Jan. 7, 1941. A. C. HANSCH ET AL 2,227,856

AUTOMATIC INTERVAL TIMING MECHANISM

Filed Dec. 21, 1938 8 Sheets-Sheet 1

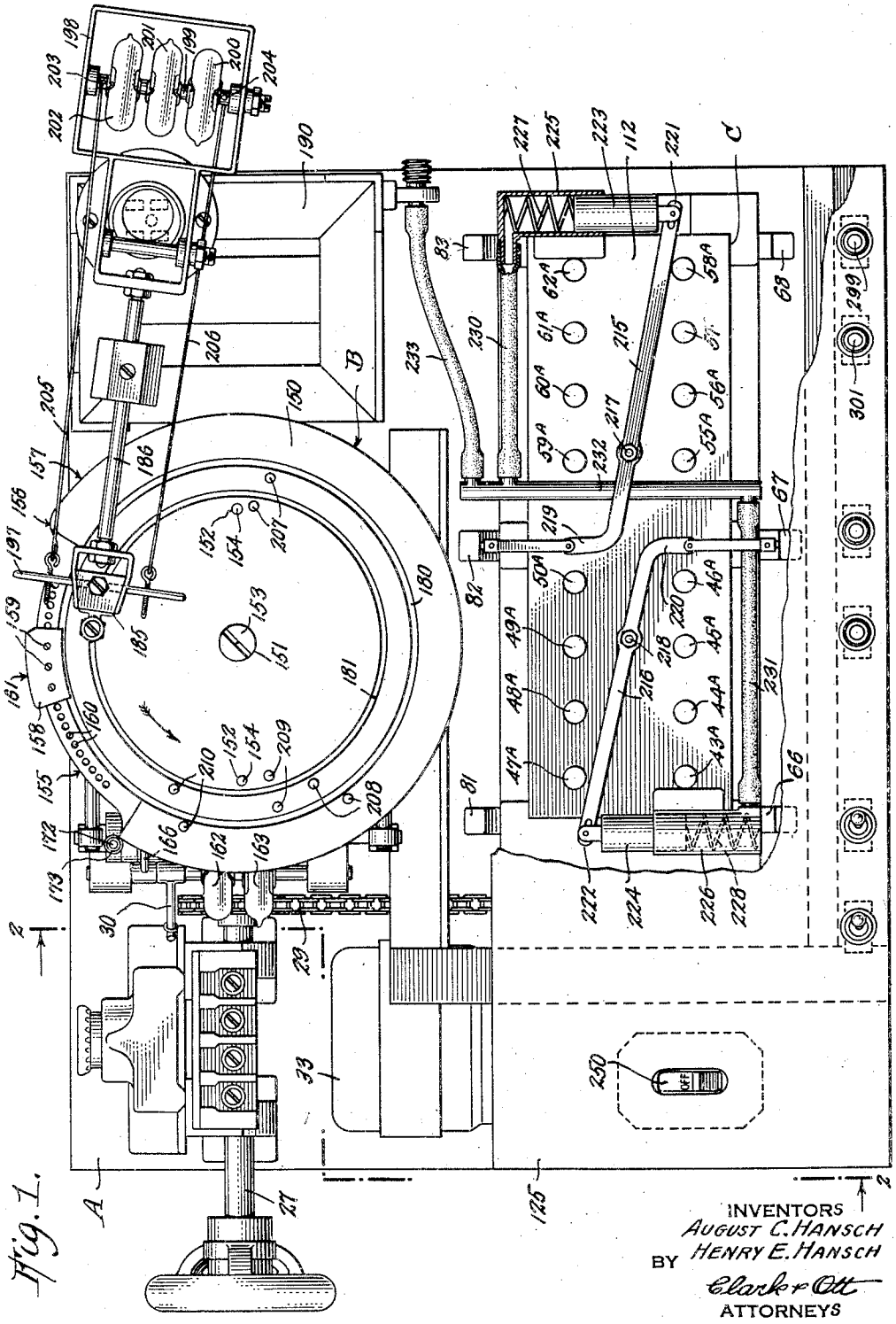


Fig. 1.

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AUTOMATIC INTERVAL TIMING MECHANISM

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Fig. 2.

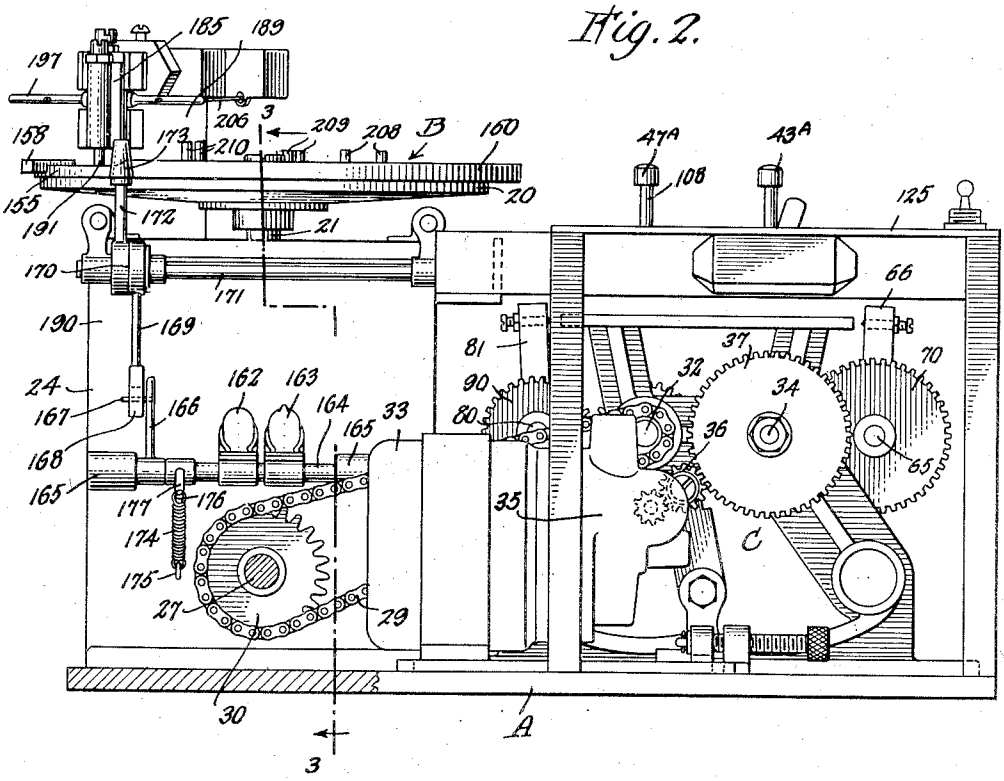
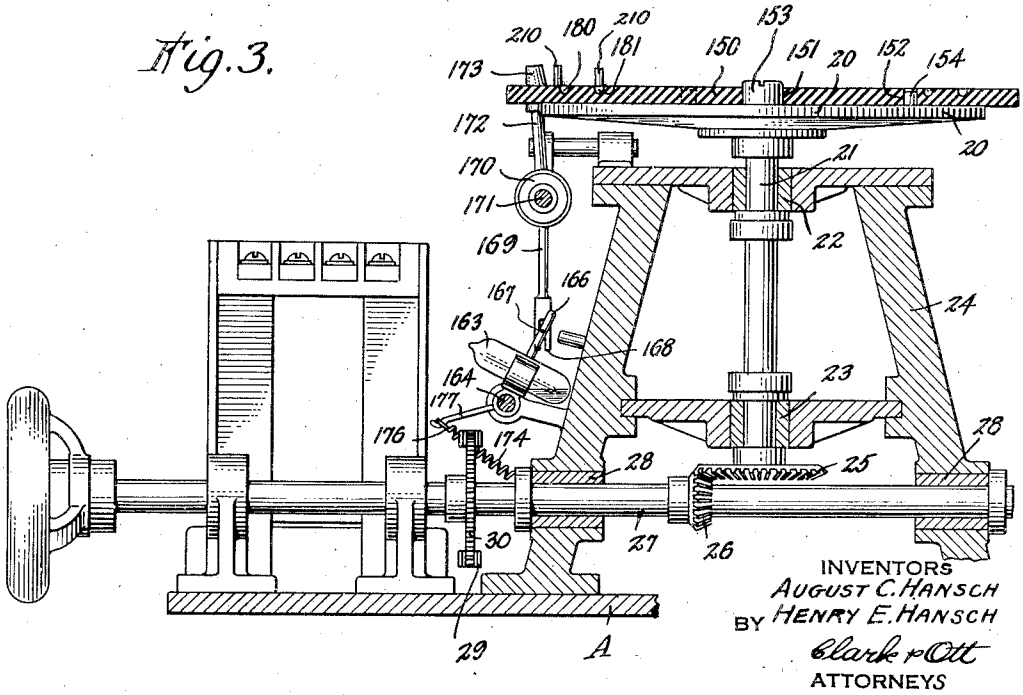


Fig. 3.



