March 31, 1942. W. L. ENGHAUSER 2,278,254

APPARATUS FOR FORMING HEATING COILS

Original Filed Dec. 1, 1938 2 Sheets-Sheet 1

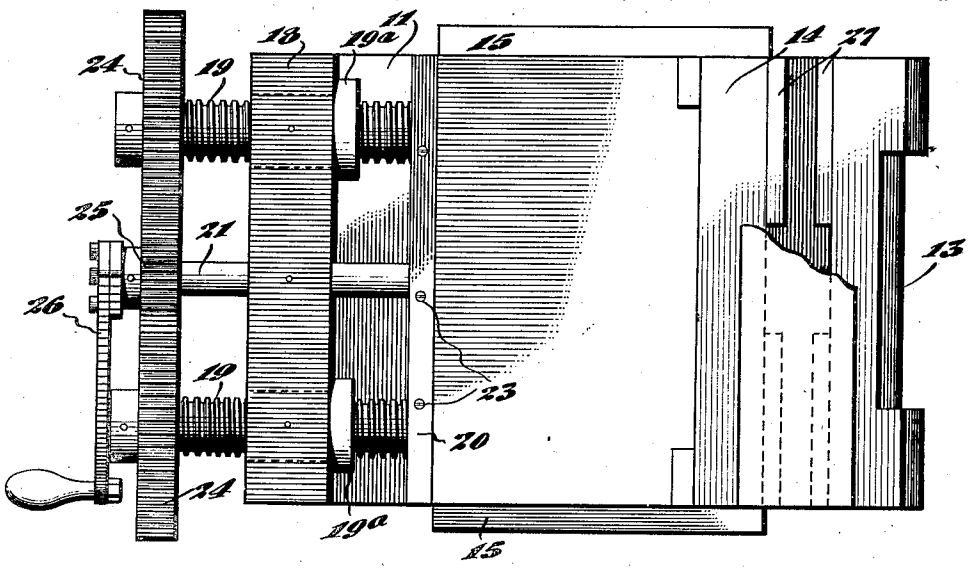



Fig. 1

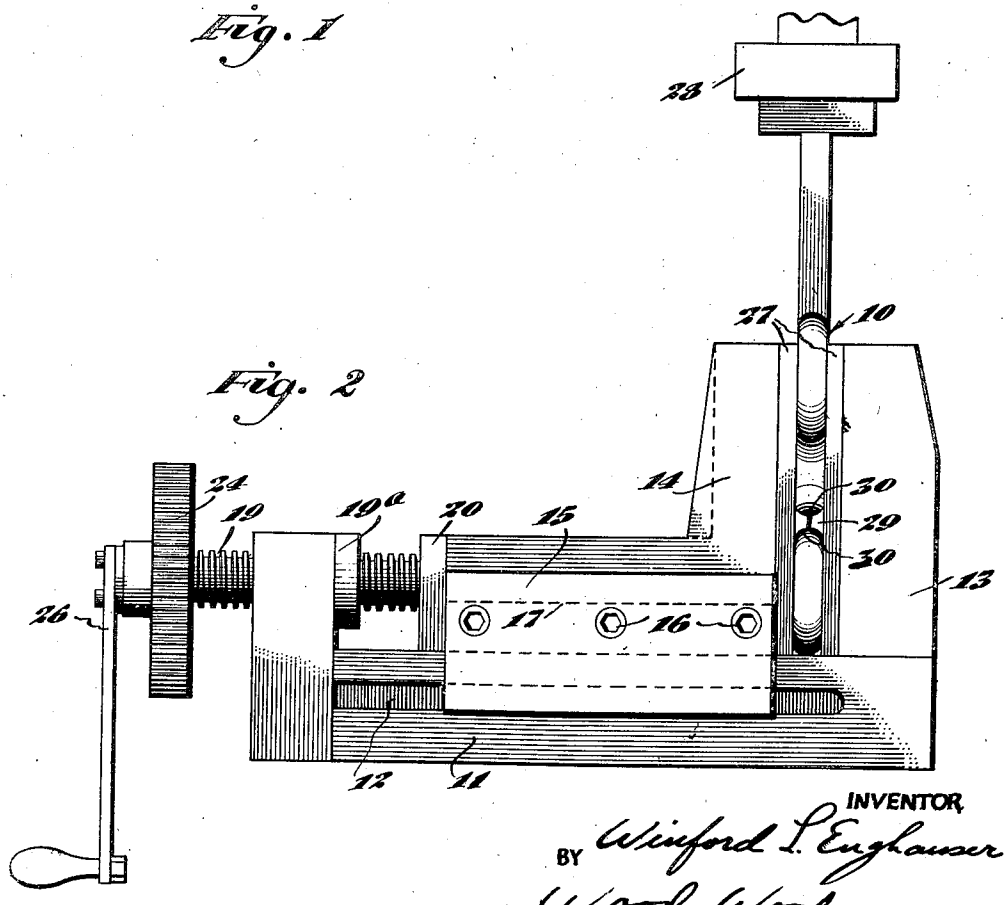



Fig. 2

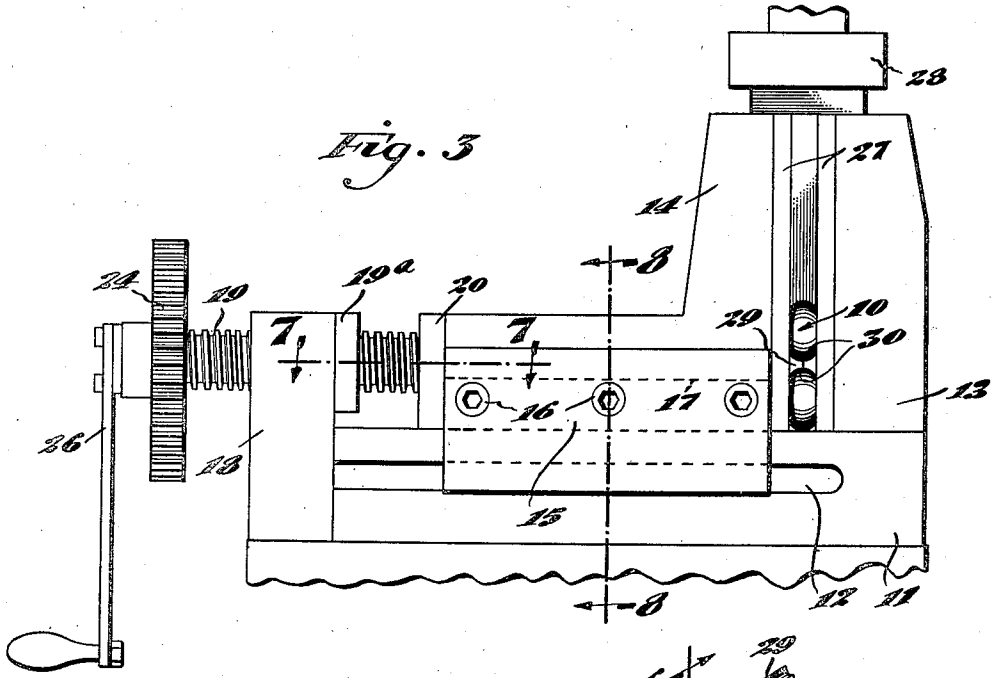
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Fig. 3



