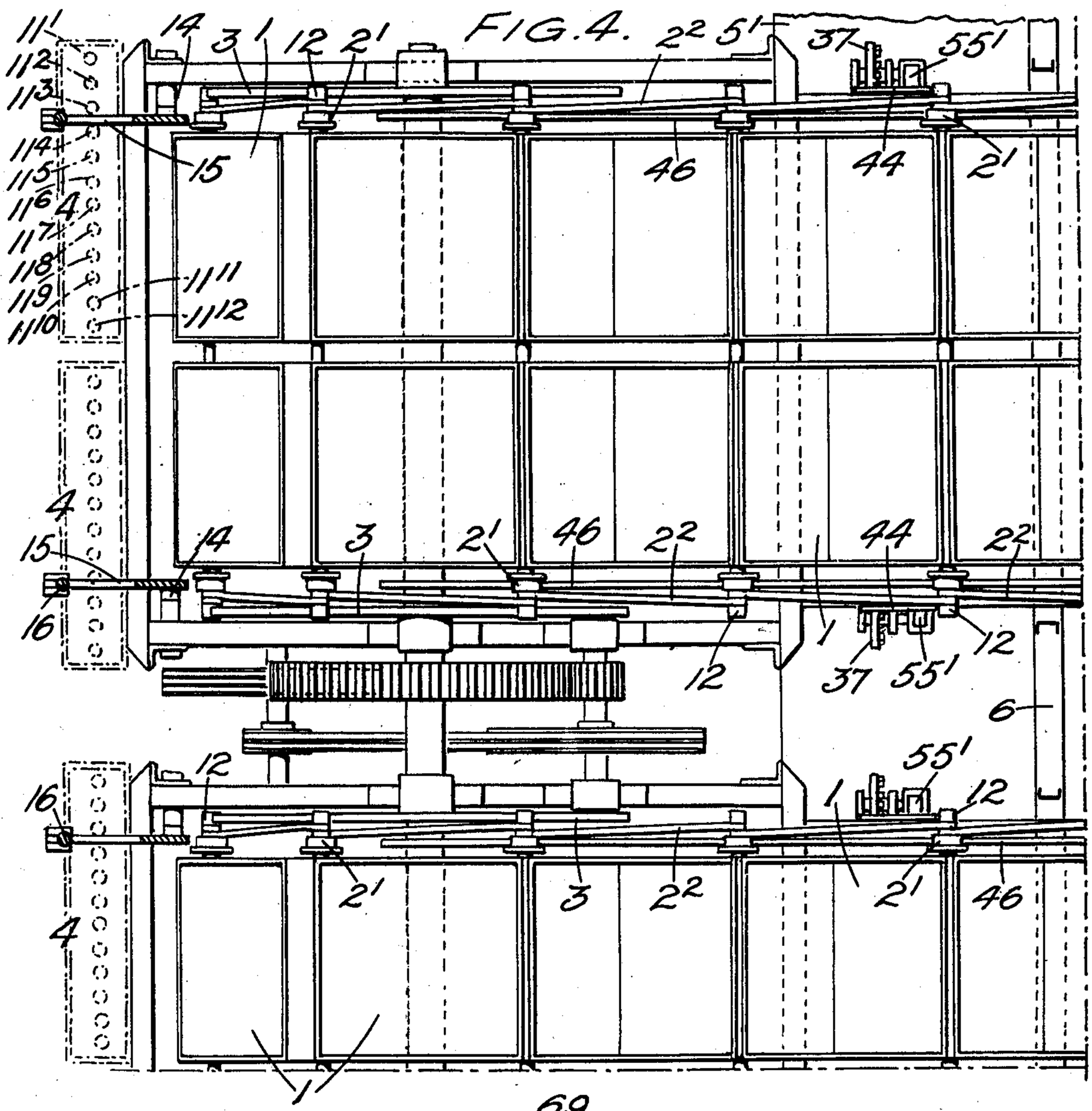
FIG. 4.



