

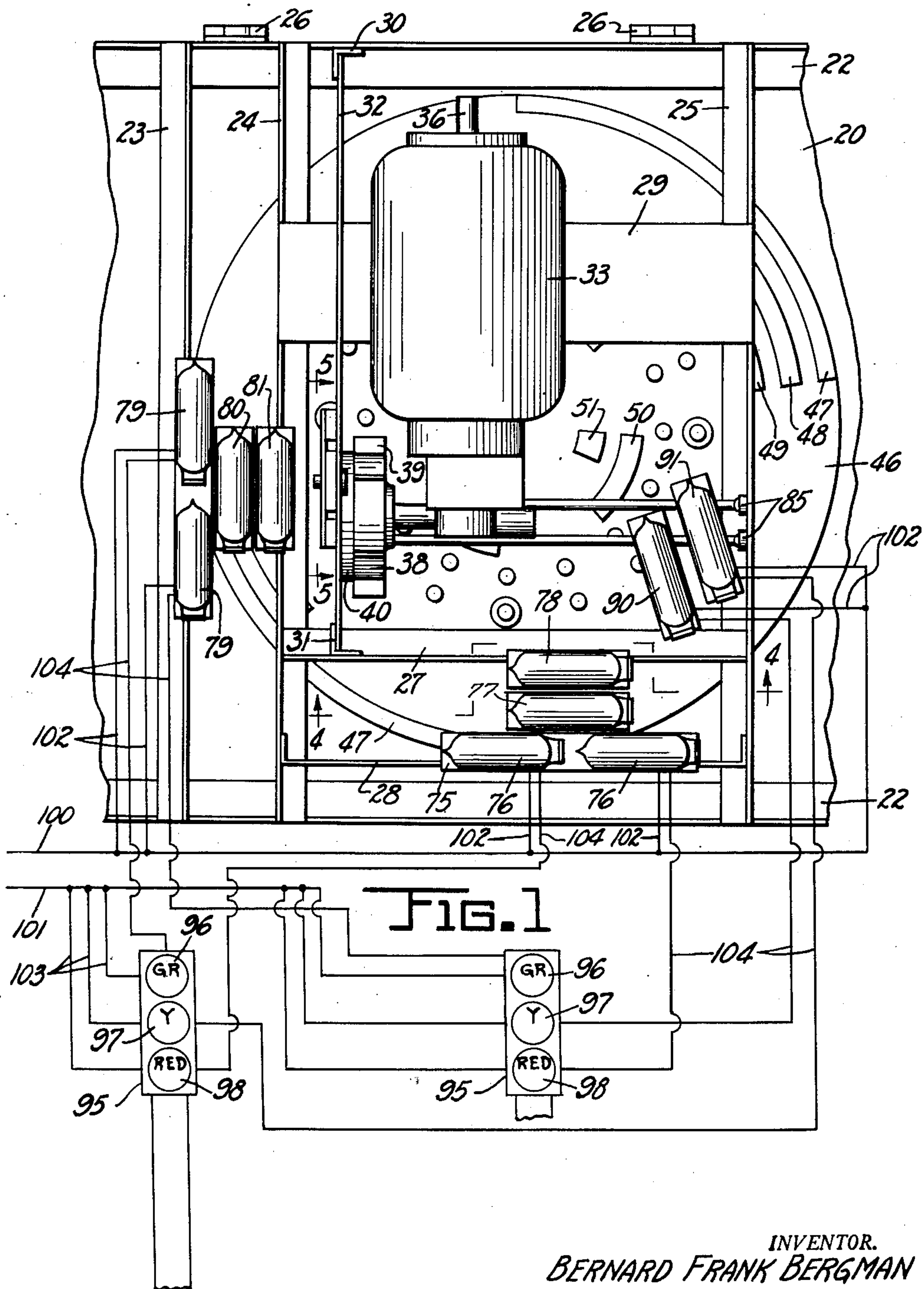
Feb. 6, 1951

B. F. BERGMAN
PROGRAMMING DEVICE

2,540,605

Filed July 3, 1946

4 Sheets-Sheet 1



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Feb. 6, 1951

B. F. BERGMAN
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2,540,605

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4 Sheets-Sheet 2

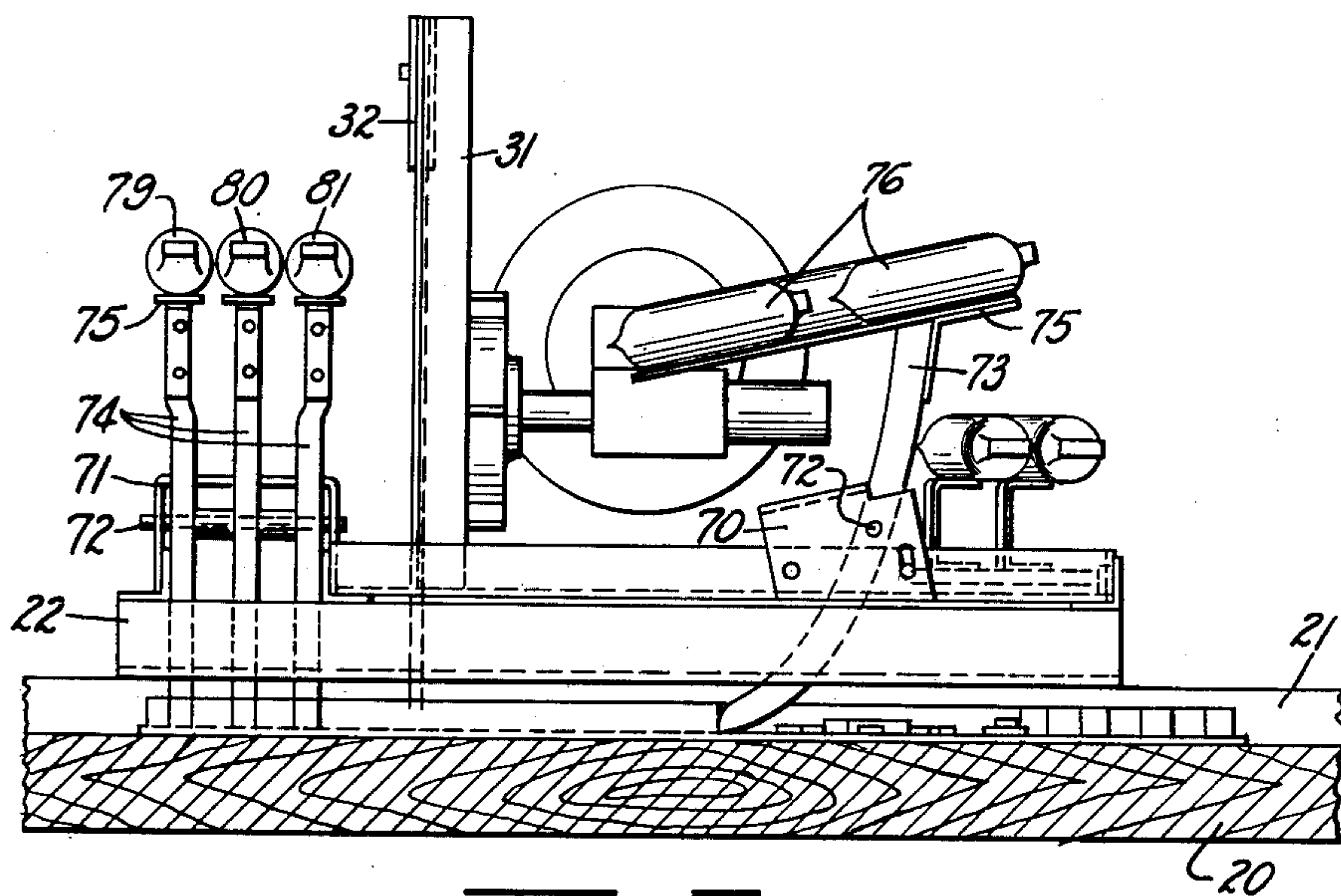


FIG. 2

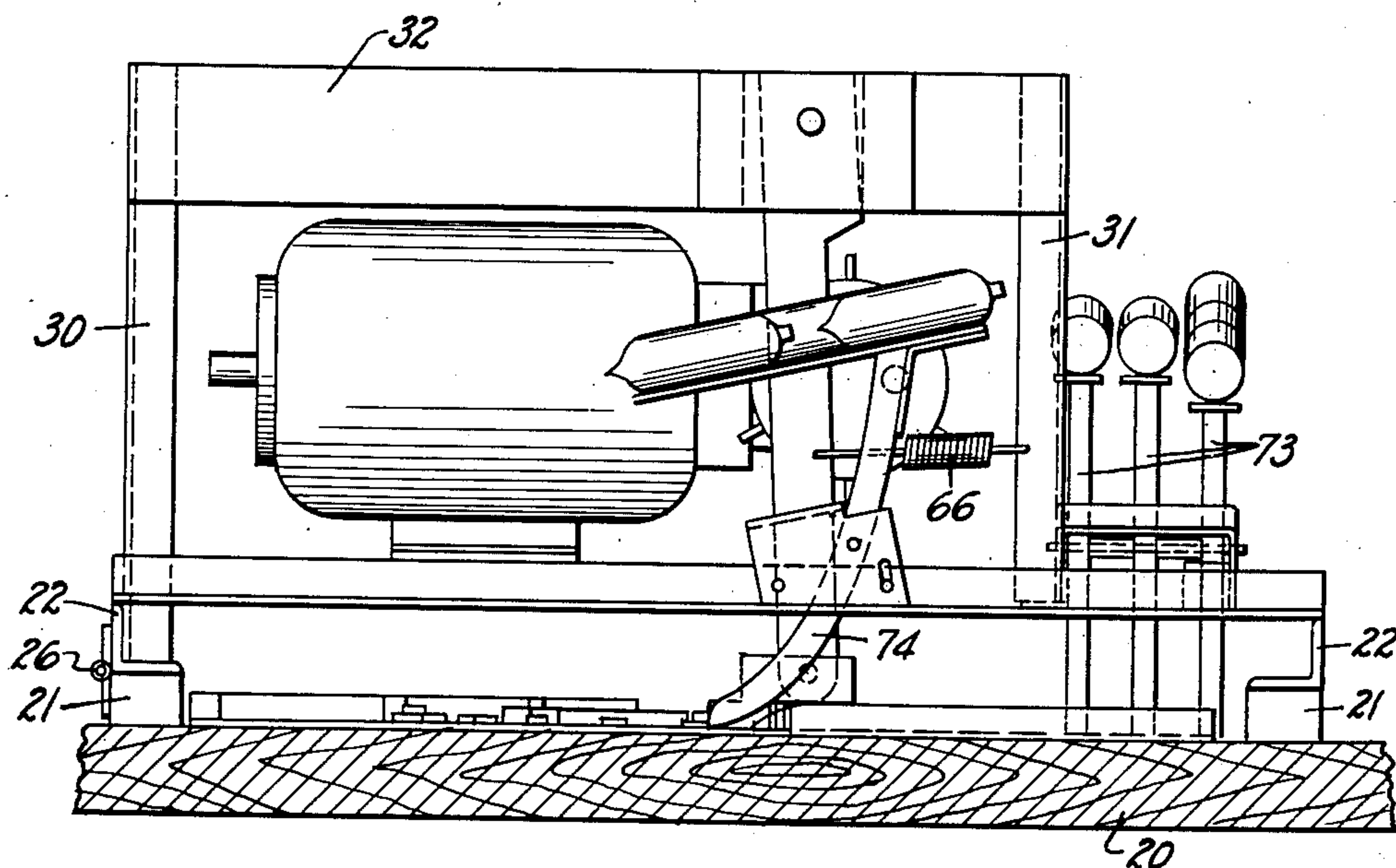


FIG. 3

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4 Sheets-Sheet 3

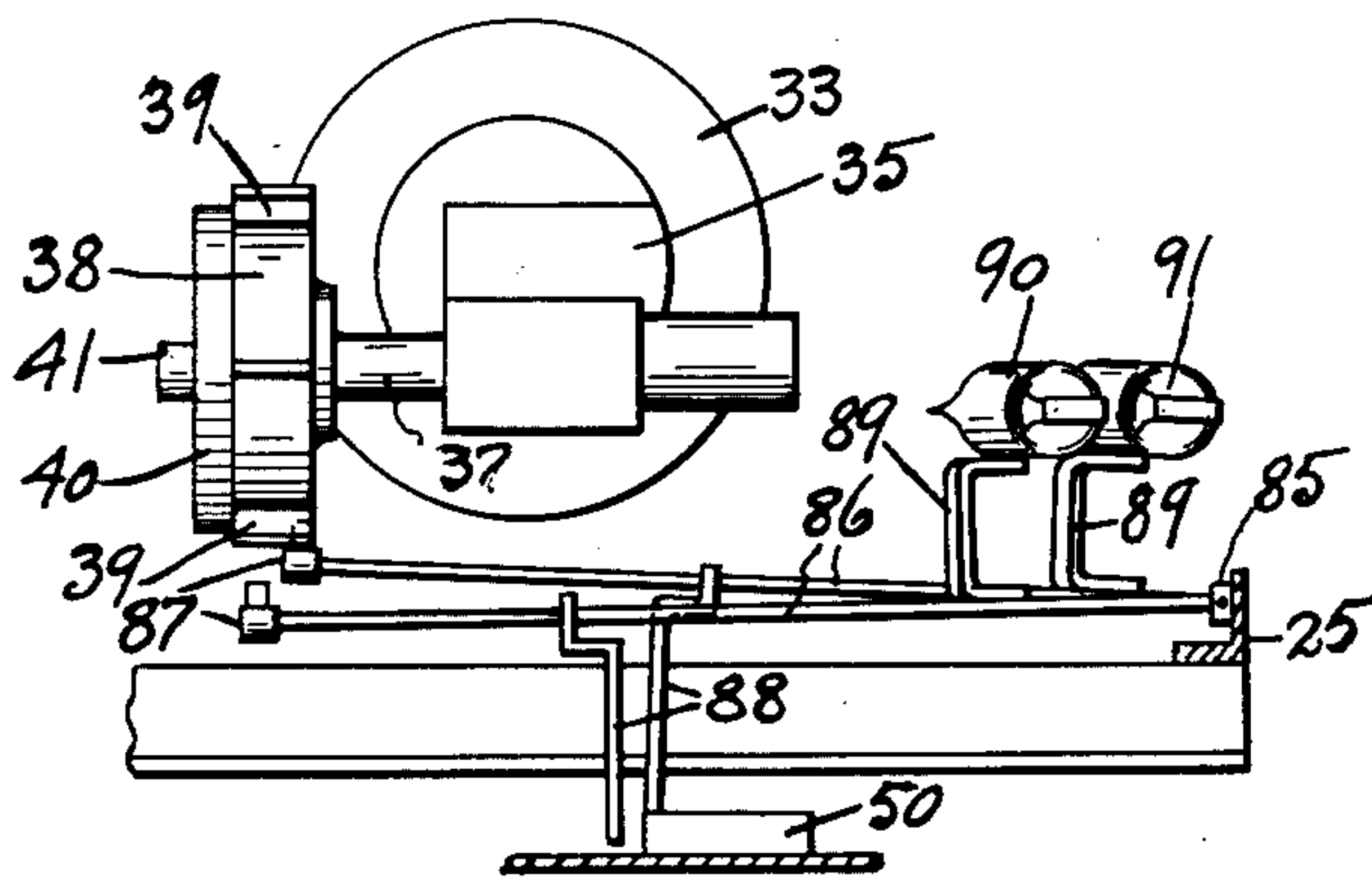


FIG. 4

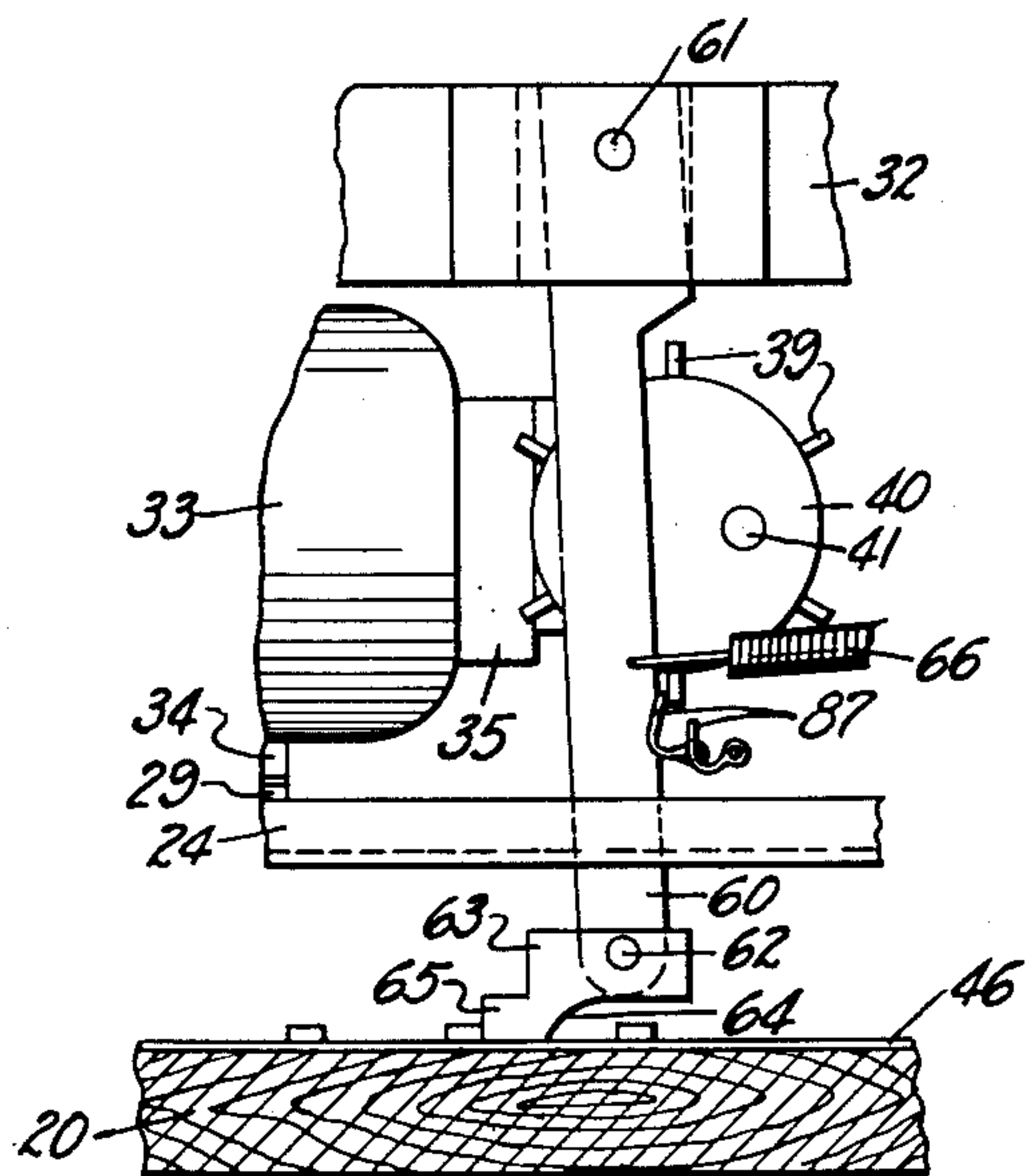


FIG. 5

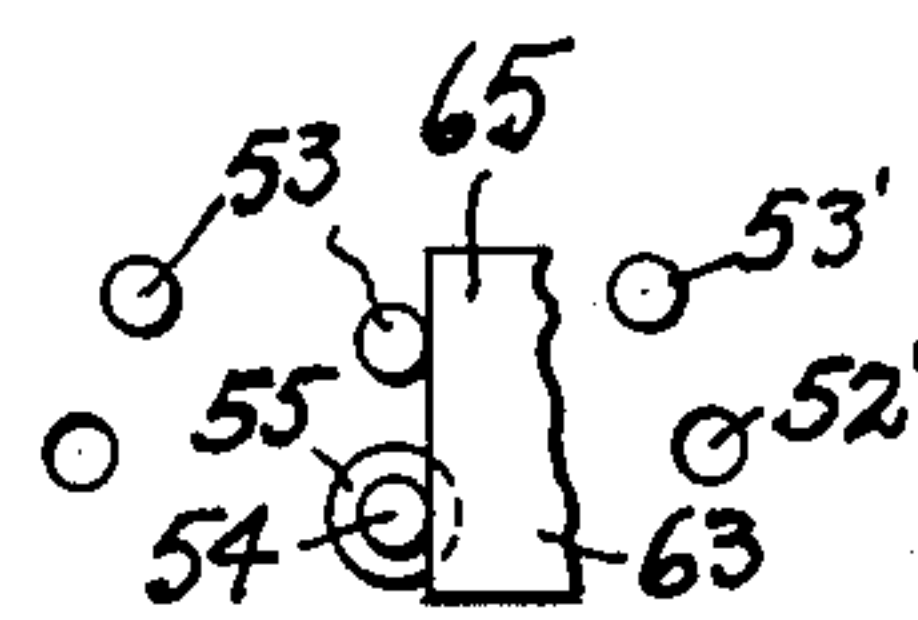


FIG. 8

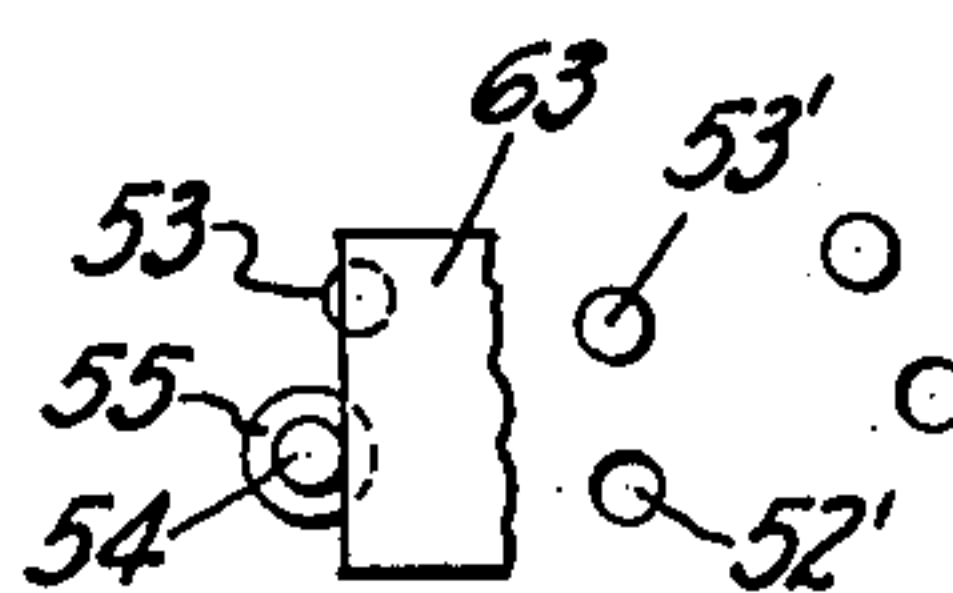


FIG. 9

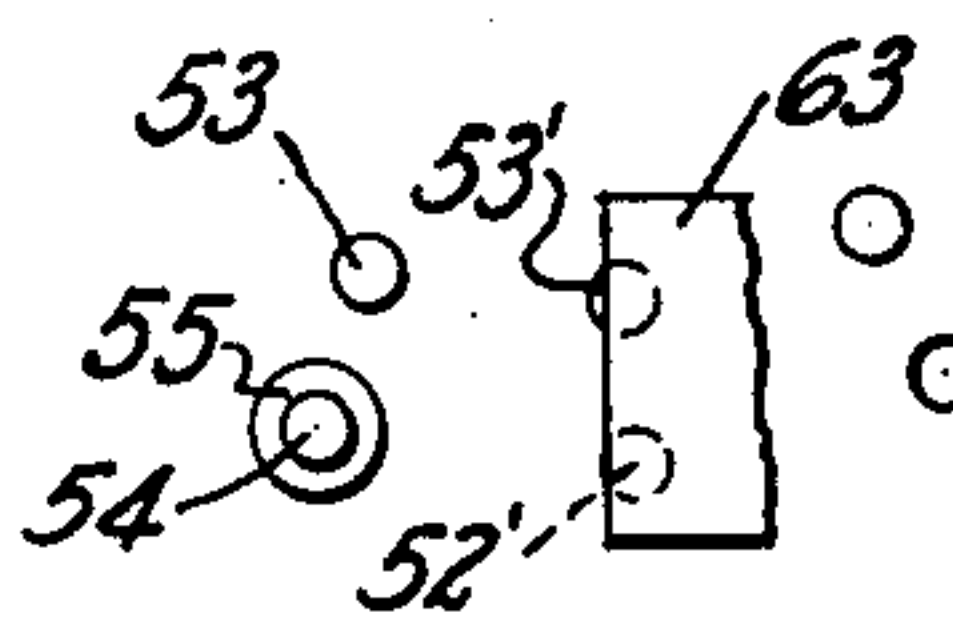


FIG. 10

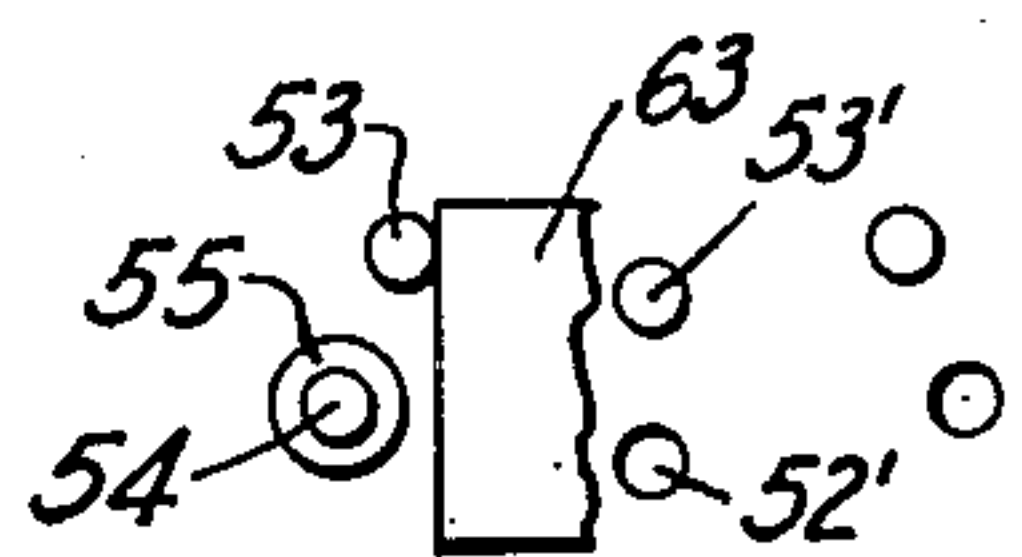


