US00RE45026E

(19) **United States**
(12) **Reissued Patent**
Jorgensen et al.

(10) **Patent Number: US RE45,026 E**
(45) **Date of Reissued Patent: Jul. 22, 2014**

(54) RESISTANCE HEATING SYSTEM

(75) Inventors: **Glenn F. Jorgensen**, Ridgewood, NJ (US); **Michael W. Kelly**, Joliet, IL (US); **Laura Patterson**, Joliet, IL (US)

(73) Assignee: **Power House Tool, Inc.**, Joliet, IL (US)

(21) Appl. No.: **12/324,501**

(22) Filed: **Nov. 26, 2008**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **7,141,766**
Issued: **Nov. 28, 2006**
Appl. No.: **11/074,507**
Filed: **Mar. 8, 2005**

(51) **Int. Cl.**
H05B 1/02 (2006.01)

(52) **U.S. Cl.**
USPC **219/497**; 219/205; 219/492; 219/506; 219/483

(58) **Field of Classification Search**
CPC H05B 1/02; H05B 1/0236
USPC ..... 219/497, 483–487, 492, 494, 505, 506, 219/533, 535, 137 PS, 24–243; 403/30
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,176,601	A		7/1937	Bates	
2,306,709	A		7/1941	Miller	
3,699,307	A	*	10/1972	Malkin	219/492
3,771,209	A		11/1973	Bennett, Jr.	
4,282,422	A	*	8/1981	Payne et al.	219/486
4,454,084	A		6/1984	Smith et al.	
4,847,468	A		7/1989	Hufstetler	
5,169,673	A		12/1992	Demeny et al.	
5,196,673	A	*	3/1993	Tanis	219/205
5,397,876	A		3/1995	Shimamoto et al.	
5,437,489	A		8/1995	Sanders et al.	
5,905,694	A	*	5/1999	Rothberg	368/113
5,994,682	A		11/1999	Kelly et al.	
6,018,137	A		1/2000	Reiff	
6,348,674	B1		2/2002	Russell	
2003/0057879	A1	*	3/2003	Capriglione	315/291
2006/0280143	A1	*	12/2006	Dabak et al.	370/329
2008/0272090	A1		11/2008	Keihle et al.	

FOREIGN PATENT DOCUMENTS

JP	361297039		12/1986
JP	361297039	A *	12/1986

* cited by examiner

Primary Examiner — Mark Paschall
(74) *Attorney, Agent, or Firm* — Greer Burns & Crain, Ltd.

(57) **ABSTRACT**

A resistance heating system is provided which includes a resistance heater, a source of alternating current electricity connected by conductors to the resistance heater, and a controller comprising a timer arranged to connect the source of alternating current electricity to the resistance heater for a selected time period and to disconnect the source from the resistance following the selected time period. In an embodiment, the resistance heating system is provided with a controller configured to be connected to a source of alternating current electricity and having a plurality of cable plug receptacles arranged to receive electricity. An electricity conducting cable having a cable plug at one end is configured to be received in the receptacles and has a resistance heater provided at an opposite end. A master timer may be connected with a communication arrangement to the controller. The master timer is arranged to control an electric output of a plurality of the receptacles.

