Jan. 28, 1936. DE HART G. SCRANTOM 2,029,037

PROCESSING OF METAL PARTS

Filed March 3, 1932

FIG. 1.

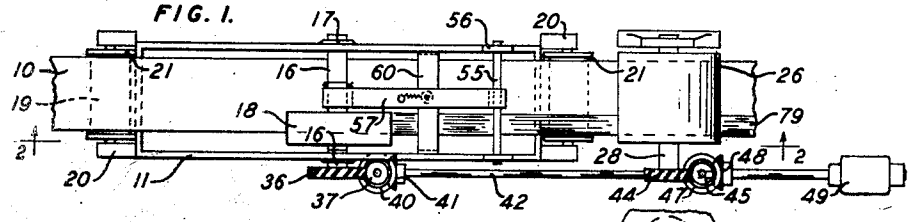


FIG. 2.

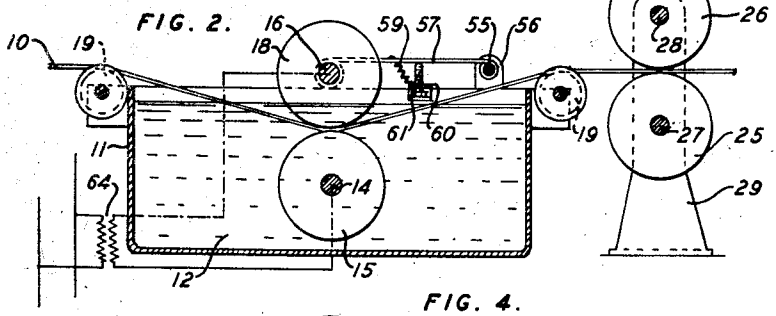


FIG. 4.

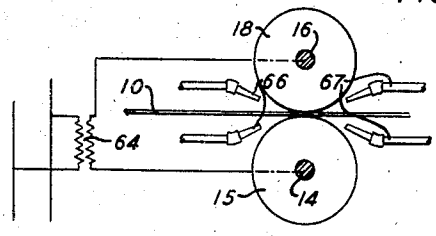


FIG. 3.

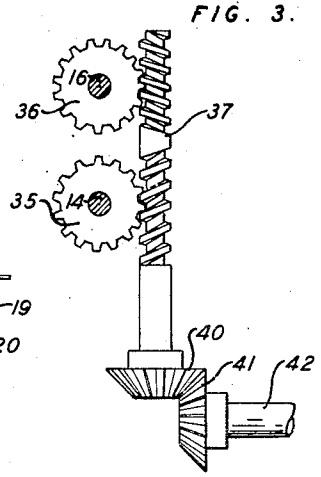


FIG. 5.

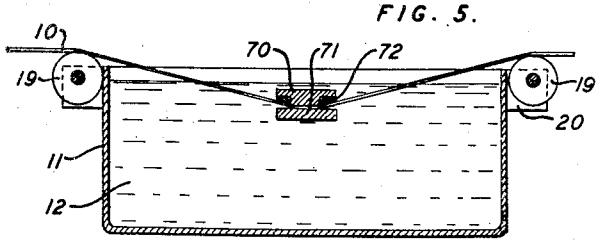


FIG. 6.

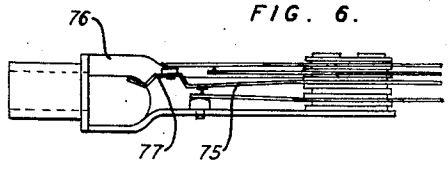


FIG. 8.

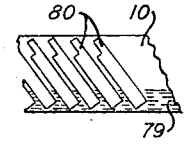
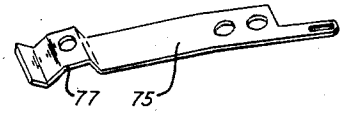


FIG. 7.



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PROCESSING OF METAL PARTS

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Application March 3, 1932, Serial No. 596,448

4 Claims. (Cl. 148—10)

This invention relates to the processing of metal parts, and more particularly to a method of annealing metal stock and producing therefrom formed metal parts.

An object of the invention is to provide an improved method for treating a portion of a body of metal.

Briefly, in the preferred embodiment of the invention, a marginal portion of a strip of metal is heated by passing it between spaced rolls which are oppositely charged from a low potential source of electrical current. The heating takes place within a quenching medium, whereby the metal is quenched immediately after heating. The strip may then be operated on by a punch press to blank and form a metal part therefrom.

