March 28, 1967 H. E. PETERSON 3,311,734

ELECTRICAL RESISTANCE HEATING APPARATUS

Original Filed Dec. 4, 1963

Fig. 1

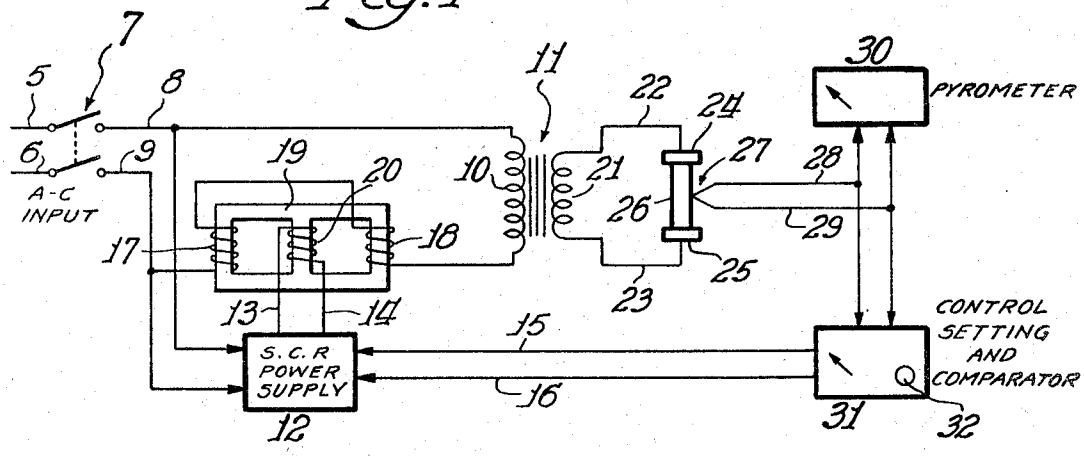
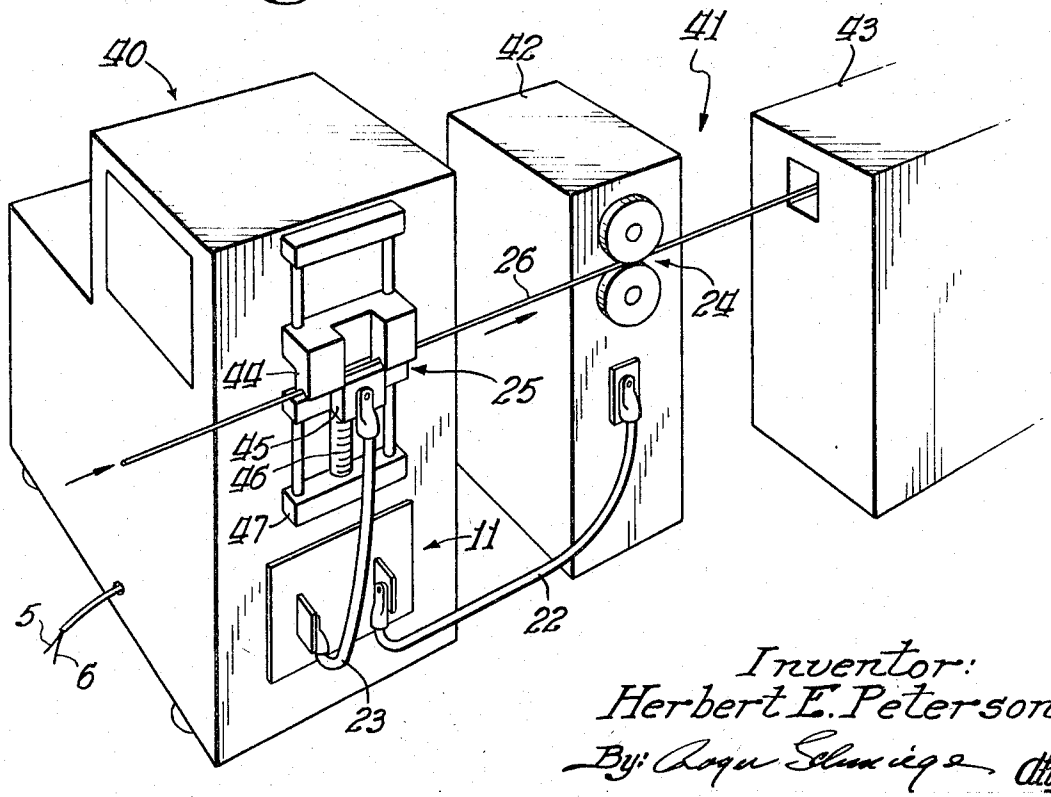


Fig. 2



Inventor:
Herbert E. Peterson
By: Roger Schweiger Atty.