28 Claims, 6 Drawing Sheets

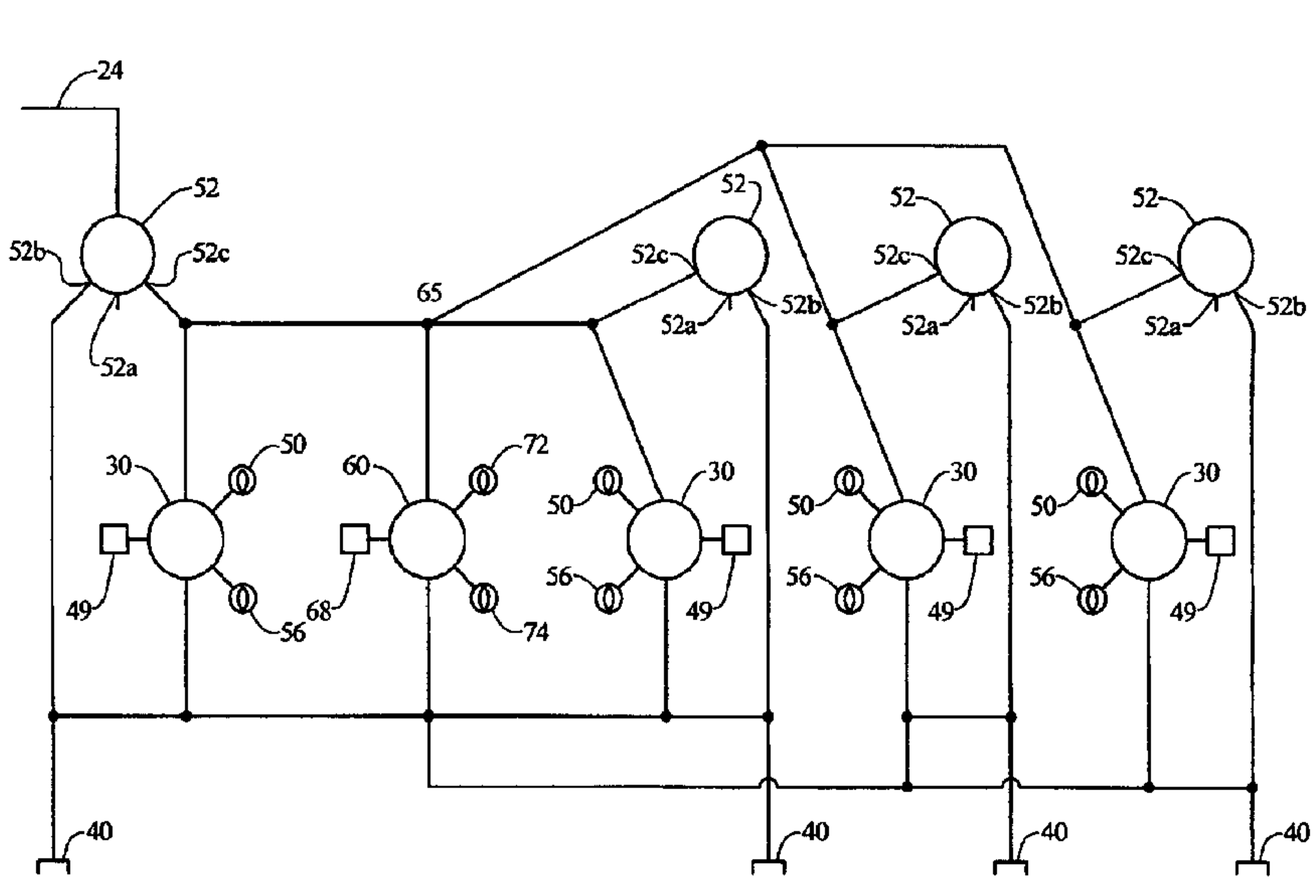


FIG. 1

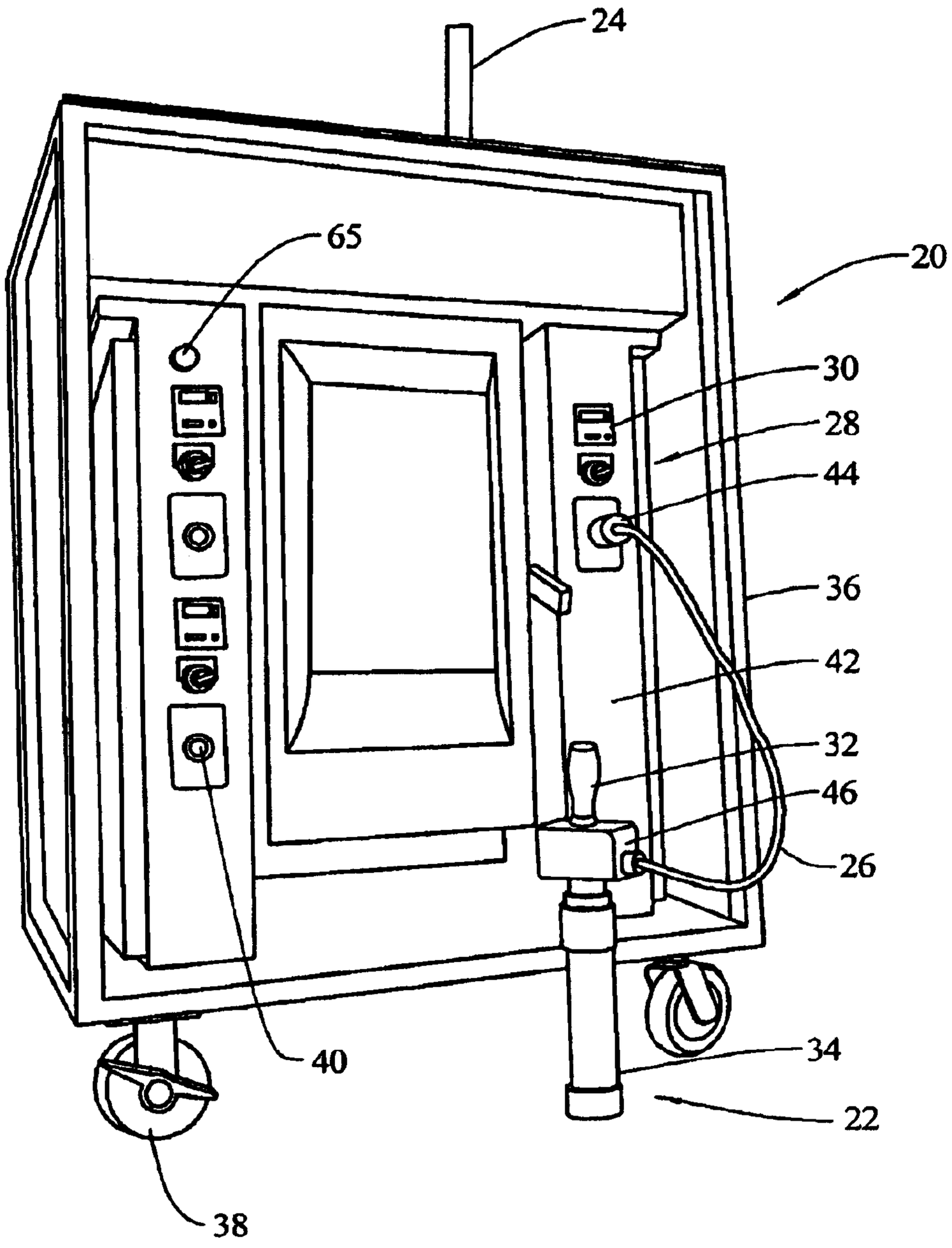


