United States Patent [19]

Clouser et al.

[11] **3,909,565**

[45] **Sept. 30, 1975**

[54] **AUTOMATIC TIMER SWITCH**

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[73] Assignee: **P. R. Mallory & Co., Inc.,** Indianapolis, Ind.

[22] Filed: **Apr. 29, 1974**

[21] Appl. No.: **464,760**

[52] **U.S. Cl.**..... **200/38 R;** 200/38 FA; 200/39 R

[51] **Int. Cl.**[2]..... **H01H 43/00**

[58] **Field of Search**..... 58/21.13, 21.14, 39.5; 200/35 R, 38 R, 38 F, 38 FA, 38 FB, 39 R, 39 A

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Primary Examiner—James R. Scott
Attorney, Agent, or Firm—Charles W. Hoffman; Robert F. Meyer; Donald W. Hanson

[57] **ABSTRACT**

A timer switch includes a clock, an interval timer, and an automatic cooking timer, the cooking timer including a start time dial and knob for setting the time that an oven is to start heating and a stop time dial and knob for setting the desired time that the oven is to stop heating.

5 Claims, 27 Drawing Figures

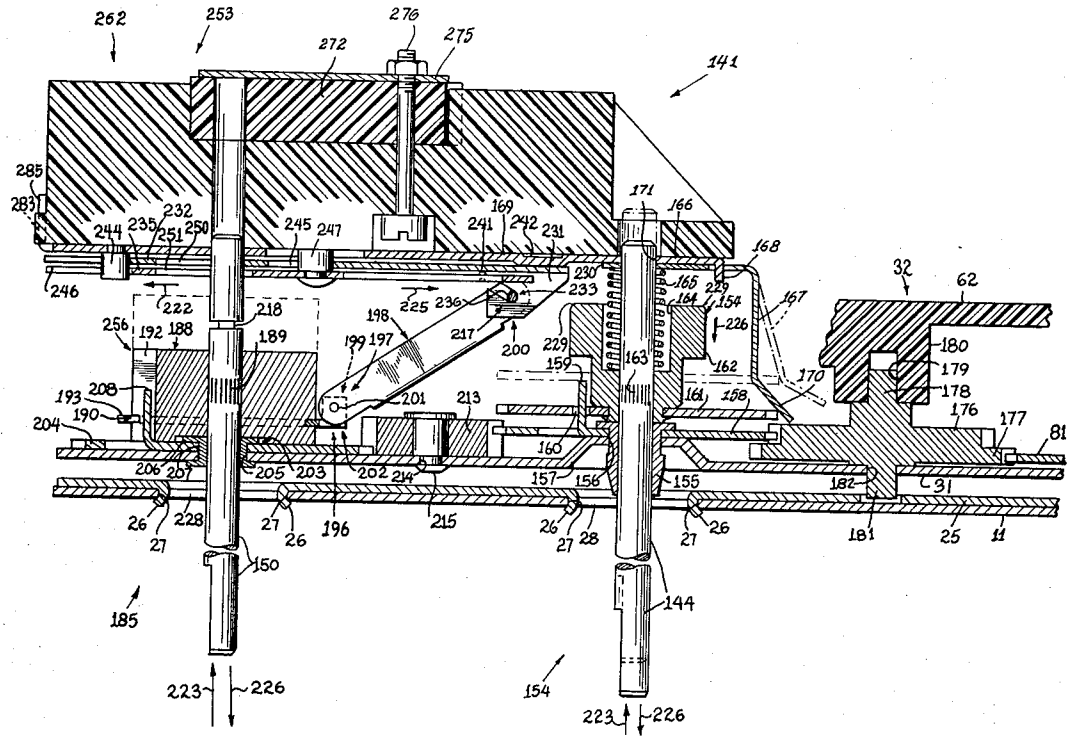


Fig. 1

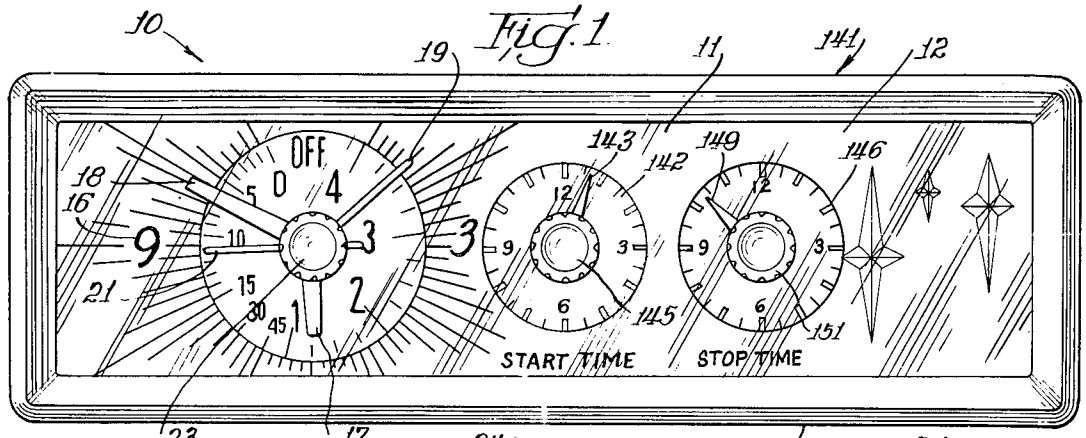


Fig. 2

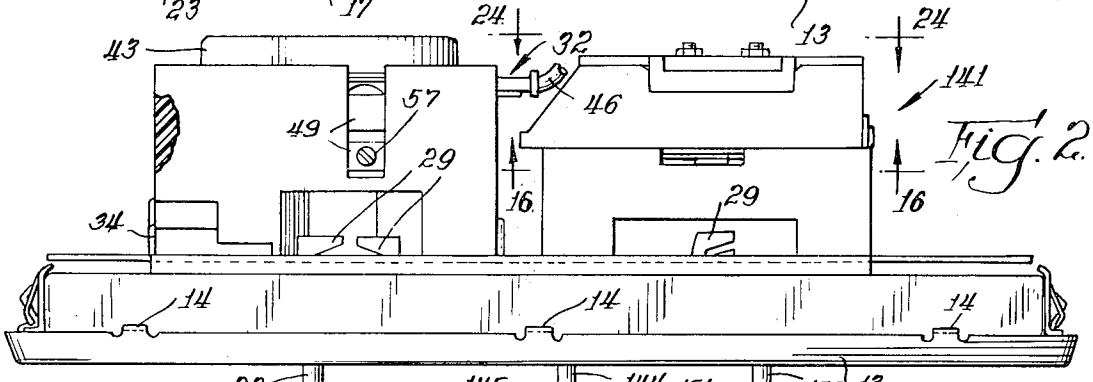


Fig. 3

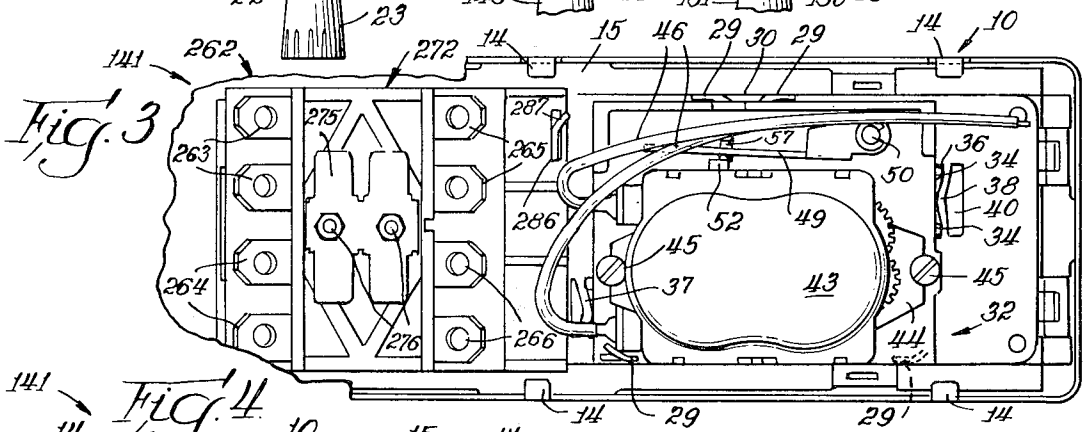
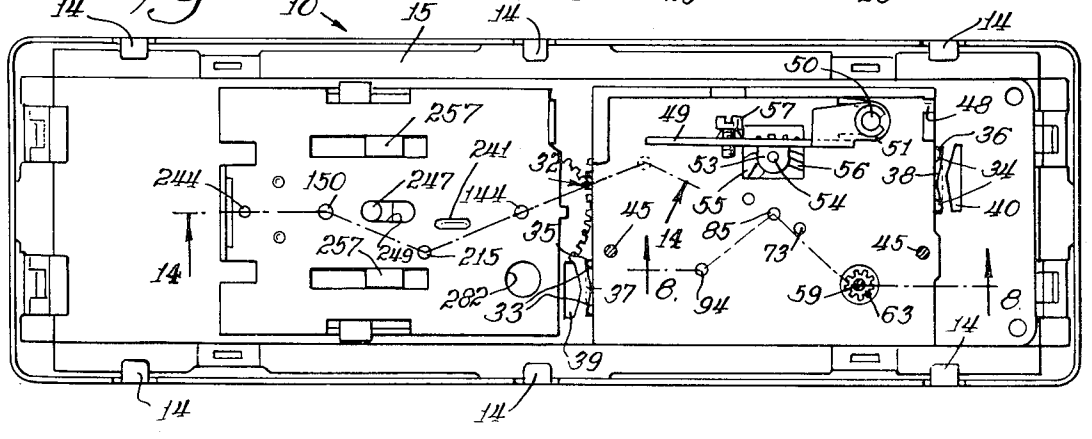


