J. H. TAYLOR.

PROCESS OF BENDING PIPE.

APPLICATION FILED FEB. 2, 1911.

996,163. Patented June 27, 1911.

Fig. 1.

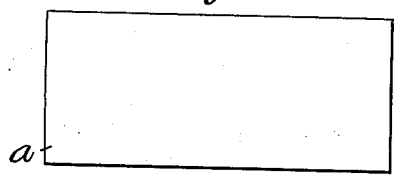


Fig. 2.

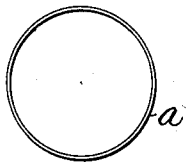


Fig. 3.

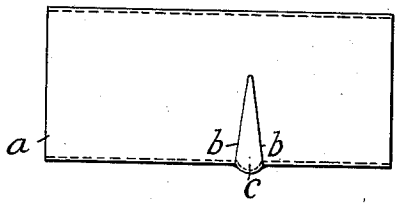


Fig. 4.

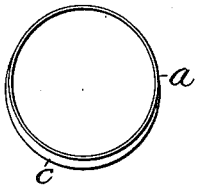


Fig. 5.

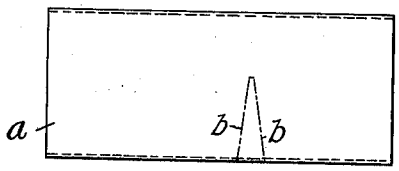


Fig. 6.

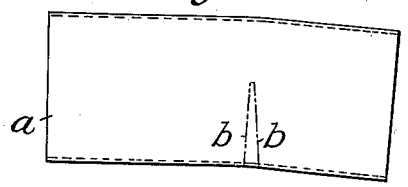


Fig. 7.

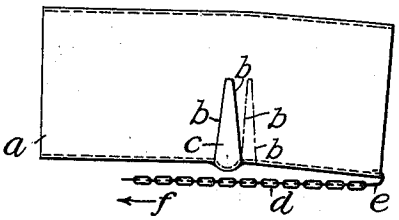


Fig. 8.

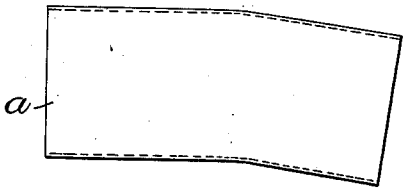


Fig. 9.

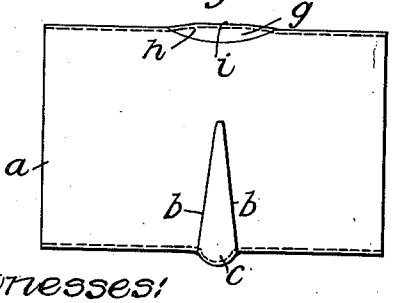
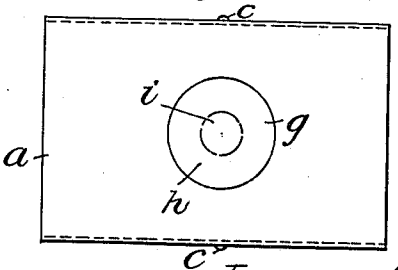


Fig. 10.



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UNITED STATES PATENT OFFICE.

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PROCESS OF BENDING PIPE.

996,163. Specification of Letters Patent. Patented June 27, 1911.

Application filed February 2, 1911. Serial No. 606,149.

To all whom it may concern:

Be it known that I, JAMES HALL TAYLOR, a citizen of the United States, residing at Oak Park, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Processes of Bending Pipe, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to wrought metal pipe manufacture and is particularly concerned with the process of bending pipe of this kind. My invention is an improved method of bending such pipe and, as will more fully appear hereinafter, is most useful in making slight or gradual bends in wrought metal pipe of comparatively large diameter.

Broadly, the process of my invention comprises a series of steps, somewhat as follows: first, heating a definite portion of the wall on one side of the pipe until that portion, by reason of its expansion under the influence of heat, buckles; then forging the bead thus formed back into the substantial line of the contour of the pipe, it being evident that such treatment will upset the metal of the heated portion so as to increase its cross-sectional dimensions; and then cooling the heated portion so that the consequent contraction of that particular portion of the wall will draw that side of the pipe together so as to bend the pipe. The action above described may be assisted by treating the other side of the pipe in a certain way, as will be described, so as to stretch the metal there, this stretching cooperating with the contraction on the opposite side to bend the pipe. If desired the bending action may be assisted mechanically and the cooling may take place naturally or be forced.