FIG. 2

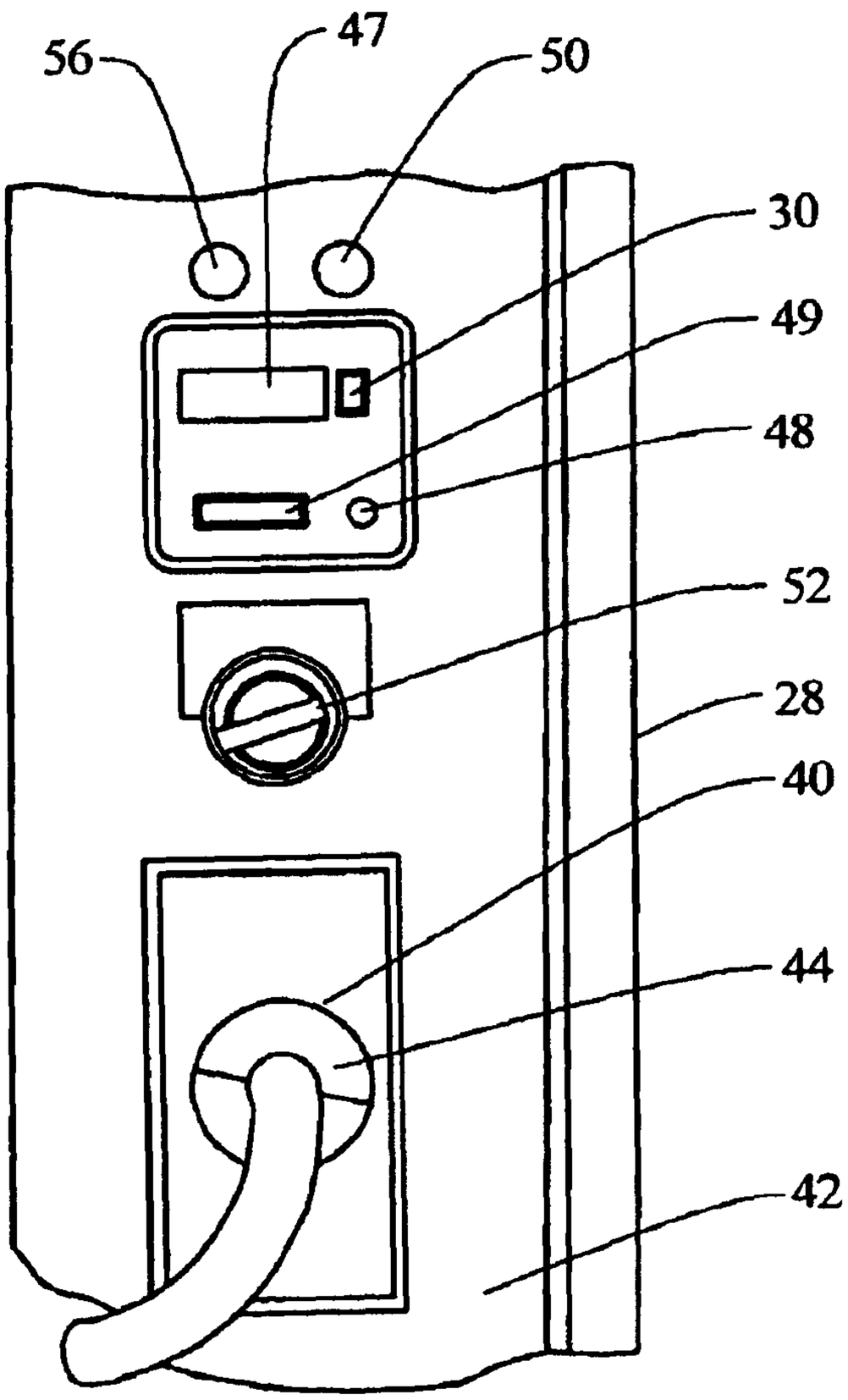
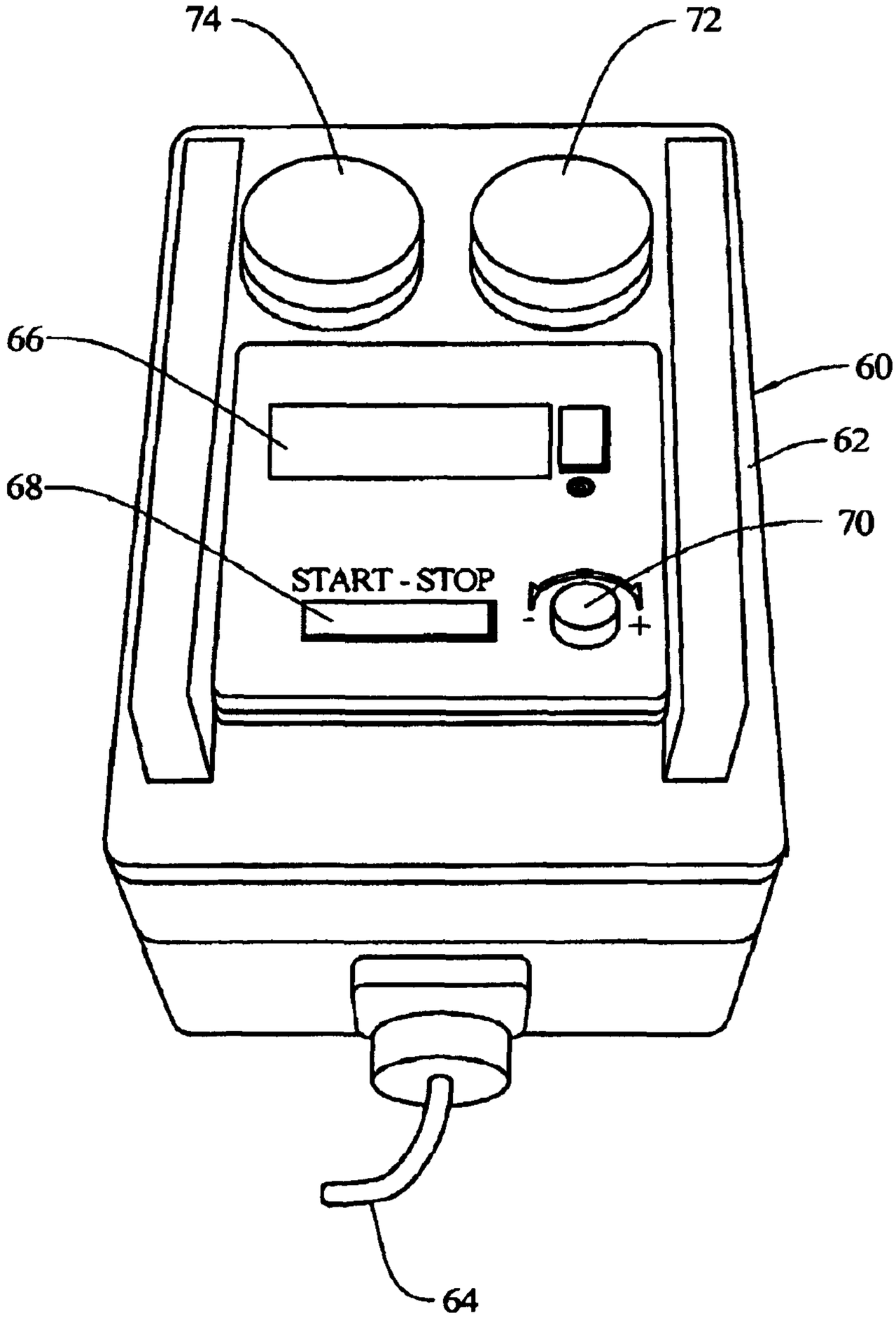


