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APPARATUS FOR ANNEALING STRIP

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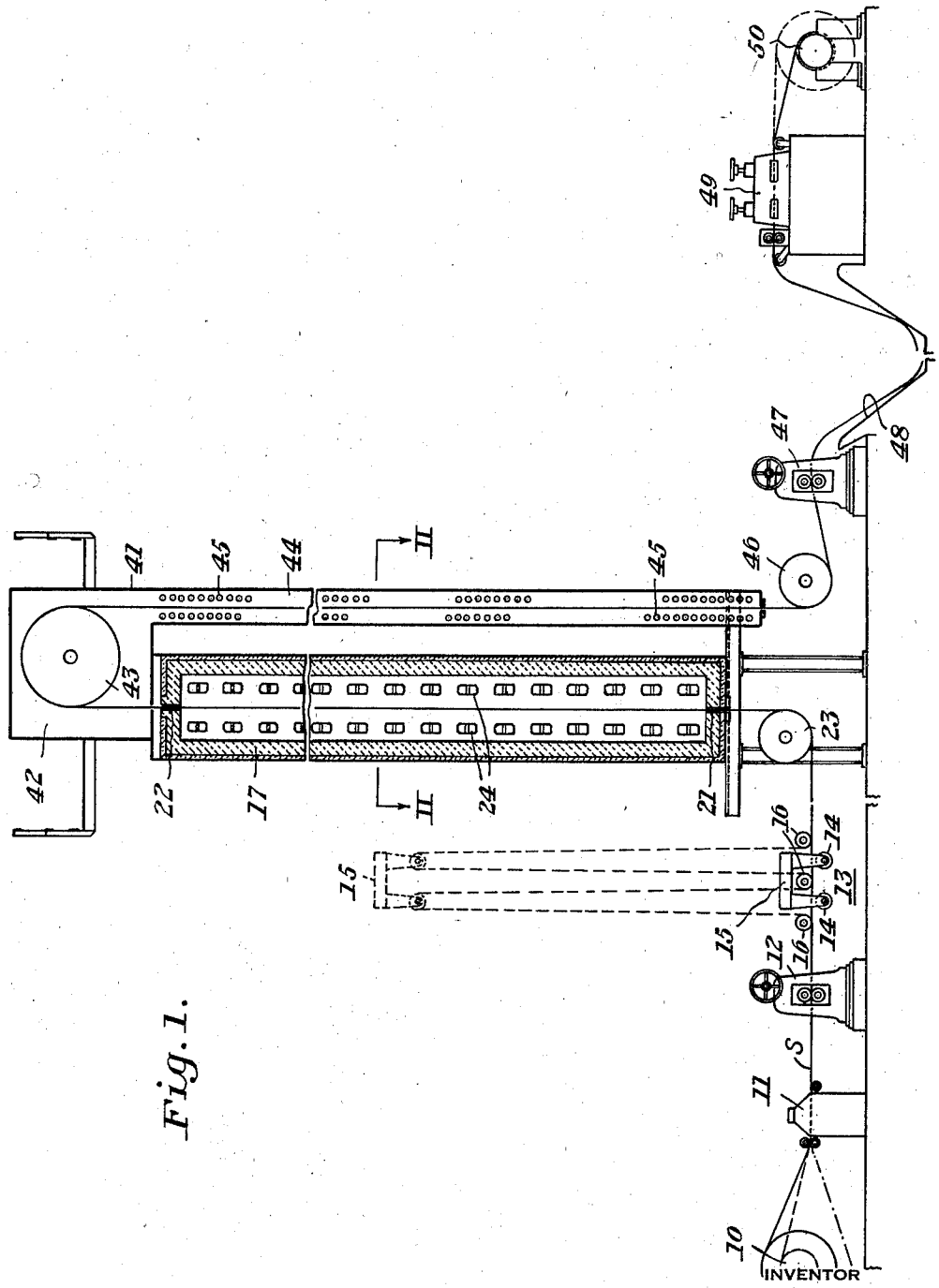


Fig. 1.

