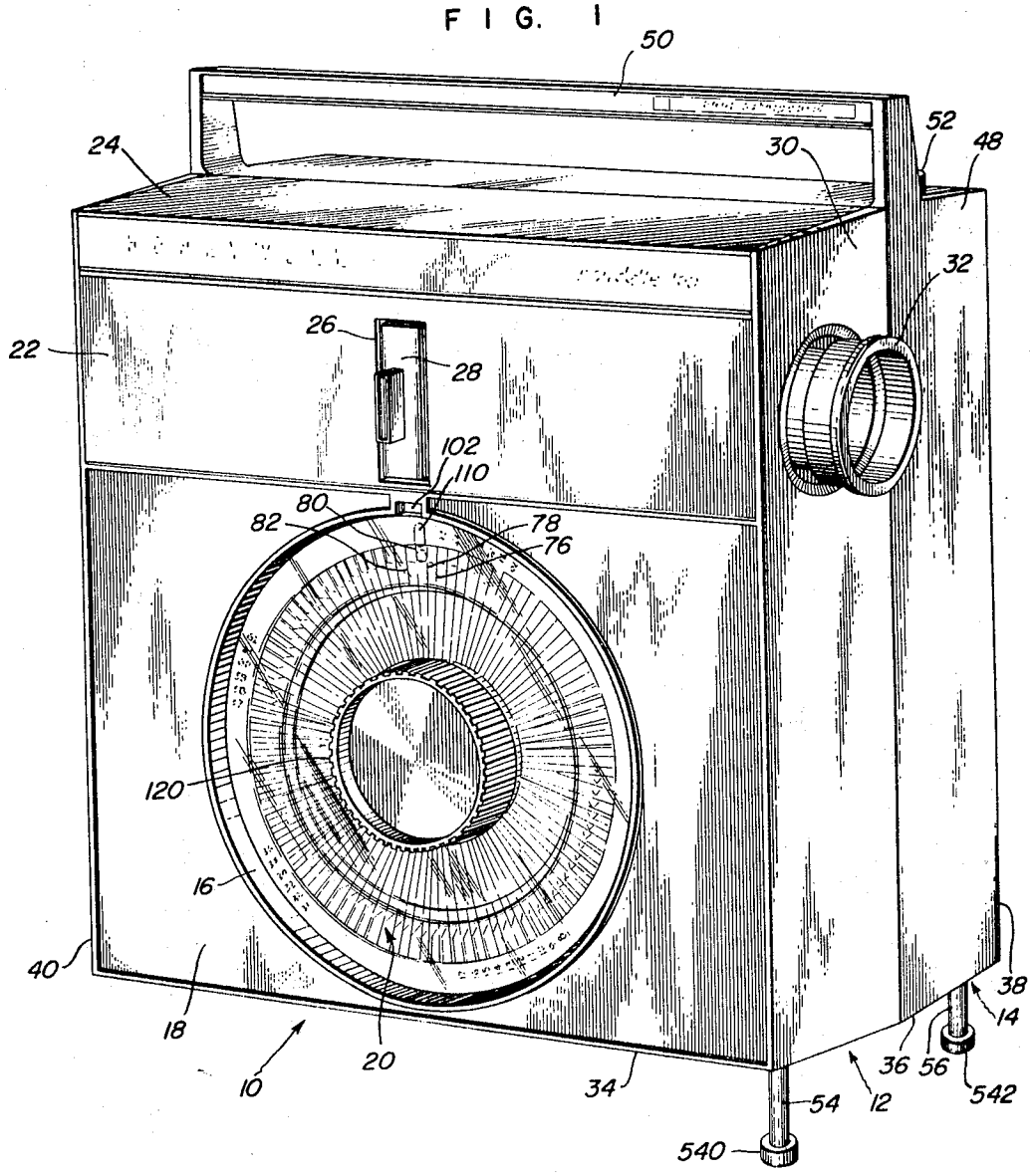
July 15, 1969 J. A. BARING 3,455,441

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FIG. 1



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FIG. 2

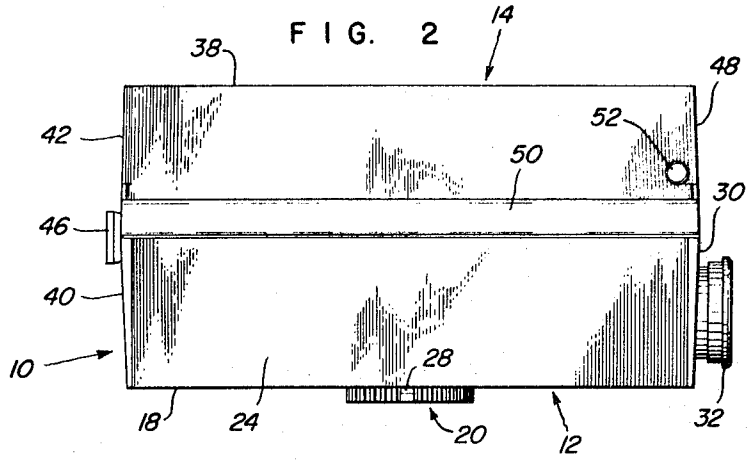


FIG. 3

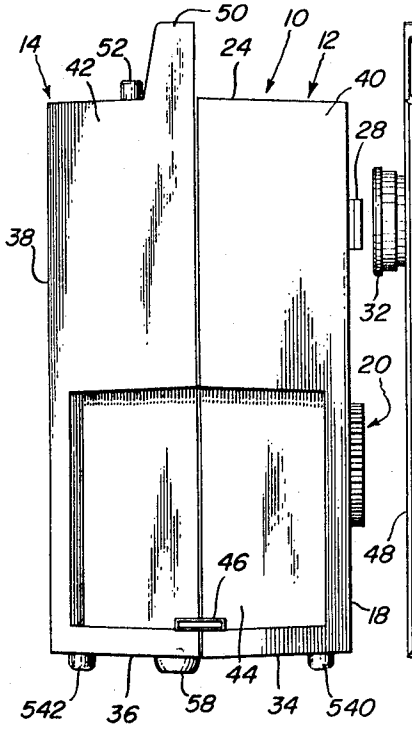
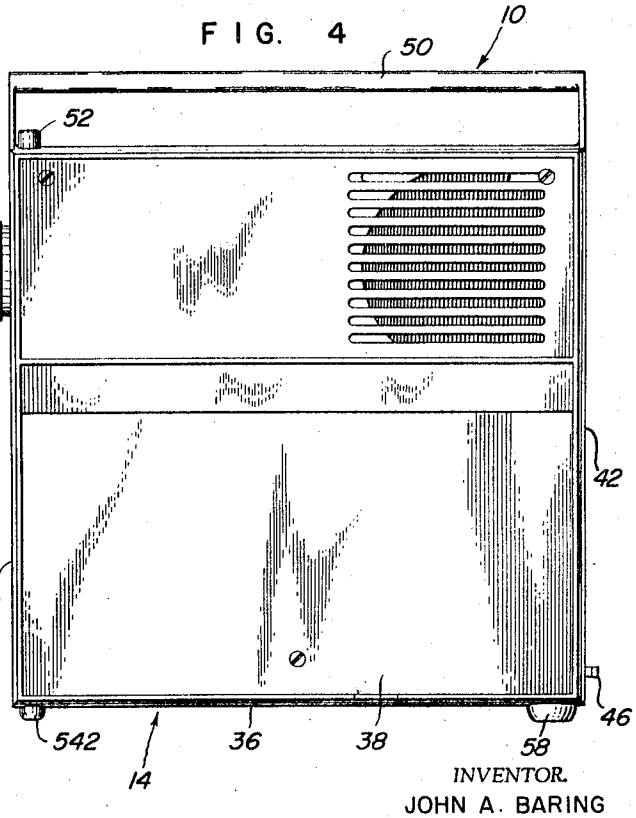


FIG. 4



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FIG. 5

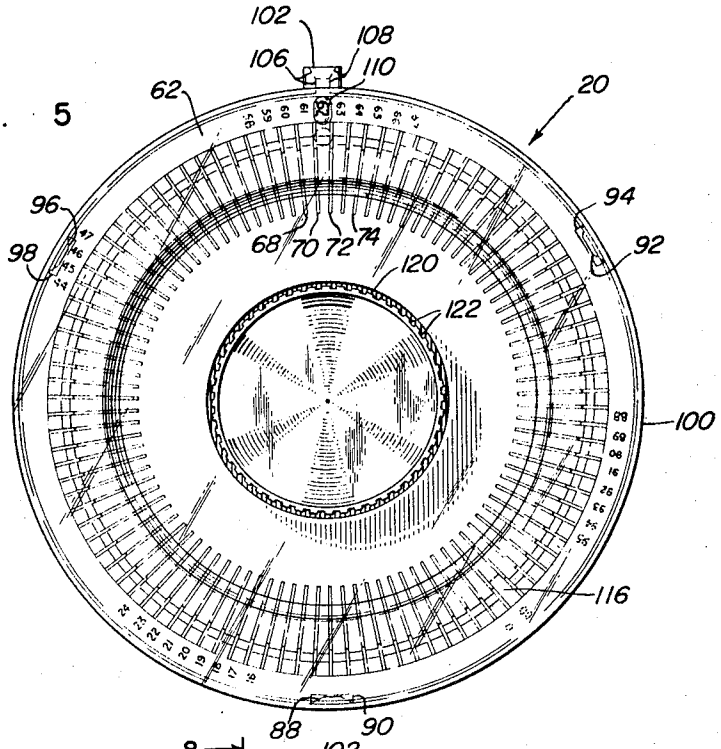
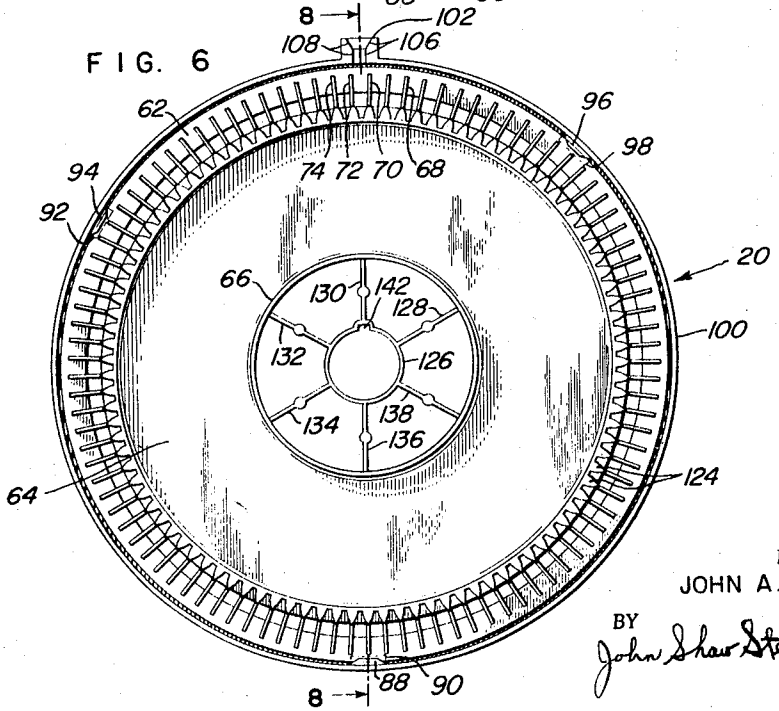


FIG. 6



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FIG. 7

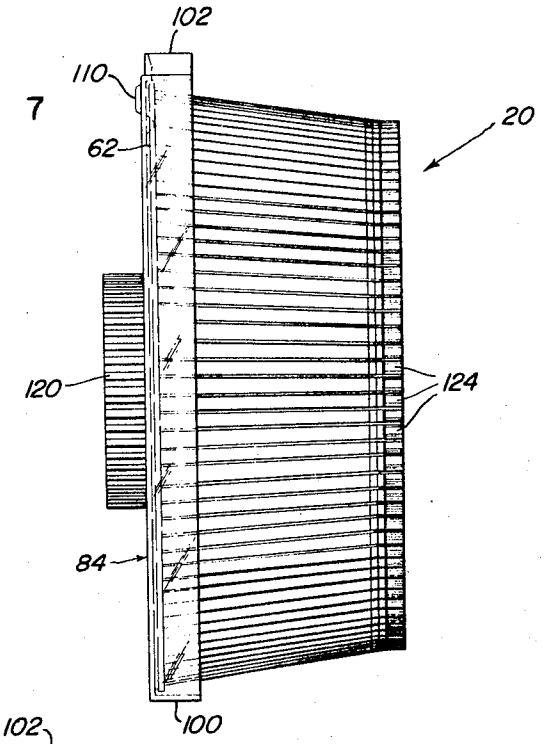
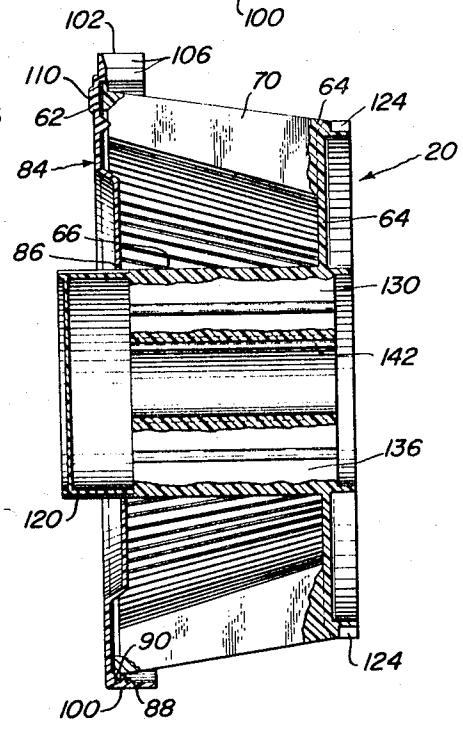