These and other objects and advantages of the invention will become apparent from the following detailed description of one embodiment thereof, reference being had to the accompanying drawing wherein

Fig. 1 is a plan view of an annealing apparatus in accordance with one form of the invention and which may be employed in practicing the process;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a detailed vertical view of part of the driving mechanism shown in Fig. 1;

Fig. 4 is a schematic view showing a modified form of the annealing apparatus;

Fig. 5 is a schematic view showing another modified form of the annealing apparatus;

Fig. 6 is an assembly view of a telephone jack employing a spring which has been annealed and formed by the improved process;

Fig. 7 is a perspective view of a jack spring used in the jack of Fig. 6, and

Fig. 8 is a plan view of a portion of a strip of metal from which jack springs have been blanked.

Referring now to the drawing wherein like reference numerals are employed to designate corresponding parts throughout the several views, and particularly to Figs. 1 and 2, the reference numeral 10 designates a portion of a continuous strip of metal, a marginal portion of which is to be annealed. A tank 11 which is intended to receive and contain any suitable quenching fluid 12, such, for example, as water or oil, is provided, in the side walls thereof, with suitable journals (not shown) for rotatably supporting a shaft 14. Mounted on the shaft and rotatable therewith, is a metal roll 15. The sides of the tank 11 are of sufficient height that the quenching fluid may completely cover the roll 15.

Mounted directly above and at a predetermined distance from the shaft 14, in suitable supports 17 is a shaft 16 on which is mounted in alignment with the roll 15 a rotatable metal roll 18. The peripheral surface of the roll 18 is spaced from that of the roll 15 sufficiently to receive the strip of metal 10 and to permit both rolls to engage the strip on opposite faces thereof, and the supports for either or both of the shafts 14 and 16 may be made adjustable in any suitable manner to enable the proper spacing between the rolls to be maintained.

In order that the strip of material 10 may be properly guided into the tank 11 and between the rolls 15 and 18, there may be provided at opposite sides of the tank, rolls or sheaves 19 journalled in supports 20 at opposite sides of the tank. The rolls 19 may have suitable flanges 21 at their ends for preventing transverse movement of the strip 10. For further guiding the strip, the roll 18, and if desired the roll 15, may be of sufficient length to engage the entire width of the strip. In such an arrangement the portion of the strip to be annealed would be engaged by a metallic portion of the roll, and the remaining portion of the roll might be of insulating material, or of metal and insulated from the heating portion of the roll in any suitable manner.

It is especially desirable that the pressure of the rolls 15 and 18 upon the strip 10 shall be barely sufficient to maintain good electrical contact. It therefore is preferable that means be provided for feeding or drawing the strip between the rolls, and also that means be provided for positively rotating the rolls 15 and 18 since excessive pressure contact might be required between the strip and the rolls if the latter are rotated by frictional engagement with the strip. For advancing the strip 10, the rolls 25 and 26 may be provided, fixed to the shafts 27 and 28 journalled in a suitable support 29. Either or both of the shafts 27 and 28 may be adjustably supported in order that the space between the rolls may be varied to permit positive frictional engagement of the rolls 25 and 26 with the strip 10.

One form of mechanism which may be employed for driving the rolls 15 and 18, and also the rolls 25 and 26 is shown in Figs. 1 and 3. Secured to the shafts 14 and 16 are worm wheels 35 and 36 respectively which mesh with a worm 37. The spiral teeth of the worm advance in opposite directions from a point of the worm, and each of the worm gears 35 and 36 meshes with one of the oppositely spiraled portions, so that when the

worm is rotated the gears 35 and 36, and consequently the rolls 15 and 18 rotate in opposite directions. Secured to the worm shaft is a bevel gear 40 meshing with a bevel gear 41 on the driving shaft 42. The shafts 27 and 28 of the driving rolls 25 and 26 are provided with worm gears similar to the gears 35 and 36, one of the gears being shown at 44 in Fig. 1. A worm 45 similar to the worm 37 is rotatably mounted to mesh with the gears carried by the driving roll shafts 27 and 28, and the rolls are thus driven in opposite directions when the worm 45 is rotated. The shaft of the worm 45 has secured thereto a bevel gear 47 meshing with the gear 48 carried by the driving shaft 42. The shaft 42 may be driven by any suitable means such as an electric motor 49 coupled directly thereto, as shown in Fig. 1, or connected through suitable gearing. From the above description it is apparent that the rolls 25 and 26 may be driven in the proper directions to advance the strip 10, and that the rolls 15 and 18 may be driven in the proper directions to offer no resistance to the advance of the strip. In the preferred arrangement, the gear ratios throughout the driving mechanism are such that the peripheral speed of the rolls 15 and 18 equals the linear speed imparted to the strip by the driving rolls, in order that there may be no slippage between the strip and the rolls.

