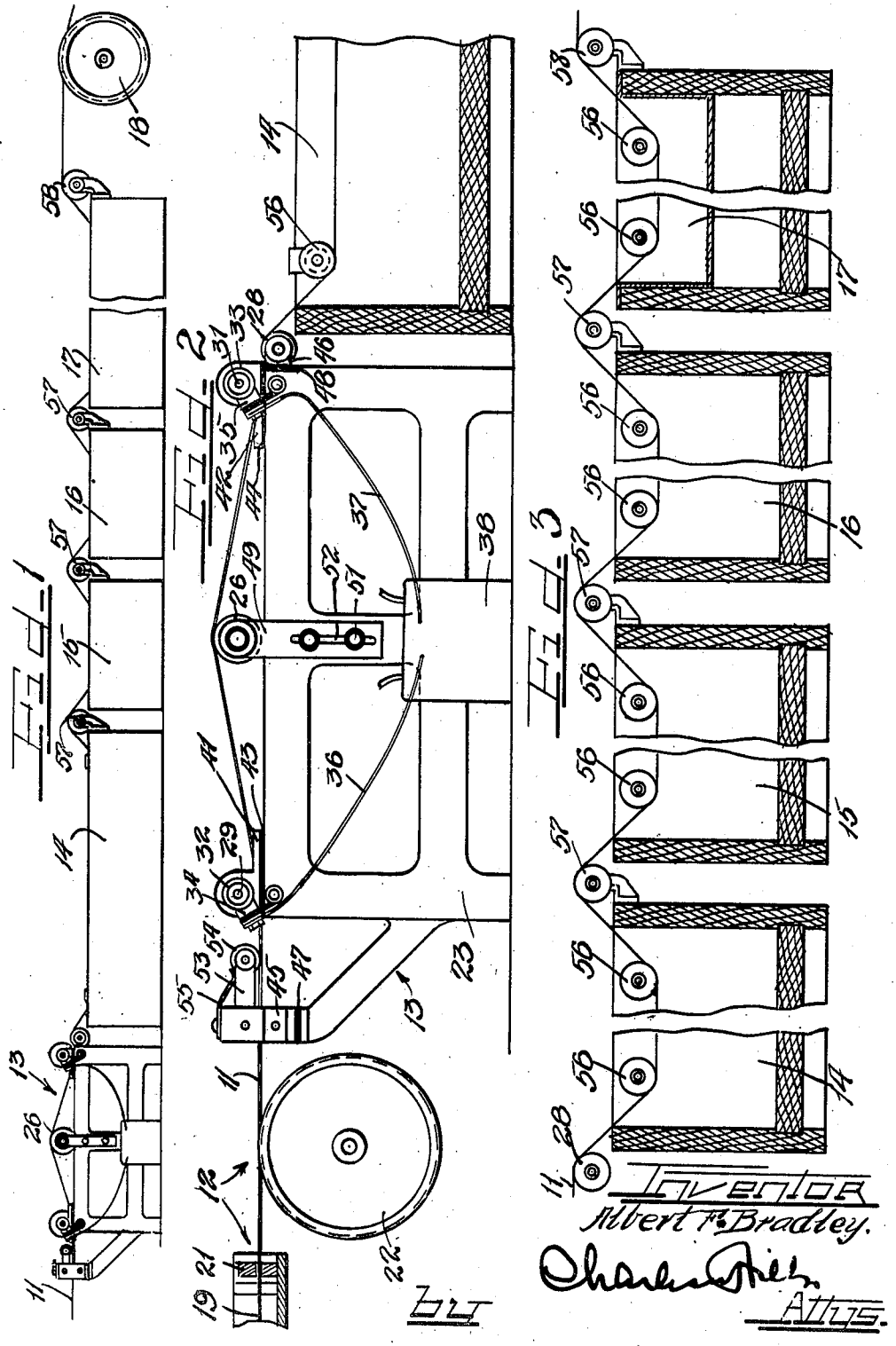
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PROCESS FOR MAKING GALVANIZED ARTICLES