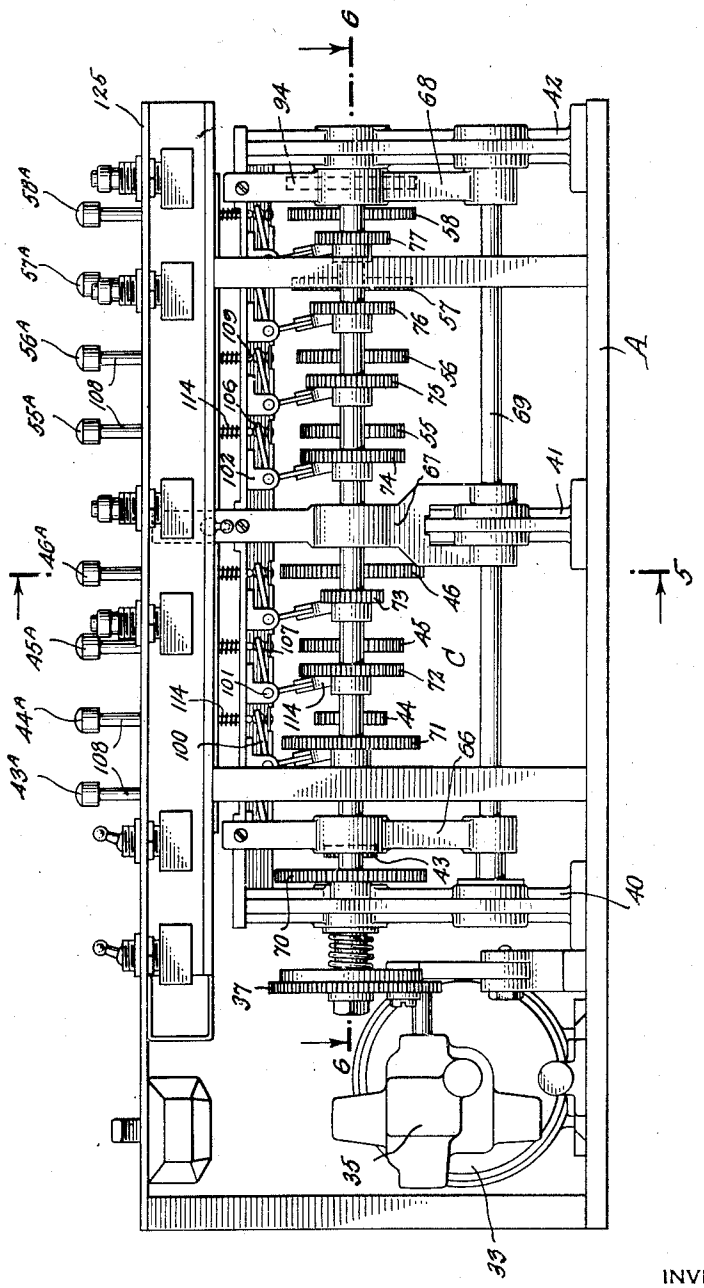
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AUTOMATIC INTERVAL TIMING MECHANISM

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Fig. 4.



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Fig. 5.

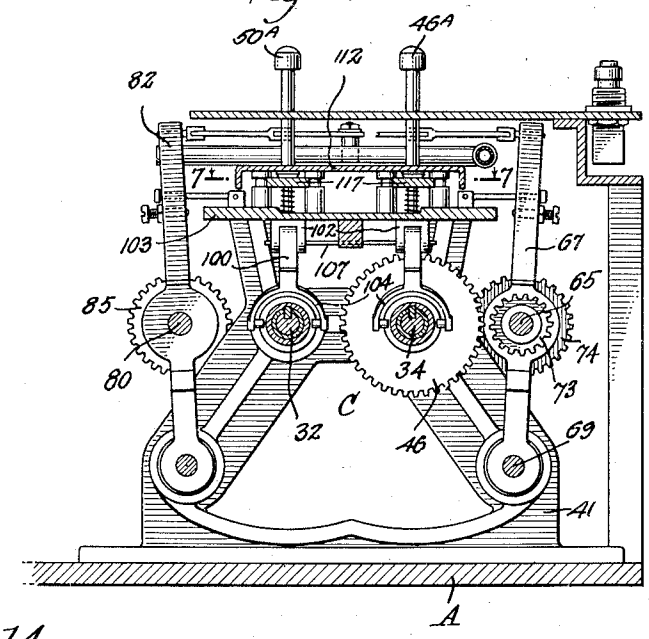
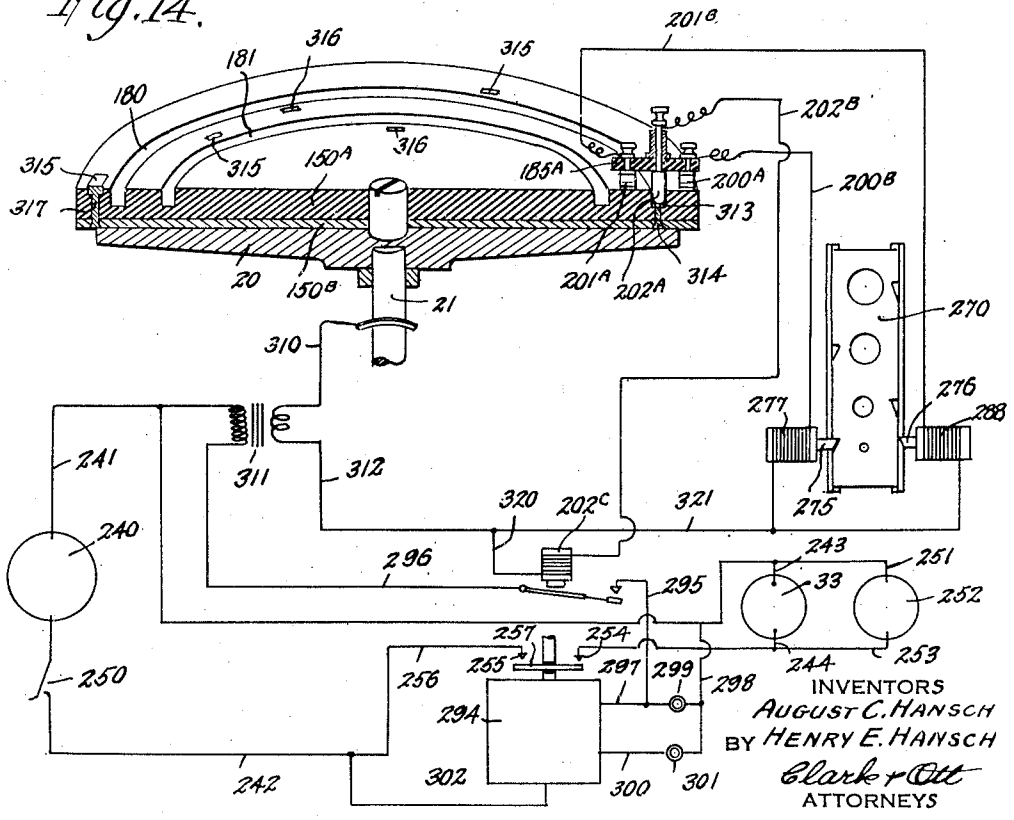


Fig. 14.

