

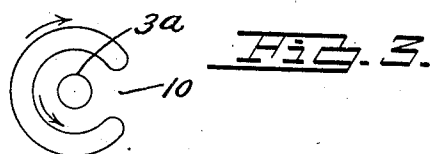
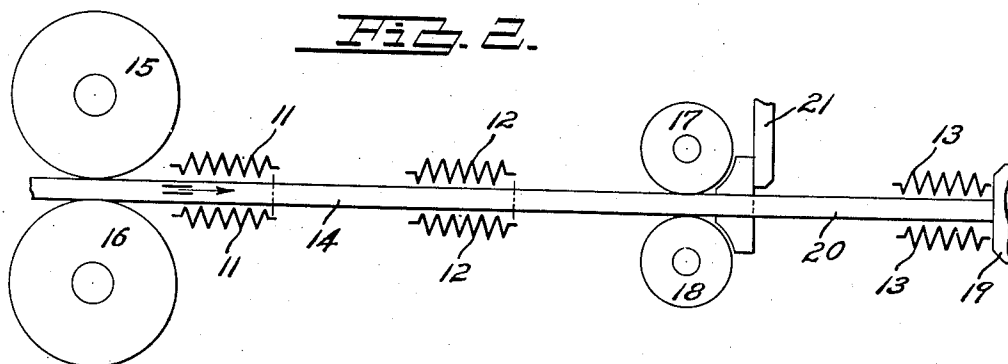
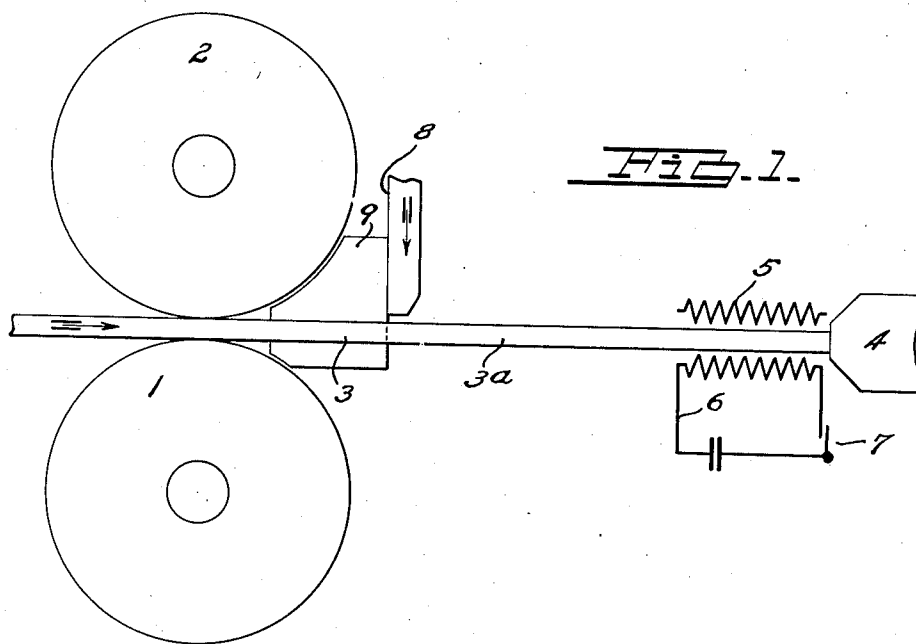
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METHOD OF FORMING OR WORKING METAL ELEMENTS

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METHOD OF FORMING OR WORKING
METAL ELEMENTS

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This invention relates to a process for the forming or working of metal elements, as for instance, in the making of cap screws, bolts, studs and the like from rod or wire stock. It has been commonly the practice to head or otherwise shape screw blanks, bolts, studs and the like by forging the same while cold, which forging has usually been performed by a series of steps and oftentimes the formed portion tends to fracture resulting in considerable loss of material and further requires several sets of dies to which the blanks are successively brought and gradually shaped to final form. One such prior structure is illustrated in the U. S. patent to Burbank, No. 1,892,445 of Dec. 27, 1932. Furthermore, in hot forging of such articles as has previously been done, there is considerable time lost in submitting the portion of the article to be forged or worked to the heat of a furnace from which it is manually removed to a forging machine provided with the proper dies to shape the article which results in considerable labor cost.

By my improved process wherein articles are formed from rod or wire stock of the desired shape in cross section, the rod is fed into a high frequency induction coil wherein it remains for the period of time required to heat the part to the desired depth for the character of work to be performed thereon, the rod then being severed to provide desired lengths of slug and passing the heated slug to the machine for working the heated portion of the same.

These and other features and objects of the invention are hereinafter more fully described and claimed and the preferred means for and method of heating metal articles preparatory to the forming and shaping step is shown in the accompanying drawing in which—

Fig. 1 is a diagrammatic view illustrating the arrangement of parts for heating a portion of the work piece to be severed from a rod for a subsequent forming operation.