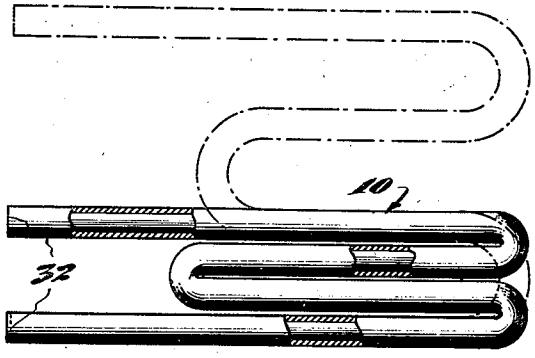




Fig. 4

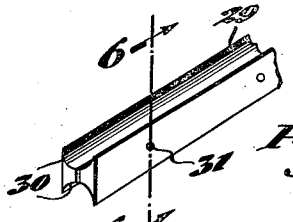



Fig. 5

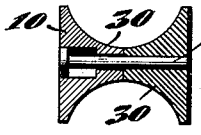



Fig. 6

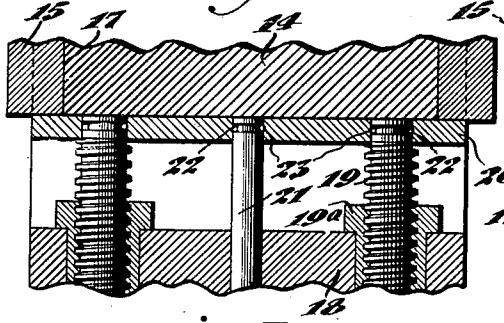



Fig. 7

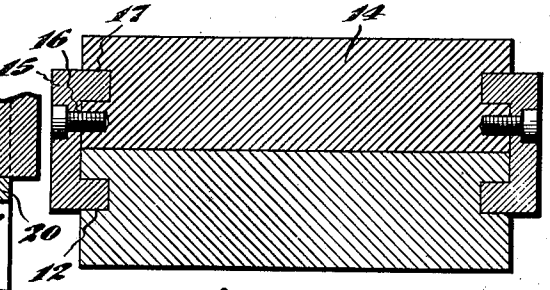



Fig. 8

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# UNITED STATES PATENT OFFICE

