July 5, 1966 J. B. KING 3,259,056

AUTOMATIC OVEN HEAT CONTROL BY WEIGHT AND TYPE OF ROAST

Filed March 26, 1963 7 Sheets-Sheet 1

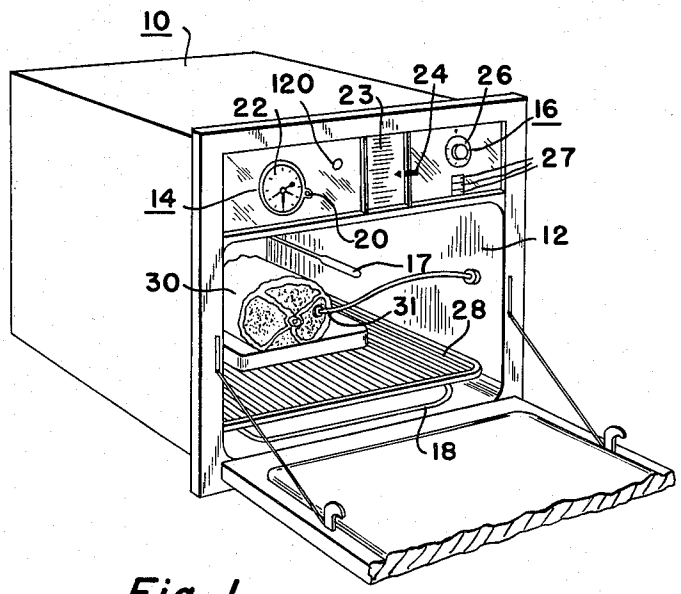


Fig. 1

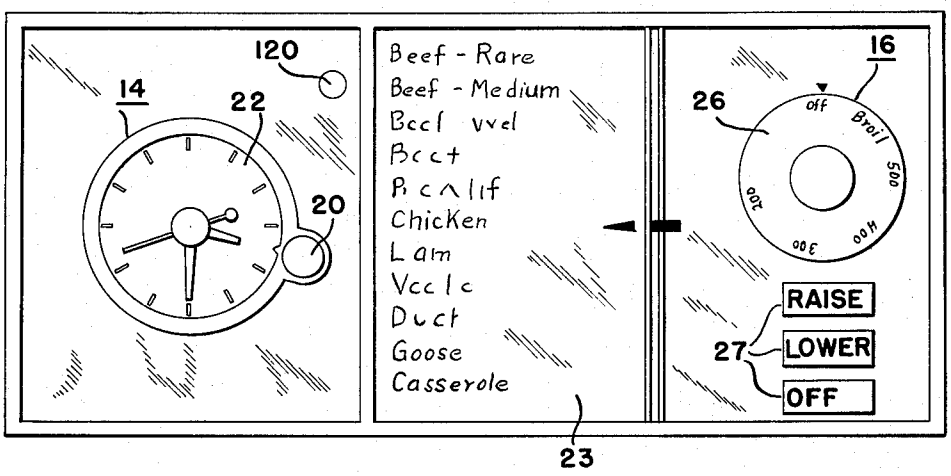


Fig. 10

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AUTOMATIC OVEN HEAT CONTROL BY WEIGHT AND TYPE OF ROAST

Filed March 26, 1963 7 Sheets-Sheet 2

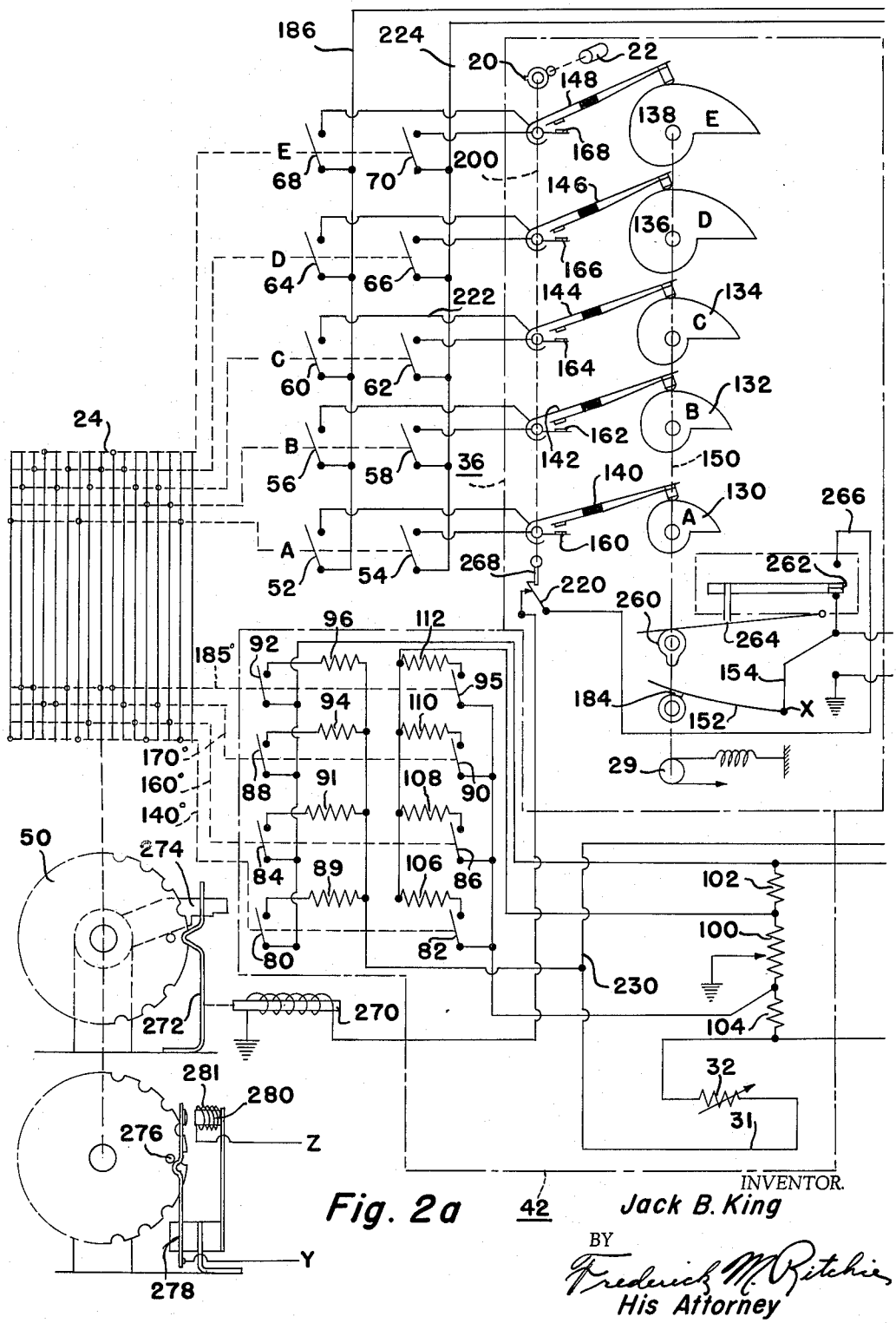


Fig. 2a

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AUTOMATIC OVEN HEAT CONTROL BY WEIGHT AND TYPE OF ROAST

Filed March 26, 1963 7 Sheets-Sheet 3

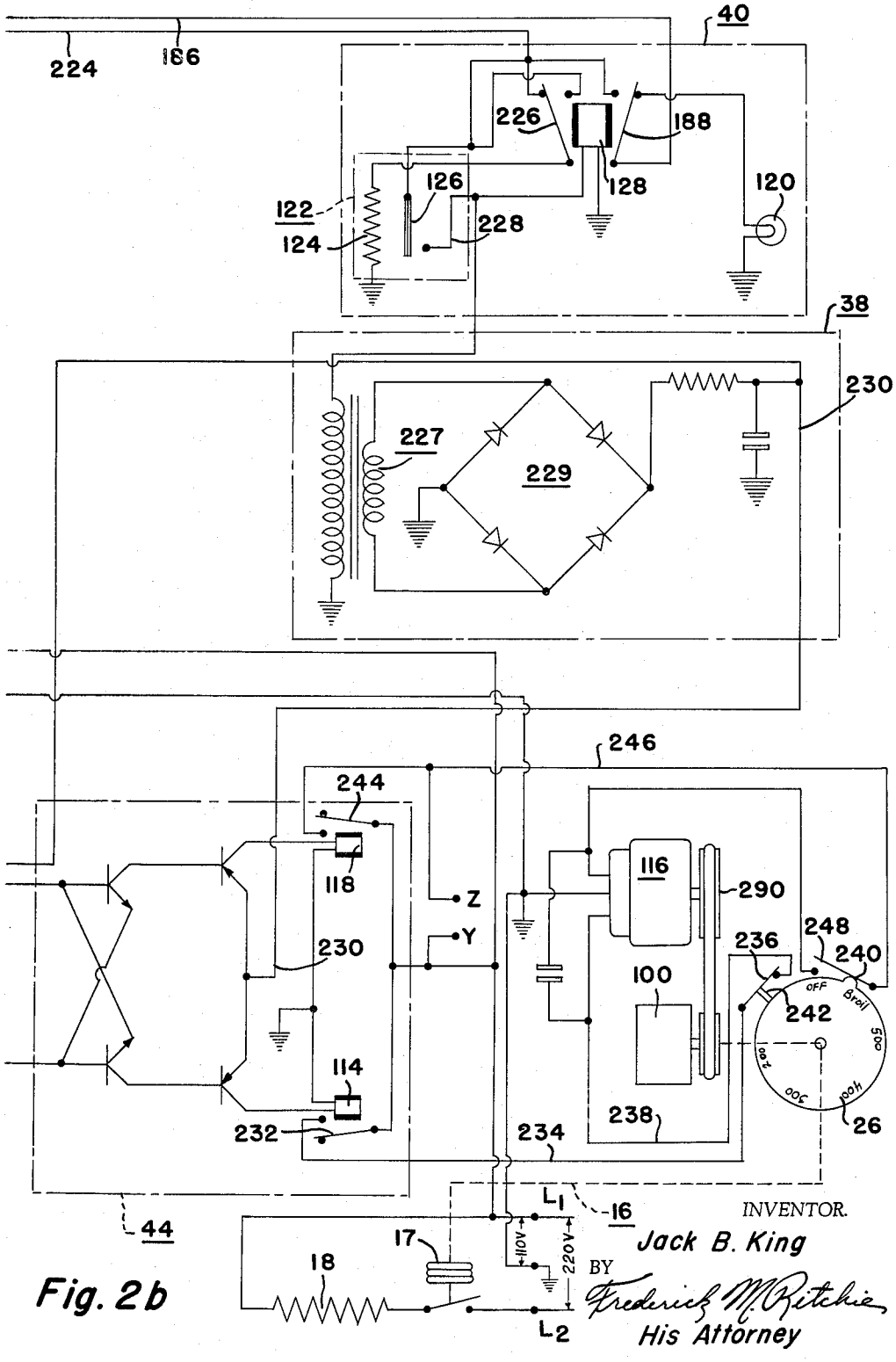


Fig. 2b

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AUTOMATIC OVEN HEAT CONTROL BY WEIGHT AND TYPE OF ROAST

Filed March 26, 1963 7 Sheets-Sheet 4

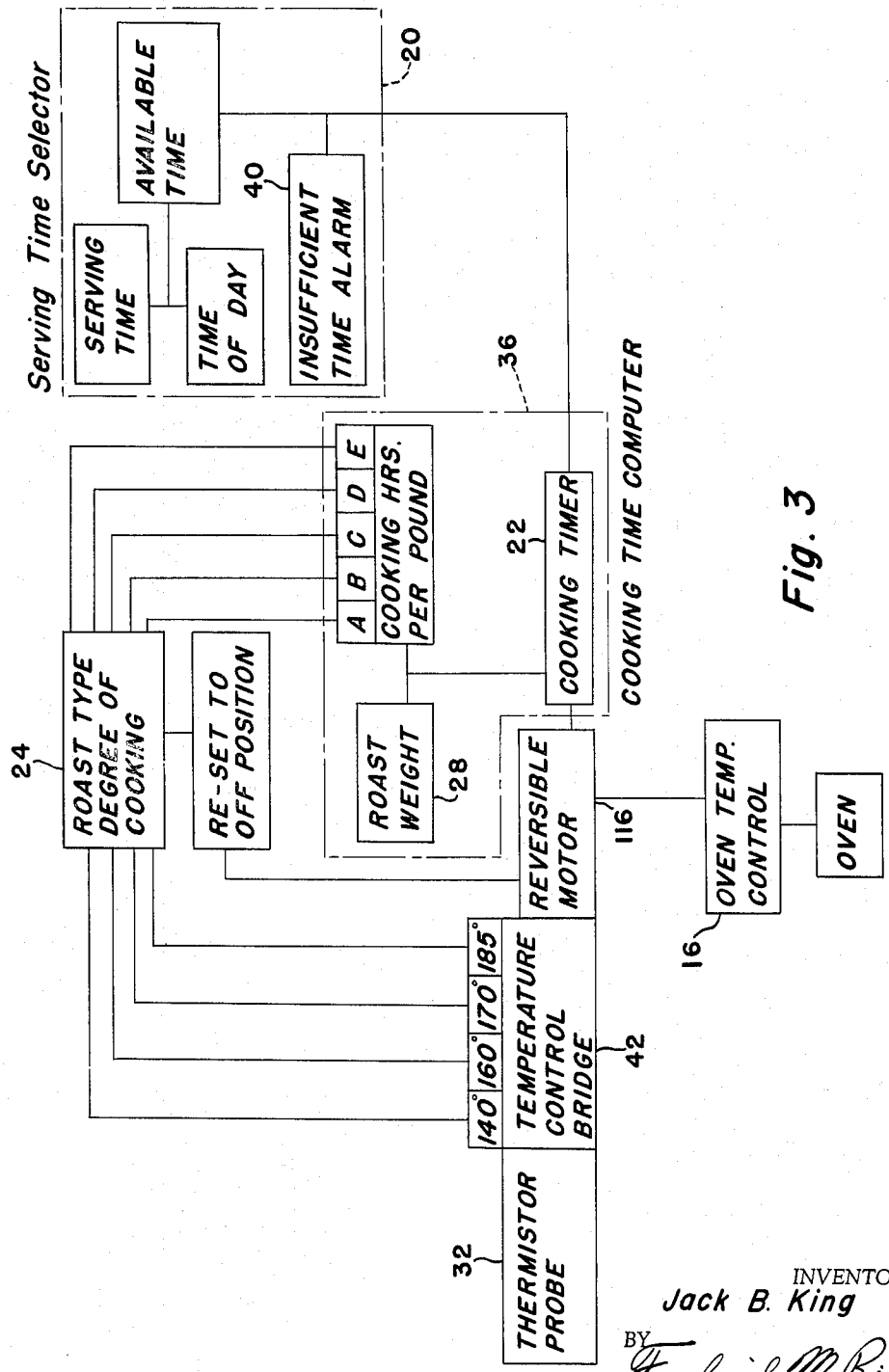


Fig. 3

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AUTOMATIC OVEN HEAT CONTROL BY WEIGHT AND TYPE OF ROAST

Filed March 26, 1963 7 Sheets-Sheet 5

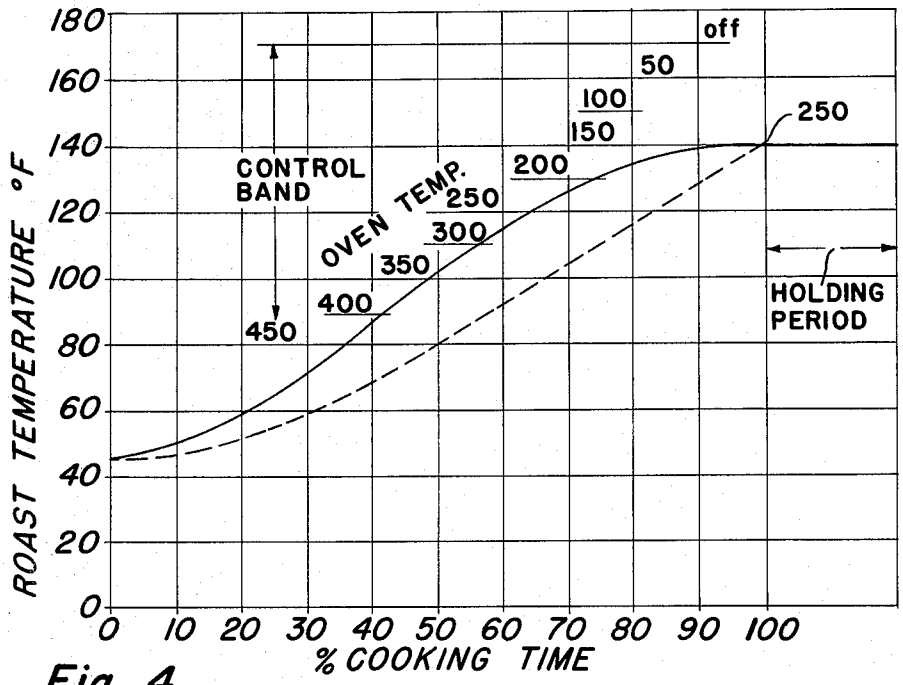


Fig. 4

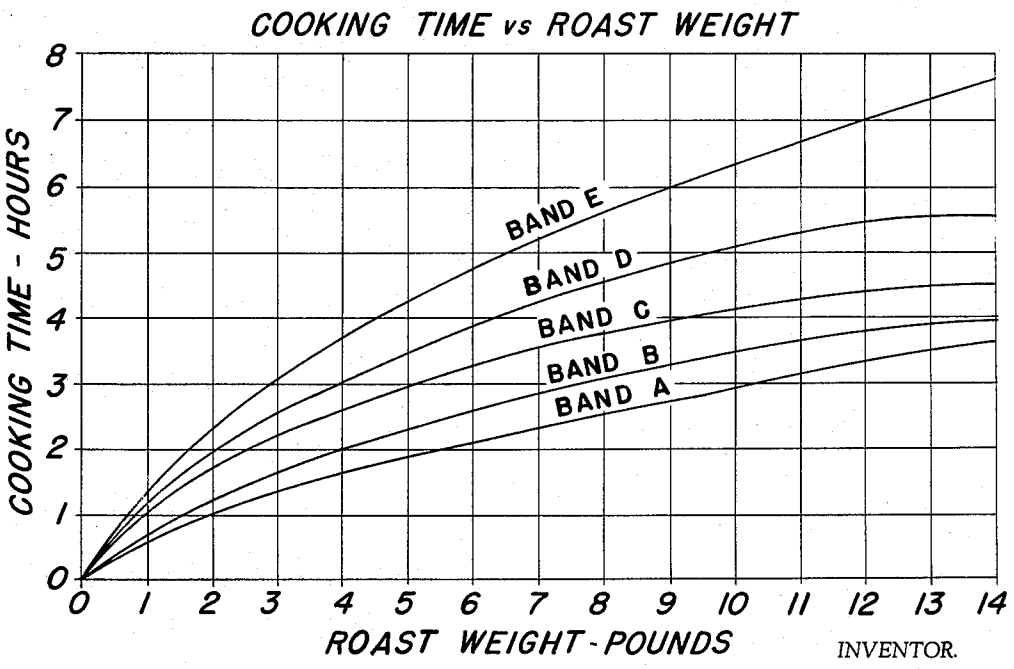


Fig. 5

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AUTOMATIC OVEN HEAT CONTROL BY WEIGHT AND TYPE OF ROAST