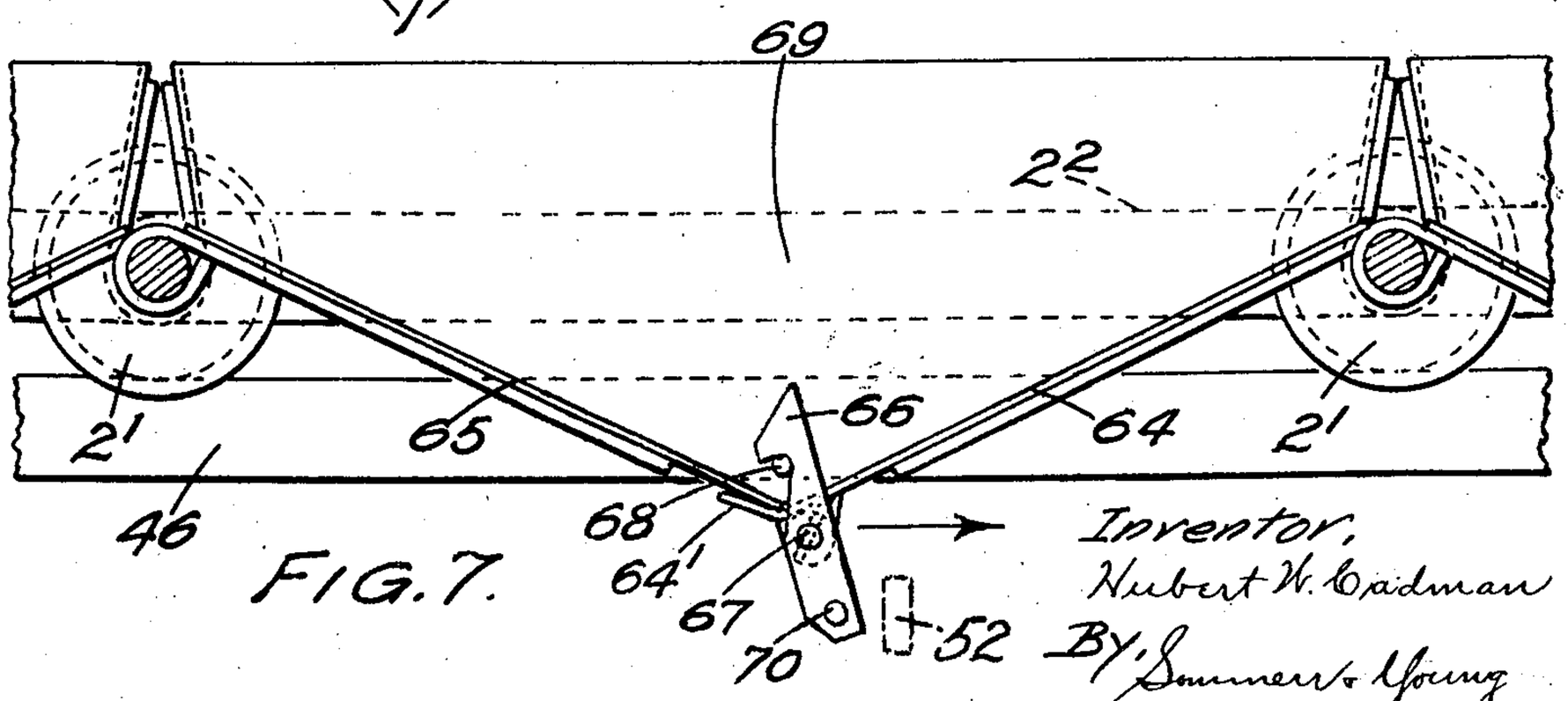


FIG. 7.

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FIG. 6.

