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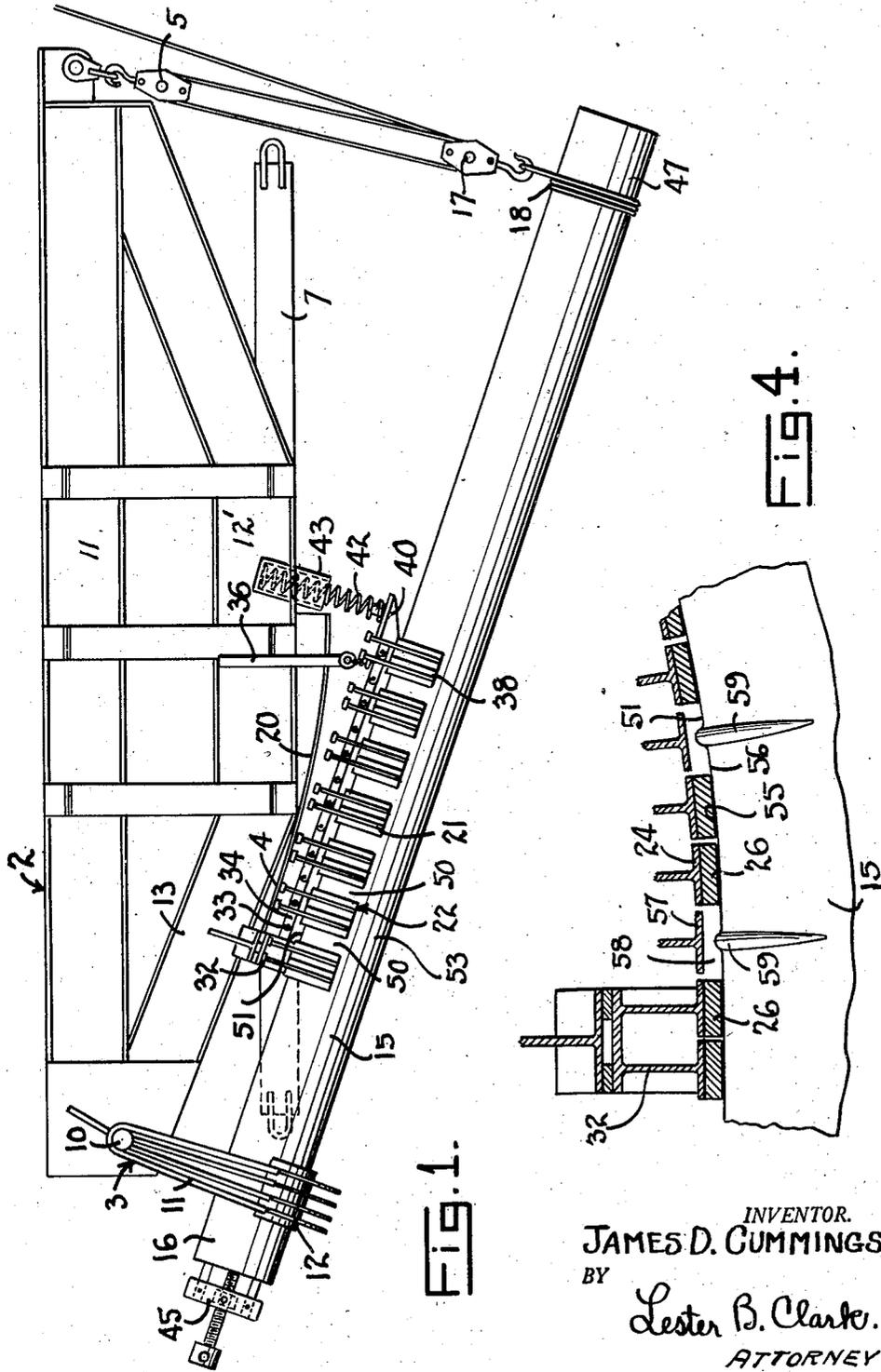
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APPARATUS FOR COLD BENDING OF LARGE DIAMETER THIN WALLED PIPE