FIG. 3



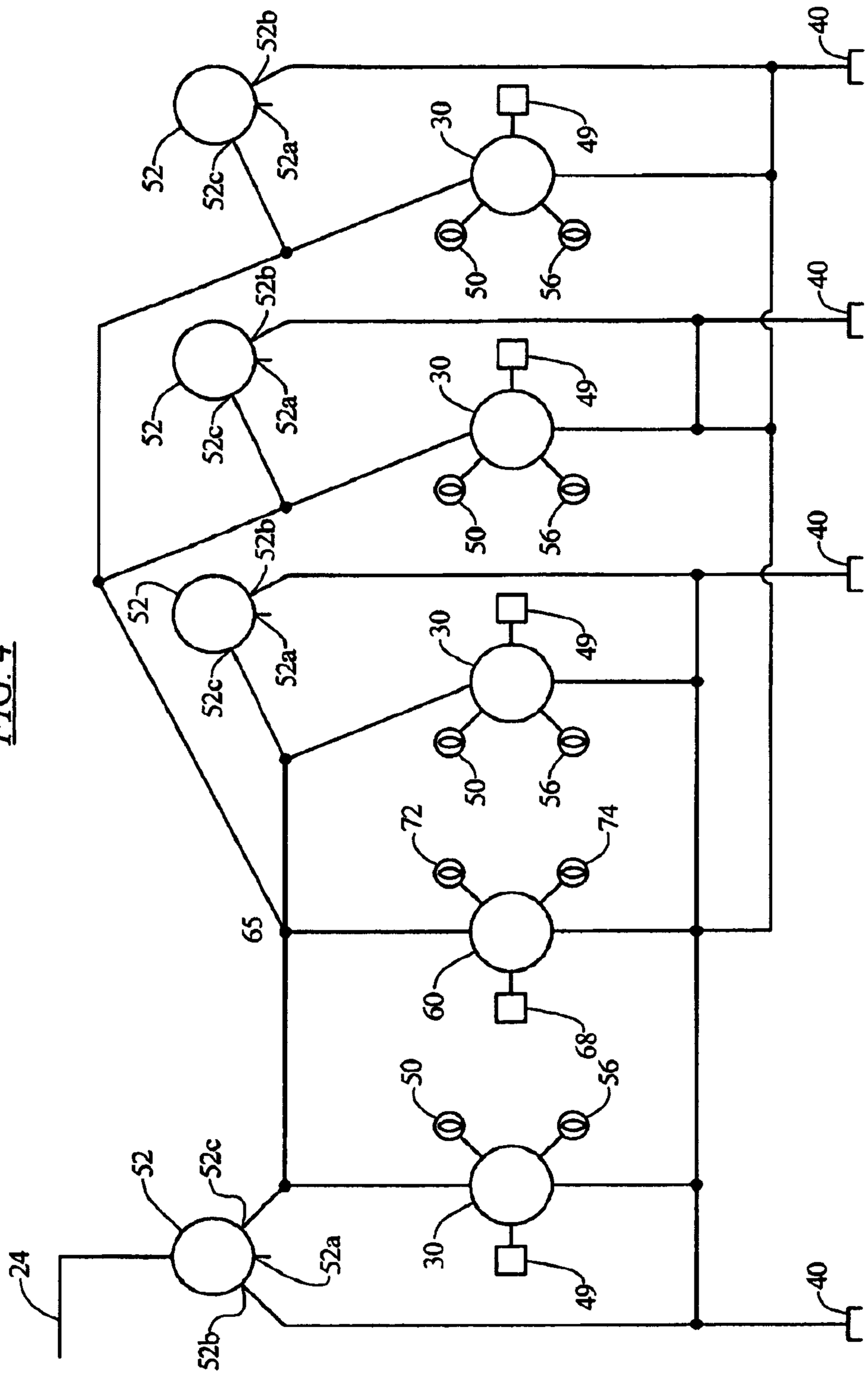


FIG. 4

FIG. 5

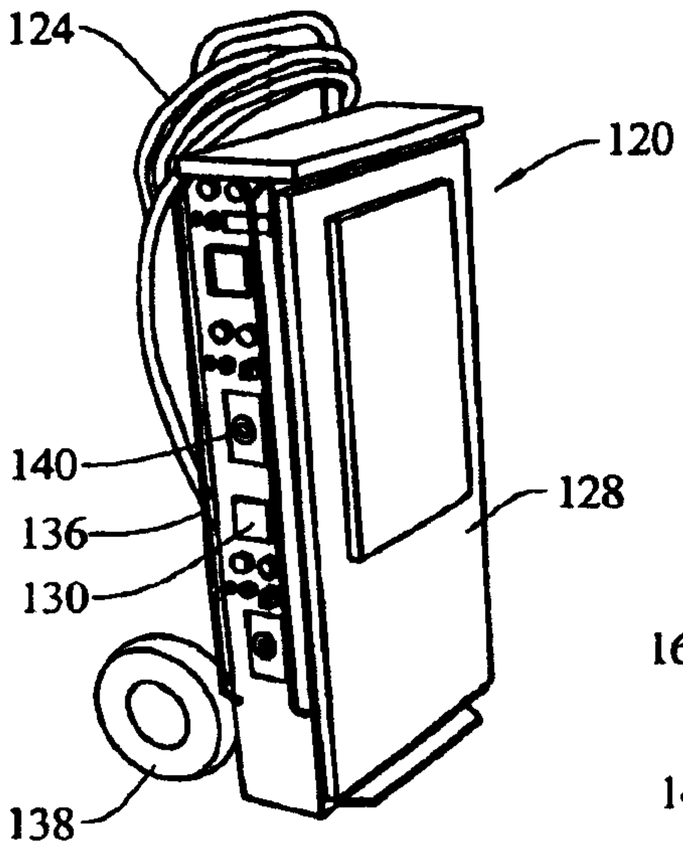

124
120
140
136
130
128
138

FIG. 6

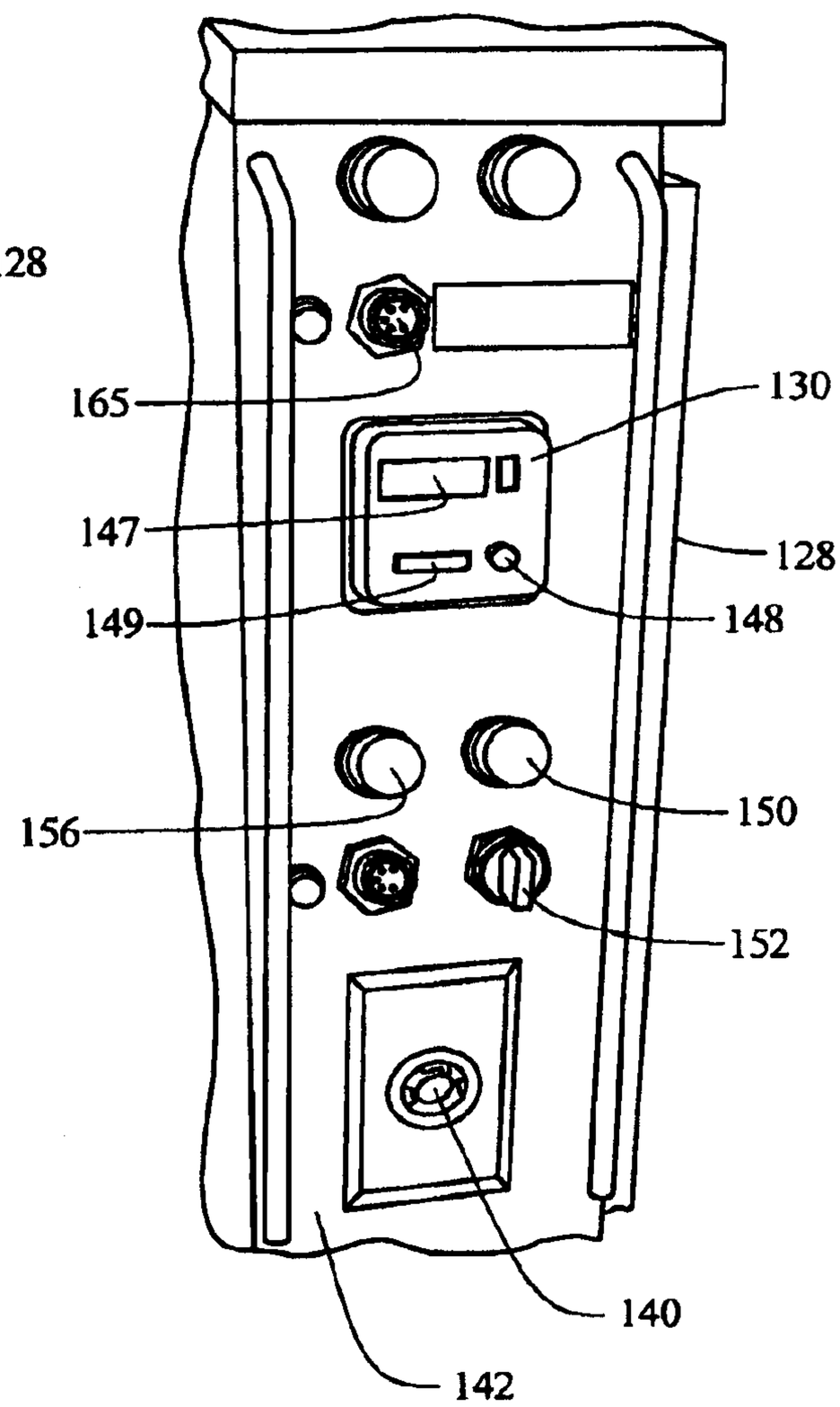

165
130
147
128
149
148
156
150
152
140
142

FIG. 7

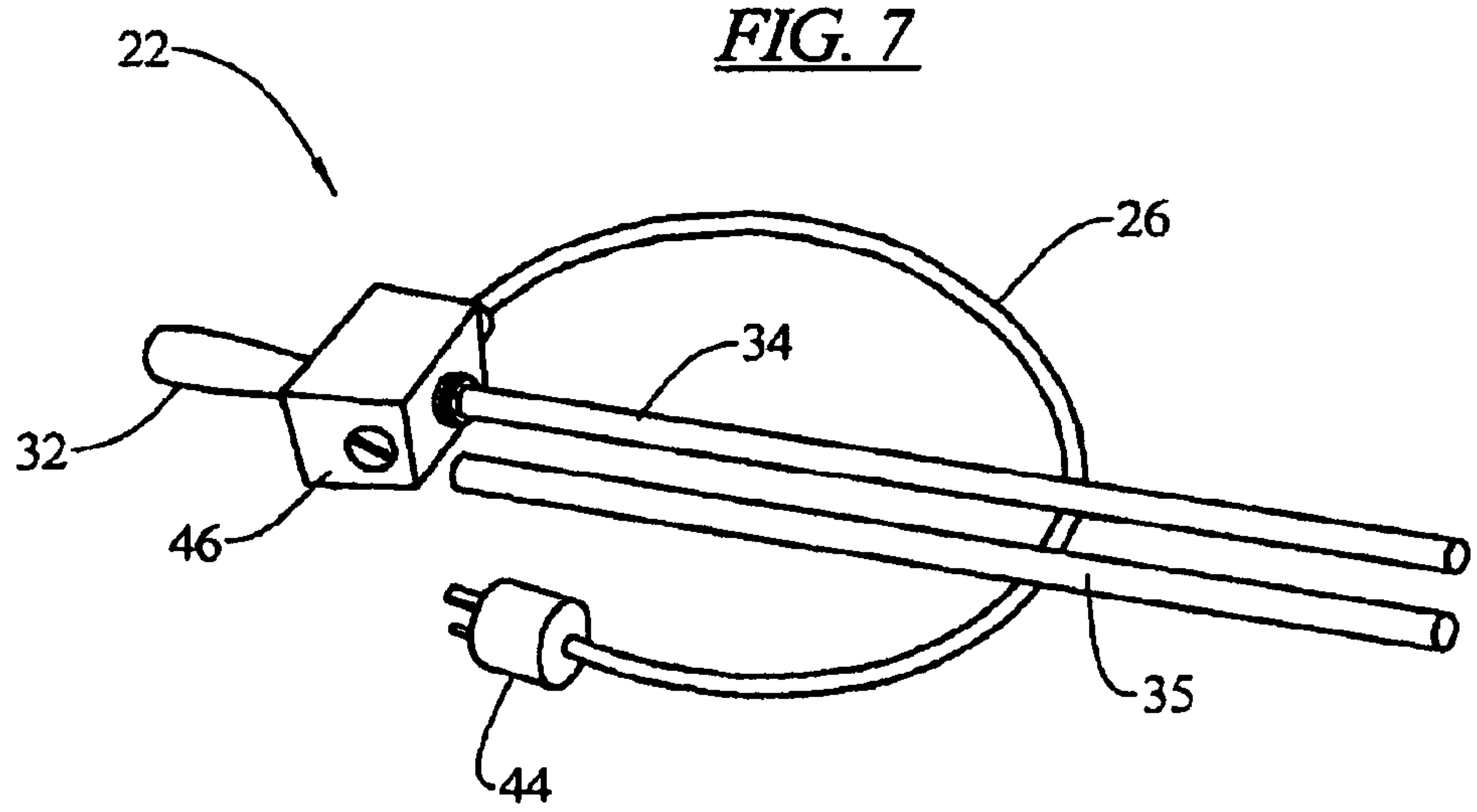
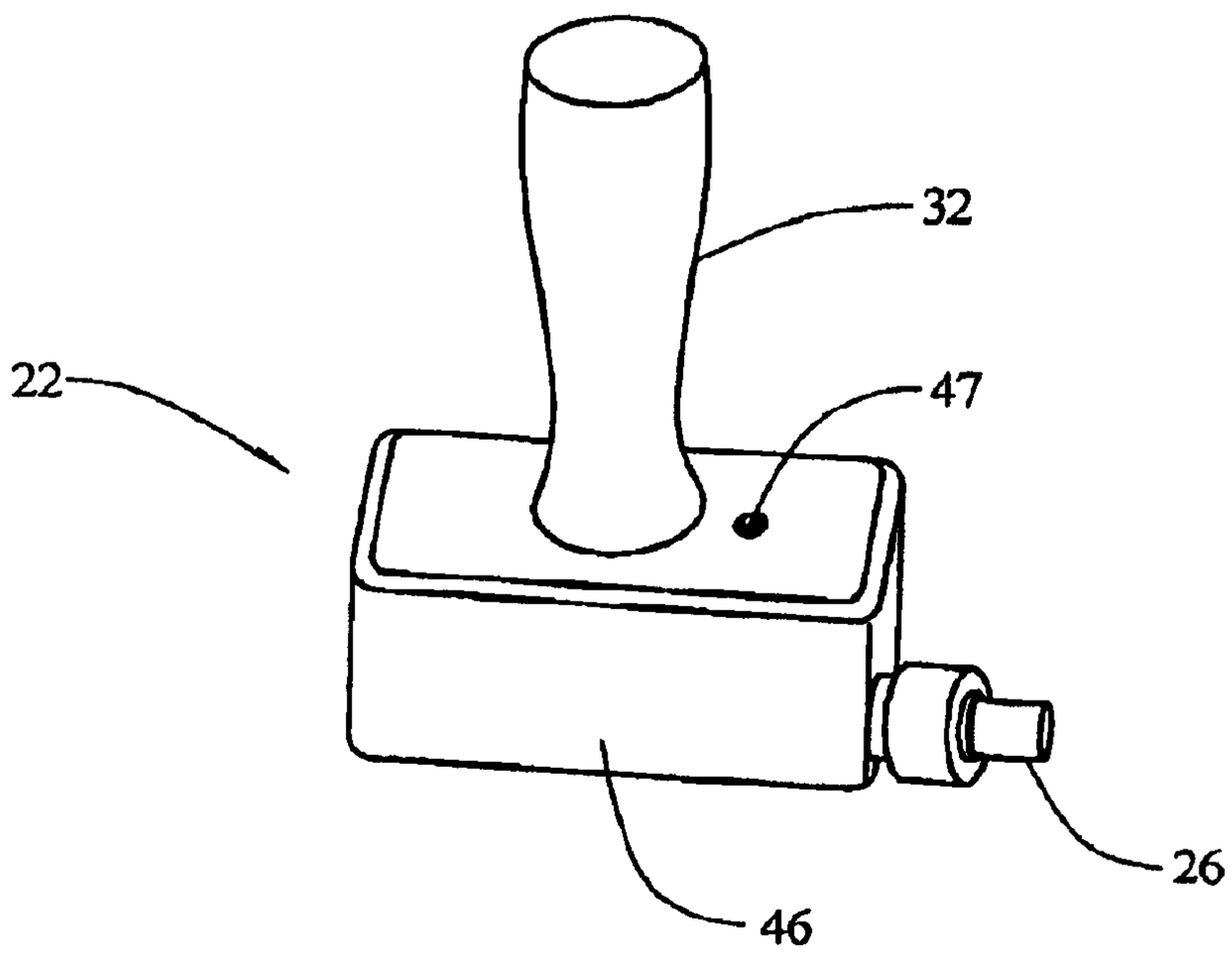


FIG. 8



RESISTANCE HEATING SYSTEM

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

The present invention relates to heating devices and controllers therefore, and in particular to a resistance heating device and its controller for heating a rod or post, such as a stud or threaded bolt.

The present invention has a particular application in the heating of studs or bolts, such as the bolts of a steam turbine casing. Although the invention is not limited to such an application, the invention will be described in such an environment and use.

It is desirable to heat the bolts used in a steam turbine casing during the fastening and unfastening thereof in that the bolt will elongate due to expansion during heating, allowing the nut to be threaded onto the bolt to a greater degree during the fastening process. When the bolt cools and shrinks, the nut is pulled tighter against the surrounding surface, thus assuring a secure fasting of the nut on the bolt and a clamping of the parts held together by the nut and bolt. In order to ease the removal of the nut from the bolt, such as during the servicing of the turbine, it is helpful to again heat the bolt to elongate it, in order to move the nut away from the surrounding surface, or at least to lessen the force holding the nut against that surface.

It has long been known to heat bolts, for example see U.S. Pat. No. 2,176,601, and to use induction heating to heat such bolts, for example, see U.S. Pat. Nos. 3,771,209 and 5,397,876.

Commonly available resistance type bolt heaters operate at 240 volts, and are individually controlled (on-off). These bolt heaters generally provide a heating power of about 50 watts per square inch. With the bolt heaters powered and controlled individually and with the given heating power output, the heating of a bolt used in a typical turbine requires generally 5 to 10 minutes or more of heating to elongate the bolt sufficiently to provide the necessary tightening or loosening of the bolt.

It would be an advance in the art if there were provided an easy to use resistance heating device and a method for heating multiple items, such as bolts.

SUMMARY OF THE INVENTION

The present invention provides a resistance heating system which can be utilized in a wide variety of environments, however, one environment of express utility is for use with bolt heaters in power plants.

The resistance heating system includes a resistance heater, a source of alternating current electricity connected by conductors to the resistance heater, and a controller comprising a timer arranged to connect the source of alternating current electricity to the resistance heater for a selected time period and to disconnect the source from the resistance following the selected time period.