My invention will be more readily understood by reference to the accompanying drawings, in which—

Figure 1 is an elevational view of a straight section of pipe; Fig. 2 is an end view thereof; Fig. 3 is an elevational view of a section of pipe, showing the result of the first step in the process; Fig. 4 is an end view of the pipe as shown in Fig. 3; Fig. 5 illustrates the result of the next step in the process; Fig. 6 illustrates the result of the next step in the process; Fig. 7 illustrates the manner of repeating the process and of mechanically assisting the action due to the cooling; Fig. 8 is an elevational view showing the bent pipe; Fig. 9 is a view showing the manner of carrying out the additional step hereinbefore referred to; and Fig. 10 is a plan view of the section of pipe shown in Fig. 9.

It will appear that my process can be employed either to straighten a bent pipe or to bend a straight pipe. For the purposes of illustration, let it be assumed that it is desired to produce a bend of about five degrees in the pipe section *a* shown in Figs. 1 and 2. A certain area of the wall on one side of the pipe is heated. This area, as shown in Figs. 3 and 4, is bounded by lines *b*, *b*, which converge toward both ends, and extends approximately half way around the pipe, preferably a little more than half, the widest portion of this area being at that portion of the pipe which will result in the "angle" of the consequent bend. The remainder of the pipe remains comparatively cool and cannot respond by distortion to the expansion of the metal in the area referred to. It follows that this heated metal must buckle one way or the other and it has been found that it will buckle outwardly into the form of a bead *c*, extending partly around the pipe, as illustrated in Figs. 3 and 4. After the bead *c* has been formed by expansion, as has been described, it is forged back, while still hot, into the substantial line of the contour of the pipe, as illustrated in Fig. 5. It is evident that the lines *b*, *b*, will remain the same as in Fig. 3 and that the metal bounded by these lines will be in a hot, expanded condition. As this heated portion is allowed to cool, it will, of course, contract and the lines *b*, *b* will be drawn together as illustrated in Fig. 6 and, since these lines bear definite relations to the main portions of the pipe, it is evident that the pipe will be bent under the influence of the pull due to this contraction and that the contracted area will lie in the "angle" of the bend. This cooling may be hastened under the influence of a spray of water or some other similar means, if desired. The bend which is secured by each cycle of operations, as above set forth, is slight and if a considerable bend is desired, this cycle must be repeated. The manner of doing this is illustrated in Fig. 7 where a bead like that shown in Fig. 3 is

formed near or adjacent to the area of metal which has already been acted upon, the bead being in line therewith. It is apparent that if this process is repeated several times, any desired bend, such as shown in Fig. 8, may be obtained. When the bead is formed, due to the heat, it may be increased mechanically, for instance by means of a jack from which a chain *d*, having a hook *e*, extends, this hook being caught in the end of the section of pipe, as illustrated in Fig. 7, and a pull being exerted thereon in the direction of the arrow *f*.

In Figs. 9 and 10 I illustrate the additional step which may be employed and which is particularly useful in connection with pipes of larger diameter. This additional step provides means for stretching the metal on one side of the pipe so that the contraction on the other side may be assisted. The bead *c* shown in Fig. 9 is analogous to the bead *c* of Fig. 3. Opposite this bead, an area *g*, as clearly illustrated in Fig. 10, is heated. This heating, of course, causes the expansion of the portion *g*, and this assists the free contraction at the opposite side of the pipe. A cooling jet of air or water is then played upon the central spot *i*, approximately, and it has been found by experiment that this cooling prevents the metal from returning to its former state. Stretching takes place and the ultimate cross-section of the metal of the portion *g* is slightly but negligibly reduced.

I claim as new and desire to secure by Letters Patent:

1. The process of bending pipe, which consists in heating a definite portion of the wall on one side of the pipe until it buckles, then forcing the buckled portion back into the substantial line of the contour of the pipe so as to upset the heated metal, and then allowing the pipe to cool.

2. The process of bending pipe, which consists in heating a definite portion of the wall on one side of the pipe until it buckles, then forcing the buckled portion back into the substantial line of the contour of the pipe so as to upset the heated metal, and then cooling said heated portion.

3. The process of bending pipe, which consists in heating a portion of the wall on one side of the pipe until that portion buckles, then forcing the buckled portion back into the substantial line of the contour of the pipe so as to upset the heated metal, and then cooling said heated portion.

4. The process of bending pipe, which consists in heating a definite portion of the wall on one side of the pipe until it buckles, then mechanically bending the pipe slightly to increase the buckle, then forcing the buckled portion back into the substantial line of the contour of the pipe so as to upset the heated metal, and then cooling the pipe.

5. The process of bending pipe, which consists in heating a portion of the wall on one side of the pipe until that portion buckles, heating an area on the other side of the pipe, forcing the buckled portion back into the substantial line of the contour of the pipe so as to upset the metal of that heated portion, and then cooling said portion and also the said area from the center outwardly.

In witness whereof, I hereunto subscribe my name this 30th day of January, A. D. 1911.

JAMES HALL TAYLOR.

Witnesses:
ARTHUR H. BOETTCHER,
ALBERT G. MCCALEB.