FIG. 11

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4 Sheets-Sheet 4

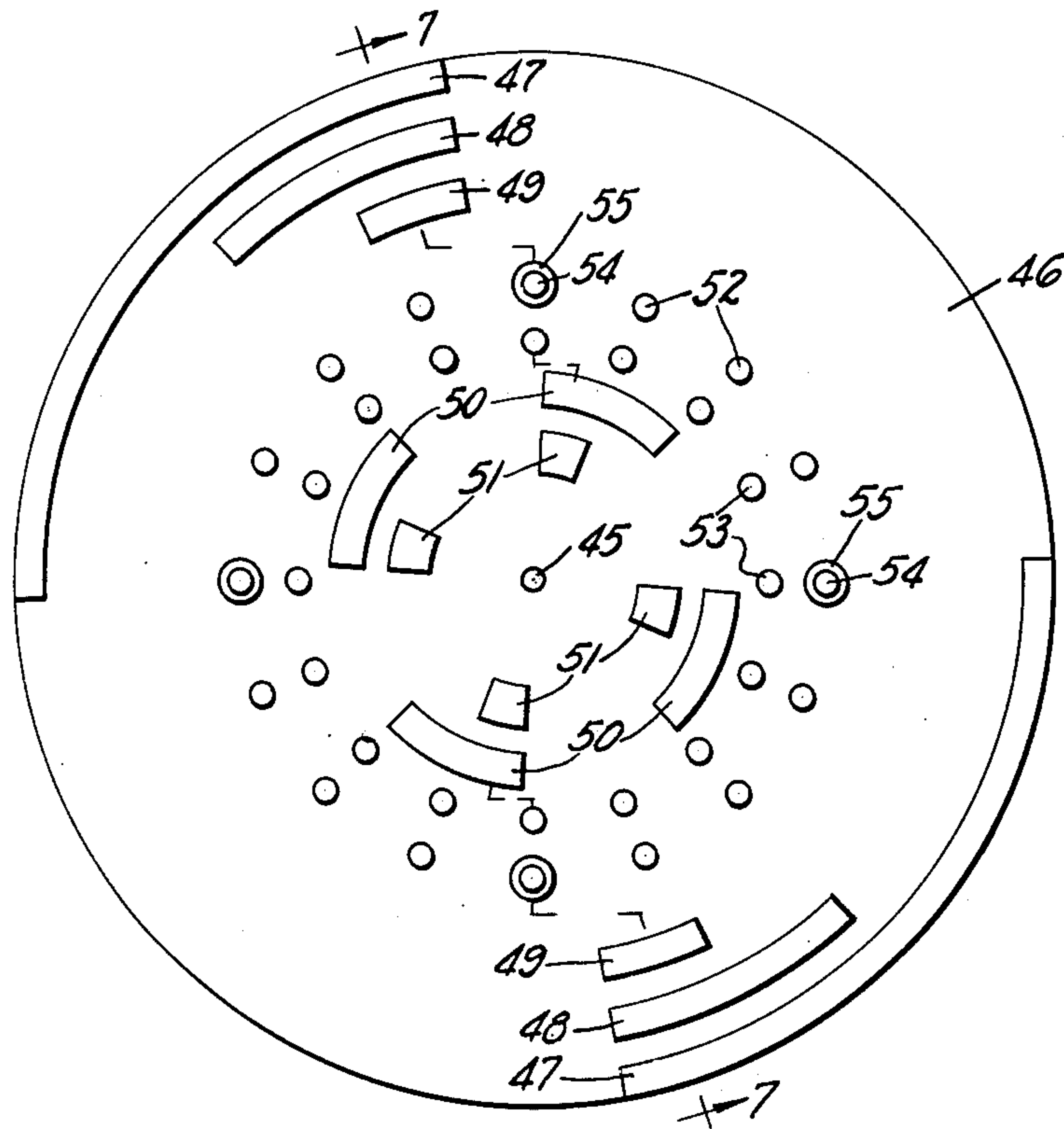


FIG. 6

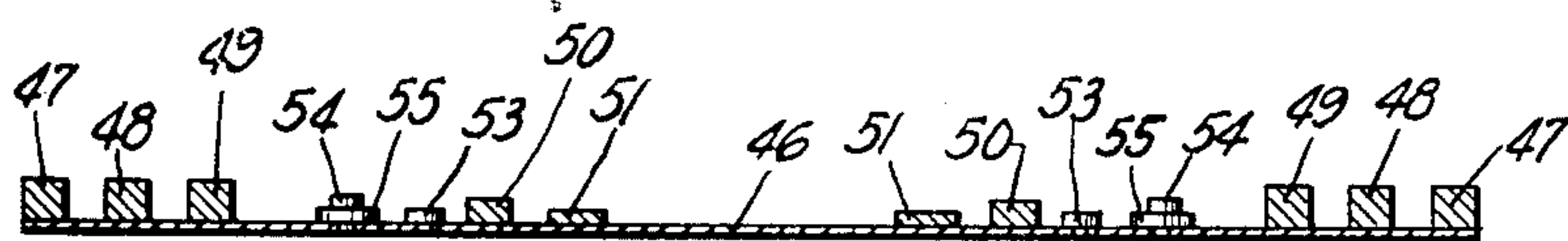


FIG. 7

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UNITED STATES PATENT OFFICE

2,540,605

PROGRAMMING DEVICE

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15 Claims. (Cl. 200—38)

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This invention relates to improvements in programming devices, and more particularly to a device by means of which a plurality of electrical circuits may be controlled in a predetermined sequence at predetermined time intervals, which sequence occurs periodically at regular time intervals. One example of the use to which a programming device of this character may be applied is for the control of traffic lights occurring at street and road intersections and commonly known as Stop and Go lights.