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by his attorneys
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UNITED STATES PATENT OFFICE

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APPARATUS FOR ANNEALING STRIP

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3 Claims. (Cl. 263—3)

This invention relates to annealing apparatus and particularly to an apparatus adapted for the continuous annealing of strip in strand form.

Various types of strip annealing apparatus have been known heretofore but all those with which I am familiar have been characterized by serious objections. Horizontal tunnel type annealing furnaces, for example, require a relatively large floor area and supports for the strip at intervals therealong which are likely to mar the surface of the material being treated.

I have invented a novel strip annealing apparatus which overcomes the aforementioned objections and is characterized by further features of novelty and advantage which will become apparent during the following detailed description and be particularly pointed out in the appended claims. In a preferred form, my invention comprises a pair of vertically disposed heating chambers located side by side and a cooling chamber having a portion overlying the heating chambers and a depending portion provided with heat-absorbing means. The heating chambers are provided with heat-exchange tubes extending therinto through the exposed side walls and arranged in spaced banks providing a free passage for strip therebetween. The heat-exchange tubes are of the return bend type whereby they may be fired from and discharge combustion products at the exposed side of the heating chamber. This embodiment is illustrated in the accompanying drawings referred to in greater detail hereinafter. In the drawings;

Fig. 1 is a view partly in side elevation and partly in section along a central vertical plane, showing diagrammatically the annealing apparatus and associated accessories;

Fig. 2 is a sectional view taken substantially along the plane of line II—II of Fig. 1; line I—I of Fig. 2 illustrates the plane on which the sectional portion of Fig. 1 is taken; and

Fig. 3 is a sectional view taken substantially along the plane of line III—III of Fig. 2.

Referring now in detail to the drawings, the annealing apparatus of my invention is adapted to receive metal strip S such as cold rolled steel from one of a plurality of coils mounted on supports 10. A welder 11 is located adjacent the coil supports, for joining successive coils end to end. It will be understood that after the strip in one coil has been fully unwound, the end of the next coil is brought forward and joined to the trailing end of the preceding coil. Driven pinch rolls 12 serve to draw the strip from the coil and through the welder 11. The pinch rolls

are stopped during the welding of one coil to the preceding coil.

A mechanical looper 13 comprises a pair of guide rolls 14 mounted on a liftable carriage 15 traveling in vertical guides and urged upward by a counterweight (not shown). The strip is initially led between the rolls 14 and fixed rolls 16. Thereafter the carriage 15 tends to maintain a loop in the strip as indicated in dotted lines, the size of the loop being determined by the relative speeds of the strip as it leaves the coil and enters the heating chamber next to be described. The looper thus provides surplus strip to enable a continuous feed through the heating chambers to be maintained during the interval when it is necessary to arrest the trailing end of a coil in order to weld thereto the leading end of a succeeding coil.

A furnace 17 is composed of a pair of heating chambers 18 and 19 disposed side by side. The walls of these chambers are built up of refractory brick within a suitable enclosure 20 composed of steel plate and a structural frame (not shown). The heating chambers have their greatest dimension vertical and have slots 21 and 22 at the lower and upper ends thereof respectively whereby strip may be drawn therethrough. Guide sheaves or drums 23 are journaled below the chambers and the strip passes around these drums before entering the chambers.

The heating chambers 18 and 19 are maintained at the desired temperature by heat-exchange tubes 24 disposed therein. The tubes 24 preferably have the shape of a flat bottle having a contracted neck 25 which is embraced by the exposed side walls 26 of the chambers through which the tubes extend. As shown in Figs. 1 and 2, the tubes 24 are arranged in spaced vertical banks providing a free space therebetween for the passage of strip.

The tubes 24 have a removable inner end 27 provided with a projecting foot 28 adapted to seat in one of a plurality of recesses 29 formed in the inner side walls 30 of the chambers. Refractory slabs 31 are disposed in the tubes 24, being supported by ribs 32 on the interior thereof, and defining connecting inward and outward passages 33 and 34 for combustion gases.