Filed March 26, 1963 7 Sheets-Sheet 6

ROAST SELECTOR

Roast Type and Degree of Cooking	Cooking Time Band	Final Roast Temperature
BEEF - RARE	A	140°
BEEF - MEDIUM	B	160°
BEEF - WELL	C	170°
BEEF - ROLLED and BONED - RARE	B	140°
BEEF - ROLLED and BONED - MEDIUM	C	160°
BEEF - ROLLED and BONED - WELL	D	170°
CHICKEN	E	185°
PORK - FRESH	D	185°
PORK - SMOKED	C	160°
PORK - SMOKED - PRECOOKED	A	140°
LAMB	D	185°
VEAL	C	170°
VEAL - ROLLED and BONED	E	170°
DUCK or TURKEY - STUFFED	D	185°
GOOSE	C	185°
CASSEROLE	A	140°

Fig. 6

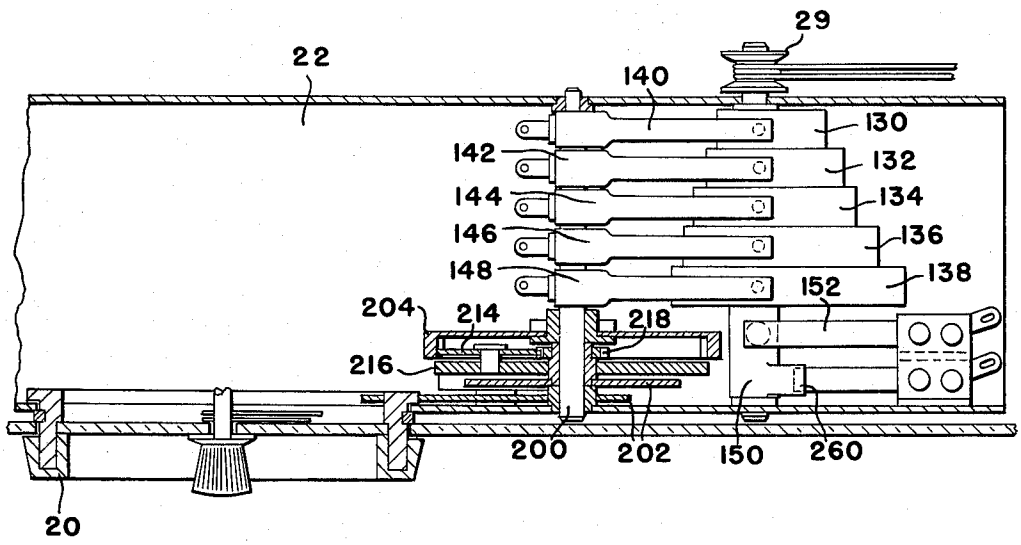


Fig. 11

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AUTOMATIC OVEN HEAT CONTROL BY WEIGHT AND TYPE OF ROAST

Filed March 26, 1963 7 Sheets-Sheet 7

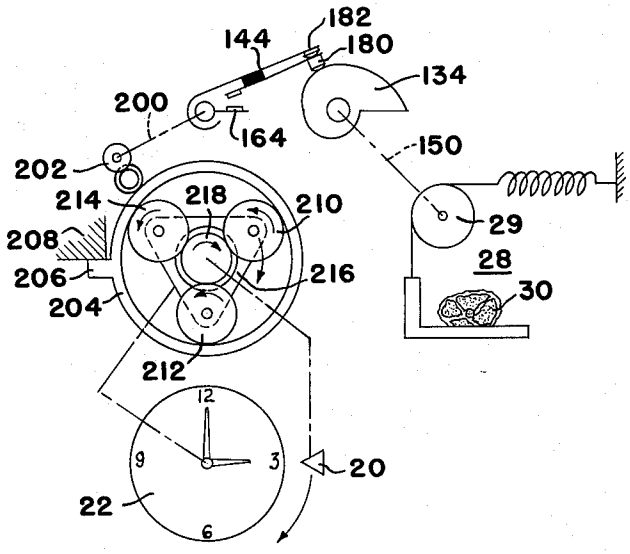


Fig. 7

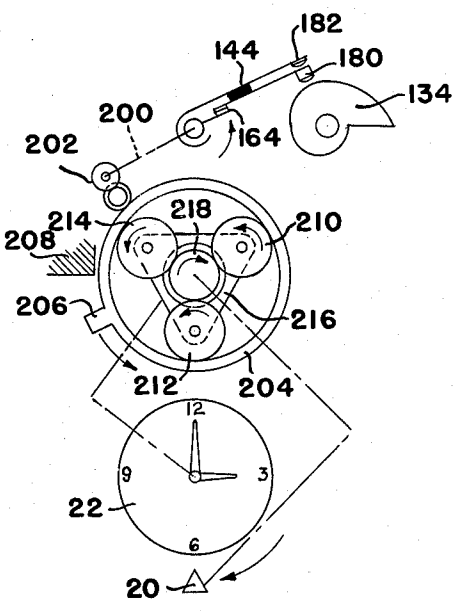


Fig. 8

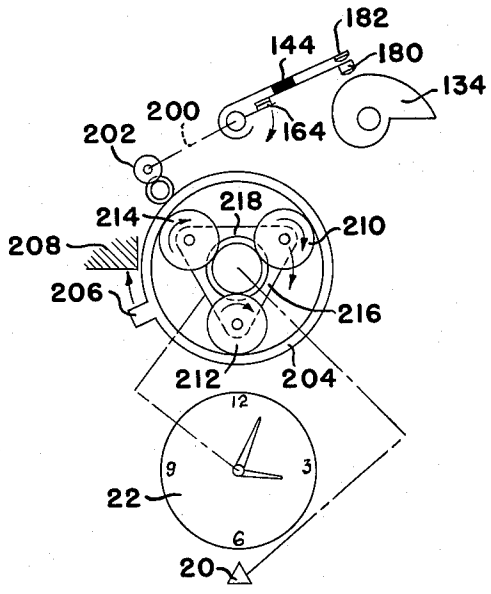


Fig. 9

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United States Patent Office

3,259,056

Patented July 5, 1966

3,259,056

AUTOMATIC OVEN HEAT CONTROL BY WEIGHT AND TYPE OF ROAST

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Filed Mar. 26, 1963, Ser. No. 267,975
23 Claims. (Cl. 99—325)

This invention relates to a domestic appliance and more particularly to an improved oven control adapted for automatically roasting meats or the like.

The prior art includes oven controls which permit housewives to select an oven operating cycle in advance so that a roasting operation can be accomplished without subsequent attention. Such controls require a knowledge of the time required to cook a given meat roast at a particular temperature to the desired degree of doneness plus sufficient mathematical ability to program the oven clock for the desired roasting cycle. These prior art devices require the housewife to (1) determine roast weight, (2) consult cook book for cooking rate (min.-lbs.), (3) calculate cooking time in minutes, (4) convert cooking time to hours, (5) insert the thermometer probe into roast, (6) place roast in oven, (7) connect probe to outlet in oven wall, (8) set roast temperature responsive device to final desired temperature, (9) dial the serving time, (10) dial the cooking hours, and (11) dial the oven temperature; then, after the roast is finished, the housewife must (12) turn the cooking hours dial to MANUAL, and, finally, (13) turn the oven thermostat to OFF.