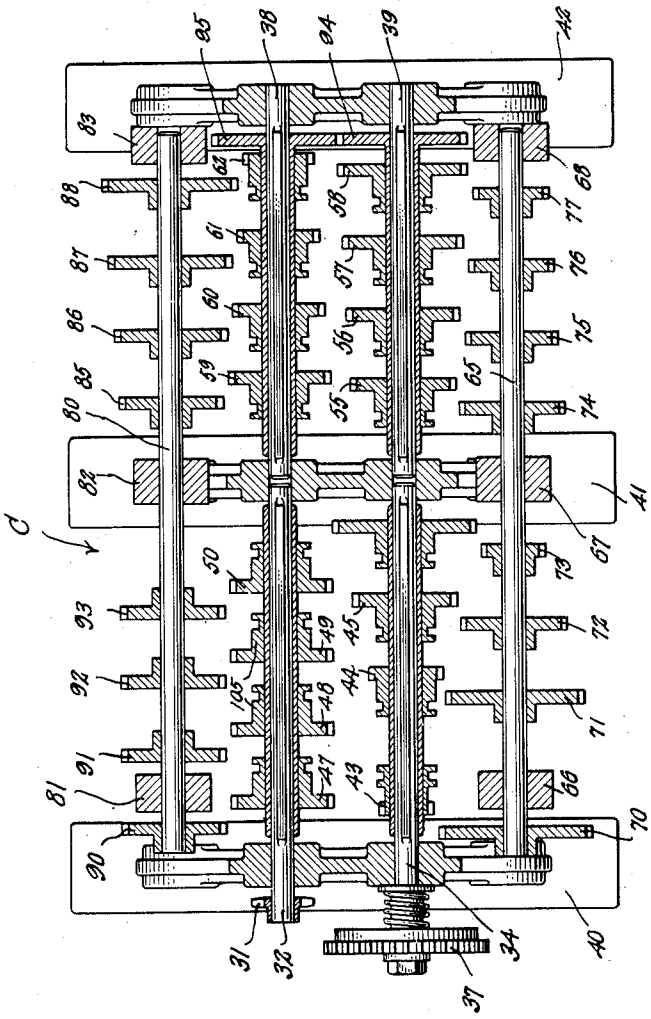


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AUTOMATIC INTERVAL TIMING MECHANISM

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Fig. 6.



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Fig. 7.

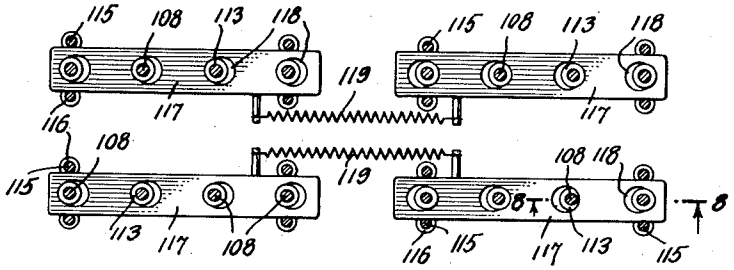


Fig. 8.

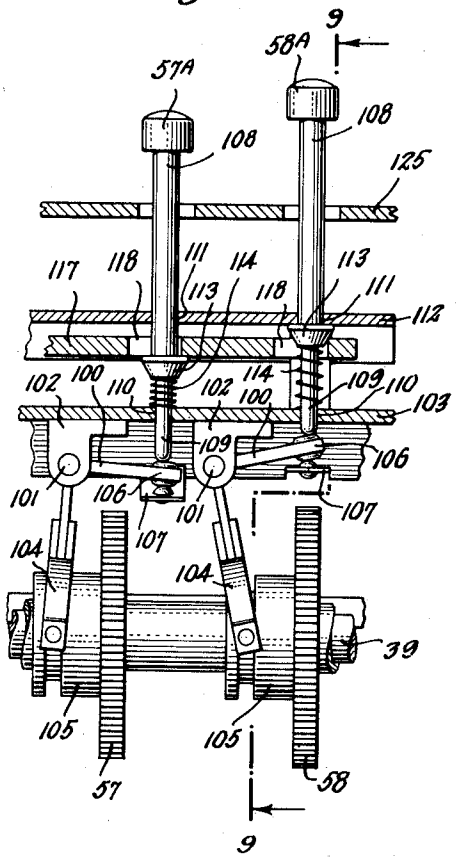
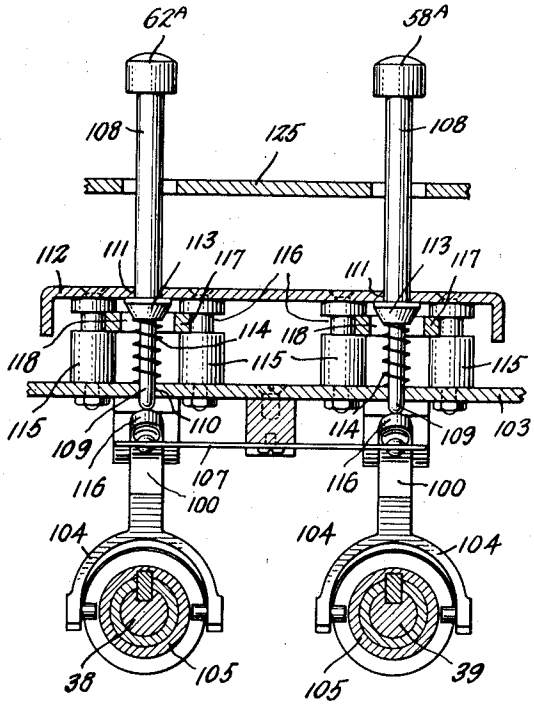


Fig. 9.



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AUTOMATIC INTERVAL TIMING MECHANISM

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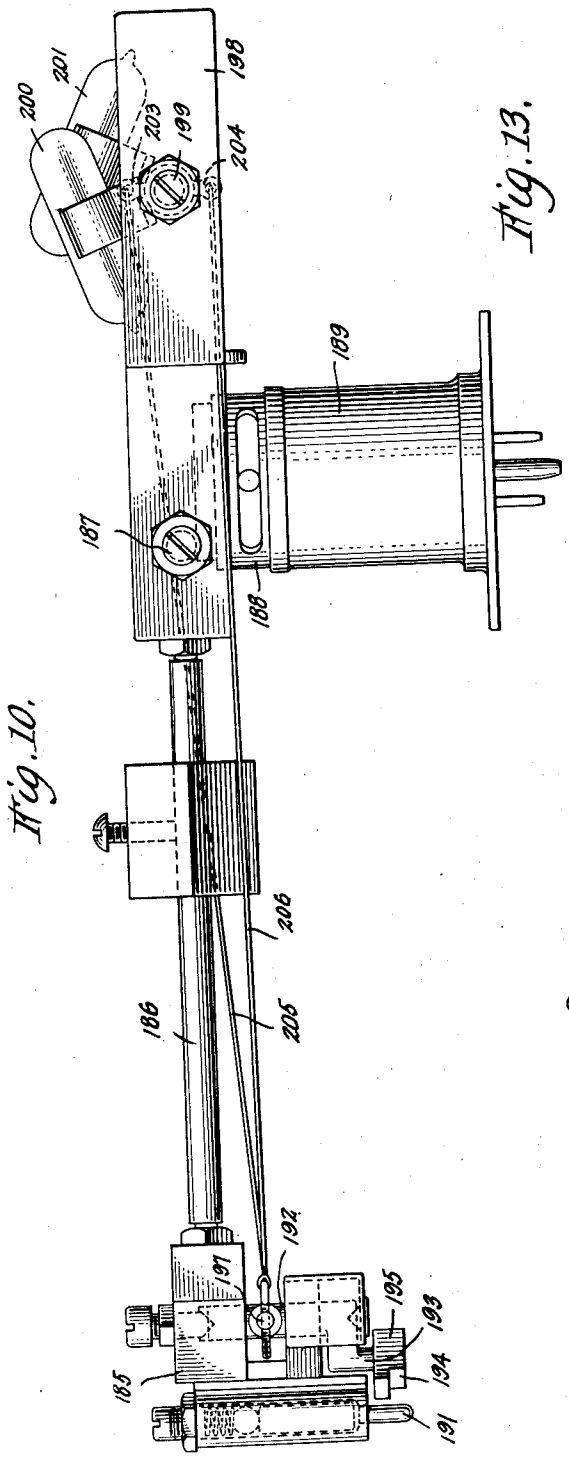


Fig. 10.

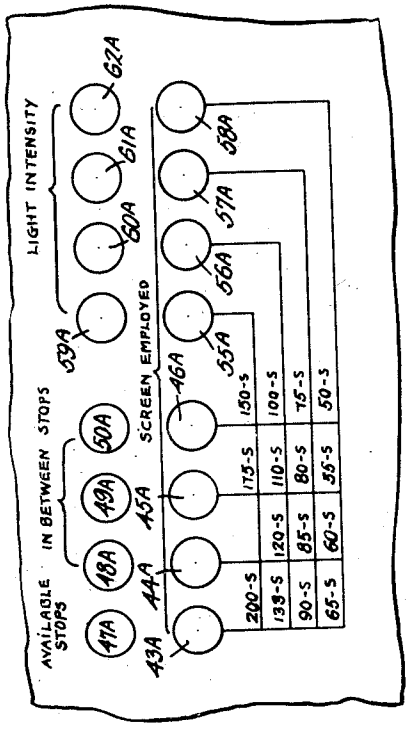


Fig. 13.