The primary object of this invention is to provide a device of this character which is simple in construction, comparatively inexpensive to manufacture, which is substantially trouble-free, and which has a substantial flexibility for purposes of regulation to vary the timing of different portions of the sequence of operation of multiple electrical circuits.

A further object is to provide a device of this character which is entirely mechanical in its operation.

A further object is to provide a device of this character which is adapted to handle heavy current loads without damage to the device.

A further object of the invention is to provide a device of this character wherein a single continuously operating motor serves to actuate all of the moving parts of the device in step-by-step or intermittent movements.

A further object is to provide a device of this character having simple means adjustable to control the timing of any one or more steps in a given sequence of operation and also the timing of each complete cycle.

A further object is to provide a device of this character having novel means for rapidly making and breaking a circuit in such a manner that it is adapted particularly for the control of flashing lights.

A further object is to provide a device of this character which utilizes mercury switches and includes mechanical means for tilting said switches to make and break the various circuits to be controlled by the device.

Other objects will be apparent from the following specification.

In the drawing:

Fig. 1 is a view of the device in top elevation with parts broken away and with other parts illustrated diagrammatically.

Fig. 2 is a view of the device in side elevation observed from the bottom in Fig. 1 with parts of the support broken away to better illustrate the operating construction.

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Fig. 3 is a view in side elevation similar to Fig. 2 but viewed from the left in Fig. 1.

Fig. 4 is a fragmentary detail view taken generally along line 4—4 of Fig. 1.

Fig. 5 is a fragmentary side detail view taken generally along lines 5—5 of Fig. 1.

Fig. 6 is a top plan view of the timing disc or turntable used in the device.

Fig. 7 is a sectional view taken along line 7—7 of Fig. 6.

Figs. 8 to 11, inclusive are diagrammatic views illustrating the operation of the driving connection between parts of the device.

