April 25, 1944. J. D. CUMMINGS 2,347,593

PORTABLE MACHINE FOR BENDING LARGE DIAMETER PIPE

Filed Sept. 3, 1943 5 Sheets-Sheet 1

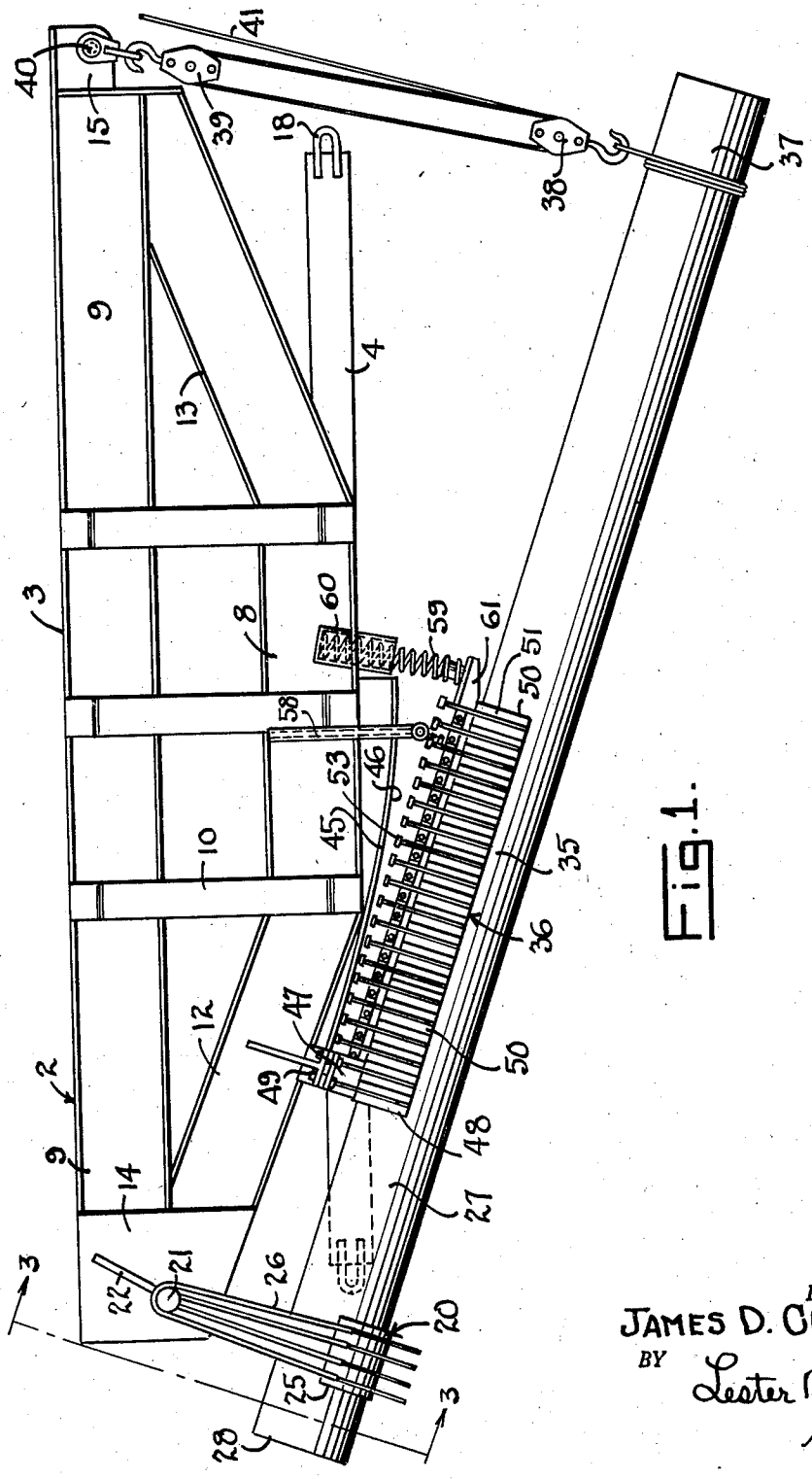

Fig. 1.

