Dec. 5, 1939.

E. G. SCHLUP

2,181,921

INDUCTION FURNACE

Filed Jan. 5, 1938

2 Sheets-Sheet 1

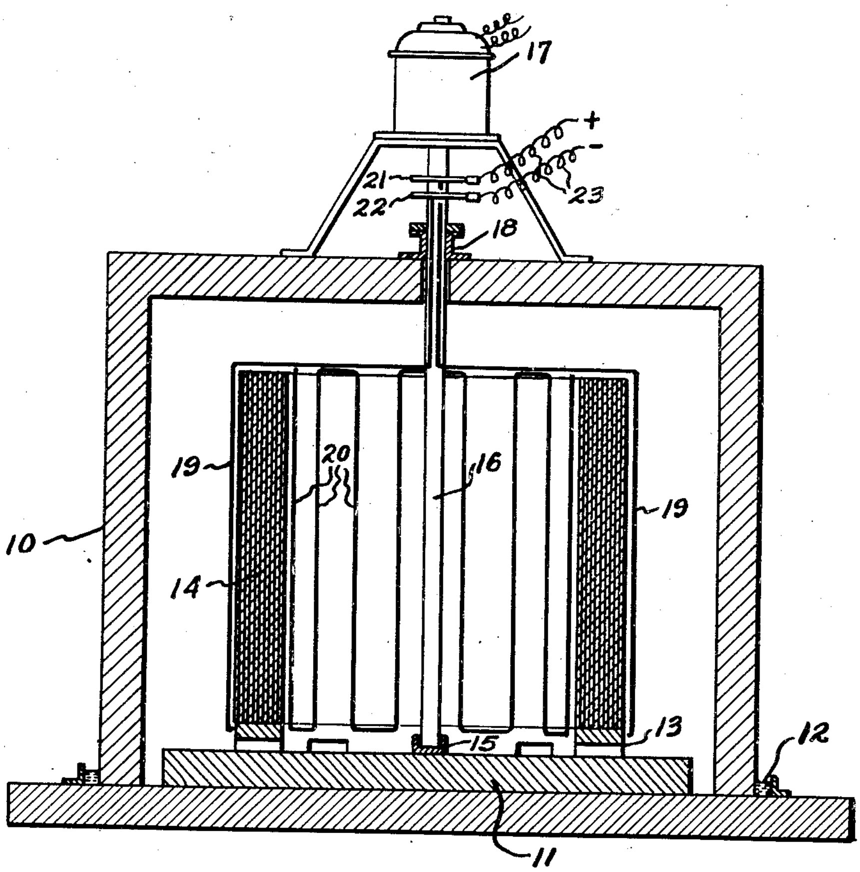

FIG. 1.

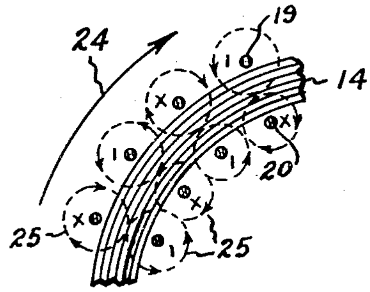

FIG. 4.

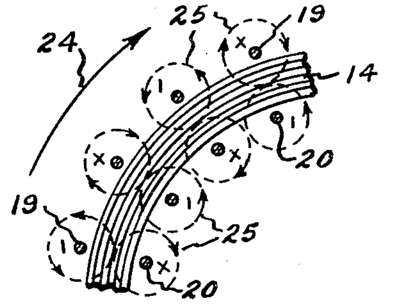

FIG. 5.

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INDUCTION FURNACE

Filed Jan. 5, 1938 2 Sheets-Sheet 2

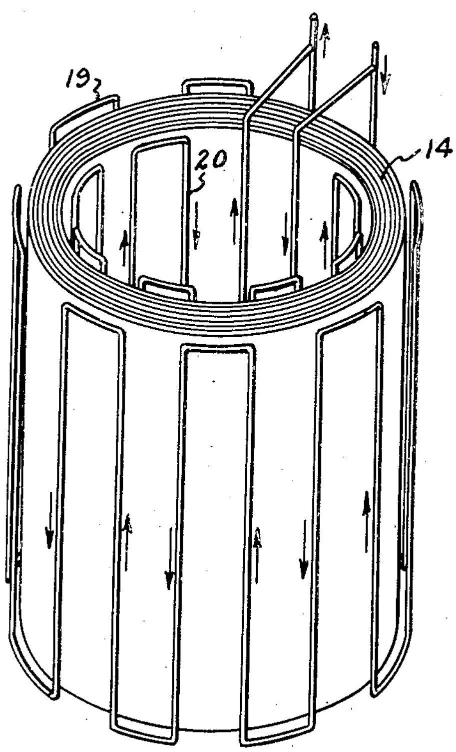

FIG. 2.

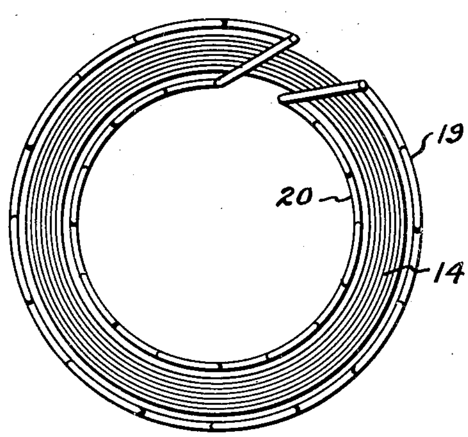

FIG. 3.