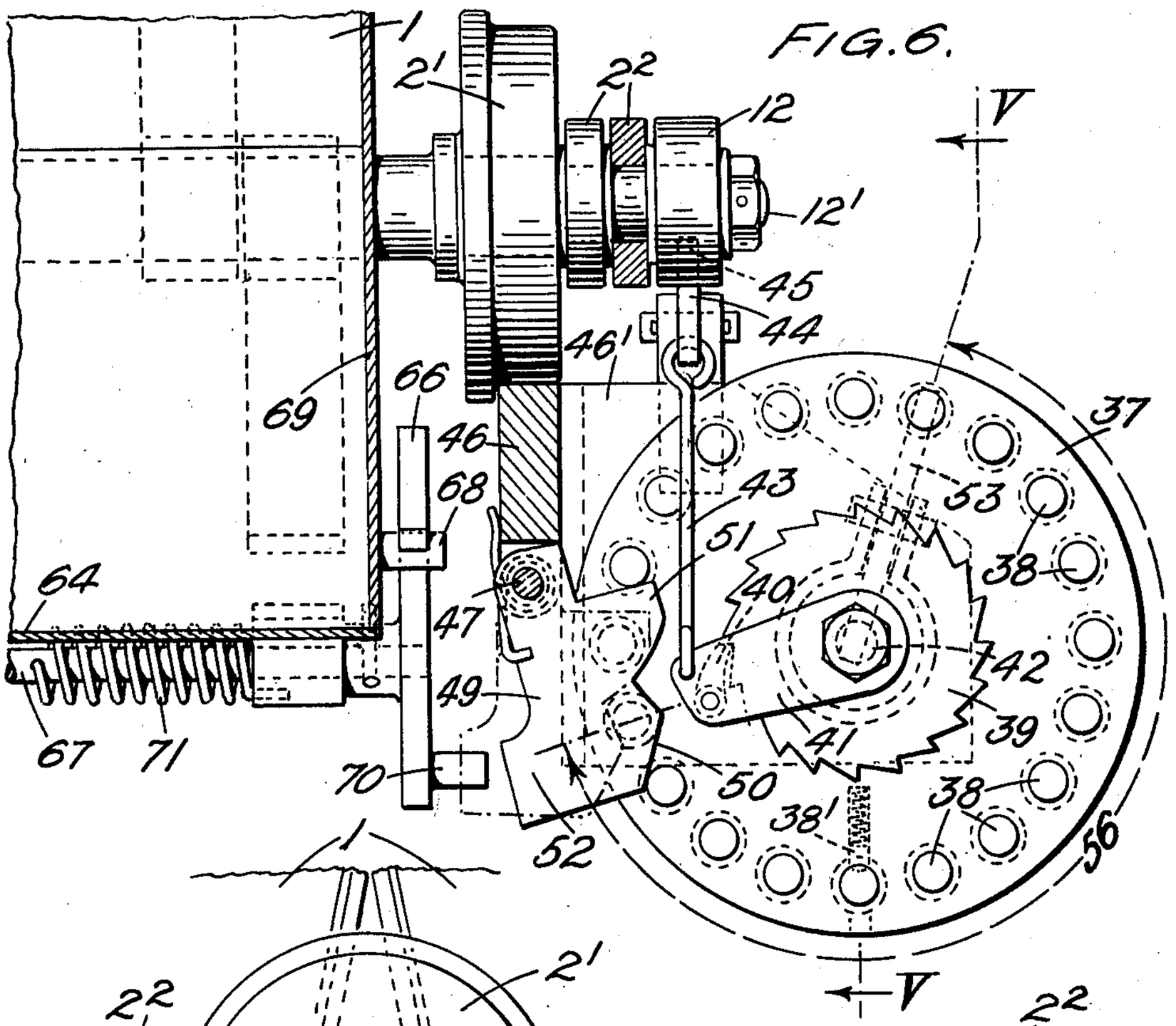

FIG. 5.

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FIG. 8.

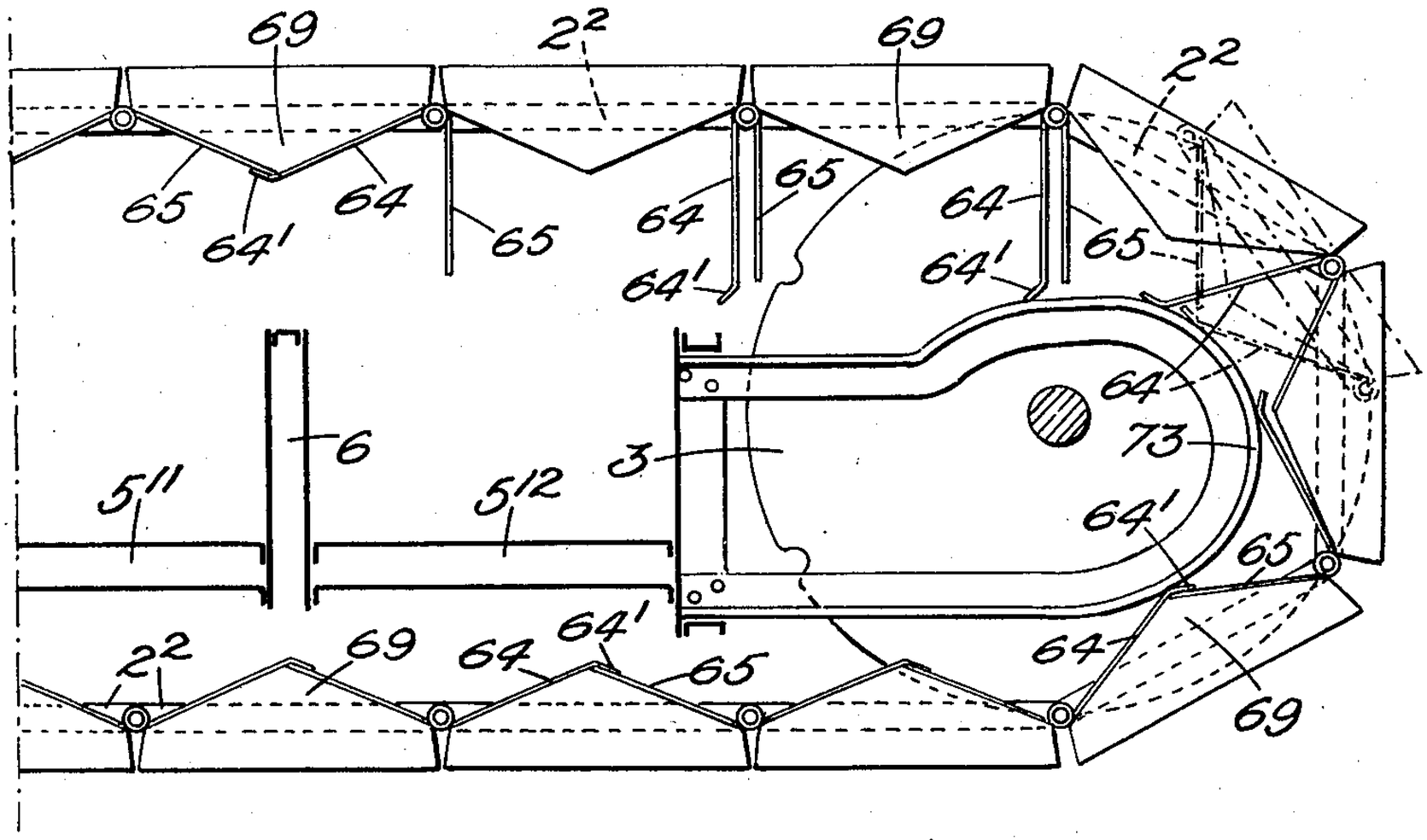
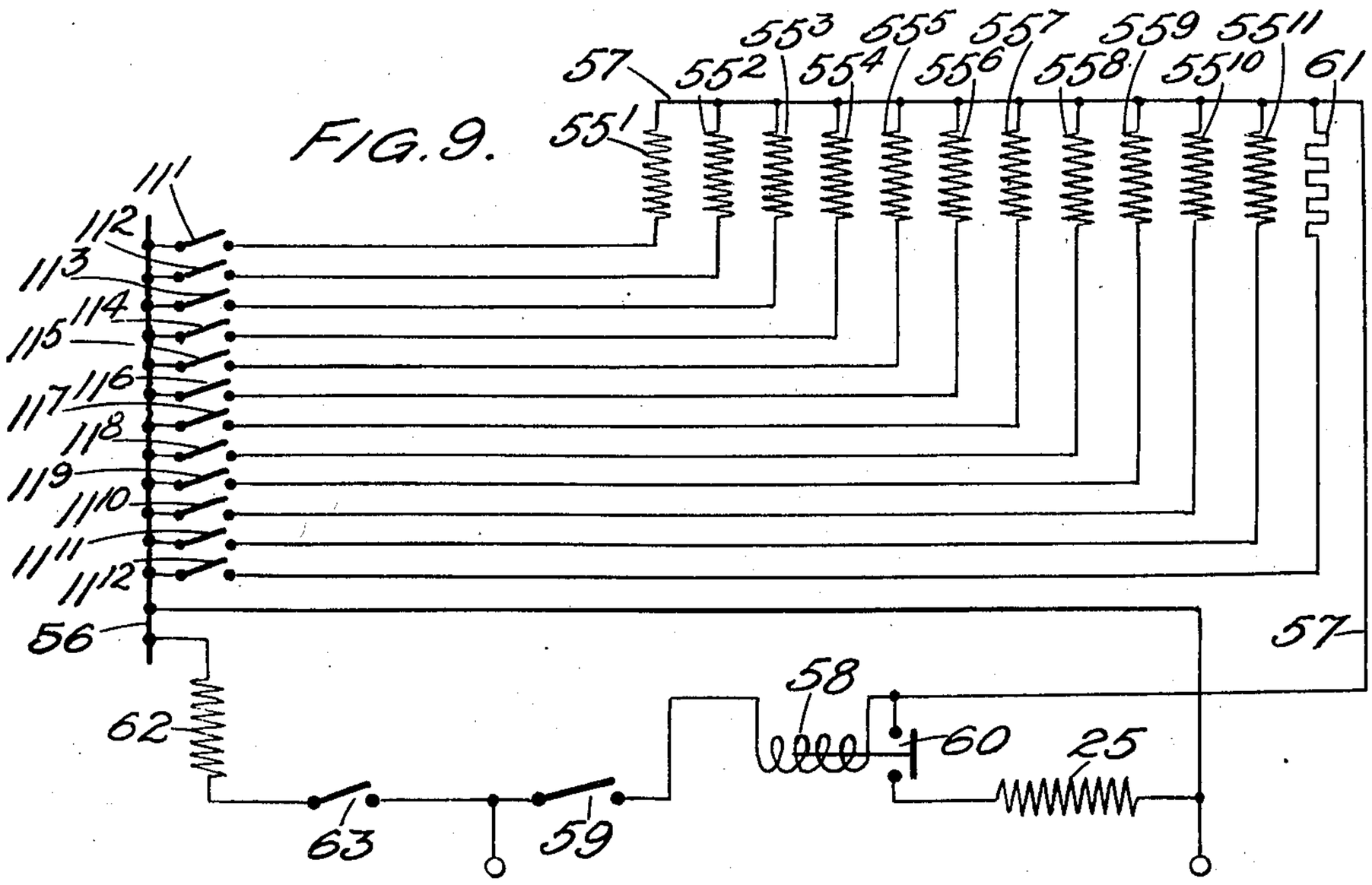


