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[45] Patented **Mar. 9, 1971**
[73] Assignee **Industrial Timer Corporation**
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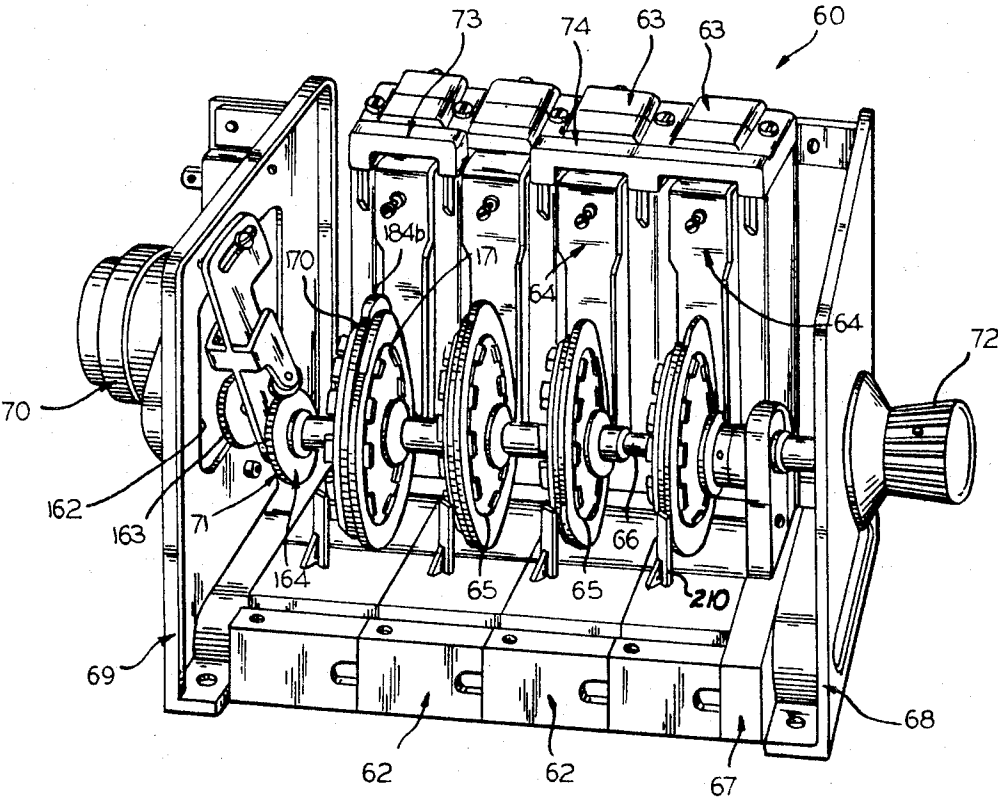
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Primary Examiner—Robert S. Macon
Assistant Examiner—J. R. Scott
Attorney—Norman Aon Witt

[54] **ELECTROMECHANICAL TIMER MECHANISM
WITH IMPROVED MODULAR HOUSING
CONSTRUCTION WITH ADJUSTABLE CAM
OPERATING MEANS**
16 Claims, 58 Drawing Figs.

[52] U.S. Cl. **200/38,**
200/153
[51] Int. Cl. **H01h 7/08,**
H01h 43/10
[50] Field of Search **200/38(all),**
168(all), 16, 153.13, 6(B1)

ABSTRACT: Timer having modular construction for mounting switches, relays and coils including actuating cam assemblies adjustable for timing intervals and sequencing, including molded plastic interfitting parts capable of providing a multitude of switching arrangements and which permits ease of assembly and maintenance.



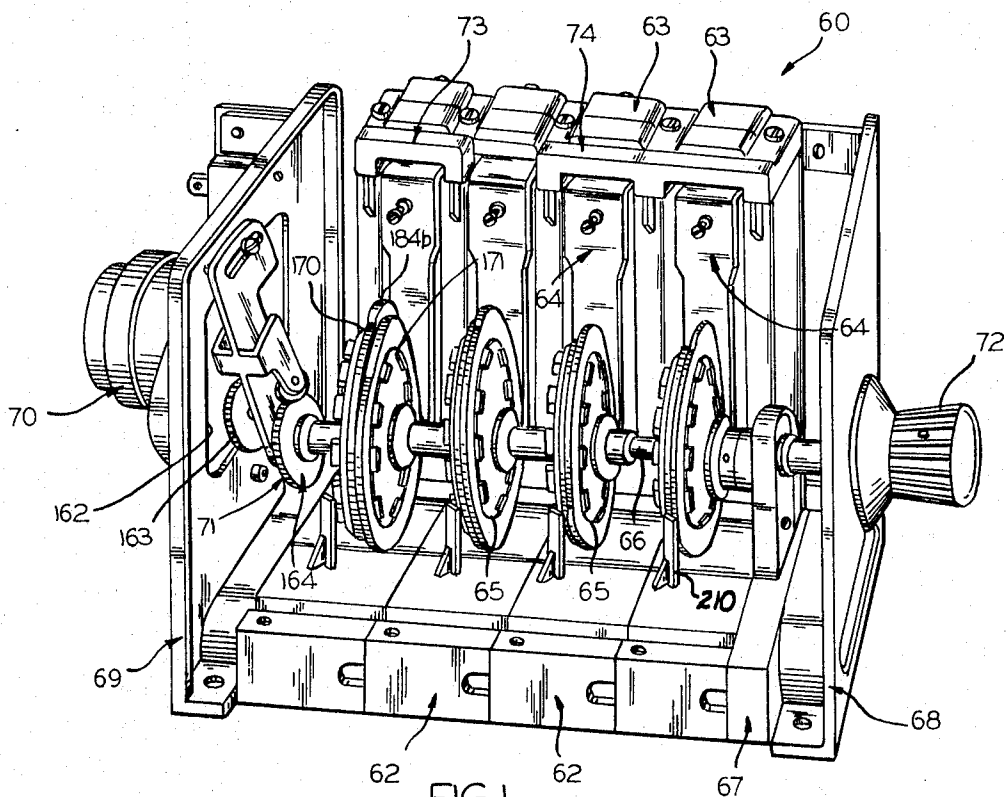


FIG. 1

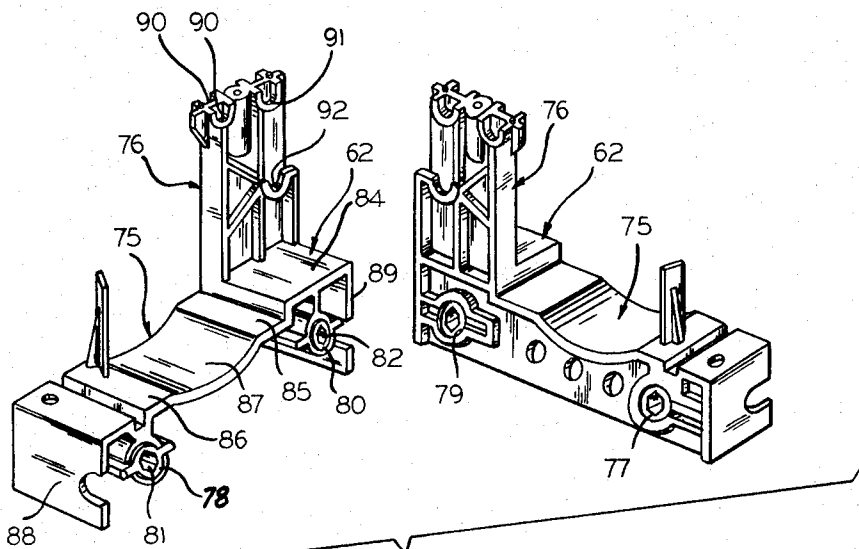


FIG. 4

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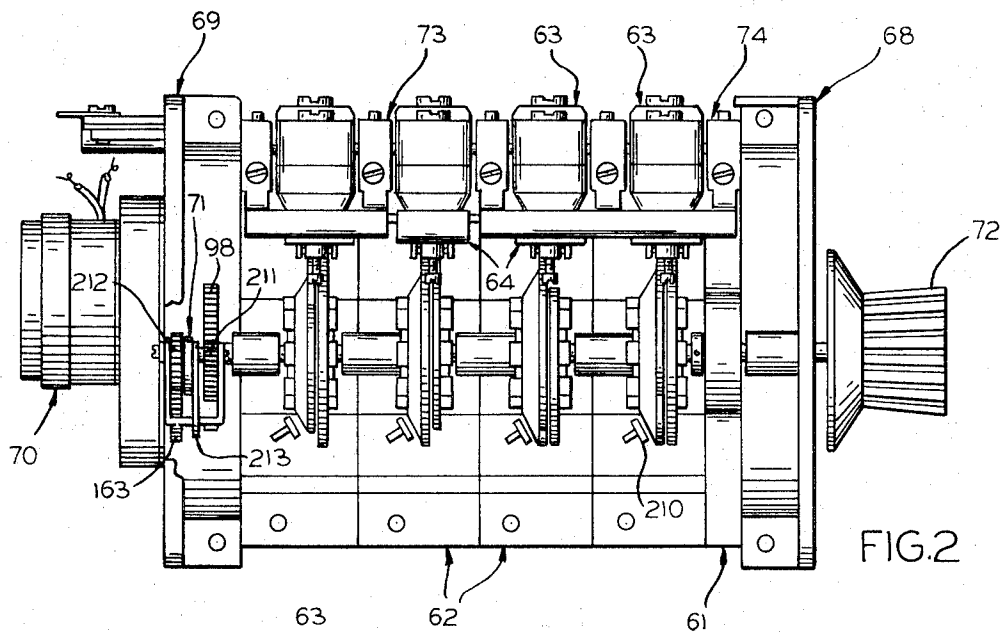