Fig. 2 is a diagram showing the arrangement of parts for heating a portion of a rod at several spaced points whereby, in movement of the rod, a portion thereof requiring to be shaped may be heated in stages whereby the said portion thereof may be heated to a higher degree of temperature than is secured by the arrangement shown in Fig. 1.

Fig. 3 is a diagrammatic end view of the heating coil.

No attempt is here made to show the machine proper. It is, however, usual in such machines

to provide a means, such as the opposed rollers 1 and 2 of Fig. 1, for intermittently feeding a rod 3 forwardly, in the direction of the arrow shown, with the projecting end of the rod engaging a stop 4. If it is desired to heat the end of the rod, the coil 5 of a high frequency circuit, diagrammatically indicated at 6, is positioned to receive the end of the rod projected thereinto by the rolls into engagement with the stop 4.

The circuit is preferably intermittently energized and de-energized at the proper time. I have here shown a manually operable switch for opening and closing the circuit through the coil inasmuch as the process is not confined to the specific character of the mechanical elements. I have also indicated a reciprocable cutter 8 adjacent the rolls which cooperates with a holder 9 in the usual manner and is movable in the direction of the arrow on the cutter 8 to sever a slug from the stock. Assuming that a slug has been cut from the stock, the end of the rod would be at the right hand end of the shear block 9. The rolls are then operated to move the rod 3 in the direction of the arrow and, prior to the end of the rod entering the end of the coil 5, the circuit is closed thereby heating the end of the rod as it moves into the coil to engagement with the stop at which time the slug 3a is severed from the rod and moved therefrom to the machine for heading or otherwise working the heated portion. The heating thereof is localized and, due to the use of a high frequency induction coil, the heating is very rapid thereby softening the metal to a depth determined by the period of heating. The slug may then be worked more readily than is the case with the cold heading process without danger of fracture and without necessity of submitting the slug to several forming steps to secure the final shape. It is further pointed out that the heated portion of the slug may be submitted to a threading operation by rolling the same between threading dies subsequent to heating and severance from the rod 3.

The previous method of threading the slug by rolling the same between threading dies has heretofore been performed when the part is cold. By performing the step of threading while the portion to be threaded is comparatively soft, the threading can be performed more rapidly and with less liability of weakening the parts by displacement of the molecules than is the case with the cold rolling process. For the performance of the method as above described, the coil has an open side 10 slightly greater in width than the diameter of the slug 3a positioned centrally

therewithin as shown in Fig. 3. This arrangement permits the severed slug to be moved laterally from the coil for the working step, that is, either threading or heading or otherwise shaping the heated portion.

Some operations require heating to a greater degree than is provided for in the arrangement shown in Fig. 1 except that it is possible to maintain the circuit and coil 5 energized for a sufficient period to secure the desired depth to which the slug is heated. Such arrangement would require a greater time period during which the slug is in the coil and therefore reduce the number of pieces produced per time period.

To increase the number of pieces per time period the heating may be accomplished by the arrangement shown in Fig. 2 wherein is shown a series of coils 11, 12 and 13, each of the same character as that heretofore described and arranged in longitudinally spaced relation on the rod 14 which may be fed in the direction of the arrow by rolls 15, 16 and rolls 17 and 18 to engagement with the stop 19.

The slug shown at 20 may be severed by the cutter 21 as above described relative to the cutter 8 of Fig. 1. The coil 13 is at the end of the rod to be heated and the coils 12 and 11 are positioned on the rod in such relation that these coils are heating a portion of the rod that will finally be introduced into the coil 13. The rod is moved step by step by the rollers, there being sufficient pause between the steps to permit the severing of the end slug, as for instance 20, from the rod at the final heating step. Thus the heating may be performed in a single or a series of steps depending largely upon the diameter of the stock and the extent to which it is desirable to soften the material prior to passing the same to a device for forging or otherwise working the slug. There are many articles to be formed from rod stock wherein the portion to be formed is between the ends thereof, as for instance, to make an enlargement on the central portion of the rod or slug. In any case the coils are positioned to heat the portion of the slug to be forged and shaped.

Machines commonly in use for forming various articles, as above mentioned, from rod or wire stock are partially, if not wholly, automatic in operation and such machines could be adapted to utilize my improved process by provision of the proper coils and thus adapting the same for heating the work pieces or slugs preparatory to a subsequent forming operation.

The process, however, is not confined to the formation of articles from rod stock. Many sheet metal parts, for instance, in shaping to the required form in a press are of such character that unusual strain is imposed upon the piece at certain points. The invention herein disclosed may be used for such an article as the metal sheet to be passed to the press for shaping may have such portions thereof subject to an undue strain first passed through a coil or coils to thereby heat such areas just as the parts are passed to the press. The softening of such treated portions of the metal sheet permits the metal to more readily flow in the formation thereof and thus prevent fracture which might otherwise occur in the forming operation.

The process as hereinbefore described is superior to the previous processes in which the parts are heated in a furnace and then forged, which former method is productive of a scale that is troublesome in forming the same in dies.

