M. HIGUCHI.

ELECTRIC CLOCK.

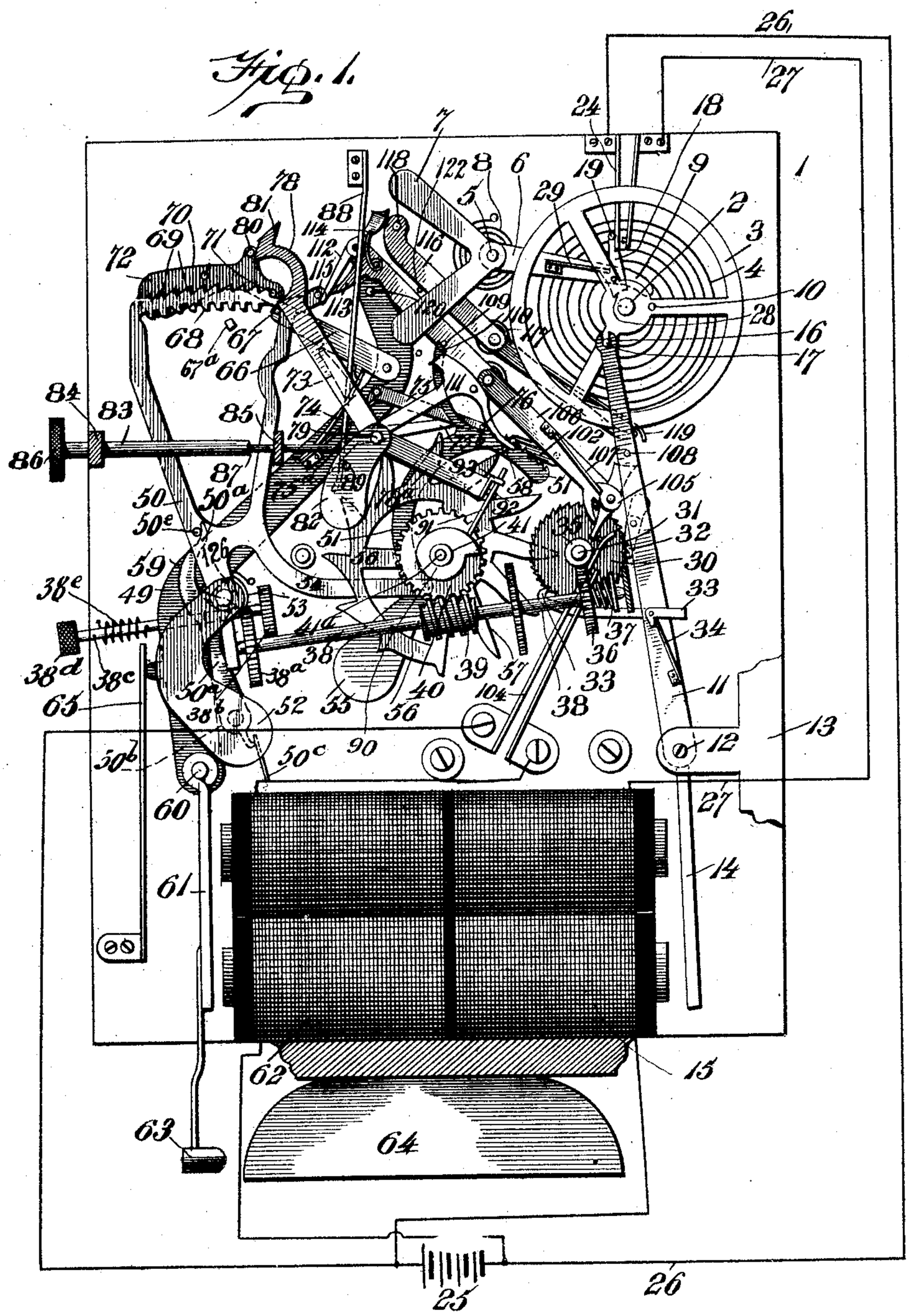
APPLICATION FILED SEPT. 15, 1905.

899,012.

Patented Sept. 15, 1908.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses
Samuel J. Horter
Loretta Flynn

Inventor
Momosuke Higuchi
By his Attorneys
Knight Bros

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4 SHEETS—SHEET 2.

Fig. 3.

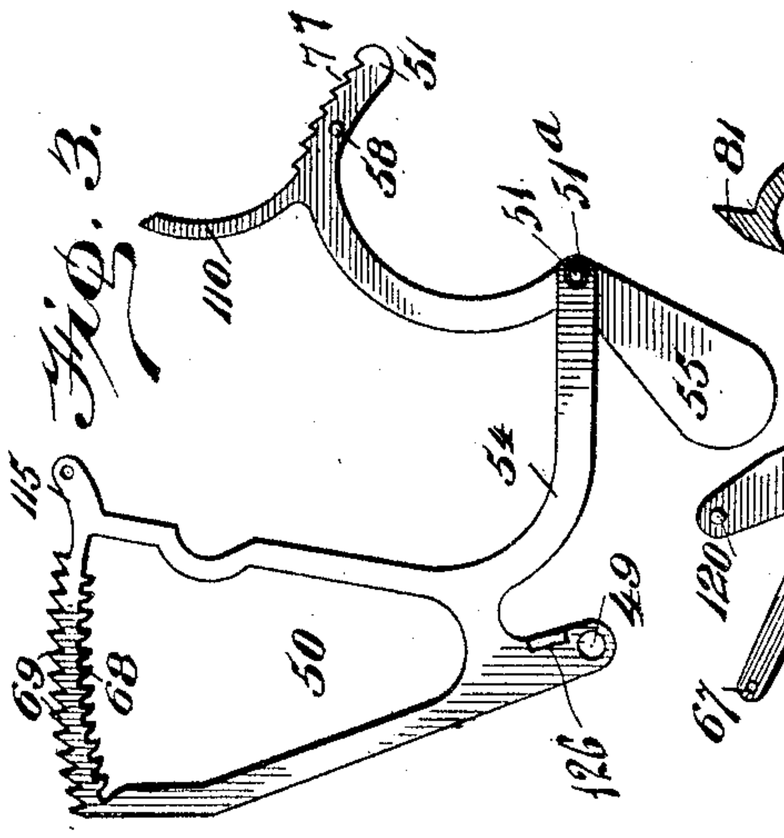


Fig. 5.

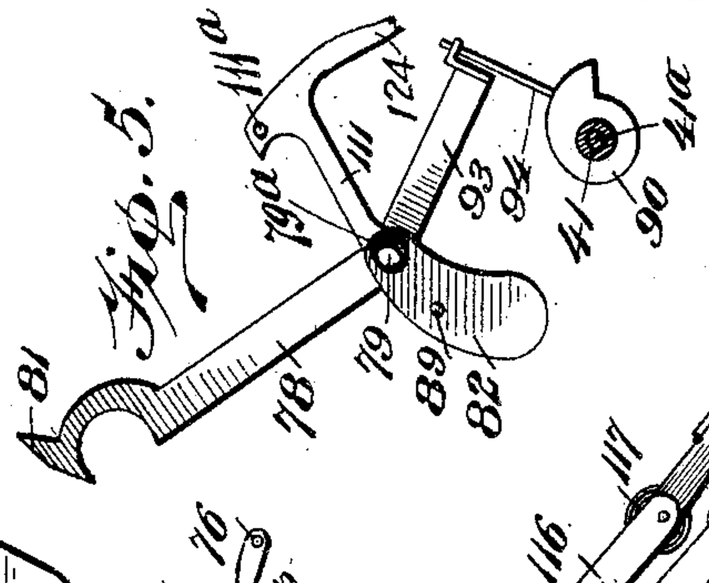


Fig. 4.