FIG. 2

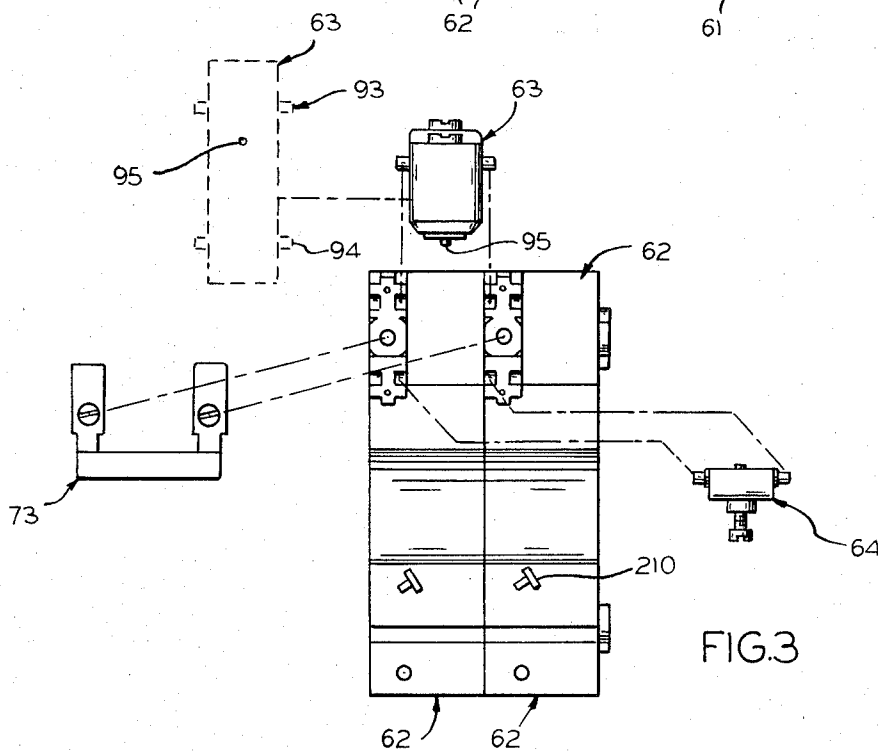


FIG. 3

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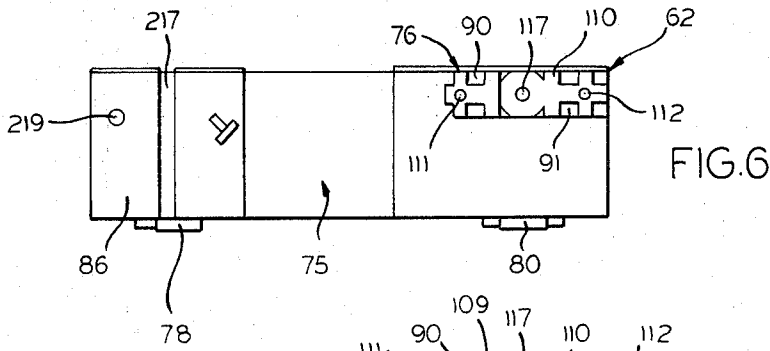


FIG. 6

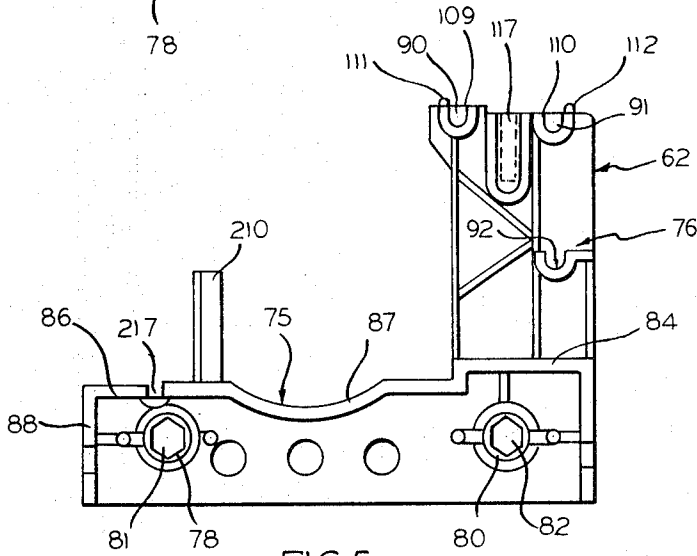


FIG. 5

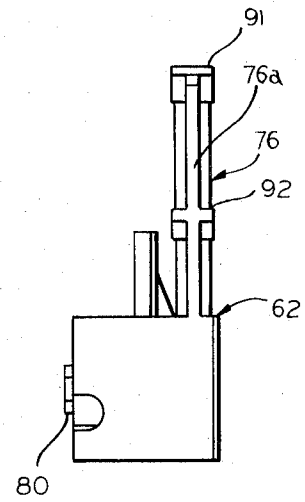


FIG. 7

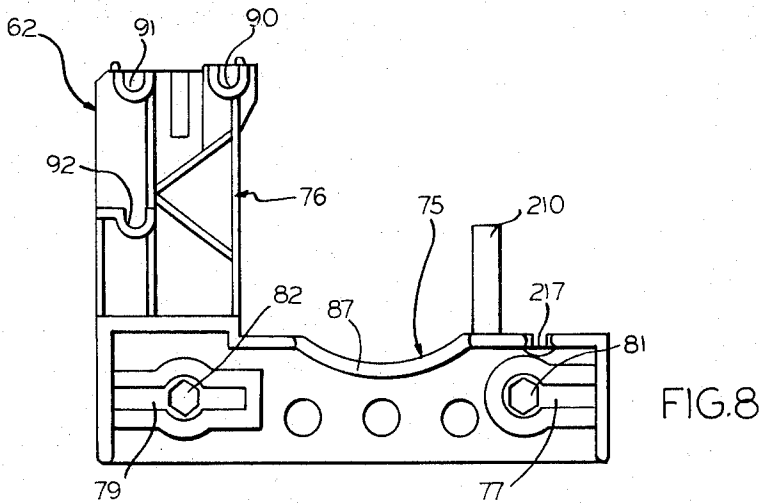


FIG. 8

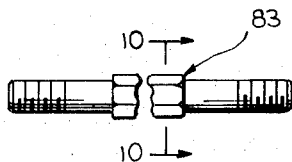


FIG. 9

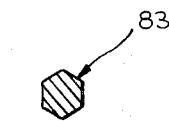


FIG. 10

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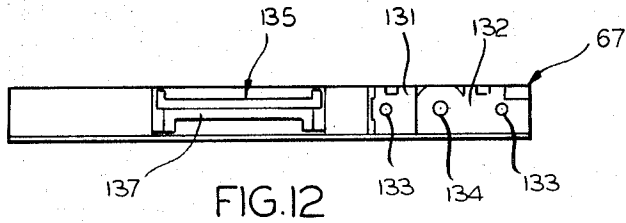


FIG. 12

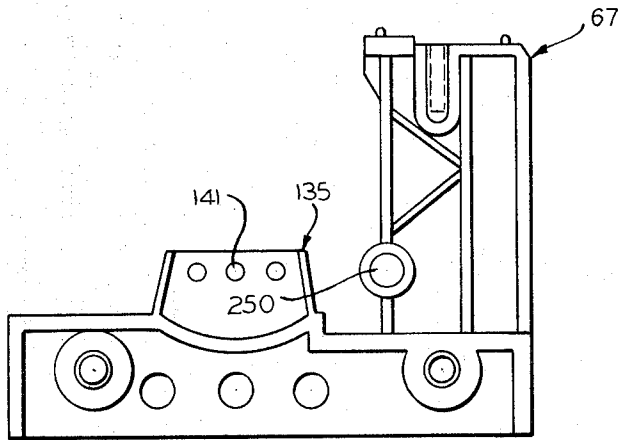


FIG. 11

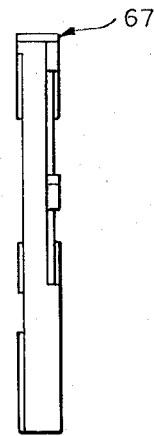


FIG. 13

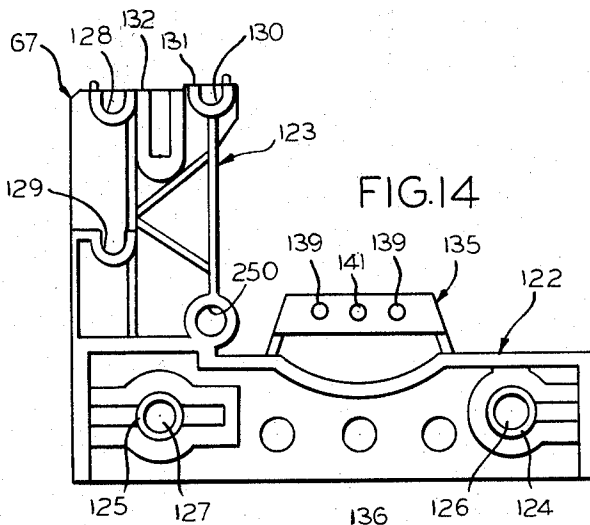


FIG. 14

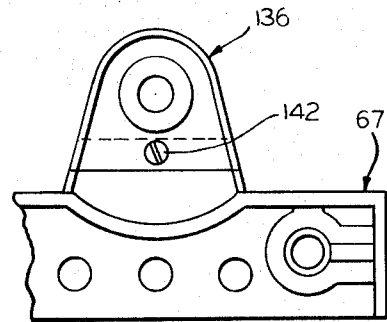


FIG. 18

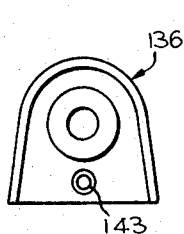


FIG. 15

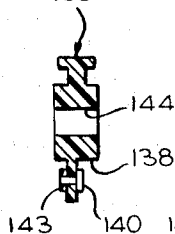


FIG. 17

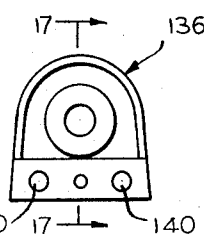


FIG. 16

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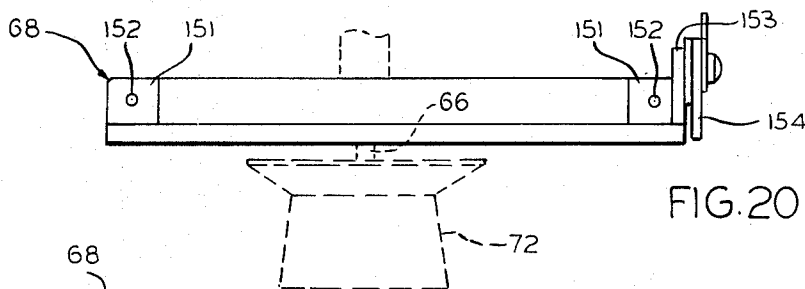