Accordingly, it is an object of this invention to provide an automatic oven control wherein the desired procedure requires the housewife only to (1) insert the thermometer probe into the roast, (2) place the roast in the oven, (3) connect the probe to the outlet in the oven wall, (4) dial the roast type and desired degree of doneness, and (5) dial the serving time.

Another problem occurring with the foregoing oven controls results from the fact that a roast continues to cook if it is not removed from the oven as soon as the roast cycle is completed, i.e., the serving time arrived at.

In later oven controls, this problem of holding the roast in the oven at a given temperature without continuing the cooking thereof is handled with a control which gradually reduces oven temperature as the temperature of the roast increases. Here, however, the roast cycle starts as soon as the control is set and, if, after a roasting cycle, the roast is retained in the oven for an extended holding period, the roast tends to dry out, as evidenced by lost weight, and the meat becomes less palatable.

Accordingly, it is an object of this invention to provide an oven control which will delay the start of the roasting cycle until such time as the roasting cycle for the preset degree of roast doneness can be accomplished in a period which will terminate substantially at the desired serving time.

A further object of this invention is the provision of an oven roast cycle control which is completely presettable with only two facts—the desired serving time and the desired degree of doneness for a particular kind of meat.

A further object of this invention is the provision of an oven control which includes a cooking time computer programmed by the weight of the roast and the desired serving time.

A still further object of this invention is the provision of a scale in an oven for weighing the meat to be roasted and for presetting an automatic oven control in accordance with the weight of the meat.

Another object of this invention is the provision of an oven thermostat for an automatic roasting cycle which includes a servo system for selectively actuating the oven thermostat.

A still further object of this invention is the provision of an automatic roasting cycle control which includes reversible prime mover means responsive to roast temperatures for changing the temperature setting of an oven thermostat, first to increase oven temperatures after a delay interval to start the roasting cycle, secondly to decrease oven temperatures as roast temperatures increase, until the roast temperature reaches a preselected value, thirdly to maintain the preselected roast temperature until the roast is removed from the oven, and lastly to return the oven thermostat to its OFF condition.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

FIGURE 1 is a perspective view of an oven provided with the automatic oven control of this invention;

FIGURE 2*a* is one half and FIGURE 2*b* the other half of a schematic wiring diagram of the automatic oven control, both figures being referred to in the following description as FIGURE 2;

FIGURE 3 is a block diagram of the automatic oven control;

FIGURE 4 is a graphic illustration of a representative roasting cycle controlled by the oven control of this invention;

FIGURE 5 is a graphic illustration of cooking time vs. roast weight depicting five cooking time bands, one of which is representative of any type of roast;

FIGURE 6 is a chart illustrating the relationship of final roast temperature and cooking time band to roast type and degree of doneness;

FIGURE 7 is a schematic illustration of the cooking time computer portion of this invention before the serving time has been selected;

FIGURE 8 is an illustration similar to FIGURE 7 of the cooking time computer portion as the serving time is being selected;

FIGURE 9 is an illustration similar to FIGURES 7 and 8 illustrating the cooking time computer portion in operation for controlling the duration of the automatic roasting cycle.

FIGURE 10 is a representative mock-up of an oven control panel using this invention; and

FIGURE 11 is a representative mock-up of the cooking time computer of this invention.

With reference to FIGURE 1, a cooking appliance **10** having an oven **12** is shown provided with an automatic roasting cycle control or oven control **14** for selectively controlling an oven thermostat **16**. The thermostat **16** temperature responsively controls the energization of an oven heater or bake unit **18** and could also be used to selectively control a broil heater (not shown) in the upper part of the oven.

In general, the automatic roast control **14** is comprised of a serving time selector **20** in conjunction with a synchronous motor driven oven clock **22** and a roast type and doneness selector **24** which is manually positioned to the name of the meat being roasted and the desired degree of doneness. An exposed face **26** of the oven thermostat **16** can also be moved to desired setting with selector buttons **27** when the housewife wants to use the oven without the automatic roasting control, such as for broiling.

The oven **12** is provided with a roast weighing arrangement **28** including a shelf which is free to move up and down in response to the weigh of a roat **30**. This is, in effect, a scale which programs the weight of the roast **30** into the automatic roasting control **14** through a suitable linkage arrangement (not shown) interconnecting the

oven shelf to the control pulley 29 (FIGURES 2 and 11) as will be understood more fully hereinafter.

Since the control 14 is to be responsive to the inner temperatures of the roast 30, a probe 31 including a thermistor 32 is designed to be inserted into the roast and to transmit roast temperatures to the automatic roasting control 14.

Turning now to the block diagram of FIGURE 3, the automatic roasting control 14 is shown comprised of the roast type and degree of doneness selector 24, the serving time selector 20, the oven thermostat 16, and a cooking time computer 36 including the clock 22, and the roast scale 28. Manually programmed roasting intelligence is interpreted by a temperature control bridge 42, including the roast probe thermistor 32, which passes roast temperature signals to a reversible motor 116 and receives feedback signals therefrom. In response thereto, the oven thermostat 16 is rotated selectively by the motor 116 to increase or decrease oven temperatures. In addition to or as part of those components in the block diagram, the FIGURE 2 schematic shows the automatic oven control 14 to include also a D.C. power supply section 38, a control start or insufficient time section 40, and a two-stage servo amplifier and motor direction control section 44. These major components will now be described separately and in detail.

Roast selector section

Selecting the type of roast and degree of cooking desired will result in the selection of one of five cooking hours per pound band (A, B, C, D, or E) and also the selection of one of four roast temperature rise programs (140, 160, 170, or 185° F.). The combination of cooking-hours-per-pound band and roast weight will determine the required cooking time.

It is assumed for the purpose of this control that the housewife will know the type of meat to be roasted and the degree of doneness which she prefers, i.e., well, medium or rare, etc. For this reason the roast selector 24 is in the form of a rotary drum 50, or the like, which, when rotated by the vertical movement of the indicator 24 on the oven control panel, will selectively pick a cooking time bank by closing a switch pair 52, 54 for cooking band A; a switch pair 56, 58 for cooking band B; a switch pair 60, 62 for cooking band C; a switch pair 64, 66 for cooking band D or a switch pair 68, 70 for cooking band E. Actually, each cooking time band is governed by the configuration of cams A, B, C, D and E in the cooking time computer as dictated by the curves therefor in FIGURE 5. The switches manipulated by the roast selector drum 50 merely pick a particular cam A, B, C, D or E. The Cooking Time Band graph of FIGURE 5 has been devised within the teachings of this invention to incorporate all of the well-known meats into the five cooking bands. However, it is within the purview of this invention to use additional cooking bands in order to minimize the amount of compromise between roasts of different types. FIGURE 6 lists the cooking time bands as well as the roast types and degrees of doneness which may appear adjacent the coast selector indicator 24 and shows the final roast temperature necessary to provide a preselected or suggested degree of doneness.

The same setting of the selector indicator 24 that selects the cooking time band when a roast type is picked will also select the internal roast temperature which is indicative of the degree of doneness selected. More particularly, this temperature is programmed by the rotation of the drum 50 which will switch a pair of resistances in the temperature control bridge section 42. For instance, if the final roast temperature for the desired degree of doneness should be 140° F., a switch pair 80, 82 will be closed. If the final roast temperature should be 160° F., a switch pair 84, 86 will be closed. If a final roast temperature of 170° F. is dictated, a switch pair 88, 90 will be closed; and if a final roast temperature of 185° F. is required, a switch pair 92 and 95 will be closed. Thus, it should be seen that a single setting of the roast type and degree of doneness selector 24 will predetermine and close one set of switches to pick a cooking time band A, B, C, D or E and, simultaneously therewith, will close one pair of switches in the temperature control bridge circuit to place in the circuit the resistances which will predetermine the desired final roast temperature 140°, 160°, 170° or 185° F.

Oven temperature control section

The oven control of this invention controls the rate of roast internal temperature rise by effecting a roast cycle wherein oven temperatures start very high and gradually decrease. Analysis of data obtained from the roasting of many roasts, in a conventional 325° F. oven, has shown that the temperature rise characteristic of any roast, regardless of size or type, falls within a narrow band. The temperature control section 42 is a means for guiding the roast temperature rise throughout the cooking time. The thermistor resistance is compared by means of a Wheatstone bridge, to a control resistance and the resultant control signal used to increase or decrease oven temperatures. More particularly, the oven temperatures are controlled, as in conventional ovens, by an oven thermostat 16 which includes a temperature sensing bulb 17 responsive to oven temperatures. Depending on the setting of the oven thermostat dial 26, the circuit to the oven heating element 18 is opened and closed. In accordance with this invention, the oven thermostat 16 is positioned by a servo motor responsive to the operation of the automatic control of this invention rather than manually as in the prior art. In general this is accomplished through the signals supplied by way of the intelligence sections, i.e., the temperature control bridge 42 and the servo amplifier section 44.

FIGURE 4 compares the proposed roast cycle with the conventional roast cycle. The solid curve represents a hypothetical case in which a roast has been cooked to 140° F. according to the proposed cycle. The dashed curve is typical of a roast cooked to 140° F. in a conventional 325° F. oven.