Fig. 4



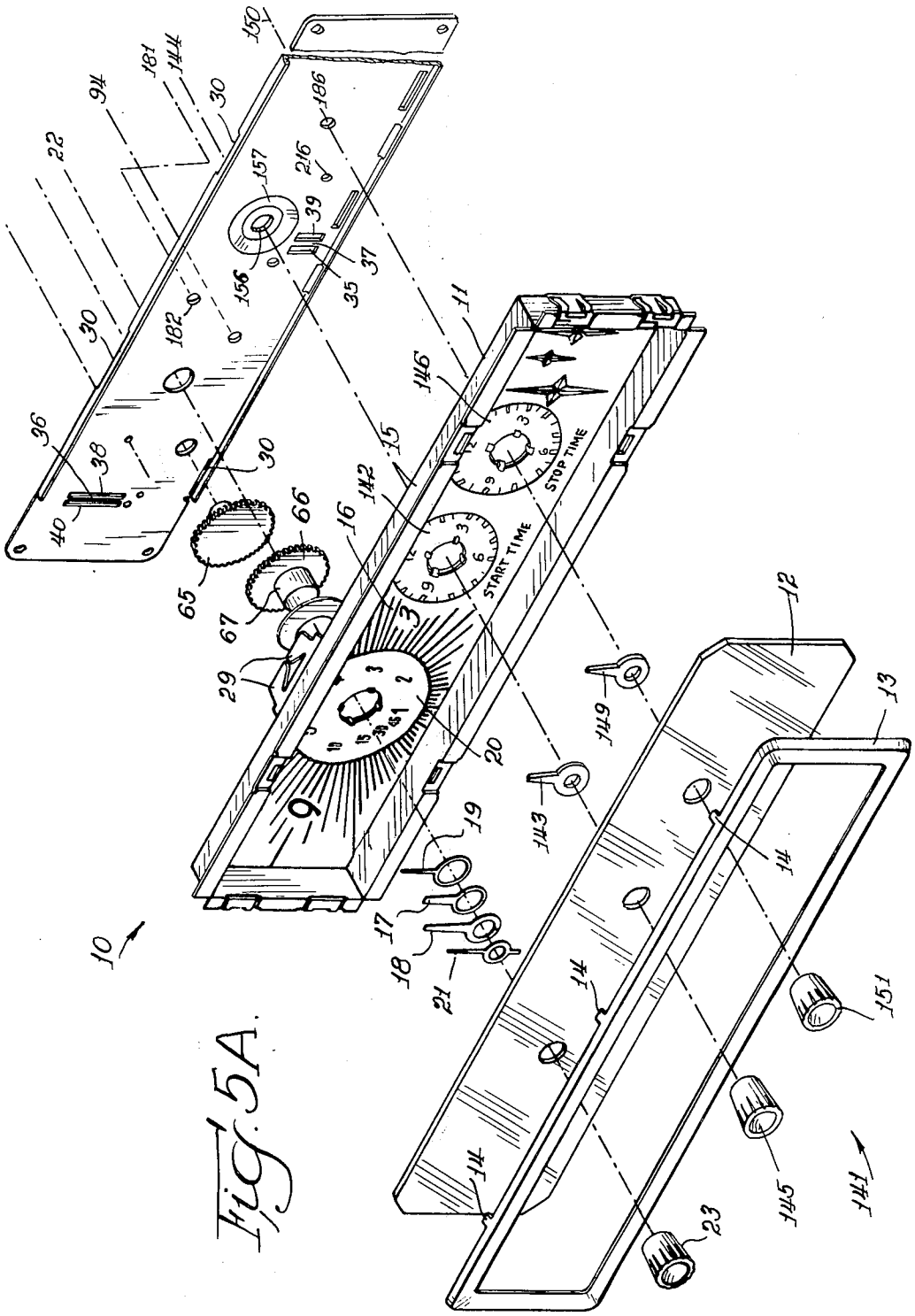


Fig. 5A.