FIG. 20

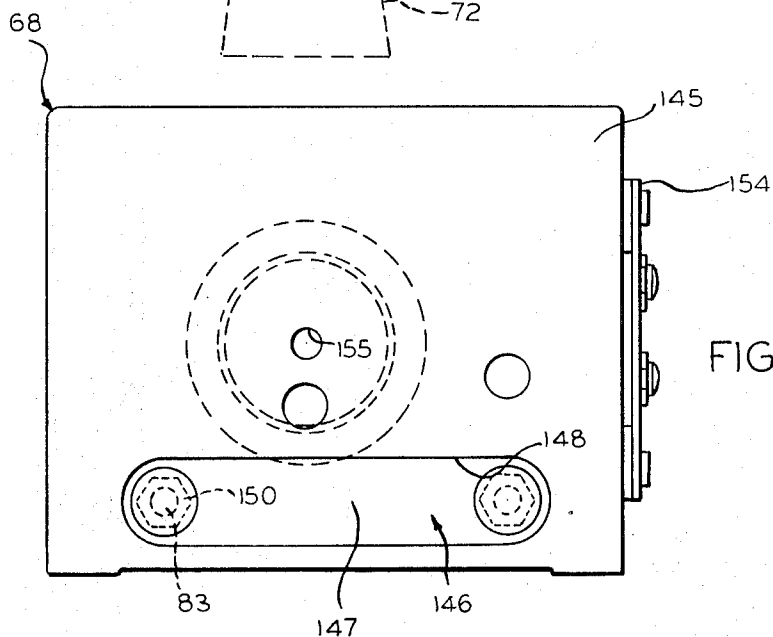


FIG. 19

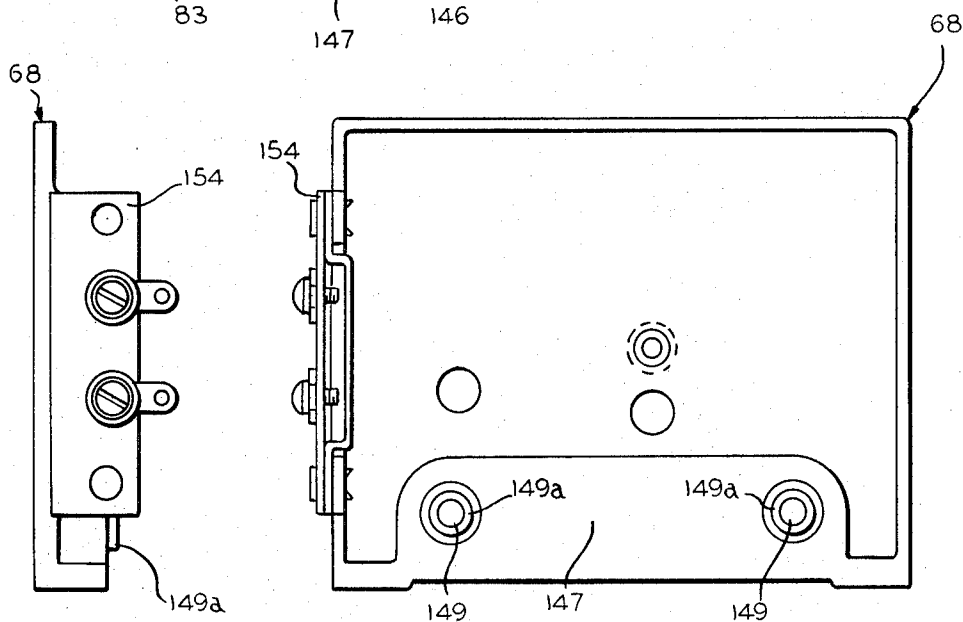
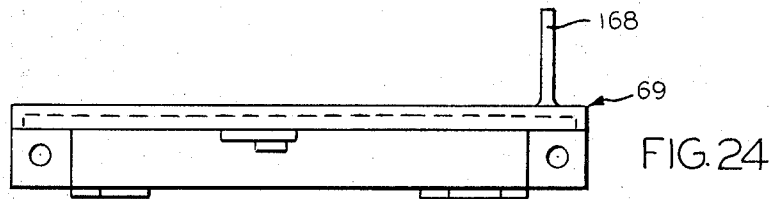
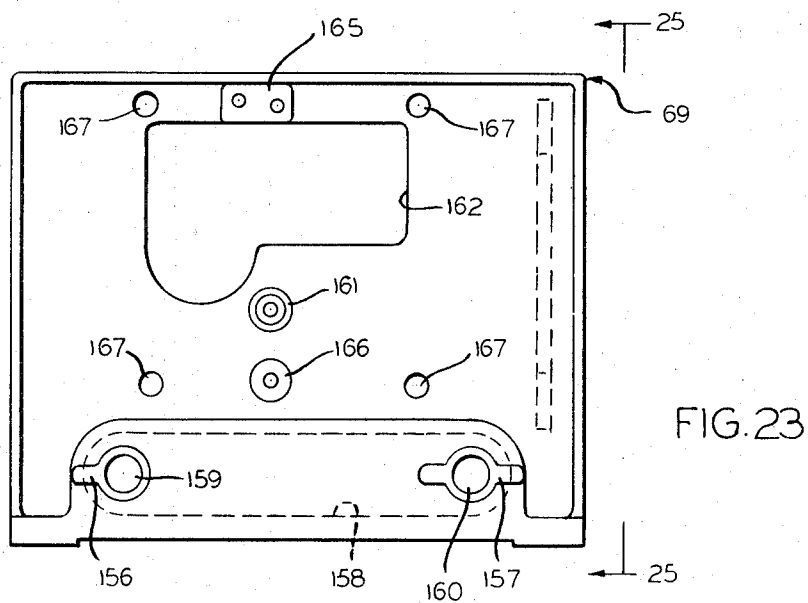
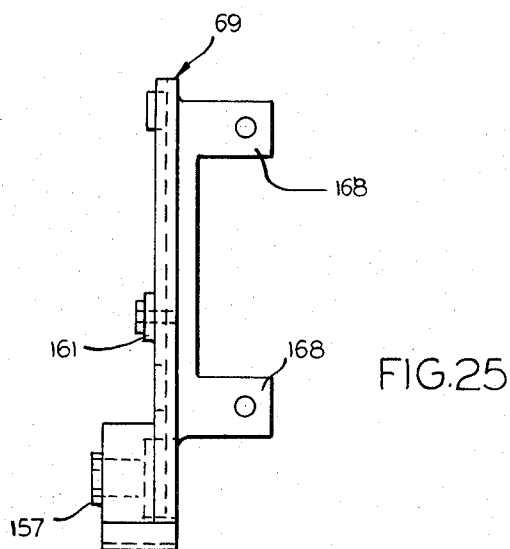


FIG. 22

FIG. 21

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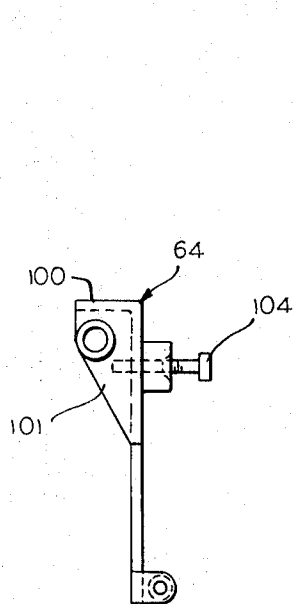


FIG. 28

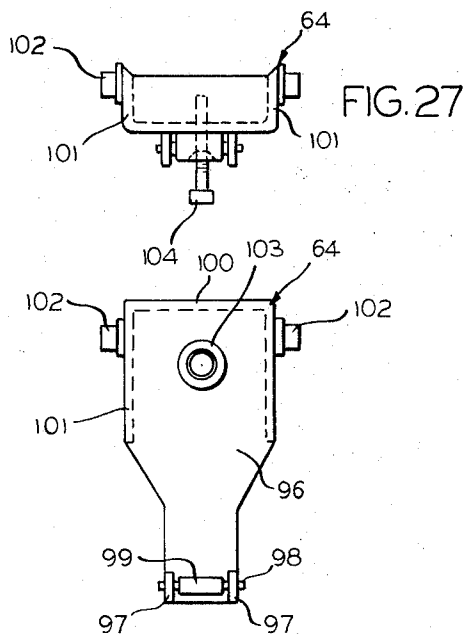


FIG. 26

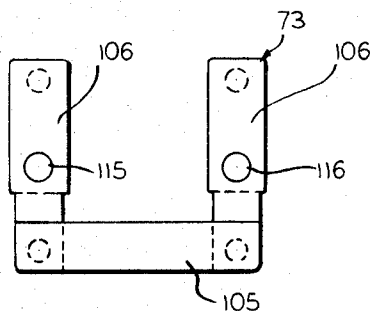


FIG. 29

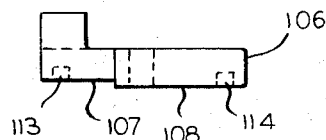


FIG. 30

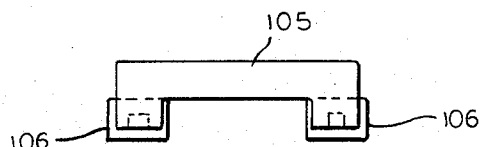
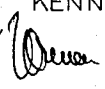
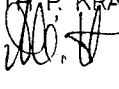


FIG. 31

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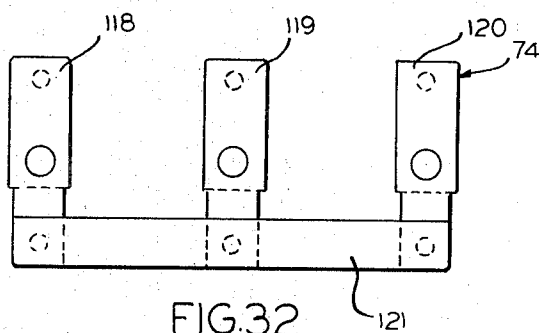