It has previously been stated that the supports for one or both of the shafts of each pair of rolls are preferably adjustable. The purpose of this is to permit the space between cooperating rolls through which the strip passes to be varied in order to accommodate strips of different thicknesses. The use of the worm and worm wheel drive enables these adjustments to be made without affecting the driving mechanism. When any one of the shafts is displaced to change the distance between cooperating rolls, the worm wheel associated therewith may rotate against the worm to advance therealong, the worm remaining stationary and the distance of the shaft from the worm remaining constant.

In addition to the adjustability of a roll shaft, it may also be desirable to have one of the shafts slightly variable within its support, in order that the roll may be under tension as it contacts with the strip, and that it may follow slight variations in the thickness of the strip. In Figs. 1 and 2 an arrangement is shown which may be employed to maintain the roll 18 under tension. A shaft 55 mounted in brackets 56 of the tank 11 has pivoted thereon an arm 57 which has an end bearing against the shaft 16. Intermediate the pivot point and the point of contact with the shaft 16, the arm 57 has secured thereto one end of a tension spring 59, the other end of which is secured to a stationary member 60 engaging the tank 11. The member 60 also supports a thumb screw 61 by means of which the downward force exerted by the spring 59 on the shaft 16 may be controlled and limited. If desired, a torsion spring fixed to the shaft 55 and bearing against the shaft 16 may be employed instead of the pivoted arm 57. The thumb screw may operate on the torsion spring to vary the pressure exerted on the roll shaft, and the tension spring 59 may be eliminated.

The heat for annealing the metal is obtained from an electrical current through the rolls associated with the tank 11, the current passing through the metal strip or a portion only thereof. This current may be supplied by a transformer 64 which has its secondary connected to the rolls 15 and 18, and its primary connected to a suitable source of alternating current to produce between the rolls a current of sufficient magnitude to heat the strip to the proper temperature. It is not essential that an alternating voltage be employed, as a direct current of sufficient magnitude to heat the metal strip may be supplied from any suitable source to the rolls 15 and 18. Since the current is passed through the rolls, it is necessary that one or both of the rolls be insulated from the tank 11, in order to prevent short circuiting through the tank. This insulation may be obtained in any convenient manner, such as making the shafts 14 and 16 of dielectric material, or providing the rolls 15 and 18 with bushings of such material, or journalling the shafts in non-conductive supports.

In Fig. 4 is shown a modified arrangement of quenching apparatus for an annealing machine. One or more jets or nozzles 66 are mounted adjacent to the rolls 15 and 18, and these jets may be connected by suitable pipes 67 to a source of quenching fluid (not shown) whereby streams of quenching fluid under pressure may be directed against the strip 10 immediately adjacent to the rolls 15 and 18. With this arrangement, the rolls and the strip are not actually immersed in quenching fluid, although sufficient quantities may be supplied thereto to obtain the proper quenching of the heated portion of the metallic strip.

In Fig. 5 is shown a modified arrangement of an apparatus for heating a marginal portion of a strip of metal, in which the tank 11 and guide rolls 19 are employed as described above, and in which contact shoes are provided instead of rolls for heating the strip of metal. In this arrangement, the strip 10 passes between upper and lower contact shoes 70 and 71 respectively. Any desired width of metal may be provided for contacting with the strip. For example, a shoe and its exposed surface may be entirely of metal, such as the shoe 71, or inserts of dielectric material such as the members 72 of the shoe 70 may form a portion of the surface engaging the strip, thus providing a surface greater in extent than the conductive surface for engaging the strip. It is to be understood that an electric current would be supplied to the shoes similarly to the manner in which it is supplied to the rolls of Fig. 2, and that suitable means for advancing the strip such as the rolls 25 and 26 and associated driving mechanism may be provided.

