July 30, 1935. H. F. KULAS ET AL 2,009,737

APPARATUS FOR PRODUCING AUTOMOBILE FRAME SIDE RAILS AND ANALOGOUS DEVICES

Filed April 14, 1932

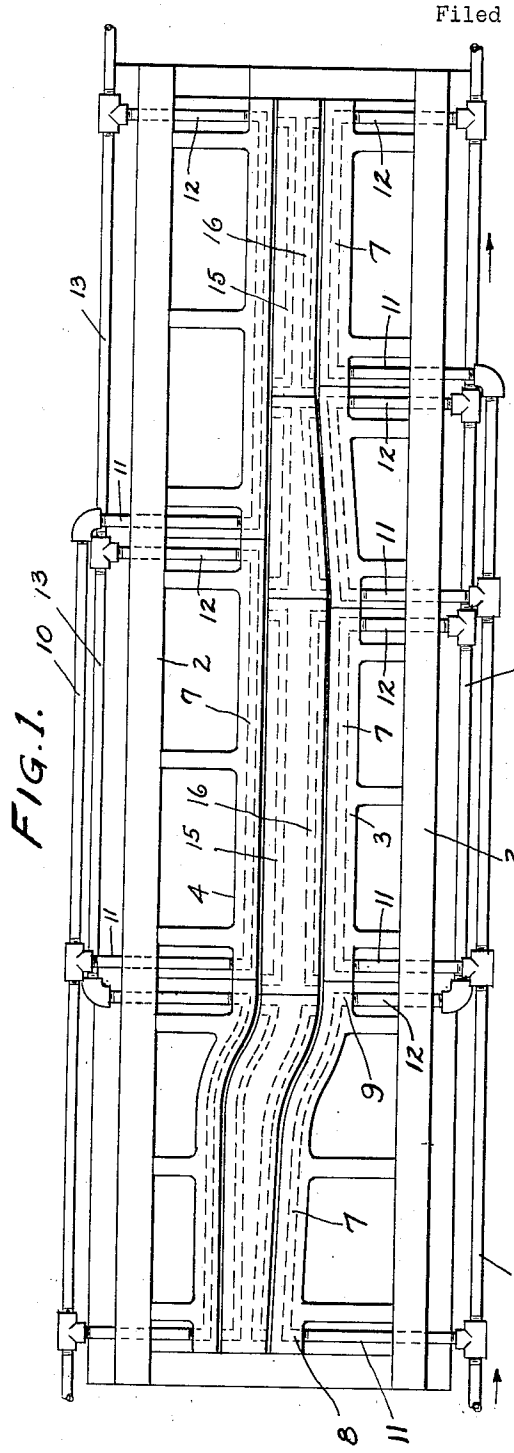


FIG. 1.

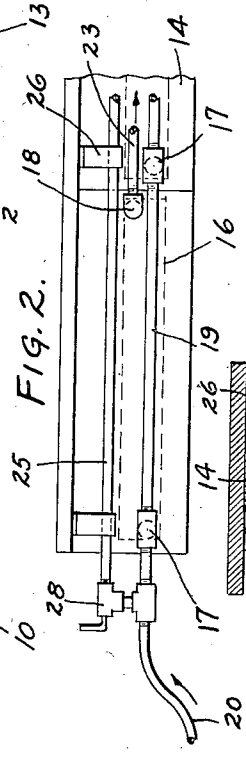


FIG. 2.

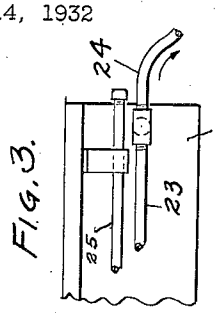


FIG. 3.

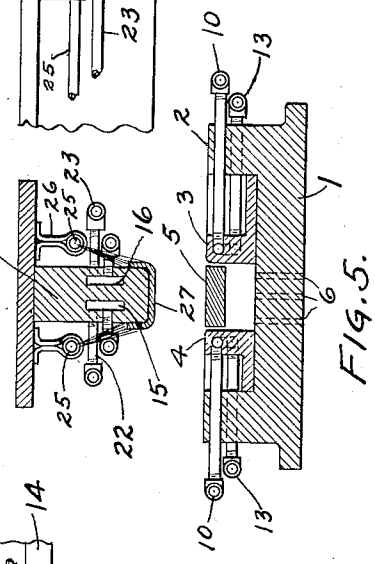


FIG. 5.