Although both roasts are shown to arrive at the final desired degree of doneness at the same time, the slope of the conventional curve is quite steep at this point and, if the roast is not removed from the oven, would certainly overcook. The roast cooked according to the proposed cycle, however, can be held at serving temperature for hours if necessary.

It should be observed that roasting speed is a function of control band width and that final roast temperature is a function of control band position. In other words, a narrow control band will subject the roast to maximum oven temperature for a longer period of time, thus, decreasing its cooking time. Raising the position of the control band will, of course, raise the point at which temperature equilibrium occurs.

As set forth hereinbefore in connection with the roast selector, resistances 89, 91, 94 or 96 are selectively placed in the circuit to constitute one leg of a Wheatstone bridge and will determine the control band position (FIGURE 4). The thermistor type roast probe 32 will form the other leg of the bridge circuit and will sense internal roast temperature. A feedback potentiometer 100, flanked by resistors 102 and 104, make up the other half of the bridge circuit. Depending upon which of the final roast temperature switches 82, 86, 90 or 95 are closed, one of the resistors 106, 108, 110 or 112 will be paralleled with the feedback potentiometer 100 and will determine the control band width.

At the beginning of the roast cycle, the resistance of the probe 32 will be quite high, compared to that of resistance 89, 91, 94 or 96 and will result in an unbalanced condition. The magnitude of this unbalanced condition will be amplified in the transistor servo amplifier section

44 to the point where a relay 114 will become energized. The energization of the relay 114 is used to selectively energize a reversible A.C. motor 116 which drives the oven thermostat 16 in one direction to raise the temperature setting thereof. Conversely, the energization of the relay 118 will cause the oven thermostat 16 to be driven in the reverse direction, thereby reducing the oven temperature setting. Note that the feedback potentiometer 100 is effected by the rotation of the thermostat 16 and this results in a rebalancing of the unbalanced bridge throughout the roast control cycle. In this manner, the roast temperature rise will cause the oven temperature to be decreased until the point of equilibrium is reached.

At the beginning of the roast cycle, however, when the unbalance condition is great, switch 236 will open the drive motor circuit before the feedback potentiometer can rebalance the bridge. This switch action determines the upper limit of oven temperature when roasting automatically.

Cooking time computer

In order to properly program the automatic roast control of this invention to terminate a roasting cycle at the desired serving time, it is necessary that the cooking time requirement also be known in advance. Since the roast cycle is to be no longer than the conventional roast cycle, the cooking time requirement can be based on known cooking data interpreted into the cooking time bands of FIGURE 9. This cooking data has been converted into five cooking time bands A, B, C, D and E into which all of the commonly known roasted items may be placed. These cooking time bands are represented by the involute shaped cams illustrated in FIGURE 2—the smaller cam indicating shorter cooking time. For instance, involute cams 130, 132, 134, 136, 138 correspond respectively to cooking time band switch pairs 52, 54; 56, 58; 60, 62; 64, 66; and 68, 70. The cams are rotated by the pulley 29 in a counterclockwise direction by the weight of the roast on the shelf 28 and are electrically conductive to carry current to the combination switch levers 140, 142, 144, 146 and 148 which ride on their respective cam faces. An electrically conductive shaft 150 and slip ring 152 is adapted to convey power from a conductor 154 to and through the cam which relates to the selected lever 140, 142, 144, 146 or 148. It should be seen that the positioning of the lever, 144 for instance, depends on the position of the cooking time cam 134 as determined by the weight of the roast.

The combination switches or levers 140–148 are also lifted or pivoted respectively by lever lifters 160, 162, 164, 166, and 168. The angle assumed by each lever 140–148, relative to its coaxially arranged lever lifter 160–168 is proportional to the cooking time requirement.

Turning now to FIGURE 7, a close examination of one of the combination levers 144 will disclose a pair of insufficient time contacts 180, 182 at the cam follower end of the lever. These contacts, shown in the closed position, will separate when the lever is lifted off of the cam surface by the lever lifter 164.

The operation can best be explained by an example and with reference to FIGURES 2 and 7. Assume that that double-pole switch 60, 62 of cooking time band C is closed. The current can be passed from electrical connector X in the cooking time computer through the brush 184 and slip ring 152 to the cam shaft 150 and the surface of cam 134 and, thence, through the closed contacts 180, 182 of the lever 144. From this point switch 60, conductor 186, and relay switch 188 complete the circuit to the insufficient time signal 120.

Control start section

The follower end of the selected lever must be spaced from the conductive surface of its respective cooking time cam before the system will indicate a "go" condition relative to the roast type and doneness selected, i.e., circuit to insufficient time lamp 120 broken at lever contacts, such as 180, 182.

The difference between time of day and selected serving time is a measure of time available to cook the roast. This is compared to the previously determined cooking time and, if found lacking, will sound an alarm. Assuming that sufficient time is available, the roasting cycle will not begin until the available time equals the cooking time.

More particularly, the purpose of this section is to provide a signal light 120 which will inform the housewife if she has selected a serving time for a given roast which is too soon to permit completion of the required roasting time as determined by the cooking time computer 36. In addition, this section includes a delay relay 122 comprising a heater 124 and a bimetal 126 operated by the heater to close a circuit to a power supply relay 128. The delay is built into the start section to prevent the start of the roasting cycle for fifteen seconds until the housewife has finally positioned her serving time selector 20 and her roast type selector 24.

Serving time selector

One of the variables which the housewife must program into the automatic control of this invention is the time at which she would like to serve the roast. With this invention, however, there is no need to mentally compute the length of cooking time required. Only a specific time at which she would like to serve is required. The mechanical functioning of the serving time selector is illustrated in FIGURES 7, 8 and 9. FIGURE 7 shows the conditions which exist before the serving time has been selected. FIGURE 8 illustrates the conditions involved while selecting a serving time and FIGURE 9 shows the relationship of parts which occurs throughout the automatic roasting cycle.

Turning again to FIGURE 7 and considering cooking time band C as selected, the representative cooking time cam 134 is shown to be rotated schematically by the action of the roast scale pulley 29. The combination lever 144 is biased counterclockwise whenever the cooking time cam 134 comes into engagement with the contact end thereof and, in addition, is pivotable counterclockwise by the lever lifter 164. Both the lever 144 and the lever lifter 164 pivot about a lever lifter shaft 200 which is rotated through a suitable gear reduction transmission 202 by a ring gear 204. The ring gear has a stop portion 206 normally engaged with a ring stop 208 to hold the ring gear 204 stationary when the automatic control is not in use. The ring 204 is one member of a planetary gear arrangement which includes planetary gears 210, 212 and 214 pivotally carried on a planetary gear carrier 216. Centrally located in continuous engagement with the planetary gears is a sun gear 218. The planetary gear carrier 216 is rotated in a clockwise direction, as seen in FIGURE 7, by a suitable connection with the motor of oven clock 22. The sun gear 218 is interconnected with the serving time indicator 20 and operates to cause the serving time pointer 20 to orbit the face of the clock.

FIGURE 7 illustrates the condition which exists before the serving time has been selected or when the automatic control is in the OFF condition. The lever lifter shaft 200 is in its rest position and is held there by the stop 206 on the ring gear 204, the latter being the driver for the lever lifter. The planet carrier 216 is driven continuously by a power take-off from the clock 22 and, since the ring gear 204 is stationary at the OFF condition, the sun gear 218 rotates. The sun gear drives the serving time pointer 20 in a manner which causes it to orbit the clock face. Before a serving time has been selected, the pointer 20 indicates the time of day.

FIGURE 8 shows what happens during the selecting operation. The pointer 20 is rotated clockwise by the housewife until the desired serving time is indicated. By doing this, the sun gear 218 has been rotated faster than the clock 22 was driving it through the planetary gears,

thereby resulting in the ring gear being backed off of its stop **208**. If the selected serving time is too far in the future to start cooking the roast at the time of selection, the lever **144** will have been lifted off the surface of the cam **134**, as shown in FIGURE 8. If the selected serving time is not sufficiently far enough in the future to allow the elapse of the required cooking time as automatically computed by the housewife's selection of meat type and degree of doneness, the insufficient time signal **120** will be illuminated. This will tell the housewife that a later serving time must be selected.

FIGURE 9 depicts the operation of the clock driven components during the automatic roasting cycle. The serving time selector pointer **20** is held at the selected serving time position by friction. Since the sun gear **218**, which drives the pointer **20**, cannot rotate, the ring gear **204** and, thus, the lever lifter shaft **200** are gradually driven back to the rest position shown in FIGURE 7. As soon as the ring gear stop **206** reaches the stationary abutment **208**, the torque applied to the sun gear **218** rises sharply and the frictional restraint of the pointer **20** is overcome, thereby allowing the pointer to resume rotation with the clock. At this point, the serving time coincides with the time of day and, from this point on, the pointer will again indicate the time of day.