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Filed Sept. 3, 1943 5 Sheets-Sheet 2

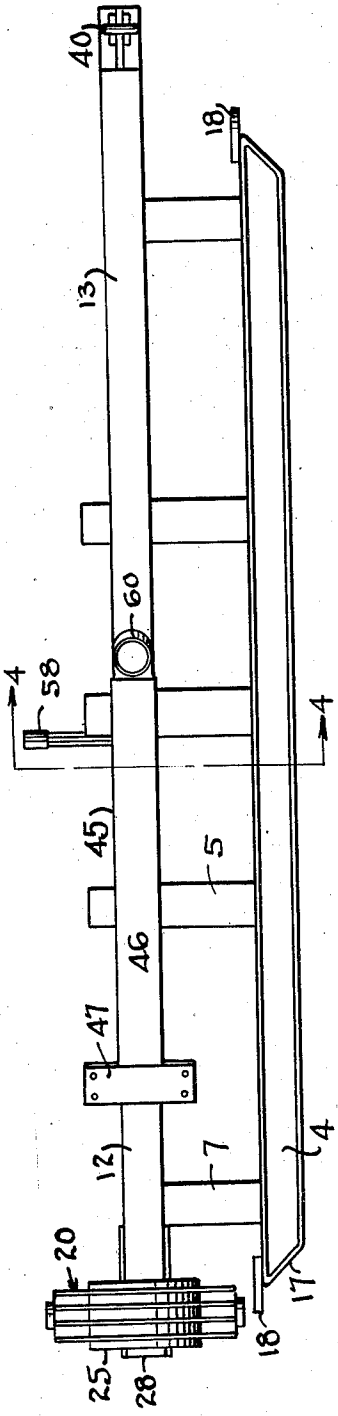

Fig. 2.

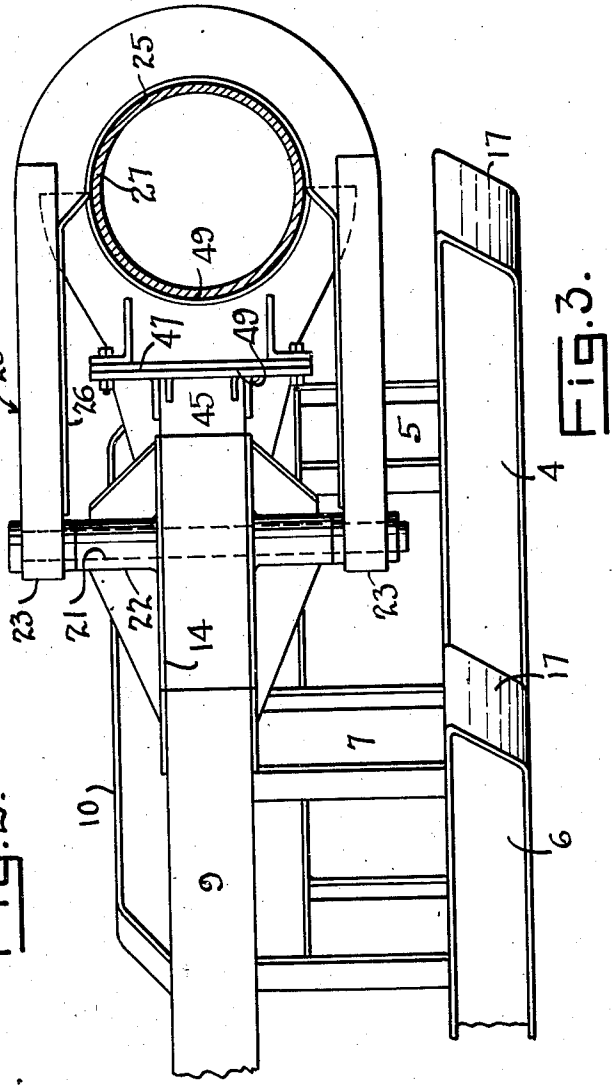

Fig. 3.

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Filed Sept. 3, 1943 5 Sheets-Sheet 3