In an embodiment, the timer includes an input arrangement for a user to input a selected time into the timer.

In an embodiment, the resistance heater comprises a bolt heater.

In an embodiment, the bolt heater includes a visual indicator to indicate when electrical current is being supplied to the bolt heater.

In an embodiment, an adapter sheath is arranged to effectively increase a diameter of the bolt heater.

In an embodiment, the source of alternating current electricity provides 480 volt electricity.

In an embodiment, the controller comprises a plurality of timers for controlling electricity flow to a plurality of resistance heaters simultaneously.

In an embodiment, the controller includes a visual indicator for displaying a status of the timer.

In an embodiment, the controller is mounted on a portable frame.

In an embodiment, the resistance heater is connected to the controller via a cable and a plug/receptacle interface.

In an embodiment, a resistance heating system is provided which comprises a controller configured to be connected to a source of alternating current electricity and having a plurality of cable plug receptacles arranged to receive electricity. An electricity conducting cable having a cable plug at one end is configured to be received in the receptacles and has a resistance heater provided at an opposite end. A master timer may be connected with a communication arrangement to the controller. The master timer is arranged to control an electric output of a plurality of the receptacles.

In an embodiment, the receptacles may each be controlled by a separate timer.

In an embodiment, a single master switch controls electricity flow to each of the receptacles.

In an embodiment, the controller includes a user operable selection switch to enable the timer controller on the cable to control the electric output of the at least one other of the receptacles.

In an embodiment, a resistance heating system is provided which comprises a controller configured to be connected to a source of alternating current electricity and having a plurality of cable plug receptacles. An electricity conducting cable having a cable plug at one end is configured to be received in the receptacles and has a resistance heater provided at an opposite end. A timer is associated with each receptacle. An input arrangement is provided for a user to input a selected time into said timers, and a visual indicator is arranged to display a status of each of the receptacles.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a side elevational view of a resistance heating system embodying the principles of the present invention.

FIG. **2** is an enlarged partial view of a receptacle and timer area of the controller of FIG. **1**.

FIG. **3** is an enlarged end perspective view of a remote master timer for the resistance heating system of FIG. **1**.

FIG. **4** is an electrical schematic of the resistance heating system embodying the principles of the present invention.

FIG. **5** is a side perspective view of an alternative embodiment of a resistance heating system embodying the principles of the present invention.

FIG. **6** is an enlarged partial view of a receptacle and timer area of the controller of FIG. **5**.

FIG. **7** is a side perspective view of a bolt heater resistance heating device and an adaptor sleeve.

FIG. **8** is an enlarged partial view of the bolt heater junction box with the handle and visual indicator.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention, as illustrated in the FIGs., provides a resistance heating system **20** which can be utilized in a wide

variety of environments. One particular environment of express utility is for use with bolt heaters used, for example, in power plants, however, the invention is not limited to such an embodiment, but rather the invention is described herein referencing such an embodiment.

As illustrated in FIG. **1**, the resistance heating system **20** includes a resistance heater **22**, a source of alternating current electricity **24** connected by conductors **26** to the resistance heater, and a controller **28** including a timer **30** arranged to connect the source of alternating current electricity to the resistance heater for a selected time period and to disconnect the source from the resistance following the selected time period.

The resistance heater **22** may be a bolt heater, such as illustrated in FIG. **1**. In such an embodiment, the bolt heater **22** is provided with a handle **32** to allow for manual grasping of the bolt heater by a user, and includes a cylindrical metal portion **34** sized to be inserted into an axial hole or bore in a bolt or stud, to heat the bolt in the tightening or loosening operation, such as described in U.S. Pat. No. 5,994,682, the disclosure of which is incorporated herein by reference. One or more adaptor sheaths **35** (FIG. **7**) may be provided to allow a single sized cylindrical metal portion **34** of the bolt heater **22** to be used for a variety of different sized bores in bolts or studs. The adaptor sheath **35** should have an internal diameter with a close tolerance with the outer diameter of the cylindrical metal portion of the bolt heater **22**, and an external diameter with a close tolerance with the inner diameter of the bore of bolt or stud. Also, the adapter sheath **35** should be made of a thermal conducting material such as metal, for example, stainless steel, such that the heat generated by the bolt heater **35** would be transmitted through the sheath by conduction to the surrounding metal of the bolt or stud. Appropriate arrangements may be provided to permit the adaptor sheath **35** to be removed from the bore either in conjunction with or separately from the removal of the cylindrical metal portion **34** of the bolt heater **22**.

The controller **28** is configured to be connected to a source of alternating current electricity, such as 480 volt three phase alternating current electricity. Other voltages of electricity, as well as single phase electricity, may be provided, however 480 volt three phase alternating current electricity is available at most industrial and power plant sites, and allows for a more rapid heating of the studs with the resistance heater **22**.

The controller **28** may be mounted on a portable frame **36** carried on casters or wheels **38** to allow the controller to be moved closely to a location where the controller is to be utilized, such as in a power plant. The controller **28** is provided with internal components, including transformers, circuit breakers and wiring which are arranged to deliver electricity to a plurality of cable plug receptacles **40** provided on one or more panels **42** of the controller.

The conductors **26** are provided in the form of an electricity conducting cable having a cable plug **44** at one end which is configured to be received in the receptacles **40**. For example, the cable plug **44** may be of the twist-lock type, to mate with a twist-lock receptacle **40** to provide a positive lock for the interface between the cable **26** and the controller **28**. The cable **26** has the resistance heater **22** provided at the end opposite the cable plug **44**.

The resistance heater **22** may be provide with a connection or junction box **46** at which the conductors **26** can be connected to the resistance element of the resistance heater. The junction box **46** may be provided with a visual indicator **47** (FIG. **8**) such as an LED powered by means of a current transformer, such as a ferrite donut shaped core, providing an induced current from one of the conductors **26** to energize the visual indicator. In this manner high voltage lamps or voltage transformers are not required for the visual indicator. The visual indicator may be positioned directly adjacent to the handle **32** so as to alert a user that the resistance heater **22** is energized, in which case, it should not be removed from the bore or hole, in order to prevent an overheating, and potential damage to the resistance heater.

In operation, the cylindrical metal portion **34** of the bolt heater **22** is to be inserted into a preformed bore in a threaded stud portion of a bolt, with close tolerances between the metal portion and the bore. The bolt heater **22** is energized and the resistance heater increases the temperature of the stud, causing the stud to elongate. A threaded nut is then tightened onto the stud, and the bolt heater is deenergized and removed, allowing the stud to cool and shrink, longitudinally, thereby increasing the holding force of the nut on the stud. To remove the nut from the stud, the reverse process is employed.

In order to provide the necessary heating for the stud, the present invention utilizes the timer **30** to energize the resistance heater **22** for a predetermined time period. The timer **30** may include an input arrangement **48** (FIG. **2**), such as a rotary switch, a toggle switch, a rocker switch, a keypad or number pad or other well known input devices for a user to input a selected time into the timer. The timer **30** may also include a display **47**, such as an LCD or other type of display to indicate the status and amount of time remaining on the timer. Each timer **30** may also be provided with a start/stop switch **49** used to start or stop the countdown of the timer, and thus the provision of electricity to the receptacle **40** while the timer is counting down the remaining time.

Typically a separate timer **30** is provided for each receptacle **40**, so that the electricity provided at each receptacle is provided by the separate and dedicated timer, and several receptacles may be provided with electricity simultaneously, if their timers are running concurrently. A visual indicator, such as an incandescent bulb or LED or other similar visual indicator **50** may be provided adjacent to each timer **30** or receptacle **40** for displaying a status of the timer or receptacle, such as that a particular receptacle is energized with electricity.