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PROCESS FOR MAKING GALVANIZED ARTICLES

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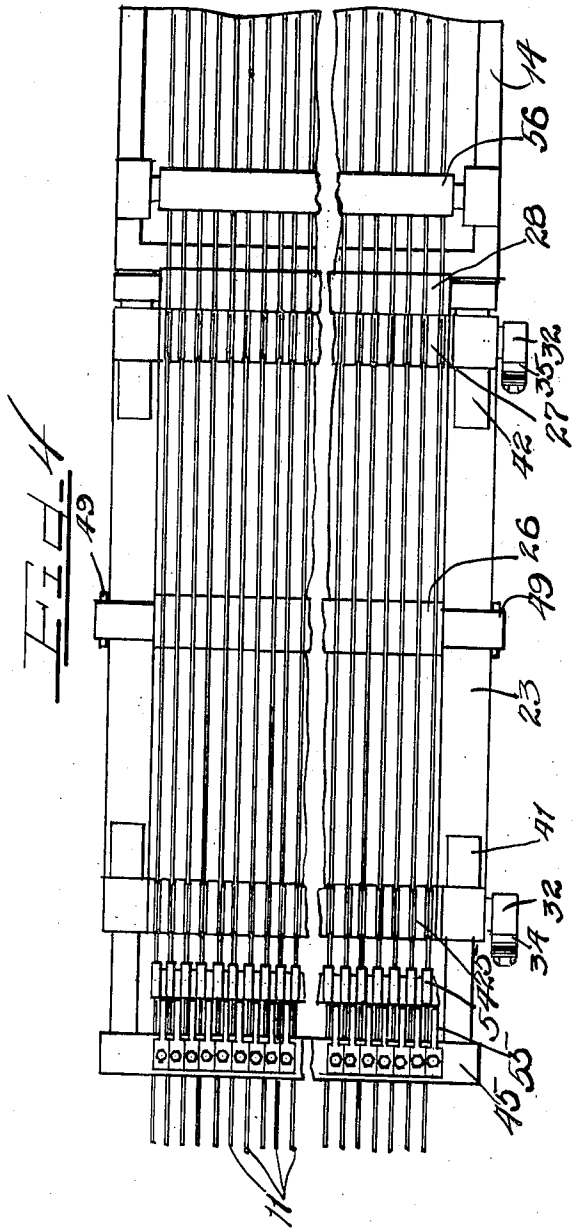


FIG. 4

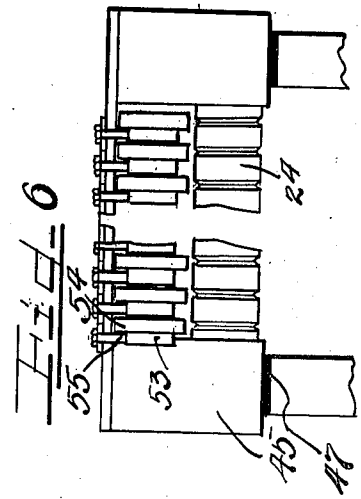


FIG. 6

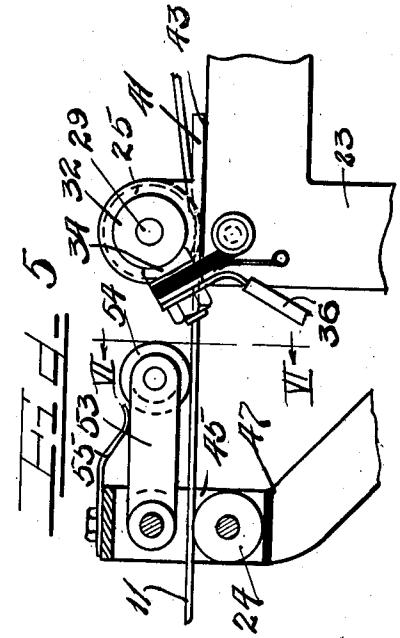


FIG. 5

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PROCESS FOR MAKING GALVANIZED ARTICLES

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2 Claims. (Cl. 91—70.3)

This invention relates to a method of and apparatus for annealing and galvanizing metal articles such as steel or iron wire, to produce a better zinc coating on annealed wire than has hitherto been attained.