In designing the components shown schematically in FIGURES 7, 8 and 9, the greatest travel arc permitted for representative lever **144**, without interference between the lever shaft and the largest lobe on representative cam **134**, was found to be 72°. This means that 72° of lever rotation must represent twelve hours. Since the pointer **20** is graduated to the scale of twelve hours per 360° of rotation, a planetary gear ratio of 5:1 is required. One complete revolution of the pointer **20** will select a serving time which is twelve hours hence and will cause the lever to travel through the full 72° arc.

Operation

To use the automatic oven control of this invention, the housewife need know only the meat type (pork, beef, etc.) and the degree of doneness that she prefers plus the time when she would like to serve the meat. This requires but two operations. Serving time is selected by orbiting the pointer **20** to the desired serving time. Types of meat and degrees of doneness are listed on a chart **23** (left column of FIGURE 6) to which the roast type and degree of doneness selector **24** may be selectively positioned. After the roast **30** is positioned within the oven on the scale **28** and the probe **31** inserted, the automatic roasting cycle is in readiness.

Assume that the housewife wishes to prepare to standing rib of beef with a well done degree of doneness. First, the roast is placed in the oven on the scale **28**. Depending on the weight of the roast **30**, the cooking time cam shaft **150** will be rotated by the pulley **29** to cause the cooking time cams to assume a particular relationship to their respective levers. Next, the movement of the selector **24** to BEEF-WELL will rotate the roast selector drum **50**, thereby to manipulate the various cam actuated cooking time band and final roast temperature switch blades in the automatic oven control. The selection of BEEF-WELL will elect cooking time band C by closing only switches **60** and **62**. The movement of the indicator **24** will also automatically elect a final roast temperature of 170° to produce the degree of doneness selected. Thus, switches **88** and **90** only are closed to place resistances **94** and **110** respectively in the temperature control bridge **42**.

The selection of a serving time by moving the pointer **20** will rotate the lever lifter shaft **200** and open a switch **220** which, when closed, will indicate the serving time has been arrived at. If the serving time selector shaft **200** has not been pivoted sufficiently to cause the lever lifter **164** to lift the lever **144** from the edge of the cooking time cam **134**, power will flow to the insufficient time signal **120** as follows: from one side of a power source L_1, through ring **152**, the brush **184**, cooking time cam shaft **150**, cam **134**, the engaged contacts **180** and **182** (FIGURE 7) of the lever **144**, conductor **222**, switch **60**, conductor **186**, relay switch **188** and the lamp **120** to ground.

If sufficient time remains in which to roast the beef to the desired degree of doneness, the shaft **200** and, thus, the lever lifter **164** will have been pivoted enough to lift the lever **144** off of the cooking time cam and to cause the contacts **182** and **180** to separate (FIGURE 8).

Now that the roast type and degree of doneness has been selected, the desired serving time has been selected and the roast positioned in the oven, the cooking time computer **36** has been completely programmed. The lever lifter shaft **200** is now clock driven in a clockwise direction (FIGURE 9). It should be remembered that the contacts **180**, **182** at the end of the lever **144** are now separated and that the follower contact **180**, on return, will be first to touch the surface of cam **134**. When this occurs, the time remaining is equal to the required cooking time and the circuit initiating the roast cycle is completed. Current will flow from the cam surface through the lever lifter **164**, switch **62**, conductor **224**, relay switch **226** to the heater **124** of the delay relay **122**.

The purpose of the delay relay is to prevent the start of a roasting cycle during the period of time that the housewife is making her selections on the control panel of the oven. At the end of the fifteen-second delay period, relay coil **128** will be energized as the bimetal **126** completes the circuit with switch member **228**. The energization of the relay **128** will move the relay switches **226** and **188** to their pulled-in position, the relay switch **188** serving to remove the insufficient time signal lamp **120** from the circuit to prevent its operation during the roast cycle. The signal current is, in fact, diverted to the heater **124** to hold it in the "ON" position throughout the roast cycle.

The D.C. power supply section **38**, including transformer **227** and silicon diode bridge rectifier **229**, is also turned on by the delay relay and, since it supplies power to the temperature control bridge **42** and servo amplifier **44**, as at common junction **230**, will cause the oven thermostat **16** to be rotated from the "OFF" position. More particularly, power at the junction **230** in the servo amplifier **44** will energize relay **114** and cause a relay switch **232** to move to its upper position whereby power can flow from L_1, switch **232**, conductor **234**, thermostat switch **236**, conductor **238** and the reversible A.C. motor **116** to ground. The motor **116** will rotate the thermostat dial **26** in a clockwise direction until the cam **240** engages the follower **242** to open the high limit switch **236**. The point at which the switch **236** is opened by the rotation of the thermostat cam **240** corresponds to an oven temperature setting of 450° F. This has been determined as the highest desirable roasting temperature at which to start the automatic roasting cycle.

At the beginning of the automatic roast cycle, the probe resistance **32** will be quite high, compared to that of the selected resistance **94** and this will result in an unbalanced bridge condition. The magnitude of this unbalanced condition will be amplified by the transistor servo amplifier **44** so that the energization of the relay **114** will be facilitated as described hereinabove. The feedback potentiometer **100** is also rotated by the drive motor **116** in an effort to rebalance the bridge. At the beginning of the roast cycle, however, when the unbalance is great, the switch **236** will open the drive motor circuit before the feedback potentiometer **100** has effected a balanced bridge condition. This switch action determines the upper limit of oven temperature when roasting automatically and has been selected as the upper limit in order to prevent the energization of the upper broil heater in the oven.

As the internal temperature of the roast rises, the resistance **32** of the thermistor probe will decrease until the bridge is unbalanced in the other direction. When this occurs, the unbalance signal will be amplified through the

servo amplifier 44 and the relay 118 will pull in to move the switch 244 to its lower position, thereby completing the drive motor circuit in the opposite direction. More particularly, power will be supplied in the reverse direction to motor 116 from L_1, switch 244, conductor 246, switch 248 (closed as soon as the thermostat dial 26 is initially rotated) and the motor 116 to ground. During this operation, the temperature setting on the thermostat dial 26 will be decreased (dial rotated counterclockwise) until the feedback potentiometer 100 has rebalanced the bridge. As soon as the bridge is rebalanced, the relay 118 will be deenergized and the motor 116 stopped. In this manner, a rise in the temperature of the roast will cause the oven temperature to be decreaesd until the point of equilibrium is reached. Referring to FIGURE 4, the point of equilibrium is shown at 250 as the time when 100% of the cooking time has elapsed. At this point, the roast has reached the desired degree of doneness at the serving time preselected by the housewife. However, if the housewife is not yet ready to serve the roast, the roast can remain in the oven during a holding period during which the degree of doneness will not change. In other words, when the serving time arrives, the roast will be at the desired degree of doneness and will be held at the temperature representative of this doneness until the roast is removed from the oven.

Automatic reset to OFF

Removal of the roast from the oven will allow the scale 28 to relax and the cooking time cam shaft 150 to return to its normal position. To initiate the automatic reset (FIGURE 2), the cooking time cam shaft 150 carries an unloading cam 260 which actuates a pulse switch 262 through a follower 264. The current passed by the pulse switch from L_1, conductor 266 and switch 220 (closed when the serving time selector shaft moves a biasing member 268) actuates a solenoid 270 which is positioned in conjunction with the detent wheel or drum 50 of the selector 24. More particularly, a detent spring 272 is pulled out of the notch in the drum 50 which originally selected the cooking time band C and the final roast temperature of 170° F. The drum or detent wheel 50 is spring-biased to return to its OFF or MANUAL position at which point, the detent spring is unlatched by a latch strip 274. As the detent wheel 50 is returning to its MANUAL position, a pin 276 cams an automatic shut-off switch blade 278 into engagement with its mating contact 280. This closes a circuit across junctions Y and Z and energizes the motor 116 to drive the oven thermostat dial 26 in a counterclockwise direction until such point as the cam 240 on the thermostat opens the switch 248. At this point, the oven thermostat is in its OFF position and the detent wheel 50 and selector 24 are in their MANUAL position with switches 60, 62, 88 and 90 returned to an open position. It should be noted that the automatic reset to off circuit shown in FIGURE 2 will only function after an automatic roast cycle. It could, however, be made to function whenever the contents of the oven are removed by simply relocating switch 278 to be actuated by solenoid 270. It should also be understood that switch 220 prevents the automatic reset circuit from operating before the serving time has arrived. This arrangement permits temporary removal of the roast from the oven for inspection during the roasting cycle.

With reference to the automatic reset to OFF, the function of the holding coil 281 which surrounds contact 280 will now be described. When switch blade 278 is cammed into engagement with contact 280 by pin 276, motor current is caused to flow through the holding coil 281 surrounding contact 280. The magnetic field setup holds the switch closed until the motor drives the thermostat dial 26 to the OFF position. Limit switch 248 is then opened by cam 240 on the thermostat dial 26.

Opening limit switch 248 stops the motor 116 and de-energizes the holding coil 281. Switch blade 278 is thus allowed to return to its normally open position.

Manual operation of the oven thermostat 16 is now possible whereas it would not be if switch 278 remained closed.