FIG. 8



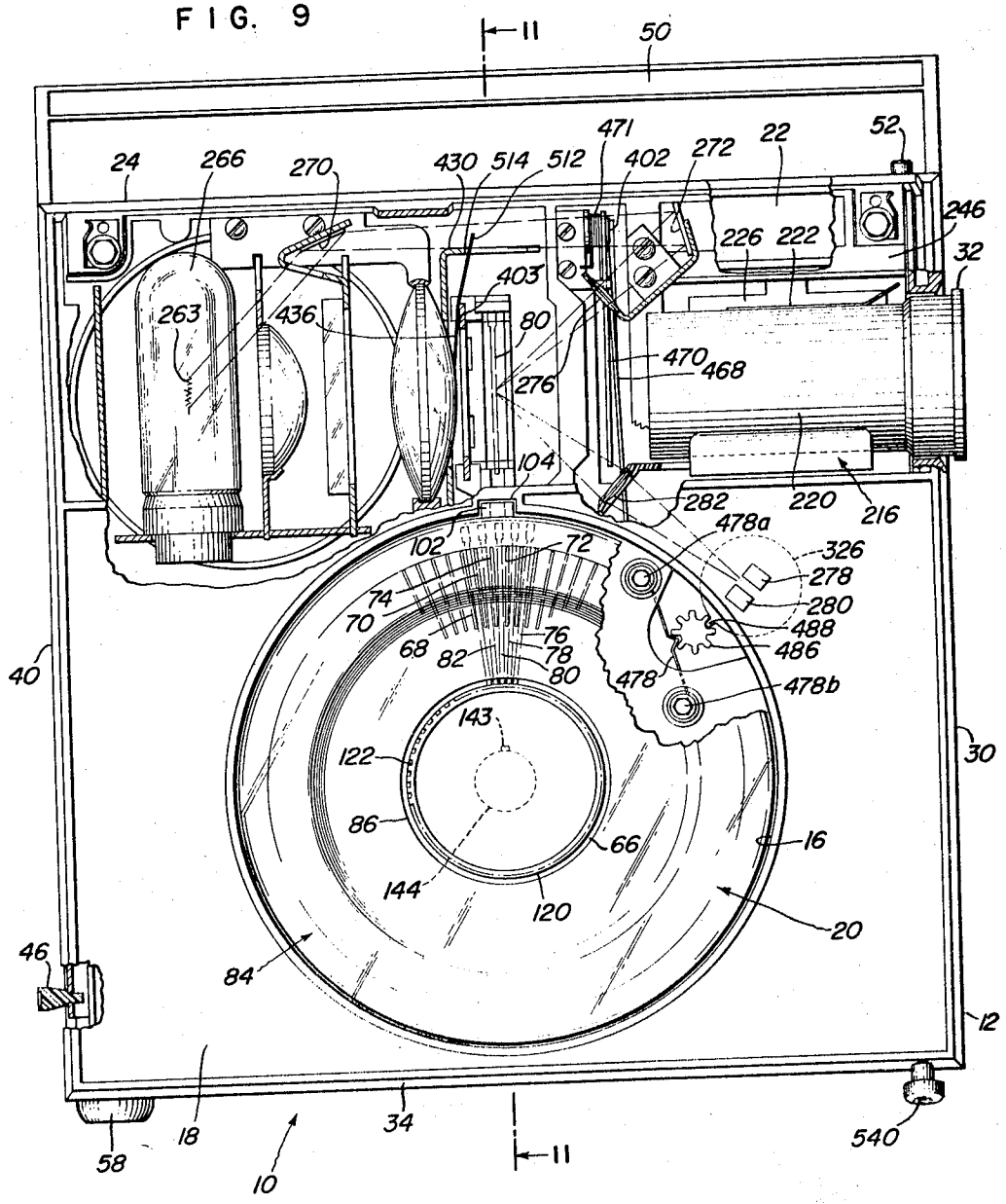
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FIG. 9



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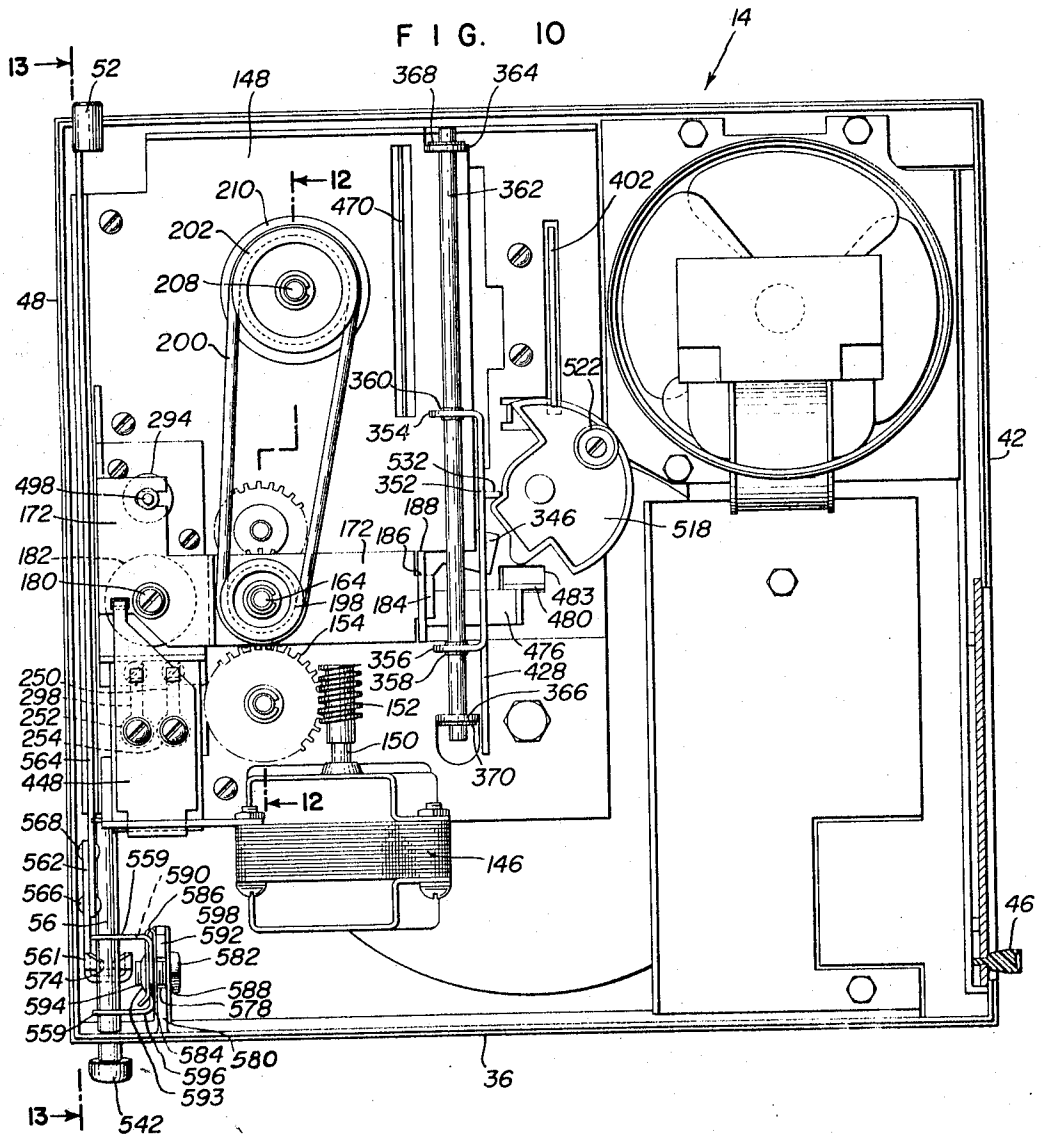
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FIG. 10



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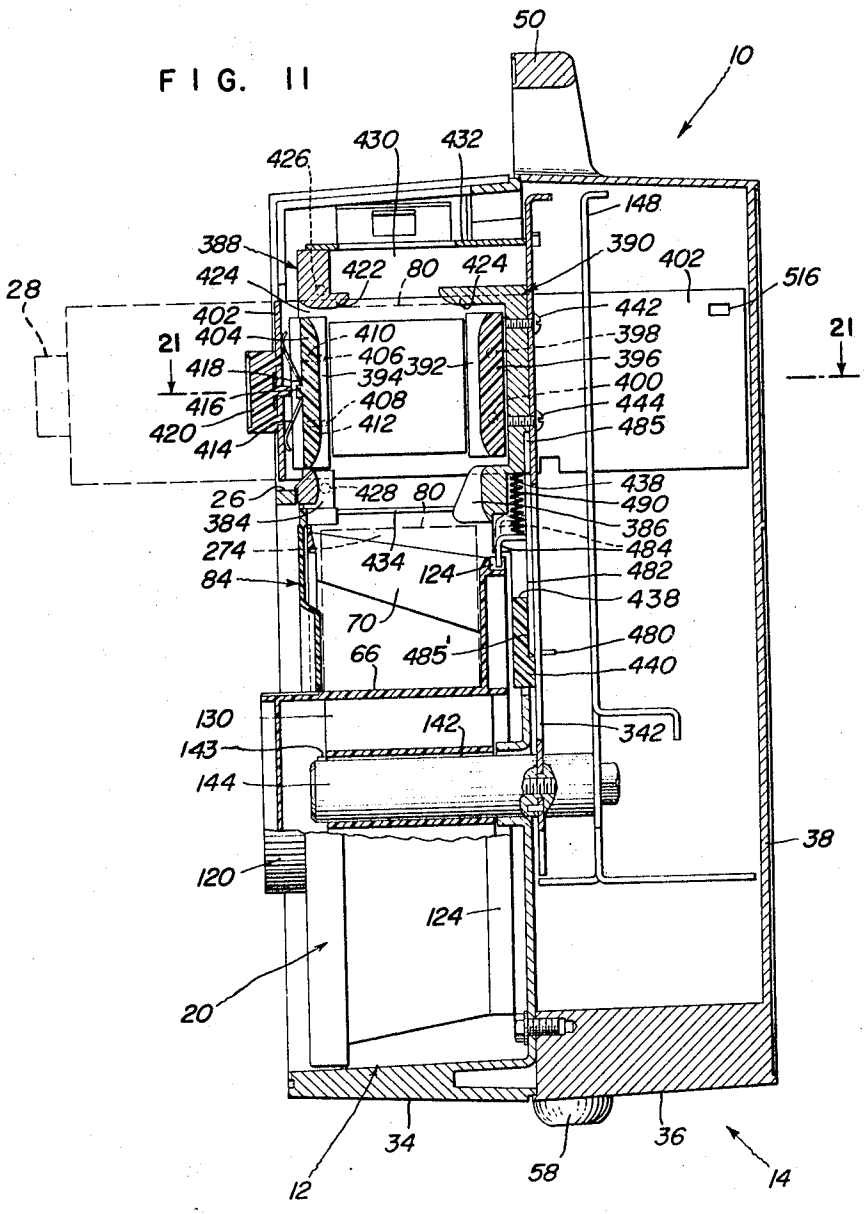
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FIG. 11



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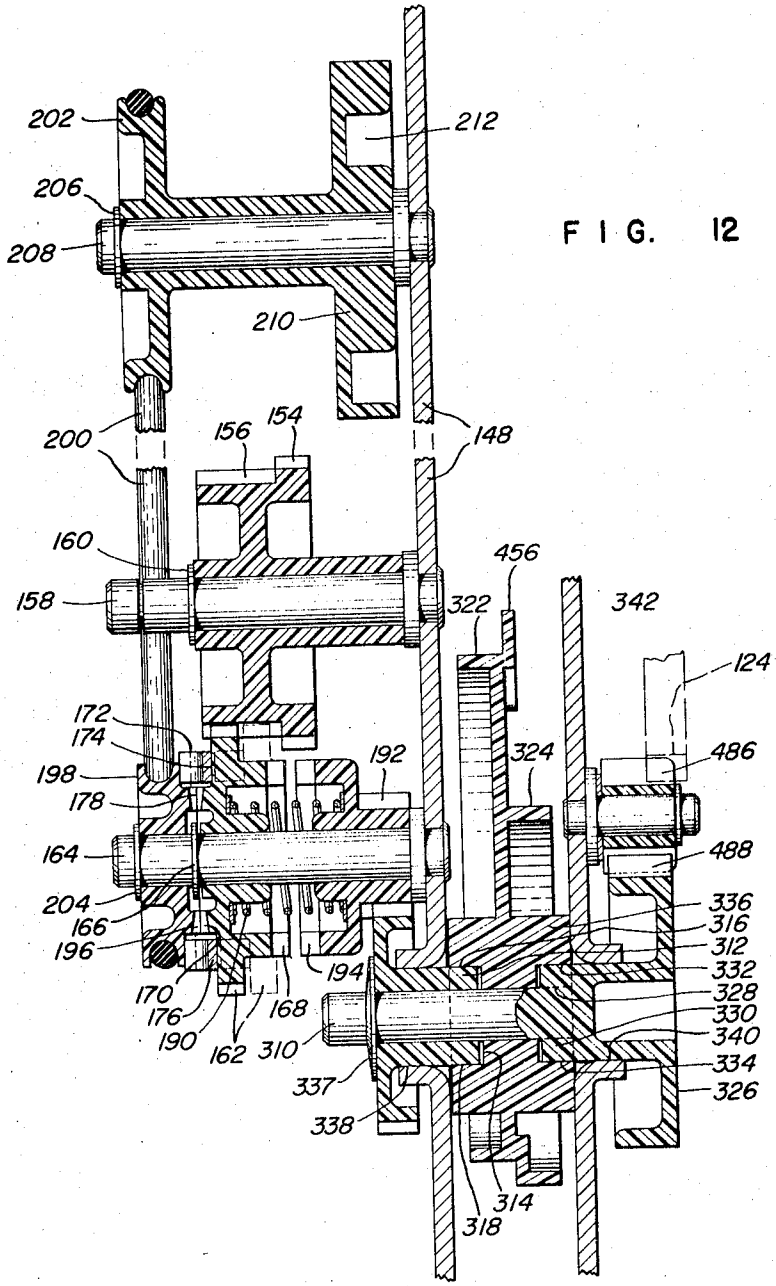