FIG. 9.



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Patented Mar. 19, 1940 2,194,381

UNITED STATES PATENT OFFICE

2,194,381

SORTING APPARATUS

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Application September 16, 1937, Serial No. 164,224
In Great Britain January 26, 1937

16 Claims. (Cl. 214—11)

This invention concerns improvements relating to sorting and distributing apparatus for parcels, particularly for the use of postal authorities, of the kind in which an endless distributing conveyor passes a sorting station and a series of receiving stations and a sorting official at the sorting station manually sets a selective control means whereby parcels transported by the conveyor are caused to be discharged therefrom at the proper receiving stations. An object of the invention is to provide a simple apparatus which takes proper account of the difficulties to be overcome if parcels are to be reliably and safely sorted and distributed. These difficulties are not the same as those which are encountered in the sorting of letters or cards and arise especially from the necessity for caring for a very wide range of sizes and kinds of parcels, including bulky parcels and also fragile parcels.

According to the invention, parcel-sorting and distributing apparatus comprises a continuously operating distributing conveyer having a series of compartments and arranged to pass a sorting station and a series of receiving stations, compartment-discharging means at each receiving station, and control means including manually set selection means located at the sorting station and discharge-effecting means each allotted to the discharging means at a respective receiving station, each discharge-effecting means being directly associated with the selection means for being selectively rendered active upon actuation thereof and associated with the conveyor for being advanced in step with the compartments towards a discharge-effecting condition in such fashion that the compartment passing the sorting station at the time when the selection means is actuated is caused to be discharged as it passes the aforesaid receiving station.

In contradistinction to arrangements in sorting apparatus proposed heretofore, the aforesaid discharge-effecting means is rendered active, that is, prepared for effecting discharge, directly by the selection means, that is, without the intermediary of register devices carried by or otherwise permanently allotted to respective compartments of the conveyor.