A selector switch **52** may be provided adjacent to each receptacle **40** with several modes of operation selectable by a user. One position **52**a of the selector switch **52** may be "off" which will prevent any electricity from being supplied to the associated receptacle **40**, despite the condition of the timer **30**. Another position **52**b of the selector switch **52** may be "hand" or "manual" in which case, the receptacle **40** would be supplied continuously with electricity, despite the condition of the timer **30**. This mode would be useful in determining the length of time required to satisfactorily heat an object, such as a stud, with the resistance heater **22**. Following this determination, the now known length of lime could be input into the timers **30** to heat other similar objects to the required degree. Thus, another position **52**c of the selector switch **52** may be "automatic" in which case the receptacle **40** would be supplied with electricity only so long as its controlling timer was supplied with a non-zero length of time.

A separate timing circuit may be utilized to measure a period of time following the termination of energization of the resistance heater **22** to allow for a cool down period for the resistance heater. A visual indicator **56** may be provided for the user to indicate when the resistance heater **22** may have sufficiently cooled so as to allow for safe removal and handling of the resistance heater following termination of energization of the heater. For example, a red light may illuminate during the period that a receptacle is energized, and for a period, such as a minute, following the deenergization of the

receptacle. At that point, the red light may be extinguished and a green light may be illuminated.

The present invention also allows for a master operation wherein a plurality of receptacles **40** may be controlled by a single timer in the form of a master timer **60** (FIG. **3**). The master timer **60** may be mounted directly on the panel **42** of the controller **28** or may carried on a remote pendent **62**. The provision of a remote pendant **62** will allow a user to control the heating operation while at a position close to the resistance heater **22**, rather than being at the controller **28**. The remote pendant **62** may be connected by a communication path, such as a cable **64** and a receptacle **65** or a wireless communication arrangement, to the controller **28** as shown in the electrical schematic of FIG. **4**. The master timer **60** may be used to provide an alternate path for electricity from the source of current to the various receptacles **40**, when the selector switches **52** are positioned in the automatic mode position. The remote pendent **62** may be provided with the master timer **60**, as well as a display **66** for the master timer, a start/stop switch **68** for the master timer, an input arrangement **70** for the master timer, and indicator lights **72**, **74**, all as described above with respect to similar components provided in association with each of the receptacle dedicated timers **30**.

By using the master timer **60**, the user may simultaneously control a plurality of the receptacles **40**, and thus energize a plurality of the resistance heaters **22** simultaneously, thereby reducing the length of time required to heat a plurality of studs, for example. In a power plant environment, this time savings will help to greatly reduce the length of time a particular electricity generating device may be out of service for repair or maintenance.

In the illustrated embodiment, an electricity conducting cable **64** having a cable plug at one end is configured to be received in the receptacle **65** at the controller **28** and has the master timer **60** located at an opposite end of the cable. The master timer **60**, when connected, controls an electric output of a plurality of receptacles **40**, so long as their associated selector switches **52**, if they are provided with such switches, are positioned in the automatic position **52**c.

FIGS. **5** and **6** illustrate an alternative embodiment of the present invention. In these FIGs., there is illustrated a resistance heating system **120** comprising a source of alternating current electricity **124** which may be connected by conductors **26** to the resistance heater **22** as illustrated in FIG. **1**. A controller **128** comprising a **130** timer is arranged to connect the source of alternating current electricity **124** to the resistance heater **22** for a selected time period and to disconnect the source from the resistance following the selected time period. The controller **128** is configured to be connected to a source of alternating current electricity, such as 480 volt three phase alternating current electricity.

The controller **128** may be mounted on a portable frame **136** carried on casters or wheels **138** to allow the controller to be moved closely to a location where the controller is to be utilized, such as in a power plant. In this embodiment, the portable frame **136** is in the form of a hand truck or dolly with two wheels **138**. The controller **128** is provided with internal components, including transformers, circuit breakers and wiring which are arranged to deliver electricity to a plurality of cable plug receptacles **140** provided on one or more panels **142** of the controller.

In order to provide the necessary heating for the stud, this embodiment utilizes the timer **130** to energize the resistance heater **22** for a predetermined time period. The timer **130** may include an input arrangement **148** (FIG. **6**), such as a rotary switch, a toggle switch, a rocker switch, a keypad or number pad or other well known input devices for a user to input a selected time into the timer. The timer **130** may also include a display **147**, such as an LCD or other type of display to indicate the status and amount of time remaining on the timer. Each timer **130** may also be provided with a start/stop switch **149** used to start or stop the countdown of the timer, and thus the provision of electricity to the receptacle **140** while the timer is counting down the remaining time.

Typically a separate timer **130** is provided for each receptacle **140**, so that the electricity provided at each receptacle is provided by the separate and dedicated timer, and several receptacles may be provided with electricity simultaneously, if their timers are running concurrently. A visual indicator, such as an incandescent bulb or LED or other similar visual indicator **150** may be provided adjacent to each timer **130** or receptacle **140** for displaying a status of the timer or receptacle, such as that a particular receptacle is energized with electricity.

A selector switch **152** may be provided adjacent to each receptacle **140** with several modes of operation selectable by a user. One position of the selector switch **152** may be "off" which will prevent any electricity from being supplied to the associated receptacle **140**, despite the condition of the timer **130**. Another position of the selector switch **152** may be "hand" or "manual" in which case, the receptacle **140** would be supplied continuously with electricity, despite the condition of the timer **130**. This mode would be useful in determining the length of time required to satisfactorily heat an object, such as a stud, with the resistance heater **22**. Following this determination, the now known length of time could be input into the timers **130** to heat other similar objects to the required degree. Thus, another position of the selector switch **152** may be "automatic" in which case the receptacle **140** would be supplied with electricity only so long as its controlling timer was supplied with a non-zero length of time.

A separate timing circuit may be utilized to measure a period of time following the termination of energization of the resistance heater **22** to allow for a cool down period for the resistance heater. A visual indicator **156** may be provided for the user to indicate when the resistance heater **22** may have sufficiently cooled so as to allow for safe removal and handling of the resistance heater following termination of energization of the heater. For example, a red light may illuminate during the period that a receptacle is energized, and for a period, such as a minute, following the deenergization of the receptacle. At that point, the red light may be extinguished and a green light may be illuminated.

The embodiment of FIGS. **5** and **6** also allows for a master operation wherein a plurality of receptacles **140** may be controlled by a single timer in the form of a master timer **60** (FIG. **3**). The master timer **60** may be mounted directly on the panel **142** of the controller **128** or may carried on a remote pendent **62**. The remote pendant **62** may be connected by a communication path, such as a cable **64** and a receptacle **165** or a wireless communication arrangement, to the controller **128**. The master timer **60** may be used to provide an alternate path for electricity from the source of current to the various receptacles **140**, when the selector switches **152** are positioned in the automatic mode position.

By using the master timer **60**, the user may simultaneously control a plurality of the receptacles **140**, and thus energize a plurality of the resistance heaters **22** simultaneously, thereby reducing the length of time required to heat a plurality of studs, for example. In a power plant environment, this time savings will help to greatly reduce the length of time a particular electricity generating device may be out of service for repair or maintenance.