My improved method does not result in surface scaling of the heated parts due to the practically instantaneous heating of smaller articles such as screw and bolt blanks and the like and inasmuch as the heated part projects from the holding die, used in the forming step, it is the unheated parts that fit in the die.

It is further pointed out that blanks and various articles to be formed do not require normalizing as is now commonly the case as by the method herein described the heating of the part to be formed is, for articles of the size of such blanks, about one second and thus there is no opportunity for scale to form as the part is immediately submitted to the forming operation. Upon completion of the forming step the part may be dropped into an oil bath and therefore normalizing and heat treating are incident to my improved process.

Furthermore, my improved method has another desirable result as the article to be formed is only heated for a distance from the surface inwardly. This is of particular value in the formation of threaded cap screws, bolts and the like as the core has not been changed in its original molecular structure. It is only the surface that has been heated and hardened by my process and therefore there is less liability of breakage because of the softer core.

While I have shown an open sided coil of a high frequency alternating current circuit such form of coil is desirable where it is necessary to remove the article laterally from the coil for a subsequent forming operation, as is the case with screw blanks, bolts and the like, hereinbefore mentioned. Insofar as the process is concerned, however, other forms of coil may be used, such as a coil having separable parts to permit introduction of a metal piece therewithin.

Other means, within the spirit and scope of this invention, may be provided for the localized heating of a metal piece by flow of inductive high frequency current through the metal. In any case the heating is caused by the motion of the molecules in the attempt to arrange themselves in relation to the polarity of the magnetic field which is being reversed several thousand times a second thereby causing friction between the molecules and generating heat. Therefore it is to be realized that many changes, within the spirit and scope of the invention as defined by the appended claims, may be made in the arrangement and structure of the parts of the circuit to cause the hysteretic action which penetrates successively from the outer surface inwardly of the metal, layer by layer, to a depth determined by the time period the metal is subjected to such action and the frequency of alternation in the current.

Having thus briefly described my new and improved method for preparing metal elements for the forming or shaping operation, what I claim and desire to secure by Letters Patent of the United States is—

1. In apparatus for heat treating blanks to be cut from rod stock for the subsequent formation of articles, a series of high frequency coils of equal length arranged in axial alignment and in equi-spaced relation through which the stock is moved, a stop against which the end of the stock engages, a heating coil at the stop into which the end of the stock is introduced, a cutting means for severing the stock at the unheated portion thereof adjacent the coil at the stop, and means for moving the stock step by

step between the cutting operations to bring successive portions thereof to the cutting means, the series of high frequency coils being spaced apart a distance greater than the portion thereof to be heated by the coils and the parts being so arranged that the portion of the rod heated by the first coil of the series is submitted to the heating operation by the remaining coils of the series including the heating coil at the stop and the cutting operation is performed on the unheated portion of the stock.

2. In an apparatus for heat treating blanks to be cut from rod stock for subsequent formation of articles, a series of high frequency induction coils arranged in axial alignment and in equi-spaced relation through which the stock is passed, means for feeding the stock step by step to position the portion of the stock heated by the first of the series of coils to a heating operation at each of the remaining coils of the series, means for cutting the stock, a stop against which the end of the stock is moved, a coil positioned about the stock from the end engaging the stop toward the cutter, the arrangement of the coils being such that the stock in the coil at the stop has been previously submitted to heating by the series of equi-spaced coils, and the cutter being positioned to sever the stock at an unheated portion thereof between the coil at the stop and a succeeding portion of the stock heated by the preceding series of coils.

3. In apparatus for heat treating blanks cut from rod stock for subsequent formation of articles, a series of high frequency coils arranged in axial alignment and having similar ends thereof spaced a distance apart approximately equal to the length of the blank to be cut from the end

thereof, a cutter across which the stock is movable, a stop beyond the cutter, a high frequency coil about the stock into which the rod is passed to engage the stop, the cutter being positioned to sever the stock at the unheated portion adjacent the coil at the stop.

4. In apparatus for heating rod stock to provide blanks for subsequent formation of articles, a series of high frequency coils arranged in axial alignment and having similar ends thereof spaced a distance apart substantially equal to the length of the blank to be cut therefrom, a cutter to which the stock is fed, a stop at a distance from the cutter substantially equal to the said spacing of the ends of said series of coils, and an open sided high frequency coil at the stop into which the portion of the stock previously heated by the said series of coils is positioned and wherein the portion of the stock within the coil is brought to desired final temperature previous to being severed from the stock, the position of the cutter being such that the stock is severed at a point unheated by the coils, and the open sided coil permitting the heated blank to be withdrawn laterally therefrom.

5. In apparatus for heating rod stock to provide blanks for the subsequent formation of articles, a cutter across which the stock is movable step by step, a stop against which the end of the stock is moved at each step, a high frequency coil at the stop for heating the end of the stock for a distance from the stop toward the cutter and providing an unheated portion extending from the end of the coil to the cutter free from scale and unchanged in molecular structure.

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