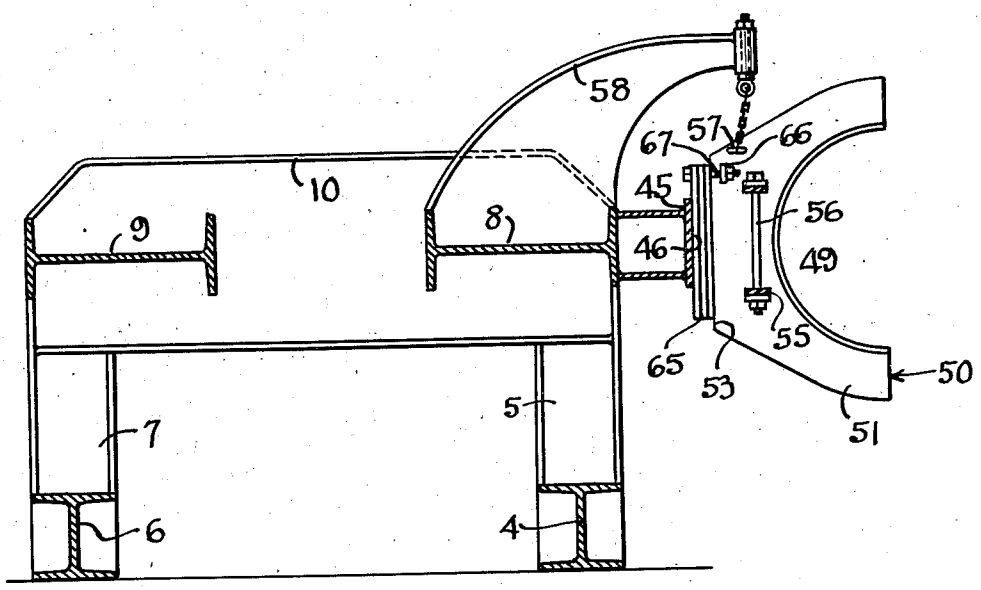

Fig. 4.

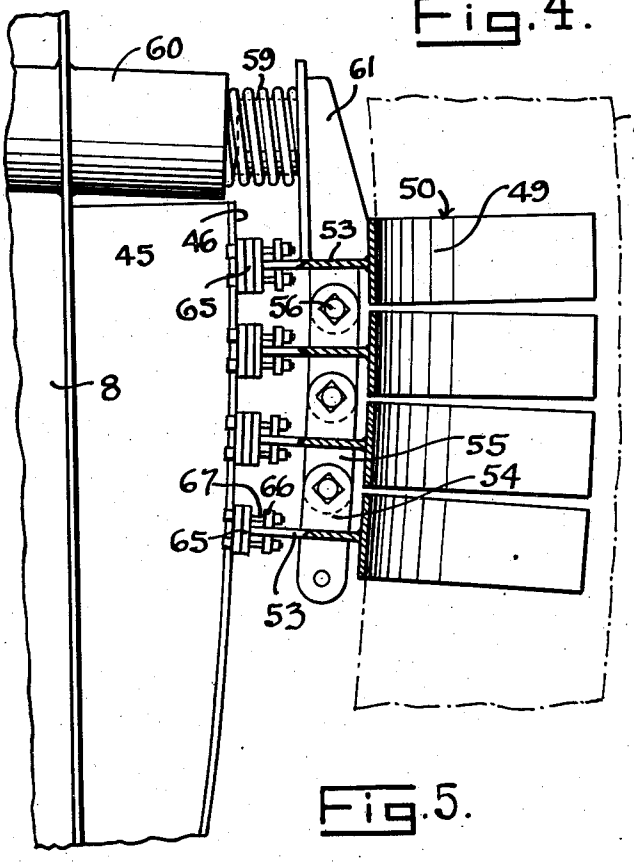

Fig. 5.

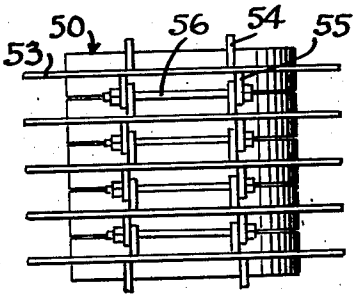

Fig. 6.