United States Patent Office 3,311,734 Patented Mar. 28, 1967

3,311,734

ELECTRICAL RESISTANCE HEATING APPARATUS

Herbert E. Peterson, 815 W. Northeast Shore Drive, McHenry, Ill. 60050

Continuation of abandoned application Ser. No. 328,017, Dec. 4, 1963. This application Apr. 11, 1966, Ser. No. 541,857

This application is a continuation of Serial No. 328,017 filed on Dec. 4, 1963, now abandoned.

This invention relates to an electrical resistance heating apparatus, and more particularly to a substantially simplified apparatus comprised of a minimum number of operating parts.

A variety of electrical resistance heating arrangements have been constructed to heat rods, wires, sheets, blanks, and various other metallic materials to facilitate working of the material. While adequate from the standpoint of providing the requisite heating to work the metal, such other arrangements have been relatively uneconomical to produce, complex, and difficult to operate. In contrast, the present invention eliminates many of the complex control elements, such as relays, tapped windings on inductive reactor units, and other complex structures, for example, those depicted in United States Patent 3,042,786.

In order to acquaint those skilled in the art with the best mode contemplated for making and utilizing the invention, a description thereof is set forth in connection with the accompanying drawing, in the several figures of which like reference numerals identify like elements, and in which:

FIGURE 1 is a simplified schematic diagram indicating the intercoupling of various components of the inventive combination; and

FIGURE 2 is a perspective illustration showing the invention in relation to other units.

As shown in FIGURE 1, a pair of input conductors **5** and **6** are provided to transfer A.-C. input energy from a commercial or other power source (not shown) to one side of on-off switch **7**. Responsive to closure of switch **7**, conductors **5** and **6** are connected to conductors **8** and **9**, and conductor **8** is coupled to one end of primary winding **10** of step-down transformer **11**. Conductors **8** and **9** are also coupled to the energy input connections of a power supply **12** which utilizes silicon controlled rectifiers (SCR's) to provide an output D.-C. signal on conductors **13** and **14** responsive to a D.-C. control signal received over conductors **15** and **16**. Input conductor **9** is also coupled over main windings **17** and **18** of saturable reactor **19** to the other end of primary winding **10**, and control winding **20** of this reactor is coupled to conductors **13** and **14** to receive the control or saturation level signal from power supply **12**.

Secondary winding **21** of transformer **11** is coupled over conductors **22** and **23** to contacts **24** and **25**, respectively. A load member **26** is shown disposed between and in contact with contacts **24** and **25**. These contacts may be work holders, rotary supports, or other members which temporarily support load **26** as it passes between the contact pair **24**, **25**. The exact configuration and support of the contacts will depend upon the precise metal (load) to be worked, its shape, and the manner in which the metal should be held for such working.

A thermocouple **27** is disposed adjacent load member **26** to provide an electrical output signal over conductors **28** and **29**, the level of which signal varies as a function of the value of temperature sensed by the thermocouple. This indication or electrical signal is transferred by conductors **28** and **29** to a pyrometer **30**, wherein it is utilized to actuate a meter movement calibrated in the thermal units and thus provide a visible indication of the temperature of load **26**. Conductors **28** and **29** also transfer the electrical signal to the input side of control setting and comparator unit **31**, which includes a knob **32** or a similar adjustable means which facilitates setting the desired temperature at which metal **26** should be worked. Such comparator unit may include a simple arrangement such as a potentiometer with a battery (neither of which is illustrated) to provide a reference voltage related to the desired temperature of the metal to be worked. In a well-known manner, this reference voltage is compared against the signal voltage received from conductors **28** and **29** to provide a difference signal indicating the extent of deviation between the temperature desired and actual temperature of load **26**. This difference signal is applied over conductors **15** and **16** to power supply **12**, to regulate the time duration of the SCR's conduction during each complete cycle of application of the A.-C. input signal over conductors **8** and **9** to the SCR power supply. The duration of SCR conduction regulates the level of the saturating signal applied over conductors **13** and **14** to control winding **20**, thereby regulating the effective impedance presented between primary winding **10** and conductors **8** and **9**. Such regulation produces a corresponding regulation of the amount of energy transferred over transformer **21** to load **26**. Accordingly, it is manifest that the circuit combination depicted in FIGURE 1 provides an accurate and simple means for setting the desired temperature (by adjusting knob **32**), and includes a closed loop regulating system for continually correcting any deviation between the actual temperature of metal **26** and the desired temperature as set on knob **32** of the comparator.