Referring to the drawings which illustrate one embodiment of the invention, the numeral 20 designates a base which may be of any suitable construction and which preferably comprises a flat horizontal plate member. A frame structure is supported upon this base in spaced relation thereabove resting upon forwardly projecting portions 21 carried by the base 20. The frame structure comprises marginal frame members 22 which are rigidly secured together to form a firm and solid frame structure which is reinforced by cross braces 23, 24 and 25. The upper frame structure is preferably pivotally mounted upon the base structure by means of hinges 26. The cross braces 23, 24 and 25 are preferably parallel and the cross braces 24 and 25 are rigidly connected by braces 27, 28 and plate 29. An upright frame portion is mounted upon the upper frame and includes upright members 30 and 31 mounted upon one of the marginal frame members 22 and upon the brace 27 respectively. A bar or plate 32 spans and interconnects the upper ends of the uprights 30 and 31. The upper frame may also include portions projecting from the opposite ends thereof as viewed in Fig. 1, which serve to mount contact blocks and the like (not shown).

A constant speed electrical motor 33 is mounted upon the plate 29 by supporting brackets 34 with its axis parallel to the braces 24 and 25. The motor has a speed reducing mechanism 35 associated with its driving shaft 36 and having a driving connection with a shaft 37 transverse or perpendicular to the motor shaft and journaled in the housing of the speed reducing unit 35. The shaft 37 extends substantially perpendicular to the cross brace 24. The shaft 37 mounts a disc or rotor 38 at its outer end at a position just inwardly of the vertical plane of the upright frame 30, 31, 32, which disc 38 has projecting radially therefrom in equal angular relation a plurality of projections, vanes or paddles 39 and form one part of a switch actuator. A somewhat larger

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disc element 40 concentric with disc 38 is positioned at the outer side of said disc and mounts a pin 41 eccentrically thereof, as best illustrated in Fig. 5.

The base 20 has an upwardly projecting pin (not shown) at its center around which is rotatably fitted the central opening 45 of a flat disc or horizontal member 46 in the nature of a turntable. The center pin of the base may include a bearing for reducing the frictional engagement of the turntable 46 with its supporting parts in a manner well understood in the art. The disc 46 has a plurality of raised arcuate elements 47, 48, 49, 50 and 51 fixedly secured thereon. Each of these curved arcuate elevated members is rigidly secured to the disc 46 at a predetermined radius of the disc and spaced from the other members or sets of members. As herein shown there are two members 47 secured at the outer margin of the disc 46 in diametrically opposed relation and each of a length to extend approximately one-quarter of the periphery of the turntable. Two members 48 are provided of shorter length and located on a radius spaced slightly inwardly from the radius at which members 47 are located. Members 49 are spaced inwardly slightly from members 48 and are of shorter length than said members. Four members 50 are shown in inwardly spaced relation to the members 49 arranged equiangularly upon the disc and each preferably of an arcuate extent approximating 45°. Four equispaced members 51 are likewise provided, said members being shorter than the members 50 and spaced inwardly with respect thereto. The arrangement of the various members 47, 48, 49, 50 and 51 with respect to each other in a circumferential or angular direction may vary according to the purposes for which the control is to be used. At intermediate portions of the turntable are provided two circular series of equispaced pins, projections or abutments 52 and 53, which pins project slightly upwardly above the upper face of the disc 46. At predetermined equal positions in the outer series of pins 52 may be provided pins 54 which project a greater distance than the pins 52 and 53, and which have enlarged shouldered portions 55 associated therewith and preferably of the same height as the pins 52 and 53. An arm 60 is positioned substantially vertically adjacent the disc 40 in a position to be engaged by the eccentric pin 41 carried by said disc. The arm 60 is pivoted to the upright frame member 32 at 61. The lower end of the arm 60 terminates in slightly spaced relation above the turntable 46 upon the base 20 and has pivotally connected thereto at 62 a foot or dog element or part 63 whose rear end portion clears the turntable and the pins and has a cam-shaped curve 64. The forward end of the dog 63 has a toe portion 65 adapted to bear freely and slidably upon the surface of the turntable 46. The swinging arm 60 has connected at an intermediate portion thereof a tension spring 66 anchored thereto at one end and anchored at its opposite end to the upright 31, which serves to normally position the leading edge of said arm closely adjacent to the center or axis of the disc 40, as best illustrated in Fig. 5. It will be observed that as the motor 33 operates to rotate the disc 40, the pin 41 will engage the leading edge of the member 60 when it reaches one vertical limit of movement and will propel the arm 60 and the dog 63 to the left as viewed in Fig. 5. The dog 63 is of a width greater than the spac-

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ing between the pins 52 and 53 and the throw thereof by the pin 41 is equal to or slightly greater than the spacing between the adjacent pins 52. Inasmuch as the pins 52 and 53 are arranged in sets of equal number and are located in radial alignment with a pin of the other set, the dog 63 serves upon each reciprocating cycle thereof to propel the turntable through an angle equal to the spacing or angular displacement between adjacent pins of each set. Since the motor 33 operates at constant speed, it serves through the drive mechanism or actuator described i. e. disc 40, pin 41, arm 60 and dog 63 to rotate the turntable intermittently in a series of steps equal in number to the number of the pins 53, thereby serving to produce one complete revolution of the turntable in a predetermined time interval in steps which are each of predetermined time length depending upon the speed of operation of the disc 40 by the speed reducing means 35.

When the pins 54 are substituted at selected points for the corresponding shorter pins 52, the time required for one complete revolution of the turntable is increased by an amount equal to the time interval required for one step of the normal rotating operation. The operation is best illustrated in Figs. 8 to 11 and entails incident to the return stroke of the toe 65 of the dog 63 riding over the pins 53 and 54 to assume a position therebehind. Inasmuch as the stroke of the pin is less than the projection of the shoulder 55, the toe 65 of the dog comes to rest upon that shoulder 55, as shown in Fig. 8. This causes, upon the subsequent forward propulsion of the dog 63 through its normal stroke, an overriding of the corresponding inner pin 53, as illustrated in Fig. 9, instead of the engagement and propulsion of the turntable by transfer at the end portion of the stroke of the dog 63 the full movement of the dog. In other words, the turntable is prevented from traveling through the full extent of possible travel as is normal where only the pins 52 and 53 are engaged by the dog. Consequently, upon the subsequent return stroke of the dog 63, its toe 65 rides upon the tops of the succeeding pins 52' and 53' and cannot engage therebehind. The next succeeding forward stroke permits the dog to slide from the tops of the pins 52' and 53' onto the upper surface of the turntable whereby it may engage the pin 53 and the collar 55 and thereby complete the full angle of rotation desired, as illustrated in Fig. 11. In other words, wherever the raised pin 54 with its shoulder 55 is substituted for a conventional pin 52, the time required for travel of the turntable through the angular distance between pins is automatically doubled. It will be apparent that, assuming that the pins 52 are removable as by screw threading within the turntable 46, the pin and collar unit 54, 55 may be inserted wherever desired so that the time interval for travel of the turntable through any selected sector may be varied at will. Also, it is possible to provide the pin 54 in place of each of the pins 52 in the outer circle of pins, thereby doubling the time required for the turntable to make one complete revolution.