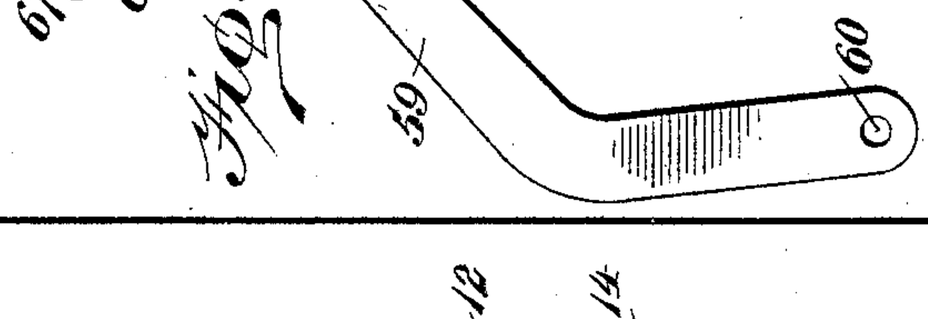
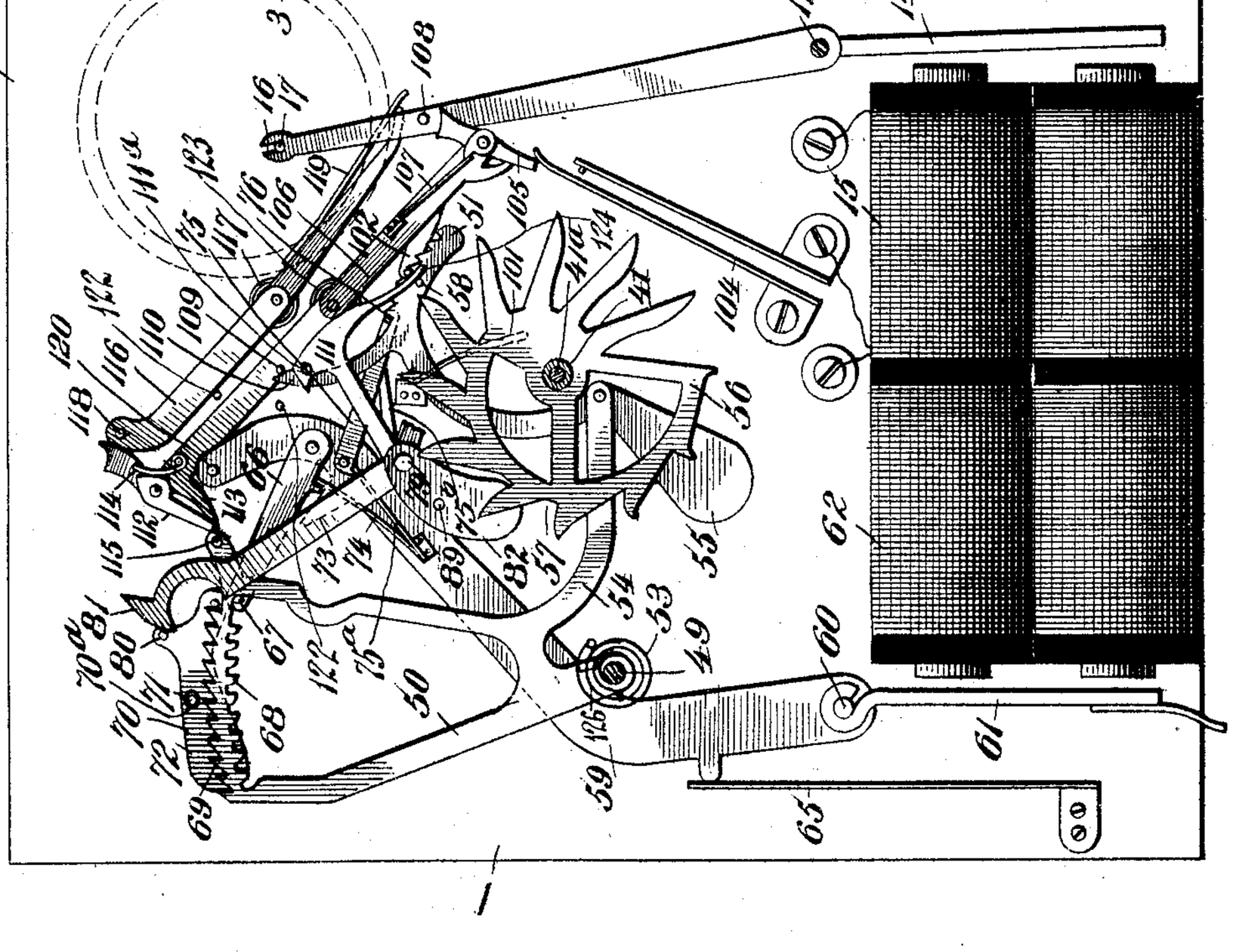


Fig. 6.

Fig. 2.



Witnesses

Samuel J. Hoyter

Gretta Flynn

Inventor

Monnosuke Higuchi

By his Attorneys

Knight Bros

M. HIGUCHI.

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4 SHEETS—SHEET 3.

Fig. 9.

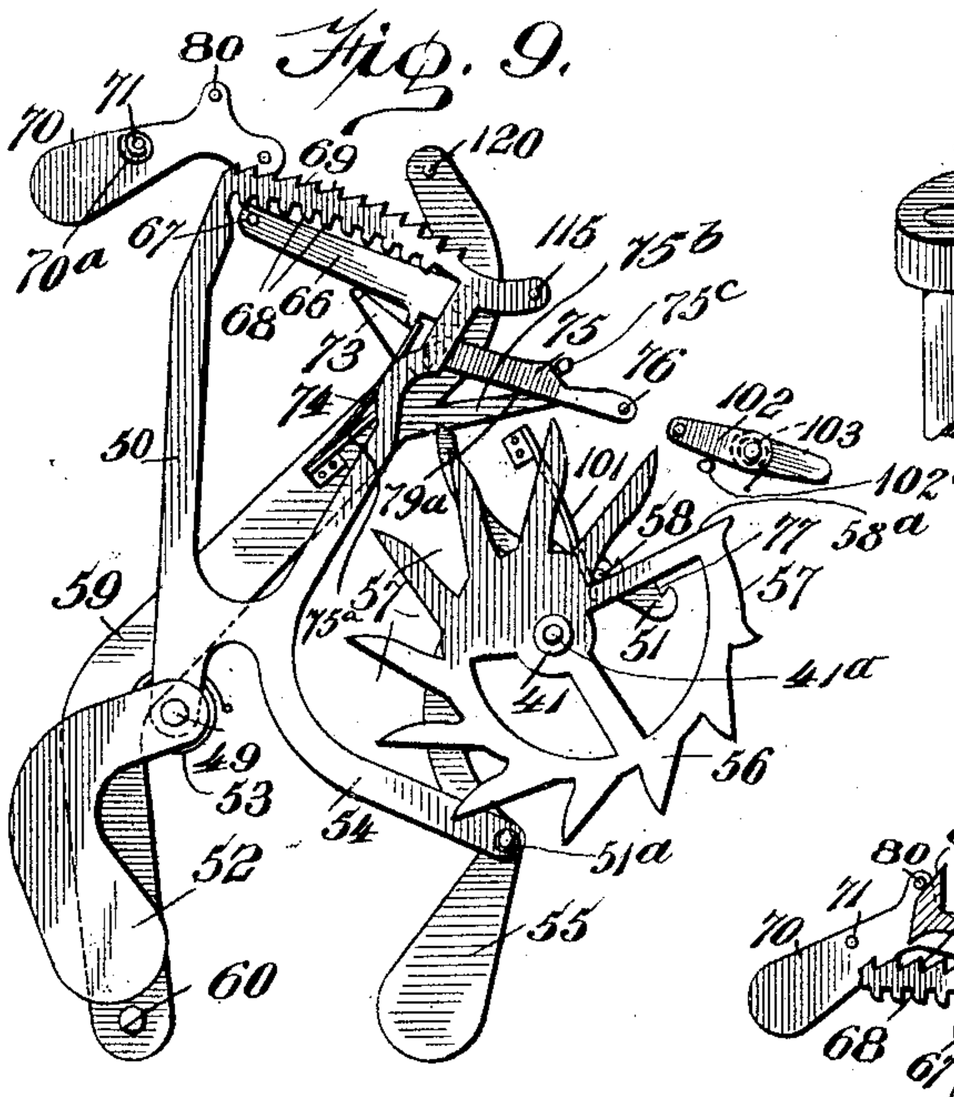


Fig. 10

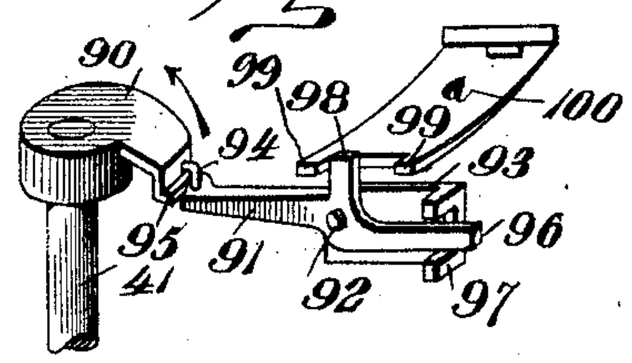


Fig. 8.

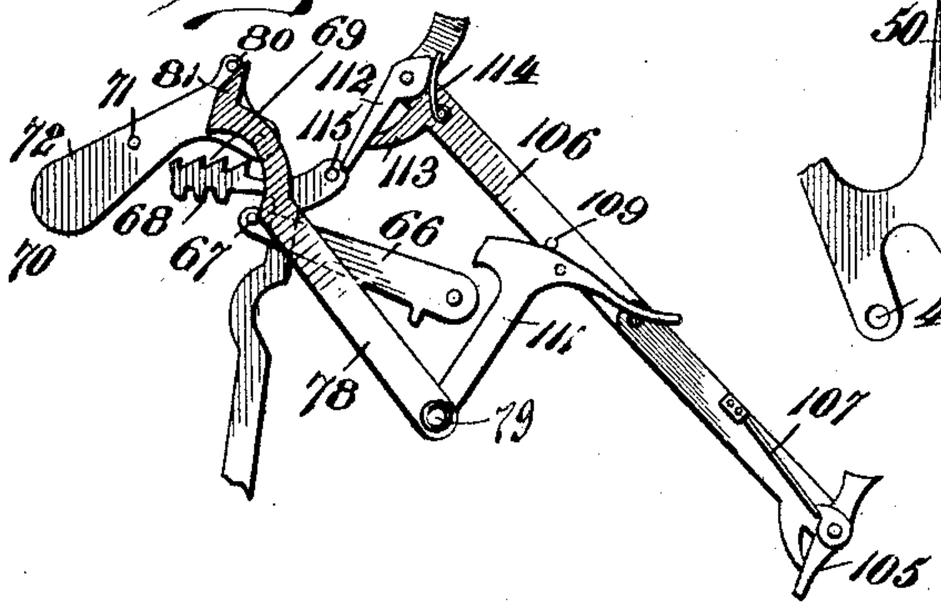


Fig. 7.