Also in accordance with the present invention, parcel-sorting and distributing apparatus comprises a continuously operating distributing conveyor having a series of compartments and arranged to pass a sorting station and a series of receiving stations, manually actuated selection means at the sorting station, timing means operated by or with the conveyor, compartment charging means at the sorting station adapted for being caused to operate by actuation of the selection means and under control of the timing means so that each parcel is charged into a definite compartment in position for receiving it, discharging means at each receiving station, discharge-effecting means each adapted for being selectively set in action by actuation of the selection means and under control of the timing means and each allotted to a respective receiving station and operatively related to the discharging means at the said station for causing discharge there of that compartment which is in position for receiving the parcel when the charging means is caused to operate.

A preferred embodiment of the invention intended for the sorting of postal parcels will now be described by way of example and with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic side elevation of an installation of apparatus in accordance with the invention,

Fig. 2 a similar plan view of the conveyors,

Fig. 3 a side elevation to a larger scale of part of a distributing conveyor and the associated chute and trap-door gear,

Fig. 4 a plan view to a larger scale of parts of several distributing conveyors,

Fig. 5 a side elevation partly in section on V—V in Fig. 6, to yet a larger scale of electro-mechanical discharge-control means,

Fig. 6 a view at right angles to Fig. 5,

Fig. 7 a side view of a box showing the latching means,

Fig. 8 a vertical section of the far end of a distributing conveyor, showing the relatching means, and

Fig. 9 a circuit diagram.

Referring primarily to Figs. 1 and 2, the distributing conveyors comprise a train of boxes 1 of shallow hopper shape carried between endless roller-chains 2 which run over sprocket-wheels 3. A number of such conveyors (four in Fig. 2) corresponding to the number of sorting stations 4 extend parallel to each other in a horizontal plane. The receiving conveyors comprise parallel endless conveyor bands 5^1, 5^2 . . . 5^{12} extending, with partitions 6 between them, at right angles to the distributing conveyors and located below the upper, effective, flights of the latter. There is a number of these receiving conveyors (as illustrated, twelve) corresponding to the required number of sorting selections. The range of sorting stations 4 extends above adjacent ends of the distributing conveyors and will generally

be accommodated upon the next floor of the building. Preferably the stations each comprise a sorting table containing an opening normally closed by trap-doors 7 from below which an inclined chute 8 leads down to a point above the end of the associated distributing conveyor. Each station is suitably supplied with parcels to be sorted, for example by a glissade 9, from an elevated platform 10.

At each station 4, there is a row of press-button switches 11^1, 11^2 . . . 11^{11}, 11^{12} (Fig. 4), one for every receiving conveyor. As hereinafter described, the switches serve two functions. Firstly, each switch, when depressed, allows the trap-doors 7 to open when a box of the distributing conveyor is approaching the correct position, or is correctly positioned, to receive a parcel by way of the chute 8. For this purpose, the control gear for the trap-doors 7 is made to comprise two elements, a first element which operates in timed relation with the associated distributing conveyor and which would permit release of the trap-doors each time a box 1 approaches the correct position and a second element which permits one such release only when a switch has been depressed. Conveniently the first element is mechanical and the second electrical. Secondly, each switch except 11^{12} controls electro-mechanical means over one particular receiving conveyor 5^1—5^{11} whereby the box 1 into which the parcel has been deposited is caused to discharge the same upon arriving above that conveyor.

A preferred form of control for the trap-doors 7 is illustrated in Fig. 3: For the first element of this control, rollers 12 on the axles 12^1 carrying the rollers 2^1 and connecting the links 2^2 of one of the chains 2 are utilized as operating members. These rollers 12 co-act with a shaped lever 13 which is pivoted at 14 and is connected by an arm 15 and link 16 to a bell-crank lever 17 pivoted at 18. An abutment 19 pivoted on the lever 17 is held upwardly by a strong compression spring 20 and is capable, in the position illustrated by chain lines, of affording support to a lever 21 freely pivoted at 18 and connected by a link 22 to trap-door release linkage 23. The lever 21 is normally supported in the position illustrated by a catch 24 which is connected to the plunger of a normally unexcited solenoid 25. This last arrangement constitutes the second element of the control.

It will be seen that as long as the solenoid 25 remains unexcited, the linkage 21—23 will be held in the position illustrated and the doors 7 closed irrespective of the condition of the linkage 13—17. If, however, the solenoid operates to release the catch 24, the doors 7 will be held closed only while the linkage 13—17 is in the position shown by chain lines in Fig. 3, that is while the lever 13 is engaged on one of its flats 13^1, 13^2 by a roller 12. As soon as a roller enters the recess 13^3, however, the linkage 21—23 will be completely released and the trap-doors will fall open. The recess 13^3 is so designed that this happens when a box 1 is approaching the correct position for receiving a parcel. As the roller subsequently runs on to the flat 13^2, the doors 7 will be raised through the linkage 13—17, the abutment 19 and linkage 21—23 and will then be locked closed by the catch 24 controlled by the solenoid 25, now unexcited.

In the arrangement illustrated in Fig. 3, closure means for the lower end of the chute 8 and control means therefor are also provided: A loop of belting 26 is anchored at one end 27 and is connected at the other end to a cross-bar 28 supported by a lever 29 pivoted at 30. This loop normally closes the lower part of the mouth of the chute and catches without shock parcels falling from the trap doors 7, while the upper part of the said mouth is closed by a stop-flap 31 having an arm 32 connected to a link 33. This link has a pin and slot connection 34 with the lever 29 and a pivotal connection with a shaped lever 35 which is pivoted at 36 and is actuated by the rollers 12. Each time a box 1 reaches the correct position below the chute, the lever 35 moves from the full-line to the chain-line position in Fig. 3 and thereby causes the belting 26 to be lowered and the stop 31 raised so that any parcel in the loop is deposited safely and correctly in the box 1. Particularly with a more gently sloping chute, this additional closure means may be dispensed with, but the control means for the trap-doors 7 must then be carefully timed so that a parcel therefrom reaches the box 1 when it is in the correct position.