As is apparent from the foregoing specification, the invention is susceptible of being embodied with various alterations and modifications which may differ particularly from those that have been described in the preceding specification and description. It should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. A resistance heating system comprising:

a controller configured to be connected to a source of alternating current electricity and having a plurality of cable plug receptacles arranged to receive electricity,

a plurality of electricity conducting cables, each having a cable plug at one end configured to be received in one of said receptacles and having a resistance heater provided at an opposite end, *wherein said resistance heater comprises a bolt heater,*

an individual timer associated with each receptacle arranged to selectively provide such receptacle with electricity during a time interval,

a master timer connected with a communication arrangement to said controller,

said master timer arranged to selectively provide a plurality of said receptacles with electricity during a time interval, and

a switch to permit a user to select a master timer or an individual timer control for each receptacle.

2. A resistance heating system according to claim **1**, wherein said individual timers and said master timer include an input arrangement for a user to input a selected time into said timers.

[3. A resistance heating system according to claim **1**, wherein said resistance heater comprises a bolt heater.**]**

4. A resistance heating system according to **[**claim **3,]** *claim 1,* wherein said bolt heater includes a visual indicator to indicate when electrical current is being supplied to said bolt heater.

5. A resistance heating system according to **[**claim **3,]** *claim 1,* further including an adapter sheath arranged to effectively increase a diameter of said bolt heater.

6. A resistance heating system according to claim **1**, wherein said source of alternating current electricity provides 480 volt electricity.

7. A resistance heating system according to claim **1**, wherein said controller includes a visual indicator for displaying a status of each of said timers.

8. A resistance heating system according to claim **1**, wherein said controller is mounted on a portable frame.

[9. A resistance heating system comprising:

a controller configured to be connected to a source of alternating current electricity and having a plurality of cable plug receptacles arranged to receive electricity,

a plurality of electricity conducting cables each having a cable plug at one end configured to be received in said receptacles and having a resistance heater provided at an opposite end,

a master timer connected with a communication arrangement to said controller,

said master timer arranged to control an electric output of a plurality of said receptacles, and

an illumination display indicator associated with each receptacle to provide an indication of a status of each receptacle.**]**

[10. A resistance hearing system according to claim **9**, wherein said controller is mounted on a portable frame.**]**

[11. A resistance heating system according to claim **10**, wherein said frame is provided with wheels.**]**

[12. A resistance heating system according to claim **9**, wherein said master timer is provided remote from said controller.**]**

[13. A resistance heating system according to claim **9**, wherein said master timer controls electricity flow to each of said receptacles.**]**

[14. A resistance heating system according to claim **9**, wherein said controller includes a user operable selection switch to enable said master timer to control said electric output of said plurality of receptacles.**]**

[15. A resistance heating system according to claim **9**, wherein said master timer includes an input arrangement for a user to input a selected time into said timer.**]**

[16. A resistance heating system comprising:

a controller configured to be connected to a source of alternating current electricity and having a plurality of cable plug receptacles,

a plurality of electricity conducting cables each having a cable plug at one end configured to be received in said receptacles and having a resistance heater provided at an opposite end,

a timer associated with each receptacle,

an input arrangement for a user to input a selected time into said timers, and

a visual indicator arranged to display a status of each of said receptacles.**]**

[17. A resistance heating system according to claim **16**, wherein said controller is mounted on a portable frame.**]**

[18. A resistance heating system according to claim **16**, further including a remote controller arranged to provide timer control for each of said receptacles simultaneously.**]**

[19. A resistance heating system according to claim **16**, wherein said source of alternating current electricity comprises 480 volts, 3 phase alternating current electricity.**]**

[20. A resistance heating system according to claim **16**, wherein said resistance heater comprises a bolt heater.**]**

[21. A resistance heating system according to claim **20**, wherein said bolt heater includes a visual indicator to indicate when electrical current is being supplied to said bolt heater.**]**

[22. A resistance heating system according to claim **20**, further including an adapter sheath arranged to effectively increase a diameter of said bolt heater.**]**

23. A multiple receptacle controller comprising:

a portable frame configured to be connected to a source of alternating current electricity and having a plurality of cable plug receptacles arranged to receive electricity from said source,

an individual timer associated with each receptacle and arranged to selectively control an electric output of the associated receptacle, including an input arrangement for a user to input a selected time into said individual timer,

a master timer arranged to selectively control an electric output of a plurality of said receptacles, including an input arrangement for a user to input a selected time into said master timer,

said input arrangement for said master timer being located on a pendant separate and remote from said portable frame of said controller, said pendant being connected to said controller frame via an electricity conducting cable,

a switch associated with each receptacle to permit a user to select a master timer control or an individual timer control for each receptacle.

24. A multiple receptacle controller according to claim **23**, wherein said frame is wheeled.

25. A multiple receptacle controller according to claim **23**, wherein said switch further permits a user to energize each associated receptacle regardless of the status of any timer associated with said receptacle.

26. A multiple receptacle controller according to claim **23**, further including a timing circuit to measure a period of time following the termination of energization of the receptacle by the selected timer and an illumination display energized following the termination of said period of time.

27. A heating system comprising:

a controller configured to be connected to a source of electric current and having a plurality of cable plug receptacles, wherein said electric current connected to said controller is 480 volt three phase alternating current;

a plurality of electricity conducting cables each having a cable plug at one end configured to be received in one of said receptacles and having a heater provided at an opposite end, wherein said heater comprises a bolt heater;

a plurality of switches, configured and arranged such that at least some of said receptacles each have one of said switches associated therewith, which control the presence of current at said associated receptacle;

a plurality of input arrangements, configured and arranged such that at least some of said switches each include one of said input arrangements associated therewith for a user to input a selected switch position to said associated switch; and

a plurality of visual indicators, configured and arranged such that at least some of said receptacles each have one of said visual indicators associated therewith to display a status of said associated receptacle.

28. The heating system according to claim 27, wherein said electric current connected to said controller is alternating current.

29. The heating system according to claim 27, wherein said heater provided with said electricity conducting cable is a resistance heater.

30. The heating system according to claim 27, wherein at least some of said switches are manual selector switches that are each located adjacent an associated one of said receptacles, and which each include at least the following two switch position modes, which are selectable by the user:

an off mode in which electricity is prevented from being supplied to said associated receptacle; and

an on mode in which electricity is supplied to said associated receptacle.

31. The heating system according to claim 30, wherein at least some of said manual selector switches include a third mode defined as an automatic mode in which electricity is supplied to said associated receptacle only until a certain stop event takes place.

32. The heating system according to claim 31, wherein said stop event is a length of time on an associated timer running down to zero.

33. The heating system according to claim 27, wherein at least some of said visual indicators comprise a light for displaying the status of said associated receptacle.

34. The heating system according to claim 27, wherein said visual indicators are arranged adjacent to said associated receptacles.

35. The heating system according to claim 27, wherein said switches are arranged adjacent to said associated receptacles.

36. The heating system according to claim 27, wherein at least some of said input arrangements each comprise a rotary switch.

37. The heating system according to claim 27, wherein at least some of input arrangements each comprise a toggle switch.

38. The heating system according to claim 27, wherein at least some of said input arrangements each comprise a rocker switch.

39. The heating system according to claim 27, wherein at least some of said input arrangements each comprise a keypad.

40. The heating system according to claim 27, wherein at least some of said input arrangements each comprise a number pad.

41. The heating system according to claim 27, wherein:

at least some of said switches each comprise a timer which energizes said associated receptacle during a selected time; and

said input arrangement associated with each of said timers enables a user to input said selected time into said associated timer.

42. The heating system according to claim 27, wherein at least one of said plurality of switches is a timer.

43. The heating system according to claim 27, wherein said controller includes at least one transformer between said source of electric current and said plurality of receptacles.

* * * * *