Filed Jan. 22, 1944

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

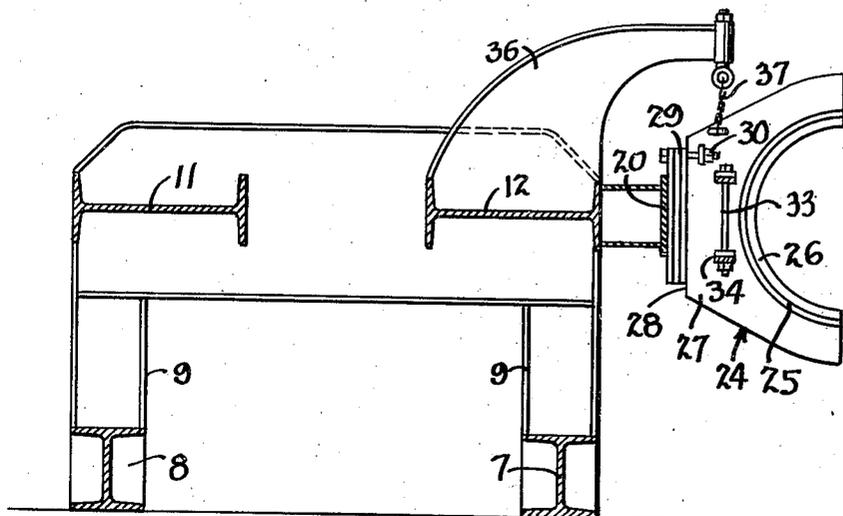


Fig. 2.

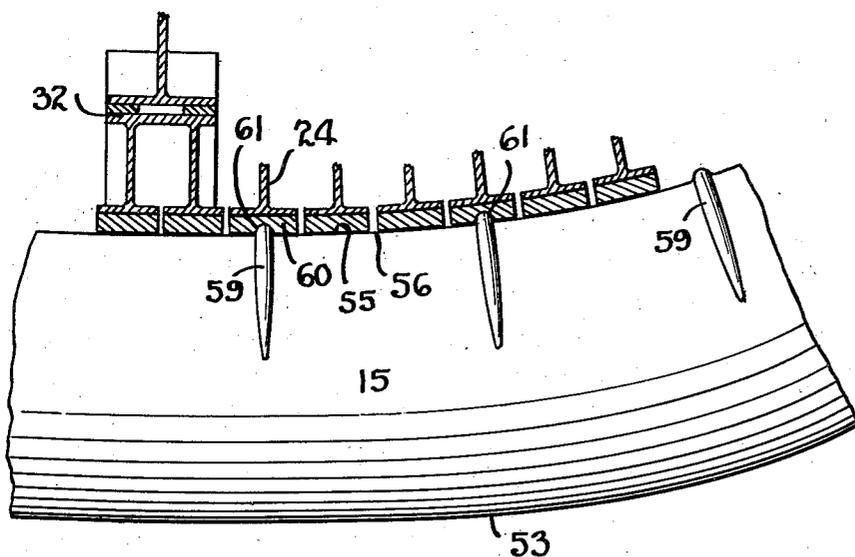


Fig. 3.

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APPARATUS FOR COLD BENDING OF LARGE DIAMETER THIN WALLED PIPE

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3 Claims. (Cl. 153—32)

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The invention relates to a method and apparatus for the cold bending of large diameter thin walled pipe in order to fit such pipe into a pipe line or other location where a curved section of pipe is required.

In the laying of pipe line it is often desirable to make bends in the pipe on location because the exact angularity of the bend, the extent thereof and other requirements may not be predictable until the pipe is being actually placed in position and it is also desirable to transport the pipe in straight lengths or sections rather than transporting pre-bent or curved sections of pipe.

The present apparatus directs itself to the bending of relatively large diameter pipe such as sixteen, twenty and twenty-four inch pipe, particularly where such pipe has a relatively thin wall; for instance, as an illustration, but not a limitation, a twenty-four inch diameter pipe having a wall thickness of one-quarter inch.

In the bending of such thin walled pipe the pipe must be internally supported to prevent its collapse on the one hand and on the other hand, it has been found that it is desirable to allow the pipe on the inside of the bend to wrinkle so as to accommodate the material subjected to compression because of the fact that the thin wall is incapable of being upset while cold as would be the case with a thicker walled pipe.

It is therefore one of the objects of the invention to provide a pipe bending machine which will permit the formation of spaced wrinkles on the inside of the bend in the pipe in order to relieve the stresses in the material.

Another object of the invention is to provide a pipe bending machine having a template and a series of pipe supporting shoes arranged adjacent thereto so that the pipe surface on the inside of the bend will be supported in such a manner as to form wrinkles in the wall of the pipe as the bending operation is performed.

Another object of the invention is to provide a pipe bending machine having an anchor for one end of the pipe, a bending section to support the area to be bent while permitting wrinkling of said areas thereof in combination with a mechanism to exert a lateral pull on the free end of the pipe so as to cause it to bend around the bending section and to wrinkle and take on the desired configuration.