The apparatus which has been described in the foregoing paragraphs is intended particularly for use in the manufacture of contact springs such as the spring shown at 75 in Figs. 6 and 7 used in the manufacture of telephone jacks such as the jack 76 shown in Fig. 6. However, the apparatus above described and the method which will presently be described are not restricted to the processing of metallic strips for the manufacture of contact springs for telephone jacks, but they may be employed for the heat treating of marginal portions of continuous metallic strips for the manufacture of many articles therefrom.

In the manufacture of contact springs for jacks it has been the practice in one instance to punch the blanks for these springs from strips of resilient or spring metal such as nickel silver, by means of a punch press. The blanks thus obtained were then separately treated to anneal the portion it was desired to form, the material being heated by a flame, the blanks then being immersed in the quenching fluid to complete the

annealing. The heating required the exercise of caution, since it is desirable to soften only the portion that is to be formed, retaining the original resilience of the remaining portion of the spring. Following the annealing, an acid bath was usually employed to remove the scale formed on the metal by the annealing process, particularly the scale on the edges of the blanks, which may injure the forming die, after which the springs were individually placed in a punch press fitted with the proper forming dies, and the annealed portions were given the proper configuration. The springs were then cleansed to remove dirt and grease which may be acquired from the dies. The process thus involved the handling of the springs, after blanking from the strip, in the annealing, quenching, forming operations, and in the acid bath and final cleansing.

Fig. 8 shows a portion of the strip 10 after the jack springs such as the spring 75 of Fig. 7 have been blanked therefrom, the apertures 80 resulting from the blanking operation. It is clearly shown that a portion of the aperture 80 corresponding to the formed portion 77 of the jack spring lies within the annealed marginal portion of the strip. The illustration thus clarifies the relationship between the annealed portion of the strip and the formed portion of the spring.

The process of producing contact springs for jacks, employing the annealing apparatus hereinbefore described, is greatly simplified as compared with the former process outlined above, and operations are combined and eliminated in a manner not previously practiced.

The strip material from which the springs are made is usually supplied in the form of a pad or roll which may be mounted to rotate on any suitable support (not shown). The outer end of the roll of material is passed between the heating rolls 15 and 18, and between the driving rolls 25 and 26, and then to any suitable rotatable take-up (not shown) which reels the strip into a pad or roll similar to that in which it was supplied. As soon as the strip has been engaged by the driving rolls, electric current may be supplied to the electrodes or contacts formed by the heating rolls by completing the electrical circuits with which the primary and secondary of the transformer are associated. This will produce an electrical current through the metal between the heating rolls and the metal strip. The current will heat the metallic strip, the temperature produced depending upon the voltage applied to the electrodes, and a voltage is chosen of sufficient magnitude to substantially instantaneously heat the metal between the electrodes to a predetermined temperature. Although the gap between the rolls is below the surface of the quenching fluid, the high temperature caused by the current will produce a pocket of vapor under sufficient pressure to expel the liquid from the actual heating space, and thus prevent the quenching fluid from reaching the metal while it is being heated, and from interfering with the heating process. Since the strip of metal is continuously advanced, the marginal portion to be annealed is continuously entering the vapor pocket, is being heated, and is emerging from the pocket. As soon as the heated portion leaves the pocket, it enters the liquid quenching medium and is thereby cooled, the heating and quenching constituting the annealing process, and producing the annealed marginal portion 79 of the strip. From the quenching tank it passes to the take-up. The passage between the heating electrodes of only the portion of the strip that is to be annealed insures the passage of the electrical current through that portion alone. Also, the passage of the entire width of the strip through the quenching fluid during the heating of the marginal portion results in dissipation of heat that tends to flow by conduction to other parts of the strip, and thereby insures retention of the original resilience by all portions except the marginal portion subjected to the electrical discharge.

After a desired quantity of strip has accumulated on the take-up, it may be removed therefrom and arranged in the usual manner adjacent to any suitable and well known type of punch press adapted to perform blanking, piercing, and forming operations. The punch press is fitted with a die constructed after the usual manner of combination blanking and forming dies, and provided with proper tools to blank, pierce, and form a jack spring in a single stroke of the press. The previously annealed strip of metal is then drawn from the roll and fed into the press, and as the strip is advanced therethrough, jack springs are blanked from the strip, are pierced to possess the proper holes, and are formed to the desired contour, one completed spring such as the spring 75 having the formed portion 77 in Fig. 7 being produced in a single stroke of the press. The springs thus obtained may be cleaned by acid or in any suitable manner to remove surface scale, dirt and grease, after which they are ready for use.