FIG. 32

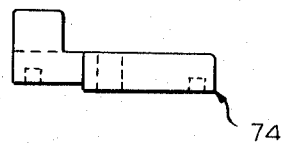


FIG. 34

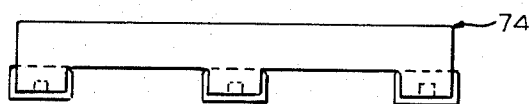


FIG. 33

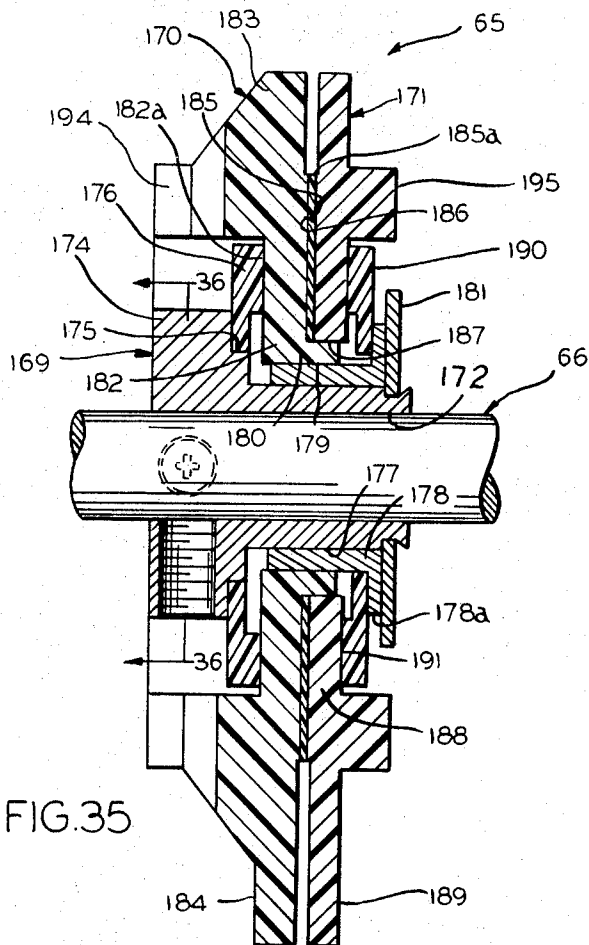


FIG. 35

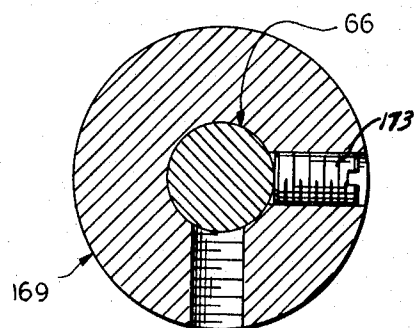
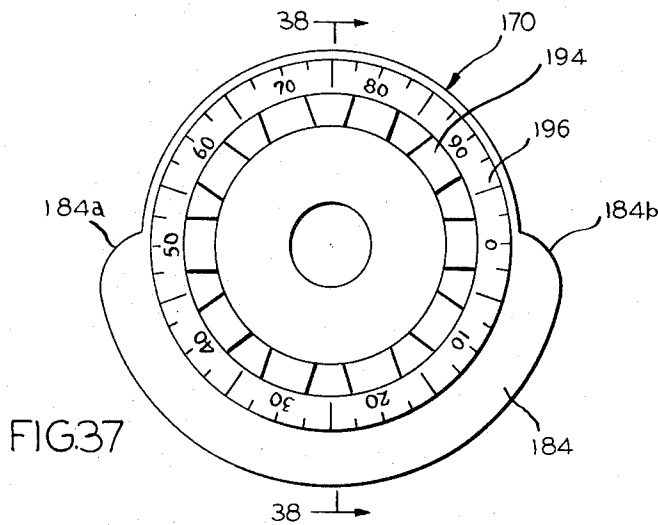
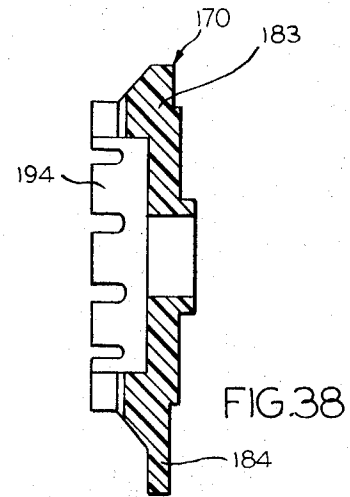
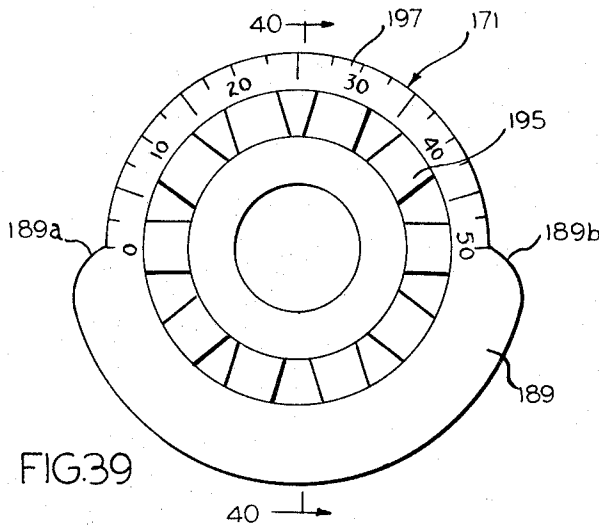
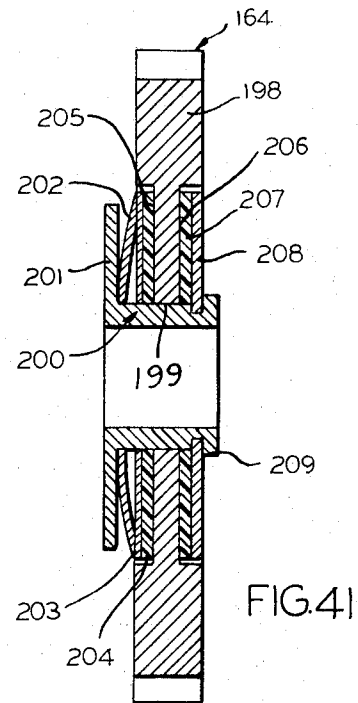
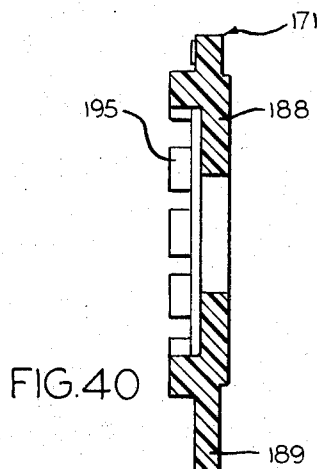
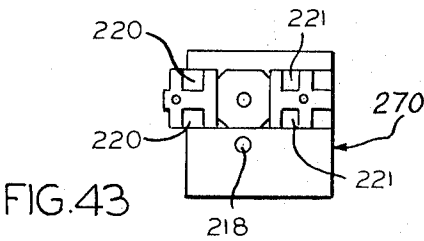
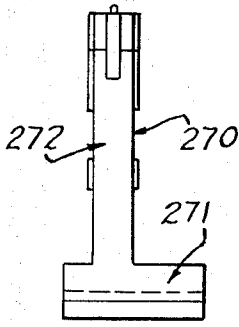
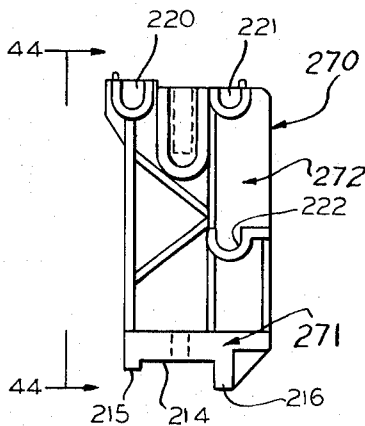
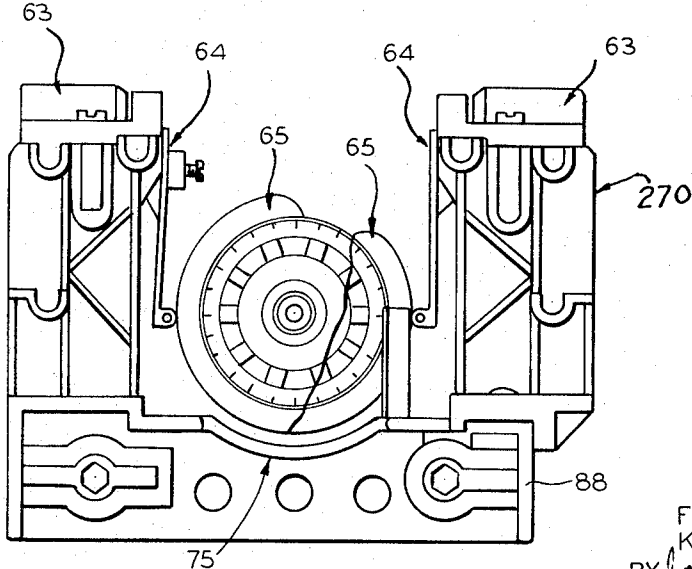


FIG. 36

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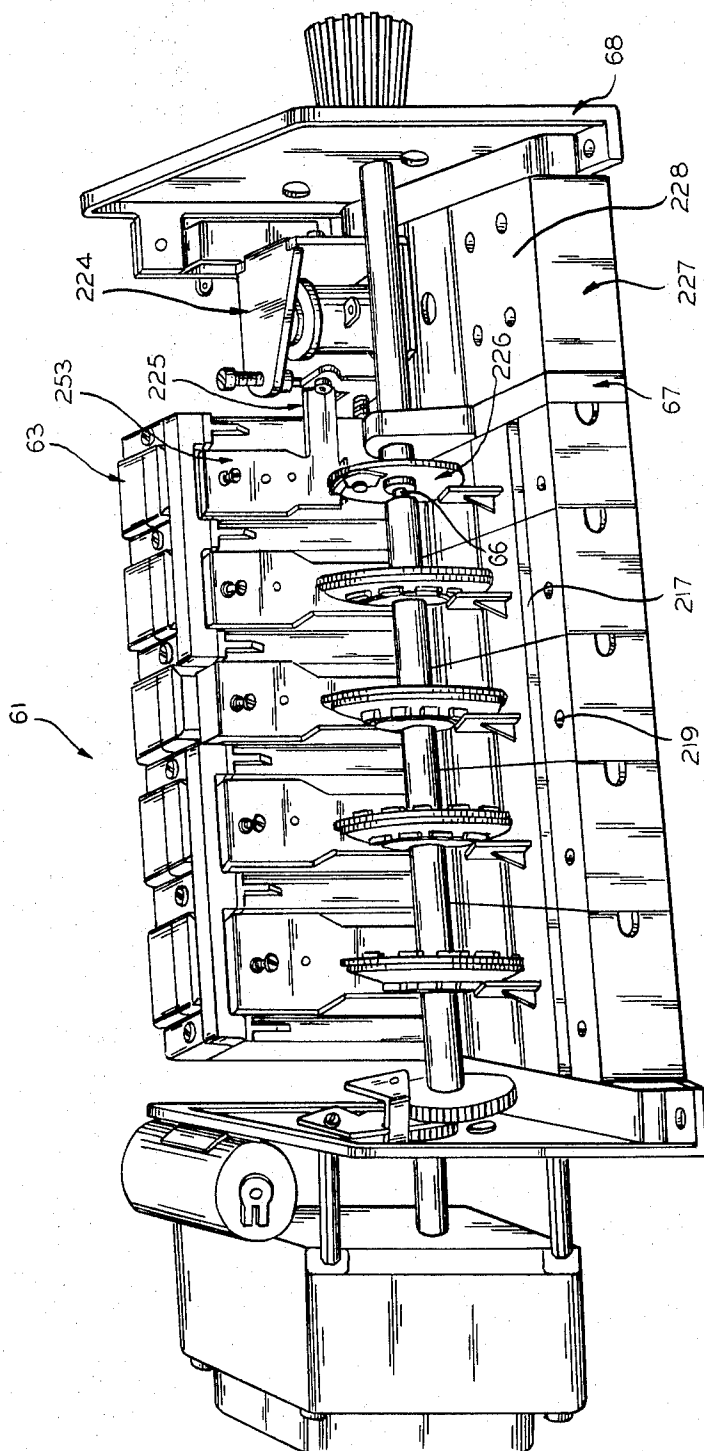


FIG. 46

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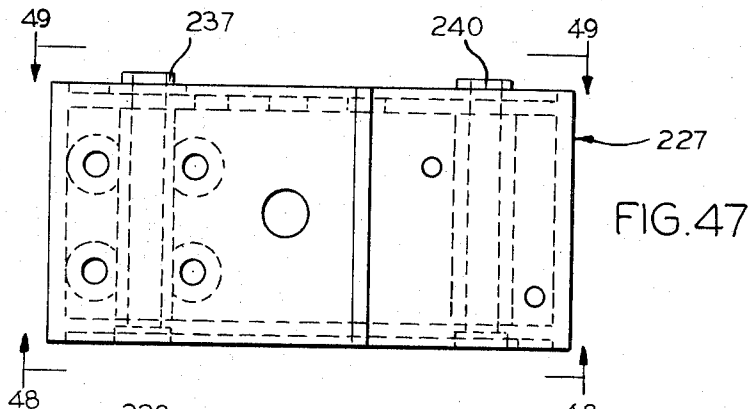