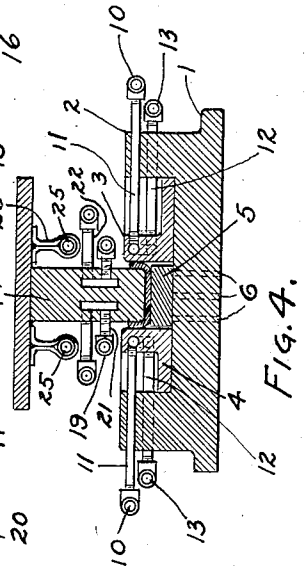


FIG. 4.

INVENTORS
HOWARD F. KULAS
JAMES H. CROWE AND
RUDOLPH H. THOMS

BY Louis W. Helmuth ATTORNEY

Patented July 30, 1935 2,009,737

UNITED STATES PATENT OFFICE

2,009,737

APPARATUS FOR PRODUCING AUTOMOBILE FRAME SIDE RAILS AND ANALOGOUS DEVICES

Howard F. Kulas, James H. Crowe, and Rudolph H. Thoms, Lakewood, Ohio, assignors to The Midland Steel Products Company, Cleveland, Ohio, a corporation of Ohio

Application April 14, 1932, Serial No. 605,210

6 Claims. (Cl. 153—48)

This invention relates to new and useful improvements in apparatus for producing automobile frame side rails and analogous devices.

An important object of the invention is to provide apparatus for producing channel-shaped automobile frame side rails which possess comparatively high elastic limits and percentages of elongation and which do not require the expensive and laborious straightening incident to heat treatment.

Another important object of the invention is to provide means for cooling the rails while they are held confined against movement to preclude distortion or deflection.

A further object of the invention is to provide apparatus in which the normal structure of steel possessing comparatively high elastic limits is maintained throughout the operation thereon and in the finished product and is not left in the unstable and temperamental state which is a necessary incident and condition existing in heat treated rails. Moreover, with the apparatus the rails are formed hot and there is no danger of plastic distortion of rails at the juncture of the web and flanges thereof such as will occur in some grades of steel when the side rails are formed cold.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the accompanying drawing forming a part of the description and wherein like numerals are employed to designate like parts throughout the several views,

Fig. 1 is a top plan of the bed of a punch press illustrating the improvements applied thereto,

Fig. 2 is a side elevation of a portion of the improved punch,

Fig. 3 is a similar view of the opposite end of the punch,

Fig. 4 is a vertical transverse section of the bedplate and punch showing the position of the parts when the punch is lowered into the die during the forming operation, and,

Fig. 5 is a similar view illustrating the punch in elevated position for removal of the work.

In the past few years a very definite demand has arisen for light gauge heat-treated automobile frames, especially those used in modern heavy trucks and busses. The side rails of such frames range from twenty to forty or more feet in length and are of the usual channel shape cross section. Heat treatment of these rails boosts the elastic limit thereof but has the effect of lowering the percentage of elongation. However, this heat treatment of the exceedingly long side rails has a very serious drawback from the standpoint of manufacture since it causes or promotes all manner and form of bending, warping, twisting and distortion in the rails, requiring difficult and costly processes of straightening, after heat treatment and sand blasting. Under this practice as disclosed in an article entitled "Treats Alloy Steel Side Frames" in the July 1930 issue of "Steel" it is the custom to work with low carbon steel plates not exceeding a percentage of 0.30 carbon so that the plates can be cold formed to the requisite shape and channel cross section without danger of being weakened by cracking. As stated in this publication, the plates are first annealed in a forty foot, oil-fired, car type furnace, equipped with automatic pyrometer control. In this furnace the plates are brought up gradually over a period of 18 hours to a temperature of 1550° F. and are then held at that temperature for 8 hours more. After they are cooled down in the furnace to 600° F., they are taken out and cooled in the air to room temperature. Obviously, this mere step of annealing the plates consumes a great amount of time and is only the initial step in a long and tedious method.