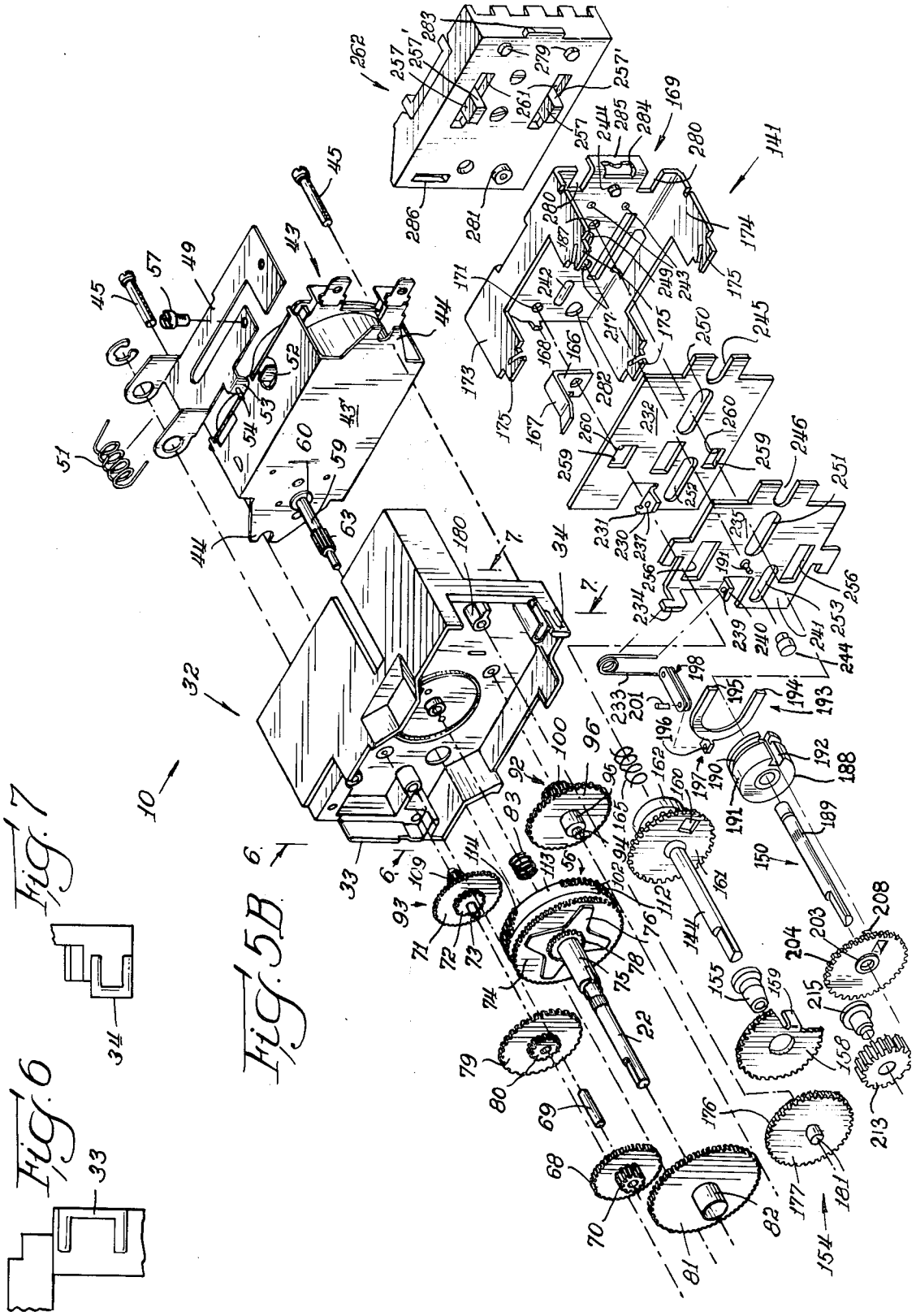


Fig. 5B
Fig. 6
Fig. 7

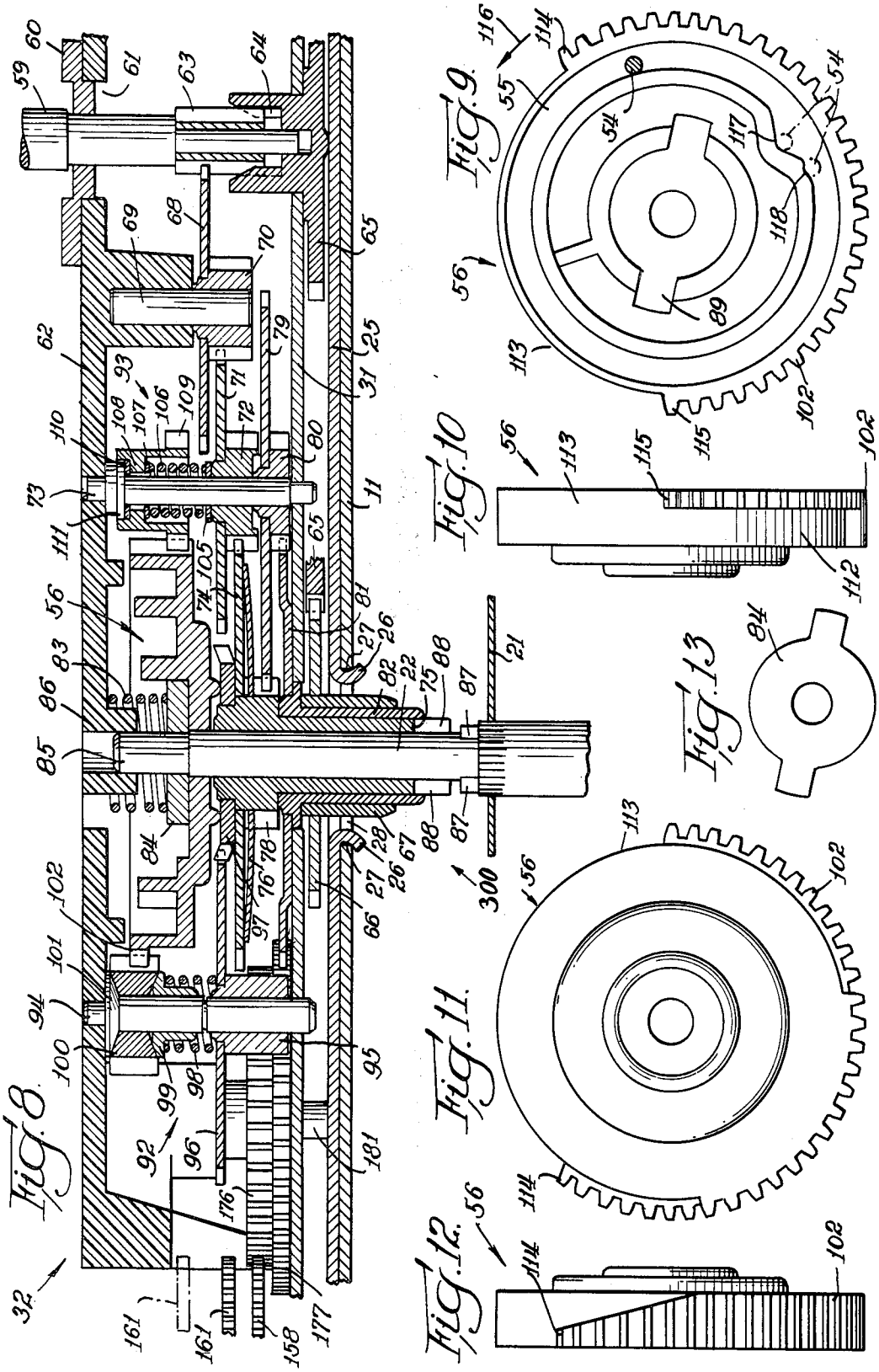


Fig. 8
Fig. 9
Fig. 10
Fig. 11
Fig. 12
Fig. 13

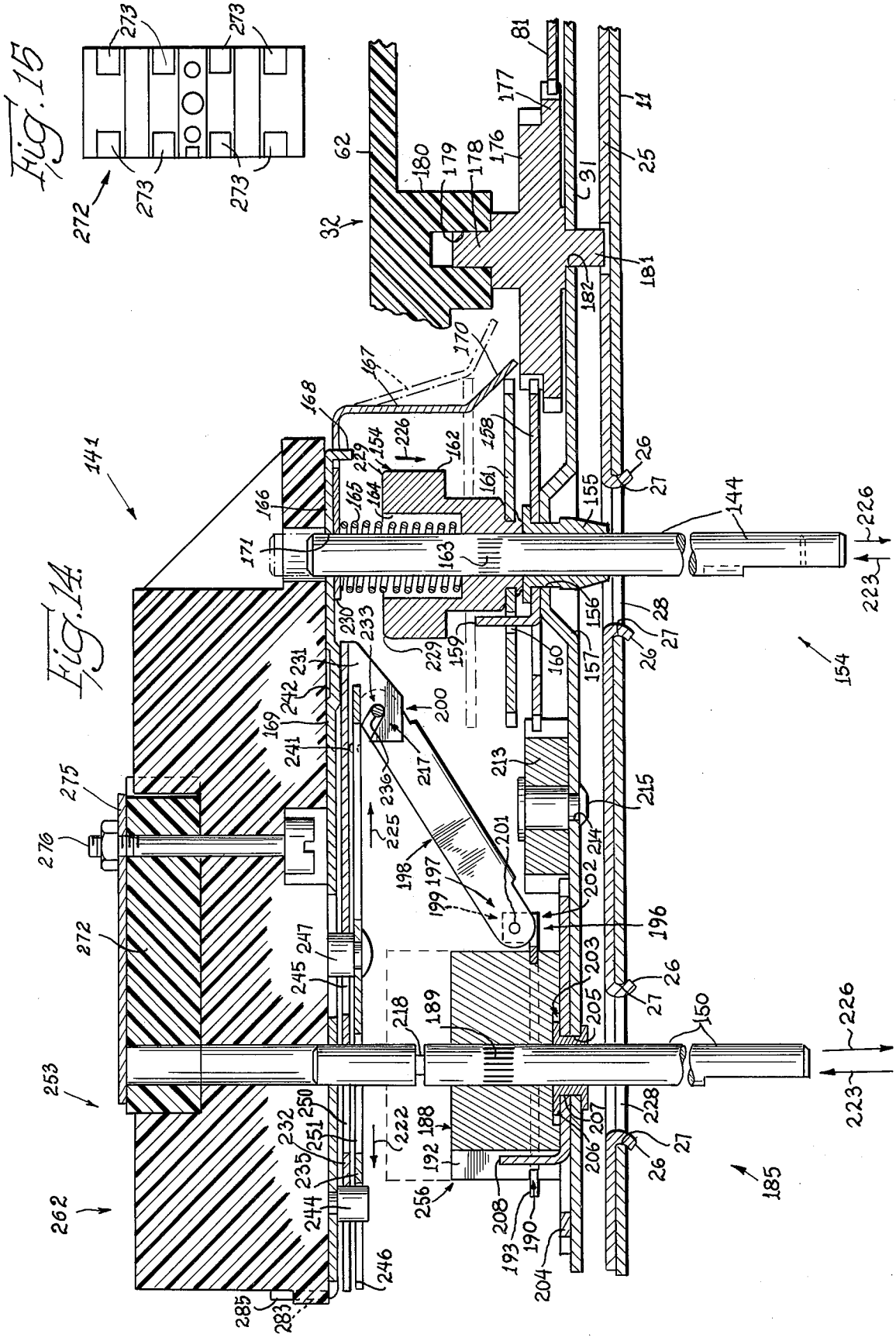


FIG. 15
FIG. 14

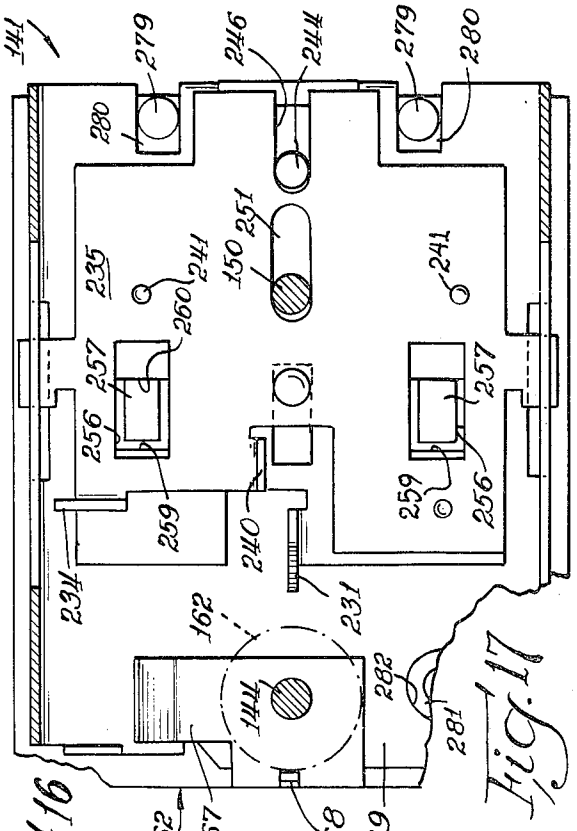


Fig. 16

Fig. 17

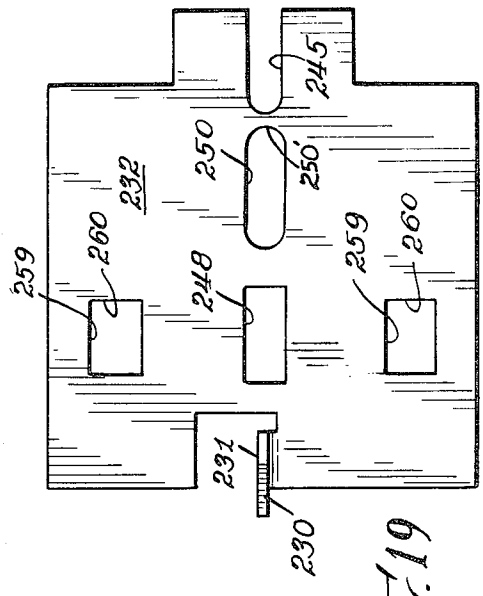
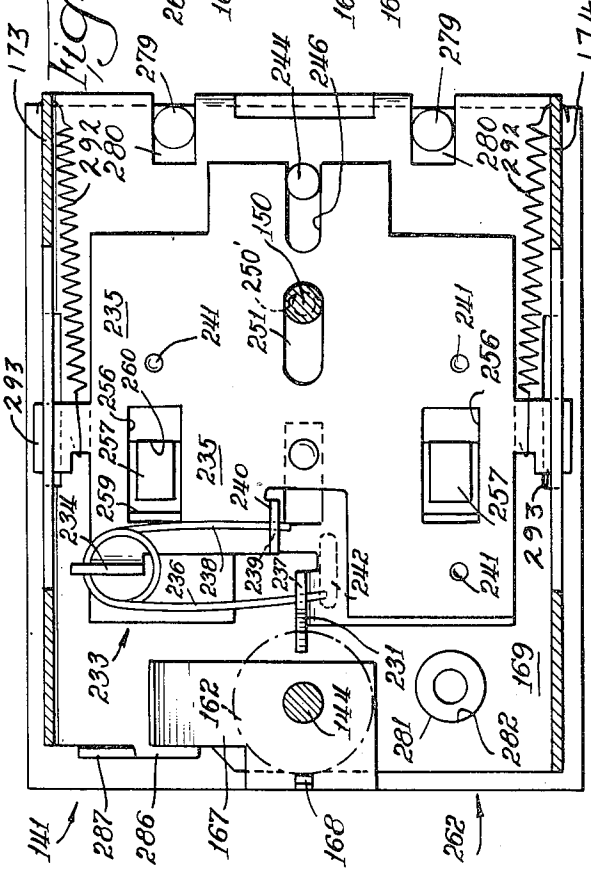