FIG. 47

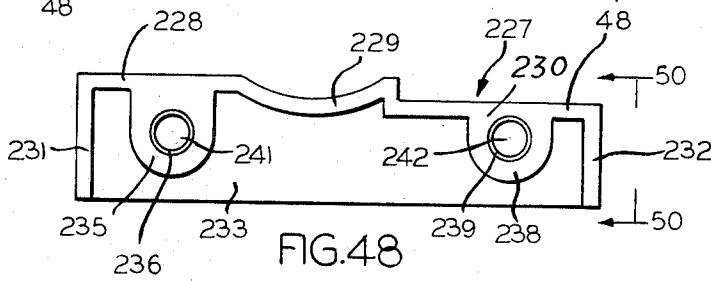


FIG. 48

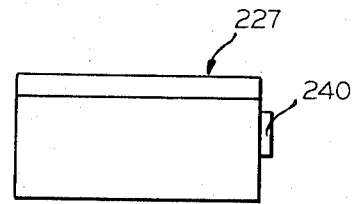


FIG. 50

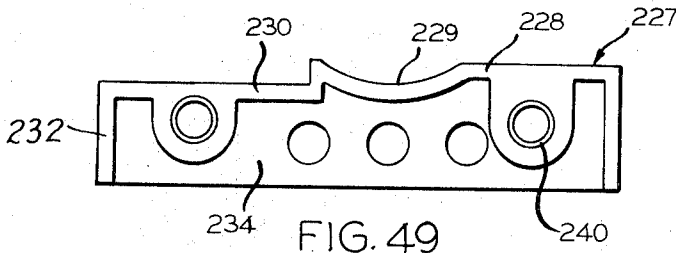


FIG. 49

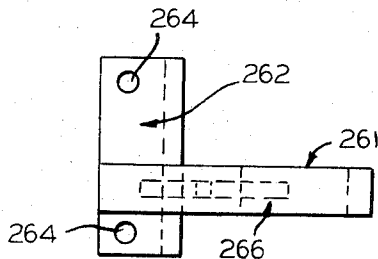


FIG. 52

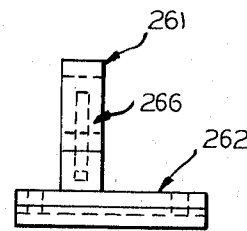


FIG. 53

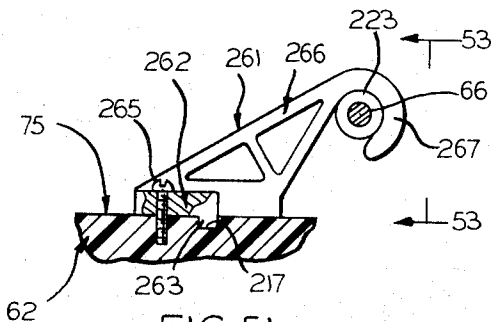
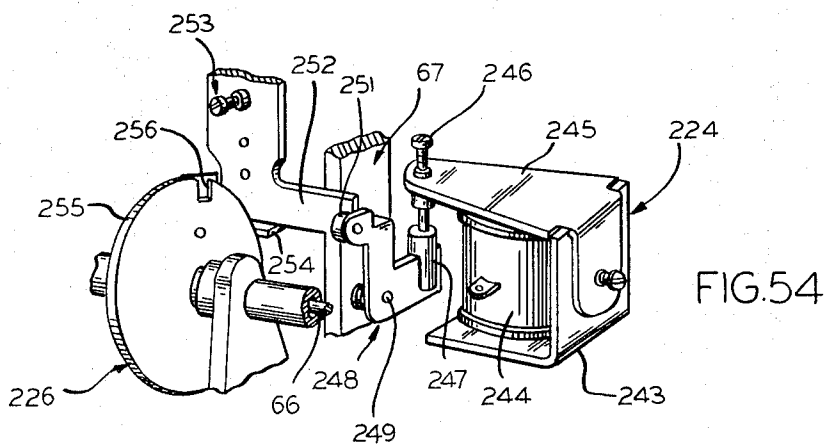
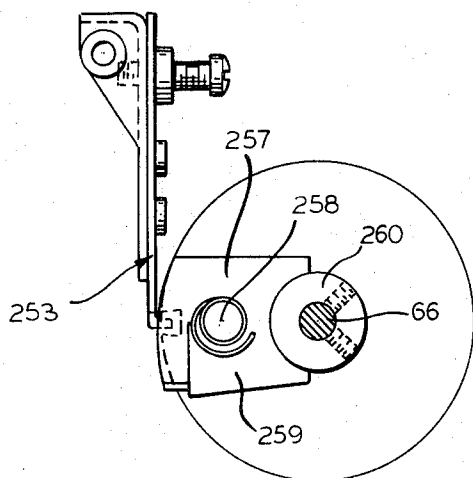
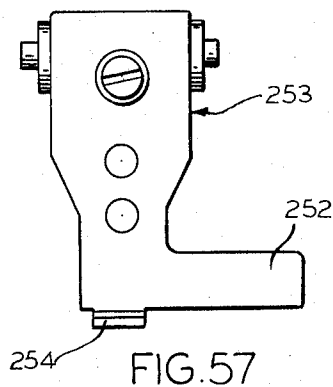
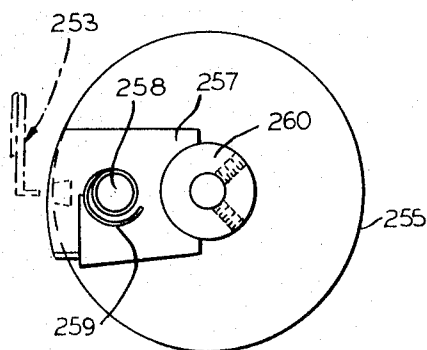
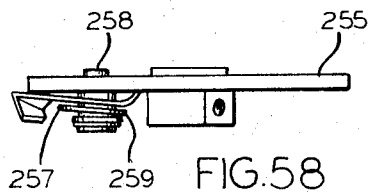


FIG. 51

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ELECTROMECHANICAL TIMER MECHANISM WITH IMPROVED MODULAR HOUSING CONSTRUCTION WITH ADJUSTABLE CAM OPERATING MEANS

This invention relates in general to a timer for providing timed operation of a plurality of switches to control timed and sequential operation of the switches, and more particularly to a timer constructed in modules, so that the number of modules may be varied for any particular installation and where each module includes a switch that is cam operated, and still more particularly to a timer constructed of plastic and metal die castings to define a modular type of construction.

The timer of the present invention by having interlocking modular construction permits the assembling of a unit that may have any desired number of switches cam operated for timing intervals and sequencing. The timer may be employed for operation of any suitable device controllable by electric circuitry, where switches function in the circuitry in a predetermined timing interval and sequencing pattern. The timer is especially suitable around machinery in that it is not affected by dust, oily conditions, corrosion or chemicals generally found around machinery, although its use is unlimited. A plurality of interengaging and identically formed switch blocks define mountings for switches and switch actuators, the latter of which are engageable by cams mounted on a timing, motor-operated camshaft. Each switch block includes an upstanding arm, which coacts with an arm of an adjacent block for defining the switch and switch actuator mounting. The switch blocks are molded of plastic, while the switch arms are die cast of metal. A plastic molded holddown or clamp locks the switch and switch actuator in place, but permits easy replacement. Because the switch blocks are identical, and end mount is needed at one end to provide an upstanding arm for coaction with an arm on the adjacent switch block to define a mount for a switch and switch actuator. A shaft bearing is also mounted on the end mount for bearingly receiving one end of the camshaft. Metal die-cast end plates are provided at each end of the switch blocks, and tie rods extend through the switch blocks, the end mount and the end plates. Fasteners are provided on the end of the tie rods to securely fasten and lock together the switch blocks, the end mount and end plates. The camshaft is also bearingly supported by one of the end plates and is driven by a timing motor mounted on one of the end plates and connected thereto through a gear train. Adjustable cams are provided on the camshaft for each switch actuator and switch. A relay base may also be arranged with the switch blocks for mounting a relay to be employed for selectively locking the camshaft against rotation. The switch cams are adjustable as to a timing interval and sequencing on the camshaft. Additional switch and switch actuating mounts may be secured to the switch blocks for providing a second switch to be operated by a cam assembly.

Therefore, it is an object of the present invention to provide an improved timer of high quality and having an operation that is not affected by dust, oily conditions, corrosion or chemicals generally found around machinery.

Another object of this invention is in the provision of a timer including molded plastic and metal die casting parts arranged together in a modular type of construction to facilitate automatic and semiautomatic assembly mounts and to permit great flexibility as to the number of cam-operated switches.

A still further object of this invention is in the provision of a modularly constructed timer including switch blocks for mounting switches and switch actuators, which switch blocks enable rapid removal and replacement of switches and/or switch actuators.

A further object of this invention is to provide a timer including a base having modular, interlocking pieces for mounting switches, relays and coils, and for adding a second row of switches on the base, all to be actuated by cam assemblies.

Still another object of this invention is in the provision of a timer having a double friction cam assembly including a pair of plastic cam sections joined by a friction device and locked to a camshaft by a second friction device, wherein the cam sections are adjustable for timing intervals and sequencing on the shaft.

A still further object of this invention is in the provision of a timer constructed of a plurality of modules that are interconnected and held together by tie bars coacting with the modules to function as torsion bars and prevent twisting and flexing of the entire assembly.