After the plates have cooled down to room temperature, they are formed cold into channeled rails after which they are heated up to 1550° F. in the heat treating furnace and quenched by plunging up and down while unrestrained against distortion in an oil bath at about 140° F. Thereafter the rails are drawn at a temperature ranging from 900° F. to 1100° F. depending upon the carbon and alloy content of the steel. After the draw, the rails are air-cooled and sand-blasted and in their warped, twisted and deformed condition must be subjected to a difficult process of straightening to render them usable. This straightening of a single side rail after the heat treatment and draw requires the services of four men for approximately one hour on a special straightening machine and in order to make this method a commercial production job, a battery of these special straightening machines is a necessity.

In order to reduce the time and expense required in the annealing, heat treatment and straightening operations and at the same time produce rails having as high or higher elastic limits and percentages of elongation as those produced by older processes, it has been discovered that all of this can be accomplished by the use of different steel and by a different meth-

od of manufacture. In carrying out this new method, any of a number of different kinds of steel may be employed, depending upon what elastic limits and percentage of elongation are desired. By way of example, it may be stated, that it has been found that by following the herein disclosed method of manufacture, that S.A.E. 1360 steel containing

Carbon	.55 – .70
Phosphorus	.040
Manganese	.90 –1.20
Sulphur	.050

will yield a minimum elastic limit of approximately 75,000 pounds per square inch and elongation of 25 percent.

Steel of the following formula:

Carbon	.45– .50
Chromium	.40– .65
Manganese	1.1 –1.4
Silicon	.65– .90

will yield a minimum elastic limit of 90,000 pounds per square inch and a 25 percent elongation, while steel of this formula:

Carbon	.55– .65
Chromium	.40– .65
Manganese	1.1 –1.4
Silicon	.65– .90

will give a minimum elastic limit of 100,000 pounds per square inch and a 20 percent elongation.

Under the present preferred method, steel of the above formulæ or that which possesses generally similar characteristics is put into the requisite shape to produce the desired shape of side rails and is heated uniformly to a substantially low red heat, well below its lower critical range. While the degree of heating is somewhat dependent upon the structure of steel used, it is preferable that it be heated only to a heat by which it can be readily formed without any appreciable scaling when formed and under which the micro-structure of the steel is not disturbed nor internal strains set up, but in which the pearlitic condition is maintained. In other words, the structure of the steel is preferably maintained in a normal state and is not put into an abnormal or unstable state such as exists when the steel is subjected to an actual heat treatment and because of such heat treatment, might in some of its proposed uses lose some of its desirable characteristics by friction or by static or dynamic stresses. By not heating the steel beyond its transformation stage, better control during forming is attained and the steel after formation still retains its normal state.

While the foregoing manner of heating the blanks is perhaps better suited to the present day production equipment from many standpoints, it is possible that the herein disclosed method can be carried out by actually heat treating the blanks in a different manner from what has been proposed heretofore in order to prevent distortion of the rails and obviate the necessity of a subsequent straightening operation. In such event, the blanks may be heated up to a temperature of 1550° F. or the particular transformation temperature of the particular steel employed to be quenched with a coolant in a press as will be presently described. Of course, when it is proposed to elevate the temperature of the steel above its transformation stage, lower percentages of carbon and variations of the other constituents of the steel other than those hereinbefore recited may be used.

The blank in either heated condition is immediately inserted into a hydraulic punch press or other suitable forming device. The press is then operated to lower the punch down upon the blank to bend it into the die into channel shape with parallel spaced flanges. The punch is left in its lowered position firmly holding the rail in the die. According to one plan the rail is not immediately removed from the press after its formation nor is the punch elevated from the die as would be the natural expectation, but the punch is retained in its lowered position holding the blank against any possible movement between the die and punch while a coolant circulated in and about the press in a manner to be presently described, conducts heat away from the confined rail and associated press parts in a thoroughly uniform manner. The punch, die and associated bulky press parts also of themselves cooperate to some degree to the dissipation of heat in the rail. With the rail so held and restrained against any possible movement during cooling, there is no opportunity for it to warp, bend, curl or distort and it is so retained until it has cooled sufficiently to be safely handled without the possibility of the web and flanges losing their shape by warping or bending. The cooling of the blank may be hastened by circulating a coolant through the die, punch and associated parts or provision may be made for flowing a coolant in direct contact with the flanges of the rail while it is held between the punch and die or suspended by the punch when the latter is raised. In cases where the blanks are heated above their transformation stage, this later method of cooling or quenching is employed.

