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METHOD OF MAKING BENT PIPE ELEMENTS

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Fig. 1

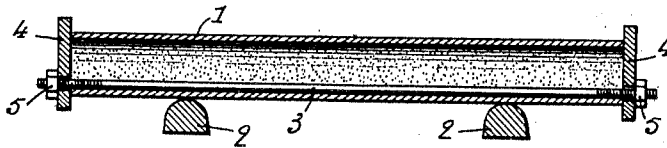


Fig. 2

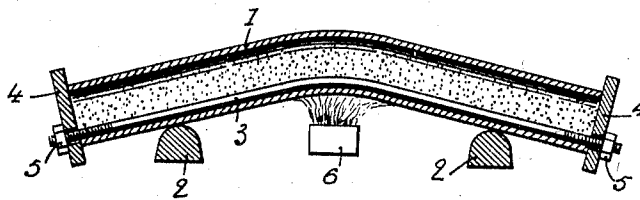


Fig. 3

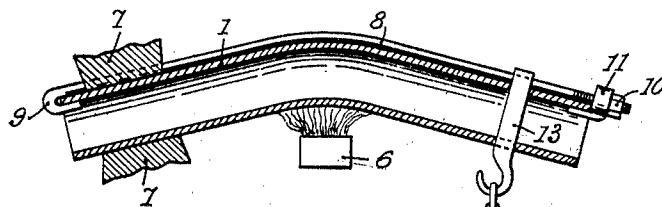
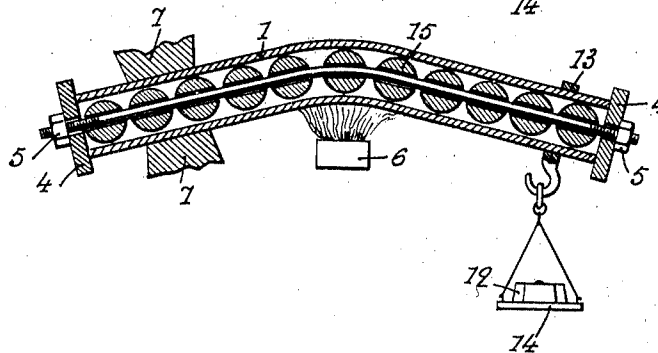


Fig. 4



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METHOD OF MAKING BENT PIPE ELEMENTS

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6 Claims. (CL 29—157)

It is known to make bent pipe elements by casting molten metal or alloy in moulds having the shape and approximately the size of the elements to be produced; such elements are thus obtained with their definite general form.

It is also known to make straight elements or pipes by casting the metal or alloy in moulds, metallic or not, having a movement of rotation on their axis. It is a known fact that this centrifugal casting process, which is followed, if necessary, by a thermic treatment of the elements, modifies the texture and the structure of the metal or alloy, and that it imparts special qualities to the said pipes; thus for cast iron pieces, the resistance to mechanical stresses of all kinds is considerably increased.

According to one feature of the present invention, bent pipe elements are manufactured in making straight pipe elements by centrifugal casting and bending said elements in the hot or cold state to the desired shape.

This bending operation should obviously be carried out according to a proper art in accordance with the intrinsic properties of the metal or alloy of which the pipes are composed; thus the bending of centrifugated cast iron pipes may, according to the invention, be preceded by a treatment by which the metal is made malleable, this being limited to the portion of the pipe which is to be shaped, or even applied to the entire element.

On the other hand, and according to a further feature of the present invention, in the case of cast iron or of similar metals or alloys which in the cold state are not adapted to receive a permanent deformation and which in the hot state will pass too rapidly from the solid to the liquid state to allow a shaping to be effected in the pasty state by the usual methods, the bending in the hot state can be effected by subjecting the pipe, during the operation, to a longitudinal compression which is adapted to prevent all undue stresses and all deformation in the parts of the pipe which, without this compression, would be subject to a traction stress and thus to an elongation which is incompatible with the nature of the metal or alloy.

The said process thus permits the production of curved or bent pieces, which have the same advantages as the straight pieces or pipes, as concerns the mechanical or other properties given to the metal by the centrifugal process, and if necessary, by any consecutive treatments.

The invention also consists of the curved or bent pipe elements, obtained by this process.

Further characteristics of the said invention will be set forth in the following description.

In the accompanying drawing, which is given solely by way of example:

Fig. 1 is a diagrammatic sectional view, before the bending, of a device adapted for use for the hot bending of a straight pipe, this bending being accompanied by a simple compression of the region of the pipe which is to be situated in the interior of the band.

Fig. 2 is a similar view, after the bending.