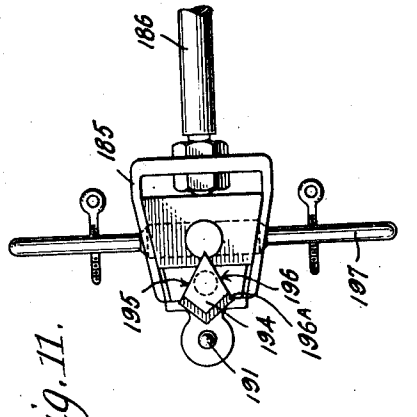


Fig. 11.

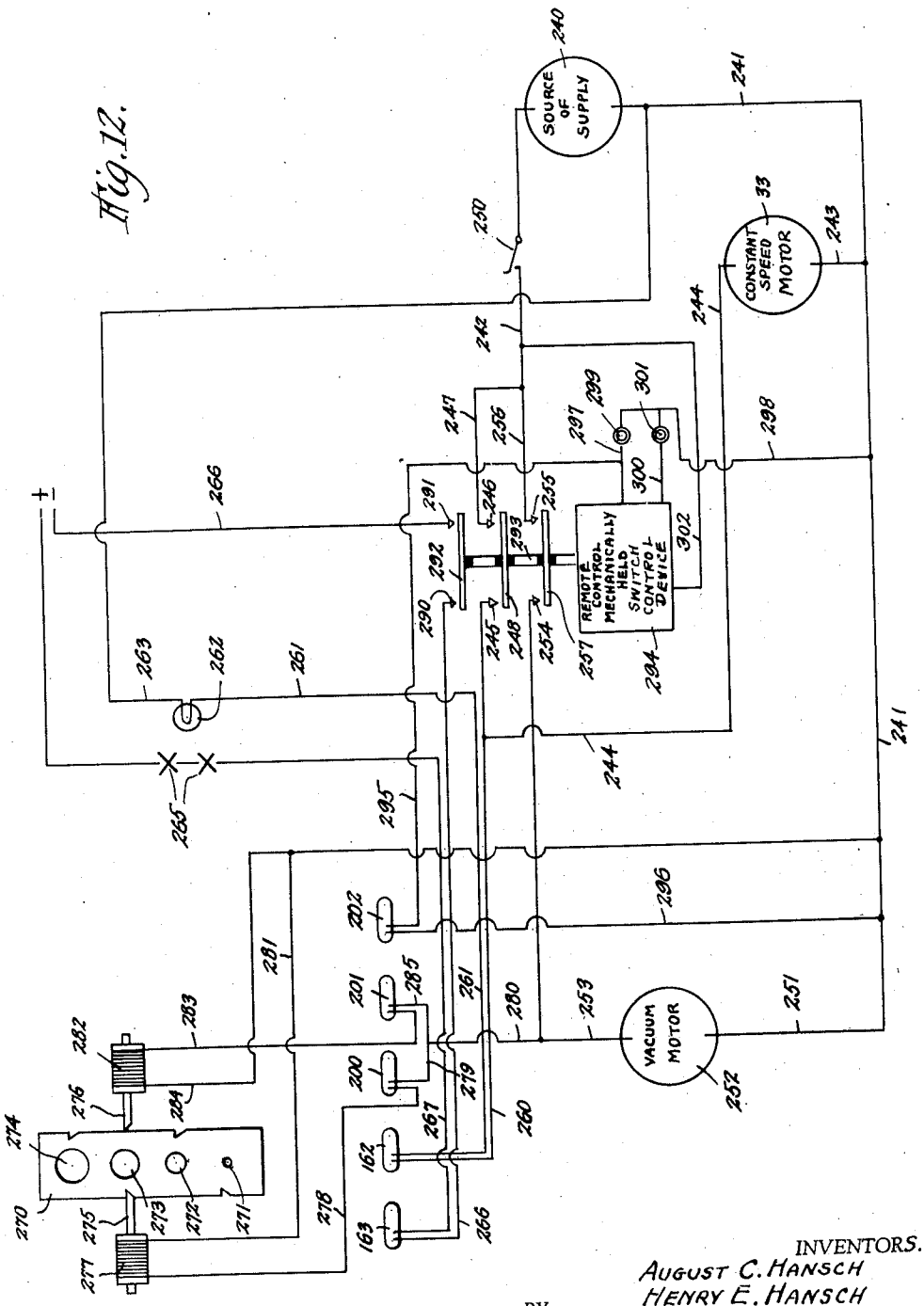
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AUTOMATIC INTERVAL TIMING MECHANISM

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Fig. 12.



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Patented Jan. 7, 1941

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UNITED STATES PATENT OFFICE

2,227,856

AUTOMATIC INTERVAL TIMING MECHANISM

August C. Hansch and Henry E. Hansch,
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Application December 21, 1938, Serial No. 247,049

12 Claims. (Cl. 161—1)

This invention relates to a time interval control apparatus for actuating one or more mechanisms at a plurality of predetermined time intervals and while not limited thereto is applicable to the automatic timing of the composite exposure in the production of screen negatives.

The invention has particular reference to an apparatus for accurately and automatically converting the combined effects of a number of variable factors into a plurality of predetermined time intervals.

The invention comprehends an apparatus responsive to the predetermined selective setting of a variable speed mechanism functioning to operate a predetermined actuator thereby effecting an actuation of a mechanism at a plurality of predetermined time intervals.

The invention, as applied to the production of screen negatives, further resides in an apparatus of the indicated character wherein a plurality of actuators cooperate with a variable speed mechanism for causing the actuators to operate mechanism thereby effecting a change of lens stops at standard intervals of time in the photographic reproduction of an original of predetermined standard tonal range, at unity magnification ratio, with the screen and light intensity upon the original of predetermined standard and means for varying the duration of the intervals of exposure proportionate to modifications from the standards due to the required original, magnification ratio and screen and actual light intensity upon the original.

The invention, in its application to the production of screen negatives, further provides means for selectively receiving and supporting any one of a plurality of interchangeable actuators having control elements positioned at predetermined spaced distances for effecting the duration of time intervals during the exposure of screen negatives.

The invention further embodies in an apparatus of the character set forth a plurality of banks of gears, each bank having a set of manipulator buttons adapted to conveniently shift the gears so that the same cooperatively function to effect any one of a plurality of definite speeds for the movement of the actuator with means for precluding the shifting to active position of more than one gear of each bank.

With the above enumerated and other objects in view, the invention is more fully disclosed in the following specification and illustrated in the accompanying drawings in which:

Fig. 1 is a top plan view of the time interval control apparatus constructed in accordance with the invention with parts broken away and shown in section to disclose the underlying structure.

Fig. 2 is a transverse sectional view taken approximately on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary vertical sectional view taken approximately on the line 3—3 of Fig. 2.

Fig. 4 is a side view of the variable speed drive mechanism.

Fig. 5 is a transverse sectional view therethrough taken approximately on the line 5—5 of Fig. 4.

Fig. 6 is a horizontal sectional view thereof taken approximately on the line 6—6 of Fig. 4.

Fig. 7 is a detail horizontal sectional view of the push button detent bars taken approximately on the line 7—7 of Fig. 5.

Fig. 8 is an enlarged sectional view taken approximately on the line 8—8 of Fig. 7, illustrating the push button control mechanism for shifting the gears.

Fig. 9 is a sectional view taken approximately on the line 9—9 of Fig. 8.

Fig. 10 is an enlarged detail side view of the timer head and supporting arm therefor.

Fig. 11 is a fragmentary enlarged bottom plan view of the timer head.

Fig. 12 is a view of the wiring diagram of the time interval control apparatus.

Fig. 13 is a fragmentary diagrammatic view of the push button control for the gearing illustrating indicia for guiding the operator in using the same.

Fig. 14 is a diagrammatic view of a modified form of actuator mechanism.