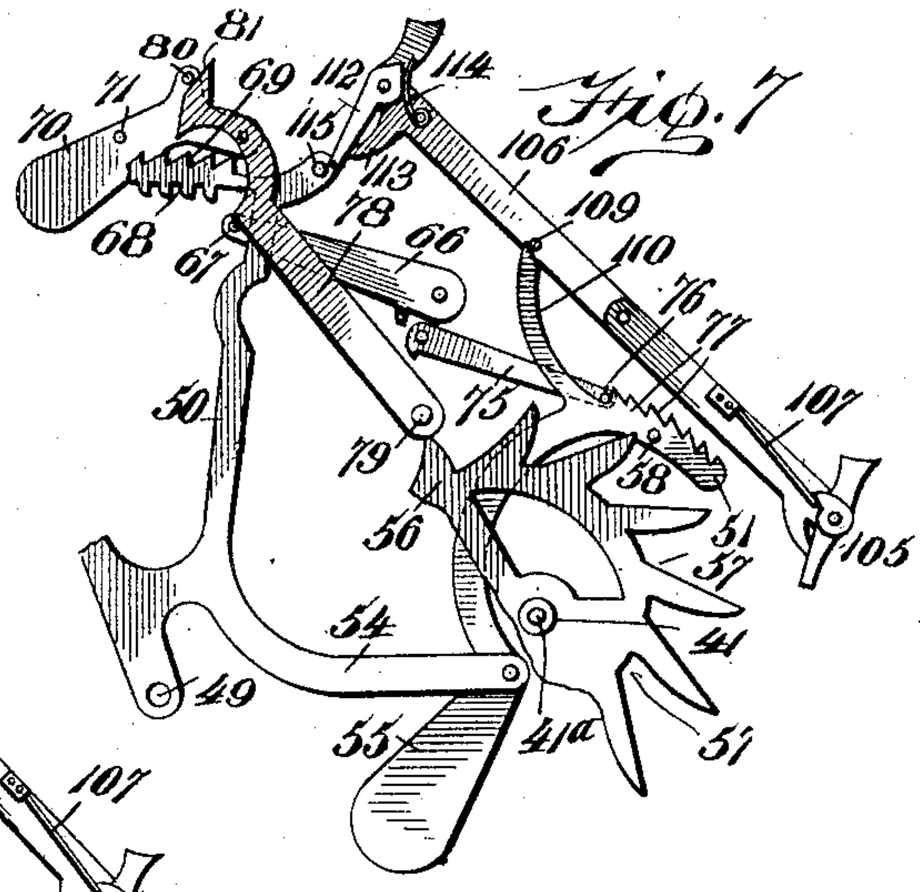


Fig 10a.

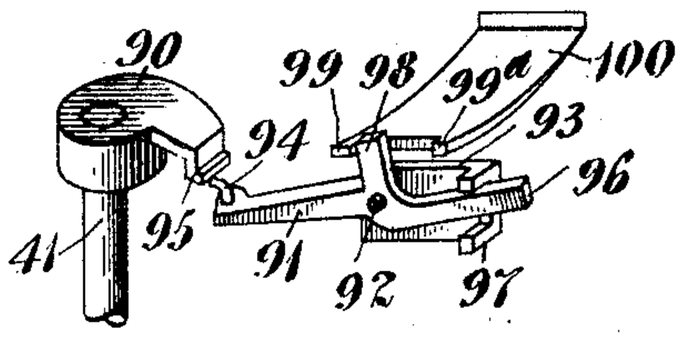
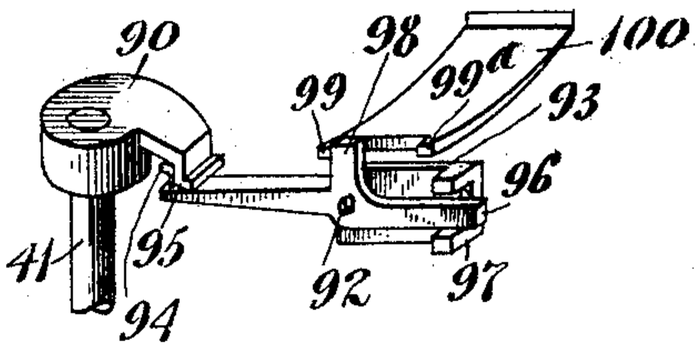


Fig 10b.



Witnesses

Samuel J. Hoester

Loretta Flynn

Inventor

Nomosuke Higuchi

By his Attorneys Knight Bros

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4 SHEETS—SHEET 4.

Fig. 11.

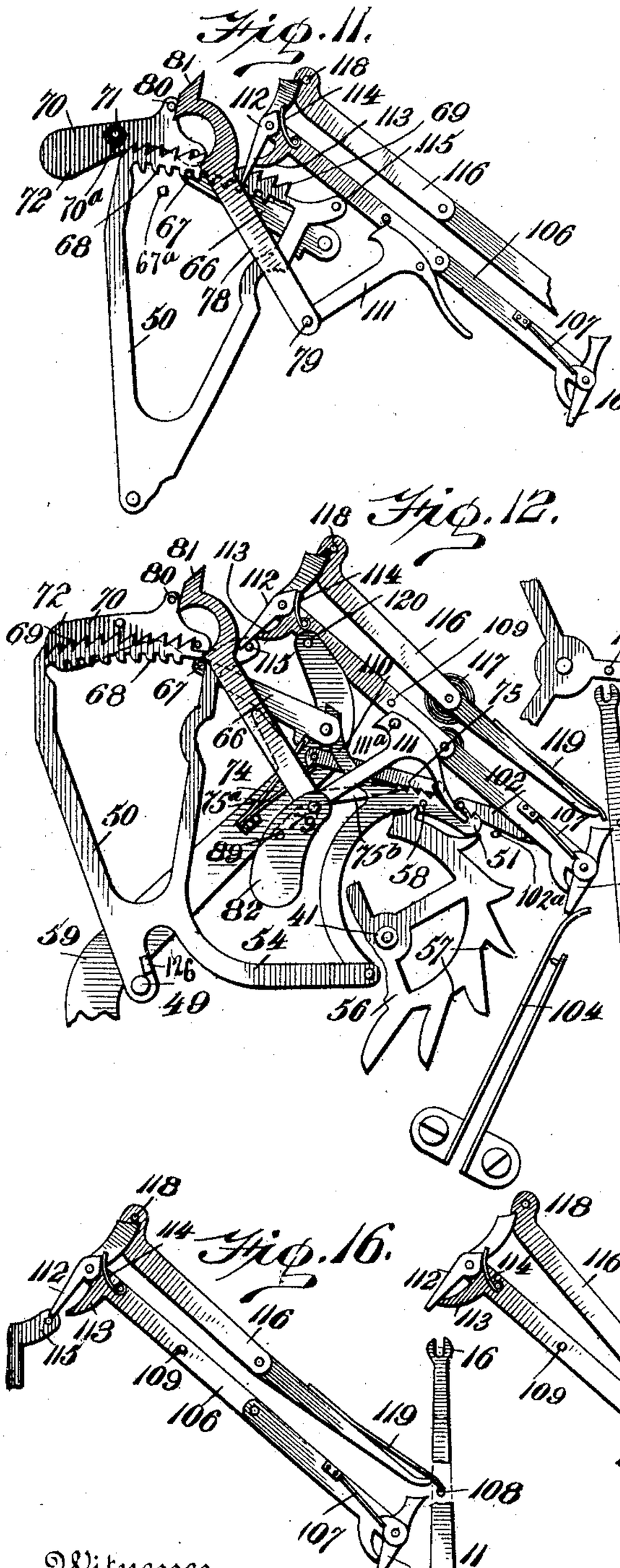


Fig. 13.