While the cooling of the restrained or confined side rails may be accomplished in several different ways, within or without the press and may either be by conduction, convection or both, the accompanying drawing illustrates one economical and commercially productive way of rapidly dissipating the heat without adverse effects upon the rails.

Referring now to the accompanying drawing for details, the numeral 1 designates a bed of a press having spaced parallel side rails 2 defining a space between them for the reception of dies 3 and 4 between which a vertically reciprocable ejector 5 operates for ejecting the work after being formed. Beneath this ejector, the bed plate is provided with a plurality of drain openings or passages 6 which may have suitable straining means associated therewith to prevent clogging of the holes with scale and other deleterious material.

Due to the length and shape of the side rails, the dies 3 and 4 are made up of a plurality of sections as clearly shown in Fig. 1. Each of these die sections in proximity to a portion of the rail formed thereby is provided with a longitudinally extending passage 7 terminating at one end in an inlet port 8 and at its opposite end with an exhaust port 9. A pipe or conduit 10 extends longitudinally alongside of the bedplate rails 2 at each side of the press for the conduct of a coolant of any suitable character to the two sets of dies 3 and 4. A branch pipe 11 from the conduit 10 leads to its respective inlet port 8 in the die for conveying coolant thereto. As the coolant passes along the side of the die, it absorbs heat from the die and article being formed in the press after which the coolant passes out of

each die section through a branch pipe 12 which is connected with an outlet pipe 13 extending along each side of the press to a point of discharge or return to the source to be re-cooled and circulated again through the dies. If desired, the ejector 5 may also be provided with suitable air or liquid coolant passages.

The punch or male die of the press indicated by the numeral 14 and which is adapted to enter the female die to form the side rail, is also sectional in character, each section being cored-out adjacent its side walls to provide a pair of longitudinally extending coolant passages or compartments 15 and 16. Each passage at one end adjacent the bottom thereof is provided with an inlet port 17 and at its opposite end adjacent the top thereof with an outlet port 18. A supply pipe 19 for the coolant extends longitudinally of the punch and is connected to a source of supply by a flexible conduit 20 which permits the usual movements of the punch. The pipe 19 is connected to the inlet port of various punch sections by branch pipes 21 to constantly supply the coolant to the individual punch sections. This coolant after becoming warmed circulates out of the passages 15 and 16 through the exhaust ports 18, branch pipes 22 which in turn are connected to a common exhaust pipe 23, which like the supply pipe at its end, is provided with a flexible conduit 24 to permit movements of the punch.

Coolant pipes 25 extend along both sides of the punch longitudinally thereof and are suspended therefrom by means of the brackets 26. These pipes 25 are provided with a series of apertures permitting the coolant to be sprayed down upon the dies, punch and the formed rails 27 to more rapidly cool them. These spray pipes 25 are connected to the coolant supply pipes 19 by means of valved couplings 28 so that the use of the spray pipes may be optional and the supply of coolant thereto controlled by the valve coupling 28. It is of course obvious that the branch pipes 11 and 12 may be connected with the die sections 3 and 4 by quick detachable couplings to facilitate change of dies when desired and these pipes may be readily disconnected from the rails of the bedplate. Likewise, suitable detachable connections may be provided for disconnecting the coolant circulating pipes from the punch sections.