FIG. 12

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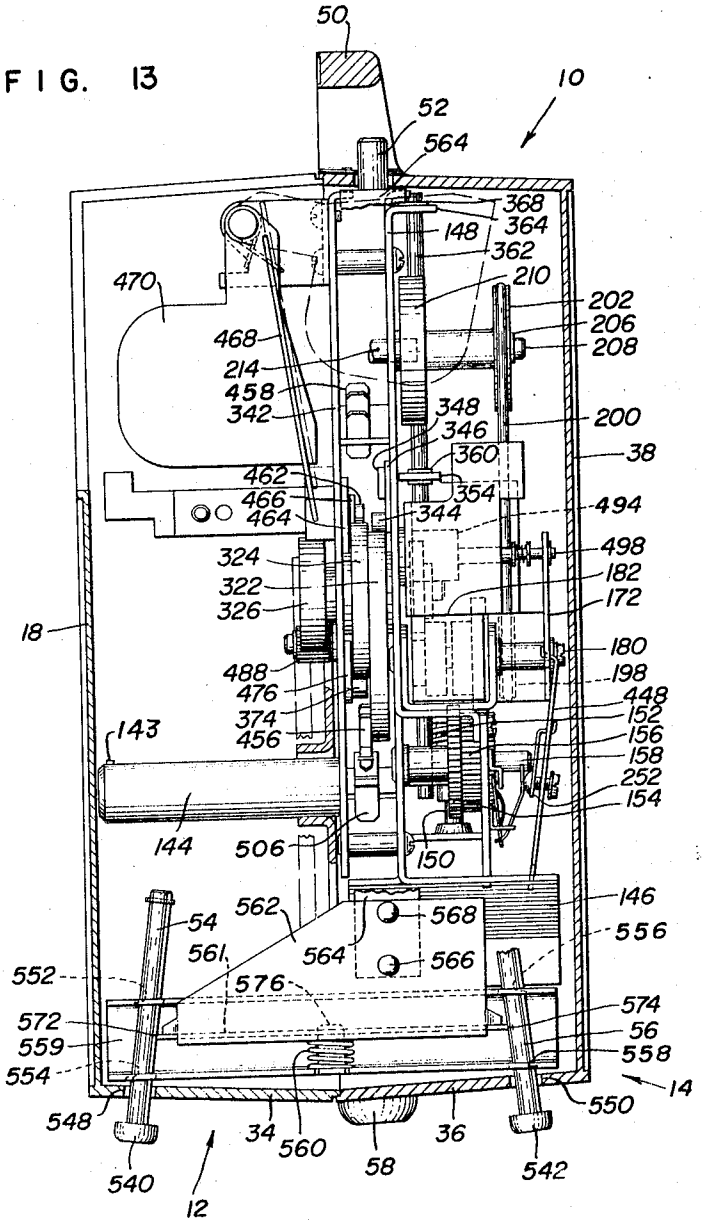
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FIG. 13



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FIG. 14

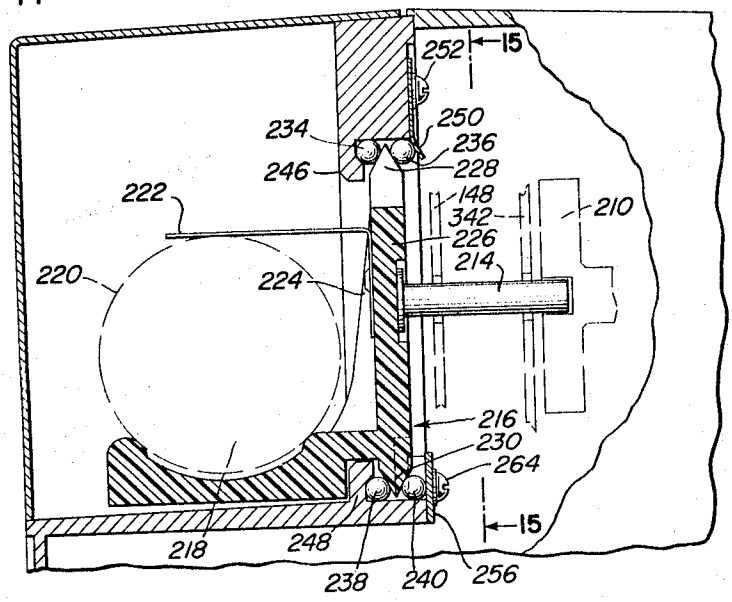
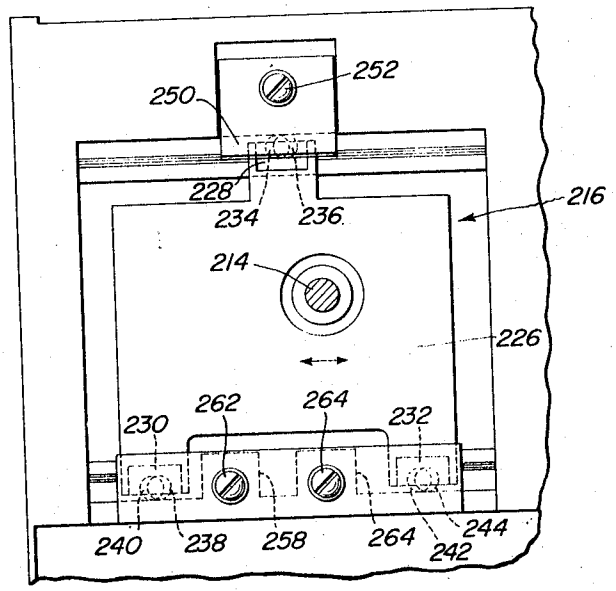


FIG. 15



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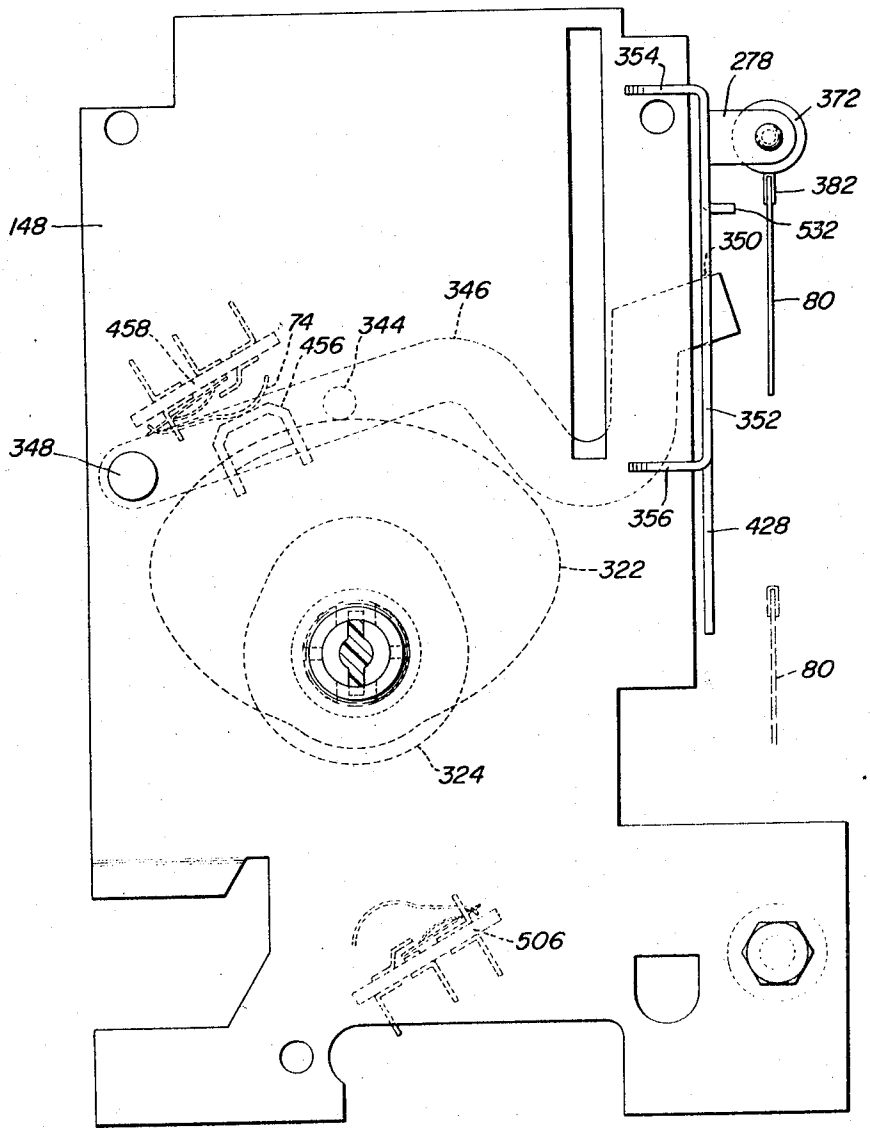
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FIG. 16



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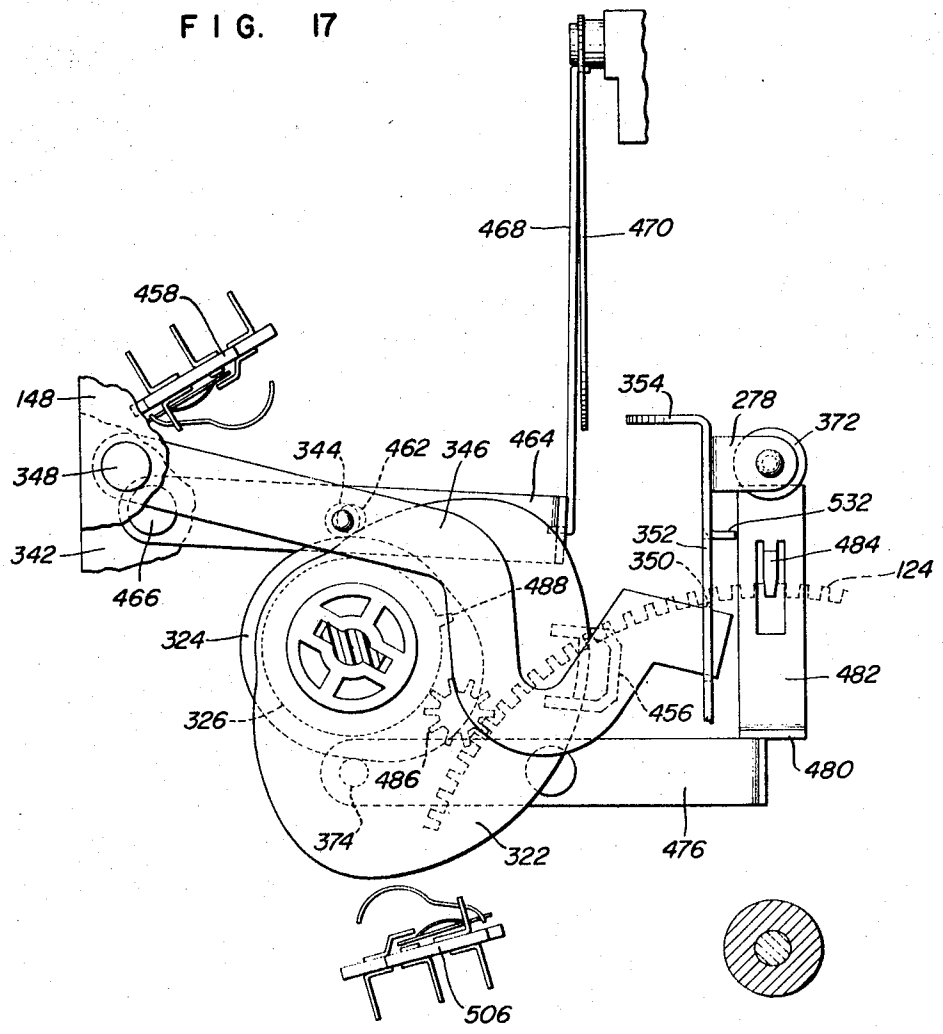
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FIG. 17