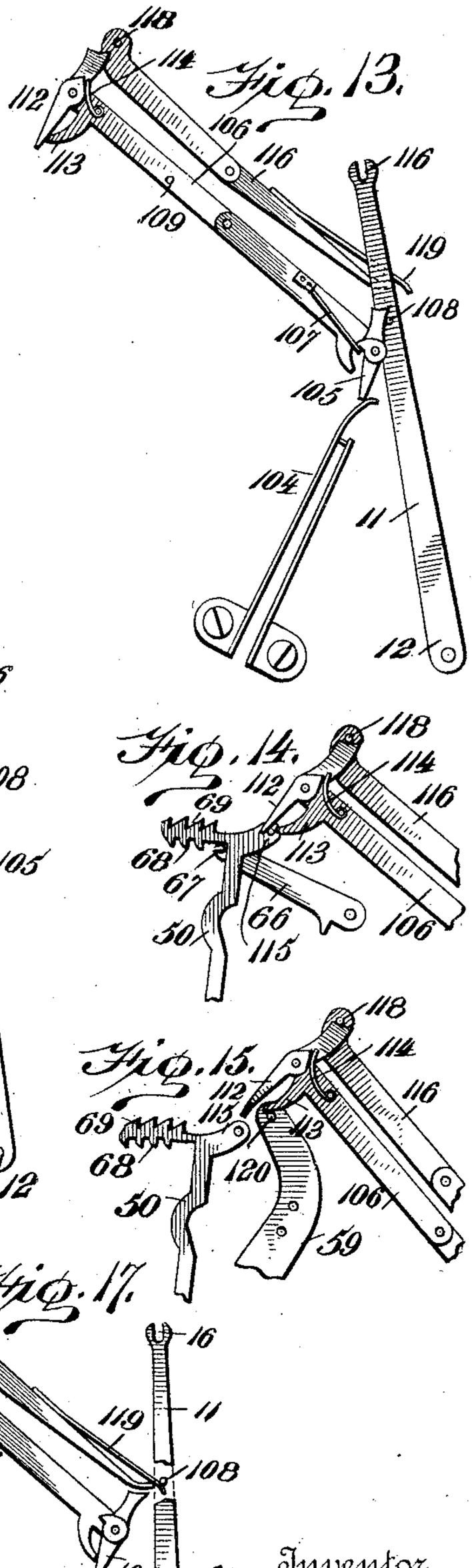


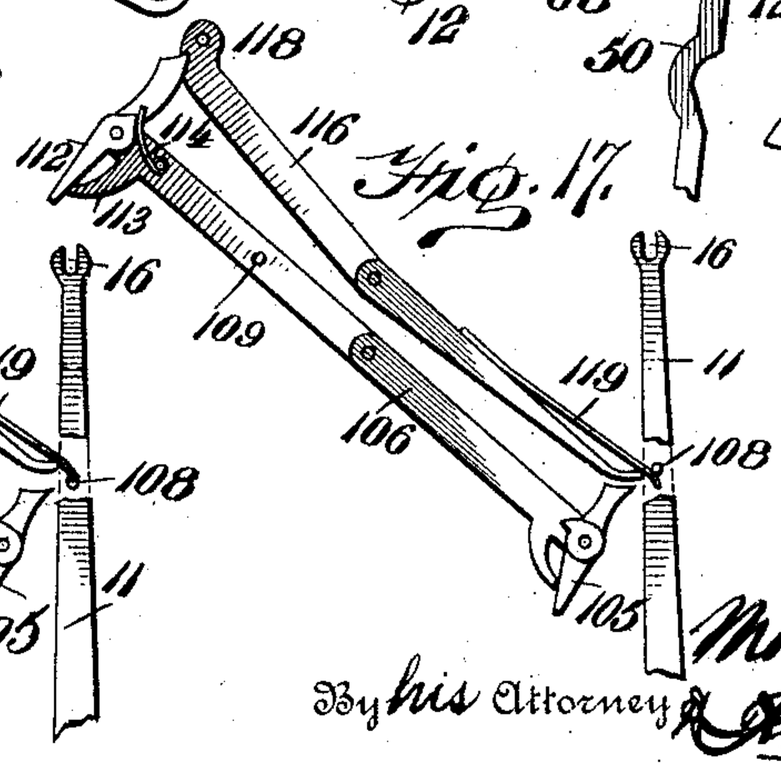
Fig. 12.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.



Witnesses

Samuel J. Hooper

Loretta Flynn

Inventor

Momosuke Higuchi

By his Attorney

Knight Bros.

UNITED STATES PATENT OFFICE.

MONNOSUKE HIGUCHI, OF NEW YORK, N. Y.

ELECTRIC CLOCK.

No. 899,012. Specification of Letters Patent. Patented Sept. 15, 1908.

Original application filed November 3, 1903, Serial No. 179,661. Divided and this application filed September 15, 1905. Serial No. 278,544.

To all whom it may concern:

Be it known that I, MONNOSUKE HIGUCHI, subject of the Emperor of Japan, residing in the borough of Manhattan, in the city and State of New York, have invented certain new and useful Improvements in Electric Striking-Clocks, of which the following is a specification.

The present application is a division of the application filed by me November 3rd, 1903, serially numbered 179,661 and entitled "Improvements in electric clocks."

My invention relates to electric clocks and more particularly to that class of electric clocks actuated by an electric impulse, and has for its object to provide an electric clock wherein the electric impulse is only received when the impulse of the balance wheel weakens.

Furthermore my invention provides an improved hour and minute striking mechanism in which the hour and minute strikes are contradistinguished, and an improved means whereby such strikes may be repeated at will. Such striking mechanism is actuated by electrical impulses, which are supplied by intermittent circuit closing mechanism and suitable hand or automatically operated controlling means.

Further objects of my invention are to provide many improved details of structure whereby the above results are attained, such details being clearly shown in the accompanying drawings in which like reference characters refer to like parts.

In the drawings: Figure 1 is a general view of the interior mechanism of a clock embodying the subject-matter of my invention. Fig. 2 is a general view of the striking and strike controlling mechanism forming the subject-matter of my invention. Fig. 3 is a detail view of the strike controlling racks comprising the hour segment or rack and the minute segment or rack pivotally mounted on an arm of the hour segment or rack. Fig. 4 is a detail view of the striking lever, with its clapper and armature removed, but showing the hour and minute segment or rack actuating pawls mounted thereon. Fig. 5 is a detail view of the arm for releasing the strike controlling racks, the cam actuated arm for actuating said releasing arm, the cam for actuating said actuating arm, the cam shaped stop arm for elevating and dogging the descent of the upper end of the lower bar of the circuit governor. Fig. 6 is a detail view of the circuit closing governor. Fig. 7 is a detail view of a portion of the strike controlling mechanism showing the positions of the parts at the moment when the hour rack is being released from the dogging action of its actuating pawl and retaining dog. Fig. 8 is a similar view of a portion of the strike controlling mechanism showing positions of the parts as the lower bar of the circuit governor is raised to allow the hour segment or rack to pass in its descent. Fig. 9 is a similar view of the strike controlling rack and striking lever, showing positions of parts after the hour and minute segments or racks have been dropped. Fig. 10 is a detail perspective view looking from beneath of a portion of the hour shaft, the cam mounted on said hour shaft, and the automatic strike controlling rack release arm actuated by said cam and the plate for limiting the movement of said release arm. Figs. 10^a and 10^b are like views of the same showing the parts in shifted positions. Fig. 11 is a similar view showing the relative positions of the two bars of the circuit governor while the hour segment or rack is being fed back to normal position. Fig. 12 is a like view of the strike controlling mechanism showing positions of the parts at completion of hour but two seconds prior to commencement of minute strike. Fig. 13 is a like view showing the relative position of the two bars of the circuit governor, the actuating lever and contact pieces during the striking operation showing the contact pieces closed. Fig. 14 is a like view showing the relative positions of the upper ends of the two bars of the circuit governor and the hour segment or rack at the completion of the hour strike. Fig. 15 is a like view of the same showing the positions of the parts during the last stroke of the hour strike. Fig. 16 is a like view of the same one second after the last stroke of the hour strike and one second before the commencement of the minute stroke, and Fig. 17 is a like view showing the relative positions of the two bars of the circuit governor and the actuating lever two seconds after the completion of the hour strike.

Referring now in detail to the drawings, 1 represents the casing of my improved clock having mounted therein an arbor 2 upon which is mounted the usual balance wheel 3 and the customary hair spring 4. Pivoted

in juxtaposition to the balance wheel 3 on an arbor 5 is an oscillatory arm 6. Arbor 5 has rigidly mounted at one end a bifurcated counterbalancing weight 7 and is influenced by a coil spring 8 so that the arm 6 is held normally in balanced position through the medium of said spring 8 and the bifurcated weight 7. The arm 6 is provided with a curved outer end 9 adapted to engage a pin or projection 10 carried by the balance wheel 3.

11 represents what I term the actuating lever. Lever 11 is pivoted at 12 in a bracket 13 on the frame 1, and provided at its lower end with an armature 14 adapted to be attracted by an electromagnet 15. (Fig. 1.)

When the electromagnet is energized the attraction of the armature 14 to the magnet 15 produces an oscillation of the lever 11. Lever 11 is notched or recessed at its upper end at 16 where it engages a pin or projection 17 on the balance wheel 3. Attraction of the armature 14 to the electromagnet 15, will, through the lever 11, give impetus to the balance wheel 3 in opposition to the hair spring 4. Pivoted to the arm 6 is a circuit closer 18 having at its upper end a pin or projection 19 in engagement with one of a pair of contact pieces 24, one of said pieces 24 being electrically connected to the battery 25 of the clock through the lead 26 and the other of said pieces being electrically connected to the electromagnet 15 through the lead 27. (Fig. 1.)

The lower end of the circuit closer 18 projects below the arm 6 and into the path of the pin 10 on the balance wheel 3, as shown in dotted lines in Fig. 1. During the normal vibration of said balance wheel 3, the pin 10 will pass under the circuit closer without operatively engaging said circuit closer. When the lever 6 is struck with full force, under normal vibrations of the balance wheel 3 by the pin 10, the said lever 6 together with the circuit breaker 18 will be thrown up a sufficient distance to allow the pin 10 to pass under the lower end of said circuit breaker and return without engaging said circuit breaker. If the oscillations of the balance wheel grow weak the pin or projection obviously strikes the curved end 9 of the lever 6 with less force, so that the circuit closer is not carried high enough to escape contact with the pin or projection 10. In such case the pin or projection 10 strikes the edge of the circuit closer 18 near its lower end oscillating said circuit breaker so that the pin 19 in the upper end thereof will move the terminal contact piece 24, of 26 into engagement with the contact piece of 27 completing the circuit through said contact pieces energizing magnet 15, so that the armature 14 is attracted and the lever 11 connected thereto will be oscillated to give the balance wheel a renewed impulse. Mounted on the lever 6 is a spring 29, Fig. 1, which engages the circuit breaker 18 above its pivotal point and tends to hold said circuit breaker in its normal position as shown in Fig. 1.