Fig. 19



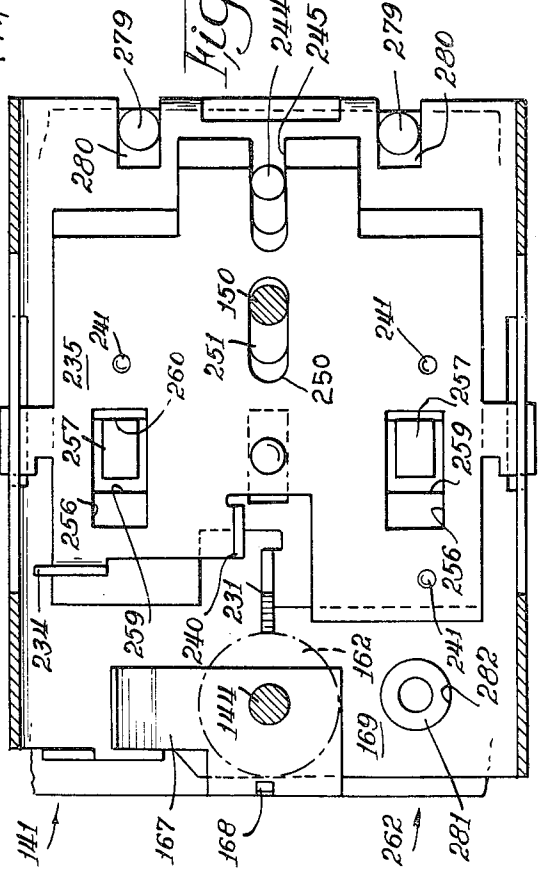
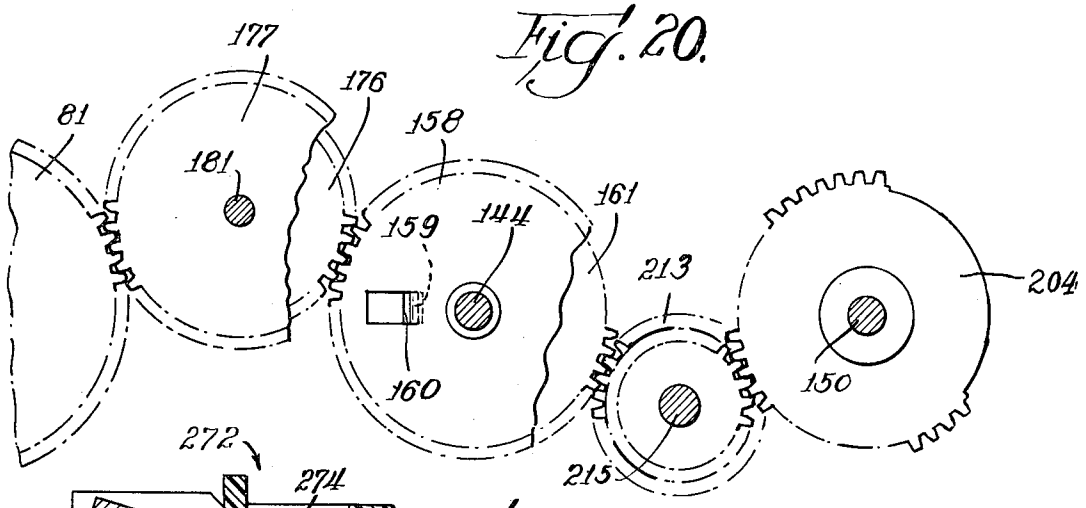


Fig. 18

Fig. 20.



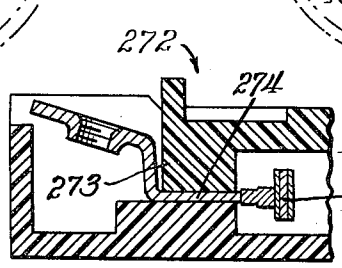


Fig. 22.

Fig. 21.

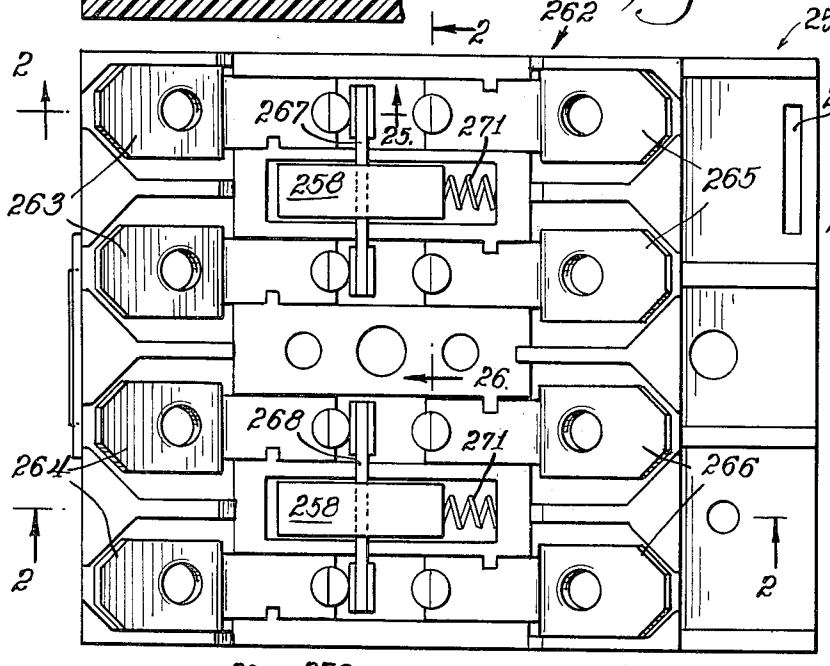


Fig. 23.

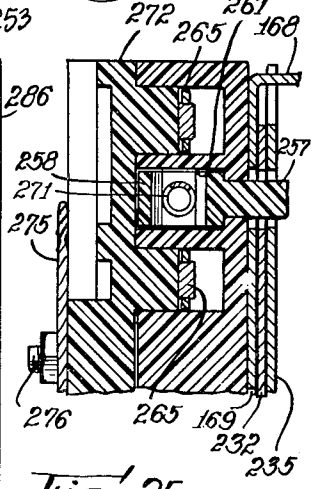


Fig. 25.

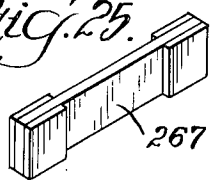


Fig. 24.

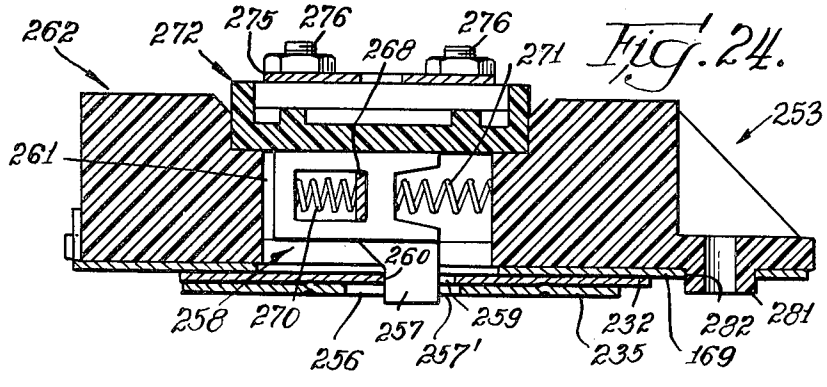
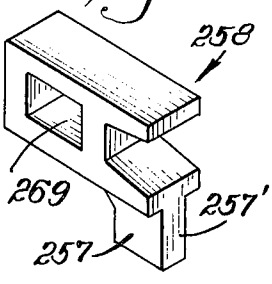


Fig. 26.



AUTOMATIC TIMER SWITCH

Generally speaking, the present invention relates to a timer and more specifically to a timer switch having a frame plate, an electric motor carried by the frame plate, a time of day indicating means coupled to the motor, and a mechanically-actuated electrical switching means carried by the frame plate for switching electrical current including a plurality of electrical contacts, an improvement comprising a manually-settable rotatable start-time means for activating the electrical switch means, a manually-settable, rotatable stop time means for activating the electrical switching means including a stop shaft rotatable in the frame plate, a stop gear carried by the stop shaft having a stop projection extending therefrom, a stop hub carried by the stop shaft, having a slot for receiving the stop projection, and a linkage means for mechanically linking the switch means to the stop hub.

Timer switches are widely used in home appliances such as ranges to time a particular function such as cooking for a preselected time interval, at the end of which an electrical function is performed, for example, the turning off of a heating element. The present invention provides a timer switch that can be set for the time a range oven is to start heating and also for the time it is to stop heating. The operator of this oven can forget about the cooking until it is finished because the present invention automatically cooks according to the preselected start and stop times.

Accordingly, it is a feature of the present invention to provide a compact motor-driven timer switch which indicates time of day and can be preset manually to effect the beginning and the end of the energization of an oven of an electric or gas range. Another feature of the present invention to provide a timer switch that includes a manually-settable, rotatable start time means for activating an electrical switching means. Another feature of the present invention is to provide a timer switch that includes a manually-settable, rotatable stop time means for activating electrical switching means including a stop shaft rotatable in a frame plate, a stop gear carried by the stop shaft having a first engagement means, a stop hub carried by the stop shaft having a second engagement means for engaging the first engagement means, and linkage means for mechanically linking the switch means to the stop hub. Still another feature of the present invention is to provide a timer switch that can be present manually to operate an audible signal at the end of a present interval. Another feature of the present invention is to provide a timer switch to close electrical contacts manually to start an oven independently of the timer control.