Referring to the drawings by characters of reference, the apparatus includes a base A upon which is mounted an actuator mechanism designated generally by the reference character B and a variable speed drive mechanism therefor designated generally by the reference character C. The actuator mechanism includes a turn table 20 which is secured to the upper end of a vertical shaft 21 journaled in bearings 22 and 23 of a frame work 24 supported on the base. The shaft 21 has secured to its lower end a miter gear 25 meshing with a miter pinion 26 secured to a shaft 27 journaled in aligned bearings 28 of the frame work 24. Motion is transmitted from the variable speed gearing mechanism C to the shaft 27 by means of a sprocket chain 29 trained around a sprocket 30 on the shaft 27 and a sprocket 31 which is secured to the out-put shaft 32 of the variable speed gearing mechanism C.

A constant speed motor 33 is connected to and

drives the in-put shaft 34 of the variable speed gearing mechanism C through the medium of suitable gearing in the reduction gear box 35 driving an idler gear 36 which meshes with a gear 37 on the in-put shaft 34.

The variable speed gearing mechanism includes, in addition to the out-put and in-put shafts 32 and 34, which are arranged in parallel relation, a pair of shafts 38 and 39 respectively, disposed in axial alignment with the shafts 32 and 34 and the said shafts 32, 34, 38 and 39 are journaled in frame brackets 40, 41 and 42 for independent rotation with reference to each other. The in-put shaft 34 has splined thereon for rotation therewith a plurality of slidable gears, four being shown in the present instance and designated by the reference characters 43, 44, 45 and 46. The gears are of successively increasing size and are adapted to be shifted axially of the shaft in opposite directions to active and inactive positions. The out-put shaft 32 has splined thereon for rotation therewith a plurality of gears, four being shown in the present instance and designated by the reference characters 47, 48, 49 and 50, the gears being of successively increasing size and adapted to be shifted axially of the shaft 32 in opposite directions to active and inactive positions.

The shaft 39 which is disposed in alignment with the in-put shaft 34 has splined thereon for rotation therewith, a plurality of gears, four being shown in the present instance, designated by the reference characters 55, 56, 57 and 58, said gears being of successively increasing size and adapted to be shifted axially of the shaft 39 in opposite directions to active and inactive positions. The shaft 38 which is disposed in alignment with the out-put shaft 32 has splined thereon for rotation therewith a plurality of gears, four being shown in the present instance and indicated by the reference characters 59, 60, 61 and 62, said gears being of successively decreasing size and adapted to be shifted axially of the shaft 38 in opposite directions to active and inactive positions.

The variable speed drive mechanism further includes a shaft 65 parallel to and extending longitudinally alongside of the shafts 34 and 39, said shaft being journaled in the rock arms 66, 67 and 68 which are fulcrumed on a longitudinally extending rod 69 which is carried by the frame brackets 40, 41 and 42 respectively, and are adapted for lateral swinging movement. The shaft 65 has secured thereon for turning movement therewith two sets of gears, each set corresponding in number to the slidable gears on the in-put shaft 34 and the slidable gears on the shaft 39 respectively. The first set of gears includes the gears 70, 71, 72 and 73 with which the gears 43, 44, 45 and 46 are adapted to mesh when the latter are shifted to active position. The gears 70 to 73 inclusive, decrease in size and consequently vary the relative speed of rotation of the shaft 65 with reference to the in-put shaft 34. The second set of gears includes the gears 74, 75, 76 and 77 which are successively of decreasing size and with which the gears 55, 56, 57 and 58 are adapted to respectively mesh when said latter gears are shifted to active position, so as to vary the relative speed of rotation of the shaft 39.

Arranged at the opposite side of the variable speed gear transmission is a shaft 80 which extends longitudinally of and parallel to the out-put shaft 32 and the shaft 38. The shaft 80 is journaled for rotation in rock arms 81, 82 and 83 which are fulcrumed in the frame brackets 40, 41 and 42 for lateral swinging movement. A pair of sets of gears are secured on the shaft 80 for rotation therewith, the sets of gears corresponding in number to the gears on the shaft 38 and the gears on the shaft 32 respectively. The gears 85, 86, 87 and 88 are of successively increasing size and are adapted to have respectively meshed therewith the gears 59, 60, 61 and 62 of the shaft 38 when the latter are shifted to active position to thereby vary the speed of rotation of the shaft 80. The remaining set of gears on the shaft 80 include the gears 90, 91, 92 and 93 which are of successively decreasing size and adapted to have meshed therewith the gears 47, 48, 49 and 50 on the out-put shaft 32 when said latter gears are shifted to active position so as to vary the speed of rotation of the out-put shaft 32. Motion is transmitted from the shaft 39 to the shaft 38 by a pair of meshing gears 94 and 95 keyed respectively to the shafts 39 and 38.

In order to provide means for shifting the gears of the groups 43 to 46 inclusive, 47 to 50 inclusive, 55 to 58 inclusive, and 59 to 62 inclusive, a bell crank lever 100 is provided for each gear which is fulcrumed at 101 to a bracket 102 depending from an overhead plate 103 supported by the frame brackets 40, 41 and 42. Each bell crank lever is formed with a depending forked terminal 104 which engages with the grooved hub 105 of the gears. The terminal 106 of the horizontal arm of each bell crank is normally urged upwardly by a leaf spring 107 to normally shift the gears to an inactive position. The bell crank levers 100 are swung to move the gears to an active position by means of a vertical push rod 108, the lower reduced portion 109 of which is mounted for guided movement through openings 110 in the plate 103 and the upper portion of which is mounted for guided movement in an opening 111 in a plate 112 superposed with reference to the plate 103, the lower terminal of the reduced lower portion 109 engaging with the terminal 106 of the horizontal arm of the bell crank lever. Each push rod is provided at the juncture of the reduced lower end 109 with the upper portion thereof with a frusto-conical collar 113 which tapers downwardly and a coiled expansion spring 114 surrounds the lower reduced portion 109 and is interposed between the collar 113 and the plate 103 for the purpose of normally raising the push rod 108 until the collar 113 engages the underside of the superposed plate 112.

The superposed plate 112 is supported from and spaced above the plate 103 by longitudinally spaced pairs of studs 115 for each longitudinal row of push rods 108. The studs are grooved at 116 to guidedly support a detent bar 117, one of which detent bars is provided for each group of gears 43 to 46 inclusive, 47 to 50 inclusive, 55 to 58 inclusive and 59 to 62 inclusive. The detent bar is provided with an aperture 118 for each push rod 108 of the group, said aperture being of a size to permit the frusto-conical collar 113 to freely pass therethrough. The detent bars are normally urged longitudinally in one direction and tensioned against movement in the opposite direction by means of a coiled contractile spring 119, in the present instance two springs 119 being employed, one for each pair of longitudinally aligned detent bars and interconnected therewith. It thus follows that when any one of the push rods 108 of a group of gears is depressed against the action of its spring 114, the lower

terminal thereof engaging the terminal 106 of the horizontal arm of the bell crank 100 swings the same downwardly against the action of the leaf spring 107 and by means of the shifting fork terminal 104, shifts the gear of said bank to active position to mesh with its respective gear on the shaft 65 or 80 respectively. As the push rod 108 moves downwardly, the detent bar 117 will be cammed longitudinally by the tapered face of the collar 113 until the upper surface of the collar is disposed below the undersurface of the detent bar. The spring 119 will then function to shift the detent bar 117 longitudinally in the opposite direction to retain the push rod 108 in its lowered position and thereby hold the gears in mesh.

By this construction the possibility of more than one gear of a group being meshed is precluded due to the fact that the longitudinal shifting of the detent bar by the depression of one push rod 108 will automatically effect the release of any previously depressed push rod and the resultant shifting of its gear to an inactive position. The push rods 108 extend upwardly through openings in a cover plate 125 and are provided at their upper ends with enlarged push buttons which buttons are respectively identified with their corresponding gears by the reference characters 43A to 46A; 47A to 50A; 55A to 58A and 59A to 62A.

The actuating mechanism B further includes a plurality of timer disks 150 each of which is provided with a central opening 151 and circumferentially spaced openings 152, the central opening being adapted to receive an upwardly projecting center stud 153 and the circumferentially spaced openings 152 being adapted to receive the studs 154 so as to center the disks on and connect the same with the turn table for turning movement therewith.

The outer edge of each timer disk 150 is provided with a circumferentially extending recessed edge 155 which terminates in a cam portion 156 merging into the outer periphery 157 of the disk. A cam lug 158 is secured to the disk 150 for circumferential adjustment thereon by means of screws 159 extending through openings 160. The outer arcuate edge 161 of the cam lug 158 is disposed intermediate of and concentric with the recessed edge 155 and the outer periphery 157 of the timer disk.