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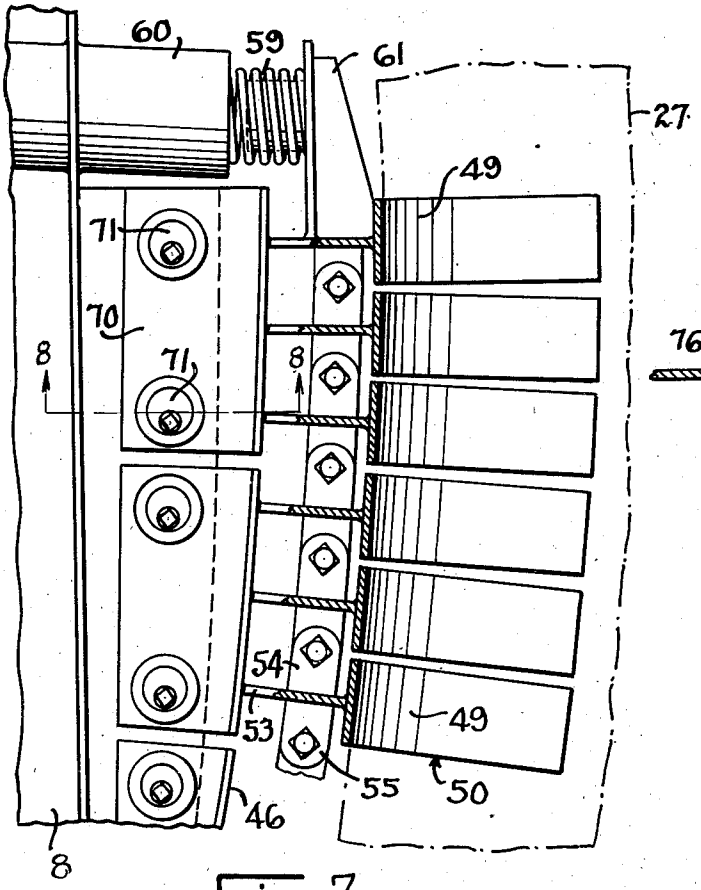

Fig. 7.

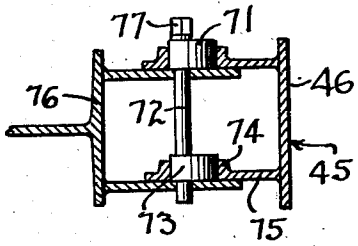

Fig. 8.

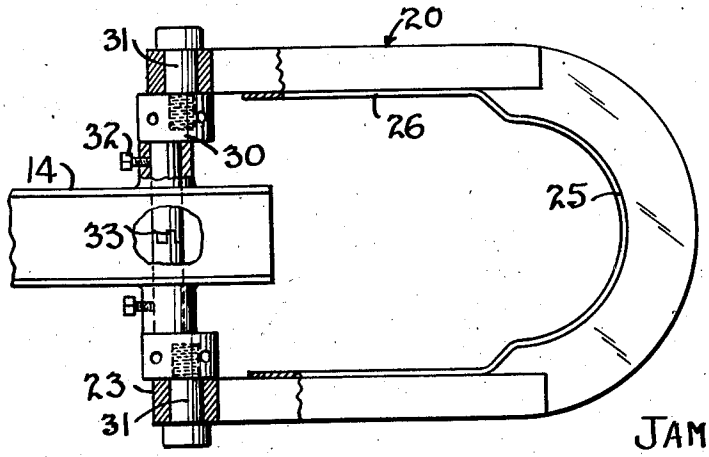

Fig. 9.

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PORTABLE MACHINE FOR BENDING LARGE DIAMETER PIPE

Filed Sept. 3, 1943 5 Sheets-Sheet 5

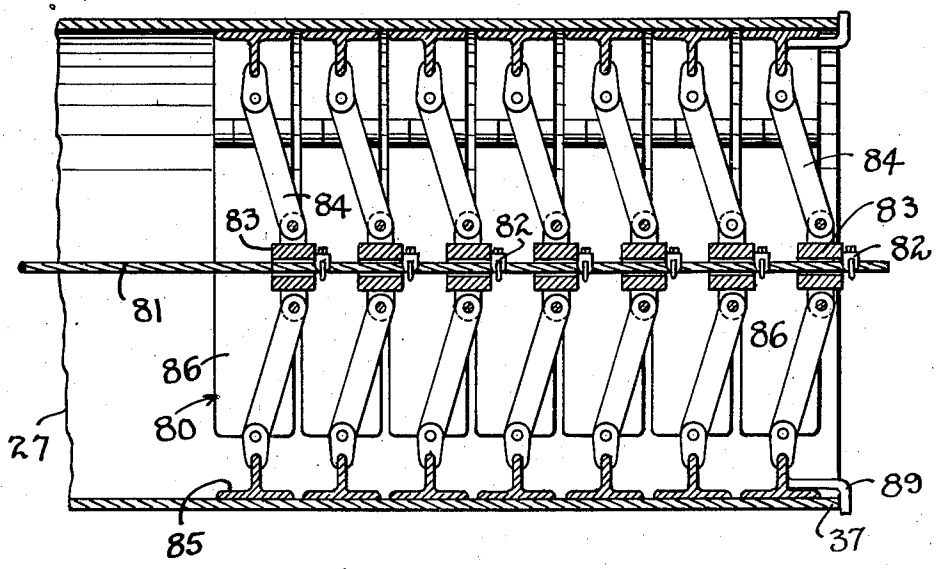

Fig. 10.