Considering now the perspective showing of FIGURE 2, a portable heating apparatus **40** is depicted in the left hand portion of this drawing. In the right hand portion, a material processing apparatus **41** is illustrated. Apparatus **41** may include a first stand **42** on which the movable contact arrangement **24** is supported, and another stand **43** in which the particular drawing, swaging, or other metal deforming step is effected. Except for the indicated placement of contact set **24**, all of the other circuit components illustrated in FIGURE 1 are supported in or upon heating apparatus **40**.

Contact arrangement **25**, shown supported directly on apparatus **40**, includes an upper fixed contact **44** and a lower movable contact **45**. A bias spring **46** is positioned between a stop member **47** and movable contact **45**. Accordingly, a portion of wire or other metal **26** is readily inserted into contact set **25**, and the other contact set **24** can likewise be made with a spring bias arrangement to facilitate the insertion of the metal stock to be worked. After insertion and energization of the equipment, the stock will travel the substantially linear path indicated in FIGURE 2.

Visible in the lower portion of heater apparatus **40** is the casing of transformer unit **11**, from which insulated conductor **22** passes energy to contact set **24**. The other energy transfer conductor **23**, also insulated, passes energy from the other end of secondary winding **21** to contact arrangement **25**.

It is emphasized that the only unit required for use with the metal processing apparatus **41** is the heater arrangement **40**, which both provides the desired level of energization and acts as a support for contact set **25**. Such operation is in marked contradistinction to prior art techniques, which generally include the mounting of a fixed contact support at a distance from the metal processing equipment **41**. Accordingly, such known arrangements require that the heater be connected both to the support standard and to the apparatus **41**. Utilization of the present invention obviates the expense and spatial re-

quirements heretofore necessitated by positioning the fixed contact post adjacent each metal working apparatus. At times heating of the metal to be worked at a given apparatus is not required, and thus one or a few of the portable heater-and-contact-support units **40** can adequately service a substantially larger number of metal working units.

In addition, with the currents of high level that pass through the heated portion of metal **26**, it is desirable to maintain the conductors of the circuit as close together as possible, thereby minimizing the inductive reactance of the current loop. Moreover, by reducing the length of leads **22** and **23** as much as practicable, the resistance losses in the circuit are correspondingly reduced and the efficiency of the entire circuit arrangement is enhanced.

While only a particular embodiment of the invention has been described and illustrated, it is apparent that modifications and alterations may be made therein. It is, therefore, the intention in the appended claims to cover all such modifications and alterations as may fall within the true spirit and scope of the invention.

What is claimed is:

1. In a system for regulating the amount of electrical energy transferred to a load to be heated by the energy, the combination of:

a step-down transformer having a primary winding and a secondary winding;

saturable reactor means having a control winding for regulating the level of saturation and at least one output winding for passing electrical energy as a function of the specific saturation level of said reactor means;

means, including said output winding of the saturable reactor means, for passing A.C. energy to the primary winding of the transformer;

conductor means for passing electrical energy from the secondary winding of the transformer to the load;

sensing means disposed adjacent said load for sensing the temperature thereof and for producing a signal voltage related to the temperature of said load;

indicating means coupled to said sensing means for providing a visual indication of the load temperature;

power supply means for receiving A.C. energy, rectifying the A.C. energy in proportion to a difference signal, and passing the resultant D.C. energy to said control winding of the saturable reactor means; and

comparator means, coupled to said sensing means, for receiving said signal voltage indicating the temperature of said load, and having an output circuit connected to apply said difference signal to said power supply and thus regulate the saturation level of the saturable reactor means, said comparator means including adjusting means for establishing a reference voltage for comparison with said signal voltage to provide said difference signal, to govern the desired saturation level of the saturable reactor means and thereby control the temperature of the load.

2. A system as claimed in claim **1** in which said conductor means for passing electrical energy from the secondary winding of the transformer to the load includes first and second electrical contact sets, with a stationary material processing apparatus on which said first electrical contact set is mounted, and a portable apparatus on which said second electrical contact set is mounted, including resilient means for urging a portion of said second contact set against the load to facilitate insertion and removal of the load from the system.

References Cited by the Examiner

UNITED STATES PATENTS

1,991,248	2/1935	Hartigan	219—503
2,079,466	5/1937	Phillips	219—503 X
2,294,775	9/1942	Edwards et al.	219—503 X
3,042,786	7/1962	Babcock et al.	219—50

RICHARD M. WOOD, *Primary Examiner.*