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AUTOMATIC INDUCTION HEATER

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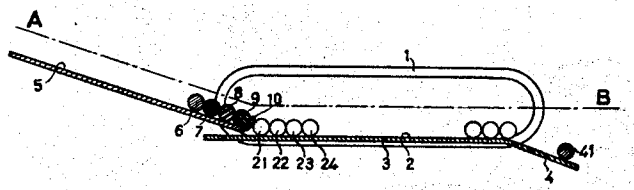


Fig.1

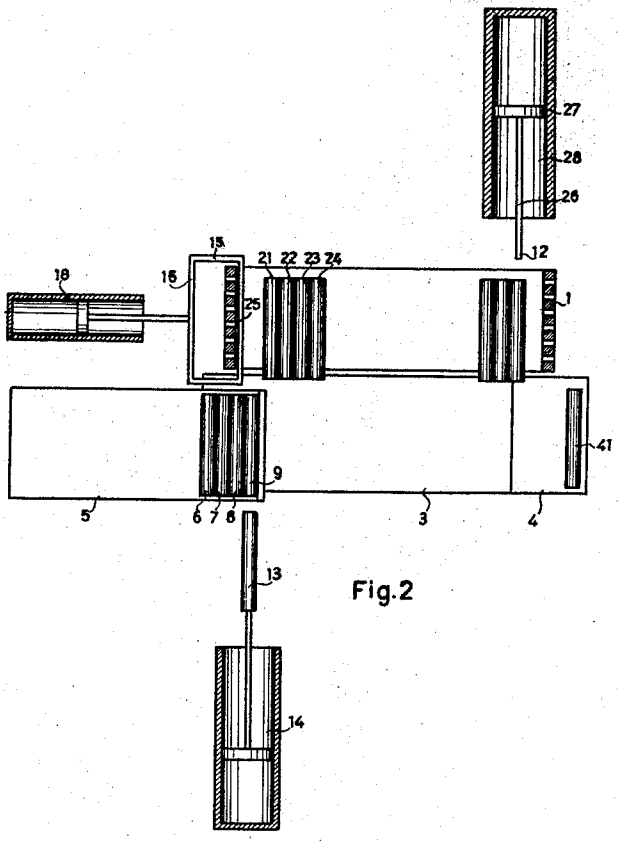


Fig.2

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AUTOMATIC INDUCTION HEATER

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8 Claims. (Cl. 219—10.69)

This invention relates to induction heating and, more particularly, to a new and improved automatic induction heater.

In the known constructions of induction heaters the charges may be delivered into the heater from a given side and are removed or otherwise ejected therefrom on the same side in known manner. The charges may be manually introduced into the induction or heating coil by means of pincers or clamps by which the individual charges are held at one end thereof while the portion that is to be heated is held inside the induction coil of the heater, during the heat cycle. Some heaters are constructed with mechanically operated devices for grasping and holding the charges at one end thereof, commonly known as the "cold end." These mechanical devices are generally quite complicated and do not function very well when a charge, as for example a bar, has to be heated substantially throughout its entire length so that the heated portion is relatively long wih respect to a very short "cold end" available for grasping of the charge.

Another known type of induction heater is that of the tunnel type which eliminates the use of manual or mechanical clamps for introducing the charges therein and a suitable conveyor is employed for transporting the charges through the heater thereby controlling the heat cycle. This type of induction heater has several practical difficulties in the operation thereof and is limited as to its application in view of the fact such heaters cannot be effectively employed when the length of a particular charge to be heated is more than half of the total length of the charge or bar.

It is a principal object of the present invention to provide a simple automatic induction heater that eliminates the use of grippers or clamps and their attendant difficulties.

Another object is to provide an induction heater within which the time factor of the heat cycle is accurately controlled without the need of a conveyer and so constructed as to make it possible to effectively heat the individual charges regardless of the ratio of the length of the portion of the individual charge that is to be heated to the length of the "cold end."