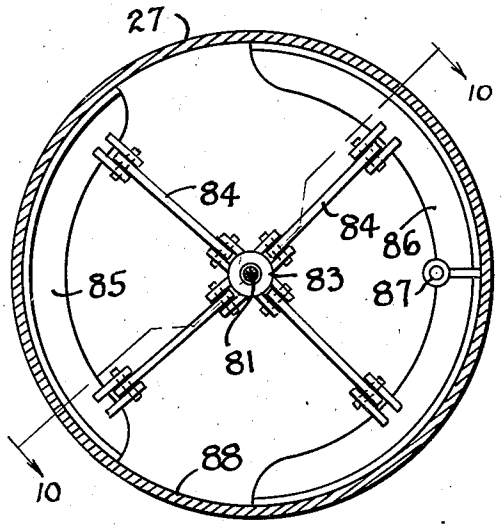

Fig. 11.

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Patented Apr. 25, 1944 2,347,593

UNITED STATES PATENT OFFICE

2,347,593

PORTABLE MACHINE FOR BENDING LARGE DIAMETER PIPE

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Application September 3, 1943, Serial No. 501,068

9 Claims. (Cl. 153—32)

The invention relates to a pipe bending machine and particularly a machine which is portable and can be used for relatively large diameter pipe.

In the laying of pipe lines 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 furthermore it is difficult to transport large diameter bent sections of pipe.

The present invention directs itself to bending relatively large diameter such as 16, 20 and 24" pipe, but it is specifically stated that the invention is not limited to the exact size of the pipe.

Pipe used in pipe lines for transporting liquids is made of steel having varying wall thicknesses, some of which is relatively thin while other pipe may be relatively thick. It is therefore the object of the present invention to provide a machine which is adaptable to bend either thin or thick pipe and whereby the angle and configuration of the bend can be controlled and adjusted.

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 adequately supported to prevent distortion or collapse during the bending operation.

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 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 to take the desired configuration.

Another object of the invention is to provide a series of interconnected pipe supporting shoes for a pipe bending machine.

Still another object of the invention is to provide a template to receive in sequence a series of pipe supporting shoes so as to determine the configuration of a bend being made in a section of pipe.

Another object of the invention is to provide for adjustment of the pipe supporting shoes in order to determine the configuration of the bend being made in a section of pipe.

Still another object of the invention is to bend a large section of pipe while the pipe is supported both internally and externally to maintain its contour.

Another object of the invention is to provide a pipe bending machine wherein the various parts thereof are adjustable to accommodate different sizes of pipe to accomplish different configurations of bends and to support the pipe against collapse.

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

Fig. 1 is a top plan view looking down on the bending machine with a pipe in position ready to be bent.

Fig. 2 is a front elevation of the machine with the pipe bending section removed.

Fig. 3 is a section taken on the line 3—3 of Fig. 1 and looking in the direction of the arrows.

Fig. 4 is a transverse section taken on the line 4—4 of Fig. 2 and illustrating the arrangement of the frame and the pipe bending section including the shoes.

Fig. 5 is a horizontal section through the pipe bending section illustrating the template, shoes and the adjustable arrangement for determining the angularity of the bend.

Fig. 6 is a rear elevation of a plurality of the shoes illustrating the manner of interconnecting the several shoes together.

Fig. 7 is a horizontal section through the shoes and template of the pipe bending section and illustrating an adjustable construction for the template parts.

Fig. 8 is a section taken on the line 8—8 of Fig. 7.

Fig. 9 is a side elevation of the pipe anchor or yoke and illustrating an eccentric pivotal connection therefor to permit adjustment of the yoke.

Fig. 10 is a transverse section through a pipe illustrating an internal jig to support thin walled pipe to prevent collapse thereof during the bending operation which is a section on the line 10—10 of Fig. 11.

Fig. 11 is a transverse section through a pipe having the jig of Fig. 10 therein.