A pair of mercury switches 162 and 163 are carried by a transverse rock shaft 164 which is journaled in bearing brackets 165 on the framework 24. The mercury switches are set at relatively different angles at a tangent to the shaft so that when the shaft is rocked in opposite directions from an intermediate position with both switches off the switches will be selectively moved to their closed positions. The rock shaft 164 is provided with a radial arm 166 provided with a laterally projecting pin 167 which is engaged by the bifurcated terminal 168 of the arm 169, of a rock lever 170 fulcrumed on a transverse rod 171 mounted in brackets on the framework 24. The opposite arm 172 of the rock lever 120 is provided at its free terminal with a roller bearing 173 which is adapted to be normally swung towards the periphery of the disk by means of a coiled spring 174 which is anchored at one terminal 176 connected to the radial arm 177 carried by the rock shaft 164. When the roller bearing 173 is in engagement with the outer arcuate edge 161 of the cam lug 158, the rock shaft 164 is in a neutral position so that both of the mercury switches 162 and 163 are inactive, thereby opening the circuits which they control. When the disk 150 is rotated in a counterclockwise direction, as indicated by the arrow in Fig. 1, the roller bearing terminal 173 will be moved by the spring 174 into contact with the recessed edge 155 thereby rocking the rock shaft 164 to a position whereby the mercury switch 162 will be actuated to close its circuit. Continued turning movement of the disk 150 will cause the roller bearing terminal 173 to be swung outwardly as it rides over the cam portion 156 until it engages the outer periphery 157 of the disk 150. This will effect the rocking of the rock shaft 164 and the movement of the mercury switches to a position whereby the switch 162 will be disposed in an inactive position, while the switch 163 will be disposed in an active position.

Each timer disk 150 is provided with one or more concentric grooves in the upper surface thereof, two being shown in the present instance, namely an outer groove 180 and an inner groove 181. The actuator mechanism also embodies a timer head, designated generally by the reference character 185 which is carried by one terminal of an arm 186 which is fulcrumed at 187 to an annulus 188 swiveled in the upper end of a tubular bearing element 189 which bearing element is detachably mounted on a juncture box 190. The timer head is provided with a depending stylus pin 191 adapted to be selectively engaged in the guide grooves 180 and 181. The timer head has journaled therein for turning movement, a vertical crank shaft 192 which is provided with a crank terminal 193 at its lower end formed with a head 194 having oppositely beveled faces 195 and 196, and said crank shaft has secured thereto a cross rod 197. The tail portion 198 of the arm 186 has journaled transversely therein a rock shaft 199 by which is carried a plurality of mercury switches 200, 201, 202 which are set at relatively different angles and at a tangent to the shaft 199 so that when the shaft is rocked in opposite directions from a normal intermediate position wherein all switches are off, the switches will be selectively moved to positions to close their circuits in the manner hereinafter described.

In order to impart rocking motion to the rock shaft 199, the said shaft is provided with an upwardly projecting radial arm 203 adjacent one end thereof and with a downwardly projecting radial arm 204 adjacent the opposite end thereof which arms are respectively connected by cables 205 and 206 to opposite terminals of the cross rod 197.

The timer disk 150 is provided with upstanding timer head control pins circumferentially spaced thereon adjacent to and on opposite sides of each groove 180 and 181 which are adapted, as the disk is turned in the counter-clockwise direction, to contact with the beveled faces 195 and 196 of the crank terminal head 185. The first timer head control pin 207 which is on the inner side of the groove 180 engages with the beveled face 195 and effects the turning of the crank shaft 192 and the cross rod 197 in a direction to rock the rock shaft 199 to cause the mercury switch 200 to be actuated momentarily to close its circuit while the control pin is in contact with the beveled face thereof. The second timer head control pin 208 is disposed on the outer side of the groove 180 to engage the opposite beveled face 196 of the crank terminal head 194 to turn the crank shaft 192 in a direction to swing the cross rod 197 so as to rock the rock shaft 199 in a direction to cause the

switch 201 to be moved to a position to momentarily close its circuit while the control pin is in contact with the beveled face, the other switches remaining open. The next following timer head control pin 209 which is disposed on the inner side of the groove 180 is adapted to engage the beveled face 195 of the crank terminal head 194 to actuate the mercury switch 200 to momentarily close its circuit, while the other switches remain open. The final timer head control pin 210 which is on the outer side of the groove 180 engages with the beveled face 196 and effects the turning of the crank shaft 192 and the cross rod 197 in a direction to rock the rock shaft 198 to close the mercury switch 201, the movement being sufficient to also cause the mercury switch 202 to close its circuit, while the mercury switch 200 remains open.

The shafts 65 and 80 are normally moved laterally to dispose the gears out of meshing position with the gears on the shafts 32, 34, 38 and 39, and said shafts are moved laterally inward to meshing position by a suitable mechanism which includes a pair of levers 215 and 216 which are respectively fulcrumed at 217 and 218 to the plate 112, the angular terminals 219 and 220 of which are respectively connected with the intermediate rock arms 82 and 67. The opposite terminals 221 and 222 of the levers 215 and 216 are connected with plungers 223 and 224 slidable in fixed cylinders 225 and 226. Coiled expansion springs 227 and 228 are arranged within the cylinders to exert a tension against the plungers for the purpose of normally swinging the levers in a direction to effect the movement of the shafts 65 and 80 laterally outward to a position to dispose the gears thereon in a non-meshing position with the gears on the shafts 32, 34, 38 and 39.

Conduits 230 and 231 communicating with the cylinders 225 and 226 and with a manifold 232 which in turn communicates with a suction pipe 233 connected with and leading to a suitable source of suction whereby when suction is applied a partial vacuum is created in the cylinders 225 and 226 to swing the levers 215 and 216 in a direction to move the shafts 65 and 80 laterally inward whereby the gears on the shafts 65 and 80 are in a position to permit of the meshing of the gears on the shafts 32, 34, 38 and 39 therewith. When the suction is discontinued, the springs 227 and 228 function to swing the levers in a position to rock the shafts 65 and 80 outwardly as hereinbefore described.

The apparatus further includes an electrical circuit in which 240 represents a source of supply from the opposite sides of which circuit wires 241 and 242 lead. From the circuit wire 241 a branch conductor 243 leads to the constant speed motor 33. A return wire 244 leads from the motor 33 to the contact 245 spaced from a contact 246 from which a wire 247 leads to the other circuit wire 242. A bridge piece 248 is adapted to close the motor circuit when it engages the contacts 245 and 246 and when the manually operated switch 250 in the circuit wire 242 is closed. The circuit wire 241 extends to and is connected with a branch wire 251 which connects with a vacuum motor 252 providing the source of suction for the suction pipe 233. A conductor 253 leads from the vacuum motor 252 to a contact 254 and a spaced contact 255 is connected by a wire 256 with the circuit wire 242. A bridge piece 257 is adapted to close the vacuum motor circuit when the switch 250 is closed and the bridge engages the contacts 254 and 255.

The mercury switch 162 which in the present disclosure of the invention is designed to control the operation of the flash exposure in the production of screen negatives has one terminal thereof connected by a conductor 260 to the conductor 244, while a second conductor 261 leads therefrom to the flash lamp 262. A conductor 263 leads from the flash lamp 262 to the circuit wire 241. The arc lamps 265 which are included in a circuit having a separate source of supply have conductors 266 and 267 leading from the mercury switch 163.

The stop plate 270 having a plurality of stop openings 271, 272, 273 and 274, for the flash, detail, highlight and middletone stops, is controlled by oppositely disposed solenoid operated latches 275 and 276 and the solenoid 277 controlling the latch 275 is connected with the mercury switch 200 by a circuit wire 278 leading from one of the contacts of said mercury switch 200 to the solenoid, while the other mercury switch contact is connected by a circuit wire 279 through a branch wire 280 with the wire 253 which leads to the source of supply 240 through the circuit wire 242. A wire 281 leads from the solenoid 277 and connects with the other circuit wire 241. The mercury switch 201 which controls the solenoid 282 for operating the stop plate latch 276 has one of its contacts connected by a conductor 283 with the solenoid 282, the other side of which solenoid is connected by a wire 284 with the wire 281 which leads to the circuit wire 241. The other contact point of the mercury switch 201 is connected by a circuit wire 285 with the branch wire 280 in turn connected with the wire 253 leading to the source of supply 240 through the circuit wire 242.