30 is what I term the seconds wheel, provided with sixty notches and pivoted on the seconds shaft 31 journaled in the frame 1.

32 is a dog pivotally mounted on the frame of the clock and adapted to engage the notches of the seconds wheel 30 and act as a detent to prevent backward rotation of said seconds wheel.

33 is a pawl pivoted to the actuating lever 11 in such manner that its free end will be held in engagement with the notches in the seconds wheel 30 by means of a spring 34 carried by said lever 11. For each oscillation of the lever 11 by the balance wheel 3, the pawl 33 will move a sufficient distance to progress the seconds wheel 30 one notch, the dog 32 holding the said seconds wheel in progressed position, as shown in Fig. 1. Mounted on the shaft 31 with the seconds wheel 30 is a worm 35 which engages with and drives a worm wheel 36 mounted on a shaft 38, projected at right angles to shaft 31 suitably journaled in brackets on the clock frame and this worm wheel 36 is held in frictional driving relation with shaft 38 by means of a spring clutch 37, that is, a spring mounted on the shaft between a fixed disk and the worm gear, and holding said worm frictionally against a taper or shoulder on said shaft 38. Shaft 38 also carries a worm gear 39 which meshes with and drives a worm wheel here termed the hour wheel 40. It will be seen that for each oscillation of the lever 11 the pawl 33 will progress the seconds wheel 30 one notch which in turn through worm 35 and worm wheel 36 will operate shaft 38 and through worm gear 39 progress the hour wheel 40.

The gearing is so arranged that the hour wheel will make a complete revolution twice every twenty-four hours and the seconds wheel once in every minute.

Shaft 38 extends beyond the hour wheel 40 and has on its extended end a pinion 38^a which is capable of being placed in mesh with a pinion 38^b mounted on a longitudinally movable shaft 38^c having suitable bearing in and extending through the side of the clock casing and provided on its outer end with a thumb wheel 38^d. This shaft 38^c is coincident with the axis of shaft 38, but sufficiently far away to allow the two pinions 38^a and 38^b to be placed in mesh (Fig. 1). Shaft 38^c also carries a coil spring 38^e adapted to be compressed when said shaft is moved longitudinally, said spring tending to normally hold the pinions 38^a and 38^b out of mesh. When shaft 38^c is drawn outward away from the clock pinion 38^b will be placed in mesh with pinion 38^a, whereupon the shaft 38 may be turned in either direction

to adjust the hands of the clock as desired. When the shaft 38 is turned by hand as above described, the worm wheel 36, worm 35 and seconds wheel 30 will not be affected, owing to the frictional engagement of said worm wheel 36 and shaft.

The mechanism thus far described is clearly shown and described in my aforesaid application of which this is a divisional application, and I herein describe the same merely to show how the hour wheel may be rotated. The hour wheel 40, is as usual, mounted by a sleeve 41, upon the minute wheel arbor 41[a].

Mounted on an oscillating shaft 49, journaled in the frame 1 is a strike controlling frame comprising two segments or racks 50, 51. Segment or rack 50 is hereinafter called the hour segment or rack and segment or rack 51 the minute segment or rack. The shaft 49 has rigidly mounted thereon at one end a counterbalance weight 52. Shaft 49 also has mounted thereon a spring 53 which tends to throw the hour segment or rack 50 of the strike controlling frame toward the center of the clock in opposition to the counterbalance weight 52 when said hour segment or rack 50 is released from its dogging means hereinafter described. Hour segment or rack 50 is provided with a downwardly extending arm 54, to which is pivoted the minute segment or rack 51. 51[a] is a spring mounted on the pivot of segment or rack 51 and adapted to throw said segment 51 to the left (Fig. 1) when the segment or rack is released. Minute segment or rack 51 is provided at its lower end with a counterbalance weight 55 adapted to hold the segment or rack normally in vertical position. (Figs. 1 and 2.) The extent of inward movement of the hour segment or rack 50 determines the number of strikes of the hammer on the clock bell in a manner hereinafter described. The descent or inward movement of the hour segment or rack 50 allows the minute segment or rack 51 to descend.

The sleeve 41 of the hour wheel 40 also carries a notched stop gage 56 (Figs. 1, 2 and 9) having a series of twelve notches 57 of graduated depths therein, each representing an hour. Carried by the segment or rack 51 is a pin 58 adapted, when the hour segment or rack 50 is allowed to drop through the action of the spring 53 on the shaft 49, to engage one of the notches in the notched stop gage 56. The inward movement of the hour segment or rack 50 is limited by the extent of drop of the pin 58 on the segment or rack 51 into one of the notches 57. It will thus be seen that inasmuch as each notch in the notched stop gage 56 represents an hour and as each succeeding notch 57 is of greater depth than the preceding notch 57, the pin 58 will allow the segment or rack 50 to move inwardly under the action of the spring 53 a distance sufficient to cause, in a manner hereinafter described, the ringing of the clock bell a number of times commensurate with the number of the hour.

59 is the striking lever pivoted on a shaft 60 suitably journaled in the clock frame 1, and provided with an armature 61 adapted to be attracted by electromagnet 62, and having at its lower end a clapper 63 (Fig. 1) adapted to strike the clock bell 64. The striking lever 59 is suitably bent at its upper end and is controlled by a spring 65, the spring 65 holding said lever within the influence of the magnetic action of the electromagnet 62 (Fig. 2). At its upper end the lever 59 carries an arm 66 provided with a pin 67 adapted to engage teeth 68 on the under side of the upper edge of the hour segment or rack 50.

67[a] is a stop lug or projection on the clock frame, (Fig. 1). Hour segment or rack 50 is also provided with teeth 69 on the upper side of the same, which teeth are adapted to be engaged by a pin 71 on pivoted dog 70, influenced by a spring 70[a]. One end of the dog 70 is slightly enlarged at 72 to counterbalance the same, (Fig. 9). Lever 59 is also provided just beneath the arm 66 with an arm 73, which limits the downward movement of the arm 66.

74 is a spring suitably mounted on arm 59 adapted to hold arm 66 in engagement with the teeth 68.

75 is an arm pivoted just below the arm 66 on the lever 59, engaged by spring 75[a] and extending in an opposite direction, and carrying at its outer end a pin 76 adapted to engage the teeth 77 on the segment 51. (Fig. 7). Downward movement of arm 75 is limited by an arm 75[b] and its forward movement by a pin projection 75[c] in the clock frame.

78 is a cam lever pivoted on the shaft 79 and adapted to force the pin 67 and the dog 70 out of engagement with the teeth 68 and 69, (Fig. 7) to allow the hour segment or rack 50 to drop. The lever 78 engages the dog 70 through means of a pin 80 seated in the dog 70 and engaging the nose 81 on the lever 78.

79[a] (Fig. 5) is a spring mounted on the shaft 79 and adapted to hold the lever 78 against the pin 67 and the pin 80, so that when the lever 78 is operated, it will force the pin 67 and the dog 70 out of engagement with the teeth 68 and 69 respectively (Fig. 2).

82 is a counterbalance weight on shaft 79.

The lever 78 may be operated in any preferred manner. Herein I have shown two means for actuating this lever 78, one means being automatic and the other being hand actuated for repeating. The repeating means consists of a shaft 83 slidably mounted in lugs 84, 85 on the clock casing 1 and extending to a point without the clock casing

where the thumb wheel 86 is mounted on the shaft 83. (Fig. 1). Shaft 83 is provided with a shoulder 87 which abuts at the limit of the inward movement of shaft 83 against the lug 85 to limit the inward movement of said shaft. At its inner end, shaft 83 abuts a spring 88 mounted in the clock casing and extending downwardly into the path of engagement with a pin 89 on the weight 82. Spring 88 tends to hold the shaft 83 normally in outer position, and the weight 82 tends to hold the pin 89 normally against the spring 88. When the thumb wheel 86 is pressed inwardly the shaft 83 displaces the spring 88, which engages the pin 89 on the weight 82, and displaces the weight 82, rotating the shaft 79 to disengage the dog 70 and the pin 67 from the teeth 69 and 68 respectively, through the medium of the cam lever 78. When thus released, the hour segment or rack 50 is allowed to drop until stopped by the pin 58, on the segment or rack 51 dropping into a notch 57. The segmental striking rack when dropped, causes the clapper 63 to strike the bell 64 a number of times, depending upon the hour registered by the hand of the clock. The thumb wheel 86 is for the purpose of causing the clock to strike to indicate the hour at any time when desired.