The pipe is seen in top plan view in Fig. 1 where a frame 2 is illustrated as being made up of a plurality of structural members such as the I beams 3. The frame may be very rigid in order to withstand the tremendous stresses occurring during the bending operation and as seen in Fig. 4 includes the front support portion 4 which is in the nature of an I beam having the stud beams 5 extending upwardly therefrom. The rear support beam 6 has similar upstanding studs 7 and these two sets of studs along the beams 4

and 6 serve to support the longitudinal front beam 8 and the rear beam 9. These beams are spaced apart at their central portion between cross beams 10, a plurality of which are seen in Fig. 1. Toward the ends of the frame the front beam 8 is inclined toward the rear beam 9 as shown by the angular beams 12 and 13. The beams 9 and 12 are joined by a plate 14 while the beam 13 and the other end of the beam 9 are joined by an end member 15. This arrangement makes up a unitary frame construction which is seen in front elevation in Fig. 2 where the support beams 4 and 6 are illustrated as having beveled ends 17 to permit skidding of the frame by a suitable power mechanism engaged in the loops 18.

In order to anchor the end of the pipe which is to be bent a pipe supporting yoke 20 is seen in Fig. 3 as being mounted on a king pin 21 which extends vertically through the frame and the plate 14. The frame carries the bearing structure 22 so as to form a pivotal connection for the ends 23 of the yoke member. This yoke is of substantially U-shaped configuration with the U lying on its side as seen in Figs. 3 and 9. The curved portion of the yoke has a pipe engaging seat 25 and particular attention is directed to the large area 26 inside of the yoke which facilitates the insertion and removal of the pipe 27 as seen in Fig. 1 because the end 28 of such pipe must be inserted in the yoke 20 in order to anchor the end 28 against movement during the bending operation. The pivoting of this yoke 20 allows it to be moved so as to accommodate the pipe in the most convenient manner. Fig. 3 shows the king pin as mounted in the supporting frame whereas Fig. 9 shows an eccentric head 30 arranged above and below the support bearings, each of which heads carries an eccentric head 31 on which the ends 23 of the yoke are mounted. It seems obvious that by adjustment of the king pin and the setting thereof by means of the set screw 32 that the position of the pipe seat 25 may be adjusted relative to the frame. The king pin of Fig. 9 is made in two parts with the interfitting portions 33 in order to permit assembly.

In operation the pipe 27 will be inserted in the yoke as seen in Fig. 1 with the end 28 projecting through the yoke. The center portion 35 of the pipe which is to be bent is positioned in the pipe bending section 36 which is supported on the frame 2. The end 37 of the pipe is engaged by a suitable pulling mechanism 38 which may be in the form of the block and tackle 39 anchored at 40 on the frame with the free end 41 of the line leading to a suitable source of power such as a winch, truck or tractor, or if desired, the pulling mechanism may be anchored directly to the source of power eliminating the block and tackle 39. With this construction a lateral pull will be exerted on the end 37 of the pipe while the end 28 is anchored, which will cause the center portion 35 of the pipe to bend in accordance with the configuration of the bending section 36. By this arrangement the bending stresses are distributed along the length of pipe and it could be said that all the metal on the outer half of the pipe is subjected to tension and stretching while the inner half is subjected to compression tending to wrinkle the pipe on the inside of the bend. The spaced shoes, however, support the pipe to substantially maintain its configuration.

The bending section 36 as seen in Fig. 1 includes a template 45 which, as seen in Fig. 4, is in the form of a double web I beam or deep channel having the bearing face 46 thereon, which may be formed to any desired curvature which may be a regular curve such as an arc of a circle or any desired irregular curvature. This template will be supported on the frame 2. Anchored on the template at the left hand end as seen in Fig. 1 will be a pipe engaging member 47. This member has the curved shoe portions 48 thereon which are substantially semi-cylindrical in order to provide a pipe seating face such as 49 seen in Fig. 4. Fig. 1 shows two of these shoes 48 as rigidly anchored on the template 45 by the supporting bracket 49. In this manner a definite point of support for the beginning of the bend of the portion of pipe section 35 to be bent is provided so that the bend will be initiated immediately beyond these rigidly supporting shoes 48.

The bending section also contemplates a plurality of additional pipe supporting members 50, each of which includes the shoe portion 51 as seen in Fig. 4. Each of these shoes includes a heel construction 53 which extends rearwardly from the forward shoe portion and is arranged to engage the surface 46 of the template. These shoes 50 are each provided with the lateral lugs 54 and 55 on the opposite sides thereof adjacent the heel portion 53. The bolt 56 may be passed through the interfitting lugs so as to provide a pivotal connection between the adjacent shoes. One of the shoes adjacent the right hand end as seen in Fig. 1 may have an additional lug 57 thereon by which the series of shoes may be supported from the arm 58 which is anchored on the frame.