The above description of the improved process of making metal parts does not include an acid treatment of the material after the annealing operation and preceding the punch press operation to remove scale. It has been stated in connection with a former process that scale produced on the edges of metal parts by the annealing process is sometimes harmful to dies, whereas surface scale is seldom objectionable. In the improved method, the metal parts are blanked from the material after the annealing operation, and the edges are therefore free from scale. If, however, it should appear desirable to remove the scale before the punch press operations this may be accomplished in a manner more simple than the former acid dipping of the metal parts. As the strip of metal emerges from the quenching fluid, and before it is formed into a pad or roll by the take-up mechanism, it may be passed through a cleansing solution contained in a suitable tank, wherein the scale would be continuously removed from the annealed portion as the strip passed through the solution. The process of removing scale would thus be applied to the stock instead of to the metal parts as in previous processes.

The proper heating of the metal is dependent upon three variables, each of which may be easily controlled to produce optimum results. The three variables are voltage, pressure and time. The heat produced by the electrical current is a function of the voltage, which may be controlled in any suitable manner, such as at the line to which the primary of the transformer is connected, or at the transformer itself. The pressure exerted by the rolls on the metal may be controlled and adjusted by the means shown in Figs. 1 and 2, and previously described. The linear speed of the strip, which is the time variable, is of considerable importance, since overheating or underheating may result from improper speed regulation. The speed of the strip may be regulated in any convenient manner, such

as by controlling the speed of the motor 49. By proper regulation of the variables, the desired conditions of quality, economy and minimum operating time may be attained.

It may be found desirable to cleanse the strip material before annealing, in order to remove any foreign materials which might be present in sufficient quantity to constitute a high resistance in the electrical circuit. The cleansing could be accomplished placing a tank similar to the tank 11 in the path of the strip 10, and causing the strip to be drawn through the tank before it enters the tank 11. Any suitable cleansing solution could be placed in the tank to envelop the strip and dissolve or wash away the foreign materials.

While the apparatus and process have been described as applicable particularly to continuous strip material supplied in rolls, it will be apparent that they are applicable to such material supplied in other forms, such, for example, as straight lengths capable of convenient handling. Many other modifications and combinations and arrangements of apparatus and process may be employed within the scope of the appended claims. It is to be especially noted that while the process has been described as applied to the annealing of nickel silver, it may be applied equally to tempering ferrous strips since it is essentially characterized by the alteration of the molecular structure of a portion only of the strip treated.

What is claimed is:

1. A method of manufacturing metal articles which comprises passing a strip of metal stock longitudinally thereof between opposed electrical contact members touching the strip at opposite sides of the same portion only and extending over only a portion of the width of the strip, simultaneously passing an electric current through the contact members and the portion of the strip therebetween only whereby only the portion of the strip between the contact members is heated, and simultaneously maintaining the contact faces of the members and the portion of the strip therebetween immersed in a quenching liquid whereby the heating effect of the electric current on the strip is confined to substantially the portion of the strip between the contact members and whereby the heated portion of the strip is immediately quenched.

2. A method of manufacturing metal articles which comprises passing a strip of metal stock through a quenching bath longitudinally of the strip and simultaneously passing an electric current through opposed contacts touching from opposite sides a portion only of the strip submerged in the bath and narrower than the width of the strip, whereby the strip is continuously heated and immediately quenched to be molecularly altered over a part only of the width thereof.

3. A method of manufacturing metal articles which comprises passing a strip of annealable hardened metal stock through a quenching bath longitudinally of the strip and simultaneously passing an electric current through opposed contacts touching from opposite sides a portion only of the strip submerged in the bath and narrower than the width of the strip, whereby the strip is continuously heated and immediately quenched to be annealed over a part only of the width thereof.

4. A method of manufacturing metal articles which comprises passing a strip of temperable soft metal stock through a quenching bath longitudinally of the strip and simultaneously passing an electric current through opposed contacts touching from opposite sides a portion only of the strip submerged in the bath and narrower than the width of the strip, whereby the strip is continuously heated and immediately quenched to be tempered over a part only of the width thereof.

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