Each tube 24 has an air-supply pipe 35 extending through the neck thereof. The pipes 35 of the several tubes are supplied with air from manifolds 36. Each tube 24 also has a fuel-supply pipe 37 and a burner 38 disposed coaxially therein, fuel being supplied to the pipes 37 from

manifolds 39. The tubes 24 also have stack portions 40 communicating with their outer ends.

The heat-exchange tubes 24 described above are also disclosed and claimed in my co-pending application Ser. No. 240,497, filed November 15, 1938.

From the foregoing description, it will be apparent that when fuel and air are supplied to the pipes 37 and 35 and the mixture ignited as it emerges from the latter, combustion will occur in the passages 33 and 34 and the combustion gases will follow generally the course indicated by the arrows, finally emerging through the stack portion 40. The tubes 24 are thus heated to radiant temperature and thereby heat the strip S as it moves upwardly between the tube banks.

A cooling chamber 41 has an upper portion 42 overlying the heating chambers 18 and 19 and provided with guiding drums or sheaves 43 over which the strip passes on emerging from the chambers through the slots 22. The cooling chamber 41 and the heating chambers 18 and 19 may be supplied with an atmosphere of non-oxidizing gas from any suitable source.

The cooling chamber 41 also has a depending portion 44 communicating with the upper portion 42 and provided with heat-absorbing means such as the manifolds 45 through which cooling fluid such as water may be circulated.

Guide drums or sheaves 46 are mounted adjacent the lower end of the depending portion 44 of the cooling chamber. Pinch rolls 47 located adjacent the sheaves 46 serve to draw the strip upwardly through the heating chambers, around the sheaves 43 and downwardly through the cooling chamber. A looping pit 48 beyond the pinch rolls 47 permits a surplus of strip to be accumulated therein from which strip is drawn through a tension device 49 by a coiler 50. The looping pit accommodates the strip accumulating between the pinch rolls 47 and the tension device 49 while a completed coil is being removed from the coiler 50 and a new coil started.

It will be apparent from the foregoing that the invention provides a pair of annealing lines disposed in close side by side relation, the uncoiler, welder, pinch rolls, tension device and recoiler being duplicated in each line. The use of a return bend heating tube makes it possible thus to position the heating chambers closely adjacent each other, thereby minimizing the amount of floor space required and facilitating inspection of both lines from either side thereof. It will be understood without further explanation that the

strip fed into the heating chambers at the lower ends thereof is quickly brought up to the desired maximum temperature, the fuel supply of the heating tubes 24 being appropriately controlled to provide the desired temperature conditions at various points along the height of the chambers. Upon emerging from the heating chambers, the strip is cooled initially on entering the overlying portion 42 of the cooling chamber. It is then further cooled progressively as it descends through the depending portion 44 between the cooling manifolds 45. Instead of recoiling the strip after annealing, it may be fed forward continuously in strand form for further processing as by shearing, coating or the like.

Although I have illustrated and described herein but a preferred form and practice of the invention, it will be understood that changes in the construction and operation disclosed may be made within the scope of the appended 20 claims.

I claim:

1. Apparatus for annealing strip comprising a vertically elongated heating furnace substantially rectangular in section, a central vertical wall dividing said furnace into a pair of chambers, heat-exchange tubes arranged in vertically spaced relation in said chambers, said tubes extending through the sides of said furnace and having feet engaging abutments in said central wall, each of said tubes being closed at one end and having a reduced neck at the other serving as an outlet for combustion gases, and a burner extending into the body of the tube through said neck.

2. Apparatus for annealing strip as defined by claim 1 characterized by each of said tubes having generally the shape of a flat bottle, with means therein defining separate entering and return passages for combustion gases.

3. Apparatus for annealing strip comprising a vertically elongated heating furnace substantially rectangular in section and having spaced side walls, heat-exchange tubes arranged in vertically spaced relation in said furnace, said tubes extending through one of said side walls and each having a foot at one end resting on an abutment in the opposite side wall, each tube being closed at the end at which said foot is located, and having a reduced neck at the other end serving as an outlet for combustion gases, and a burner extending into the body of the tube through said neck.

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