The second means for dropping the segmental striking rack is automatic and operates every hour. Such means will now be described. Rigidly mounted on the minute shaft 41 is a hollow cam disk 90. 91 is an arm pivoted at 92 to a bracket 93 on the end of an arm 78^a rigidly mounted on the shaft 79. (Fig. 1.) The arm 91 is provided at its forward end with a bent pin 94 adapted to engage a flange 95 on the hollow cam disk 90 and slide thereover. The arm 91 is provided with a rearward extension 96 adapted to vibrate between lugs 97 on the bracket 93, which limit the extent of movement of the arm 91. Arm 91 is also provided with an upward extension 98 adapted to vibrate between lugs 99, 99^a on a plate 100 mounted on the clock frame 1. (Fig. 10.) The lugs 99, 99^a limit the extent of forward and rearward movement of the upward extension 98 on the arm 91, and thereby also the extent of movement of the arm 78^a on the shaft 79, and hence limit the movement of the lever 78. As the minute shaft 41 rotates in the operation of the clock, the hollow cam disk 90, mounted thereon, is rotated in the direction of the arrow (Fig. 10). The pin 94 riding over the flange forces the arm 91 outwardly from the disk 90 to an extent determined by the lugs 99 thereby forcing the arm 78^a upwardly, rotating the shaft 79 in opposition to the spring 79^a and counter balance weight 82, and depressing the lever 78. The lever 78 through its cam portion 81 engages the pin 80, moving the dog 70 to disengage the same from the teeth 69, and, by depressing the pin 67, disengages said pin 67 from the teeth 68, whereby the segmental striking rack is allowed to drop a distance determined by the depth of the particular notch 57 in the notched stop gage 56 into which the pin 58 is dropped.

When shaft 83 is operated by the thumb wheel 86 to cause the striking mechanism to repeat, the lower end of arm 78^a is forced away from hollow cam 90 carrying with it plate 93 and arm 91 until lug 98 strikes lug 99^a. In an intermediate position of the lug 98 between the lugs 99, 99^a, the pin 94 is allowed to drop below the plane of the flange 95 or until arrested by engagement of extension 96 with lug 93, (Fig. 10^a). Upon release of the thumb wheel 86 the parts return to normal positions under influence of a spring 79^a on shaft 79, the pin 94 at this time traveling under flange 95 to a position within the cam 90 (Fig. 10^b) in which position it will be engaged by the surface of cam 90 and in the course of rotation of said cam 90 ride out onto the flange 95 to the position shown in Fig. 10. It is, of course, obvious that if the repeating mechanism be operated when the pin 94 is in the position shown in Fig. 10, upon release of the thumb wheel 86 the pin 94 will return to a position within disk 90 behind flange 95 so that the automatic means for setting the striking mechanism into operation will not operate on the succeeding hour. Pin 94 is in the position shown in Fig. 10 only at a few minutes say three or four minutes before the hour so that the failure to operate under such circumstances is immaterial. It is obvious that if the hands of the clock are reset by reversal the cam disk will rotate in the opposite direction in which event there will be no interference on the part of pin 94 as the pin will, if in the position shown in Fig. 10 travel back along flange 95 onto the hub of disk 90 and, if in the position shown in Fig. 10^b the pin travels about only on the hub so long as the disk is being reversed. It will thus be seen that the hands can be reset without disturbing the striking mechanism or throwing out the striking mechanism, although the time of operation of such mechanism remains dependent upon the positions of the hands through the medium of disk 90.

The lever 78 is allowed to return to normal position under influence of the spring 79^a when pin 84 reaches the end of the flange 95, at which time there being no resistance against pin 94, the weight 82, through shaft 79 and arm 78^a, moves bracket 93 and pin 94 until pin 94 abuts the hub of the cam 90, at which time the lever 78 is in normal position and the dog 70 and pin 67 are in engagement again with the teeth 69 and 68 respectively but at a point nearer the outer end of the segment 50. (Fig. 10.) As soon as the lever

78 is released the same, under influence of spring 79ª returns to normal position allowing the pawl 70, under the influence of spring 70ª to reëngage teeth 69 at an advanced position and allowing pawl 102 to drop again into normal position under influence of its spring 102ª in which position it will reëngage teeth 77 upon return of segment or rack 51 to the plane of said pawl 102.

The segmental striking rack being in lower position, intermittent currents of electricity are passed through magnet 62, through means hereinafter described, the lever 59 is attracted thereto, feeding the segment or rack 50 through action of pin 67 step by step back to its normal position. The stop lug or projection 67ª striking the arm 66 at each stroke of lever 59 prevents the pin 67 from moving segment or rack 50 more than one tooth at a time. At each attraction of the lever 59 the clapper 63 strikes the bell 64 and the number of strikes on bell 64 is dependent upon the number of teeth engaged by the pin 67 in feeding segment or rack 50 back to normal position.

Having now described the hour strike, I will proceed to describe the minute strike, which is adapted to show approximately the number of minutes past the hour. The minute segment or rack 51 which is pivoted on the arm 54 of the hour segment or rack 50 determines the number of minute strikes. Each minute strike represents a ten minute period so that if there are five minute strikes after the hour strike it means that the clock registers fifty minutes after the hour or ten minutes before the succeeding hour. In descending into the interdental of one of the notches 57, the pin 58 on the minute segment or rack 51 describes a curve by reason of the fact that segment or rack 51 is under influence of spring 51ª, and which, while the spring 53 is drawing the hour segment or rack 50 downward, tends to throw the minute segment or rack 51 to the left in seeking its center of gravity.

101 is a curved plate stationarily mounted on the clock frame 1, and adapted to be struck by pin 58 when the latter drops into the interdental of a notch 57. Plate 101 is curved so that the same will be coincident with the interdental of each notch 57 as the same comes into line therewith. If the current in magnet 62 becomes too weak to attract armature 61 so that the two segments or racks will not be fed back into normal positions, the rear edge of the notch 57 into which pin 58 has dropped will press against pin 58 as gage 56 rotates in direction of arrow and force the same up the stationary plate 101 back into normal position. (Figs. 2 and 9).

If the hands of the clock are adjusted through means of the shaft 38ᶜ when the segments or racks 50, 51 are dropped, it is obvious that the hands may be turned in one direction and the segments or racks 50, 51 returned to normal positions in the manner just described but without the following mechanism it would be impossible to turn the hands in the opposite direction to adjust them, since pin 58 engaging the forward edge of the notch 57 will lock gage 56 against rotation. Such mechanism comprises an arm 50ª pivoted at 50ᵇ to the clock frame and engaged at its lower end by a spring 50ᶜ. Arm 50ª is irregular in shape and has an upwardly extending finger 50ᵈ adapted to engage a pin or projection 50ᵉ on segment or rack 50. When the pinion 38ᵇ is drawn into engagement with pinion 38ª through thumb wheel 38ᵈ, said pinion 38ᵇ strikes arm 50ª on the side opposite pin or projection 50ᵉ on segment or rack 50 and returns segment or rack 50 to normal position and elevating the segment or rack 51 a distance sufficient to carry the pin 58 out of the notch 57 into which the same has dropped, thus leaving notched stop gage 56 free to rotate in either direction

The teeth 77 each represent a ten minute period, there being a greater number than five of these teeth for the purpose of accommodating a dog 102, which engages said teeth 77 in the feeding operation of the minute segment or rack 51 to hold the frame against the spring 51ª as the same is fed back into normal position step by step by the pin 76. The dog 102 is pivotally mounted and held in engagement with the teeth 77 by a spring 103. (Fig. 9.) Dog 102 is limited in downward movement by stop 102ª. The extent of movement of the minute segment or rack 51 from right to left when released is determined by the position of the forward edge of the notch 57 into engagement with which the pin 58 drops, that is, the pin 58 when the hour segment or rack 50 is elevated through action of the pawl 67 rides up the forward edge of the notch 57 into which the same is dropped (as in the position shown in Fig. 9) until the minute segment or rack 51 or one of the teeth thereon comes into engagement with the pin 76 and the dog 102 (as in the position shown in Fig. 12), and hence the distance between the forward edge in the notch 57 at its upper end and the normal position of the pin 58 will be commensurate with the distance between the first tooth 77 on the minute segment or rack 51 and the tooth 77 engaged by pin 76 upon the elevation of the minute segment or rack 51 by arm 54. The minute segment or rack 51 reaches its uppermost position at the completion of the feeding movement of the hour segment or rack 50, at which time the teeth 77 come into engagement again with the pin 76. As has already been stated, upon dropping of the segments or racks 50, 51, suitable mechanism is set into operation whereby the magnet 72 is energized inter-

mittently to actuate the lever 59 with the arm 66 carrying the pawl 67. At the same time the arm 75 carrying the pin 76 is actuated, but is not effective, since the teeth 77 on the frame 51 have not been elevated into engagement therewith. Such teeth 77 come into engagement with the pin 76 upon the completion of the return of the hour segment or rack 50, (Fig. 12) to normal position. It is obvious that the feeding of the minute segment or rack 51 transversely to normal position would immediately commence, so that it would be impossible to contradistinguish the hour strike and the minute strike. For this reason, I have provided suitable mechanism, hereinafter described for interrupting the intermittent energizing of the magnet 62 for the space of several seconds at the completion of the return of the rack 50 to its normal position. At the end of such intermission however, the intermittent energizing of the magnet continues, whereupon the rack 51, now in elevated position again, commences its transverse return to the right to normal position by the step by step feed, already described, and taking a number of steps equal to the number of teeth which have, up to such time, passed to the left of the vertical plane of the pin 76. (Fig. 12.) Such step by step movement continues until the pin 76 occupies the position shown in Fig. 1, and for each step the clapper 63 strikes the bell 64 one stroke.