The arc lamp circuit wire or conductor 266 is provided with spaced contacts 290 and 291 which are adapted to be bridged by a bridge piece 292. The bridge pieces 248, 257 and 292 are attached to and insulated from a shift rod 293, the movement of which in opposite directions to make and break the circuits is effected by means of a remote control mechanically held switch operating device 294 which may be of any of the well known types which are now in general use.

In the present instance, the device 294 is remotely controlled by means of the mercury switch 202 from the contacts of which respectively lead the circuit wires 295, and 296, the former connecting with a conductor 297 and the latter connected with the wire 241. The conductor 297 which leads into the device 294 is connected with a feed wire 298 and is controlled by a push button switch 299. A second input wire 300 extends from the feed wire 298 into the device 294 and is provided with a push button switch 301. A return wire 302 leads from the device 294 and is connected with the conductor 242.

In use and operation of the apparatus as applied to the production of screen negatives, a plurality of stop plates 270 having flash, detail, highlight and middletone stop openings varying in size, are adapted to be selectively employed and a plurality of timer disks 150 are selectively utilized. The operator initially selects one of the plurality of stop plates 270 as required by screen and camera extension employed, which stop plate may be regarded as standard. The proper timer disk is also selected as required by tonal range of the copy being reproduced and positioned on the

turn table 20, the stylus pin 191 being positioned in the proper groove 180 or 181 as the case may be. The push buttons 43A, 47A, 56A and 59A are then depressed to set the gears of the variable speed drive mechanism for operation at standard and a switch 301 is closed to start the motor and effect operation of the apparatus, it being understood that the main switch 250 is closed at the beginning of the day.

The initial movement imparted to the turn table to turn the same together with the timer disk 150 in the direction of the arrow in Fig. 1 causes the roller bearing terminal 173 which is initially positioned against the outer arcuate edge 161 of the cam lug 158 of the rock lever 170 to move radially inward with reference to the timer disk until said bearing terminal engages the recessed edge 155, thus rocking the mercury switch 162 to a position to close the circuit to the flash lamp 262 which illuminates the film through the flash stop opening 271 in the stop plate 270. Continued rotation of the timer disk 150 in the direction of the arrow causes the cam portion 156 to engage with the bearing terminal 173 of the rock lever 170 and swing the same in a direction to rock the mercury switch 162 in the opposite direction to break the circuit to the flash lamp terminating the flash exposure. Simultaneously, with the termination of the flash, the swinging movement of the rock lever 170 rocks the mercury switch 163 to a position to close the circuit to the arc lamps 265, thereby illuminating the surface of the copy being reproduced. The arc lamp circuit remains closed through the complete balance of the cycle of operation due to the fact that the bearing terminal 173 retains the mercury switch in this position through engagement with said bearing terminal with the outer periphery 157 of the timer disk.

As the timer disk continues to rotate, the stylus pin 191 engaging in the groove 181, as illustrated, guides the beveled face 195 of the crankshaft head 194 into engagement with the first timer head control pin 207 and effects the turning of the crankshaft 192 and the cross rod 197 in a direction to rock the rock shaft 199 thereby causing the mercury switch 200 to be actuated to close its circuit to the electro-magnet 277 and allowing the stop plate 270 to drop until the latch 276 engages in the notched edge of the stop plate so as to expose the film through the detail stop opening 272.

Continued rotation of the timer disk 150 causes the beveled face 195 to disengage the first control pin 207 thereby rocking the mercury switch 200 to its neutral position. The beveled face 196 of the crank terminal head 194 is then engaged by the next succeeding timer head control pin 208 which rocks the rock shaft 199 in the opposite direction to close the mercury switch 201 controlling the circuit to the magnet 282 thereby releasing the latch 276 and allowing the stop plate to drop until it is engaged by the latch 275 to expose the film through the highlight stop opening 273.

When the second control pin has passed beyond the beveled face 196, the mercury switch 201 is restored to its normal position. Continued movement of the disk causes the beveled face 195 of the crank terminal head 191 to be engaged by the next succeeding timer head control pin 209 which again moves the mercury switch 200 to a position to close the circuit to the solenoid 277 for retracting the latch 275 and permitting the stop plate to drop until its notched edge is engaged by the latch 276 thereby completing the exposure of the film through the middletone stop opening 274.

When the final timer head control pin 210, which is of greater height than the pins 207, 208 and 209, engages the beveled face 196 of the crank terminal head 191, the rock shaft 199 is rocked in a direction to close the mercury switch 202. This is effected due to a greater throw of the rock shaft by the engagement of the upper end of the pin 210 with the extended upper portion 196A of the beveled face 196 of the crank terminal head 194. This closes the circuit to the remote control mechanically held switch operating device 294, the current flowing from the source of supply 240 to the wire 241, the wire 296, the mercury switch 202, the wire 295, the wire 297, the switch operating device 294 and thence through the wire 302 to the wire 242 leading to the other side of the source of supply 240. Assuming that the bridge pieces 248, 257 and 292 are in engagement with their respective contacts, the shift rod 293 will then be moved downwardly immediately upon closing the mercury switch 202 thereby simultaneously breaking all of the circuits to the vacuum motor, the constant speed motor and the arc lamps. After the cycle of operation of the apparatus is completed and the bridge pieces are in open relation to their contacts. The switch 301 is closed at the start of the production of each screen negative to effect the re-engagement of the bridge pieces with their contacts. This initiates the starting of the motors 33 and 252 and effects a re-operation of the device. The push button switch 299 may be utilized as a means for manually stopping the apparatus in lieu of the mercury switch 202.

In event the screen employed or the light intensity deviates from standard, other combinations of push buttons controlling the banks of gears are depressed which mesh the required gears and produce the speed to compensate for said variations. The correct push button of the remaining bank of gears is depressed so as to compensate for deviation from the standard or available sizes of stop openings and the required size of stop openings.

As illustrated in Fig. 13, the push buttons 43A to 46A and 55A to 58A are utilized for screen photography to set the gearing in accordance with the screen employed, and push buttons 43A to 46A are selectively depressed with the push buttons 55A to 58A for screens varying from fifty to two hundred lines to the inch, the combination of push buttons 43A and 56A being employed for standard screen of one hundred and thirty-three lines to the inch. In event any other screen is used, the diagram illustrates the combinations which are employed to set the gearing for a particular screen. For instance, if a screen having one hundred and seventy-five lines to the inch is used, push buttons 45A and 55A are depressed, while if a screen of eighty-five lines to the inch is used, push buttons 44A and 57A are depressed. When the light intensity is standard or one hundred percent, push button 59A is depressed, whereas if the light intensity deviates from standard one of the remaining push buttons 60A, 61A or 62A is depressed in accordance with the light intensity. Where the stops required are available, push button 47A is depressed and this is considered as standard, whereas if the stops required are in between those available, one of the remaining push buttons 48A, 49A or 50A is employed. For instance, if the stop openings required are of a size midway between two adja-

cent available stop plates, the push button 49A is used. Whereas, if the stop openings required are of a size which would fall between midway and the two adjacent available stop plates, the buttons 48A and 50A would be selectively used.

In lieu of the actuator mechanism A previously described, the invention comprehends a modified form thereof as illustrated in Fig. 14, wherein circuits to the electro-magnetic latches 275 and 276 are actuated by a low voltage. In this instance, the turn table 20, which is of a conducting material and secured to a shaft 21 of a conducting material, is adapted to selectively receive timer disks 150A of an insulation material having a bottom plate 150B of a conducting material which rests upon and contacts with the turn table 20. Each timer disk 150A has any number of annular stylus pin guide grooves 180 and 181 to receive the stylus pin contact element 202A carried by a timer head 185A of insulation material and from which stylus pin contact element a circuit wire 202B leads to an electro-magnetic switch 202C which controls the opening and closing of the circuit in which the remote control mechanically held switch control device 294 is arranged. The shaft 21 of the turn table has connected therewith, by a wiper contact, a conductor 310 which leads therefrom to one terminal of the low tension side of a transformer 311, the opposite terminal of which has a conductor 312 leading therefrom. The timer disk grooves are each provided on the bottom walls thereof at the stop position with a contact 313 which is connected by a conductor pin 314 with the bottom plate 150B. The timer disk is further provided at opposite sides of each of the grooves with contacts 315 and 316 circumferentially spaced thereabout and electrically connected by pins 317 with the bottom plate 150B.