Fig. 3 is a diagrammatic sectional view of another device for hot bending, comprising a means for the local strengthening of the part which is to be located at the outside of the bend, and permitting of exerting simultaneously a general bending force upon the piece.

Fig. 4 is a diagrammatic sectional view of another bending device which permits of exercising simultaneously upon the piece a general bending force and a general compression force.

In the embodiment shown in Figs. 1 and 2, the pipe 1, consisting of cast iron of a like metal or alloy, which is obtained in the straight form by the centrifugal process, is laid upon two blocks 2. The generatrix which is to be located in the internal portion of the bend is situated at the lower part of the pipe. There is inserted into the pipe, near its lower generatrix, a rod 3, for instance of steel, which is adapted to support a considerable force of traction. Its two ends are threaded, and pass through two discs 4, mounted on the respective ends of the pipe 1. Two nuts 5 are screwed upon the rod 3 and are well screwed down in order to effect, through the discs 4, a compression of the lower part of the pipe.

At the same time, there is placed under the pipe a heating device, which may consist of a gas burner 6 which is so mounted and regulated as to especially heat the lower part of the pipe.

As soon as a proper temperature is attained and the force of compression is sufficient, the pipe will slightly bend in the upward direction, as shown in Fig. 2, for, owing to the compression due to the rod 3, the lower generatrix will shorten, while the length of the upper generatrix will remain practically unchanged. During the progress of the heating, and of the screwing of the said nuts, the curvature becomes greater.

The same result can be obtained, according to the modification shown in Fig. 3, by another method of operation. The pipe 1 is held at one end between two jaws 7. The upper generatrix of the pipe is reinforced by a rod 8 which is straight at the beginning. The said rod bears

at one end upon the end of the pipe by means of a hook 9; its other end is threaded and carries a nut 10 co-operating with a claw 11 which is in contact with the other end of the pipe.

- 5 The nut 10 is tightly screwed, in order to stretch the rod 8 and to slightly compress the upper part of the pipe. The said rod should possess on the one hand a sufficient flexibility in order that it will not interfere with the subsequent bending of the pipe, and on the other hand, a sufficient strength to prevent all excessive elongation and hence all undue traction stress upon the upper part of the pipe.

- A heating device is then placed under the lower part of the pipe, at the same time a bending stress is exerted upon the heated part, either by the weight of the free portion of the pipe, if this is sufficient, or if necessary, by suspending from this free portion an additional weight 12, for instance by means of a collar 13 and a plate 14.

- When the temperature is high enough and the bending force sufficient, the pipe will become curved, as herein represented, by the compression of the lower central region of the pipe, and the rod 8 follows this movement and has the same bend.

- In the embodiment shown in Fig. 4, the pipe 1 is held between two jaws 7. There is inserted into the interior a rod 3 which is threaded at its end and is provided with nuts 5 which exert—through discs 3—a strong compression upon the ends of the pipe. The said rod is coaxial with the pipe, and it is maintained in this position, whatever be the deformations of the pipe, by centering members 15 which are run upon the said rod and are mounted in the pipe with a certain lateral and longitudinal play.

- Use is made, as before, of a heating device placed under the part to be bent, and a bending stress is applied, either by the action of the weight of the free portion itself, or as in the preceding case, by adding to this weight the action of an additional load carried by a collar 13 and a plate 14.

- The general bending stress is manifested by local forces of traction at the upper part of the pipe, and of compression at the lower part. On the other hand, the tension of the rod 3 located on the axis of the pipe is manifested by local compression forces which are the same for all of the generatrices of the said pipe. The tension of the rod 3 is regulated in such manner that the compression forces thus produced will neutralize, at the upper part of the pipe, the forces of traction resulting from the general bending of the said pipe, and that in this manner, the upper part will not be subject to any excessive stress, and will only have an admissible elongation. At the lower part of the pipe, the general compression force resulting from the action of the traction rod 3, will on the contrary be added to the local force of compression due to the bending of the pipe, and when the lower part of the pipe subjected to the action of the burner 6 is raised to a sufficient temperature, the bending of the pipe will take place.

Obviously, the embodiments herein described are susceptible of numerous modifications.

- Thus the compression rods 3 may be replaced by chains or cables. Use may be made at the same time, of one or several cables, rods or chains, which are located at one or more points in the interior or at the exterior of the pipe for the purpose of compressing its walls. Blocks or like supporting pieces may be mounted between

the said rods, cables or chains, and the walls of the pipe, in order to reduce the local piercing stresses, and chiefly in the hot parts of the piece.

Use can also be made of means for insertion which are different from the means above represented and which may be provided with a device for changing the direction of the inserted part according to the progress of the pipe bending.