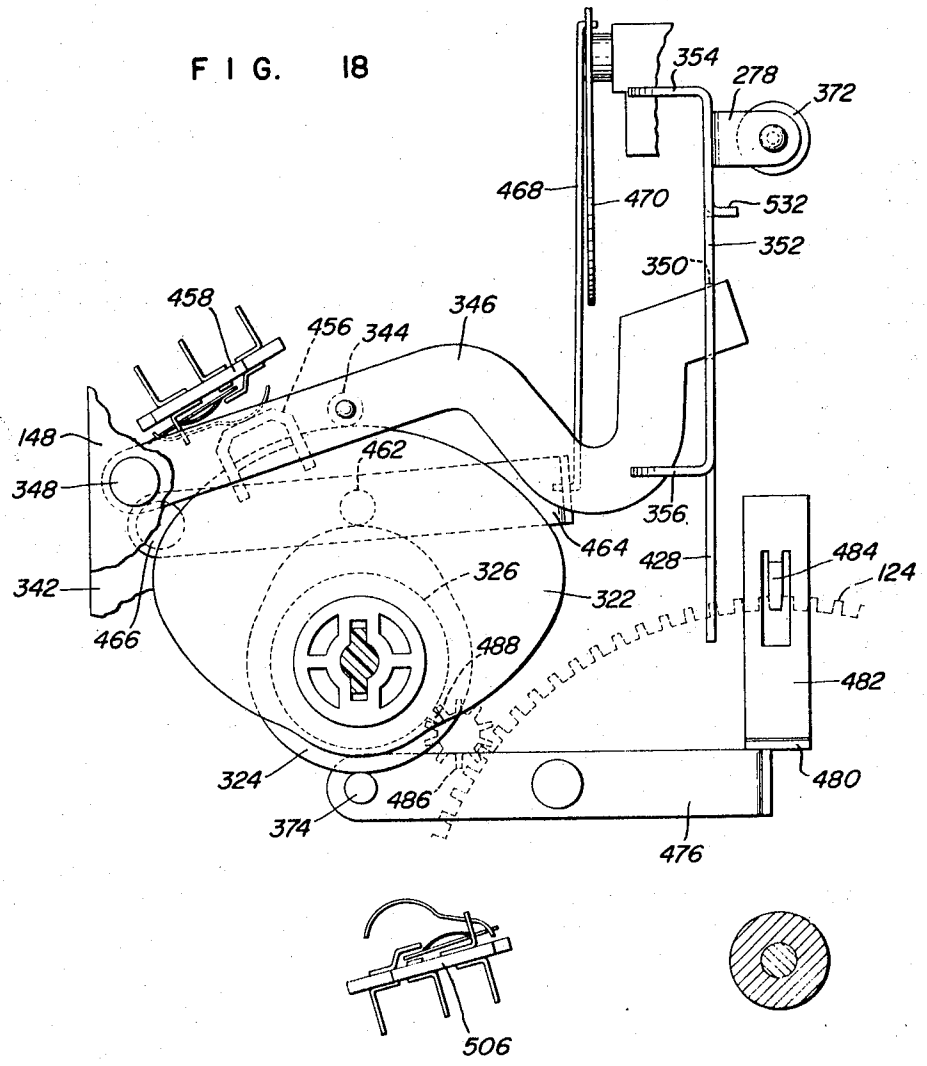


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FIG. 18



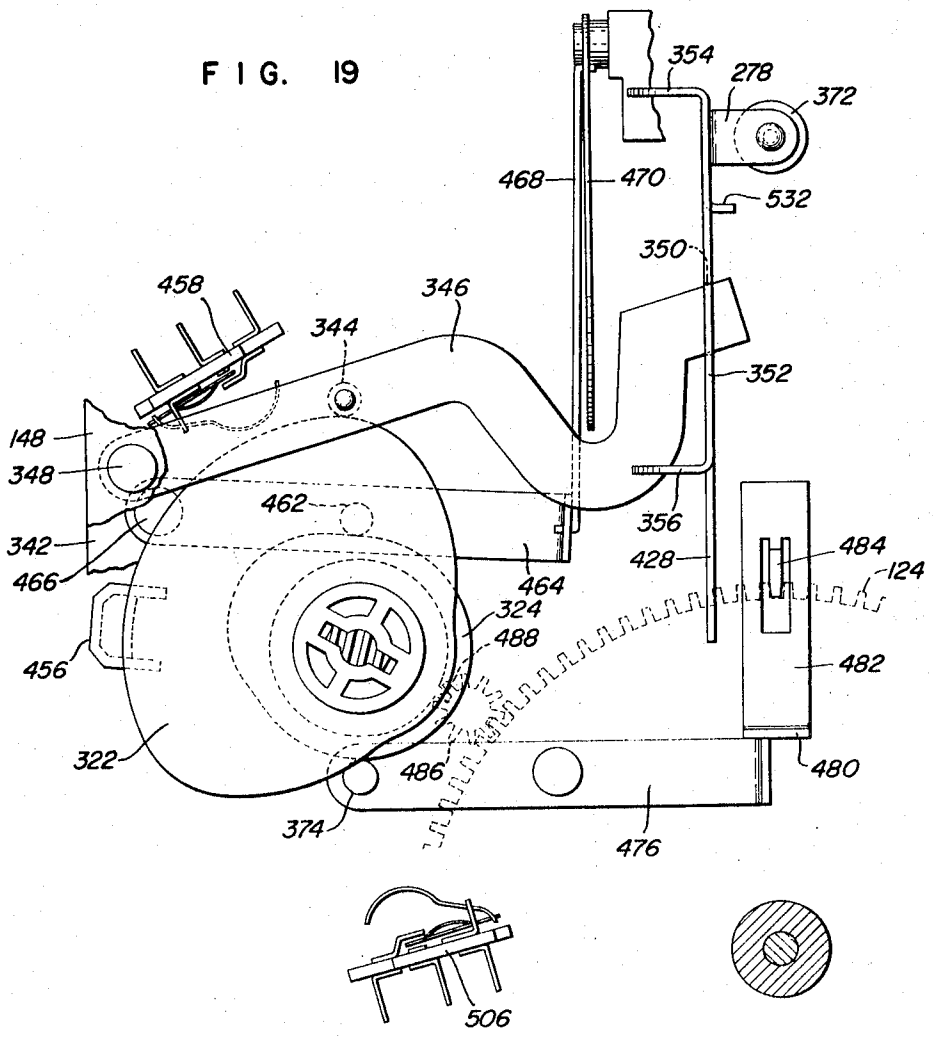
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FIG. 19



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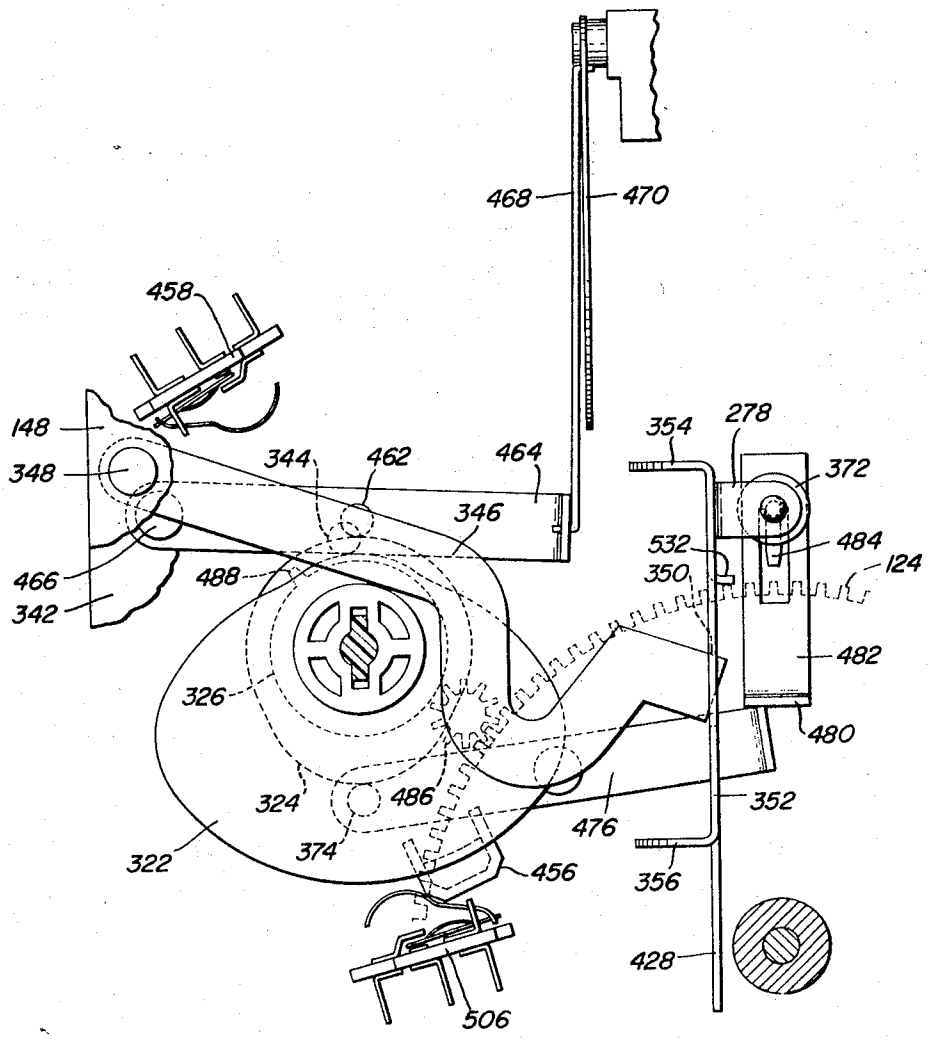
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FIG. 20



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FIG. 21

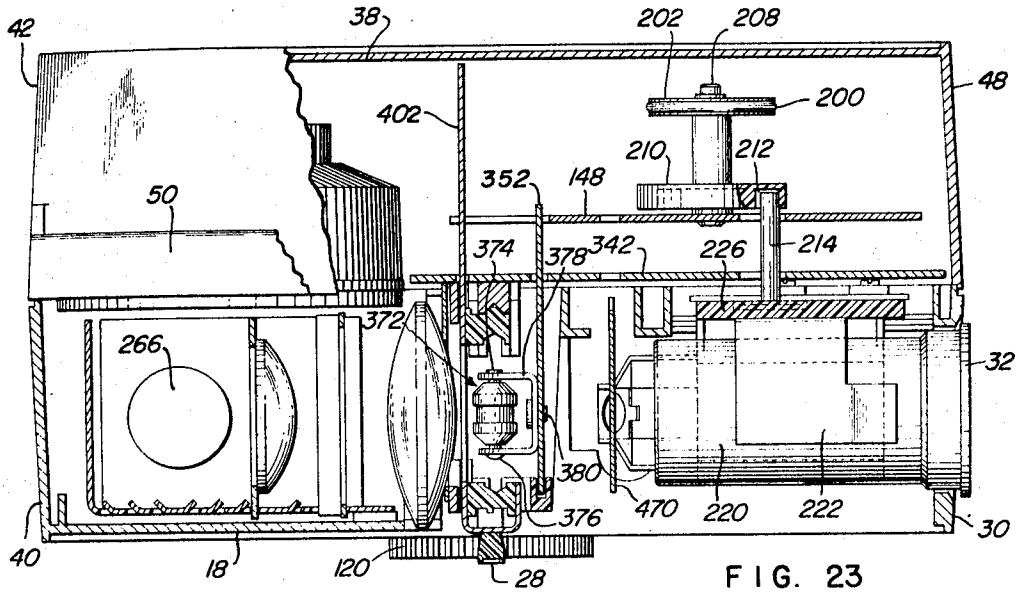


FIG. 22

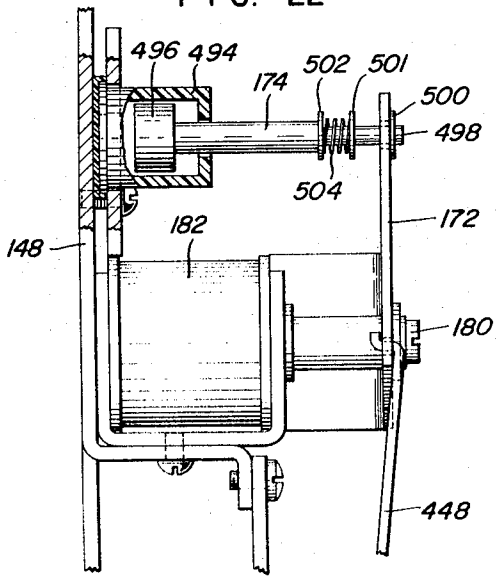
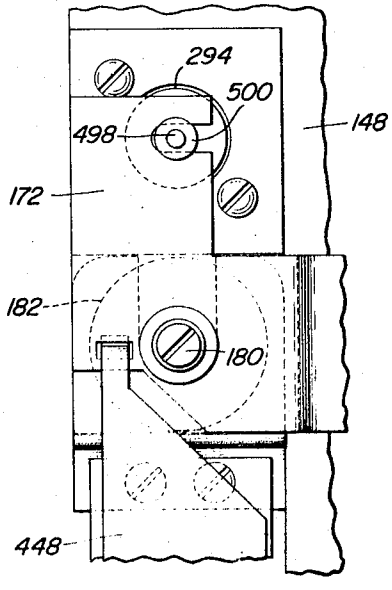


FIG. 23



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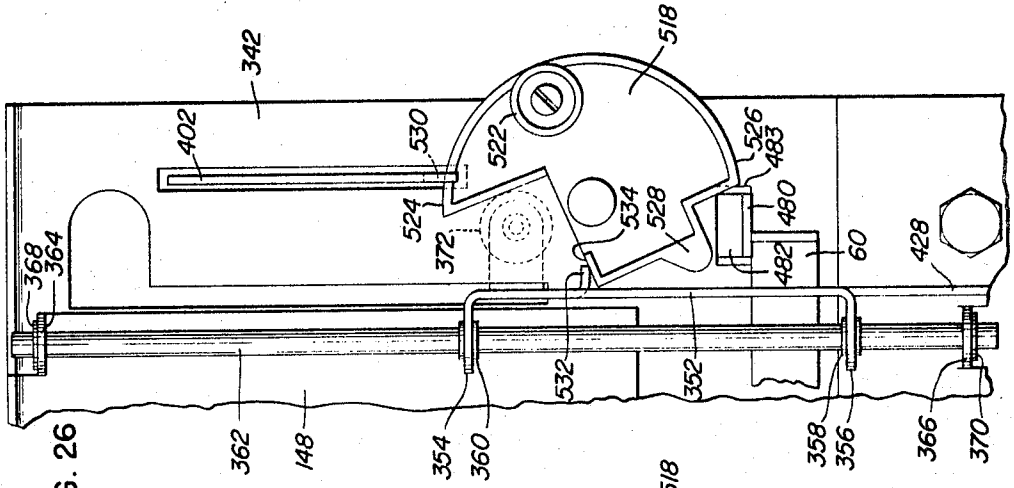