Manual operation

Since the roast selector automatically returns to the MANUAL position after an automatic roast cycle, the housewife need only set the oven thermostat for the proper temperature for baking, broil, etc. A slip clutch 290 on the drive motor shaft permits this to be done. The slip clutch could be eliminated however if a pair of normally open switches were incorporated so as to permit the drive motor to be used to power operate the thermostat as by selectively depressing the buttons 27 (FIGURE 10). This feature would also require that at least a ten r.p.m. drive motor be used whereas a one r.p.m. motor would otherwise be sufficient. This represents a ten-fold increase in torque motor requirement.

It should now be seen that an improved oven roast control has been devised wherein cooking time is automatically computed in accordance with the housewife's selection of serving time and roast type and degree of doneness. The control delays the start of the roasting cycle automatically so that the termination of the roasting will coincide with the desired serving time. This eliminates extended holding periods which tend to dry out the cooked roast.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In combination with a cooking oven having heating means adapted for roasting meat and weighing means adapted for weighing meat, thermostat means for controlling said heating means and operable from an off position to set a temperature for said oven, electrical bridge means having a first portion preselectable for establishing a temperature for said oven suitable for roasting a type of meat and a second portion insertable into a body such as a meat roast to be roasted in said oven for sensing an internal temperature of the body, means for preselecting said first portion, reversible drive means operable forwardly in response to an unbalance signal from said electrical bridge means in one direction for operating said thermostat means to increase the oven temperature setting on said thermostat means and operable reversely in response to an unbalance signal from said electrical bridge means in the opposite direction for operating said thermostat means to decrease the oven temperature setting on said thermostat means, said electrical bridge means including a feedback means operated concurrently with said reversible drive means for rebalancing said electrical bridge means to terminate the operation of said reversible drive means, a D.C. power source actuatable for energizing said electrical bridge means, and means for computing the time required for roasting said body and for actuating said D.C. power source, said computing means including a plurality of preselectable cooking time cams rotatable in response to the operation of said weighing means when loaded, each of said cooking time cams being configured to reflect a cooking time band indicative of a particular type of meat and degree of doneness, means for selecting a serving time for said body, a plurality of preselectable cooking time lever means associated respectively with each of said cooking time cams and manually rotatable out of engagement with their respective cooking time cams a predetermined distance in response to the selection of a serving time for said body, said predetermined distance being greater as the serving time is more remote from the time of selection, means for preselecting one of said cooking time cams and thereby one of said cooking time lever means to form a roast cycle start switch, an A.C. power source connectible through said start switch to actuate said D.C. power source, timing means operable for returning the selected

cooking time lever means to the selected cooking time cam thereby to close the roast cycle start switch and actuate said D.C. power source for initiating a roasting cycle, reset means actuated by the combined operation of said timing means at said serving time and said weighing means when unloaded for negating the preselection of said cooking time cam and the preselection of a temperature for said oven, said reset means including means for energizing said reversible drive means for operation in said reverse direction to operate said thermostat means to said off position, thereby to terminate said roasting cycle, and signal means energizable when said selected cooking time lever means is in engagement with said selected cooking time cam before the initiation of said roasting cycle for indicating an insufficient time for said roasting cycle when the serving time selected does not allow sufficient time to complete the roasting cycle.

2. In combination, a cooking oven having heating means adapted for roasting meat, weighing means adapted for weighing meat, thermostat means for controlling said heating means and operable from an off position to set a temperature for said oven, electrical circuit means having a first portion preselectable for establishing a temperature for said oven suitable for roasting a type of meat and a second portion insertable into a body such as a meat roast to be roasted in said oven for sensing an internal temperature of the body, means for preselecting said first portion, reversible drive means operable forwardly in response to a signal from said electrical circuit means in one manner for operating said thermostat means to increase the oven temperature setting on said thermostat means and operable reversely in response to a signal from said electrical circuit means in another manner for operating said thermostat means to decrease the oven temperature setting on said thermostat means, said electrical circuit means including a servo means operated concurrently with said reversible drive means for effecting a condition whereby said electrical circuit means produces no signals thereby to terminate the operation of said reversible drive means, a first power source actuatable for energizing said electrical circuit means, and means for computing the time required for roasting said body and for actuating said first power source, said computing means including a plurality of preselectable cooking time cams rotatable in response to the operation of said weighing means when loaded, each of said cooking time cams being configured to reflect a cooking time band indicative of a particular type of meat and degree of doneness, means for selecting a serving time for said body, a plurality of preselectable cooking time lever means associated respectively with each of said cooking time cams and manually rotatable out of engagement with their respective cooking time cams a predetermined distance in response to the selection of a serving time for said body, said predetermined distance being greater as the serving time is more remote from the time of selection, means for preselecting one of said cooking time cams and thereby one of said cooking time lever means to form a roast cycle start switch, a second power source connectible through said start switch to actuate said first power source, timing means operable for returning the selected cooking time lever means to the selected cooking time cam thereby to close the roast cycle start switch and actuate said first power source for initiating a roasting cycle, reset means actuated by the combined operation of said timing means at said serving time and said weighing means when unloaded for negating the preselection of said cooking time cam and the preselection of a temperature for said oven, said reset means including means for energizing said reversible drive means for operation in said reverse direction to operate said thermostat means to said off position, thereby to terminate said roasting cycle, and signal means energizable when said selected cooking time lever means is in engagement with said selected cooking time cam before the initiation of said roasting cycle for indicating an insufficient time for said roasting cycle when the serving time selected does not allow sufficient time to complete the roasting cycle.

3. In combination, a cooking oven having heating means adapted for roasting meat, weighing means adapted for weighing meat, thermostat means for controlling said heating means and operable from an off position to set a temperature for said oven, electrical circuit means having a first portion preselectable for establishing a temperature for said oven suitable for roasting a type of meat and a second portion insertable into a body such as a meat roast to be roasted in said oven for sensing an internal temperature of the body, means for preselecting said first portion, reversible drive means operable forwardly in response to a signal from said electrical circuit means in one manner for operating said thermostat means to increase the oven temperature setting on said thermostat means and operable reversely in response to a signal from said electrical circuit means in another manner for operating said thermostat means to decrease the oven temperature setting on said thermostat means, said electrical circuit means including a servo means operated concurrently with said reversible drive means for effecting a condition whereby said electrical circuit means produces no signals thereby to terminate the operation of said reversible drive means, a first power source actuatable for energizing said electrical circuit means, and means for computing the time required for roasting said body and for actuating said first power source, said computing means including a plurality of preselectable cooking time cams rotatable in response to the operation of said weighing means when loaded, each of said cooking time cams being configured to reflect a cooking time band indicative of a particular type of meat and degree of doneness, means for selecting a serving time for said body, a plurality of preselectable cooking time lever means associated respectively with each of said cooking time cams and manually rotatable out of engagement with their respective cooking time cams a predetermined distance in response to the selection of a serving time for said body, said predetermined distance being greater as the serving time is more remote from the time of selection, means for preselecting one of said cooking time cams and thereby one of said cooking time lever means to form a roast cycle start switch, a second power source connectible through said start switch to actuate said first power source, timing means operable for returning the selected cooking time lever means to the selected cooking time cam thereby to close the roast cycle start switch and actuate said first power source for initiating a roasting cycle, and reset means actuated by the combined operation of said timing means at said serving time and said weighing means when unloaded for negating the preselection of said cooking time cam and the preselection of a temperature for said oven, said reset means including means for energizing said reversible drive means for operation in said reverse direction to operate said thermostat means to said off position, thereby to terminate said roasting cycle.

4. An automatic oven control for a cooking oven having heating means adapted for roasting meat and the like comprising weighing means adapted for weighing meat, thermostat means adapted for controlling said heating means and operable from an off position to set a temperature for said oven, electrical bridge means having a first portion preselectable for establishing a temperature for said oven suitable for roasting a type of meat and a second portion adapted to be insertable into a body such as a meat roast to be roasted in said oven for sensing an internal temperature of the body, means for preselecting said first portion, drive means operable in one manner in response to an unbalance signal from said electrical bridge means in one direction for operating said thermostat means to increase the oven temperature setting on said thermostat means and operable in another manner in response to an unbalance signal from said electrical

bridge means in the opposite direction for operating said thermostat means to decrease the oven temperature setting on said thermostat means, said electrical bridge means including a feedback means operated concurrently with said drive means for rebalancing said electrical bridge means to terminate the operation of said drive means, a D.C. power source actuatable for energizing said electrical bridge means, and means for computing the time required for roasting said body and for actuating said D.C. power source, said computing means including a plurality of preselectable cooking time cams rotatable in response to the operation of said weighing means when loaded, each of said cooking time cams being configured to reflect a cooking time band indicative of a particular type of meat and degree of doneness, means for selecting a serving time for said body, a plurality of preselectable cooking time lever means associated respectively with each of said cooking time cams and manually rotatable out of engagement with their respective cooking time cams a predetermined distance in response to the selection of a serving time for said body, said predetermined distance being greater as the serving time is more remote from the time of selection, means for preselecting one of said cooking time cams and thereby one of said cooking time lever means to form a roast cycle start switch, an A.C. power source connectible through said start switch to actuate said D.C. power source, timing means operable for returning the selected cooking time lever means to the selected cooking time cam thereby to close the roast cycle start switch and actuate said D.C. power source for initiating a roasting cycle, reset means actuated by the combined operation of said timing means at said serving time and said weighng means when unloaded for negating the preselection of said cooking time cam and the preselection of a temperature for said oven, said reset means including means for energizing said drive means for operation in said another manner to operate said thermostat means to said off position, thereby to terminate said roasting cycle, and signal means energizable when said selected cooking time lever means is in engagement with said selected cooking time cam before the initiation of said roasting cycle for indicating an insufficient time for said roasting cycle when the serving time selected does not allow sufficient time to complete the roasting cycle.