In order to urge this series of shoes against the pipe 27 a coil spring 59 is arranged for sliding movement in the socket 60 on the frame and is arranged to engage the end piece 61 carried by the last bracket 50.

As a pull is exerted upon the pull member 38 it seems obvious that the pipe will begin to bend about the first shoes 48 and that as it gradually bends, the shoes 50 in sequence will move against the template 45 until the pipe assumes the configuration of the template because the heel portion 53 of each of the shoes will in this manner move against the surface 46 of the template.

In this bending operation it seems obvious that the periphery of the pipe in the area where the bend is being formed is adequately supported by the semi cylindrical configuration of the pipe seats 49 in the series of shoes. This supports the contour of the pipe and maintains it circular during the bending operation whereas the pipe might otherwise collapse or become non-circular during the bending operation.

If it is desired to change the degree or inclination of the bend it seems obvious that suitable adjustments can be made a best seen in Figs. 4 and 5 where a number of shims or adapter plates 65 may be attached to the heel portions 53 of the shoes. This construction shows a lug 66 arranged on each side of the heel by which the bolts 67 may be retained in order to support the shims 65. As seen in Fig. 5 the lowermost shoe has two shims and the next succeeding shoes each carry three shims. The number of shims may be varied in order to define the desired bend. In this manner the same template may be used and variations in the bend accomplished by the use of these shims.

Figs. 7 and 8 show a modified form of the template 45 in that the template is made up of a plurality of sections or segments 70, each of which is supported on a plurality of eccentric

bearings 71 which are best seen in Fig. 8 as including a pin 72 which carries the eccentrics 73 which are mounted in the openings 74 in the flanges 75 of the template 45. The rear portion 76 of the template is anchored on the frame and supports the pin 72. The pin has a non-circular member 77 thereon to permit its adjustment. It seems clear that with this construction that the inclination of the various sections can be controlled and practically any desired bend may be thus obtained by suitably adjusting the template.

In some instances the wall thickness of the pipe being bent is such that it must be internally supported to prevent distortion and Figs. 10 and 11 show a jig 80 which is arranged to support the inside of the pipe. The jig illustrated includes a cable or a pull member 81 which may have a series of anchor clevises 82 thereon so that each clevis forms a stop for a hub 83 which forms a link in the jig. Each hub has a plurality of arms 84 pivoted thereon as seen in Fig. 11. Two of the arms support a shoe 85 to engage the pipe in the inner area of the bend while the other two arms support a shoe 86 which is arranged to engage the pipe in the outer portion of the bend. This shoe 86 may have a pivot 87 therein to permit the shoe to align itself accurately with the inner periphery 88 of the pipe 27.

This jig will be moved into the pipe and the hook portions 89 engaged over the end 37 of the pipe. A pull is then exerted to the left as seen in Fig. 10 on the cable 81 so that each clevis 82 will move against its hub 83 so as to move the hub to the left tending to move the links 84 into vertical alignment with the hub and the shoes. This moves the shoes radially outward so as to press them firmly into engagement with the outside of the pipe. When this jig has been set as seen in Fig. 11 and the bending of the pipe has begun the outer shoe 86 holds the outside of the bend in an exact circular configuration while the inside of the bend is supported internally by the shoe 85 and externally by the series of shoes 50 of the bending section. It has been found with a construction of this sort that exceptionally thin walled pipe may be readily bent without distorting the pipe.

In actual operation machines built in accordance with this disclosure have bent a great many sections of pipe on location saving literally thousands of man hours in the building of strategic pipe line.

The portable nature of the pipe bending machine adapts it for use on location as the laying of a pipe line proceeds and eliminates the transportation of particular pipe sections to a bending machine at a remote location when it is determined that a bend of a particular configuration is to be made.

With a machine of the type herein disclosed, when the two portions of the pipe line which are to be joined together by a bent section of pipe are laid, then the exact bend can be measured, the machine adjusted therefor, and the pipe bent in a total elapsed time of a few minutes so that broadly the invention contemplates a portable pipe bending machine which is adjustable to bend the pipe to various configurations and to adequately support the pipe against distortion.