It is also feasible to produce the torque necessary for the bending, by any other known means, for instance by subjecting the pipe to a bending under axial compression which is manifested both by a general effect of compression and by a maximum bending effect in the central part of the pipe.

On the other hand, the gas burner 6 may be replaced by a row of burners, or more generally, by any other heating devices.

An interesting feature of the invention consists in carrying out an unequal heating of the pipe, in which the concave part of the bend is the most heated. Such heating is a considerable aid in the operation, as a rule. The unequal heating can be obtained either by the form or the location of the heating apparatus, or by a local cooling, for instance by a stream of air, of the part of the pipe which should remain in the least heated state. This inequality thus permits of bending, with the minimum force, the part of the pipe which is subject to compression, while reducing, as little as possible, the mechanical strength of the part which is to form the convex portion of the bend and which may be subject to traction stresses during the bending operation.

On the other hand, the process according to the invention can be applied to pipes which have been previously filled with sand or like material in order to prevent them from becoming oval-shaped. It is further possible to provide for a sufficient compression of this material by causing the tension of the longitudinal bar or bars to act partially upon it.

It is even possible, if the length of the piece to be bent is sufficient, to bring entirely upon the filling material the force of traction of the bar or bars, this force being manifested by a compression of the said material, and also, owing to the friction of the material upon the inner walls of the pipe, by a sufficient longitudinal compression of the walls of the pipe.

The sand can be replaced by a substance adapted to act upon the composition of the metal or alloy constituting the pipe, and thus to modify its mechanical or other properties. For instance, if the pipe is a cast iron pipe, the sand may be replaced by an oxidizing powder, thus obtaining, during the heating of the pipe, a more or less complete transformation of the ordinary cast iron into malleable iron, this transformation being effected before, during or after the shaping of the pipe.

Owing to the invention, it is possible to bend pipes which in the conditions of temperature of the operation have only a small possibility of deformation by elongation, but which, on the contrary are susceptible of a considerable deformation by compression.

Thus it is possible to bend—at a temperature of 650° to 680° C.—cast iron pipes having normal diameters and thicknesses, without producing any cracks or fissures and without changing the mechanical or other properties of the pipe after bending.

Obviously, the operation should be performed without abrupt action, also allowing the heated metal the time required for its deformation under the action of the forces which are brought upon it.

In this way, by a progressive displacement of the gas burner, it is possible to obtain considerable deflections which will readily attain 90° and which may exceed this value without difficulty in the few cases in which this may be useful.

It is evident that the invention provides for the construction of simple bends having dimensions, radii of curvature and angles of deflections which are determined in advance and once for all, but also of special pieces whose sizes and shape are determined in each case according to the necessities of the line of piping, of bends having a variable radius, or double bends of an S shape, compensators for expansion, worm-tubes in spiral or helical form, and in general, all plane or warped pieces of any kind.

Owing to its great flexibility of application, the process is particularly applicable to the bending of pipes in the factory or upon working grounds, according to the local necessities of the pipe-laying.

The methods above described may also be employed for bending non-centrifugated cast iron or other metal pipes, while in the case of centrifugated pipes and when the nature of the centrifugated metal (steel for instance) will permit it, any other usual method of bending may be used.

The pipe elements obtained by the methods according to the invention may be used not only as piping elements for the conveyance of fluids, but also for all other purposes.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. A method for making bent cast-iron pipe elements having smooth walls, which comprises

casting straight elements by centrifugal casting, unevenly heating the portion of said elements to be bent, the concave wall of the bend being the most heated and subjecting said elements to a bending stress.

2. A method for making bent cast-iron pipe elements having smooth walls, which comprises casting straight elements by centrifugal casting, heating the portion of said elements to be bent, and subjecting said elements to a longitudinal compression and to a bending stress.

3. A method for making bent cast-iron pipe elements having smooth walls, which comprises casting straight elements by centrifugal casting, heating the portion of said elements to be bent, and subjecting said elements to a longitudinal eccentric compression such that the concave wall of the bend will be the most compressed and to a bending stress.

4. A method for making bent cast-iron pipe elements having smooth walls, which comprises casting straight elements by centrifugal casting, heating the portion of said elements to be bent and subjecting said elements to stresses adapted to produce their bending, said stresses and the heating being conjugated so as to prevent excessive elongation of the convex wall of the bend.

5. A method for making bent cast-iron pipe elements having smooth walls which comprises casting straight elements by centrifugal casting, providing said elements with longitudinal reinforcing members arranged along the generatrices which are to constitute the convex part of the bend and adapted to prevent excessive elongation of said convex part, heating the portion of said elements to be bent, and subjecting said elements to a bending stress.

6. A method as claimed in claim 4, in which the straight elements are subjected before bending to a thermic treatment.

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