A preferred form of electro-mechanical means over each receiving conveyor 5^1—5^{11} is shown in Figs. 5 and 6: A round disc 37 containing a ring of studs 38 slidable in a direction parallel to the axis of the disc is connected to a ratchet wheel 39 engaged by a spring-loaded pawl 40 which is carried by an oscillatory lever 41. This lever is mounted freely on a stub 42 projecting from the wheel 39 and is connected by a link 43 to a see-saw lever 44 having one end 45 elevated for engagement by a part connected to each passing box 1, as illustrated a roller 12. Such engagement results in the lever 44 being rocked clockwise, raising its bevelled end 45^1 into position for engagement by the next roller 12 by which the lever is returned to its initial position before being rocked again. The mechanism is supported from the frame-rail 46, on which the rollers 2^1 run, by a bracket 46^1.

The lever 44 is thus rocked and actuates the pawl 40 once for each box 1 that passes. The arrangement is made such that the disc 37 is thereby advanced by the pitch-distance between two studs 38 each time a box passes. The studs, each controlled by a spring detent 38^1, normally occupy an inoperative position in which they all project upon one side of the disc, the right hand side in Fig. 5. Mounted on the other side of the disc on a pivot 47 is a spring-loaded trip-lever 49 which normally occupies an inoperative position, illustrated in full lines in Fig. 6, in which it overlaps the disc. This lever has a cam-face 50 on its edge engageable by the side of any stud 38 projected from the adjacent side of the disc and a cam-face 50^1 (Fig. 5), upon the back of the part 51 (Fig. 6), engageable subsequently by the end of such projected stud for returning it to its normal position. Engagement of the edge-cam 50 by a stud 38 rocks the trip-lever 49 to its operative position (chain line, Fig. 6) in which a finger 52 is engageable with latch means, hereinafter described, on a passing box 1 for causing the latter to discharge its contents. The projection of a stud 38 to the operative position is effected through a rocking lever 53 by the attraction of the core 54 of a solenoid 55. In Figure 5, the uppermost stud has just been projected and the core 54 has returned to its normal position. In the mechanism over each receiving conveyor 5^1—5^{11}, the angular interval 56 (Fig. 6) between the point at which the lever 53 can operate to project a stud 38 and the point at which that stud can actuate the trip-lever 49 is equal

to the angular pitch of the studs multiplied by the number of boxes 1 in the interval between the chute 8 and the receiving conveyor 5^1—5^{11} in question. Consequently, a stud projected at the time when a parcel is deposited in a box 1 engages the edge-cam 50 of the trip-lever to cause opening of that box just as it reaches the required conveyor. The stud, after riding over the same cam 50, runs on to the rear face-cam at 51 and is returned to its initial position.

The bottom of each box 1 consists of two hinged flaps 64, 65 (Fig. 7), the flap 64 being longer than the flap 65 and having a lip 64^1 engaged under the edge of the latter. The flaps are normally held closed by hook-members 66 which are mounted at the ends of a shaft 67 carried on the flap 64 and are engaged over studs 68 on the fixed side-walls 69 of the box. An extension of one hook-member 66 beyond the shaft 67 carries a pin 70 located for engagement by the finger 52 of any projected lever 49 (Fig. 6). The hook-members 66 are normally maintained in engagement with the studs 68 by a spring 71 (Fig. 6) acting on the shaft 67. When encountered by a finger 52, however, the hook-members are unlatched from the said studs 68 and the flaps 64, 65 fall down to discharge the contents of the box upon the respective receiving conveyors 5^1—5^{11}. Over the last receiving conveyor 5^{12}, a stop 72, in effect a permanently projected finger 52, is provided for tripping all of the box-latches to ensure that any parcels remaining in the boxes 1, whether by error or otherwise, are deposited on that conveyor. The hanging flaps of the boxes are closed partly by gravity and partly by ramps 73 (Fig. 8) as each box passes around the remote sprocket wheel 3. Each longer flap 64 encounters the ramp 73 and is swung and held up as shown in Fig. 8. Each shorter flap 65 clears the ramp 73 and in its hanging condition comes to lie inside the lip 64^1 on the flap 64 as the box passes downwardly around the sprocket wheel 3. As the box becomes inverted, the flap 64 falls under gravity upon the flap 65 and the hook-members 66 become relatched automatically with the studs 68.

An appropriate circuit arrangement is illustrated in Fig. 9: The switches 11^1—11^{11} are connected in series with respective solenoids 55^1—55^{11} and are arranged upon depression to make connection between the said solenoids and a common negative bus-bar 56. A common lead 57 to the solenoids is connected through the winding 58 of a relay and the contacts of a master-switch 59 to the positive supply terminal. The contacts 60 of this relay are connected in series with the solenoid 25 on the one hand and with the winding 58 and switch 59 on the other. It will be seen that the relay winding 58, the solenoid 25 and a preselected one of the solenoids 55^1—55^{11} are not excited immediately upon depression of one of the selected switches 11^1—11^{11}; the master switch 59 must first close. This switch is closed automatically and periodically for a short interval of time as each box 1 approaches the mouth of the chute and ensures that the solenoid 25 and selected solenoid 55^1—55^{11} are synchronously excited in proper timed relation to the movement of the boxes 1. The timing is preferably also such that the discs 37 are at rest when the master switch 59 is closed. This switch may be located as shown in Fig. 3 and actuated by the rollers 12.