Other objects, features and advantages of the invention will be apparent from the following detailed disclosure, taken in conjunction with the accompanying sheets of drawings, wherein like reference numerals refer to like parts, in which:

- 10 FIG. 1 is a front perspective view of an assembled timer according to the present invention;
- FIG. 2 is a top plan view of the timer illustrated in FIG. 1;
- FIG. 3 is a top plan view of a pair of interengaging switch blocks and illustrating in exploded relation a switch, a switch actuator and a switch holddown or clamp;
- FIG. 4 is a perspective view of a pair of switch blocks in separated relation to illustrate the interengaging ends;
- FIG. 5 is an elevational view of a switch block according to the present invention;
- FIG. 6 is a top plan view of the switch block;
- FIG. 7 is a back elevational view of the switch block;
- FIG. 8 is an end elevational view of the switch block opposite from the view of FIG. 5;
- FIG. 9 is a broken elevational view of a tie rod or hexagonal bar employed in the present invention to interconnect switch blocks and like parts;
- FIG. 10 is a sectional view of the tie bar taken substantially along line 10-10 of FIG. 9;
- FIG. 11 is an end elevational view of an end mount according to the present invention;
- FIG. 12 is a top plan view of an end mount of FIG. 11;
- FIG. 13 is a rear elevational view of the end mount;
- FIG. 14 is an end elevational view of the end mount opposite from the view shown in FIG. 11;
- FIG. 15 is a side elevational view of an end bearing employed with an end mount to bearingly receive one end of the camshaft;
- FIG. 16 is a side elevational view of the end mount taken of the side opposite that shown in FIG. 15;
- FIG. 17 is a vertical sectional view of the end mount taken substantially along line 17-17 of FIG. 16;
- FIG. 18 is a fragmentary view of an end mount having an end bearing mounted thereon;
- FIG. 19 is an outside elevational view of an end plate according to the present invention;
- FIG. 20 is a top plan view of the end plate of FIG. 19;
- FIG. 21 is an inside elevational view of the end plate of FIG. 19;
- FIG. 22 is an end elevational view of the end plate illustrating the terminal strip;
- FIG. 23 is an inside elevational view of a chassis motor end plate according to the present invention;
- FIG. 24 is a top plan view of the chassis motor end plate;
- FIG. 25 is an end elevational view of the chassis motor end plate taken along line 25-25;
- FIG. 26 is a front elevational view of a switch actuator or actuating lever according to the present invention;
- FIG. 27 is a top plan view of the switch actuator of FIG. 26;
- FIG. 28 is an end elevational view of the switch actuator, the other end of which would be identical;
- FIG. 29 is a top plan view of a single switch holddown or clamp;
- FIG. 30 is an end elevational view of the holddown of FIG. 29;
- FIG. 31 is a front elevational view of the switch holddown;
- FIG. 32 is a top plan view of a double switch holddown or clamp according to the present invention;
- FIG. 33 is a front elevational view of the holddown of FIG. 32;
- FIG. 34 is an end elevational view of the holddown of FIG. 32;
- FIG. 35 is a vertical sectional view taken diametrically through a cam assembly according to the present invention and illustrating the assembly mounted on a shaft;

FIG. 36 is a detailed sectional view taken substantially along line 36-36 of FIG. 35;

FIG. 37 is a front elevational view of the fixed cam of the cam assembly;

FIG. 38 is a vertical sectional view of the fixed cam taken substantially along line 38-38 of FIG. 37

FIG. 39 is a front elevational view of the adjustable cam of the cam assembly according to the present invention;

FIG. 40 is a vertical sectional view of the adjustable cam taken substantially along line 40-40 of FIG. 39;

FIG. 41 is a vertical sectional view taken through a friction gear assembly according to the present invention;

FIG. 42 is a side elevational view of an additional switch bracket according to the present invention, the other side of which is identical;

FIG. 43 is a top plan view of the switch bracket of FIG. 42;

FIG. 44 is an end elevational view of the switch bracket of FIG. 42 taken along line 44-44;

FIG. 45 is an end elevational view of a part of the timer of the present invention illustrating the use of the additional switch bracket for mounting of an additional switch and switch actuator to be operated by a cam assembly;

FIG. 46 is a front perspective view of a modified timer according to the present invention that additionally illustrates the use of a relay in connection with the operation of the switch and the rotation of the camshaft;

FIG. 47 is a top plan view of a relay base according to the present invention;

FIG. 48 is a side elevational view of the relay base of FIG. 47 looking along line 48-48 of FIG. 47;

FIG. 49 is a side elevational view of the relay base taken along line 49-49 of FIG. 47;

FIG. 50 is an end elevational view of the relay base taken along line 50-50 of FIG. 48;

FIG. 51 is a side elevational view of an additional shaft support employed where an unusually long shaft is needed, and illustrating its coaction with a switch block illustrated in fragmentary section;

FIG. 52 is a top plan view of the additional shaft support shown in FIG. 51;

FIG. 53 is an end elevational view of the shaft support of FIG. 51 taken along line 53-53;

FIG. 54 is a perspective view of the relay actuating linkage according to the present invention and illustrating its association with a relay;

FIG. 55 is a side elevational view of the relay lock assembly and illustrating the locking lever in locking engagement with the shaft locking disc or wheel;

FIG. 56 is a view similar to FIG. 55 with the locking lever shown fragmentarily and in phantom and in retracted position to allow free rotation of the locking disc;

FIG. 57 is a front elevational view of the locking lever employed in the relay actuating linkage; and

FIG. 58 is a top plan view of the locking disc shown in FIG. 55.

One embodiment of the timer according to the present invention is illustrated in FIG. 1 and generally indicated by the numeral 60. Another embodiment of the invention illustrating other features and the versatility of the invention is shown in FIG. 46 and generally indicated by the numeral 61. The features of the timer 60 are included in the timer 61, although additional features are shown in the timer 61.

Referring now to the timer 60 of FIG. 1, it includes a plurality of interengaging switch blocks 62 for supporting a plurality of switches 63 and switch actuators 64, a plurality of cam assemblies 65 mounted on a camshaft 66 and coacting with switch actuators 64, an end mount 67, end plates 68 and 69, and a timer motor 70. The timer motor 70 drives the camshaft 66 through a gear train 71. Rotation of the camshaft 66 causes rotation of the cam assemblies thereon the time and sequential operation of switches 63 through the switch actuators 64. The cam assemblies may be adjusted to change the timing and sequencing as will be more clearly hereinafter appreciated.

Further, a knob 72 is connected to the camshaft 66 for providing sequencing adjustment. Holddown or clamping members 73 and 74 serve to hold the switches and switch actuators in place on the switch blocks, while also permitting easy removal for replacement purposes.

The switch blocks 62 are shown in greater detail in FIGS. 3 to 8. FIG. 3 illustrates a pair of switch blocks arranged together and the manner in which they receive a switch, a switch actuator and a holddown member for holding the switch and switching actuator in position. It should be appreciated that any number of switch blocks 62 may be associated together to provide mounting for any number of switches and switch actuators. Thus, the timer of the invention may be easily adaptable for any number of models that would include a variable number of switches.

Each switch block is L-shaped, as shown in FIG. 8 and includes in general a base 75 and an upstanding arm 76. In assembly, the bases 75 are locked together in abutting relationship, while the arm 76 of one switch block coacts with the arm 76 of another switch block to define a switch and switch actuator mount. The base 75 includes front opposed socket and socket members 77 and 78, and rear opposed socket and socket members 79 and 80, all arranged so that placement of a pair of switch blocks in abutting relation to each other causes the socket members 78 and 80 of one switch block to matingly engage in the sockets 77 and 79 of an adjacent switch block, thereby preventing relative movement in any direction between switch blocks. Hexagonal openings 81 and 82 are provided through the center of the front and rear socket and socket members for receiving a hexagonally-shaped tie rod 83, FIGS. 9 and 10, that locks the switch blocks together and further prevents relative twisting between switch blocks. The ends of the tie rods are threaded for receiving nuts and are associated with the end plates 68, and 69, as will be further explained hereinafter. The top wall of the base 75 is contoured for facilitating coaction with the components associated therewith, wherein a rear, flat wall 84 from which the arm 76 upstands is in superposed relation with the rear socket and socket member. The front edge of the rear, flat wall 84 drops down to a flat wall section 85 that is on the same level as a front, flat wall 86. A concave wall 87 extends between the flat wall section 85 and the front, flat wall 86. The concave wall 87 is aligned with the cam assemblies to facilitate adequate tolerance. The front and rear hexagonal openings 81 and 82 extend parallel to each other and parallel to the front and rear vertical walls 88 and 89. In assembled relation, the bases 75 of the abutting switch blocks form a structural base of frame for the timer, while the upstanding arms 76 define mountings for the switches 63 and the switch actuator 64. Each upstanding arm 76 is symmetrically formed on opposite sides to include on each side adjacent the front edge and upper end a bearing socket 90 for facilitating the mounting of a switch actuator, and at the rear edge thereof, upper and lower bearing sockets 91 and 92 for facilitating the mounting of a switch. As seen most clearly in FIGS. 4, 5 and 8, the sockets are open at the upper ends to permit entry from the upper ends of bearing members formed on the switch actuators and switches. The upper and lower switch bearing sockets 91 and 92 are in superposed relation and vertically aligned behind the switch actuator in bearing socket 90.

The switch blocks 62 are molded of a suitable plastic that will provide the desired strength and operating characteristics for the timer. The switch blocks are identical and formed so that any number of them can be placed in side-by-side, interengaging relationship.

Referring particularly to FIG. 3, each switch 63 includes superimposed pin 93 and 94, which project from each side and which are spaced apart the same distance as the upper and lower switch bearing sockets 91 and 92, whereby positioning of a switch in a mount defined by adjacent switch block arms 76 is accomplished by moving a switch toward the arms from the rear side and allowing the pins 93 and 94 to be seated in the upper-lower bearing sockets 91 and 92. As seen particu-

larly in FIG. 7, the upper and lower bearing sockets 91 and 92 extend from opposite sides of a wall 76a serving as a body for the upstanding arm 76. Thus, it can be appreciated that an open area is provided between the upper and lower bearing sockets to allow access of the switch pin 94 as it is moved into position in the lower bearing socket 92. Each switch 63 includes a plunger 95 adapted to be actuated by a switch actuator. The switches may be of any suitable type, such as the well-known microswitch that requires only slight movement of the plunger for actuation. Each switch actuator 64 is preferably formed of die-cast metal, and as shown in FIGS. 26 to 28, includes a base 96 necked down at its lower end and having extending from the front face a pair of parallel-spaced flanges 97. A pin 98 extends through the flanges and is secured in place and has freely rotated thereon between the flanges a sintered, bronze roller 99 that is engageable by the cam assemblies 65. The upper, broader part of the base 96 includes rearwardly extending walls 100 and 101. Mounted on the opposed walls 101 are pintles or stub shafts 102 that are adapted to be pivotally received in the switch actuator sockets 90 of the switch block upstanding arms 76. A boss 103 having a tapped hole therein threadingly receives a plunger-actuating screw 104, the inner end of which is adapted to engage the plunger 95 of the switch 63 for actuating same upon pivoting of the switch actuator 64. Thus, the mounting of the switch 63 and the switch actuator 64 in the switch blocks is such that the actuating screw 104 will be aligned with the plunger 95. Adjustment of the plunger-actuating screw 104 will enable adjusting of the actuation point of the switch 63 in relation to the movement of the switch actuator.

The switches 63 and the switch actuator 64 are locked in the mount defined by the switch blocks 62 by a holddown 73, as seen in FIGS. 29 to 31, or a holddown 74 as seen in FIGS. 32 to 34. The difference between the holddown 73 and 74 is merely that the holddown 73 is capable of holding only a single switch and switch actuator in position, while the holddown 74 is capable of holding a pair of switches and switch actuators in position on the switch blocks. It should be appreciated that the holddown may be formed to hold down or clamp any number of switches and switch actuators on switch blocks.