The timer head 185A is provided with spring contact fingers 200A and 201A which are adapted to wipe over the upper surface of the timer disk 150A as the same rotates so that the low tension circuit is completed through the conductors 200B and 201B to the solenoids 277 and 288 which operate the electro-magnetic latches 275 and 276 which control the stop plate 270. In order to complete the low tension circuits to the various solenoids and magnets therein, a circuit wire 320 leads from the conductor 312 through the winding of the electro-magnetic switch 202C and a manifold circuit wire 321 leads from the conductor 312 to the solenoids 277 and 288 respectively. In all other respects the apparatus works in the manner set forth in the previous form of the invention, the only purpose of the modification is to provide the circuits directly controlled by the timer disk with low tension current.

What is claimed is:

1. In an apparatus of the character described, a driven actuator, a variable speed mechanism operatively connected to said actuator for driving the same, said mechanism including a plurality of manipulators for selectively establishing the speed of said actuator, and means responsive to the setting of certain of said manipulators for causing said actuator to move at a predetermined standard speed, means engageable with said actuator and responsive to the movement thereof for effecting the operation of a device at standard time intervals when said actuator is driven at said standard speed, and said mechanism further including means responsive to the selective setting of certain of the remaining manipulators for causing a variation in the speed of the actuator from said standard speed and for thereby varying from standard the time intervals of operation of said device.

2. In an apparatus of the character described, a driven actuator, a variable speed mechanism operatively connected to said actuator for driving the same, said mechanism including a plurality of sets of manipulators for selectively setting the same to drive said actuator at different speeds, and means responsive to the setting of one manipulator in each set of manipulators for driving said actuator at a predetermined standard speed, means engageable with said actuator and responsive to the movement thereof for effecting the operation of a device at standard time intervals when said actuator is driven at said standard speed, and said mechanism further including means responsive to the setting of any one of the remaining manipulators of said sets of manipulators for causing a variation in the speed of the actuator from standard and for thereby varying from standard the time intervals of operation of said device.

3. In an apparatus of the character described, a driven actuator, variable speed mechanism operatively connected to said actuator for driving the same, said mechanism including a plurality of independent banks of gears, and means for coupling one gear of each bank in series to drive said actuator at a standard speed, means engageable with said actuator and responsive to the movement thereof for effecting the operation of a device at standard time intervals when said actuator is driven at said standard speed, and said mechanism further including means for selectively coupling any one of the remaining gears of one bank in series with any one of the gears of the other banks for varying said speed of the actuator from standard and for thereby varying from standard the time interval of operation of said device.

4. In an apparatus of the character described, a driven actuator, said actuator including a plurality of control elements disposed at predetermined relative positions; a variable speed mechanism operatively connected to said actuator for driving the same, said mechanism including a plurality of manipulators for selectively setting the same to cause said mechanism to drive said actuator at different speeds, and means responsive to the cooperative setting of certain of said manipulators to cause said mechanism to drive said actuator at a predetermined standard speed; means having a cam head disposed in the path of movement of said control elements and actuated by engagement therewith for effecting the operation of a device at a plurality of successive standard time intervals when said actuator is driven at said standard speed and said mechanism further including means responsive to the setting of certain others of said manipulators so as to vary the speed of the actuator from standard and for thereby varying the time intervals of operation of said device.

5. In an apparatus of the character described, a rotary support, a timer disk adapted to be mounted upon said support to turn therewith; a variable speed mechanism operatively connected to said support for driving the same, said mechanism including a plurality of independent banks of gears, and means for coupling a certain gear of one bank in series with a certain gear of each of the remaining banks to drive said ro-

tary support and timer disk at a predetermined standard speed; said timer disk having a concentric guide track and a plurality of control elements spaced along said track; an electric circuit connected with a source of current supply; a plurality of switches arranged in parallel in said circuit; and a switch actuating mechanism having guided engagement with said guide track and including means disposed in the path of movement of said control elements for successive engagement therewith to actuate said switches so as to effect the opening and closing of said circuit and thereby effect the operation of a device for predetermined standard periods of time when said mechanism is driven at said standard speed.

6. In an apparatus of the character described, a rotary support; a timer disk adapted to be mounted upon said support to turn therewith; a variable speed mechanism operatively connected to said support for driving the same, said mechanism including a plurality of independent banks of gears, and means for coupling a certain gear of one bank in series with a certain gear of each of the remaining banks to drive said rotary support and timer disk at a predetermined standard speed; said timer disk having a concentric guide track and a plurality of control elements spaced along said track; an electric circuit connected with a source of current supply; a plurality of switches arranged in parallel in said circuit; a switch actuating mechanism having guided engagement with said guide track and including means disposed in the path of movement of said control elements for successive engagement thereby to actuate said switches to effect the opening and closing of said circuit and thereby effect the operation of a device for predetermined standard periods of time when said mechanism is driven at said standard speed, and said variable speed mechanism further including means for coupling any one of the remaining gears of one bank in series with any one of the gears of each of the other banks for varying said speed of the timer disk from standard so as to thereby vary the time of the opening and closing of said circuit by said switch actuating mechanism and the time intervals of the actuation of said device from said standard periods of time.

7. In an apparatus of the character described, a driven support, a variable speed mechanism for driving said support and including a plurality of independent banks of shiftable gears, means adapted to selectively couple together any one of the gears of one bank in series with any one of the gears of each of the other banks for driving said support at different speeds, a manipulator for each gear, and independent means engaging each gear and its manipulator for selectively shifting the gears to active position upon actuation of the manipulators, and means coacting with the manipulators of each bank of gears for shifting an actively positioned gear of a bank to an inactive position simultaneously with the shifting of a gear in said bank to active position.

8. In an apparatus of the character described, a rotary support; a timer disk adapted to be mounted upon said support to turn therewith, said disk having a guide track and a plurality of control elements spaced along said track; a variable speed mechanism operatively connected to said support for driving the same; a timer head having guided engagement with said guide track; a plurality of switches controlled by said timer head and arranged respectively in circuits to be controlled thereby, said timer head having means disposed in the path of movement of said control elements for successive engagement thereby to actuate said switches to effect the opening and closing of said circuits; said variable speed mechanism including a plurality of independent banks of gears and means for selectively coupling together in series one gear of each bank for driving said support and disk at relatively different speeds to vary the time interval of actuation of said switches.

9. In an apparatus of the character described, a driven support, a variable speed mechanism for driving the same including a plurality of independent banks of shiftable gears, a manipulator for each gear for moving the same from an inactive to an active position, pneumatically operated means for automatically coupling the gear banks in series, and means operable upon initial movement of the variable speed mechanism to actuate said pneumatic means.

10. In an apparatus of the character described, a rotary support; a timer disk adapted to be mounted upon said support to turn therewith; said timer disk having a guide track and a plurality of control elements spaced along said track; a variable speed mechanism operatively connected to said support for driving the same; an electric circuit connected with a source of current supply; a timer head having guided engagement with said guide track and provided with a pair of switches in said circuit and said timer head having means disposed in the path of movement of said control elements for successive engagement thereby to actuate said switches to effect the opening and closing thereof and thereby effecting the operation of a device; said variable speed mechanism including a plurality of independent banks of gears, means for selectively coupling together in series one gear of each bank for driving said support and disk at different speeds to thereby vary the time interval of actuation of said switches and the actuation of said device for varying the time interval of operation thereof, and means co-acting with the last mentioned means for shifting an actively positioned gear of a bank to an inactive position simultaneously with the coupling of a gear in said bank in active position.

11. In an apparatus of the character described, a rotary support; a timer disk adapted to be mounted upon said support to turn therewith; said timer disk having a guide track and a plurality of control elements spaced along said track; a variable speed mechanism operatively connected to said support for driving the same; a timer head having guided engagement with said guide track and provided with a pair of switches in circuit with a device, said timer head having a rock shaft provided with means disposed in the path of movement of said control elements for successive engagement thereby to actuate said rock shaft to thereby effect actuation of said switches for operation of said device at a plurality of time intervals; said variable speed mechanism including a plurality of independent banks of gears and means for selectively coupling together in series one gear of each bank for driving said support and disk at different speeds to thereby vary the time intervals of actuation of said switches and thereby varying the time intervals of operation of said device.

12. In an apparatus of the character described, a variable speed mechanism including a rotatable shaft, a plurality of shiftable gears mounted up-

on said shaft to turn therewith, a depressible manipulating plunger for shifting each gear on said shaft from a normal inactive to an active position, a detent bar having apertures through which the plungers respectively extend, means normally shifting said detent bar in one direction, a tapered lock collar on each plunger for shifting the detent bar in the opposite direction as the plunger is depressed to thereby release a previously depressed plunger, and means on each plunger for normally projecting the same upwardly when released from the detent bar.

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