5. An automatic oven control for a cooking oven having heating means adapted for roasting meat and the like comprising weighing means adapted for weighing meat, thermostat means adapted for controlling said heating means and operable from an off position to set a temperature for said oven, electrical bridge means having a first portion preselectable for establishing a temperature for said oven suitable for roasting a type of meat and a second portion adapted to be insertable into a body such as a meat roast to be roasted in said oven for sensing an internal temperature of the body, means for preselecting said first portion, drive means operable in one manner in response to an unbalance signal from said electrical bridge means in one direction for operating said thermostat means to increase the oven temperature setting on said thermostat means and operable in another manner in response to an unbalance signal from said electrical bridge means in the opposite direction for operating said thermostat means to decrease the oven temperature setting on said thermostat means, said electrical bridge means including a feedback means operated concurrently with said drive means for rebalancing said electrical bridge means to terminate the operation of said drive means, a D.C. power source actuatable for energizing said electrical bridge means, and means for computing the time required for roasting said body and for actuating said D.C. power source, said computing means including a preselectable cooking time cam rotatable in response to the operation of said weighing means when loaded, said cooking time cam being configured to reflect a cooking time band indicative of a particular type of meat and degree of doneness, means for selecting a serving time for said body, a preselectable cooking time lever means associated with said cooking time cam and manually rotatable out of engagement with said cooking time cam a predetermined distance in response to the selection of a serving time for said body, said predetermined distance being greater as the serving time is more remote from the time of selection, means for preselecting said cooking time cam and thereby said cooking time lever means to form a roast cycle start switch, an A.C. power source connectible through said start switch to actuate said D.C. power source, timing means operable for returning the selected cooking time lever means to the selected cooking time cam thereby to close the roast cycle start switch and actuate said D.C. power source for initiating a roasting cycle, and reset means actuated by the combined operation of said timing means at said serving time and said weighing means when unloaded for negating the preselection of said cooking time cam and the preselection of a temperature for said oven, said reset means including means for energizing said drive means for operation in said another manner to operate said thermostat means to said off position, thereby to terminate said roasting cycle.

6. An oven control comprising oven thermostat means temperature settably adapted to control the temperature in an oven, power means drivably connected to said thermostat means and operable for increasing and decreasing the temperature setting of said thermostat means, and means responsive to the changing temperature of a body adapted to be roasted in the oven and adapted to produce a signal responsive to said changing temperature, said power means being energizable in response to said signal for selectively and progressively changing the temperature setting of said thermostat means.

7. The oven control of claim 6 wherein said responsive means includes an electrical bridge having one portion thereof presettable for a desired roast doneness and another portion adapted to be responsive to actual roast doneness.

8. The oven control of claim 6 including switch means closeable to energize said responsive means and including first and second contacts, scale means adapted to weigh the body to be roasted and connected for operating said first contact, and timing means connected for operating said second contact to close said switch means thereby to initiate an oven control cycle.

9. The oven control of claim 8 including delay means energizable when said switch means are closed to delay the energization of said responsive means a predetermined interval.

10. An oven control comprising oven thermostat means temperature settably adapted to control the temperature in an oven, power means drivably connected to said thermostat means and operable for increasing and decreasing the temperature setting of said thermostat means, and means responsive to the increasing temperature of a body adapted to be roasted in the oven and energizable for selectively operating said power means to progressively decrease the temperature setting of said thermostat means.

11. In combination with a domestic cooking appliance having an oven and an exposed control panel therefor, an oven control comprising oven thermostat means temperature settably adapted to control the cooking temperature in said oven, power means drivably connected to said thermostat means and operable for increasing and decreasing the temperature setting of said thermostat means, and manually operable selector means on said control panel for selectively operating said power means.

12. An automatic cooking control adapted to control the cooking of a body such as meat or the like and comprising adjustable thermostat means temperature settably adapted to control temperature throughout an automatic cooking cycle, and cooking time computer means operable to effect the selective adjustment of said thermostat

means between an off position and a cooking position, said computer means including means presettable for selecting a serving time, means adapted for weighing a body to be cooked and timing means in control relationship to said thermostat means and preconditioned by the preselection of said serving time and the weighing of a body by said weighing means for initiating and terminating said cooking cycle.

13. An oven control comprising oven thermostat means temperature settably adapted to control the temperature in an oven, power means drivably connected to said thermostat means for increasing and decreasing the temperature setting of said thermostat means, electrical bridge means energizable to be responsive to the internal temperature of a body such as a meat roast adapted to be roasted in an oven and in control relationship to said power means for selectively operating said power means to change the temperature setting of said thermostat means, said electrical bridge having one portion thereof presettable for a desired roast doneness and another portion adapted to be responsive to actual roast doneness, power supply switch means adapted to energize said electrical bridge means and including first and second contacts, scale means adapted to weigh the body to be roasted and connected for operating said first contact, and timing means connected for operating said second contact to close said switch means thereby to determine when the electrical bridge means is energized.

14. The oven control of claim 13 wherein said first contact is a cam configured in a manner to prescribe a cooking time band for a particular type of meat roast and degree of doneness.

15. An oven control comprising oven thermostat means temperature settably adapted to control the temperature in an oven, power means drivably connected to said thermostat means for increasing and decreasing the temperature setting of said thermostat means, electrical bridge means energizable to be responsive to the internal temperature of a body such as a meat roast adapted to be roasted in an oven and in control relationship to said power means for selectively operating said power means when unbalanced to change the temperature setting of said thermostat means, said electrical bridge having a first portion thereof presettable for a desired roast doneness and operable to unbalance said electrical bridge means in one direction, a second portion adapted to be responsive to actual roast doneness and operable to unbalance said electrical bridge means in another direction and a third portion responsive to said power means and operable to rebalance said electrical bridge means, power supply switch means adapted to energize said electrical bridge means and including first and second contacts, scale means adapted to weigh the body to be roasted and connected for operating said first contact, and timing means connected for operating said second contact to close said switch means thereby to determine when the electrical bridge means is energized.

16. An automatic control for a domestic cooking oven having a heating element adapted to roast meat or the like comprising means adapted to regulate said heating element in a roasting cycle including means for determining and automatically controlling the duration of said roasting cycle, said last named means including means for selecting a meat type and degree of doneness, means for weighing said meat or the like, first movable contact means selectable in response to the selection on the means for selecting a meat type and degree of doneness thereby to predetermine a serving time for said meat or the like and second movable contact means positionable in response to the means for weighing said meat or the like thereby to predetermine a starting time for said roasting cycle.

17. The automatic control of claim 16 wherein said means for determining the duration of said roasting cycle includes means for signaling when an insufficient duration exists to complete the roast cycle at the selected serving time with the selected meat at the selected degree of doneness.

18. The automatic cooking control of claim 12 including power means drivably connected to said thermostat means for adjusting said thermostat means between said off position and said cooking position.

19. The automatic cooking control of claim 18 wherein said power means is a reversible motor.

20. An automatic cooking control adapted to control the cooking of a body such as meat or the like and comprising adjustable thermostat means temperature settably adapted to control temperature throughout an automatic cooking cycle, and cooking time computer means operable to effect the selective adjustment of said thermostat means between a first position and a second position, said computer means including means presettable for selecting a serving time, means adapted for weighing a body to be cooked and timing means in control relationship to said thermostat means and preconditioned by the preselection of said serving time and the weighing of a body by said weighing means for initiating and terminating said cooking cycle.

21. An oven control comprising oven thermostat means temperature settably adapted to control the temperature in an oven, power means drivably connected to said thermostat means and operable for increasing and decreasing the temperature setting of said thermostat means, means responsive to the changing temperature of a body adapted to be roasted in the oven and energizable for selectively operating said power means to change the temperature setting of said thermostat means, said responsive means being an electrical bridge having one portion thereof presettable for a desired roast doneness and another portion adapted to be responsive to actual roast doneness, switch means closable to energize said responsive means and including first and second contacts, scale means adapted to weigh the body to be roasted and connected for operating said first contact, and timing means connected for operating said second contact to close said switch means thereby to initiate an oven control cycle, and delay means energizable when said switch means are closed to delay the energization of said responsive means a predetermined interval.

22. The oven control of claim 6 wherein said power means includes an electrically operable motor and a manually operable dial.

23. The oven control of claim 10 wherein said power means includes an electrically operable motor and a manually operable dial.

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