The single holddown 73, FIGS. 29 to 31, includes a front crossbar 105 and rearwardly extending bars 106, thereby defining a U-shaped holddown as seen in FIG. 29. As seen in FIG. 30, the lower surface of each rearwardly extending bar 106 is stepped and includes offset surfaces 107 and 108, which respectively mate with offset surfaces 109 and 110 of each upstanding switch block arm 76 (FIG. 5), thereby providing location guide means for each holddown relative to the switch block arms. To provide further locating means, locating pins 111 and 112 extend from the surfaces 109 and 110 and are adapted to respectively mate in sockets 113 and 114 formed on the holddown surfaces 107 and 108 respectively. As seen particularly in FIG. 31, the crossbar 105 is offset upwardly from the rearwardly extending bars 106 to facilitate clearance for the switch actuator 64. In order to secure the holddown 73 in position, holes 115 and 116 are formed in the bars 106 to freely receive a screw fastener that may be of the self-tapping type and screwed into holes 117 formed in the surface 110 of the switch block upstanding arms. Thus, it should be appreciated that removal of the screw fasteners and the holddown facilitates easy removal of a switch and/or a switch actuator for replacement purposes.

The holddown 74 of FIGS. 32 to 34 differs from the holddown 73 only in that rearwardly extending bars 118, 119 and 120 extend from the crossbar 121, wherein the arms are spaced apart to be mounted on the top of a switch block upstanding arm. So, it can be appreciated that the holddown 74 will hold a pair of adjacent switches and switch actuators in position as shown in the embodiment of FIG. 1. Otherwise, the form of each rearwardly extending bar is the same as and performs the same function as the bars 106 in the embodiment of FIGS. 26 to 28. It should be further appreciated that a holddown could include a single crossbar and any number of rear-

wardly extending bars in parallel-spaced relation for alignment with switch block upstanding arms for holding down any number of switches and switch actuators. However, by providing the versatility of having available one and two switch hold-downs, any combination of switches in a timer may be handled. It should also be appreciated that, as shown in FIG. 1, the switch holddown 74, while particularly holding in place the two right-hand switch and switch actuator arrangements, coacts with the holddown 73 to hold the second-from-the-last switch and switch actuator arrangement in place. In this respect, a switch bar covers the upper open ends of both upper bearing sockets 90 and both upper bearing sockets 91 to prevent displacement of a switch or switch actuator positioned therein. The switch holddowns are likewise molded of a suitable plastic material. Inasmuch as each switch block 62 includes only a single upstanding arm 76, utilization of the endmost switch block on the right end as seen in FIG. 1 is accomplished by providing the end mount 67, which is shown in detail in FIGS. 11 to 14.

The end mount 67 includes generally a base 122 and an upstanding arm 123, the cross-sectional shape of the base 122 as taken from front to back is substantially identical to that of the base 75 of the switch block 62, and is provided on the side that fits against the endmost end block with sockets 124 and 125 that matingly receive socket members 78 and 80 of the endmost switch block. Circular holes 126 and 127 are formed through the center of the sockets 124 and 125 for freely receiving the tie rod 83. While it is not necessary that these holes be hexagonal, they may so be if desired. The hexagonal shaping of the tie rod holes in the switch blocks is sufficient to inhibit twisting and flexing of the assembled timer.

The upstanding arm 123 is formed similar to the upstanding arm 76 of the switch block 62 with the exception that bearing sockets 128 and 129 for a switch and the bearing socket 130 for a switch actuator is formed only on the side of the switch arm facing the endmost switch block to coact with the switch arm thereof in defining a mount for the endmost switch and switch actuator. Offset surfaces 131 and 132 are formed on the upper end of the upstanding arm 123 in the same relation as the offset surfaces 109 and 110 of the switch block upstanding arm 76. Further, holddown locating pins 133 are provided for mating engagement with sockets formed in the holddowns as mentioned above. Similarly, a hole 134 is formed in the upper surface 132 for receiving a holddown fastener.

An upstanding mounting flange 135 is formed on the base 122 for having secured thereto an end bearing 136 that bearingly supports the camshaft 66. The flange 135 includes a shoulder 137 coacting with the shoulder 138 on the end bearing for facilitating mating engagement between the end bearing and the flange. Guide holes 139 are formed in the flange 135 for matingly receiving guide pins 140 formed on the end bearing to further facilitate precise alignment with the end bearing with respect to the base 122 of the end mount. A hole 141 is formed in the flange 135 to freely receive a screw fastener 142 that is threadedly secured in a boss 143 having a hole therethrough and formed on the end bearing 136. Thus, the mounting of the end mount 67 may be easily accomplished and performed with accuracy. A shaft bearing member 144 is formed on the end bearing to bearingly receive the shaft 66. Both the end mount 67 and the end bearing 136 are molded of a suitable plastic and preferably of the same type as the switch blocks 62.

End plates 68 and 69 serve to close the ends of the timer and to provide support for terminal strips and a motor. The end plate 68 is similar to the end plate 69, but the latter also is particularly formed for operating as a chassis for the timing motor. Further, the end plates also coact with the tie rods in maintaining the entire timer assembly together.

The end plate 68, as shown in FIGS. 19 to 22, on its outer face 145, is formed with a recess 146 that is defined by a panel 147 extending substantially vertically and an elongated, generally rectangularly-shaped wall 148 that is rounded at its ends. Holes 149 are formed in the panel 147 for freely receiving

ing the ends of the tie rods 83. Socket members 149a are provided around the holes 149 on the inner side of the end plate for mating engagement with the socket formed in the end mount 67 to facilitate alignment of the end plate 68 with the end mount. Nuts 150 are threaded on the ends of the tie rods and located in the recess 146. The tie rods are of such a length that they do not extend out beyond the outer face 145 of the end plate. Mounting flanges 151 having holes 152 therein are provided at the lower end of the end plate to permit mounting onto a surface. Lugs 153 extend from one end of the side plate for facilitating the mounting thereon of a terminal strip 154. The hole 155 is formed in the end plate for permitting the extension of the camshaft 66 therethrough, so that the knob 72 may be secured to the camshaft at the outer face of the end plate.

The end plate 69 as shown in FIGS. 26 to 28 is generally of the same configuration as the end plate 68, but differs by being adaptable for fitting directly against one of the switch blocks and having means for mounting the timing motor and gear train. In this respect, at the inner side of the end plate 69, socket members 156 and 157 are adapted to be matingly received in sockets 77 and 79 of the adjacent switch block. A recess 158 similar to recess 146 is located at the outer surface of the end plate 69 for providing flush mounting of the tie rods and nuts thereon at the end plate. Holes 159 and 160 are formed through the center of the socket members 156 and 157 for freely receiving the ends of the tie rods. A bearing boss 161 is provided for bearingly receiving the end of the camshaft 66 and supporting the respective end of the camshaft. An opening 162 enables the interconnection between the gear train 71 and the motor pinion 163 and a gear 164 that is coupled to the camshaft 66. Fastener bosses 165 and 166 facilitate the receiving of the fasteners for mounting of a motor on the end plate and for mounting of the gear train frame. Other motor mount holes 167 are provided for mounting of the type shown in the embodiment of FIG. 46. Like the end plate 68, lugs 168 are provided for mounting of a terminal strip on the end plate 69. Thus, the motor chassis end plate 69 is capable of having mounted thereon either the timing motor 70 or a timing motor of the type shown in FIG. 46.

The end plates 68 and 69 are metal die cast, and together coact as a support for the timer for mounting the timer on a desired machine or table. Each cam assembly 65 includes a metal cam bushing 169 fixedly mounted on the camshaft 66 by setscrew means, a fixed cam 170 carried on and frictionally coupled to the bushing, and an adjustable cam 171 adjustably carried on and frictionally coupled to the fixed cam 170, as shown in FIGS. 35 to 40.

The cam bushing 169 includes a bore 172 fitting over the shaft 66. Setscrew 173 locks the bushing to the shaft and locks the entire cam assembly against movement along the shaft. A flange 174 is provided at one end of the cam bushing, and defines at one side a shoulder 175 for receiving an annular friction washer 176 of spring steel which frictionally couples under spring pressure the cams 170 and 171 to the camshaft 66 through the bushing 169.

Cams 170 and 171 are rotatably mounted on the cylindrical surface 177 of cam bushing 169 through a metal bushing 178 that is externally knurled and essentially locked to the cam 170 by being press fitted into a bore 179 formed within the hub 180 thereof. The metal bushing 178 is flanged at 178a and held on the cam bushing 169 by a washer 181 that is locked to the end of the cam bushing in any suitable manner. A web 182 extends from the fixed cam hub 180 and terminates in an enlarged annular portion 183 and provides a face 182a against which the friction washer 176 bears. A cam portion 184 extends from the annular portion 183 and covers approximately one-half of the periphery of the annular portion. The cam portion terminates at ends 184a and 184b. A radially extending face 185 is defined along one side of the fixed cam for engagement with a Mylar washer 185a that in turn engages a radially arranged face 186 of the adjustable cam 171. The adjustable cam 171 also includes a bore 187 that is adapted to be

rotatably fitted on the hub 180 of the fixed cam 170, as shown particularly in FIG. 35.

The adjustable cam is essentially disc-shaped and includes a body 188 that has at its periphery a cam portion 189, which extends around about one-half of the periphery and terminates at ends 189a and 189b. The adjustable cam is frictionally locked to the fixed cam by means of a friction washer 190 of spring steel that engages on one side the flange 178a of the metal bushing 178 and on the other side the radial face 191 of adjustable cam 171. Essentially, the fixed cam 170 and the adjustable cam 171 are frictionally mounted on the bushing 169 for rotation relative thereto, while the adjustable cam 171 is frictionally coupled to the fixed cam 170.

The frictional coupling between the adjustable cam 171 and the fixed cam 170 permits relative adjustment of the cam assembly to vary the switch time interval. As seen in FIG. 1, the leftmost cam assembly is adjusted so that the cam portion of the fixed cam 170 coacts with the cam portion of the adjustable cam 171, wherein the cam portions overlap and provide a gap between the cam portion ends 184b and 189a. When the gap passes the roller of a switch actuator, the switch actuator will be allowed to release the plunger of a switch. Otherwise, engagement of the cam portions depresses the switch actuator. Circumferentially arranged lugs 194 on the fixed cam 170 and circumferentially arranged lugs 195 on the adjustable cam 171 define circumferentially arranged sockets for receiving a tool that facilitates relative adjustment of the cams. To further facilitate relative adjustment of the cams, a graduated scale 196 is provided on the enlarged, annular portion 183 of the fixed cam, while a graduated scale 197 is provided on the periphery of the body 188 of the adjustable cam 171. The scale markings are arranged so that they can be aligned with the cam portion ends. Because of the frictional coupling between the bushing 169 on which the fixed cam 170 is mounted relative to the shaft 66, positioning of the cam portions relative to the shaft can be adjusted. Adjustment of the relative positioning between the cams and/or the relative position of the fixed cam on the shaft permits adjustment of the timing interval and sequencing for a particular cam assembly relative to the associated switch. Thus, it can be appreciated that any desired timing interval and sequencing may be provided by the cam assembly according to the present invention. The fixed and adjustable cams are molded of plastic, and running of the cam portions on the sintered, bronze roller of a switch actuator results in a minimum of friction and wear.