FIG. 26

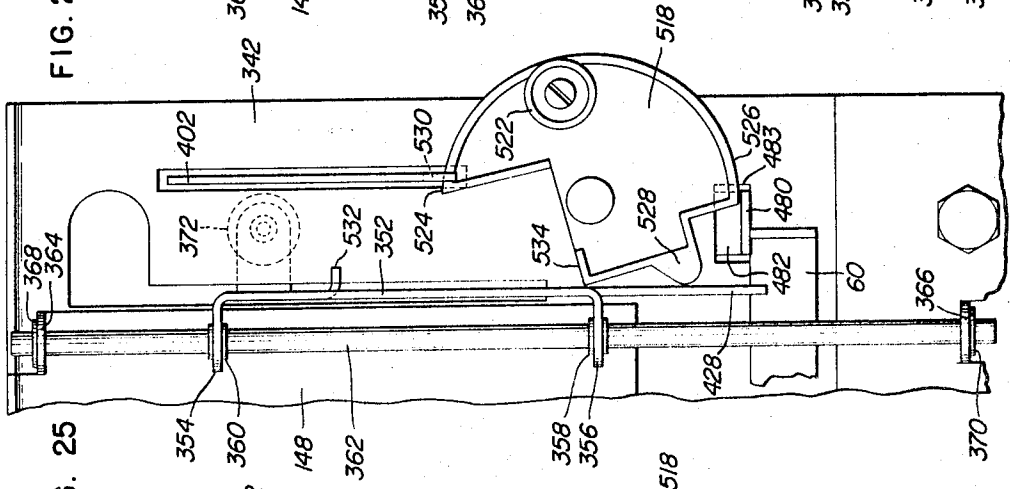


FIG. 25

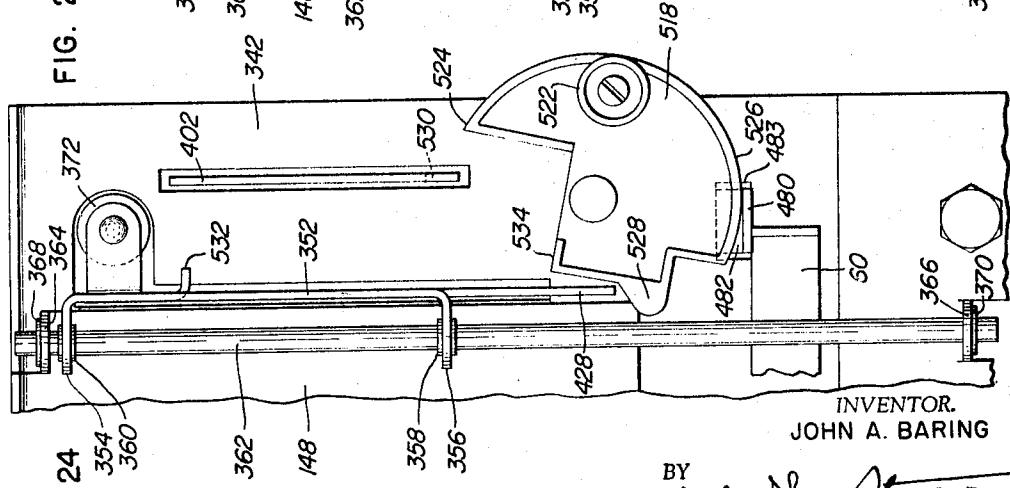


FIG. 24

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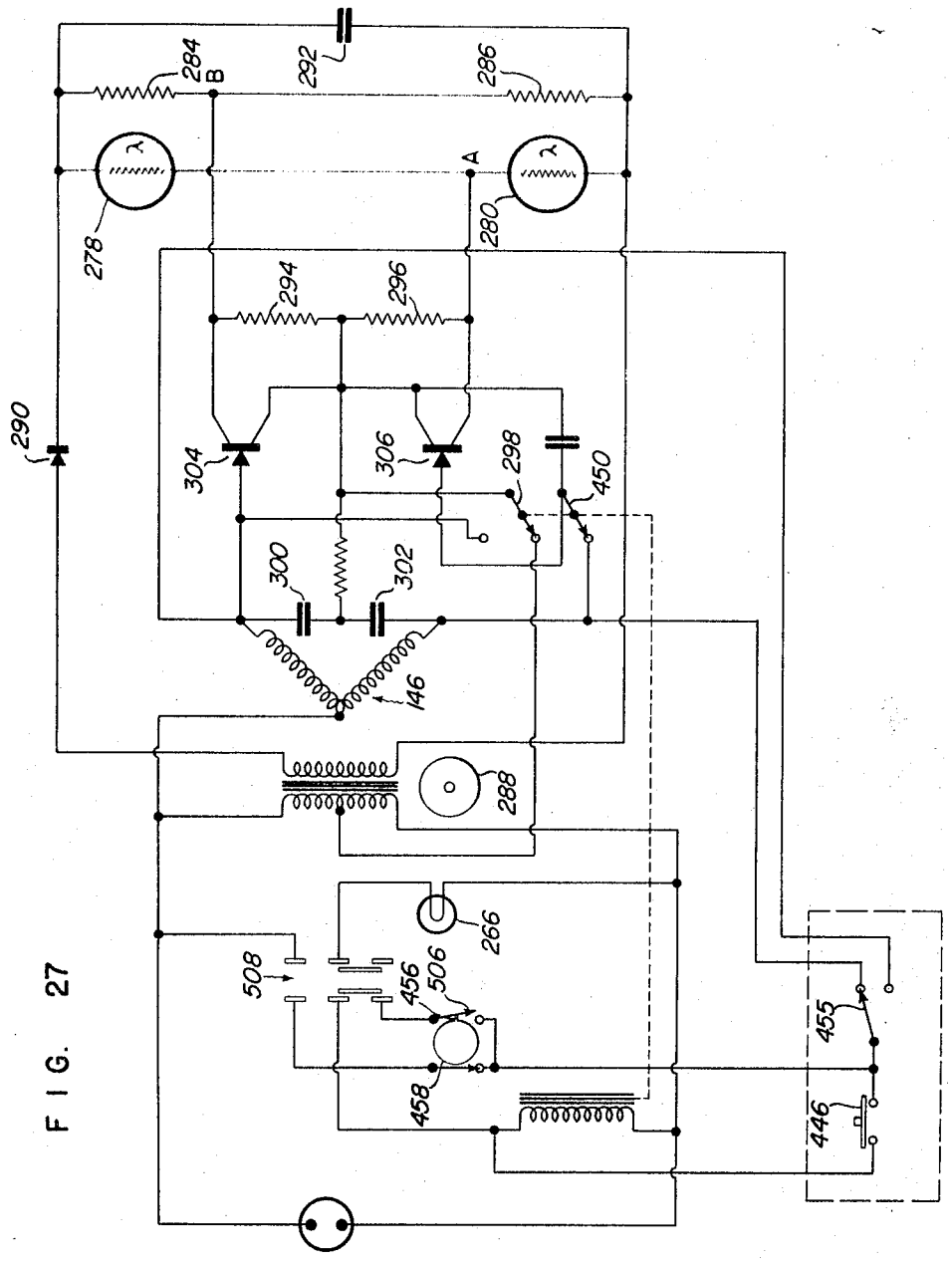


FIG. 27

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United States Patent Office 3,455,441 Patented July 15, 1969

3,455,441

PROJECTING APPARATUS

John A. Baring, Golden, Colo., assignor to Honeywell Inc., Minneapolis, Minn., a corporation of Delaware

Original application Aug. 16, 1965, Ser. No. 479,827, now Patent No. 3,359,667. Divided and this application July 12, 1967, Ser. No. 660,854
Int. Cl. B65d 1/34; G09f 11/30
U.S. Cl. 206—73 9 Claims

ABSTRACT OF THE DISCLOSURE

A compact slide projector tray having a front and back spaced apart annular face portions attached to a central hub. A series of radially positioned spaced-apart spacer plates extending between the front and back face portions to guide the inner end of the slides inserted therein into contact with the outer surface of the hub and into contact with adjacent slides positioned therein.

This is a division of application Ser. No. 479,827 filed Aug. 16, 1965, now U.S. Patent No. 3,359,667.

The present invention relates to a photographic slide tray projector.

More specifically, it is an object of the present invention to disclose a compact, thin line projector having a ring-shaped wall extending inwardly from the front of the projector to receive a removable rotary slide tray therein.

It is another object of the present invention to disclose a rotatable slide tray for the aforementioned projector that is provided with a series of unique, abnormally short, radially oriented spacer plates adjacent its outer circumferential rim to allow the inner ends of slides inserted therebetween to be mounted in extremely close proximity with one another adjacent the hub of a slide tray, thereby enabling many more slides to be mounted in a much smaller diameter tray than has heretofore been possible when other different types of slide tray constructions that are commercially available have been employed.

It is another object of the present invention to disclose a rotatable slide tray of the aforementioned type having a side ring portion thereof that has a circumferential portion forming an outer surface of the projector that is of a greater diameter than an opposite disc side portion that forms an inside projector portion to enable the slide to be more easily inserted and removed in a substantially frictionless manner into an in-gate projecting position than is possible when other conventional slide trays whose outer surface are of the same uniform diameter are employed for this purpose.

It is another object of the present invention to disclose a bendable transparent cup-shaped slide selecting indexing lid for the aforementioned tray that has a central cut out portion that is of a greater diameter than the hub of the tray about which the lid can be selectively rotated to line up a slotted rim slide emitting portion and a magnifying portion of the lid with any selected one of the slides in the tray.

It is another object of the invention to provide the aforementioned lid with several pairs of spaced-apart accurate lug portions protruding from an inner wall and base surface thereof to thereby allow the lid to be snapped into a slide retaining position on the tray and to provide guiding surfaces along which a rim surface of the tray can slide.

It is another object of the present invention to disclose a projector having a rotary slide tray of the aforementioned type in combination with a rotatably mounted moving magnet for easily attracting and lifting a slide from its radial position in the aforementioned tray in an outward direction away from the rim of the tray through the single slotted portion of the lid to an in-gate projecting position in a projector and with a great deal less wear and tear on the slide than is possible when other types of projector trays and slide lifting devices that are commercially available are employed for this purpose.

Prior to the present invention, it has been the practice to employ power actuating apparatus such as an electric motor to move a slide in a continuous pushing manner from an in-tray position to a projecting position and to employ this same power actuating means to return the slide in a continuous pulling manner to the in-tray position. Experience has shown that when these power actuating means are used to push and/or to pull a slightly bent slide in this continuous manner between its in-tray and its projecting positions, the bent portion of such a slide invariably has a tendency to become jammed and further bent between the power actuating means and a stationary portion of the slide guide through which the slide is being continuously moved.

Continuously operated power actuated slide moving devices of this type also often jam a slide in the projector without the operator's knowledge. When this occurs, the next slide that is continuously pushed into the projector is forced against the slide that is already in the projector and further bending of both slides occurs.

It is another object of the present invention to provide a slide moving apparatus for a projector which will vertically lift the top portion of the slide rather than using a continuous pushing force on a slide in moving it from its in-tray to its projecting position and thereby eliminate the aforementoned slide jamming problem that is present in other slide projectors that are commercially available.

It is another object of the present invention to disclose a slide moving apparatus for a projector which will return a slide that is in a projecting position to its in-tray position by allowing the slide to be dropped in a vertical plane toward and into the rim of its associated tray by the force of gravity acting on the slide rather than by the pulling force of a power operated slide moving device and thereby eliminate the aforementioned slide jamming that occurs when the aforementioned power actuated slide moving devices are used.

A better understanding of the present invention may be had from the following detailed description when read in connection with the accompanying drawings in which:

FIGURE 1 shows a prospective view of the projector;

FIGURE 2 is a top view of the projector;

FIGURE 3 is a left side view of the projector;

FIGURE 4 is a back view of the projector;

FIGURE 5 shows in detail a front view of a circular tray that is retained within the aforementioned projector;

FIGURE 6 is a back view of the tray;

FIGURE 7 is a side view of the tray;

FIGURE 8 is a section taken along the line **8—8** of FIGURE 6 with the top front plate removed;

FIGURE 9 shows a front view of the projector with its back plate removed;

FIGURE 10 shows a rear view of the projector;

FIGURE 11 shows a vertical section taken along section line **11—11** of FIGURE 9;

FIGURE 12 is a sectional view taken along the line **12—12** of FIGURE 10;

FIGURE 13 is a view partially in section taken along the line **13—13** of FIGURE 10;

FIGURE 14 is a view showing the projector lens and how its associated cam-actuated lens carrier can move the lens from one position to another;

FIGURE 15 is a view along line **15—15** of FIGURE 14 showing the right end view of the lens carrier;

FIGURE 16 is a view of the main and secondary cams shown in FIGURES 12 and 13;

FIGURE 17 shows the position of the slide-lifting drive bar and shutter as this cam-driven, magnet-carrying drive bar is starting to move the slide in an upward position from the tray;

FIGURE 18 shows the "show" position of the slide lifting drive bar and shutter as the aforementioned cam-driven, magnet-carrying drive bar has moved the slide into an in-gate slide projecting position;

FIGURE 19 shows the position of the slide-lifting drive bar and shutter as this cam-driven, magnet-carrying drive bar is starting to let the slide be returned by gravity to the tray;

FIGURE 20 shows the position of the slide-lifting drive bar and shutter as this cam-driven, magnet-carrying drive bar has moved the slide back into its original slide tray position and the tray is being rotated to bring the next slide in the tray to a twelve o'clock position;

FIGURE 21 shows a top plan view of the slide guides as taken along the line **21—21** of FIGURE 11 and how a movable permanent magnet, such as is shown in FIGURES 16 and 25, is attached to a slide;

FIGURE 22 shows how a damping device can be connected to the solenoid actuator shown in FIGURES 10 and 13;

FIGURE 23 shows a right end view of FIGURE 22;

FIGURE 24 shows an up or "show slide" position of the index lock cam and its associated linkage;

FIGURE 25 shows the lock cam of FIGURE 24 rotated counter-clockwise to a position in which no editing of the slides can take place;

FIGURE 26 shows the drive bar at its lowermost position and its lug thereof as having rotated the interlock cam further in a counter-clockwise direction;

FIGURE 27 is a circuit diagram showing the relationship that exists between all of the electrical components disclosed in FIGURES 9, 10, 13 and 16.

The rotary slide projector **10** shown in FIGURES 1–4 of the drawing is comprised of a front half casing portion **12** and a rear half casing portion **14**. The front half casing portion **12** has a ring-shaped wall **16** extending inwardly from a lower front surface **18** thereof for retaining a rotary slide tray **20** therein. The upper part **22** and the top part **24** of the front casing portion **12** is of a separate angular single part construction and has a wall **26** forming an opening therein to accommodate the sliding of the slide editing gate **28** therethrough.

The right side **30** of the front half casing portion **12** of the projector **10** is shown having a projecting lens **32** extending therethrough. The entire base part **34** of the front half casing portion **12** is shown tapered in an upward and outward direction between the part that contacts the rear half casing portion **14** and the portion of the base that contacts the lower front surface **18**.

The entire base part **36** of the rear casing portion **14** is also shown tapered in an upward and outward direction between the part that contacts the front half casing portion **12** and the portion of the rear end of the base part **36** that contacts the lower end of the back surface **38** of the rear half casing portion **14**.

The upper left side of the projector **10** is formed by two contacting wall portions **40, 42** that form respective parts of the front and rear half casing portions **12** and **14**. The lower left side of the projector **10** is formed of a single slidable door plate portion **44** having a handle **46** thereon that can be moved in an upward vertical direction to a position that is immediately behind its contacting wall portions **40, 42**. This door **44** provides access to a compartment (not shown), that contains a slide tray loading switch, a slide showing switch and a switch for either showing the slides in tray in immediate consecutive forward manner, a switch for showing the slides in the tray in a reverse sequence and an electrical power plug-in wire connection which is necessary to supply an electrical current to the projector **10**.