To prevent pin 58 from coming to a dead center on the point of one of the teeth separating two of the notches 57, I have provided a pin or projection 111[a] on arm 111 adapted to engage the upward extension or projection 110 hereinafter described on segment or rack 51. If the pin 58, upon actuation of shaft 83, strikes the point of a tooth separating two of the notches 57, a further pressure of shaft 83 will throw pin or projection 111[a] against extension or projection 110 moving segment or rack 51 far enough to move pin 58 out of engagement with said tooth thus allowing the segment or rack to drop.

I have now described the mechanism for determining the number of strikes and will now proceed to describe the mechanism for attracting the armature 61 on the lever 59 to strike the clapper 73 against the bell 64 to produce and cause intermission between an hour and minute strike.

104 are a pair of contact pieces electrically connected to the magnet 62. (Fig. 2.) 105 is a circuit closer pivoted on the lower end of the lower bar 106 of a circuit governor. Bar 106 is influenced by spring 123 mounted on the pivot and is limited in downward movement by pin or projection 121 (Fig. 6). Circuit closer 105 is controlled by a spring 107 engaging it and mounted on the bar 106. Circuit closer 105, or a suitable projection thereon at its lower end, rests against one of the contact pieces so that upon displacement of the circuit closer 105 in opposition to the spring 107 the contact pieces 104 will be brought into engagement to close a circuit and energize the magnet 62. 108 is a pin mounted on the main actuating lever 11. Pin 108 is adapted to actuate the circuit closer 105 in opposition to the spring 107 when the circuit closer 105 is in the path of engagement with said pin 108. The upper end of the bar 106 is normally held in elevated position, so that the circuit closer 105 will normally be beneath the horizontal plane of the pin 108, (Fig. 2). This is accomplished through a pin 109 mounted on the bar 106 and adapted to engage an arm or projection 110 on the minute segment or rack 51 when said segment or rack is in normal position. When the minute segment or rack 51, however, is in dropped position, and until it is fed back into normal position, the arm or projection 110 is out of engagement with the pin 109 so that the bar 106, except when temporarily checked by other means, hereinafter described, is allowed to drop at its upper end under influence of spring 123 to elevate its lower end until the same strikes pin or projection 121 and bring the circuit closer 105 into the path of engagement with pin 108, at which time, upon the next movement of the lever 11 the circuit closer 105 will be operated, closing the circuit through the contact pieces 104, energizing the magnet 62 and attracting the armature 61 on the lever 59. This will occur at each successive engagement of the pin 108 with the circuit closer 105 at each successive movement of the lever 11, so that the armature 62 will be intermittently energized and in a manner already described, the racks 50, 51 will be fed back into normal position. Upon the last stroke of the pawl 76 on the teeth of the rack 51 the arm or projection 110 rides under the pin 109 and elevates the upper end of the lever 106 to depress the circuit closer 105 out of the path of engagement with the pin 108. For the purpose of temporarily holding the circuit closer 105 out of the path of engagement with the pin 108, when the striking rack is released, either automatically or through thumb screw 86, I have provided a cam shaped dog 111 rigidly mounted on the shaft 79, which, when the shaft 79 is rotated, rides under the pin 109 on the lever 106 and takes the place of the upward extension or projection 110 on the segment or rack 51. This allows the segments or racks 50, 51 sufficient time to reach the limit of their downward movements before the upper end of the lever 106 is allowed to drop to bring the circuit closer 105 into the path of engagement with the pin 108, and hence the striking of the clock will not commence until the pin 67 and the dog 70 are returned to engagement with

respective teeth, through the return of the parts mounted on the shaft 79 to normal positions.

It now becomes necessary to contradistinguish the hour and the minute strikes. For this purpose, I have provided an automatic means or circuit governor for throwing the circuit closer 105, temporarily, out of the path of the pin 108 between the hour and minute strikes. This is done through the following mechanism: At the upper end of the bar 106 is pivoted an arm 112 held normally against a lug 113 on the bar 106 by a spring 114. Arm 112 has a widened upper end for a purpose hereinafter described, and an elongated lower end projecting outwardly and normally in the path of pin or projection 115 on the hour segment or rack 50. In its normal position the arm 112 being in the path of the pin or projection 115 would prevent the dropping of the segment or rack 50, but the projection 110 or the cam shaped arm 111 on the shaft 79 engaging the pin 109 on the bar 106 raises the upper end of the bar 106 a distance sufficient to carry the arm 112 out of the path of the pin 115, as shown in Fig. 8; this occurring simultaneously with the release of the teeth 68, 69 through engagement respectively with the pawl 67 and the dog 70. Projection 110 or cam shaped arm 111 performs a double function of temporarily holding the circuit closer depressed out of the path of engagement with the pin 108, and to sufficiently elevate the upper end of the bar 106 to carry the arm 112 out of the path of engagement with the pin or projection 115.

Pivoted substantially parallel with the bar 106 in the frame of the clock, and forming part of the circuit governor, is a bar 116 which is capable of limited oscillatory movement and is normally held against a pin or projection 122 by a spring 117. (Figs. 1 and 6). At its upper end the bar 116 is provided with a pin 118 adapted to rest normally against the side of the arm 112 when the arm 112 is elevated. 119 is a strip preferably of spring metal running along the back of the bar 116 and extending slightly over the lower end of the same, at which point the strip 119 is slightly curved downwardly. When the segments or racks 50, 51 have been allowed to drop, the pin 118 on the bar 115 is in position slightly above and to the side of the arm 112, as clearly shown in Figs. 12 and 13. While the parts are in these positions the arm 105 is in the path of the pin 108 on the actuating lever 11, so that a circuit is closed intermittently by the contact points 104, as already described, with the result that the hour segment or rack 50 is gradually fed back to its normal position. Fig. 12 shows the position of arm 12 with relation to the pin or projection on the hour segment or rack 50 just prior to the last hour stroke of the striking lever 59. During such last stroke in the hour strike of such striking lever 59 the arm 112 striking the pin or projection 115 is forced under the pin 118 on the bar 116, as shown in Fig. 14. At the same time, the pin 120 carried at the upper end of the striking lever 59 engages the underside of the lug or projection 113, (Fig. 15), forcing the lever 106 upwardly at its upper end and the arm 105 downwardly at its lower end out of the line of engagement with the pin 108 on the striking lever 11.

The circuit is broken at the end of the striking operation by pin 120 striking the underside of the lug or projection 113. The blow by pin 120 or pin or projection 113 being very sudden it will be seen that the duration of flow of current through magnet 62 is extremely short and that the clapper 63 strikes the bell 64 very quickly. One advantage of throwing arm 105 out of the path of lever 11 or pin 108 thereon at the end of the striking operation is, that the objectionable clicking noise of contact between arm 105 and pin 108 is done away with. As soon as pin 108 has left arm 105 the circuit is temporarily broken by return of arm 105 to normal position under influence of spring 107. This allows armature 61 to leave magnet 62 just a little thereafter. The next succeeding stroke of the actuating lever 11 after the last stroke of the hour strike, will carry the pin 108 over the curved upper end of the arm 105 as shown in Fig. 16, and the said pin 108 on its return will spring out from under the strip carried by the bar 116. At the moment when the arm 112 is raised on top of the pin 115 on the hour segment or rack 50, continuing in its return movement, the spring 108 springs out from under the strip 119 to a position above the same. It is obvious that an elevation of the upper end of the bar 116 through the means just described will depress the lower end of the bar 116 so that the strip 119 is thrust into the path of the pin 108 on the lever 11. Upon the next return of the pin 108 it will strike the upper side of the strip 119 (Fig. 17) forcing the bar 116 down at its lower end and separating the pin 118 from the notched or curved upper end of the arm 112, which, under influence of the spring 114, springs away and allows the pin 118 to drop to normal position, bearing against the under edge of said arm 112, and thus allowing the lower end of the bar 116 and the strip 119 to elevate itself as soon as free from the pin 108. At this moment, after two successive strokes of the actuating lever 11 the arm 112 having passed the pin 115 drops again, allowing the arm 105 to ascend into the path of engagement with the pin 108 on the actuating lever. Since there are two strokes of the actuating lever subsequent to the last stroke in the hour strike, in which the pin 108 does not engage the contact arm 105, it is

obvious that the magnet 62 during said time, or for the space of several seconds, will not be energized and hence the striking lever 59 will not be actuated. However when the arm 105 is again raised into the path of engagement with the pin 108 the intermittent energizing of the magnet 62 will continue and the minute segment or rack 51 will begin its feed back to normal position in a manner already described.

I claim:

1. In a clock, the combination with an hour arbor and a striking lever, of means for intermittently actuating said lever to effect an hour and minute strike, controlling means to throw said lever actuating means into operation to temporarily throw said lever actuating means out of operation at the completion of the hour strike and to permanently throw said lever actuating means out of operation at the completion of the minute strike to determine the number of hour and minute strikes and means mounted to rotate with said hour arbor to gage the operation of said controlling means.