At predetermined positions upon the upper frame structure are positioned brackets such as the brackets 70 and 71, to which are journaled by means of horizontal pivot pins 72 a plurality of sets of arms such as the arms 73 and 74. Each of these arms mounts one or more fixtures 75 at its upper end, and each fixture mounts a mercury

switch. The arms 73 and 74 are preferably curved at their lower ends and are so arranged that they may bear slidably upon the upper surface of the turntable 46, and the fixtures 75 are so arranged with respect to the supporting arms therefor that the mercury switches supported thereby will be tilted in one direction, for instance, in circuit breaking position. Each of the arms 73 and 74, of which three are shown, is arranged to be engaged by one of the raised portions 47, 48 and 49 upon the turntable. Thus referring to Fig. 1, the fixtures upon the respective arms 73 mount two mercury switches 76 on the arm 73 which is positioned outermost and adapted for engagement with the portion 47 of the turntable. The fixture 75 mounted upon the central arm 73 mounts a switch 77 which is adapted to be tilted when its corresponding arm 73 engages the section 42 upon the turntable. The innermost arm 73 mounts a mercury switch 78 and is adapted to be tilted when its corresponding arm engages the portion 49 upon the turntable. A similar set of mercury tubes 79, 80 and 81 is mounted upon the fixtures carried by the arms of the set 74 whereby the switch 79 is tilted by engagement of its arm with one of the parts 47 of the turntable, the switch 80 is tilted by the engagement of its mounting arm with one of the parts 48 of the turntable, and the switch 81 is tilted upon engagement of its supporting arm with one of the parts 49 of the turntable. The parts are so proportioned and arranged that when the lower end of one of the arms 73 or 74 bears upon the top of a part 47, 48 or 49, the switches supported thereby will be tilted oppositely to their inoperative arrangement shown, thereby permitting the mercury to flow to the opposite end of the tube for the purpose of closing a circuit.

The frame member 25 has pivotally connected thereto, as by means of pivot brackets 85, a pair of tilt or rock shafts 86 which extend substantially parallel to the brace member 27 and the plate 29. The inner free ends of the shafts 86 terminate below the disc 38 and the paddles 39 and have forwardly projecting parts 87 mounted thereon adapted for engagement with the paddles 39, as illustrated in Fig. 4. Each of the shafts 86 has a depending portion 88 rigid therewith and located at different positions along the length of the shaft 86 which mounts it, whereby the lower ends of said depending members 88 are positioned for engagement by one of the series of projections 50 and 51 carried by the turntable. Each of the shafts 86 mounts a bracket 89 upon which mercury tubes or switches 90 and 91 are located, said cooperating shaft 86 and brackets 88 and 89 forming a carrier for one of said tubes. Tubes 90 and 91 are normally positioned in closed circuit inclination.

In the operation of the device it will be observed that when either one or both of the depending parts 88 of the shaft 86 strike the cooperating one of the projections 50, 51 of the turntable 46, that shaft will be elevated, as shown in Fig. 4, to a position where its end fixture 87 is engageable by the vanes 39 upon the disc 38. The interengagement of these parts serves to rotate the corresponding shaft through a slight angle whereby the bracket 89 and the corresponding one of the mercury switches 90, 91 is tilted lengthwise and thereby momentarily placed in closed circuit condition. The brackets 89 are preferably mounted off center or in unbalanced relation upon the shaft 86 so that upon disen-

agement of the fitting 87 with a paddle 39 the shaft will be returned automatically to its open circuit rotative position. Thus disc 38 and vanes 39 form one part of an actuating means for switch 90 or 91; and shaft 86, brackets 88 and 89, projection 87 and depending member 88 form another actuating means for the same switch.

In the use of the device, for instance, for the purpose of controlling traffic lights 95, as shown in Fig. 1, which traffic lights include a green or "Go" light 96, a yellow warning light 97, and a red or "Stop" light 98, the control may be wired as illustrated in Fig. 1. The power lines 100 and 101 from any suitable source of power are tapped by leads 102, each of which extend to one of the contacts or terminals of each of the switches 76, 77, 78, 79, 80, 81, 90 and 91. The other line 101 is connected by leads 103 to the various corner lights 96, 97 and 98. Leads 104 connect the opposite terminal of each of the mercury switches to the corner lights 96, 97 and 98. This arrangement permits the following operation: Actuation of any of the control switches, for example, the switches 79, by tilting thereof to closed circuit condition upon engagement of the supporting arm 74 thereof with the turntable portion 47 energize the "Go" signal 96 for a predetermined period of time dependent upon the length of time required for the arm 74 to transverse said turntable projection 47. Thereupon, assuming a proper relation of the parts as to their angular position, one of the mercury switches 90, 91 will be tilted back and forth between open and closed circuit position to cause the light 92 to flash for a predetermined period. When this flashing operation stops, the switch 76 will be energized to closed circuit position, thereby controlling or energizing the stop light 98 for a predetermined period of time. This sequence of operation is repeated continuously as long as the control is in course of operation, and the period of time required for each operation of the sequence is always the same and occurs in the same order.

In the event that it is desired to lengthen or shorten the overall time required for the completion of one cycle of operation, the turntable may be adjusted by either adding or withdrawing pin assembly 54, 55 in place of the pins 52 upon the turntable. By properly locating the position at which the pin or pins 54, 55 are added or withdrawn, the operating time for any given operation in the sequence or cycle may be varied. A further possibility for control is by substituting for a given turntable another turntable having an entirely different arrangement of cams or projections thereon. This replacement operation is easily performed by virtue of the fact that all of the operating parts except the turntable are mounted upon the frame and are movable as a unit with respect to the base of the turntable upon the hinges 26. This provides easy access to the turntable for the purpose of lifting the turntable from its centering pin and removing it from the device and inserting in its place an entirely different turntable. This tilt mounting of the upper frame has other advantages, particularly with respect to the access which it affords to all of the operating parts of the device, not only from the top of the frame, but also from the bottom thereof.

While the invention has been described herein as applied to the purpose of controlling traffic lights, it will be understood that it may be used for any other purpose wherein a given sequence of operations, which are to be repeated in given

cycles, may be controlled. The example of use given has not entailed the usability of the turntable with the projections 47 to 51, inclusive, thereof of different lengths, but it will be obvious that this provision, together with the provision of multiple mercury switches in sets, such as the switches 76, 77 and 78, mounted upon the arms 73 at one position, and the switches 79, 80 and 81 mounted upon the arms 74 at another position, afford further means for selecting the period of time at which a given operation in a sequence of operations is to be performed.

While the construction and arrangement of parts herein described and illustrated constitutes one preferred embodiment of the invention, it will be understood that the invention may be embodied in other constructions within the scope of the appended claims and the spirit of the invention. Also, while the device has been described as means for controlling plural electrical circuit through switches, it may likewise be used to control other types of power transmitting means, such as valved fluid lines.

I claim:

1. A device for controlling a plurality of electrical circuits to make and break the circuits in a predetermined timed program, comprising a frame, a plurality of switches each adapted to control a circuit, a continuously operating motor, an actuator driven by said motor at predetermined time intervals, and a program member detachably mounted on said frame and having a plurality of projections and shiftable a predetermined small portion of its complete operative range by engagement of said actuator with one of a selected group of projections during each operation of said actuator, others of said projections actuating each switch at a selected portion of the complete operative range of movement of said program member.