The upper right and left side wall portions **42, 48** of the rear half casing portion **14** of the projector **10** have portions that are integral therewith which extend upwardly therefrom to form a projector handle **50**.

A push button **52** extends through an aperture **54** in the top surface of the rear half casing portion **14** of the projector **10** to move a linkage hereinafter described which will adjust the position of two legs **54, 56** against a level or non-level surface on which the projector **10** is placed.

These legs **54, 56** are shown extending through the respective tapered base parts **34, 36** of the front and rear half casing portions **12** and **14** while the projector **10** is pivoted about stationary resilient foot **58** that is shown in FIGURE 3. The tapered base parts will thus enable the projector to be placed in a position in which the front half of the casing portion is upward and spaced away from a non-level support surface or vice versa.

ROTARY SLIDE TRAY

The previously-mentioned rotary slide tray **20** shown in FIGURES 1 and 5–8 is complised of two space-apart circumferential side ring and disc portions **62, 64** that are of different diameters and that are integrally joined together at their central portion by means of a hub **66**.

A series of substantially equally spaced apart radially oriented spacer plates **68, 70, 72, 74** are also joined together in an integral manner with the outer circumferential side ring and disc portions **62, 64**. These spacer plates **67–74** are purposely positioned adjacent the circumferential ring and disc portions **62, 64** of the tray **20** in order to allow the inner end of the slides, for example the slides **76, 78, 80** and **82** shown in FIGURE 1 that are to be dropped from a position that is located outwardly from the peripheral portion of the tray into a load position so that their inner ends are in contact with the hub **66** and brought into extremely close proximity with one another.

It can thus be seen from FIGURE 1 that such a tray construction will enable many more slides to be mounted in a much smaller tray than has heretofore been possible when other types of commercially-available trays are used.

It can also be seen by observing FIGURE 1 that since the spacer plates, for example **68, 74**, are positioned between spaced-apart side ring and disc portions **62, 64** of the tray **20** that are purposely made of considerably different diameters, the slides can, therefore, be readily inserted and removed from the tray **20** in a substantially frictionless manner. Such a tray construction, therefore, considerably reduces the frictional slide spacer rubbing effect that has heretofore been encountered with trays that have side ring portions that are of the same diameter.

The rotary slide tray **20** is also provided with a bendable transparent cup-shaped slide selecting indexing lid **84**. The indexing lid **84** has a wall **86** forming an aperture in its central portion to enable the slide indexing tray **20** to be rotated about its outer hub portion **66**.

An inner surface adjacent the outer circumferential part of the lid **84** is provided with three pairs of arc-shaped lug portions **88, 90, 92, 94**, and **96, 98** which protrude from the inner side wall and the inner base surface of the cup-shaped lid **84**. The lug portions **88–98** are located in a position with respect to the ring portion **62** that allows the lid to be snapped into a slide retaining position on the ring portion **62**. These lug portions **88–98** also provide guiding surfaces along which the lid **84** can rotatably slide along the tray portion **62** when a slide indexing operation takes place.

The indexing lid **84** also has a circular flange portion **100** and a rectangular protuberance **102** that extends in an outward direction therefrom that acts as a removable twelve o'clock indexing key when inserted into

the slide **104** of the projector **10** that is shown in FIGURE 1 of the drawing. This protuberance **102** contains two spaced-apart wall portions **106, 108** that form a slot therein. The slot formed by the walls **106, 108** provides the only passageway in the lid **84** through which a slide in the tray **20** can be removed when the lid has been snapped onto the left side of the tray **20**.

The lid also contains a raised magnifying portion **110** which can be aligned with any one of the slide identifying embossed numbers, for example "62," that are formed on the flat ring portion **62** of the tray **20**.

A part of the space between these spacer plates **112, 114** identified as "00" on the tray is shown filled in at **116** so that no slide can be inserted therein or removed from the tray **20** when the tray is not being used and the side wall portions **106, 108** have been brought into side alignment with "00."

The entire front outermost peripheral surface **120** of the outer hub portions **66** of the tray **20** is shown containing a series of grooves **122** to form a hand grip by which the tray **20** can be rotated relative to the lid **84** and to allow any selected slide in the tray to be moved into alignment with the slide emitting slot **106, 108** in the lid **84**.

The entire rear outermost peripheral surface of the tray **20** contains a series of teeth **124** thereon for indexing which will be hereinafter described.

The outer hub **66** is joined to the inner hub portion **126** by means of a series of identical rib support members **128–138**. The inner hub portion contains a keyed-out slot **142** to allow the tray **20** to be slidably moved into the projector over a key **143** that is fixedly connected to the outer end of a stationary shaft **144** as is shown in FIGURE 11. This will require the rectangular protuberance **102** on the lid **84** to always be moved to its twelve o'clock or "0" position before the tray and the lid can be slid into its assembled position within the projector **10**. Once the tray **20** is assembled on the shaft **144** in the aforementioned manner the left end of the inner hub **126** will be moved to the right of the key **143** so that it can be rotated about the stub shaft **144**.

MULTIPLE FUNCTION OF MOTOR

The projector to be hereinafter disclosed in detail is unique in that it only requires a single split-phase electric motor having a single solenoid operated clutch to supply the necessary energy that is required:

(1) To actuate an automatic projecting lens focusing mechanism during one instant of projector time;

(2) To actuate a slide raising mechanism during another instant of projector time;

(3) To actuate a mechanism that will cause a shutter to be moved between the projector's light source and the projector's lens at another instant of time;

(4) To actuate still another mechanism for moving a tray locking tooth actuator out of engagement with an indexing gear on an outer ring portion of the tray after a slide that has been projected is returned by gravity to the tray, and;

(5) To actuate a tray moving mechanism that will rotate the tray through a preselected angle to a position in which the next slide to be shown is moved into a twelve o'clock position.

(1) Auto-focus function of motor

The A.C. motor **146** used to perform the aforementioned function is a split-phase type. The motor **146** is mounted on a rear chassis plate **148** and is best shown in FIG. 10 that discloses a rear view of the projector **10**. The shaft **150** of the motor **146** has a worm **152** fixedly mounted thereon to rotate therewith in a clockwise and counter-clockwise direction. The worm **152** is in mesh with a worm wheel **154** of a preselected diameter in order to act as a motor speed reducing unit. FIG. 12 shows the worm wheel **154** and a spur gear **156** that is integral therewith is freely mounted for rotation on a stationary stub shaft **158** which shaft is fixedly mounted on a stationary support plate **148**.

The gears **154, 156** are retained in position on the shaft **158** by means of a snap-on gear retaining ring **160**. The spur gear **156** is in splined driving engagement with a second spur gear **162** that, in turn, is mounted in a slidable and rotatable fashion on another stationary stub shaft **164**.

All of the worm and gear driving parts that have been previously described and which will hereinafter be described are constructed on a plastic material trade-named nylon, or from an equivalent material.

FIG. 12 shows that the second spur gear **162** is prevented from sliding toward the left end of the shaft by means of a snap-on gear retaining ring **166**. The gear **162** has a first series of circumferentially spaced-apart molded face clutch teeth **168** forming an annular right end face surface portion thereof and a second series of circumferentially spaced-apart molted clutch teeth **170** forming an annular left end surface thereof.

A lever **172** is shown in FIG. 12 in the form of a bent plate which has two V-shaped portions **174, 176** formed therein. The points of these V-shaped portions **174, 176** are shown in engagement with two opposite flat left side face portions of the gear **162**. A circular wall portion **178** of the plate lever **172** is shown between these V-shaped portions **174, 176** to form an aperture in the plate lever **172**.

FIGS. 10 and 13 show the left end of the plate lever **172** is connected for actuation by means of an actuating rod-shaped plunger **180** of a solenoid **182** that is, in turn, mounted on a chassis plate **148**. The other end portion **184** of the lever **172** is pivotally supported in a wall **186** forming a slot in a bent portion **188** of the chassis plate **148**.

When the motor **146** is used to perform an automatic focusing function the plunger **180** of the solenoid **182** will be moved to its outward position, the face of the spring **190** that is shown extending in compressing engagement between the right face of the gear **162** and the left face of the gear **192** that has clutch teeth **194** thereon will be in the solid line spring expanded position as shown in FIG. 12. Under this condition the clutch teeth **160** on the right face of the driven gear **162** will be retained in non-driving clutched-out engagement with the clutch teeth **194** of the gear **192** that is rotatably mounted on the stub shaft **164**. Under this condition the clutch teeth **170** of the motor driven gear **162** will be forced by the spring **190** into clutched-in driving engagement with the clutch teeth **196** on the right face of the pulley **198**. A belt **200** is then used to transmit the transmitted rotary motion of the motor **146** to a second pulley to **202**.

A snap-on retaining ring **204** is employed to retain the pulley **198** that is mounted to rotate about the shaft **164** from sliding off its left end and another similar retaining ring **206** is employed for the same purpose with the pulley **202** that is rotatably mounted on the stationary stub shaft **208**. The stub shaft **208**, in turn, is shown supported on an upper portion of the previously-referred-to chassis support plate **148**.

The face cam **210** of FIG. 12 is shown in FIGS. 13, 14 and 21 as having an eccentric grooved-out cam face portion **212** thereof in sliding rotating engagement with a metal cam follower pin **214** that is fixedly attached to a plastic L-shaped carrier-support member **216** for supporting the lower and right side portions of the barrel part **218** of a projecting lens **220**.

A metal spring plate **222** is attached by means of a rivet connection for example **224** to the vertical rectangular-shaped portion **226** of the L-shaped lens carrier-support plate **216** in order to maintain the lens **220** in a fixed position in the plate **216**. The upper end and the two lower ends of the substantially rectangular-shaped portion **226** each contain a part that is shown in FIGS.

14 and 15 terminating in a V-shaped end **228, 230, 232.** Each of the V-shaped ends **228, 230, 232** are supported by means of a pair of spheres **234, 236, 238, 240, 242, 244.**

Appropriate elongated L-shaped portions of the chassis **246, 248** are used as seating portions against which their associated spheres **234, 240, 244** can rotate. A bent spring plate **250** is shown attached to the chassis by screws **252, 254** so that the lens **220** can be moved axially in a forward or rearward direction with the L-shaped member **216** on the spheres **234–244.**

Another elongated rectangular metal strip **256** is shown attached to the chassis portions **258, 260** by screws **262, 264.**

It can be seen that the lens **220** can be driven in a forward and reverse axial direction in its L-shaped lens carrier-support member **216** to whatever distance the shape of the eccentric groove **212** in the face cam **210** is constructed to move its associated following pin **214.**

The auto-focus control system shown in FIG. 9 is basically similar to and operates in a similar manner as the automatic-focus control system disclosed in the Norman L. Stauffer patent application, Ser. No. 286,708 filed June 10, 1963, now Patent No. 3,249,001. The light rays from the projector lamp filament **263** of the illumination source **266** disclosed herein is reflected by the mirrors **270** and **272** and a reduced image of the filament **263** focused at the normal plane of the slide **80** by the fixed lens **276.** The reflected image is refocused in the plane of the photocells **278** and **280** by the lens **282** which is mounted on an extension of the projection of the previously-mentioned lens carrier **216.** Thus, if the slide **80** is displaced from the normal position, one or other photocells **278, 280** causes the previously-referred-to motor **146** to drive the aforementioned lens carrier **216** until the image is centered between the photocells **278, 280** again and the slide **80** is brought into focus.

Reference should now be made to the circuit diagram shown in FIG. 27. The two photo-conductive cells **278** and **280** form two arms of a bridge circuit, while the resistors **284** and **286** form the remaining two arms. An A.C. supply voltage from a transformer winding on the fan motor **288** is rectified by the diode **290** and filtered by the capacitor **292** and provides a D.C. voltage for the bridge circuit. When the illumination on the photocells **278, 280** is equal, the voltages at points A and B are equal and no current flows in the resistors **294** and **296** and no voltage is developed across them. When the light spot is displaced to one or the other of the photocells **278, 280** the resistance of that cell drops compared to the other cell and a difference in voltage appears between points A and B.

The split-phase motor **146** is supplied with power from a low voltage winding (25–30 volts) on the fan motor **288** through the switch **298.** Two capacitors **300, 302** are connected across the motor winding so that the winding is balanced with no phase shift between them. In this condition no power is developed by the motor **146.** Connected across each capacitor **300** and **302** is a silicon controlled rectifier **304, 306,** the gate of one being connected to point A, while the other is connected to point B. The center point of resistors **294** and **296** is connected to the common cathodes of the two silicon-controlled rectifiers **304** and **306.** The polarity of the voltage difference between A and B will depend on which of the photocells **278** and **280** is more strongly illuminated and this, in turn, will determine which of the two rectifiers **304** or **306** will conduct. With one rectifier **304** or **306** conducting, half wave voltage will be applied directly to that side of the motor winding so that a phase shift appears between the two windings and the motor **146** drives in the appropriate direction as previously explained until, via the mechanical optical system already described, the bridge is restored to balance.

(2) Slide raising machanism

When the motor **146** is employed to perform a slide raising function, the plunger **180** of the solenoid **182** will be energized to pull the plunger into the solenoid. When this occurs, the plate lever **172** that is connected to the outer end of the plunger **180** will be moved in the same general inwardly moving direction as the plunger about the chassis plate **188** on which its other end **184** is pivotally mounted. Movement of the lever **172** in this fashion will, in turn, cause its V-shaped portions **172, 174** that are in contact with the gear **162** to apply a force to the gear **162** in a direction that will move it from its solid line position to its dotted line position as shown in FIG. 12.

When the gear **162** is moved to its dotted line position, the spring **190** will be compressed to a greater extent than it was before this gear movement took place.