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Patented Dec. 5, 1939

UNITED STATES PATENT OFFICE

2,181,921

INDUCTION FURNACE

Ernest G. Schlup, Middletown, Ohio, assignor to The American Rolling Mill Company, Middletown, Ohio, a corporation of Ohio

Application January 5, 1938, Serial No. 183,501

2 Claims. (Cl. 13—26)

This invention relates to devices for electromagnetically heating metal without the application of an external source of high frequency current. More specifically my invention relates to a device for heating a coil of strip metal and is particularly adapted thereto, although it should be understood that other materials or bodies, particularly of annular configuration may be heated thereby.

Conventional induction furnaces require an external source of high frequency current. Generally, a frequency of 1000 cycles or more is used, although frequencies of less than 1000 cycles per second are practical. In all cases, however, some external source of such high frequency current has been necessary.

According to my invention no external source of high frequency current is required; and I am thereby enabled to eliminate all expensive high frequency generating equipment as well as the cumbersome high frequency leads to the furnace.

It is an object of my invention to provide a device for electromagnetically heating a coil of conductive material at a uniform and adjustable rate. Another object of my invention is to electromagnetically heat a coil of conductive material with a minimum expenditure of electrical energy. Other objects of my invention include the provision of the devices above outlined which will be relatively inexpensive to manufacture and simple and inexpensive to operate.

These and other objects of my invention which will be set forth hereinafter or which will be apparent to one skilled in the art upon reading these specifications, I accomplish by that certain construction and arrangement of parts of which I have shown exemplary embodiments. Reference is made to the drawings forming a part hereof and in which:

Figure 1 is a cross sectional view of an induction furnace in accordance with my invention.

Fig. 2 is an isometric view of the arrangement of the externally and internally located electric conductors with reference to a coil of strip metal.

Fig. 3 is a plan view of Fig. 2.

Figs. 4 and 5 are partial plan views showing the orientations of magnetic fluxes in the coil.

Briefly, in the practice of my invention, I provide a casing of any desired form such as is indicated generally at **10** in Fig. 1. This furnace has a base or floor **11**, and may be provided with a seal of any conventional type, as generally indicated at **12**. On the base **11** I provide a spacer **13** of annular form upon which a coil **14** may rest. Centrally of the base **11** I provide a step bearing **15** for the motor shaft **16** which is directly coupled to the motor **17**, and also has a bearing of the vertical thrust type at **18**.

Upon the shaft **16** I mount preferably two conductor elements designated at **19** and **20**. The configurations of these elements is best seen in Fig. 2. Each is an annular formation comprising a conductor extending continuously in a series of alternatively arranged return bent loops. At **21** and **22** I have indicated current collector rings for the members **19** and **20**, respectively. These collector rings draw power from the leads **23**.

It is preferred that the motor **17** be of the type having an adjustable speed characteristic for the purpose of providing for accurate heat regulation. In the operation of my device an object to be heated, as for example, the coil **14**, is placed in the furnace upon the spacer **13** and the cover **10** is then emplaced, whereby the conductors **19** and **20** are brought into position inside and outside of the coil. The motor **17** is then started and current is supplied to the conductors **19** and **20** from the leads **23**. The current supplied may be either alternating or direct. The rotation of the conductors with respect to the coil produces a rapidly alternating magnetic field and the coil is heated by eddy currents caused thereby. Since the heat produced varies with the speed of alternation of the magnetic fluxes, very accurate heat regulation can be accomplished by adjusting the speed of the motor **17**.

Generally speaking, coils of strip metal as produced in rolling mill plants today have an internal diameter of approximately three feet and an external diameter of approximately five feet. If the conductors **19** and **20** are spaced approximately two inches apart and the motor **17** rotates these conductors at a speed of approximately 600 revolutions per minute, an alternating flux of approximately 900 cycles per second can be produced, when a unidirectional current source is applied to the leads **23**. On account of space limitation, the number of conductors in the inner member **20** may be approximately half that in the outer member **19**, thus providing an alternating flux of approximately 450 cycles per second. However, it will be within the skill of the electrical engineer to provide an equal number of conductors on the inside as on the outside. If the electrical conductors are fed from an alternating current source, as for example, a conventional 60 cycle current, the rate of heating will be somewhat higher, due to the heating effect of the 60 cycle base current.

It will be understood that a variable capacity may be provided across the conductors in order to correct the power factor, and that the value of this capacity will depend, among other factors, upon the speed of rotation of the conductors 19 and 20, and also upon the characteristics of the magnetic circuit.

In Figs. 4 and 5 the arrow 24 indicates the direction of rotation of the conductors 19 and 20, respectively, and the arrows 25 indicate the direction of the magnetic field about the various conductors.

It should be understood that although I have referred throughout the specification to the heating of coils of strip metal, my device is equally adapted to the heating of other objects, particularly of annular formation whereby inner and outer rotating conductors may be used. It will also be clear that while I have shown the coil as being stationary and the conductors as being rotated, the same result would be obtained if the conductors were stationary and the coil was rotated. It is therefore to be understood that various modifications may be made without departing from the spirit of my invention, and that I do not intend to limit myself otherwise than as pointed out in the claims that follow.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. An induction furnace for heating annular metal elements, comprising a casing, a pair of annular formations comprising conductors extending continuously, respectively, in a series of alternately arranged return bent loops, one of said formations being disposed to surround the metal element to be heated, and the other disposed within the same, power leads for said conductors, and means for rotating said formations.

2. A method of heating annular metal members, which includes the steps of setting up a plurality of substantially parallel cylindrical electromagnetic fields cutting through a member to be heated from the outside, setting up a plurality of substantially cylindrical electromagnetic fields cutting through said member from the inside, the sense of adjacent such fields both in the inner and outer annulus being opposite, and causing relative movement between said metal member and said fields about an axis substantially parallel to the axis of said fields.

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