Another object of the invention is to provide a series of interconnected pipe supporting shoes which support a substantial area of the inside of the bend in the pipe but permit wrinkling of

certain areas therein during the formation of the bend.

Another object of the invention is to omit certain of a series of pipe supporting shoes in a pipe bending machine so as to allow the formation of a wrinkle where a shoe is omitted.

Another object of the invention is to omit the liners on certain of a series of pipe bending shoes so as to provide an unsupported area on the inside of the bend so as to encourage the wrinkling of a pipe at such unsupported area.

Still another object of the invention is to provide a series of pipe supporting shoes for a pipe bending machine where certain of the shoes are constructed of a configuration to encourage and permit the formation of a wrinkle in the pipe.

Another object of the invention is to provide the combination of a thin walled large diameter pipe having an internal supporting jig therein and a pipe bending machine which provides unsupported areas to encourage wrinkling of the pipe on the inside of the bend during the bending operation and the method of using such equipment.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a top plan view looking down on a pipe bending machine embodying the invention where certain of the supporting shoes have been omitted.

Fig. 2 is a transverse section taken through the frame of the machine and illustrating the semi-cylindrical configuration of the shoes.

Fig. 3 is a broken horizontal sectional view through a modified arrangement of the shoes wherein some of the shoes are formed as dies to determine the configuration of the wrinkle being formed during the bending.

Fig. 4 is a broken horizontal sectional view of another arrangement of the shoes wherein the liner on certain of the shoes has been omitted to encourage the formation of a wrinkle at that location during the bending operation.

The present application is a continuation in part of my prior copending application, Serial No. 501,068, filed September 3, 1943, for a Portable machine for bending large diameter pipe, which has matured into Patent No. 2,347,593, issued April 25, 1944, wherein the general combination of the bending machine and the method are disclosed and claimed.

The machine and the pipe are shown in top plan view in Fig. 1 where the machine 2 is made

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up of suitable beams, channels and the like, arranged in rigid relationship so as to support the anchor construction 3 at one end, the pipe bending assembly 4 adjacent the center and the pipe pulling equipment 5 at the other end. The general details of this construction are disclosed in my copending application, but generally include the longitudinal beams or skids 7 and 8 by which the machine is skidded from place to place or moved in loading and unloading. These base beams carry the uprights 9 which support the top girders 11 in the rear and 12 on the front. The front girder 12' is formed with inclined end portions 13 so as to provide a rigid support for the pipe bending assembly 4. It seems obvious that this frame will be subjected to heavy stresses and it is therefore rigidly constructed.

The anchor assembly 3 includes a king pin 10 which is vertically mounted in the frame and carries the yoke 11 having a pipe holding bracket 12 thereon. As disclosed in the copending application this anchor may be mounted eccentrically to obtain adjustment to and from the frame in order to suitably support the pipe 15 and particularly the end 16 thereof which is to be anchored. In Fig. 1 the pipe 15 is shown as a straight section positioned in the machine preparatory to being bent by the application of a pull on the block and tackle 17 which makes up the pulling equipment 5 which is in turn connected to the pipe by a suitable cable or other hitch 18.

The pipe bending section 4 is made up of a template 20 which is shown in Fig. 1 as rigidly mounted upon the frame and would normally determine the curvature or inclination of the pipe as it is to be bent, but such template can be replaced with a template having a different curvature, it may be an adjustable template made up in sections or suitable shims or plates may be positioned upon the various shoes 21 which go to make up the series of shoes 22 which support the pipe 15.

Each shoe 21 is seen in side view in Fig. 2 and is composed of a body 24 having a semi-cylindrical surface 25 therein which is arranged to receive either the surface of the pipe 15 or a suitable liner 26. The body 24 has a vertical flange 27 thereon having a rear supporting face 28 that may contact the template 20 directly if desired, or a suitable number of shims or plates 29 of any desired thickness may be attached by the bolts 30 so as to position the pipe contacting surface at the desired distance to effect the intended bending. One end of the series of shoes will be rigidly supported at 32 on the frame 2 and the various shoes will be interconnected by the vertical bolts 33 passing through the extension lugs 34 on the sides of the flanges so that the shoes may have relatively limited movement relative to each other in order to move back against the template 20. A davit 36 supported from the frame may carry a chain 37 to connect one of the end shoes 38 for supporting it in horizontal alignment with the rigid shoes 32. An extension 40 receives the coil spring 42 mounted in the guide cylinder 43 in the frame so as to normally urge the shoes into axial alignment with the straight pipe when it is positioned in the machine.