More specifically the invention relates to the inside annealing of cold drawn wire, to retain some of the strain and/or some residual pattern of the original drawn structure on the outside of the wire, followed by a galvanizing of the wire to produce a better coating due to the retained surface properties of the wire.

While the invention will hereinafter be specifically described as applied to wire, it should be understood that it is not limited to such application.

I have found that steel or iron wire which has been cold-drawn and not subsequently annealed will, when immersed in a bath of molten zinc, acquire a coating of given thickness in less time and the coating will be stronger and more adherent than when a coating of similar thickness is applied in a similar manner to annealed wire. The reason for this is not known, but it is thought by some to be due to changes which take place in the crystalline structure of the metal when it is drawn into wire.

I have discovered that a certain method of annealing cold-drawn wire causes it to acquire the ductility and toughness which it would have if annealed in the ordinary manner, while allowing it to retain, to a large extent, its superior galvanizing properties. This method comprises heating wire by the generation of heat uniformly throughout its cross-section while continually allowing its surface to lose heat by radiation, thus making the interior of the wire hotter than the surface. In this manner, the interior of the wire is heated well up into the range of temperatures at which relief of internal strains and recrystallization can take place while the surface of the wire is heated to a temperature just short of this range. The surface of the wire therefore retains at least some of the strains and surface pattern imparted thereto during the cold-drawing operation.

It may be that in the process as actually carried out the surface of the wire is also heated up into the annealing temperature range, but if that is the case the surface is still much less hot than the interior of the wire and is hot for a much shorter interval of time. At any rate, the momentary heating of the surface of the wire to a temperature considerably lower than that necessary to thoroughly anneal the interior does not materially lessen its ability to take galvanizing.

Whatever may be the correct explanation of the process which I have discovered, the fact remains that my discovery results in a new and improved process for galvanizing wire.

Another result of my discovery is annealed wire with a more adherent galvanizing than has hitherto been produced.

In addition, the annealing process used in this invention produces greater softness and ductility than is obtained in customary annealing practice. In order to obtain the same softness according to usual annealing practice it would be necessary to use a very high temperature or a longer annealing time, which would result in heavy scale or oxide and a consequent increase in cost of pickling and loss of weight of steel, or iron.

The means which I have found most convenient for generating heat in the interior of a wire is an electric current, preferably direct current or alternating current caused to flow along a length of the wire. Ordinary 60 cycle alternating current is satisfactory. One of the most convenient ways of causing an electric current to flow through a wire and heat it to the proper temperature is to pull the wire along in contact with a pair of spaced rollers maintained at different electric potentials and adjusting the potential difference, the distance between the rollers or the rate of movement of the wire to give the temperature desired.

In order to carry out the process which I have discovered, I have invented an improved device for heating wire by electricity, and I have also invented a new combination of wire-drawing mechanism, electric annealing device and galvanizing apparatus which operates on continuously moving wire.

An object of the invention is to anneal the interior of cold worked metal articles without destroying the cold worked surfaces and to coat these surfaces with a protective metal.

A specific object of the invention is to anneal the interior of cold drawn ferrous metal wire while retaining at least some of the strain and residual metal pattern in the surface of the wire and to then galvanize said wire.

One of the further objects of my invention is to provide an apparatus for conveniently and economically carrying out my process.

Another object of my invention is to provide an apparatus for producing electrically annealed drawn wire in which the annealing device is arranged to continually receive wire from a wire-

drawing machine so that the wire reaching the annealing device will be heated from just having been drawn and will require less electrical energy than otherwise to raise it to the desired temperature.