In order to permit combined sequential adjustment of all cam assemblies on the shaft 66, the friction gear assembly 164 coupled to the shaft and to the gear train 71 between the shaft and motor enables rotation of the shaft relative to rotation of the gear 198. The gear 198 includes a center bore 199 that is freely received on a bushing 200 that is in turn suitably fixed on the camshaft 66, FIG. 38. A radial flange 201 is provided at one end of the bushing 200 against which is positioned a friction washer 202. A flat metal washer 203 is arranged on the other side of the friction washer 202. Abutting against the flat metal washer is a lubricant coated, cork washer 204 that is in friction engagement with a radial extending, recessed face 205 on the gear 198. The opposed radial extending, recessed face 206 is similarly provided with an abutting lubricant coated, cork washer 207. The washers and gear 198 are held in place on the bushing 200 by a flat, metal washer 208, which is held in place by a flared-over portion 209 of the bushing. Thus, a frictional coupling relationship between the bushing 200 and the gear 198 is established to enable rotation relative the timing motor shaft of the camshaft by manipulation of the knob 72. To facilitate adjustment of the camshaft and cam assemblies, an indicator 210 is provided on each switch block for coaction with the graduated scale 196 on the fixed cam 170. A pair of idler gears 211 and 212 mounted on a common shaft supported on a frame 213, FIG. 2, interconnects the camshaft gear 198 with the motor pinion gear 163.

Referring now particularly to FIGS. 42 to 45 and also to FIGS. 5 to 8, in the event that it is desired to mount a second

bank of switches on the timer for operation by the cam assemblies, a switch bracket 270 of molded plastic may be mounted on the base 75 of a switch block. A pair of switch brackets coact to define a mount for a switch and switch actuator in a position that will enable the switch and switch actuator mounted thereon to be actuated by a cam assembly. While the cam assembly may be arranged for actuating a switch and switch actuator on both sides of the base 75, the preferable arrangement would essentially double the number of cam assemblies on the camshaft, so that a single cam assembly would be operative only for a single switch and switch bracket arrangement. Each switch bracket 270 includes a base 271 and an upstanding arm 272. The base 271 includes a flat undersurface 214 and depending bars 215 and 216. A slot 217 is provided on the base 75 of the switch block for reception of the switch bracket bar 215 as seen particularly in FIG. 45, while the switch bracket bar 216 fits over the front, vertical wall 88 of the switch block base. A hole 218 is provided in the switch bracket base 271 for freely receiving a fastener that may be self-tapped in a hole 219 formed in the front, flat wall 86 of the switch block base 75, thereby enabling the switch bracket to be secured and properly located onto the switch block base 75. The upstanding arm 272 of the switch bracket 270 is identical in configuration to the upstanding arm 76 of a switch block 62, in that it includes opposed switch actuator bearing sockets 220, upper opposed switch bearing sockets 221 and lower opposed switch bearing sockets 222. The upper end of the switch bracket arm 272 is provided with stepped surfaces and locating pins to facilitate the location and securing of a holddown 73 or 74 for locking a switch and switch actuator in position. Thus, a second bank of switches may be provided for the timer according to the present invention. As shown most clearly in FIG. 1, spacers 223 are provided on the camshaft 66 to facilitate spacing of the cam assemblies along the camshaft.

The embodiment of the FIG. 46 differs mainly from the embodiment of FIG. 1 in that it includes a magnet assembly 224 for operating a relay actuating linkage 225. Cooperation with a combined cam and shaft locking assembly 226 mounted on the camshaft 66 is achieved. Actuation of the magnet assembly 224 simultaneously actuates the adjacent switch 63 and releases the shaft 66 for rotation, as will be more clearly understood hereinafter.

A magnet assembly base 227 is provided in modular form for abutting engagement against the end mount 67 and the end plate 68 to provide a mount for the magnet assembly 224. The magnet assembly base is particularly shown in FIGS. 47 to 50 and includes an upper horizontal wall 228 adapted to coalign with the front wall 86 of an adjacent switch block, a concave wall 229 that generally coaligns with the concave wall 87 of a switch block, and a lower flat wall 230 upon which the magnet assembly 224 is mounted. A front vertical wall 231 depends from the front edge of the horizontal wall 228, while a rear vertical wall 232 depends from the rear edge of the lower flat wall 230. Front to back reinforcing walls 233 and 234 extend between the front and back vertical walls 231 and 232, while depending from the edges of the horizontal and concave walls. An enlarged front boss 235 extends transverse the base and below the horizontal wall 228, and includes a socket 236 that is adapted to meet with one of the socket members 149a on the end plate 68. The opposite end of the boss 235 includes a socket member 237 that is adapted to align with and fit in a socket formed in the adjacent end mount 67. Similarly, a rear boss 238 includes a socket 239 on one end and a socket member 240 on the other end for mating engagement with the end plate and end mount. Bores 241 and 242 respectively extend through the bosses 235 and 238 to allow the tie bars 83 to pass therethrough.

Thus, the magnet assembly base 227 constitutes an extension of the bases formed by the switch blocks to permit mounting of the magnet assembly 224. The magnet assembly base is likewise molded of a suitable plastic.

Referring now to FIGS. 54 to 58, the magnet assembly 224 is seen to include a frame 243 having secured thereto a coil

244 that, when energized, draws down an armature 245. An adjustable actuating screw 246 is mounted in the free end of the armature for engaging the input end 247 of an L-shaped lever 248, that is pivotally mounted on the end mount 67 by means of a stub shaft 249. The stub shaft 249 is secured to a preformed hole 250, FIGS. 11 and 14, of the end mount 67. A roller 251 is mounted on the other end of the lever 248 and adapted to engage an extension 252 formed on the switch actuator 253. The lower end of the switch actuator 253 includes a forwardly extending lug 254 adapted to be engaged by the cam 255 of the cam and shaft locking assembly 226. The lug 254 is also adapted to engage in a notch 256 formed along the cam 255 for locking the camshaft in a predetermined position. Thus, the cam and shaft locking assembly constitutes a locking disc or wheel that coacts with the switch actuator 253 for locking the shaft 66 in a predetermined position, and coacts with the switch actuator to maintain same in depressed position, when the lug 254 is riding on the cam 255. To aid in guiding the lug 254 into the notch 256, a guide lever 257 is mounted along the side of the cam and locking assembly. The guide lever 257 is received on a stud 258 and resiliently held against the cam by means of a spring 259. The inner end of the lever 257 is bifurcated to straddle the hub 260 of the cam.

It may be appreciated that when the timer includes a certain number of switch blocks and switch assemblies, additional support for the shaft 66 intermediate its supported ends would be desirable. For this purpose, an additional shaft support 261, FIGS. 51 to 53 may be mounted at any one of the switch blocks 62 on the base 75. The additional shaft support 261 includes a base 262 having a positioning bar 263 at its underside for engagement with the slot 217 of the switch block base 75. Holes 264 are provided in the base 262 for freely receiving fasteners that may be self-tapped into the hole 219 of a switch block. A fastener so positioned is illustrated in FIG. 51 at 265. Extending upwardly and rearwardly from the support base 262 is an arm 266 having a hook-shaped end 267 adapted to receive a spacer 223 within which the camshaft 66 rotates. Any number of additional shaft supports may be provided, depending upon the length of the shaft. The shaft support 261 would also be molded of a suitable plastic.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

We claim:

1. In a timer, a plurality of molded plastic interlocking switch blocks, a plurality of switches and coacting switch actuators mounted on said blocks, each switch block including a base and an upstanding arm, the upstanding arm of one switch block coacting with an upstanding arm of the immediately adjacent switch block to define a mount for a switch and a switch actuator, an end mount at one end of the blocks including a base and an upstanding arm for coacting with the endmost block to define a mount for a switch and switch actuator, removable holddown means for holding the switches and switch actuators in position, bearing means on said end mount for supporting a camshaft, end plates at the opposite ends of said switch blocks and the end mount, tie rods extending through said switch blocks, the end mount and the end plates, fastening means on the ends of said rods holding the switch blocks, end mount and end plates together, a camshaft supported on said end mount and by an end plate, a plurality of adjustable cam means on said camshaft one each for each of the switch actuator and switch combinations, and a timing motor for driving said camshaft.

2. In a timer as defined in claim 1, wherein each interlocking switch block base includes socket means on one side and socket member means on the other side, so that socket means of one switch block mates with socket member means of an adjacent switch block.

3. In a timer as defined in claim 2, wherein said end mount base includes socket means on one side and socket member means on the other side for interlocking coaction with a switch block and an end plate.

4. In a timer as defined in claim 3, wherein said end plates include socket or socket member means for interlocking coaction with said switch blocks and said end mount.

5. In a timer as defined in claim 1, wherein each interlocking switch block upstanding arm includes bearing sockets for supporting said switches and bearing sockets for pivotally supporting said switch actuators.

6. In a timer as defined in claim 5, wherein said bearing sockets open upwardly and the sockets pivotally supporting the switch actuator and at least part of the sockets supporting said switches are closed by said holddown means.

7. In a timer as defined in claim 1, wherein the upper ends of said switch block upstanding arms include locating means for said holddown means, and said holddown means includes guide means coacting with said locating means for precisely positioning said holddown means on said arms.

8. In a timer as defined in claim 1, wherein said holddown means is molded of plastic and said end plates are metal die cast.

9. In a timer as defined in claim 1, wherein said cam means includes a fixed cam frictionally mounted on said shaft and an adjustable cam frictionally mounted on said fixed cam, whereby time interval and sequencing operation of said switches may be adjusted.

10. In a timer as defined in claim 9, wherein said cams include graduated scale means for setting time interval and sequencing operation of the switches, and are of molded plastic.

11. In a timer as defined in claim 1, wherein said switches actuators include a metal die-cast body and sintered bronze rollers mounted thereon engaging the plastic cams.

12. In a timer as defined in claim 1, and switch bracket means mountable on the switch block base for supporting a second bank of switches and switch actuators, said switch bracket means including a plurality of switch brackets each including a base and an upstanding arm, the base having means thereon coacting with means on said switch block base for aligning the switch brackets relative the camshaft to support the switches and switch actuators in operative relation to said camshaft.

13. In a timer as defined in claim 1, and a shaft support including a base and a shaft hanger, and means on said shaft support base coacting with a switch block base for mounting same to align the hanger with respect to the general axis of the camshaft.

14. In a timer as defined in claim 1, and a frictional coupling between said timing motor and said camshaft.

15. In a timer as defined in claim 1, and a magnet assembly base between the end mount and adjacent end plate coaligned with the bases of said switch blocks, a magnet assembly on said base, a combined cam and camshaft positioning device on said camshaft, a switch actuator and latching member mounted on said adjacent switch blocks to coact with said combined cam and camshaft positioning device, and actuating linkage between said magnet assembly and said switch actuator and latching member.

16. In a timer as defined in claim 15, wherein said actuating linkage includes a lever pivotally mounted on the end mount in driven engagement with the magnet assembly and in driving engagement with said switch actuator and latching member.

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