The movement of the gear **162** to this new dotted line position will cause the clutch teeth **170** on its left face to be moved to a disengaged-unclutched position with the clutch teeth **196** on the right face of the pulley **198** and will cause the clutch teeth **168** on the right face of the gear **162** to be moved into clutched engagement with the clutch teeth **194** of the gear **192.**

The gear **192** is shown in driving relationship with a gear **308** that is pressed fitted on a shaft **310** and coupled by means of two keys **312, 314** and its associated slot connections **316, 318** with the hub portion **320** of a first cam **322.**

A second cam **324** is molded as a single unit to the first cam **322** so that both cams **324** and **322** and the driving gear **308** rotate as a single unit. Cams **324** and **322** are preferably made of a suitable plastic material such as that tradenamed Nylon or an equivalent material.

The right end of the shaft **310** has a single tooth gear **326** mounted thereon that has a pair of spaced-apart keys **328, 330** that engage key slots **332** and **334** in the hub portion **336** at the right end of the cam **324** so that the rotary motion that is transmitted by the motor **146** and the aforementioned gearing to the cams **332, 324** can be transmitted by the cam **324** to a single tooth gear **326** which is preferably made of the same material as the cams **324, 322.** The left end of the shaft **310** has a retaining clip **337** thereon to prevent the shaft **310** from moving to the right.

From the above description it can be seen that the shaft **310,** the gear **308,** cams **322, 324,** and single tooth gear **326** are constructed to rotate as a single unit on the cylindrical punched-out wall surface portions **338, 340** of the chassis plates **148** and **342.**

As the main cam **322** is rotated during a slide lifting operation, it moves a pin follower **344** that is fixedly mounted on a drive arm **346** in an upward direction as shown in FIG. 16. As this operation takes place, the drive arm **346** will be rotated in a counter-clockwise direction about a rivet-shaped stub shaft **348** that is fixedly connected to the chassis plate **148.**

While this upward movement of the arm **346** takes place the upper free or right end of the drive arm **346** will be moved into lifting sliding engagement with the upper end of a wall **350** forming a slot in the drive bar **352.** The length of the wall **350** that forms this slot is purposely made of a greater height than the height of the right end of the drive arm **346** in order to provide freedom of movement for the different portions of the free end of the arm **346** that are brought into alignment with the slot as it is moved about its pivot.

The drive bar **352** is shown in FIG. 10 as having two bent apertured bar portions **354, 356** that have cylindrically-shaped, nylon-bearing inserts **358, 360** therein. These bearings will enable the drive bar **352** to be easily slideably moved by the drive arm **346** along the support shaft **362** when clockwise or counter-clockwise rotation is transmitted by the reversible motor **146** to the cam **322** as shown in FIGS. 16–20.

The shaft **362**, in turn, is supported against sidewise movement in two apertured wall portions **364**, **366** of the chassis plate **148** and also supported against up and down movement by means of snap-on retaining rings **368**, **370** as shown in FIG. 10.

FIG. 21 shows a rotatable magnet **372** having cylindrical portions **374**, **376** extending from its opposite ends that rotatably mount the magnet **372** on a U-shaped member **378**. The magnet **372** employed herein may be of the same basic type as that disclosed in the Robert F. McCammon Patent 2,999,424 issued Sept. 12, 1961. The aforementioned U-shaped member **378** is, in turn, fixedly connected to the drive bar **352** by means of a buttonhead rivet **380**.

When the motor **146** is driving the cam **322** in a forward direction as shown in FIGS. 9, 16 and 11 the magnet will lift the metal clip **382** and the slide **80** to which it is clamped in an upward direction between this slide's lower dotted line or in slide tray position to its slide projecting position.

This slide raising action will take place as the roller **344** is brought into contact with the outer surface portion of the cam **322** whose radial distance from its rotating center is being gradually increased to a point on the cam that is at the farthest radial distance from its center of rotation. When the cam **322** is being driven in this forward direction to lift the roller **344**, drive arm **346**, drive bar **352** and the magnet **372** and the clip-slide unit **80**, **382** attached thereto the side walls of the slide **80** will initially be moved in a freely sliding manner in the grooved-out slide guiding portions **384**, **386** in the guide plates **388**, **390** as shown in FIGS. 11 and 16. As the slide continues its travel in an upward direction its sides are guided by grooves **392**, **394**. The first groove **392** is formed in a side support member **396** and is made of a hard plastic material such as a material tradenamed Bakelite. The support member **396**, in turn, is fixedly connected by screws **398** and **400** to a slide editing plate **402** that is of a J-shaped configuration.

The other groove **394** is formed in a second similar plastic member identified by reference numeral **404** in the drawing. This support member **404** contains a pair of spaced apart cup point set screws **406**, **408** that extend away from the outer wall of the support member **404** toward the left end of the projector **10**.

As shown in FIG. 11, one of the extending portions of the set screw **406** passes through a wall **410** that forms a horizontal slot in the J-shaped editing plate **402**. The extending portion of the second set screw **408** passes through a wall **412** that forms a second slot in J-shaped editing plate **402**. A curved leaf spring **414** extends between the inner left end of the editing plate **402** and a grooved-out left side of the support member **404** to retain the cup point set screws **406**, **408** of support member **404** pressed against the right end of the slots **410**, **412** in the J-shaped member **402**. A protuberance **416** is shown on the left grooved-out surface of support member **404** over which an apertured wall portion **418** of the spring can be placed in order to prevent slippage of the spring by the force of gravity from the position shown.

This construction provides a spring-biased left end support **404** for a slide as soon as it is moved into its in gate projecting position between the support member **396**, **404**. This construction also permits the slide to be retained in a supported position between the support members **396**, **404** when the knob **420** which is fixedly attached to the slide editing plate **402** is manually pulled out to its slide editing position shown in dotted line form in FIG. 11.

When the slide has been moved into its projecting position as described supra, the top of the slide **80** will be brought into contact with two grooved-out stops **422**, **424**.

The lower wall surface of the stop **422** and the upper surface or grooved-out part **384** form the narrow top and bottom portions of an apertured inner wall of a substantially rectangular-shaped wall **424** forming the interior of the guide plate **388** through which the editing plate **402** is moved to its dotted or editing position outside the projector **10**. The single piece guide plate **388** containing the aforementioned rectilinearly-shaped apertured wall portion and the stop member **422** is fixedly attached by means of a suitable number of screw connections, for example **426**, **428**, to a metal plate **430**. This metal plate **430** contains bent over end portions **432** and **434** and a centrally located apertured portion **436** as shown in FIG. 9. The plate **430** is shown fixedly mounted on the chassis **342**.

The guide plate **390** contains the stop portion **424** at its upper end, the slide guide **386** at its central portion and has a slotted wall **438** in a lower portion **440** thereof. This guide plate **390** is fixedly mounted by threaded connecting means **443**, **444** to the chassis plate **342**. When the cam **322** has passed the previously-referred-to slide in gate projecting position or a position in which its pin follower **344** is at its greatest distance from the center of shaft **310** on which it is rotatably mounted, any additional clockwise rotation of the cam **322** as shown in FIG. 16 will allow the pin follower **344** to be lowered by gravity along with its associated drive arm **346**, drive bar **352**, the U-shaped member **278**, magnet **372**, the metal clip **382** and the slide **80** until the slide **80** has been returned to the same position in the tray **20** and into contact with the outer surface of the hub **66** from which it was previously lifted.

When a slide change is thereafter required, a show switch **446** as shown in FIG. 27 is operated and this completes the circuit through the solenoid **182** and the split-phase motor **146**. The solenoid plunger **180** acts on two levers **172**, **448** in the mechanism. Lever **448** operates the switches **298** and **450** via the adjustable insulating buttons **452** and **454** shown in FIGS. 10 and 13. At this point, switch **298** disconnects the low voltage winding from the motor **146** and shorts out the capacitor **300** leaving capacitor **302** connected across the motor **146**. Switch **450**, at the same time, disconnects the anode of the silicon-controlled rectifier **306** so that the higher voltage from the line supply will not damage it. The silicon controlled rectifier **304** is protected by the fact that it is shorted out by switch **298**. The previously-mentioned second lever **172** actuated by the solenoid **182** moves the gear **162**, overcoming the force of spring **190** to engage the face clutch teeth **168** of gear **162** with the clutch teeth **194** of gear **192**. The motor rotates in the selected forward or reverse switch direction selected by switch **455** driving gear **192** which, in turn, drives the gear **308** which is attached to the main cam **322**. The lob **456** which forms part of the main cam **322** has been holding switch **458** open and, as soon as the cam **322** has rotated through a small angle, the switch **458** reverts to its normally closed condition and maintains the circuit so that the button operating slide change **446** need not be held depressed by the operator.

(3) Shutter actuator

FIGS. 16–20 show the main cam **322** as having a secondary cam **324** attached to it. This secondary cam **324** has been acting on the follower **462** as shown in FIGS. 16–20 so that the lever **464** on its pivot **466** has been held in the up position. A link **468** is used to pivotally connect the free end of lever **464** with the shutter **470**. As shown in FIG. 9 the shutter **470** in turn, is shown spring biased to a closed position by a pivoted spring member **471** with respect to the chassis of the projector **10**. The purpose of the lever **464** is to keep the shutter **470** swung back on its pivot **472** clear of the optical path during non-projecting portion of the slide projecting cycle. As soon as the cam system turns, the secondary cam **324** lowers the shutter lever **464** so that the shutter **470** drops cutting off the optical path from the slide **80** to the projection lens **220**.

Further movement of the cam system causes the main cam **322** through the follower **344** to allow the drive arm **346** to move down to its lower position. A drive bar **352** is mounted on a guide rod **362** and slides freely vertically as previously described under the description of FIG. 10. The drive bar **352** extends into the area of the gate system and carries the magnet **372** to which the slide **80** adheres by means of the clip **382** which is made of magnetizable material. The slide **80** is maintained in correct position in the gate by means of the previously-mentioned slide guides **396** and **404**. When the drive arm **346** moves down, gravity causes the drive bar **352** to follow it down and the slide **80** is carried down into the tray **20** being guided additionally on its way down by the grooves **384**, **386** of fixed guide plates **388** and **390**.

(4) Tray locking tooth mechanism

(5) Tray rotating mechanism

Only when the slide is in position in the tray, will further rotation of the cam system such as shown in FIG. 20 then cause the secondary cam **324** to act on a follower **474** to move the lever **476** about its stationary pivot **478** to apply an upward force on the tail **480** of the index slide **482**, of FIGS. 11 and 20. This action will free the tooth **484** from the teeth **124** of the tray **20** which is then free to rotate except as restrained by the pinion **486** and the V-shaped detent spring **487**. This detent spring **487** is fixed at its ends by suitable screw connection **478***a*, **478***b*.

Further rotation of the cam system causes the single tooth **488** of the single tooth gear **326** of FIGS. 9 and 12 to engage the pinion **486** to overcome the action of the detent spring **487** and rotate the pinion **486** one tooth in the appropriate clockwise or counter-clockwise direction by the rotation being transmitted thereto by motor **146**. This action will cause the tray **20** to be rotated in a step fashion so that the next slide **78** or **82** of FIG. 9 is moved into position under the magnet **372**. This next slide will be slide **78** or **82** depending on which direction the motor **146** is selectively positioned to rotate at this time. Continued rotation of the system causes the secondary cam **324** to move away from the follower **474** as shown n FIG. 18. FIG. 11 shows the index slide **482** urged downwards by the spring **490** in the apertured wall **438** of the side guide walls **390** so that the tooth **484** engages in the tray teeth **124** locking the tray **20** in place and pivoting lever **476** back to its former position. Because the tooth **484**, carried by index slide **482** is in slidable relationship with the grooves **484**, **486** in the guide part **490**, it will automatically make any necessary readjustment to the angular position of the tray **20** so that the slide, e.g., **80** will always be accurately located in its correct position in the tray to be drawn up into its gate projecting position.

When this last action has taken place, the cam system continues rotation and the main cam **322** acts on the follower **344**, pivoting the drive arm **346** upwards, so that the drive bar **352** moves up carrying the magnet **372** which, in turn, raises the slide **80** to the projection position. The stops **422** and **424** act on the slide **80** stopping it in the proper position. The magnet **372** may or may not remain in contact at the uppermost position, however, the slide **80** will not fall since it is held by the pressure of the outer guide **404** urged inwards by the spring **414**.

Finally, the lobe **456** acts on switch **458** through the switch arm **492** and opens the switch **458** so that the solenoid **182** is deenergized, the levers **488** and **172** as shown in FIG. 10 move back under the influence of the spring **190**, as shown in FIG. 12. Switches **298** and **450** return to their former position restoring the auto-focus circuit to operation and the gear **162** re-engages with the auto-focus pulley **198**.

FIGS. 22 and 23 show a preferred embodiment of the above that includes a damper cup **494** and plunger **496**. This may be an air system with an O ring seal and a fine orifice (possibly a porous material) or a viscous system using a high viscosity fluid. The plunger shaft **498** passes through the lever **172** between the shoulder **174** and stop **500**. When the solenoid **182** pulls the lever **172** the lever **172** acts on the shoulder **174** by way of washer **501**, spring **502** and washer **504** and drives the plunger **496** inward. When the solenoid **182** releases, the lever **172** shown in FIG. 12 travels rapidly out to the stop **500**, a distance sufficient to disengage the clutch teeth **168** on the moving gear **162** from the clutch teeth **194** on gear **192**. The action of the damper system then slows down the remaining travel of the gear **162** so that the clutch teeth **170** do not engage the clutch teeth **196** of the auto-focus pulley **198** until the inertial rotational forces of the motor **146** have been substantially dissipated. This prevents the residual inertia of the motor **146** which is rotating at a higher speed during the slide changing process, from driving the system out of focus during the intitial stage in which the motor **146** is switched over from its slide lifting operation to perform its automatic focusing operation. In this manner no defocusing and refocusing is unpleasantly apparent in the projected image.

LOAD CONDDITION

So far the mechanism has been described moving from the projection of one slide **80** to the next slide **78** or **82**, depending on which direction the motor is rotating, with a slide always under projection in the gate. A condition to be hereinafter described as "load" is also required in which the slide **80** in the gate projecting position is returned to the tray **20** and the tray **20** is freed for manual rotation to any position and for removal from the projector **10**. FIGURES 16 and 27 show a switch **506** positioned so that the lobe **456** will act upon it when the slide **80** has been returned to the tray **20** and the tooth **484** is disengaged from the tray teeth **124**. Under projection position "show" this switch **506** is not in circuit. Movement of the operator-controlled switch **508** from the "show" position to the "load" position shown in FIGURE 27 disconnects switch **458** and connects switch **506** so that the system driven by motor **146** will not stop in the position determined by switch **458** but will rotate to the desired "load" position determined by the switch **506**. The switch **508** may also be conveniently used to disconnect the projector lamp **266** when it is not required in the "load" position.