Another object of my invention is to provide an electric annealing device through which wire may be drawn continuously and which will automatically stop the electric current in the wire in case the wire breaks.

Another object of my invention is to provide a multiple electric annealing device through which a large number of wires may be drawn continuously and simultaneously and wherein each may be rapidly heated to an annealing temperature.

Other objects of my invention will appear from the following description and the accompanying drawings, in which:

Figure 1 is a side elevational view of the annealing portion and the pickling and galvanizing portion of the apparatus;

Figure 2 is a side elevational view, on an enlarged scale, of the annealing portion of the apparatus shown in Figure 1, a vertical longitudinal section of part of the pickling and galvanizing portion of the apparatus, and a diagrammatic representation of the wire-drawing portion of the apparatus;

Figure 3 is a broken vertical longitudinal section of the pickling and galvanizing portion of the apparatus;

Figure 4 is a broken plan view of the annealing portion of the apparatus and part of the pickling and galvanizing portion of the apparatus;

Figure 5 is a fragmentary enlarged side view, partly in section, of a part of the annealing portion of the apparatus;

Figure 6 is a fragmentary enlarged back view of part of the annealing portion of the apparatus as seen from the line VI—VI of Figure 5, looking in the direction of the arrows.

The form of the apparatus shown in the drawings is arranged to continuously draw, anneal and galvanize a number of wires 11 which pass through the apparatus in parallel paths. In the particular apparatus illustrated, forty-eight wires 11 are operated on simultaneously, but obviously, the apparatus may be designed to handle any number. The apparatus comprises a wire-drawing mechanism 12, an electric wire annealing device 13, a pickle tank 14, a rinse tank 15, a flux tank 16, a galvanizing tank 17, and take-up reels 18 for winding up the finished wire and drawing it through the annealing device 13 and the various tanks 14, 15, 16 and 17. The various pieces of apparatus are arranged one after the other so that the wires 11, entering the wire-drawing mechanism as rod stock or heavy wire 19, can pass directly through the entire apparatus in the minimum time and emerge as finished annealed wire.

The wire-drawing mechanism 12, which is shown diagrammatically in Figure 2, comprises a die 21 for each wire and one or more wire-drawing drums 22 for pulling the wire through the dies. There may be a single horizontal drum or a plurality of narrow horizontal drums, one for each wire, mounted on a single shaft, or any other arrangement that will handle the number of wires for which the apparatus is designed. Also, while I have diagrammatically illustrated a single draw machine, the drawing mechanism may comprise a multiple draw machine if a large reduction is required to produce the desired gauge of wire from the rod stock or wire being used as the raw material.

In the apparatus illustrated, the wire 11 passes from the die 21 and makes enough turns around the drum 22 so that a light tension on the wire leaving the drum will keep it wound tightly enough around the drum to enable the drum to draw it through the die.

From the wire-drawing mechanism 12, the wires 11 pass to the electric annealing device 13 which comprises a table or frame 23 carrying a plurality of grooved rollers or sheaves 24, 25, 26, 27 and 28 arranged so that the wires 11 can pass over the first, third and fifth sheaves 24, 26 and 28 and under the second and fourth sheaves 25 and 27. The shafts 29 and 31 on which the second and fourth sheaves 25 and 27 are mounted are provided with contact discs 32 and 33. The peripheries of the contact discs 32 and 33 are engaged by spring pressed brushes 34 and 35 connected by wires 36 and 37 to the secondary of a suitable transformer 38 which causes a current to flow between the two sheaves or rollers 25 and 27. In order to cause this current to flow in the wires 11 and heat them, the shafts 29 and 31 of the two contact sheaves 25 and 27 are carried in bearings or brackets 41 and 42 separated from the frame 23 by suitable electrical insulation 43 and 44 so that there is no path for the current except through the wires 11.