The switch 11^{12} is connected to the relay winding 58 through a resistance 61 equivalent to the resistance of a winding 55^1—55^{11}. Depression of the switch 11^{12} is thus followed by operation of the relay and excitation of the solenoid 25 only.

Whenever one of the switches 11^1—11^{12} is depressed, it is maintained in the depressed condition automatically until the trap-doors 7 operate. For this purpose the switches may be of the kind which, upon depression, is automatically engaged by a catch and is released only when the catch is withdrawn. As shown, an electro-magnet 62 for withdrawing the catch to release the switches 11^1—11^{12} is connected in series with a switch 63 which is arranged to be closed momentarily by the link 22 (Fig. 3) as the trap-doors 7 operate.

The manner of operation of the apparatus as a whole will be readily understood: During sorting, the distributing and receiving conveyors are driven continuously. A sorter, standing at one of the stations 4, reads the destination of a parcel, places it upon the trap-doors 7 and presses the switch 11^1—11^{12} corresponding to the appropriate receiving conveyor 5^1—5^{12}. When the master switch 59 next closes, the circuits are completed for permitting opening of the trap-doors and projection of a stud 38 in the mechanism over the appropriate conveyor 5^1—5^{11}. Discharge of the parcel upon that conveyor is now completly provided for and, after the trap-doors have reclosed, a further sorting operation may be commenced at once, that is without waiting for the actual discharge of the parcel at the receiving conveyor. A convenient sorting speed of about 20 parcels per minute may be maintained in this fashion.

In the installation illustrated, the four distributing conveyors are arranged in pairs (Figs. 2 and 4) with common driving gear extending up between the pairs. Each pair of conveyors is supported between two chains 2 and the control means for the trap-doors 7 and for the discharge of the boxes 1 is disposed on the outer sides of the conveyors for co-action with respectively adjacent chains.

I claim:

1. Apparatus of the kind set forth, comprising a sorting station, a series of receiving stations, an endless conveyor composed of a chain of compartments and moving continuously past the sorting station and the receiving stations in succession, charging means at the sorting station, timing means operated by the conveyor and arranged to control the charging means so that an article is charged into a definite compartment in position for receiving the same, compartment-discharging means at the receiving stations, delayed-action devices operated by the conveyor and arranged each for setting a respective discharging means, and selective control means operatively associated with the timing means and the delayed-action setting devices whereby any setting device can be selected by the control means for being directly set in action by the timing means at the time of charging, the delayed action of each setting device being such that the respective discharging means is set to discharge the article after the time-period required by the charged compartment to move from the sorting station to the respective receiving station.

2. Apparatus of the kind set forth, comprising a sorting station, a series of receiving stations, an endless conveyor composed of a chain of compartments and moving continuously past the sorting station and the receiving stations in suc-

cession, charging means including a trapdoor at the sorting station, timing means including a master switch closed periodically by the conveyor, an electro-magnet excitable by the said switch and a catch normally operative upon the charging door to maintain the same closed but releasable upon excitation of the electro-magnet by the switch to open the door in timed relationship with the conveyor movement, compartment-discharging means at the receiving stations, delayed-action devices at the receiving stations including a rotatable member with a ring of projectable pins and a ratchet device for driving the said member from the conveyor and in timed relationship therewith, the rotatable member being arranged so that a projected pin in the course of the rotation of the said member will encounter and cause operation of the compartment-discharging means at the same station, electro-magnetic means arranged adjacent to each rotatable member for projecting a pin therefrom, selective switches at the sorting station each adapted for preparing exciting circuits through the master switch for a selected electro-magnetic means and the electro-magnet, the angular interval measured on the rotatable member between the electro-magnetic means and the compartment-discharging means at each receiving station being proportional to the numper of compartments separating that station from the sorting station.

3. In combination with sorting apparatus comprising a conveyor, conveyor-charging means adjacent to a sorting point, an conveyor-discharging means at a series of receiving points, control apparatus comprising an electro-magnetic release device operatively connected to the charging means, delayed action operating devices respectively engageable with each of the discharging means and arranged to be driven by the conveyor, electro-magnetic means respectively adapted for setting the operating devices for engagement with the discharging means after the delay in action of the said devices, manually operated selective switch means for preparing circuits to the electro-magnetic release device and to a selected electro-magnetic setting means, and a master switch arranged for being closed in timed relation with the movement of the conveyor and for completing the said circuits.

4. In parcel-sorting apparatus, in combination with a conveyor comprising a chain of compartments moving past a charging point and a series of discharging points, manually operated selective control means at the charging point and discharging means for each discharging point including a compartment-discharging member, a counting device driven by the conveyor and adapted for actuating the said member after counting a number of compartments equal to the number thereof between the respective discharging point and the charging point and means directly connected to the selective control means for setting the said counting device in operation.