2,278,254

## APPARATUS FOR FORMING HEATING COILS

Winford L. Enghauser, Cincinnati, Ohio, assignor to The Production Plating Works, Inc., Lebanon, Ohio, a corporation of Ohio

Original application December 1, 1938, Serial No. 243,423. Divided and this application November 17, 1939, Serial No. 304,983

2 Claims. (Cl. 153—21)

This invention relates to the art of forming pipe into water heating coils or similar shapes and is particularly directed to apparatus for forming water heating coils. The heating coil, referred to, is used for heating water and is adapted to be placed within the fire chamber of a stove or in the domestic heating system. Coils of this character, in accordance with past practice, have been cast or fabricated or have been formed by bending malleable or ductile pipe into the required shape.

A coil, formed by means of each of these general methods, has certain advantages and disadvantages. If the coil is cast, it can be made more compactly, that is to say, a passageway of the requisite length can be provided in much less space. Casting, however, is more expensive than bending and, of course, is much more subject to breakage. If the coil is fabricated of L's and straight lengths of pipe, it can be made relatively compact but still the disadvantage of high cost is present. The pipe must be threaded and assembly operations are necessary. If the coil is formed by bending, the process is cheaper and there is much less likelihood of breakage. However, past practice has not developed a coil made of ductile or malleable pipe which is compact, since it has been impossible to bend pipe with relatively sharp bends because the pipe tended to split or collapse. A compact coil is particularly desirable for use in stoves.

It has been the object of the present inventor to provide an apparatus for forming a heating coil having all of the advantages above listed and none of the disadvantages. This objective has resulted in the provision of an apparatus which will bend malleable or ductile pipe into a heating coil without collapsing or splitting the pipe in any way, and which forms the coil in an extremely inexpensive manner. As a further result, an entirely new form of heating coil may be formed which provides a maximum of water conducting passageway in a given space with the walls of the coil formed of ductile material, is less apt to fracture or break in use, and is more heat conductive.

This application is filed as a division of my previous application, Serial No. 243,423, filed December 1, 1938, which application is directed to the method of forming the heating coil.

Other objects and certain advantages will be more fully apparent in a description of the accompanying drawings in which:

Figure 1 is a top plan view of the fixture or apparatus for holding the bendable pipe during the process of formation.

Figure 2 is a side view of Figure 1.

Figure 3 is a fragmentary side view taken similar to Figure 2 but showing the die in position, having fully formed the coil.

Figure 4 is a side view of the finished coil showing the lead therein and illustrating, in dotted lines, the form of the pipe before it is compressed into completed form.

Figure 5 is a perspective view of a portion of one of the spacers utilized in the fixture.

Figure 6 is a sectional view taken on line 6—6, Figure 5, depicting one of the pins holding the sections of the spacer together or in alignment.

Figure 7 is a fragmentary sectional view taken on line 7—7, Figure 3, illustrating the actuating means of the clamp fixture.

Figure 8 is a sectional view taken on line 8—8, Figure 3, illustrating the guides of the movable clamp element.

The completed shape of the coil is illustrated in Figure 4, the coil being generally identified at 10. It is well known that malleable or ductile pipe can be bent within certain limited degrees without injury to the metal or without splitting or fracture of the tubing or destruction of its cross sectional contour. The pipe is originally bent to the shape illustrated in dotted lines. Thereupon, it is annealed by heating to restore the crystalline structure and eliminate the stresses caused by the bending. This annealing is carried on, in the case of steel or copper, at 600–700° C.