These and other features will become more apparent from the following description taken in conjunction with the drawings wherein:

FIG. 1 is a view, in front elevation, and at full scale of a motor driven timer in which this invention is embodied.

FIG. 2 is a top plan view of the motor driven timer shown in FIG. 1.

FIG. 3 is partial view, in rear elevation of the motor driven timer shown in FIG. 1.

FIG. 4 is a rear view of the motor driven timer, the synchronous motor having been omitted to show more clearly how the mechanism case is independently secured to the rear side of the mechanism plate and the contact housing also having been omitted to show the rear side of the frame plate on which it is mounted.

FIGS. 5A–5B show an exploded view of the motor driven timer.

FIG. 6 is a view, taken generally along line 6—6 of FIG. 5B looking in the direction of the arrows and shows a part of the mechanism case provided with a shouldered portion for interfitting with the mechanism plate to be secured thereto be a deformable rib.

FIG. 7 is a view taken generally along line 7—7 of FIG. 5B and looking in the direction of the arrows to show another shouldered portion of the mechanism case for interfitting with the mechanism plate and to be held thereto by a deformable rib.

FIG. 8 is a horizontal sectional view at an enlarged scale looking in the direction of the arrows and taken generally along line 8—8 of FIG. 4 and shows the gear train mounted within the mechanism case.

FIG. 9 is an elevational view of the cam that is mounted on the interval shaft.

FIG. 10 is an elevational view of the cam shown in FIG. 9 looking from left to right.

FIG. 11 is a view of the cam shown in FIG. 9 looking from the opposite side.

FIG. 12 is an elevational view of the cam shown in FIG. 11 looking from left to right.

FIG. 13 is an elevational view of the drive dog that is secured to the interval shaft.

FIG. 14 is a horizontal sectional view at an enlarged scale looking in the direction of the arrows and taken generally along line 14—14 of FIG. 4 and shows the gearing and related parts for the range timer section.

FIG. 15 is an elevational full scale view of the cover for the contact housing.

FIG. 16 is a vertical elevational view at an enlarged scale taken generally along line 16—16 of FIG. 2 and shows the range timer section of the timing in "manual" position.

FIGS. 17 and 18 are views, similar to FIG. 6 in which the range timer section is shown in the "off" position and in the "timed cooking" position.

FIG. 19 is an elevational view of the contact operating plate.

FIG. 20 shows the gear train for the range timer section.

FIG. 21 is an elevational view at an enlarged scale of the contact housing and contacts taken along line 21—21 of FIG. 2 and looking in the direction of the arrows, the cover having been omitted.

FIGS. 22, 23 and 24 are sectional views taken generally along lines 22—22, 23—23 and 27—27 respectively, of FIG. 21.

FIG. 25 is a perspective view at an enlarged scale of the contact bar.

FIG. 26 is a perspective view at an enlarged scale of the contact slide which carried the contact bar.

In FIGS. 1 and 5A–B the reference character 10 designates, generally, a motor driven timer embodying this invention. It includes an elongated metallic dial plate 11 that is arranged to be viewed through a glass 12 that is held in place by a rectangular escutcheon 13. Tabs 14 extend rearwardly from the escutcheon 13 and overlies a flange 15 on the dial plate 11 to hold the assembly together. Time markings 16 are imprinted on the dial plate 11 and with respect to them an hour hand 17, a minute hand 18 and a second hand 19 are arranged to rotate. Concentrically within the time markings 16 in-

terval markings 20 are imprinted on the dial plate 11 and with respect to them an interval hand 21 rotatable with an interval shaft 22 is arranged to rotate.

It will be observed that the interval markings 20 extend from 0 to 4. The markings between 0 and the 15 minute mark are laid out over an angle of 90° while the markings from 15 minutes to 1 hour are laid out over an angle of 49°. The angular spacing between the hour marks 1, 2, 3, and 4 is 46°. As will appear hereinafter provision is made for rotating the interval hand 21 relatively slowly from the 4 hour marking to the 1 hour marking. During the next 45 minutes the speed of the interval hand 21 is increased slightly and finally during the last 15 minutes it rotates at a relatively high speed. This makes it possible to adjust accurately a setting of the interval hand 21 for a relatively short interval while it is possible to obtain an interval setting of 4 hours within the confines of the interval markings 20.

A knob 23, secured to the end of the interval shaft 22 that projects through the glass 12, permits manual adjustment of the interval hand 21 to the desired interval mark. When the shaft 22 and knob 23 are moved inwardly, as will appear hereinafter, the setting of the hour hand 17 and minute hand 18 to the correct time can be accomplished.

Mounted on the rear side of the dial plate 11 is a metallic adapter plate 25. As shown in FIGS. 8 and 17 tabs 26 extend forwardly from the adapter plate 25 through notches 27 in the dial plate 11 and around openings 28 therein for securing the adapter plate 25 to the dial plate 11. The tabs 26 are turned over to secure the adapter plate 25 in place. Four tabs 26 are employed at each location only two being shown.

Lugs 29, FIG. 3, extend rearwardly from the adapter plate 25 for entering openings 30, FIG. 5A, in a rectangular metallic mechanism plate 31 which is held in spaced relation to the rear side of the adapter plate 25.

A molded plastic mechanism case 32 is mounted on the rear side of the mechanism plate 31. The manner in which it is held in position to facilitate assembly of the motor driven timer 10 is important. As shown in FIGS. 6 and 7 shouldered portions 33 and 34 are molded integrally with the opposite ends of the plastic mechanism case 32 and they are arranged to interfit with openings 35 and 36, FIGS. 3 and 5A in the mechanism plate 31. After the plastic mechanism case 32 has been positioned on the mechanism plate 31 with the shouldered portions 33 and 34 extending through the openings 35 and 36, ribs 37 and 38 extending between the openings 35 and 36 and slots 39 and 40 in the mechanism plate 31 are deformed inwardly to overlie the shouldered portions 33 and 34. In this manner the plastic mechanism case 32 is securely held in place on the mechanism plate 31. Thus it is held temporarily in position until additional fastening means are employed for further securing the mechanism case 32 to the mechanism plate 31.

After the mechanism plate 32 has been assembled in the manner described, a synchronous motor, indicated generally at 43, is mounted on the rear side of the plastic mechanism case 32. Ears 44 extend laterally from the bottom of the rectangular magnetic field structure 43' of the motor 43 and they are notched to receive screws 45 which extend through the plastic mechanism case 32 and are threaded into the mechanism plate 31. In this manner not only is the motor 43 held in position but also the mechanism case 32 is further secured to the mechanism plate 31. The motor 43 is arranged to be energized from a suitable alternating current source. For this purpose leads 46, FIG. 3, are provided.

After the end of the interval for which the interval hand 21 is set, it is desirable that an audible signal be given. For this purpose a vibrator arm 49 is employed. The vibrator arm 49 is pivoted on a shaft 50 that extends rearwardly from the plastic mechanism case 32. A torsion spring 51 acts to bias the vibrator arm 49 in a counter-clockwise direction, FIG. 3, toward an extension 52 of the magnetic field structure 43' of the motor 42. As shown in FIG. 4 a flange 53 extends from the vibrator arm 49 and carries a cam follower pin 54 that extends into a groove 55, FIG. 9, of a cam that is indicated, generally, at 56. The cam 56 is secured to the inner end of the interval shaft 22 and is arranged to be driven in a manner to be described. As adjusting screw 57, which extends through the vibrator arm 49, is employed for adjusting the tension of spring 51 and thus the frequency of the sound generated by the vibrator arm 59 when it is released.

A time of day indicating means 300 is generally shown in FIG. 5, 5A, 5B, and 8, wherein a shaft 59 extends forwardly from the motor 43. It is driven through a reduction gear train by the motor 43 at a speed of 1 RPM. The shaft 59 is journaled in a bearing 60 that is secured to the flat bottom portion of the magnetic field structure 43' of the motor 43. The shaft 59 extends through a clearance opening 61 in a rear wall 62 of the plastic mechanism case 32. At its forward end the shaft 59 carries a pinion 63 which has a splined connection 64 with a gear 65 that is journaled in the mechanism plate 31 and between it and the adapter plate 25. The gear 65 meshes with a gear 66 that is secured to a second hand sleeve 67 which extends through the opening 28 in the dial plate 11 and on which the second hand 19 is mounted for rotation therewith.

Also as shown in FIG. 8 the pinion 63 meshes with a gear 68 that is rotatably mounted on a stub shaft 69 that is carried by an embossment formed integrally with the front side of the rear wall 62. Rotatable together with the gear 68 is a pinion 70 which drives a gear 71 that is secured to a pinion 72. The pinion 72 is fast on a shaft 73 one end of which is journaled in the mechanism plate 31 while the other end is journaled in the rear wall 62 of the plastic mechanism case 32. The pinion 72 meshes with a rear 74 that is rotatable with respect to a minute sleeve 75 which is journaled on the interval shaft 22 and to which the minute hand 18 is secured for rotation therewith. In order to permit setting of the time in the manner previously described, a diaphragm time set clutch 76 is secured to the minute sleeve 75 and frictionally engages the juxtaposed surface of the rear 74. Thus, for time setting purposes, the gear 74 remains stationary while the minute sleeve 75 is rotated for setting the correct time.