2. A device for controlling a plurality of electrical circuits for repeated energization thereof in a selected sequence for selected time intervals, comprising a frame, a plurality of switches mounted on said frame to control selected circuits and biased to a normal condition, a constant speed motor carried by said frame, an actuator operated intermittently by said motor at regular intervals, a shiftable program member mounting a plurality of projections and detachably carried by said frame, and means on said frame for guiding said program member in a predetermined path for operation of said switches by certain projections in sequence to bias the switches oppositely from said normal condition at selected positions in said path, said actuator normally advancing said means step-by-step a predetermined extent along said path upon engagement with others of said projections during each operation thereof.

3. A device for controlling a plurality of electrical circuits for repeated energization thereof in a selected sequence for selected time intervals, comprising a plurality of switches each controlling a circuit and biased to a normal condition, a constant speed motor, an actuator operated intermittently by said motor at regular intervals, and means traveling in a predetermined path for operating said switches in sequence to bias the same oppositely from said normal condition at selected positions in said path, said actuator normally advancing said means step-by-step a predetermined extent along said path upon each operation thereof, and means carried by said traveling means for limiting movement of said

traveling means to a portion only of a normal step upon engagement thereof by said actuator, whereby the succeeding operation of said actuator is required to complete the balance of said normal step movement of said traveling means.

4. A sequencing device comprising a frame, a horizontal turntable removably journaled on said frame, a plurality of projections carried in spaced relation relative to the axis of and by the upper face of said turntable and including a circular series of projections, a plurality of electric switch units supported solely by said frame and each including a shiftable portion overlying and juxtaposed to said turntable and shiftable by a selected projection thereon, constant speed driving means, and an actuator for said turntable operated at regular intervals by said driving means in a path tangent to said series and engageable with successive projections of said series to rotate said turntable at predetermined angular extent upon each operation.

5. A sequencing device comprising a frame, a horizontal turntable removably journaled on said frame, a plurality of spaced projections carried by the upper face of said turntable at different radii and at different distances from the axis of said turntable and include a circular series of substantially equispaced projections, a plurality of electric switch units supported solely by said frame and each including a shiftable portion overlying and juxtaposed to said turntable and shiftable by a selected projection, constant speed driving means, and a turntable actuator operated at regular intervals by said driving means and successively engaging a projection of said series to rotatively advance said turntable a predetermined angular extent upon each operation, each switch unit comprising a bracket pivoted to said frame spaced above said turntable and having a portion positioned in the path of a disc projection, and a mercury tilt switch carried by said bracket.

6. A programming device comprising a frame, a horizontal member journaled on a vertical axis to said frame and adapted to actuate a plurality of electric switches in predetermined sequence, a plurality of circularly arranged equi-spaced abutments projecting upwardly from said member, constant speed driving means, an arm pivoted to said frame above said member and swung on an axis substantially parallel to said member in a plane substantially tangent to said abutments by said driving means at spaced intervals, and a dog pivoted to the lower end of said arm and adapted for propelling engagement with an abutment when traveling in one direction and adapted to pivot and ride over an abutment positioned intermediate the ends of its path of movement when traveling in the other direction.

7. A programming device comprising a frame, a horizontal program controlling member journaled on a vertical axis to said frame and adapted to control a plurality of electric switches in predetermined sequence, a plurality of circumferentially arranged equi-spaced abutments projecting upwardly from said member, constant speed driving means, and means shiftable in a predetermined stroke at regular intervals by said driving means and including a pivoted part reciprocating in a path tangent to said circumferentially arranged abutments and of a length at least equal to the spacing between abutments, said pivoted part having a toe portion for advancing an abutment and a cam surface at the rear end thereof engageable with a succeeding abutment to swing

said part for free sliding movement over said succeeding abutment.

8. The construction defined in claim 7, and a second circumferential series of abutments carried by said program controlling member, each abutment of said second series being paired and aligned radially of said member with one of said first named abutments, the end of said reciprocating part opposite said cam bearing against the outermost abutment of the adjacent pair at the beginning of its advancing movement and bearing against only the innermost abutment at the end portion of its advancing stroke.

9. The construction defined in claim 7, and a second circumferential series of abutments carried by said program controlling member, each abutment of said second series being paired and aligned radially of said member with one of said first named abutments, the end of said reciprocating part opposite said cam bearing against the outermost abutment of the adjacent pair at the beginning of its advancing movement and bearing against only the innermost abutment at the end portion of its advancing stroke, one of said outer abutments being of greater height than the others and having a shoulder projecting in counter-rotational direction at an elevation at least equal to that of the inner abutment paired therewith.

10. In a device of the character described, constant speed driving means, an actuator operated intermittently by said means, means operated step-by-step in a predetermined path by said actuator, a switch, switch actuating means including a pair of parts, one of said parts being operated by said driving means at a higher frequency than said actuator, the other part of said switch actuating means being normally biased to inoperative condition, said step-by-step means being adapted to engage and shift said last named part of said switch actuating means into operative relation to said first named part.

11. In a device of the character described, constant speed driving means, an actuator operated intermittently by said means, means operated step-by-step in a predetermined path by said actuator, a switch, switch actuating means operated intermittently by said driving means at a higher frequency than said actuator, said switch being shiftable between open and closed circuit positions and normally biased in open circuit position and located spaced from said switch actuating means, said step-by-step means at a predetermined position thereof shifting said switch for engagement with said switch actuating means for alternate opening and closing thereof, said switch actuator constituting a rotatable member having a plurality of radial projections and said first named actuator being operated by an eccentric rotated by said driving means in synchronism with said rotatable member.

12. In a device of the character described, con-

stant speed driving means, an actuator operated intermittently by said means, means operated step-by-step in a predetermined path by said actuator, a tilt switch, an elongated rock shaft mounting said switch, means pivotally mounting said shaft on an axis transverse of the axis of rotation thereof, and means operated by said driving means and adapted to rotatively rock said shaft, said shaft being selectively positioned by said step-by-step means to be engaged by and disengaged from said last named means.

13. In a device of the character described, a plurality of electric switches, shiftable means for operating said switches for predetermined intervals in a predetermined sequence, constant speed drive means, and an actuator operated by said drive means at regular intervals and advancing said switch operating means step-by-step, and means actuated by said driving means and cooperating with said shiftable means for rapidly opening and closing a selected switch when said shiftable means is in a predetermined position.

14. In a device of the character described, a frame, a turntable mounted on said frame for rotation, means for rotating said turntable, a driven rotor having a peripheral projection, a switch, a switch carrier pivoted to said frame about an axis parallel to said turntable and including a member rotatable about a second axis perpendicular to said first axis and normally biased to one switch controlling position, said rotatable member having a projection adjacent to but normally spaced from said rotor, and means carried by said turntable for swinging the projection of said rotatable member into the path of said rotor projection whereby said member is rotated by said projection to a different switch controlling position upon each engagement of the rotor projection with the projection of said rotatable member.

15. The construction defined in claim 14, wherein said rotatable member is elongated and is positioned above and substantially parallel to said turntable, said rotatable member being pivoted to said frame at one end and having a depending foot intermediate its ends bearing upon said turntable, said last named means constituting an elevation on said turntable engageable with said foot.

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