5. In parcel-sorting apparatus, in combination with a compartmental endless conveyor moving continuously past a charging point and a series of discharging devices, control apparatus comprising, for each discharging device, a compartment-counting element, means for rendering the said element operative for actuating the discharging device whereby the latter is actuated after the said element has been rendered operative and has counted the number of compartments separating the respective discharging device from the charging point, and selection means near the charging point directly connected to the means for rendering the counting elements operative whereby any selected element can be so rendered operative.

6. Control apparatus according to claim 5, wherein the counting element comprises a rotatable member, means operated by the conveyor compartments for rotating the said member in steps, a ring of normally retracted but projectable studs slidably mounted in the said rotatable member and engageable, when projected, with the discharging device and the means for rendering the counting element operative comprises an electro-magnetic device positioned adjacently to the ring of studs and adapted for projecting that stud which is opposite to it when it is excited, the angular interval on each rotatable member between the operative positions of the electro-magnetic device and the discharging device being proportional to the distance from the charging point of the respective discharging device.

7. In combination with a sectional endless conveyor moving continuously past a charging device and a series of discharging devices, control apparatus comprising first control means for rendering the charging device operative, second control means for rendering the discharging devices operative, selective manual devices adapted for preparing the first control-means and one second control means for rendering the charging device and one required discharging device operative, and an automatic device driven from the sectional conveyor and adapted for causing the prepared first and second control means to render the said charging and discharging devices operative in synchronism with each other and in fixed time-relation with the movement of the conveyor-sections past the said devices.

8. Control apparatus according to claim 7, wherein the control means is electrically actuated and the manual and automatic devices respectively comprise selective switches and an automatic switch arranged in the vicinity of the conveyor so as to be closed and opened by the conveyor sections as they pass.

9. Control apparatus for controlling a combination of a sectional endless conveyor which moves continuously past a charging device, and past a series of discharging devices, comprising, firstly, means for controlling operation of the charging device, secondly, a manually actuated means for preparing the control means for causing operation of the charging device and consisting of an electrical switch, and electro-magnetic device excited under the control of the said switch, and a locking means connected to the electro-magnetic device and acting upon the control means, and thirdly an automatic device driven from the sectional conveyor and adapted for actuating the prepared control means to cause operation of the charging device in timed relation with the movement of the conveyor sections past the charging point, the said device consisting of a further locking means acting upon the control means and an operative mechanical connection between the sectional conveyor and the latter locking means.

10. Parcel-sorting and distributing apparatus, comprising a sorting station, a continuously operating distributing conveyor having a series of compartments and arranged to pass the sorting station, a series of receiving stations along said

distributing conveyor, selectively controlled compartment-discharging means at each receiving station, control means including manually actuated selection means corresponding to each receiving station located at the sorting station, and operating means for the compartment-discharging means at each receiving station, said operating means comprising elements each corresponding to one of the compartments of the distributing conveyor, means for moving said elements in timed relation with the conveyor to bring said elements into the proximity of the compartment-discharging means, and means controlled by said manual selecting means for moving said elements into operating position to operate the compartment-discharging means to discharge its corresponding compartment when it is in position to discharge at the proper receiving station.

11. Parcel-sorting and distributing apparatus, comprising a sorting station, a continuously operating distributing conveyor having a series of compartments and arranged to pass the sorting station, a series of receiving stations arranged along the distributing conveyor, manually actuated selection means at the sorting station, timing means operated in timed relation to the conveyor, charging means at the sorting station, control means for said charging means responsive to the selection means and the timing means for charging each parcel into a definite compartment when said compartment is in position for receiving it, discharging means at each receiving station, operating means for each of said discharge means at each receiving station, each controlled and selectively set in action by actuation of the corresponding manual selection means and under control of the timing means, each of said operating means corresponding to a respective compartment of the conveyor and operatively related to the discharging means at its station for causing discharge thereof that compartment which is in position for receiving the parcel when the charging means is caused to operate and the station selection means has been actuated.

12. Apparatus according to claim 11, wherein the selection means comprises manually operated electric switches and the timing means includes a switch arranged to be closed periodically by the conveyor for completing a circuit, selectively prepared by one of the said manual switches, which controls the charging means and a selected discharge-effecting means.

13. Apparatus according to claim 11, wherein the timing means includes a mechanical device controlling release of the charging means and operated periodically by the conveyor to permit such release each time a compartment reaches the charging point.

14. Apparatus according to claim 11, wherein the charging means includes a chute, a loop of flexible material which normally closes the chute at its lower end for catching falling parcels with little shock, means for lowering the said loop to deposit the parcel gently in the compartment, and control means for the said loop-lowering means operated periodically by the conveyor each time a compartment reaches the charging point under the chute.

15. Apparatus according to claim 10, wherein each compartment of the distributing conveyor comprises a bottom divided transversely into two flaps and a self-engaging latch which normally holds the said flaps closed and is disengageable by the discharging means for allowing the flaps to fall.

16. Apparatus according to claim 10, and cam means at the returning point of the distributing conveyor and, for each compartment of the latter, a bottom divided transversely into two flaps and a self-engaging latch which normally holds the said flaps closed and is engageable by the discharging means for releasing the said flaps to allow them to fall open, the trailing flap normally engaging inside the leading flap and being shorter than the latter so that, in its fallen position, it clears the cam-means whereas the leading flap, in its fallen position, is engageable by the cam-means for rocking the said leading flap up outside the freely hanging trailing flap, whereby the said flaps become re-engaged and secured by the latch.

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