The sheaves 24 and 28 at the ends of the annealing device are carried by brackets 45 and 46 which may be separated from the frame 23 by electrical insulation 47 and 48, in a manner similar to that employed in connection with the contact sheave bearings 41 and 42, in order to prevent "sneak" currents from flowing through the frame 23. The central sheave 26 between the two contact sheaves is carried by a pair of brackets 49, which need not be insulated, but which are made vertically adjustable by being clamped to the frame 23 by bolts 51 passing through slots 52 in the brackets 49. This allows the central sheave 26, which is under the wires 11, to be raised or lowered to a position in which the wires make good contact with the contact sheaves 25 and 27 at either side of the central sheave 26.

The bracket 45 which carries the first sheave 24 of the annealing device also carries a series of arms 53 above the wires 11, one arm for each wire. Each arm 53 is pivoted to the bracket 45 so that it can swing vertically, and it carries its own individual grooved wheel 54 which rests on top of one of the wires 11 between the first sheave 24 and the first contact sheave 25. Each arm 53 and grooved wheel 54 is provided with a leaf spring 55 which presses the wheel 54 down lightly on the wire 11 so that, if any one of the wires breaks, that wire is immediately pushed down out of contact with the contact sheave 25 and the current through it is broken, thus preventing it from overheating.

From the last sheave 28 of the annealing device, the wire 10 passes down into and out of the pickle tank 14 and successively down into and out of the rinse tank 15, the flux tank 16 and the galvanizing tank 17 containing a bath of molten zinc. Each of these tanks is provided with sheaves 56 or other suitable means for holding the strands of wire 11 below the level of the liquid in the tank, and other sheaves 57 are provided between the tanks for guiding the strands from one tank to the next.

From the galvanizing tank 17, the wire 11

passes over another sheave 58 to the take-up reels 18 or other mechanism for drawing the wire 11 through the apparatus. This mechanism may comprise a group of conventional reeling machines or any other suitable mechanism, such as a fence making machine, which will draw the wire 11 through the preceding parts of the apparatus at a steady rate.

The exact rate at which the wire moves is not critical, as the apparatus can be designed to properly treat the wire while moving at any speed which would be commercially desirable for use with the wire-drawing machines or other portions of the apparatus. An extremely slow wire speed would make the annealing time too long and at the same time make the production rate undesirably low. I have found that wire speeds of 42 ft. a minute give good results when employed with an annealing device in which the contact sheaves are three feet apart, this combination providing an annealing time of between four and five seconds. Higher or lower wire speeds may be employed, and the annealing time may be shorter or longer than that given, but long annealing times should be avoided because the success of the process apparently depends on the incomplete annealing of the surface of the wire. With lower wire speeds, the annealing time can be kept down by placing the contact sheaves closer together and lowering the electrical potential difference between them.

In practice, it has been found to be sufficient to provide some means, such as a multi-tap transformer, of making small changes in the potential difference applied to the contact sheaves and to keep the contact sheave spacing and wire speed constant while varying the potential difference until the best results were secured.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim as my invention:

1. In a process of making metal articles including an initial cold working step and a subsequent coating of a cold worked article with a protective metal, the improvement comprising an intermediate step including disposing a cold worked article so as to permit its surface to radiate heat freely and generating heat within the cold worked article at such a rate and for such a time in relation to the rate of dissipation of heat from the surface of the article as to raise the interior of the article but not the exterior of the article to a temperature within the annealing range for a time sufficient to remove substantially completely the cold worked structure of the article only in the interior thereof.

2. The continuous process of making galvanized annealed wire which comprises drawing wire stock through a reducing die, continuously passing the resulting wire through a heating zone, flowing an electric current through the traveling wire in the heating zone, dissipating heat generated by said electric current from the wire surface, adjusting the magnitude of said current and the rate of heat dissipation to maintain the temperature of the interior of said wire in the recrystallization range and the temperature of the exterior of the wire below said range, and continuously passing the heat treated wire through a bath of molten zinc.

ALBERT F. BRADLEY.