What is claimed is:

1. A pipe bending machine for bending relatively large diameter metal pipe comprising a frame, means to retain a pipe end at one end of the frame, a bending section carried by said frame and including a template of the curvature of the bend, a series of connected shoe members mounted on said frame, means normally urging some of said shoes against the pipe, and means to exert a pull on the free end of the pipe to force said shoes against the template as the pipe bends around the shoes.

2. In a pipe bending machine having a frame, a bending section thereon including a plurality of interconnected shoe members, each member including a substantially semicircular piece to receive the pipe, and a heel portion projecting therefrom, and template means on said frame to receive said heels of said portions to limit the movement of said shoes and of the configuration of the bend to be applied to the pipe, and additional means to be disposed between each heel portion and said template to determine the position thereof and to vary the configuration of the bend to be made.

3. In a pipe bending machine having a frame, a bending section thereon including a plurality of interconnected shoe members, each member including a substantially semicircular piece to receive the pipe, and a heel portion projecting therefrom, and template means on said frame to receive said heels of said portions to limit the movement of said shoes and of the configuration of the bend to be applied to the pipe, and additional means to be affixed to each heel portion to determine the position thereof and to vary the configuration of said template means and the bend to be made, and eccentric means to effect adjustment of said template means.

4. A portable pipe bending machine for cold bending relatively large diameter line pipe including a frame, a bending section carried by said frame and including a plurality of independently adjustable pipe contact shoes to form the configuration of the bend, fixed means to anchor one end of the pipe to the frame, means normally urging said shoes to contact the pipe so as to support the pipe as it is being bent, and means to exert a lateral force by being connected to the other end of said pipe to bend it around said bending section.

5. In a pipe bending machine a frame, a series of pipe bending shoes, means to rigidly support at least one of the series of said shoes upon said frame, means connecting adjacent shoes and allowing limited movement therebetween, and spring means on said frame and normally extending the last shoe to normally present said shoes in a straight line to receive the pipe to be bent.

6. In a pipe bending machine a frame, a series of pipe bending shoes, means to rigidly support at least one of the series of said shoes upon said frame, means connecting adjacent shoes and allowing limited movement therebetween, spring means on said frame extending the last shoe to normally present said shoes in a straight line to receive the pipe to be bent, stop means on said frame, approximating at least a portion of the curvature to be imparted to the pipe, to receive said shoes as the pipe is bent so as to effect bending in the desired curvature, and additional means to adjust the stopping of said shoes to vary the angle of bending as desired.

7. In a pipe bending machine, a frame, said frame comprising a pair of spaced longitudinal skid members so that the machine may be moved along a pipe line right of way where pipe is being bent and laid, a plurality of upright supports on said skids, a top on said supports including a pipe bending section supporting beam, a yoke mounted at one end of the frame to receive and

retain one end of the pipe to be bent, means on the other end of the frame to connect to the other end of the pipe to exert a pull thereon toward the frame, and a pipe bending section against which the portion of the pipe to be bent is to be pulled, said section including a substantially semi-circular portion to receive and embrace the inside of the bend, and a web formed on the back of said portion to support such portion against said beam to resist the pull on the pipe.

8. In a pipe bending machine, a frame, said frame comprising a pair of spaced longitudinal skid members so that the machine may be moved along a pipe line right of way where pipe is being bent and laid, a plurality of upright supports on said skids, a top on said supports including a pipe bending section supporting beam, a yoke mounted at one end of the frame to receive and retain one end of the pipe to be bent, means on the other end of the frame to connect to the other end of the pipe to exert a pull thereon toward the frame, and a pipe bending section again which the portion of the pipe to be bent is to be pulled, said section including a substantially semi-circular portion to receive and embrace the inside of the bend, a web formed on the back of said portion to support such portion against said beam to resist the pull on the pipe, and an expansible jig for insertion in the pipe so as to internally support the pipe during bending.

9. In a portable pipe bending machine, a frame including a base having a pair of spaced longitudinal skid members so that the machine may be moved along the line where the pipe is being bent, a pipe anchor on one end of the frame, a pipe pulling mechanism on the other end of the frame, and a pipe bending section supported on the frame between said anchor and pulling mechanism, said section being curved longitudinally and substantially semicircular to receive and have a pipe curved there around when the pipe is anchored and pulled, and a plurality of transverse radial flanges supporting said section against said frame to resist the thrust due to the pull and bending of the pipe.

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