From the foregoing description, it will be obvious that a blank, heated as above described is suitably centered upon the dies at which time the press is operated to cause the punch 14 to descend upon the blank and form it into channel-shape shown in Fig. 4. As stated hereinbefore, in cases where the blanks have been given only a low forming heat, the punch is not elevated immediately after the formation of the rail but is preferably permitted to remain in the position shown in Fig. 4 to preclude any possible movement of the rail while it is so clamped and being cooled. The cooling of the rails may be hastened by circulating coolant through the die and punch passages or by spraying the coolant from pipes 25 directly upon the rail, punch and dies or upon the rail on the punch when elevated as shown in Fig. 5. This latter form of cooling is preferably resorted to when the blanks are heated above the transformation stage as it takes the place of the quench under the heat treatment plan. After the rail has been cooled to the extent that there is no possibility of bending, warping or distortion when restraining action thereon is released, the press is operated to elevate the punch 14 and ejector 5 to eject the formed rail from the die. Due to the cooling of the rail while held between the dies, it contracts to some extent about the male die or punch 14 so as to adhere thereto when the punch 14 is elevated as shown in Fig. 5 whereby coolant from the pipes 25 can be sprayed directly into contact with the side rail and male die to more rapidly cool the same to handling temperatures. When the rail is being formed between the dies as shown in Fig. 4, it will be apparent that the upper edges of the flanges of the rail are exposed between the male and female dies so that coolant from pipes 25 may be sprayed directly into contact with the flanges while the entire rail is firmly held in formed position between the dies. Due to the fact that the blank was heated prior to forming, there is no tendency for the rail to crack or become ruptured at points where the flanges of the rail are bent from the flat blank, such as is apt to occur in certain grades of steel formed cold. Moreover, it is preferred that, the blanks to be only heated within a certain range which takes into consideration the idea of minimizing the amount of scale formed on the side rail and the maintenance of the steel structure in its normal condition.

Obviously, the herein disclosed apparatus and method not only makes it possible to obtain greater elastic limits with certain increased percentage of elongation in side rails which must be given channel shape formation, but also reduces the time incident to and the many tedious steps involved in the usual heat treatment and straightening process. Moreover, this increase in elastic limit has a tendency to increase the ductility of the steel and prevent the rail from taking on a permanent deflection or set under load, but is controlled by the component parts or structure of the steel within a range so as not to adversely affect the tensile strength of the material or its resistance to static and dynamic stresses under the proposed uses. Last, but not least, is the tremendous saving in equipment and the decrease of time required for the production of side rails resulting from practicing the herein disclosed method as compared with the laborious heat treatment and straightening process.

It is to be understood that the herein described apparatus is not limited to the production of side rails as the other component parts of the frame and analogous devices may be similarly formed and that various changes in the sequence of steps, components of the steel and their proportional parts, as well as in the method of cooling the rail after formation may be resorted to without departing from the spirit of this invention or the scope of the appended claims.

We claim:

1. The combination with a metal working press including a plurality of sectional die and punch members for forming heated metal into an elongated article, the sections of said members having individual coolant passages extending through the same and adapted to cool the formed metal while held against movement between said members, and common supply and exhaust means for circulating coolant through the plurality of sections.

2. The combination with a metal working press including male and female die members imparting channel form to heated metal pressed therebetween with the edges of the flanges exposed, and means for discharging coolant directly upon the formed flanges of the channel while held by the die member.

3. The combination with a metal working press

including a vertically reciprocable punch for imparting channel form to heated metal, of coolant spraying means arranged on opposite sides of the punch and movable therewith for spraying coolant directly upon the formed flanges of the channel while held by the punch.

4. The combination with a metal working press including a female die having liquid drain openings, a vertically reciprocable punch adapted to enter the die for imparting form to heated metal, of coolant discharging means movable with the punch for discharging coolant directly upon the punch, die and formed metal.

5. The combination with a metal working press including male and female dies for forming heated metal into a flanged article with the flanges exposed between the dies when the latter are in cooperative forming position, and coolant spraying means disposed to spray coolant upon the exposed flanges of the article while it is held clamped between the dies.

6. The combination with a metal working press including male and female dies for forming heated metal into a flanged article, cooling means for causing the article to contract and adhere to the male die as it is elevated, and coolant spraying means carried by the press in position to spray coolant upon the article held elevated by the male die.

HOWARD F. KULAS.
JAMES H. CROWE.
RUDOLPH H. THOMS.