A feature of the automatic induction heater in accordance with the invention is that the charges are delivered axially into an elongated induction coil by means of an automatically controlled device operating a reciprocable push-rod which engages the charges in an endwise relationship between the push-rod and the charge and delivers them extending transversely of the heater primary coil into a charging zone at one end of the coil. Accordingly, the charges are introduced by being pushed without the need of clamps or other holding means. The charges are held by support means alongside the heater in a ready position for introduction into the heater. A pusher automatically operated in time sequence, by an automatically controlled device, with the charging device engages each charge as it is delivered into the charging zone and moves it by pushing it in a direction corresponding to the longitudinal dimension of the coil thereby moving the charges clear of the charging zone. As the individual charges are delivered into the charging zone the pusher means keeps delivering them individually out of the charging zone into engagement with one another and pushes them jointly toward the opposite end of the coil. The opposite end of the coil forms an ejection zone at which a second push-rod, automatically operated by an automatically controlled device, ejects the charges one-by-one out of the coil by pushing them toward the side of the heater from which they were introduced. The second push-rod also engages the charges individually in an endwise relationship.

Other objects, features and advantages of the invention will be better understood from the following description and claims in conjunction with the accompanying drawing which illustrates by way of example, a preferred embodiment of the induction heater, in which

Fig. 1 is a side elevation view of a heater according to the invention illustrating the manner in which the charges are held alongside the primary coil in readiness for introduction into the heater and their disposition in the coil during the heat cycle and the ejection thereof; and

Fig. 2 is a diagrammatic plan view of the heater shown in Fig. 2 and is taken at line A—B.

The induction heater in accordance with the drawings has an elongated or rectangular, continuous primary or induction coil **1** connected to a source of suitable frequency, not shown, effective for the entire range of work and capable of maintaining a suitable heating rate for the entire run or heat cycle. The heating coil **1** is provided with a smooth inner surface **2** on which charges are disposed transversely of the coil when introduced therein for heating in a manner later herein described. Alongside of the coil **2** is disposed a table **3** having a flat horizontal portion extending substantially the full length of the coil. The upper surface of this table portion is substantially flush with the inner surface of the coil **2**. The table **3** is constructed with an end portion **4** downwardly inclined as shown.

The heater is provided with a gravity hopper or support means **5** resting on table **3** inclined relative to the horizontal so that charges, such as rods or bars **6**, **7**, **8**, and **9**, can be accumulated thereon whereby the support member **5** acts as a magazine or hopper from which the charges can be introduced into the heater. A lower end of the member **5** is provided with an upturned end forming a stop **10** holding the gravity biased charges in position alongside the coil **1** for delivery into a charging zone **11** of the coil. A reciprocable push-rod **13** connected to an automatic device for reciprocably driving the rod, as for example, a pneumatic device comprising a piston (not shown) reciprocable in a cylinder **14**. The push-rod **13** engages with the corresponding ends of the individual bar charges and delivers them longitudinally into the charging zone **11** one-by-one by pushing them longitudinally out of the hopper **5** into the coil **1**. As each bar is delivered into the heater and the push-rod **13** returns to its starting position the next bar to be delivered moves into a ready position against stop **10**. It will be understood that push1rod **13** can be adjusted as to its stroke so that it can deliver the individual charges entirely into the heater or leave a "cold end" extending out of the coil **1**. The push-rod never enters the coil and is stopped in a plane lying outside the coil or corresponding with the side of the coil. The push-rod **13** is provided with an enlarged end portion for engaging the charges and this end portion has substantially the same cross-sectional dimensions as the charges. The enlarged portion may be constructed as an electromagnet connected to a suitable source of current supply, not shown, if desired.

Once the individual charges have been introduced into the coil a pusher **16**, removably connected to an automatic pneumatic device **18** similarly constructed as the device associated with rod **13**, is cyclically reciprocated to engage the charges and move them in a direction corresponding to the longitudinal dimension of the coil and clear of the charging zone so that the charging zone is available for the next successive charge to be introduced. As the charges are pushed one-by-one, they assume a position as shown by charges **21**, **22**, **23** and **24** alongside one another and are eventually jointly pushed throughout substantially the full length of the coil which determines the heat cycle.