The pipe section 15 may be a thin walled pipe which would probably collapse if the bending operation were performed on the hollow pipe and no internal support provided. In order to provide support internally for the pipe a collapsible jig 45 has been shown as having been inserted in the pipe and is illustrated by a portion

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projecting from the pipe. Such internal jig may take the form of the jig disclosed in my prior copending application, but is preferably of the type shown in my copending application Serial No. 521,722, filed February 10, 1944, issued May 28, 1946, as Patent No. 2,401,052, for an internal jig support for bending large diameter pipe.

Such jig will be inserted in the pipe 15 and it will then be placed in the machine by anchoring the end 16 with the anchor device 3 and hitching the block and tackle 17 and the pulling equipment to the free end 47 so that a pull may be exerted toward the frame of the machine.

As seen in Fig. 1 there are spaces 50 between adjacent pairs of shoes 22 where the inside surface 51 of the pipe is unsupported on the exterior. It seems obvious that under these circumstances that when a pull is exerted on the pipe tending to bend it first at the point of the rigid shoes 32, and with the stresses distributed along the pipe, that there will be a tendency of the inside surface 51 to wrinkle so as to accommodate the metal which is placed in compression on the inside of the bend of the pipe. The jig inside the pipe supports the outside portion of the bend 53 so as to cause the metal to be stretched sufficiently that the pipe may be bent. It seems obvious that the spaces 50 may be provided at any desired distance apart by inserting or omitting such of the shoes as may be desired. Of course, if a sharper bend is to be provided the wrinkles will be spaced closer together whereas if a slight bend is made, maybe only one or two wrinkles will be necessary in the pipe to obtain a proper bend.

A whole series of shoes has been illustrated in Fig. 1, but if desired, only the rigid shoes and the first or second pairs of shoes may be provided, a short bend negotiated, and then the pipe moved along axially of the machine and additional bends made in the pipe.

In some instances as seen in Fig. 4 the shoes 24 may be provided with the liner 26 which forms a smooth pipe supporting face 55 to bear against the periphery 56 of the pipe. As seen in Fig. 4 certain of the shoes such as 57 may have the liner 26 omitted therefrom so as to provide a space 58 in which the wrinkle 59 may form as the bending operation is accomplished. The omission of these liners is a simple matter and can be arranged as the pipe is inserted in the machine depending upon the particular bend to be imparted to the pipe and the spacing of the wrinkles desired.

Fig. 2 shows another arrangement where certain of the liners such as 60 will be of a special configuration which might be said to be in the form of a die having a depression or recess 61 therein of the contour and configuration which is desired for the wrinkle 59. In this manner the material placed under compression will flow into this recess 61 and a large or small wrinkle may be formed depending upon the type of recessed shoe or die 60 which is provided. It seems clear that if desired, every one of the liners 26 could be replaced with liners such as 60 having small grooves therein to provide wrinkles of uniform size and spacing.

Broadly the invention contemplates a means and method of bending large diameter thin walled pipe by internally supporting the pipe while subjecting it to bending and allowing the wrinkling of the pipe wall on the inside of the bend.

What is claimed is:

1. A bending shoe for pipe bending machines.

including a substantially semicircular member having an area to receive that portion of the periphery of the pipe to be bent which is on the inside of the curve or bend, a means extending radially from the back of said member to stop said shoe in pipe bending position, means on said shoe adapted for connection to adjoining shoes, and another pipe receiving area formed in said shoe to receive the pipe as it bends, said last area being spaced from said first to provide an unsupported portion whereby the pipe material may bulge thereinto.

2. A machine for the cold bending of large diameter pipe comprising a frame, a pipe anchor thereon, a pipe bending section thereon, means to exert a lateral pull on the free end of the pipe to cold bend the pipe around said section, said section including a plurality of adjacent shoes each having a pipe receiving portion to resist the thrust of the cold metal bending, a recessed area in said pipe receiving portions which permits the metal of the pipe to bulge thereinto during the cold bending to form a crescent shaped bulge on the inside of the bend to relieve the stress of the metal.

3. A pipe bending section for large diameter pipe cold bending machines, comprising a plurality of pipe bending shoes, each shoe having a pipe engaging portion, means to support said shoes to resist the thrust of the pipe being bent, a recessed area in said pipe engaging portions to accommodate the bulging of the cold metal of the pipe at the inside of the bend and shaped to permit a crescent shaped bulge.

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