EDIT FEATURE

It is convenient to be able to view slides which are not in the tray **20** or to add or remove single slides without taking the tray **20** from the projector **10**.

The guides **396** and **404** are mounted as previously described on the plate **402**. This plate **402** can be slid outward in the plane of the slide **80** so that the two guides **396**, **404** and the slide **80** held in them are brought outside the case of the projector as shown in FIGURE 11. The slide **80** can then be removed or changed or another slide inserted if the position is vacant. A leaf spring **512** acting on slot **514** in plate **430** and slot **516** in the plate **402** provide a firm V-shaped detent **403** when the plate **402** is inward and acts as a slide stop to prevent the plate from being slid all of the way out of the front side of the projector **10**.

INTERLOCK SYSTEM

It is desirable to interlock some of the functions of the projector **10** so that no incorrect operation that is initiated by the operator or by a malfunction occurring in the parts of the projector will be allowed to damage its slide **80**, etc., or the other parts of the projector.

An interlock or index lock cam **518** as shown in FIGURES 10, 24–26 is so shaped and located that it will provide the following interlocks:

(a) If the drive bar **352** does not travel downwards until the slide **80** is back in the tray **20**, the cam **518** will prevent rotation of the tray **20**. This action is necessary

because, if the slide **80** is still in the gate or projecting position and the tray **20** rotates, the next slide "change" operation will attempt to raise the second-mentioned slide **78** or **82** into a position occupied possibly by the first slide **80**. On the other hand, if the first slide **80** has moved from the gate projecting position but not fully into the tray **20**, rotation of the tray **20** under this condition would cause serious damage to the slide **80** and the associated part of the projecting mechanism itself.

(b) The "edit" slide operation must only be possible when the drive bar **352** is at the top of its travel, for example in the "show" position shown in FIGURE 27. Otherwise the user could try to load slides into already occupied positions or could pull the plate **402** outward when the mechanism is in motion with resulting damage to the slide or projector.

(c) The system must be "fail safe" if the user leaves the "edit" plate **402** pulled outward and attempts to operate the slide-lifting mechanism.

(d) The tray **20** must only be allowed to be indexed by the mechanism or by hand when the drive bar **352** and magnet **372** are in the down position, for example when there is no slide in the gate-projecting position.

These requirements are met by the action of the index lock cam **518** shown in FIGURES 10 and 24–26. FIGURE 24 shows the drive bar **352** in the up or "show" slide position and the cam **518** rotated to its maximum clockwise position by the gravity weighted member **522** mounted thereon. Under this condition, the points **524** of the cam **518** is clear from the editing plate **402** which can be operated as described earlier under "edit" feature. At the same time, the constant radius section **526** of the cam **518** is located above the tail **480** of the index slide **482** which passes through apertured wall **483** so as to prevent any applicable upward movement of the hook **484** of the index slide **482** shown in FIGURE 11.

In FIGURE 25, the drive bar **352** has moved down part way so that the tail **480** of the drive bar **352** has acted on the lobe **528** of the index lock cam **518** rotating the latter counter-clockwise to a new position. The point **524** has passed through notched-out wall portion **530** in the edit plate **402** to prevent the aforementioned editing operation from taking place while part of the constant radius section **526** of the cam **518** remains in position above the tail **480** of the index slide **482**. This condition persists throughout the major part of the downward travel of the drive bar **352** so that if the latter should be stopped for any reason, such as a slide coming in contact with a projector part, the secondary cam **324** will be unable to raise the index tooth **484** and the mechanism will stall. When this happens, the clutch teeth **168** and **194** transmitting the drive from gear **162** to gear **192** are so shaped that they force the clutch teeth **168** of the movable gear **162** to be moved axially as the rotation of the motor causes them to ride over the then stationary clutch teeth **194**. This latter action causes a clicking or ratcheting noise which is useful as a signal to the operator that an uncorrect condition exists.

If conditions are normal, then the drive bar **352** will move down to the bottom of its travel and the lug **532** on the drive bar **352** contacts the shoulder **534** of the index interlock cam **518** causing a further counter-clockwise rotation of the cam **518**. Since the constant radius section of the cam **518** is now clear of the tail **480** of the index slide **482**, this index slide **482** is now free to move under the action of the secondary cam **324** as previously described. The upper part of the cam **518** in the FIGURE 26 position remains engaged in the notch **530** of editing plate **402** to prevent the plate **402** from being moved to an "edit" position.

During the upward travel of the drive bar **352**, the conditions are identical except for sequence. The index lock cam **518** is shaped and weighted at **522** so as to be urged by gravity in a counter-clockwise direction, but a light spring (not shown) could be alternatively used.

One unique feature of this mechanism is the use of a single reversing motor **146** of FIGURE 10 and a system which drives in opposing directions to provide "forward" drive as shown in FIGURES 12 and 16 and the "reverse" operation as shown in FIGURE 12 and FIGURES 17–20. This eliminates the unnecessary practice of using a conventional motor drive mechanism to drive a tray pinion in one direction and to use another separate drive mechanism to drive it in the opposite direction.

Another added advantage of extreme value that is derived through the use of the single reversing motor drive is that when any sort of mechanical or other type of fault condition arises, the operator can move the switch **555** to obtain the opposite direction of operation to the one in which the trouble occurred. This latter action will allow the mechanism to thereby immediately "back away" from the trouble to the point from which it started and come to rest. This gives the operator an opportunity to correct any sort of mechanical or other fault condition with a minimum of trouble on his part.

Reverse action (Figs. 17 to 20)	Forward action (Fig. 16)
(1) Start at "Show" position shown in Fig. 18.	Start at "Show" position shown in Fig. 16.
(2) Impulse from "Reverse" button 536 starts cam 322 in a counter-clockwise direction.	Impulse from "Forward" button switch 536 starts cam 322 in a clockwise direction.
(3) Switch 458 closes, cam 322 continues in a counter-clockwise direction.	Switch 458 closes. Cam 322 continues clockwise.
(4) The shutter 470 closes	Shutter 470 closes.
(5) Drive bar 352 descends under gravity.	Drive bar 352 descends under gravity.
(6) Index lock tooth 484 rises freeing tray.	Index lock tooth 484 rises freeing tray.
(7) Cam switch lobe 456 passes switch 506.	Single tooth gear 326 drives pinion 486 and therefore tray 20 one tooth space.
(8) Single tooth gear 326 drives pinion 486 and therefore tray 20 one tooth space.	Cam switch lobe 456 passes switch 506.
(9) Index lock tooth 484 comes down, locking and positioning tray 20.	Index lock tooth 484 comes down, locking and positioning tray 20
(10) Drive bar 352 rises driven by cam 322.	Drive bar 352 rises driven by cam 322.
(11) Shutter 470 opens	Shutter 470 opens.
(12) Switch 458 opens and mechanism stops in "Show."	Switch 458 opens and mechanism stops in "Show."

ELEVATE AND TILT MECHANISM (FIGURES 1, 10 and 13)

The projector **10** is provided with a single fixed foot **58** adjacent its right end and two adjustable feet **540, 542** adjacent its left end. The front feet **540, 542** are attached to their associated rods **54, 56** that pass through their respective walls **548, 550** that form clearance openings in the respective base parts **34, 36** of the projector **10** and then through their associated non-aligned walls **552, 554, 556, 558** that form clearance holes in the flange of the channel-shaped chassis support bracket **559**. Each pair of walls **552, 554, 556, 558**, is, therefore positioned with respect to one another so that each rod **54, 56** has its upper end tipped inward at a small angle to the vertical shown in FIGURE 13. Located between the two rods **54, 56** and urged upward by the spring **560** is a locking piece **561** forming leg-engaging parts of a locking piece or brake **562**. The brake **562** is fixedly connected to the link **564** by means of the rivets **566, 568**. The depression of a knob **570** that is mounted on the top end of the link **564** overcomes the force of the spring **560** as it is moved downwardly out of frictional engagement with the rods **54, 56** as the spring **560** is guided by the tab **576** that is fixedly connected to the bracket **559** so that the rods **54, 56** are free to move axially. While the rods **54, 56** are free, the projector **10** may be raised and lowered or tilted laterally about the longitudinal center line of the base on its foot **538**.

The aforementioned construction for the support legs or rods **54, 56** of the projector **10** will enable either one of its two leg portions **54, 56** to be mounted in any one of a number of a variety of extended positions on one

support surface while its other leg **56** or **54** is mounted in any one of a different number of other extended positions on the same or a different support surface that is at the same level or which is at a different level than that on which the first-mentioned leg is mounted.

As soon as the then depressed knob **570** is released, the portions **572, 574** on the opposite ends of the brake part **561** are urged by the force of spring **560** so that the two rods **54, 56** are forced outward against the lower outer edge portions of their associated apertured walls **552, 554, 556, 558** and thereby locked in the desired position by the wedging action of the locking piece **561** in the shallow angle area that is formed between the two legs **54, 56.** The weight acting on the two legs **54, 56** is also employed to increase the aforementioned locking action after the knob **570** has been released.

One preferred way of mounting the aforementioned support bracket **559** directly on the chassis of the projector **10,** is as shown in FIGURE 10. With the FIGURE 10 construction, a wall **578** forming a U-shaped slot in the end of the stationary rectangular chassis plate **580** is shown having a threaded screw connecting means **582** extruding therethrough and through an aperture **584** in the webbed portion of the channel-shaped bracket **559.** An n-shaped spring clip **586** is shown mounted at one of its ends between a spring washer **588** and the right surface of the chassis plate **580** and at its other end in spring engaging surface contact with the inner vertical surface of the bracket **559.** A left upper portion of the spring clip **586** is shown passing through a wall **590** that forms an aperture in the bracket **559** and another wall **592** that forms an aperture in the upper end of the chassis plate **580.** A spring retaining means **593** is shown mounted in a grooved-out surface portion **594** to retain the central portion of the bracket **559** and central portion of the spring clip **586** in fixed relation with the chassis plate **580.** This construction thus enables the lower and upper flange portions **596, 598** to always have a spring bias applied thereto so that the aforementioned leg retaining function which these bracket flange portions perform can be carried out in an efficient manner for the life of the projector **10.**

From the aforementioned description, it can be seen that a full-loaded, easily transportable, more compact, less cumbersome, unique construction for a projector-slide tray unit has been disclosed that has a single multipurpose motor for sequentially driving a magnetizable slide lifting actuator, an automatic projector lens focusing device, a shutter, a slide lowering interlock device, a tray locking and tray releasing device and a tray advancing and reversing device as well as providing a single gate into which the slides may be projected and edited without jamming.

What is claimed is:

1. A slide projector tray, comprising a ring forming a front face of the tray, a disc forming a back face of the tray, the outer circumference of the disc being of a substantially smaller diameter than the ring, a hub extending from the disc through the central opening formed by the inner wall of the ring, a series of radially positioned spaced-apart spacer plates extending between the ring and the disc to form a tray that is of a frustro-conical shaped configuration.

2. The slide projecting tray defined by claim **1,** wherein each spacer plate extends radially outwardly from an inner plane that is spaced outwardly of the hub to a plane that passes through radially aligned circumferential portions of the ring and disc and thereby provides a tray structure in which the inner ends of the slides inserted between consecutive spacer plates can be brought into compact physical surface-to-surface contact with the hub and their adjacent slides.

3. The slide projecting tray defined by claim **1,** wherein each spacer plate extends radially outwardly from an inner plane that is spaced outwardly of the hub and immediately adjacent the ring and disc and thence to a plane that passes through radially aligned circumferential portions of the ring and disc and thereby provides a tray structure in which the inner ends of the slides inserted betweeen consecutive spacer plates can be brought into compact physical surface-to-surface contact with the hub and their adjacent slides.

4. The slide projecting tray defined in claim **1** wherein, a ring-shaped lid is provided with spaced-apart lugs on its inner top and inner side surfaces, the lugs on the inner side surfaces of the lid being so positioned that they are constructed to be moved from a physical obstructed engaged position with the front face of the ring into physical surface-to-surface rotatable engagement with a back circumferential surface of the ring when a mechanical force is applied to the outer front surface of the lid to snap it into the last-mentioned position.

5. A compact slide projector tray, comprising front and back cylindrically-spaced-apart face portions wherein the outer circumference of the back face portion is of a substantially smaller diameter than the front face portion, a series of radially positioned spaced-apart spacer plates extending between the front and back face portions, a hub extending from one of the cylindrical face portions, pairs of adjacent spacer plates each being constructed to direct the inner ends of the slides inserted therein into contact with the outer surface of the hub and into physical contact with one another at their hub contacting end.

6. A compact slide projector tray, comprising front and back spaced-apart face portions wherein the area covered by the back face portion is of a substantially smaller area than that covered by the front face portion, a series of radially positioned spaced-apart spacer plates extending between the front and back face portions, a hub extending from one of the face portions, pairs of adjacent spacer plates each being constructed to direct the inner ends of the slides inserted therein into contact with the outer surface of the hub and into physical contact with one another at their hub contacting end.

7. The projector tray defined in claim **6** wherein, each of a series of spacer plates that extend between the front and back faces of the tray are of a partially wedge-shaped configuration.

8. The projector tray defined in claim **6** wherein, each of a series of spacer plates that extend between the front and back faces of the tray are of a partial wedge-shaped configuration and wherein the highest dimension of each of the partial wedge-shaped spacer plates is at a location where it is connected to the back plate.

9. A compact slide projector tray, comprising front and back spaced-apart face portions wherein a series of radially positioned spaced-apart spacer plates extend between the front and back face portions, a hub extending from one of the face portions, each adjacent pair of spacer plates being positioned to guide the inner ends of the slide inserted therebetween into substantially simultaneous contact with the outer surface of the hub and the sides of the slide that are adjacent its hub contacting end into physical surface to surface contact with each of the similarly positioned side portions of other slides that are adjacent the first mentioned slide.

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