The pusher means **16** is rectangular and has one end of the coil extending through it as shown so that member **15** limits the length of its stroke. The pusher head **16** has a transverse push-rod **25** for engaging the charges to carry out the pushing operation. The rectangular head portion **16** may be constructed of hollow tubing which is heat resistant and connected to a source of cooling fluid, not shown, in known manner to continuously cool the rod **25**. The rod **25** may also be constructed as a solid bar member having a transverse dimension which is less than a minimum diameter which can be heated by induction at the frequency utilized in the heater. For example, the member **25** may be a circular rod having a diameter of eight millimeters when the frequency being applied to the coil is 8,000 cycles per second.

As the charges are moved toward the opposite end of the coil **1**, which forms an ejection zone, they are automatically ejected from the heater by an axially reciprocated rod **26** connected to another automatically controlled device comprising a piston **27** reciprocable in cylinder **28** forming a pneumatic device similar to the devices operating rods **13** and pusher means **16**. The rod **26** is of the same transverse dimension as the rod member **25** and engages the individual charges in an endwise relationship so that they are delivered axially out of the heater to the same side from which they were introduced. As the charges are ejected they are delivered on to the inclined portion **4** of the table **5** and are delivered by gravity to the next successive station or operation. It will be understood that the push-rod **26** is reciprocated in timed sequence with the pusher means **16** so that after each succesive advancement of the charges toward the ejection zone the push-rod **26** is operated to carry out the ejection operation. In this manner, the heater is continuously maintained charged and each charge goes through the entire heat cycle. Moreover, it will be understood that the pneumatic devices are connected to a source of air pressure and the sequence of their operation is controlled by known means, not shown.

While preferred embodiments of the invention have been illustrated and described, it will be understood that the invention is in no way limited to these embodiments and that many changes may be made within this sphere and scope of the invention as defined by the following claims.

What I claim and desire to secure by Letters Patent is:

1. An automatic induction heater comprising, in combination, an elongated induction coil having an inner surface adapted to receive charges disposed transversely of the coil and longitudinally thereof alongside of each other, a source of alternating current connected to provide a current of suitable frequency to the coil, means to support charges for the heater in readiness for introduction to the heater, first means cyclically operable automatically to introduce the charges one-by-one by pushing them in a direction transversely of the coil into a charging zone of the coil substantially at one end of the coil, pusher means cyclically operable automatically in timed relationship with the charging means for pushing the charges one-by-one in a direction corresponding to the longitudinal dimension of the coil and clear of the charging zone thereby advancing the charges jointly longitudinally of the coil to an ejection zone substantially at an end of the coil opposite to the charging zone, second means cyclically operable automatically to eject the charges one-by-one out of the coil at the charging zone by pushing them in a direction transversely of the charging coil to a side from which the charges were initially delivered into the coil by the charging means and for ejecting the charges subsequent to each advancement thereof by the pusher means.

2. An automatic induction heater comprising, in combination, an elongated closed induction coil having an inner surface adapted to receive charges disposed transversely of the coil and longitudinally thereof alongside of each other, a source of alternating current connected to provide a current of suitable frequency to the coil, means to support charges alongside the heater in readiness for introduction to the heater, means comprising means cyclically operable automatically to introduce the charges one-by-one by pushing them in a direction transversely of the coil into a charging zone of the coil substantially at one end of the coil, pusher means cyclically operable automatically in timed relationship with the charging means for pushing the charges one-by-one in a direction corresponding to the longitudinal dimension of the coil and clear of the charging zone thereby advancing the charges jointly longitudinally of the coil to an ejection zone substantially at an end of the coil opposite to the charging zone, ejector means cyclically operable automatically to eject the charges one-by-one out of the coil at the charging zone in a direction transversely of the charging coil to a side from which the charges were initially delivered into the coil by the charging means and for ejecting the charges subsequent to each advancement thereof by the pusher means.