It is then filled with a material of low melting point, such as lead. In the shape illustrated, the pipe has been bent traversely upon itself three times so that, if turned with the ends of the pipe downwardly, it substantially resembles the letter M. This formed length of pipe, filled with lead, is then placed in a fixture which maintains the structure against lateral displacement and, at the same time, permits collapsing of the shape without collapsing of the tube wall structure. Inserts are used between the runs of pipes to procure the proper final spacing. Thereupon, a die is lowered into the slot of the fixture and the pipe is laterally compressed into a space which is no greater than the total width and spacing of two of the previously mentioned runs. The return bends of the pipe are now as sharp as it is possible to make them with the exception of a very slight space between the walls, which is maintained for heating purposes. The coil, thus produced, is not only compact but is sub-

stantial and there is no possibility of it being broken. After the tube has been bent to the final compact shape, it is heated, preferably to an annealing temperature and the lead is then poured out of it.

The fixture, which holds or clamps the coil 10 in the process of formation, is mounted on a base. This base 11 is formed of a heavy block of steel, rectangular in form, and including slots 12 extending along and within its side walls. The stationary jaw 13 of the fixture rises from and is attached to the rear portion of the base. The movable jaw 14 is slidably mounted on the top of the base for movement toward and from the jaw 13. The movable jaw is held in guided relationship with the base by means of U-shaped guide elements 15, fixed to its sides by screws 16 and including lower flanges slidably disposed in the guide slots 12 of the base and into assembly slots 17 along the side walls of the jaw.

A journal block 18 is fixed against the forward end of the base and projects above it. The journals 19a of this journal block are traversed by heavy screws 19. The inner ends of the screws are loosely rotatably attached within an attachment plate 20 fixed across the front of the movable jaw. An operating shaft 21 also traverses the journal block 18 and has its inner end rotatably mounted in the plate. The inner ends of the screws and the shaft include annular grooves 22 and a screw 23 in the plate in each instance, engages the annular groove for preventing displacement and permitting rotation.

A large gear 24 is fixed on the outer end of each screw 19 and a small gear 25 is fixed on the outer end of the shaft 21 in mesh with both of the gears. Since the gears rotate in reverse directions, the threads of the respective screws are reverse. A crank handle 26 is bolted against the end of the hub of the pinion 25 and provides the means for translating the movable jaw toward the stationary jaw. The inner or adjacent walls of the jaws are appropriately provided with removable wear plates 27.

The ram 28 carries a die of plate form and of slightly less width than the diameter of the pipe. This die is reciprocated into the slot by means of the ram. The means for moving the ram is not disclosed, since it is conventional.

In order to provide a slight and controlled space between the runs of the coil, after they are pressed into final shape, and to further support the walls of the tubing, spacer elements 29 are provided, three in the present instance. In order that these spacers may be conveniently removed, after the finished coil has been lifted from the die, they are formed of sections. When assembled, the sections form or provide arcuate tube engaging top and bottom surfaces 30, 30. The sections abut on a line which is diametric of the tubing so that the spacer sections are removable laterally of the finished coil after it is lifted from the slot. Pins 31 are disposed between the sections and are effective for holding the sections in alignment.

Thus, it may be seen that the single length of tubing is pressed into the most compact shape possible without damage to the walls of the tubing or the metal of which it is formed. After the coil is removed from the slot, the finished coil is heated to a degree sufficient for removing the metal of low melting point and it is complete except for threading the terminal ends 32 thereof. This temperature is preferably an annealing temperature of 600–700° C. and is therefore sufficient for melting out the lead filler.

If the tubing used is a low carbon steel, it is preferably coated with brass or tin by dipping the tubing in a molten brass or tin bath.

Having described my invention, I claim:

1. An apparatus for forming a heating coil, comprising a base, a stationary jaw fixed on said base, a movable jaw adjustably mounted on said base for movement toward and from the first jaw, said jaws in their relationship providing a deep slot for receiving a reversely bent length of pipe adapted to form the coil, two or more screws engaged through the base and attached relative to the movable jaw, means for rotating said screws for adjusting the movable jaw on the base for clamping the jaw upon the pipe in the slot to prevent lateral spread of the pipe, and a plate-like die adapted to enter said slot for pressing the runs of the pipe closer together.

2. An apparatus for forming a heating coil, comprising a base, a stationary jaw fixed on said base, a movable jaw adjustably mounted on said base for movement toward and from the first jaw, said jaws in their relationship providing a deep slot for receiving a reversely bent length of pipe adapted to form the coil, means attached to the movable jaw and arranged to react against a portion of the base for adjusting the movable jaw on the base for clamping the jaw upon the pipe in the slot to prevent lateral spread of the pipe, and a plate-like die adapted to enter said slot for pressing the runs of the pipe closer together.

WINFORD L. ENGHAUSER.