This invention relates to a process and apparatus utilizable in the production of hollow tubular automotive tubular axle housings and more particularly to a system for straightening these axles without inducing therein permanent injurious strains.

It is current practice to produce automotive rear axle housings by arc welding together a plurality of components. It is inherent in such a process that the actual arc welding procedure starts and stops at approximately the same location. This progressive and asymmetric heating and welding induces in the finished structure an unpredictable shrinkage and warpage. Herefore this warpage has been corrected by cold straightening in a press. This cold straightening operation has left injurious strains which are highly undesirable in the finished product.

The instant invention has been perfected to accomplish this straightening operation in a manner which will leave a minimum of strains and which may be executed rapidly and economically by unskilled labor, and if the volume of work justifies, may be completely automatic.

This invention will be explained in connection with the figure of drawing in which a rear axle housing is generally indicated by the numeral 10. This axle housing is supported upon centers 11. It will be noted that this axle comprises a banjo shaped inner portion 12 and a pair of tubular portions 13 terminating in a pair of flanges 14.

The first step in the straightening operation is to support axle housing 10 between centers 11 applied to flanges 14 and then to determine the deviation of the structure from print by measuring the location of face 15. This deviation from print will normally be determined in two planes. That is, in a vertical plane in which plane includes the axis of the housing, and a horizontal plane which includes the axis of the housing.

The operation of this invention depends upon a quick, sharply localized heating of a section of tubular portion 13. This heating is sufficiently rapid that only a small area of tubular portion 13 is affected. As this heating progresses the heated metal expands and becomes much weaker than the surrounding cool rigid metal. Consequently during the heating operation the heated metal is slightly, although significantly upset. When cooling takes place and the heated metal shrinks and rigidifies the heated portion is permanently shrunk. This causes a change in shape of the rear axle housing in a direction which will tend to compensate for this shrinkage.

It will often be found that the axle deviates from print in both planes. Under these circumstances it is possible to locate the heating zone in a manner so that one heating operation will correct the deviation in both planes. It is, of course, possible to heat in two locations and by each heating step to correct for deviation from print in that same plane.

If the rear axle housing were found to deviate from print because face 15 was distorted towards the front this distortion can be corrected by applying heat to tubular section 13 at a location in a horizontal plane which includes the axis of the housing and on the forward portion of tubular portion 13. Ordinarily in commercial usage heat would be applied simultaneously to both tubular portions 13 and at symmetrical locations. Similarly if face 15 were displaced in an upward direction heat would be applied to tubular portions 13 at a location in a vertical plane which includes the axis of the housing and at the uppermost face of tubular portions 13.

In the event the housing is distorted in both planes it is usually possible to pick an intermediate location for heating which will simultaneously correct both deviations. Due to the complex geometry of the rear axle housing these locations are best determined experimentally for each particular case. While commercially both sides of the axle will be heated simultaneously, this invention clearly contemplates the consecutive heating of each of tubular portions 13.

This heating is best applied electrically and may be done inductively, employing high frequency currents, or by direct resistance heating using ordinary commercial 60 cycle power. To use ordinary commercial power two electrodes spaced a short distance apart are placed firmly against tubular portions 13 at a location approximately half way between flange 14 and inner portion 12 and the electrodes then energized by low voltage high current source.

A typical axle housing to which this invention has been applied was found to be distorted in a vertical direction eighteen thousandths of an inch and in a horizontal direction twenty thousandths of an inch. In this case the heating was done at a location half way between the vertical and horizontal planes. Two electrodes shaped to fit the periphery of tubular portions 13 were employed to do the heating. These electrodes were spaced one inch apart and comprised of copper blocks one inch wide and one and one-half inches long as measured on the arc of tubular portion 13. These electrodes were applied to the axle housing at a location twelve and one-half inches from the flange 14 and pressed against the axle housing with the pressure of approximately 700 pounds. This pressure should be applied by clamps which apply a like pressure to the opposite side of tubular portion 13 to prevent distortion by the 700 pounds force. A current of approximately 15,100 amperes was caused to flow from one electrode into the axle housing through the axle housing to the second electrode. This current is caused to flow for a period of eight seconds, at which time the heated area was quenched with a stream of water. In this particular case only one side of the axle was treated at one time. After applying this treatment to both halves of the axle housing the deviation from print in a vertical direction was seven thousandths of an inch and in a horizontal direction five thousandths of an inch. Quenching of the heated part has not been found to be absolutely necessary but does serve to speed up the operation.

While excellent commercial results have been attained by application of the electrodes approximately halfway between flange 14 and inner portion 12, the invention is by no means so limited. The electrodes may be applied at any location intermediate inner portion 12 and flange 14 as dictated by experience. Axle housings have, for example, been successfully straightened by applying the electrodes to tubular portions 13 almost adjacent the weld joining tubular portions 13 to inner portion 12.

We claim as our invention:

The process of permanently altering the shape of a rear axle housing comprising applying a pair of closely spaced electrodes to the axle housing at a location intermediate inner portion 12 and the center of the housing, said electrodes delineating a small area on the surface of one side only of the axle housing, supporting the axle housing against dis-
placement by the electrodes, forcing the electrodes into electrical contact with the axle housing, energizing the electrodes from a low voltage, high current source, causing a localized flow of electric current by conduction from one electrode to the other through the delineated area of the axle housing, said electric current being sufficiently intense and flowing for sufficient time to locally heat the axle housing in said delineated area on one side only of the axle housing until softening and permanent deformation of the heated area occurs, and then cooling the heated area.

References Cited in the file of this patent

UNITED STATES PATENTS

2,078,746 Vasey ------------ Apr. 27, 1937
2,428,825 Arnoldy ------------- Oct. 14, 1947