3. An automatic induction heater comprising, in combination, an elongated closed induction coil having an inner surface adapted to receive charges disposed transversely of the coil and longitudinally thereof alongside of each other, a source of alternating current connected to provide a current of suitable frequency to the coil, means to support charges alongside the heater in readiness for introduction to the heater, means comprising a first pneumatically operated push-rod operable automatically to introduce the charges one-by-one by pushing them in a direction transversely of the coil into a charging zone of the coil substantially at one end of the coil, pusher means reciprocable pneumatically operated operable automatically in timed relationship with the charging means for pushing the charges one-by-one in a direction corresponding to the longitudinal dimension of the coil and clear of the charging zone thereby advancing the charges jointly longitudinally of the coil to an ejection zone substantially at an end of the coil opposite to the charging zone, a second pneumatically operated push-rod operable automatically to eject the charges one-by-one out of the coil at the charging zone in a direction transversely of the charging coil to a side from which the charges were initially delivered into the coil by the charging means and for ejecting the charges subsequent to each advancement thereof by the pusher means.

4. An automatic induction heater comprising, in combination, an elongated closed induction coil having an inner surface adapted to receive charges disposed transversely of the coil and longitudinally thereof alongside of each other, a source of alternating current connected to provide a current of suitable frequency to the coil, means to support charges alongside the heater in readiness for introduction to the heater, means comprising a first reciprocable push-rod operable automatically to introduce the charges one-by-one by pushing them in a direction transversely of the coil into a charging zone of the coil substantially at one end of the coil recip-

rocable pusher means operable automatically in timed relationship with the charging means for pushing the charges one-by-one in a direction corresponding to the longitudinal dimension of the coil and clear of the charging zone thereby advancing the charges jointly longitudinally of the coil to an ejection zone substantially at an end of the coil opposite to the charging zone, a second push-rod operable automatically to eject the charges one-by-one out of the coil at the charging zone in a direction transversely of the charging coil to a side from which the charges were initially delivered into the coil by the charging means and for ejecting the charges subsequent to each advancement thereof by the pusher means.

5. An automatic induction heater according to claim 4, in which the pusher means comprises a rod made of a heat-resistant material and disposed extending in a direction transversely of the coil for pushing the charges and having a transverse dimension which is less than a minimum diameter which can be heated by induction at the frequency utilized in the heater.

6. An automatic induction heater according to claim 4, in which the pusher means comprises a hollow rod extending in a direction transversely of the coil for pushing the charges, and means to circulate a cooling fluid through the hollow rod.

7. An automatic induction heater according to claim 4, in which the first reciprocable push-rod comprises an electromagnetic rod for engaging the charges and pushing them into the heater charging zone.

8. An automatic induction heater comprising, in combination, an elongated closed induction coil having an

inner surface adapted to receive charges disposed transversely of the coil and longitudinally thereof alongside of each other, a source of alternating current connected to provide a current of suitable frequency to the coil, means to support charges alongside the heater in readiness for introduction longitudinally into the heater, means comprising a first push-rod reciprocable axially to engage the charges individually end-to-end to introduce the the charges one-by-one by pushing them off the support means in a direction transversely of the coil into a charging zone of the coil substantially at one end of the coil, reciprocable pusher means cyclically operable automatically in timed relationship with the charging means for pushing the charges one-by-one in a direction corresponding to the longitudinal dimension of the coil and clear of the charging zone thereby advancing the charges jointly longitudinally of the coil to an ejection zone substantially at an end of the coil opposite to the charging zone. A second push-rod reciprocable axially to engage the charges individually end-to-end to eject the charges one-by-one out of the coil at the charging zone a direction transversely of the charging coil corresponding to a side from which the charges were initially delivered into the coil by the charging means and for ejecting the charges subsequent to each cyclical advancement thereof by the pusher means.

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