A pinion 78, integral with the minute sleeve 75, drives a gear 79 which, together with a pinion 80, is rotatably mounted on the shaft 73. The pinion 80 drives a gear 81 that is secured to an hour sleeve 82 which is journalled on the minute sleeve 75 within the mechanism plate 31. The hour hand 17 is mounted on the hand sleeve 82 for rotation therewith. It will be noted that the second hand sleeve 67 is journaled on the hour sleeve 82 for rotation therewith. It will be noted that the second hand sleeve 67 is journaled on the hour sleeve 82.

Normally the interval shaft **22** is held in its outermost position by a coil compression spring **83** which reacts between the rear wall **62** of the plastic mechanism case **32** and the rear side of a drive dog **84**, FIG. **13**, which is secured to the interval shaft **22**. The function of the drive dog **84** will be described presently. The inner end **85** of the interval shaft **22** is journaled at **86** in the rear wall **62** of the plastic mechanism case **32**. Rearwardly extending teeth **87** are provided on the outer end of the interval shaft **22** for engaging slots **88** in the forward end of the minute sleeve **75**. When it is desired to set the time, the knob **23** and the interval shaft **22** are moved inwardly to bring the teeth **87** into engagement with the slots **88**. Then, on rotation of the knob **32**, the minute sleeve **75** is rotated and, through the gear train including the pinion **78**, gear **79**, pinion **80** and gear **81**, the hour sleeve **82** also is rotated to rotate the minute hand **18** and hour hand **17** to the correct time indication with respect to the time markings **16**. The drive dog **84** is slidably located in a correspondingly shaped slot **89**, FIG. **9**, in the cam **56** and provides a driving connection between the interval shaft **22** and the cam **56** regardless of whether the interval shaft **22** is in the position shown in FIG. **8** or is in the time setting position just described in which the coil spring **83** is compressed.

As pointed out above, position is made for rotating the interval hand **21** and the interval shaft **22** at a relatively low speed for a major portion of the presettable time interval and then to increase this speed of rotation during the last or minor portion of the interval in order to make it possible to set accurately the position of the interval hand **21** during this remaining interval. For this purpose a relatively low-speed high-torque clutch, FIG. **8**, is employed and it is indicated, generally, at **92**. Also there is provided a relatively high-speed low-torque clutch that is indicated, generally, at **93**.

The relatively low-speed high-torque clutch **92** comprises a shaft **94** that is journaled at one end in the mechanism plate **31** and at the other end in the rear wall **62** of the plastic mechanism case **32**. A hub **95** is secured to the shaft **94** for rotation therewith and it carries a gear **96** that is driven by a gear **97** which is secured to and rotates with the minute sleeve **75**. A coil compression spring **98** reacts between the gear **96** and a bushing **99** which is slidable on the shaft **94** and has frictional engagement with one side of a pinion **100** the other side of which frictionally engages a flange **101** that is integral with the shaft **94**. The pinion **100** is arranged to have driving engagement with gear teeth **102** along the periphery of the cam **56**.

The relatively high-speed low-torque clutch **93**, FIG. **8**, includes the shaft **73** previously described. Also it includes the gear **71** which is secured to the pinion **72** that, in turn, is secured to the shaft **73** and rotates therewith. A washer **105** bears against the pinion **72** at one side. A coil compression spring **106** reacts between it and a washer **107** which overlies an annular flange **108** that extends inwardly from a pinion **109** which is rotatable on shaft **73**. A washer **110** on the other side of the flange **108** bears against a flange **111** that is integral with the shaft **73**. The teeth of the pinion **109** are arranged to engage the gear teeth **102** on the cam **56**.

It will be observed in FIG. **10** that the gear teeth **102** are partially omitted at **112**. The purpose of this is to bypass the teeth on the pinion **109** of the high speed clutch **93** during a portion of the revolution of the cam **56**. The teeth **102** are omitted entirely as indicated at **113** from another portion of the periphery of the cam **56** in order to provide a section of the cam **56** that is not engaged by the teeth of either the pinion **100** of the low speed clutch **92** or the teeth of the pinion **109** of the high speed clutch **93**. It is only during the presettable interval that the cam **56** and the interval shaft **22** are rotated. Otherwise they remain stationary in the off position of the interval hand **21**.

In order to facilitate engagement between the teeth of the high speed pinion **109** and the teeth **102** on the cam **56**, as shown in FIG. **12**, the teeth **102** increase in face width from a minimum width indicated at **114** gradually to the full width. During the interval between the one hour mark and the **15** minute mark, both of the pinions **100** and **109** engage the teeth **102** on the cam **56**. However, because the low speed clutch **92**, due to the tension of the spring **98**, is capable of exerting a higher driving torque than is the high speed clutch **93** with a correspondingly weaker spring **106**, the drive is essentially at the relatively low speed until the cam **56** is rotated to disengage the last tooth **115**, FIG. **10**, from the pinion **100**, whereupon the drive is entirely through the high speed clutch **93** for the last **15** minutes of the interval.

During the presettable interval the cam **56** is rotated in a counter-clockwise direction as indicated by arrow **116** in FIG. **9** with the cam follower pin **54** remaining in the groove **55** and holding the vibrator arm **49** in an inoperative position. At the end of the presettable interval, the cam **56** rotates relative to the cam follower pin **54** until it drops into a relatively deep notch **117** as shown by a broken line. This releases the vibrator arm **49** and it is then free to vibrate in the alternating magnetic filed of the synchronous motor **43**. At this time the teeth **102** are not engaged by the teeth of the pinion **109** and the cam **56** remains motionless while the vibrator arm **49** continues to vibrate. In order to stop vibration of the arm **49**, the knob **23** and the interval shaft **22** are rotated to being the cam follower pin **54**, shown by a broken line, into a relatively shallow notch **118**. This lifts the vibrator arm **49** to the inoperative position and facilitates stopping the cam **56** in the off position which is indicated by the interval hand **21** registering with this indication on the interval markings **21**, FIG. **1**.

In those instances where it is desired to operate the interval shaft **22** and the interval hand **21** at the same speed throughout the entire interval, for example through an interval of 60 minutes instead of the 4 hour interval indicated by the interval markings **20**, then the relatively low speed high torque clutch **92** is omitted and the **56** is modified to provide the teeth **102** along its periphery, except for a relatively short span in which the teeth are omitted which corresponds to the end of the interval and to the off position. With such a modification the interval markings **20** are appropriately changed, for example to indicate a 60 minute interval over the span of the 4 hour interval markings.

FIGS. **1–4**, **5A–B**, it will be observed that the dial plate **11** carries start time markings **142** with respect to which a start time hand **143** rotates. The start time hand **143** is mounted on a start time shaft **144** which can be preset manually by a knob **145** that extends forwardly of the glass **12**.

The dial plate **11** also has stop time markings **146** thereon, and a stop time hand **149** is arranged to rotate

relative to these markings and is mounted on a stop time shaft **150** which can be preset manually by a knob **145** that extends forwardly of glass **12.**

In FIG. **14** it will be observed that the start time shaft **144** extends through an opening **28** in the adapter plate **25** and that it comprises a part of a start time means that is indicated, generally, at **154.** The start time shaft **144** is endwise slidable through a sleeve **155** and is thereby rotatably mounted intermediate its ends. The sleeve **155** is mounted in an opening **156** that is formed at the base of a deformed section **157** of the mechanism plate **31.** Rotatably carried on the sleeve **155** is a gear **158** that is referred to in the claims as a first start gear. The gear **158** has a lug **159** stuck therefrom for entering an opening **160** in a gear **161** which is referred to in the claims as a second start gear. Lug **159** comprises engagement means **251,** and opening **160** comprises engagement means **252.** The gear **161** is rotatable with an annular operating member **162** which is secured at a knurled section **163** for rotation with the start time shaft **144.** The annular operating member **162** has a counterbore **164** for receiving a coil compression spring **165** that reacts between the bottom of the counterbore **164** and a flat section **166** of a friction spring **167** with which an inturned tang **168** on a metallic frame plate **169** cooperates to prevent turning about the start time shaft **144** which extends through the flat section **166.** As will appear hereinafter, the start time shaft **144** is arranged to be moved inwardly against the coil compression spring **165** for the purpose of setting the start time by positioning the start time hand **143** at the desired time with respect to the start time markings **142.** When the start time shaft **144** is moved inwardly to position the gear **161,** as shown by broken lines, it is desirable that provision be made for preventing rotation of the start time shaft **144** and the gear **161.** It is for this purpose that the friction spring **167** is employed and it is arranged to have frictional contact engagement with some of the teeth **170** along the periphery of the gear **161.** When the gear **161** is shifted to the broken line position, it is located slightly past the distal end of the lug **159** and then it can be rotated out of registry with opening **160.** Upon release of the manual force moving the start time shaft **144** inwardly against the biasing action of the coil compression spring **165,** the latter causes the face of the gear **161** to engage the distal end of the lug **159** to hold the start time shaft **144** in the depressed position until the gear **158** is rotated to again position the lug **159** in registry with the opening **160** which occurs at the beginning of the cooking cycle. At its inner end the start time shaft **144** is rotatably and slidably mounted in a bearing opening **171** in the metallic frame plate **169.**

As shown more clearly in FIG. **5B** the metallic frame plate **169** includes integral forwardly extending walls **173** and **174** having lugs **175** along their distal edges for entering suitable openings in the metallic mechanism plate **31.** The lugs **175** are twisted slightly after passing through the mechanism plate **31** to hold the metallic frame plate **169** securely in position thereon.