2. In a clock, the combination with an hour arbor and a striking lever, of means for intermittently actuating said lever to effect an hour and minute strike, means for controlling said lever actuating means to throw said lever actuating means into operation, to temporarily throw said lever actuating means out of operation at the completion of the hour strike and to permanently throw said lever actuating means out of operation at the completion of the minute strike, means mounted to rotate with said hour arbor for automatically operating said controlling means and means mounted to rotate with said hour arbor to gage the extent of operation of said controlling means.

3. In a clock, the combination with an hour arbor and a striking lever, of means for intermittently actuating said lever to effect an hour and minute strike, means for controlling said lever actuating means to temporarily throw said lever actuating means out of operation at the completion of the hour strike and to permanently throw said lever actuating means out of operation at the completion of the minute strike, hand operated means for throwing said controlling means into operation, means mounted to rotate with said hour arbor to throw said controlling means into operation, and means mounted to rotate with said hour arbor to gage the extent of operation of said controlling means.

4. In a clock, the combination with an hour arbor and a striking lever, a stop gage mounted to rotate with said arbor, means for intermittently actuating said lever, a pivoted hour strike controlling segment or rack, a minute strike controlling segment or rack pivoted to said hour strike controlling segment or rack and adapted to engage said gage to limit the movement of said segments or racks when released from their normal positions, pawls carried by said striking lever in engagement with said segments or racks, to feed said segments or racks back to normal positions upon actuation of the striking lever, means actuated by the hour segment or rack when it reaches its normal position for temporarily throwing the lever actuating means out of operation, means actuated by the minute segment or rack when it reaches its normal position for permanently throwing said lever actuating mechanism out of operation and means for releasing said segments or racks from dogging engagement with said pawls.

5. In a clock, the combination with an hour arbor and a striking lever, of means for intermittently actuating said lever, a stop gage mounted to rotate with said arbor and having a graduated series of notches, a pivoted hour strike controlling segment or rack, a minute strike controlling segment or rack pivoted to said hour strike controlling segment or rack and adapted to engage any one of the graduated series of notches in said stop gage to limit the movement of said segments or racks when released from normal positions, means for returning said segments or racks to normal position, a governor actuated by the hour strike controlling segment or rack when it returns to normal position for temporarily throwing the lever actuating means out of operation, means actuated by the minute strike controlling segment or rack for permanently throwing out of operation said lever actuating mechanism when said minute strike controlling segment or rack reaches its normal position, and means for releasing said segments or racks from dogging engagement with their pawls.

6. In a clock, the combination with an hour arbor and a striking lever, of means for intermittently actuating said lever, a stop gage mounted to rotate with said arbor and having a graduated series of notches, a pivoted hour strike controlling segment or rack, a minute strike controlling segment or rack pivoted to said hour strike controlling segment or rack and adapted to engage any one of the graduated series of notches in said stop gage to limit the movement of said segments or racks when released from normal positions, means for returning said segments or racks to normal positions, a governor actuated by the hour strike controlling segment or rack when it returns to normal position for temporarily throwing the lever actuating means out of operation, means actuated by the minute strike controlling segment or rack for permanently throwing out of operation said lever actuating mechanism when said minute strike controlling segment or rack reaches its normal position, and

hand actuated means for releasing said segments or racks from dogging engagement with their pawls.

7. In a clock, the combination with an hour arbor and a striking lever, of means for intermittently actuating said lever, a stop gage mounted to rotate with said arbor and having a graduated series of notches, a pivoted hour strike controlling segment or rack, a minute strike controlling segment or rack pivoted to said hour strike controlling segment or rack and adapted to engage any one of the graduated series of notches in said stop gage to limit the movement of said segments or racks when released from normal positions, means for separately returning said segments or racks to normal positions, a governor actuated by the hour strike controlling segment or rack when it returns to normal position for temporarily throwing the lever actuating means out of operation, means actuated by the minute strike controlling segment or rack for permanently throwing out of operation said lever actuating mechanism when said minute strike controlling segment or rack reaches its normal position, means actuated by the hour arbor and hand actuated means for releasing said segments or racks from dogging engagement with their pawls.

8. In a clock, the combination with an hour arbor, a striking lever and an electromagnet for intermittently actuating said striking lever to effect an hour and minute strike, of a governor for controlling the energizing of said magnet, a strike controller for operating said governor to energize said magnet at the commencement of the hour strike to temporarily deënergize the magnet at the completion of the hour strike and to permanently deënergize the magnet at the completion of the minute strike, and means rotating with the hour arbor for gaging the extent of operation of said controller.

9. In a clock, the combination with an hour arbor, a striking lever and an electromagnet for intermittently actuating said lever to effect an hour and minute strike, of a governor for governing the energizing of said magnet, and a strike controller actuated by said lever for controlling by its extent of operation the operation of said governor to energize said magnet at the commencement of the hour strike to temporarily deënergize the magnet at the completion of the hour strike and to permanently deënergize the magnet at the completion of the minute strike, and means rotating with the hour arbor for gaging the extent of operation of said controller.

10. In a clock, the combination with the actuating lever and an hour arbor, of means for intermittently actuating said lever to effect an hour and minute strike, and means gaged by said hour arbor for controlling said lever actuating means to commence the hour strike, to temporarily suspend the operation of said lever actuating means at the completion of the hour strike and to permanently suspend the operation of said lever actuating means at the completion of the minute strike.

11. In a clock, the combination with an hour arbor, a striking lever and an electromagnet for intermittently actuating said striking lever to effect an hour and minute strike, of contact pieces in electrical connection with said magnet, a governor, a circuit closing device carried by said governor, a main actuating means for operating said arbor and adapted to actuate said circuit closing device, a gage mounted to rotate with said arbor, a strike controller for determining the number of hour and minute strikes of said lever, gaged in its operation by said gage and adapted to operate said governor at the completion of the hour strike to temporarily throw the circuit closing device out of the path of engagement with the main operating means and to throw and permanently hold said circuit closing device out of the path of engagement with said main operating means at the completion of the minute strike.

12. In a clock, the combination with an hour arbor, an electromagnet and striking lever actuated by said magnet, of contact pieces electrically connected to said magnet, a circuit controller comprising a pair of parallel members, a circuit closing device mounted on one of said members, a main actuating means adapted to actuate said circuit closing device, a strike controller gaged in its operation by said arbor and adapted to actuate one member of said controller to temporarily throw the circuit closing device out of the path of engagement of the said main operating device at the completion of the hour strike and adapted to throw the other member of said controller into the path of engagement of the main operating device to prevent its engagement with said circuit closing device to cause an interval between the hour and minute strikes, means actuated by the strike controller for engaging circuit governor to move said circuit closing device permanently out of the path of engagement with the main operating means at the completion of the striking operation.

13. In a clock, the combination with an hour arbor, an electromagnet, a striking lever and a main actuating means for actuating said arbor, of means for determining the number of hour and minute strikes and for causing an interval therebetween comprising a circuit governor consisting of a pair of members, a circuit closing device mounted on one of said members and actuated by engagement with said main actuating means and means gaged in operation by said hour arbor for moving one of said members to carry

said circuit closing device out of engagement temporarily at the completion of the hour strike and to move the other member of said circuit governor into the path of engagement with said main actuating means to hold said circuit closing device out of the path of engagement at the completion of the hour strike, and means for holding the circuit closing device permanently out of the path of engagement with the main actuating means at the completion of the striking operation.

14. In a clock, the combination with the hour arbor, an electromagnet and striking lever and a main actuating means, of a gage mounted on said arbor, a strike controller rack comprising an hour segment or rack and a minute segment or rack adapted to be thrown into engagement with said gage, means actuated by the striking lever for returning the said segments or racks to normal positions, contact pieces electrically connected with said magnet, a circuit governor comprising parallel members, a circuit closing device mounted on one of said members and adapted to be actuated by said main actuating means, means carried by the hour segment or rack for moving one of said members of the circuit governor to carry the circuit closing device into inoperative position and for moving the other of said members into the path of engagement with said main operating means to hold said circuit operating device temporarily in inoperative position upon the return of the hour segment or rack to normal position, means carried by the minute segment or rack for moving one of said members of the circuit governing device to carry into and hold in operative position the circuit closing device at the completion of the return of said minute segment or rack to normal position.

15. In a clock, the combination with an hour arbor, a striking lever, an electromagnet for actuating said lever and circuit closing means, of a stop gage mounted on said arbor, a strike controlling rack adapted to be thrown into engagement with said gage and to be returned to normal position by said striking lever, and means for automatically returning said rack to normal position upon failure of said magnet to operate said lever.

16. In a clock, the combination with an hour arbor, a striking lever, an electromagnet for actuating said lever and circuit closing means, of a stop gage mounted on said arbor, a strike controlling rack adapted to be thrown into engagement with said gage and to be returned to normal position by said striking lever, and a curved plate adapted to be also engaged by said rack and coöperating with said gage to force said rack back to normal position upon failure of said magnet to actuate said lever.

17. In a clock, the combination with an hour arbor, a striking lever, an electromagnet for actuating said lever, a stop gage mounted on said arbor, a strike controlling rack adapted to be thrown into engagement with said gage and returned to normal position by said striking lever, means for resetting the clock hands and means actuated by said resetting means for returning said rack to normal position.

MONNOSUKE HIGUCHI.

Witnesses:
WM. P. HAMMOND,
ELIAS GOLDBERG.