Again referring to FIG. **14** it will be noted that the gear **158** is driven from the gear train that is driven by the motor **43.** The gear train includes a gear **176** the teeth of which mesh with the teeth on the periphery of the gear **158.** Integral with the gear **176** is a gear **177** the teeth of which mesh with the teeth of the gear **81** previously described which rotates at a speed of one revolution in 12 hours. A stub shaft **178** extends from one side of the gear **176** into a bearing opening **179** that is molded in an embossment **180** which forms a part of the molded plastic mechanism case **32.** A stub shaft **181** extends from the other side of the gear **177** through a bearing opening **182** in the metallic mechanism plate **31.** In this manner, as long as the synchronous motor **43** is energized, the gear **158** is continuously driven. When the lug **159** registers with the opening **160** in the gear **161,** the start time shaft **144** is continuously driven so that the start time hand **143** also indicates the time of day as does the hour hand **17.**

In FIG. **14** it will be noted that stop time shaft **150** extends through an opening **228** in the metallic adapter plate **25.** It forms a part of a stop time means that is indicated, generally, at **185.** At its inner end, stop time shaft **150** is journaled in a bearing opening **187** in metallic frame plate **169.** A hub **188,** which is substantially cylindrical in shape, is pressed onto knurling **189** on stop time shaft **150** to rotate therewith. Hub **188** includes an annular groove **190** and a longitudinal slot **192,** both being disposed on an outer periphery **141** of hub **188.** Slot **192** comprises an engagement means **256.**

A yoke **193** includes two spaced apart prongs **194** and **195** which straddle hub **188.** Prongs **194** and **195** are carried in annular groove **190** in such a manner so as to move longitudinally with hub **188,** at the same time allowing the hub to rotate freely of the prongs. As can be seen best in FIGS. **5B** and **14,** yoke **193** also includes an apertured projection **196** generally located at a closed end **197** of yoke **193** equidistant from prongs **194** and **195.** A link member **198** includes an apertured fork **199** near one end and another apertured fork **200** near the other end. Apertured fork **199** embraces apertured projection **196** on yoke **193** and a pin **201** is inserted therethrough producing a pivotal joint **202.** The connection of the remaining apertures ford **200** of link member **198** will be described presently.

Again referring to FIG. **14,** stop time shaft **150** is endwise slidable and rotatable through a bushing **203.** A stop time gear **204** is shown with its rotational axis substantially coincident with the rotational axis of stop time shaft **150.** The bushing **203** is staked in an aperture **205** in mechanism plate **31.** A lip **206** of bushing **203** loosely entraps stop time gear **204** against plate **31.** Gear **204** is rotatable about an outer periphery **207** of the bushing. Gear **204** has a lug **208** stuck therefrom for entering longitudinal slot **192** in hub **188.** Lug **208** comprises engagement means **255.**

Driving engagement with gear **204** is had by a gear **213** which is carried by a stub shaft **215.** The stub shaft is staked, in a hole **214** in mechanism plate **31** loosely entrapping gear **213** against the plate and allowing the gear to rotate about the shaft. Gear **213** also engages gear **158** for rotation therewith as can be seen in FIG. **14.**

When the start time shaft **144** is moved inwardly, accompanied by corresponding movement of the annular operating member **162,** switch actuator means **250,** comprising a convex end portion **229** of the operating member **162,** engages an inclined surface **230,** FIG. **22,** that is provided by a shoulder member **213** which is formed integrally with a slidable contact operating plate which is indicated, generally, at **232.** This movement of the contact operating plate **232** on inward movement of the annular operating member **162** is

against the biasing action of a hairpin spring **233**, FIG. **19.** The hairpin spring **233** has a central convolution located around a lug **234** that extends from and is formed integrally with a control plate **235** which is slidably mounted on the contact operating plate **232.** One arm of the hairpin spring **233** comprises a linkage pin **236** which extends through an opening **237** in the shoulder member **231** and also through apertured fork **200** of link member **198,** thereby securing contact operating plate **232** to link member **198** and forming a pivotal joint **217.** The other arm **238** extends through an opening **239** in a lug **240** which is stuck from and is formed integrally with the control plate **235.** In order to reduce frictional engagement between the plates **232** and **235** the latter has dimples **241** formed therein which permit only limited frictional contact engagement therebetween. Limited frictional contact engagement between the contact operating plate **232** and the juxtaposed surface of the metallic from plate **169** is obtained through the provision in the latter of an elongated shoulder **242** and dimples **243** as is best shown in FIG. **5B.** In order to guide the plates **232** and **235** for translatory movement relative to the metallic frame plate **169,** the latter has a guide pin **244** extending therefrom through a slot **245** in the correct operating plate **232** and through a slot **246** in the control plate **235.** Another guide pin **247,** which is staked into plate **235,** extends through slot **248** in plate **232** and slot **249** in metallic frame plate **167.** Guide pin **247,** like guide pin **244,** helps guide plates **232** and **235** for translatory movement.

The stop time shaft **150** extends through both of the plates **232** and **235.** As shown in FIGS. **17, 19** and **22,** a slot **250** in the contact operating plate **232** has the inner end of the stop time shaft **150** extending therethrough. Overlying the slot **250** is a slot **251** in the control plate **235** through which shaft **150** is also extended therethrough. Slot **250** is capable of engaging an annular groove **218** disposed on stop time shaft **150** near a distal end thereof.

An electrical switching means **253** is best shown in FIGS. **1618** and **21** to **26.** As shown in FIGS. **16, 17** and **18** clearance openings **256** are formed in the control plate **235** for receiving therethrough operating arms **257** from plastic contact slides, one of which is indicated at **258** in FIG. **26.** The operating arms **257** also extend through openings **259** in the contact operating plate **232** which underlie the clearance openings **256.** The ends **260** of the openings **259** engage one slide **257'** of each of the arms **257** for controlling the positions of the contact slides **258.** The operating arms **257** from the contact slides **258** extend through slots **261** (FIG. **5B**) in the base of a plastic contact housing that is indicated, generally, at **262.**

FIGS. **21–23** show in more detail the construction of the plastic contact housing **262** and parts associated therewith. Here it will be observed that pairs of stationary contacts **263** and **264** are suitably mounted in the contact housing **262** along one side and additional pairs **265** and **266** of stationary contacts are suitably located on the other side. Bridging contact members **267** and **268** are arranged to interconnect the contacts **263** and **264,** respectively, or the contacts **265** and **266,** respectively. It will be understood that only a single pair of stationary contacts can be employed in conjunction with a single bridging contact member. However, for purposes of illustration several pairs are shown together with a pair of bridging contact members **267** and **268.** One of the bridging contact members **267** is illustrated in FIG. **25.** It is arranged to be positioned in a slot **269** in the respective contact slide **258.**

As shown in FIG. **24** the bridging contact member **268** is arranged to be biased in one direction by a relatively weak spring **270** which reacts between the bridging contact member **268** and one end of the slot **269.** It is arranged to be biased in the opposite direction by a relatively strong spring **271** which reacts between one end of the slot **261** and one side of the contact slide **258.** The relatively strong springs **271** bias the operating arms **257** against the ends **260** of the openings **259** in the contact operating plate **232** and urge hub **188** in a direction indicated by arrow **226** in FIG. **14** through the hairpin spring **233** and link **198.**

The pairs of stationary contacts **263–264** and **265–266** are held in place by a plastic cover **272,** FIGS. **15, 22, 23** and **24.** The plastic cover **272** has rectangular shoulders **273** on its underside which, as shown in FIG. **22,** are arranged to overlie a shank **274** of each of the stationary contacts to hold the same securely in place. A grounding plate **275** overlies the cover **272** and it and the cover **272** are held in place on the plastic contact housing **262** by bolt **276.**

In order to locate properly the plastic contact housing **262** on the rear side of the metallic frame plate **169,** the former is provided with integrally formed dowel pins **279,** FIG. **16,** which extend through slots **280** formed in the frame plate **169.** At the other end of the plastic contact housing **262** there is integrally formed a hollow dowel pin **281** which extends through a corresponding opening **282** in the metallic frame plate **169.**

For securing the plastic contact housing **262** to the metallic frame plate **169,** the former is provided with an elongated lug **283,** FIG. **5B,** that is arranged to extend laterally through a slot **284** in an upstruck lug **285** from the metallic frame plate **169.** As shown in FIG. **3,** the other end of plastic contact housing **262** is an elongated slot **286** molded therein for receiving a lug **287** which is struck from the metallic frame plate **169.**

In operation, when the start time-stop time timing is not functioning, hour hand **17,** start time hand **143,** and stop time hand **150** are in running synchronization and indicate the same time of day on their respective time markings **16, 142** and **146.** In this condition, which is illustrated in FIGS. **14, 17** and **21** the bridging contact members **267** and **268** are biased out of engagement, respectively, with the pairs of stationary contacts **265** and **266** by springs **271** and into engagement with pairs of contacts **263** and **264.**

The operation of the automatic cooking timing function comprises the following events in the order recited:

1. Start time is manually set.
2. Stop time is manually set.
3. The timer is driven by motor **43** until the start time function begins according to the time set in event 1 above. The beginning of start time is characterized by the contacting of bridging contacting members **267** and **268** with stationary contacts **265** and **266.** This action can turn an oven (not shown) on.
4. The timer continues to be driven by motor **43** until the stop time function occurs according to the time set in event 2 above. Stop time is characterized by the disconnection of bridging contacting members **267** and **268** with stationary contacts **265** and **266.** This action

can turn an oven (not shown) off. These events are explained in more detail in the paragraphs that follow.

The start time is set by indexing start time shaft **144** inwardly by manually depressing knob **145**, and rotating it either clockwise or counterclockwise until start time hand **143** points to the desired time on start time markings **142**. The inward indexing causes lug **159** on gear **158** to come out of engagement with slot **160** in gear **161**, so that the driving connection provided by lug **159** to gear **161** is interrupted. Spring **165** holds gear **161** against the distal end of lug **159**. Note that plates **232** and **235** are in no way moved by the indexing an rotation of shaft **144**, so that bridging contact members **267** and **268** are still out of engagement with pairs of stationary contacts **265** and **266**, respectively. It should be understood that only a single bridging contact **267** and a single pair of stationary contacts **265** can also be employed for controlling the completion of a single circuit.

After setting the start time, the stop time is set by indexing the stop time shaft **150** inwardly by manually depressing knob **151** and rotating it until the stop time hand **149** points to the desired time on stop time markings **146**. This inward indexing causes lug **208** on gear **204** to come out of engagement with longitudinal slot **192**, so that the driving connection provided by lug **208** to stop time hub **188** is interrupted. Springs **292**, acting through plates **232** and **235**, hairpin spring **233**, and link member **198**, urge hub **188** against the distal end of lug **208**. The inward indexing of shaft **150** also causes contact operating plate **232** to be pushed in the direction of arrow **288** by hub **188** acting through link member **198**. There is a corresponding shifting in the movement, also indicated by arrow **288**, of plate **235** transmitted from plate **232** through hairpin spring **233** to plate **235**. However, plates **232** and **235**, and, therefore, arms **257**, are not pushed far enough to cause engagement of bridging contact members **267** and **268** with stationary contacts **265** and **266**. Plate **232** is prevented from complete translating movement by interference of shoulder member **231** with annular operating member **162**. This condition is shown in FIG. **18**.

After both start and stop times have been set, motor **43** drives from motor output pinion **63** through a train of gears and pinions **68, 70, 71, 80, 81, 177** and **176** to gear **158**. Through this train of gears and pinions, hours hand **17**, being carried with gear **81** on hours sleeve **82**, and gear **158** run in synchronization. It should be recalled that when start time shaft **144** was manually indexed inwardly and rotated, the driving connection between lug **159** and gear **161** was broken. When the gear **158** is rotated in synchronization with the time of day as indicated by hours hand **17** to such position that lug **159** registers with opening **160** in gear **161**, gear **161** and the whole start time assembly **154** moves outwardly in the direction of arrow **226** in FIG. **14** under the influence of spring **165**. Movement of convex end portion **229** in the direction of arrow **226** allows hairpin spring **233** to advance shoulder member **231**, and therefore plate **232**, in the direction of arrow **225**. And, movement of plate **232** in the direction of arrow **225** also moves operating arms **257** (as shown in FIGS. **19**, 20 and **21**) by the engagement of ends **260** of openings **259** with sides **257'** of arms **257**. Operating arms **257**, in turn, urge bridging contact members **267** and **268** into engagement, respectively, with pairs of stationary contacts **265** and **266**. In one example of an application of this timer in conjunction with a cooking oven in the closing of contacts just described turns an oven heating element on. Therefore, the start time indicated by start time hand **143** indicates the time an oven cooking function is started.

Stop time gear **204** is driven by start time gear **158** through gear **213** at the same speed and in synchronization with start time gear **158** and hours hand **17**. When gear **204** is rotated to such a position that lug **108** registers with slot **192** in hub **188**, the hub moves outwardly under influence of springs **292** in the direction of arrow **226** in FIG. **14**. As hub **188** moves outwardly, plates **232** and **235**, also under the influence of springs **292**, are allowed to be returned in a direction indicated by arrow **222**. As plate **232** moves in this direction, the ends **260** of slots **259** move away from arms **257**, allowing arms **257** to also move in the direction of arrow **222** under the urging of springs **271**. This action, in turn, causes bridging contact members **267** and **268** to separate from stationary contacts **265** and **266**. In the previously described example of an application of this time with an oven, the opening of contacts **267** and **268** from **265** and **266** turns the oven off. Therefore, the stop time indicated by stop time hand **149** indicates the time an oven cooking function is stopped.

The operation explained in the preceding paragraphs involves setting the time an oven is to be started and the time it is to be stopped. Another function an operator of the timer may desire to perform is an un-timed "cook now" function wherein the oven is manually turned on and, after a period of cooking, manually turned off. This is accomplished by this timer by first manually indexing stop time shaft **150** in to turn the oven on and then manually indexing start time shaft **144** in to turn the oven off. It should be recalled now that the automatic timing described in the previous paragraphs was initiated by doing just the opposite, that is, indexing in the start time shaft first, then indexing the stop time shaft. Refer now to FIGS. **14** and **21**. By indexing stop time shaft **150** in the direction of arrow **223**, (start time shaft **144** being in its "indexed out" position) both plates **282** and **235** are pushed in the direction of arrow **225** far enough to completely move bridging contact members **267** and **268** into contact with stationary contacts **265** and **266**. Because start time shaft **144** is in its indexedout position, convex end portion **229** of operating member **162** cannot prevent plate **232** from moving its complete journey as it did in the automatic cooking function wherein the start time shaft **144** was manually indexed in prior to the indexing in of stop time shaft **150**. An edge **250'** of slot **250** catches annular groove **218** in stop time shaft **150** upon indexing in of the stop time shaft and prevents it from indexing out when manual force is removed from the shaft. When it is desired to turn the oven off, start time shaft **144** is manually indexed in (in the direction of arrow **223**), whereupon convex end portion **229** of operating member **162** engages inclined surface **230** of shoulder member **231** urging plate **232** back in the direction of arrow **222**. This action disengages edge **250'** of slot **250** with annular groove **218** and allows stop time shaft **150** to pop out (in the direction of arrow **266**) under the influence of springs **292**. Movement of plates **232** and **235** in the direction of arrow **222** also causes bridging contact members **267** and **268** to disengage stationary contacts **265** and **266**, thereby shutting the oven off.

It should be noted that when the timer is operating automatically and the start time shaft pops out allowing plates **232** and **235** to move in the direction of arrow **225,** the edge **250'** described in the previous paragraph does not engage annular groove **218** in shaft **150.** At the time plates **232** and **235** move in the direction or arrow **225,** groove **218** is slightly out of alignment with slot **250.** It is only when shaft **144** is in its out position as shown in FIG. **14,** that shaft **150** may be pushed in far enough to cause slot **250** to grab annular groove **218** and hold shaft **150** in.

What is claimed is:

1. In a timer switch having a frame plate, an electric motor carried by said frame plate, a time-of-day indicating means coupled to said motor, and a mechanically-actuated electrical switching means carried by said frame plate for switching electrical current including a plurality of electrical contacts, the improvement comprising:

a. a manually-settable, rotatable start-time means for activating said electrical switching means;

b. a manually-settable, rotatable stop-time means for activating said electrical switching means including:

i. a stop shaft axially displaceable and rotatable in said frame plate.

ii. a stop gear carried about said stop shaft having a first engagement means,

iii. a stop hub carried by said stop shaft having a second engagement means engaging said first engagement means; and

iv. linkage means mechanically linking said switch means to said stop hub including:

an annular groove disposed in said stop hub;

a yoke member having a first aperture and two side-by-side prongs, said prongs carried in said annular groove of said stop hub;

a link member having second and third apertures, each disposed near a distal end of said link member;

a first linkage pin located in said first aperture in said yoke member and said second aperture in said link member, thereby forming a pivotal joint; and

a second linkage pin passing through said third aperture in said link member and an aperture in said mechanical-actuated electrical switching means, thereby forming a pivotal joint;

whereby, axial movement of said stop hub is transmitted by said yoke member through said link member to said mechanically actuated electrical switching means thereby actuating said switching means.

2. The improvement to a timer switch as recited in claim **1,** wherein said first engagement means comprises a stop projection extending from said stop gear, and said second engagement means comprises a slot receiving said stop projection.

3. The improvement to a timer switch as recited in claim **1,** wherein said manually-settable rotatable start-time means comprises:

a. a start shaft rotatable in said frame plate;

b. a first start gear carried by said start time shaft having a third engagement means;

c. a second start gear carried by said start shaft having fourth engagement means engaging said third engagement means; and

d. a switch actuator means fixedly carried by said start shaft for actuating said electrical switching means.

4. The improvement to a timer switch as recited in claim **1,** wherein said third engagement means comprises a lug extending from said first start gear and said fourth engagement means comprises an opening disposed in said second gear capable of receiving said lug.

5. The improvement to a timer switch as recited in claim **1** wherein said stop shaft further includes an annular groove and said mechanically actuated electrically switching means includes a slot in a slideable contact operating plate, sides of said slot engaging sides of said annular groove to restrict axial movement of said stop shaft upon alignment of said annular groove with said slot.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,909,565

DATED : April 29, 1974

INVENTOR(S) : Michael T. Clouser and Bruce W. Shell

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 50 delete "present" and substitute therefore ---preset---

Col. 1, line 51 delete "present" and substitute therefore ---preset---

Col. 2, line 9 delete "be" second occurrence and substitute therefore ---by---.

Col. 4, line 17 delete "As" and substitute therefore ---An---

Col. 4, line 47 delete "rear" and substitute therefore ---gear---

Col. 4, line 54 delete "rear" and substitute therefore ---gear---

Col. 4, line 63 delete "hand" and substitute therefore ---hour---

Col. 5, line 27 delete "position" and substitute therefore ---provision---

Col. 6, line 8 insert " " around --off--

Col. 6, line 43 insert " " around ---off---

Col. 6, line 57 insert " " around --off---

Col. 8, line 64 delete "213" and substitute therefore ---231---

Col. 9, line 25 delete "correct" and substitute therefore ---contact---

Col. 10, line 56 insert " " around ---set---

Col. 10, line 57 insert " " around ---set---

Col. 10, line 59 insert " " around ---set---

Col. 10, line 65 insert " " around ---set

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,909,565

DATED : Sprıl 29, 1974

INVENTOR(S) : Michael T. Clouser and Bruce W. Shell

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 11, line 3 insert " " around ---set---

Col. 11, line 20 insert " " around ---set---

Col. 11, line 43 insert " " around ---set---

Col. 12, line 9 delete "108" and substitute therefore ---208---

Col. 13, line 8 insert " " around ---out---

Col. 13, line 26 delete "." and substitute therefore ---,---

Signed and Sealed this

twenty-fourth Day of *February 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks