(No Model.) 5 Sheets—Sheet 1.

W. J. WOODWARD & H. E. BRETT.

WOOD BENDING MACHINE.

No. 596,645. Patented Jan. 4, 1898.

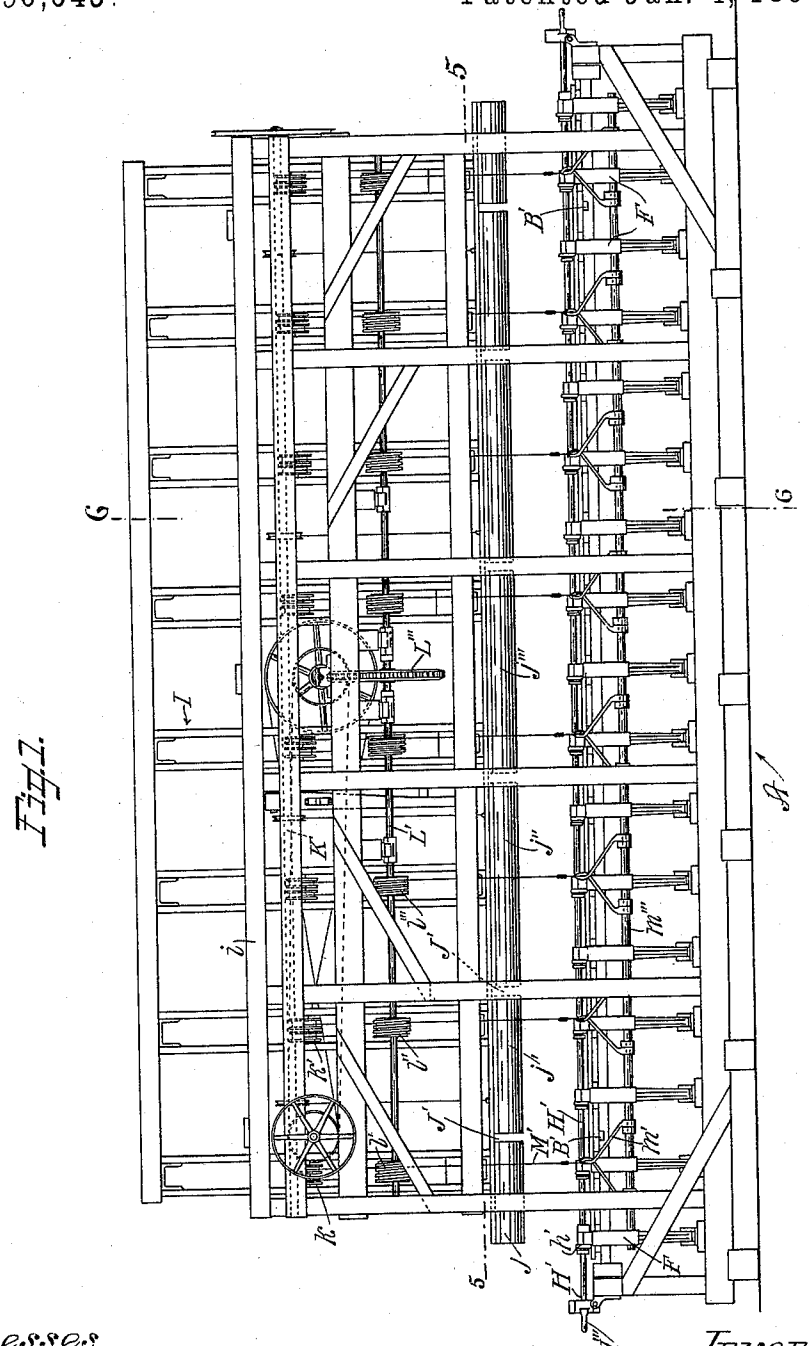


Fig. 1.

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(No Model.) 5 Sheets—Sheet 2.

W. J. WOODWARD & H. E. BRETT.

WOOD BENDING MACHINE.

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Fig. 2.

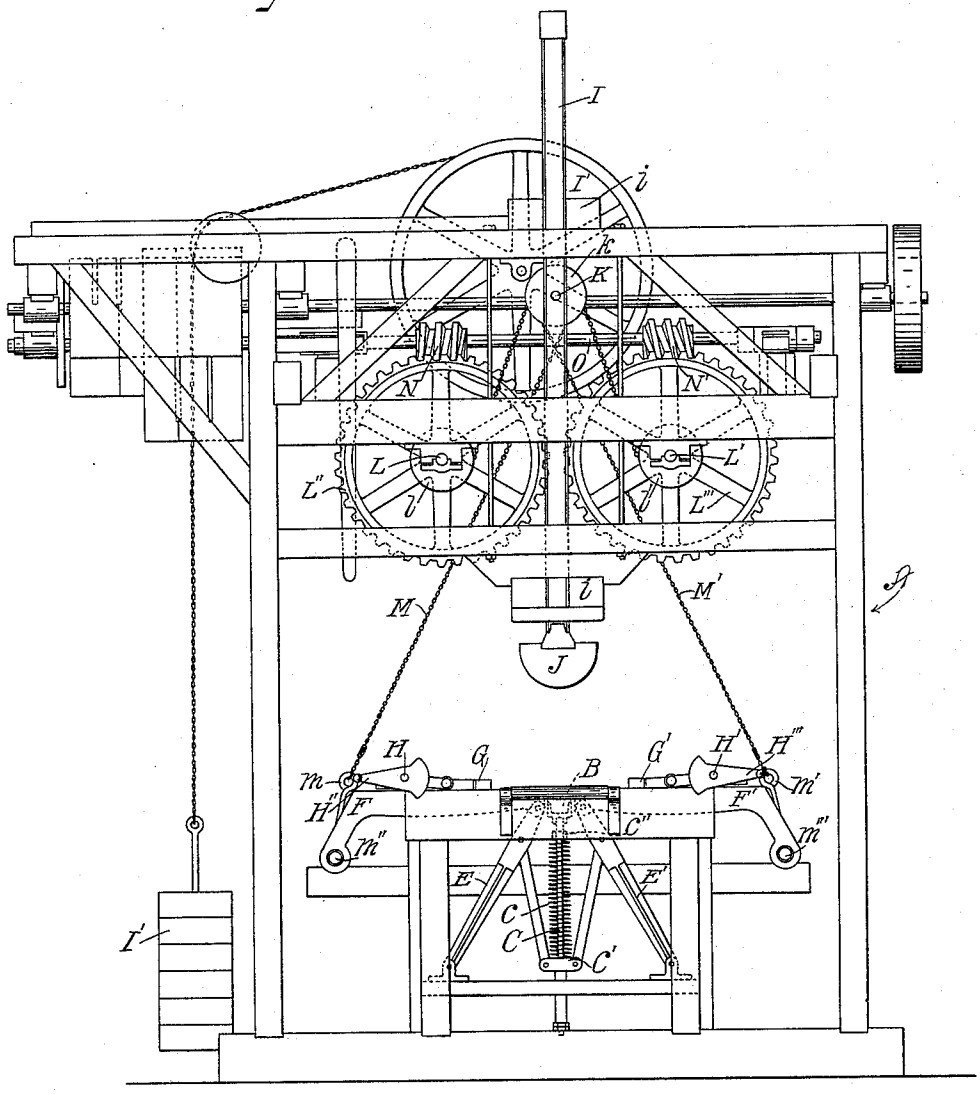
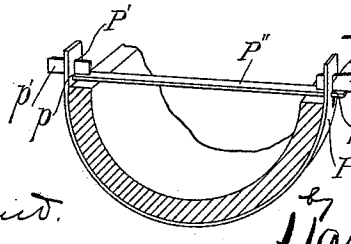


Fig. 3.



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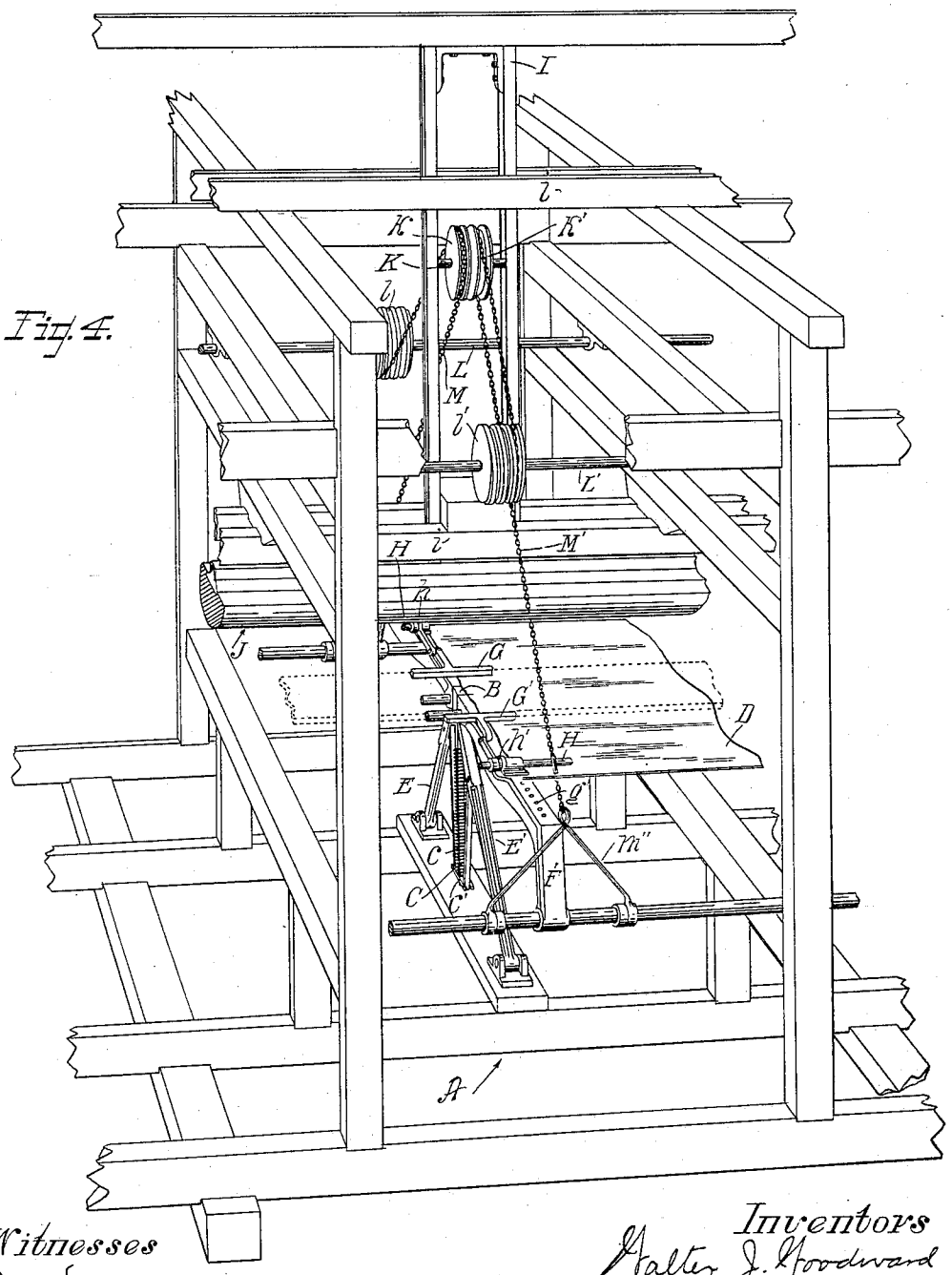
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WOOD BENDING MACHINE.

No. 596,645. Patented Jan. 4, 1898.

Fig. 4.



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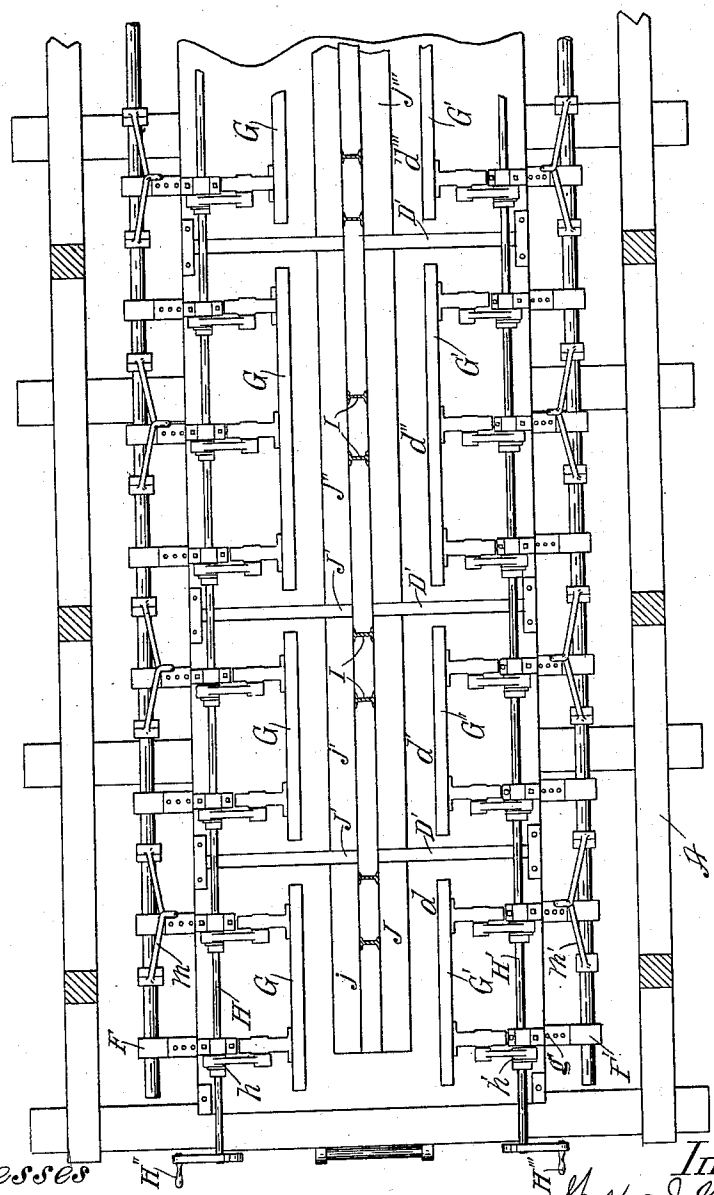
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W. J. WOODWARD & H. E. BRETT.

WOOD BENDING MACHINE.

No. 596,645. Patented Jan. 4, 1898.

Fig. 5.



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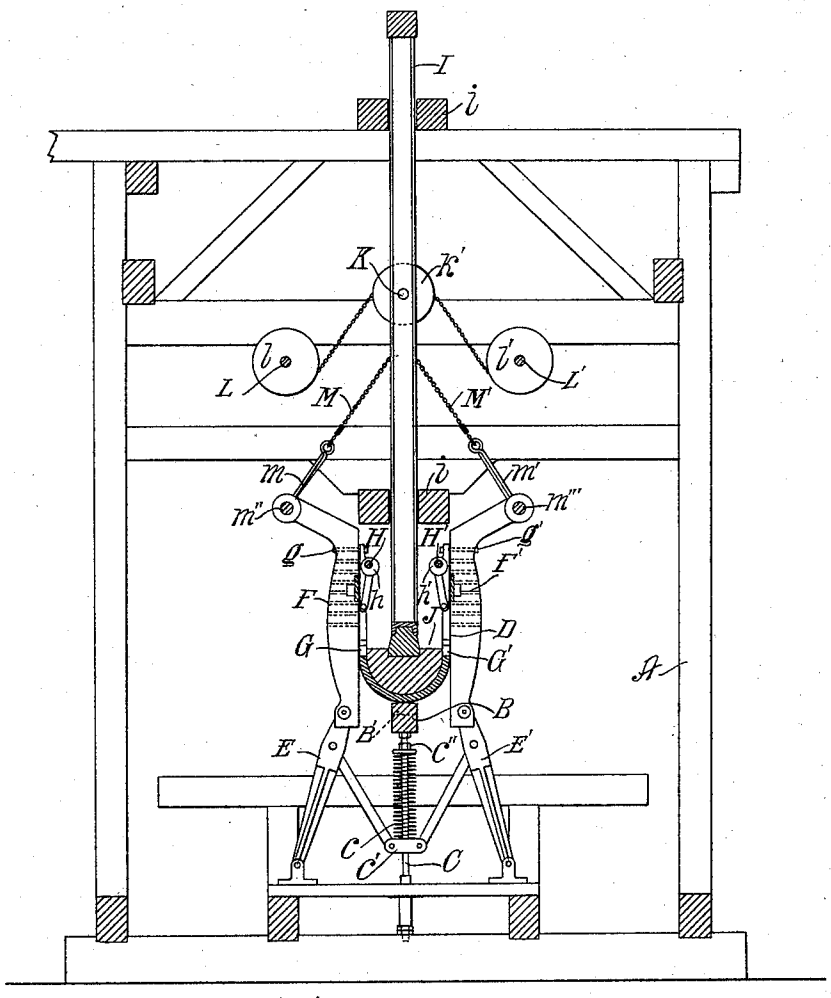
(No Model.) 5 Sheets—Sheet 5.

W. J. WOODWARD & H. E. BRETT.

WOOD BENDING MACHINE.

No. 596,645. Patented Jan. 4, 1898.

Fig. 6.



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UNITED STATES PATENT OFFICE.

WALTER J. WOODWARD, OF NATIONAL CITY, AND HENRY E. BRETT, OF LOS ANGELES, CALIFORNIA; SAID WOODWARD ASSIGNOR TO D. P. N. LITTLE, C. W. SANDERS, AND EMMA A. HARRINGTON, OF LOS ANGELES, AND HATTIE I. WOODWARD, OF NATIONAL CITY, CALIFORNIA.

WOOD-BENDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 596,645, dated January 4, 1898.

Application filed February 15, 1897. Serial No. 623,560. (No model.)

To all whom it may concern:

Be it known that we, WALTER J. WOODWARD, residing at National City, in the county of San Diego, and HENRY E. BRETT, residing at Los Angeles, in the county of Los Angeles, State of California, citizens of the United States, have invented new and useful Improvements in Wood-Bending Machines, of which the following is a specification.

Our invention relates particularly to machines for bending boards longitudinally into trough-shaped sections for the purpose of forming wooden pipes. It must be understood that the bending of long boards along the grain is a matter much more difficult to accomplish than that of bending comparatively narrow strips of wood across the grain, as is common for the purpose of producing fellies, plow-handles, bicycle-rims, &c. Bending across the grain is comparatively easy to accomplish, since wood bent across the grain has no great tendency to split, the principal difficulty being its tendency to shiver or splinter by the expansion of the outer fibers or buckling caused by compression of the inner fibers during the process of bending. When, however, one attempts to bend a long board longitudinally into semicircular shape or any segment of a circle, it is found that unless wood is used which is very tough and fibrous, such as elm and analogous woods, the amount of stock which is split and rendered worthless during the process of bending is very apt to exceed the amount which is successfully bent.

In southern California a large quantity of pipe is used for conveying water for irrigation and other purposes. It has heretofore been customary, where possible, to employ for this purpose cement pipe, which is of a low degree of tenacity and incapable of withstanding heavy pressure, but is comparatively cheap. Cement pipe is only satisfactory for use in conveying water where no pressure is required, and even without pressure the loss of water from seepage and accidental defects in the joints, which occur about every two feet, is very great. Where it is necessary that the pipe withstand pressure, it has been customary to use riveted sheet-metal pipe, which is extremely susceptible to rust and is liable to leak, owing to its many joints and seams. Joints and seams also reduce the carrying capacity of the pipe. On account of excessive freight rates from eastern points to this coast this pipe is expensive, and the tendency has been to use metal of light quality in order to reduce cost. Many soils in California abound in alkali, and consequently these thin metal pipes soon rust out and become worthless. Screw-pipe is highly satisfactory in use, but its excessive cost precludes its use for irrigation purposes. This is also true of cast-iron pipe, the interest upon the difference in cost between cast-iron and wooden pipe being estimated to be sufficient to lay a new system of wooden pipe about every eight years.

Ever since the development of extensive irrigation systems in California attempts have been made to provide a pipe which is strong, cheap, and durable. Some partial successes have been made, and many devices, which upon use have proved wholly unsatisfactory, have been invented, tested, and abandoned.

Wooden pipes have long been in limited use in Eastern States and have proved highly satisfactory. These pipes have, however, been formed by boring a hole longitudinally through an integral stick of timber, cutting staves into curved form, or bending into tubular form boards of tough wood, such as elm or other wood having interlocking fibers, which render splitting difficult, and securing the overlapping edges together by riveting. Lumber is too expensive in southern California to permit the use of pipes of integral timbers bored out or of pipe formed of curved staves cut into shape. Tough wood, such as elm, must be imported from Eastern States, and high freight rates, combined with first cost, renders it more expensive than sheet metal.

California produces a species of wood known as the "California redwood," which is very straight-grained, easy to split, and is particularly free from knots and other blemishes. It is characterized by extreme durability when saturated with water, and therefore in this

respect is peculiarly fitted for use in making pipes for irrigation purposes. In experimenting, however, it was found that when it was attempted to bend this wood by any of the ordinary means heretofore in use for wood-bending, owing to its straight grain and lack of toughness, the boards would split from end to end, rendering them worthless.

The especial object of our invention is to produce a machine whereby we may bend long boards into semicircular shape without liability of their splitting.

A further object of our invention is to produce a machine of this class in which formers of different sizes may be used without necessity of changing any of the mechanism of the machine except the formers and the position of the edge clamps, and whereby boards of different widths may be bent into shape to form pipes of different diameters—that is to say, with our machine it is possible without changing anything but the formers and edge clamps to bend boards into shape to form a six-inch pipe or to form a twelve-inch pipe of two sections or a larger pipe of three or more sections.

Another object of our invention is to provide a machine of this kind in which any expansion of the outer fiber of the wood will be prevented and the inner fibers will be compressed, to thereby form a pipe having an inner lining of compressed wood, which will prevent seepage of water through the walls of the pipe. In this respect it is well to state that the redwood is formed of alternate layers of hard and soft grain, and in making pipe of small diameter we find it is essential that the grain be vertical, or nearly so, or, in other words, that the grain extend parallel with the thickness of the board instead of parallel with its width. Thus when the boards are bent the soft layers of wood, which in their normal condition are pervious to water, are compressed between the hard layers, which are practically impervious and incompressible, thus rendering the soft layers equally impervious with the hard layers, so that liability of seepage of water through the pipe is avoided.

The amount of compression which takes place in bending a ten-inch board is much greater than appears possible from a mere casual inspection. For instance, in making pipe we use boards of seven-eighths-inch thickness, and in bending a twelve-inch board into semicircular shape the outside of the board after bending measures exactly twelve inches, while the inside measures but nine and one-fourth inches, thus showing that the inner surface of the board has been compressed two and three-fourths inches. It is essential that the boards be held in their bent shape a sufficient length of time to allow them to set. This necessitates the use of clamps to hold them in position or the allowing of the boards to remain in the machine until set. The length of time required for this precludes the practicability of allowing the boards to set while in the machine, and therefore it becomes necessary to so arrange and adapt the machine as to allow clamps to be inserted at frequent intervals along the board after it is formed and before it is released from the machine, so that such clamps may be placed in position, the machine released, the former removed from the interior of the board, and the bent board, with its clamps, removed from its machine and allowed to set before the clamps are removed.

Another object of our invention is to provide a machine adapted for bending long boards and to allow the placing of clamps at frequent intervals along the length of the board before the board is released from the machine and the ready removal of the former after the clamps are applied.

Our invention comprises the various features of construction and combinations of parts whereby we accomplish the objects hereinbefore set forth.

Our invention further comprises the clamp which we have devised for the purpose of retaining the formed board in its bent position while it is setting.

The accompanying drawings illustrate our invention.

Figure 1 is a side elevation of a machine embodying our invention. Fig. 2 is an end elevation of the same. Fig. 3 is a detail showing our improved clamp in use upon a fragment of board formed into shape. Fig. 4 is a perspective fragmental view showing one section of our machine. Fig. 5 is a fragmental sectional plan view on line 5 5, Fig. 1. Fig. 6 is a sectional view on line 6 6, Fig. 1, looking toward the left.

In the drawings, A represents the main frame, which is of a length suitable to receive the length of board which it is desired to bend. Boards of sixteen feet in length have been successfully bent in a crude machine embodying the essential features of our present invention.

B is a presser-bar which is arranged in the main frame and extends longitudinally from one end to the other end thereof. This presser-bar is provided with guide-rods C′, which reciprocate in guideways provided in the main frame.

c are springs arranged encircling the guide-rods and resting upon movable collars *c*′, which are arranged to slide upon the guide-rods. Tension-nuts *c*″, screwed upon the guide-rods, are adapted to regulate the tension of the springs.

Upon the top of the presser-bar and supported thereby is a bending-table D, which is formed of flexible sheet metal, preferably sheet-steel. This bending-table is formed in separate sections *d d*′, &c., and is arranged with a space D′ between the opposing ends of the sections, the purpose of which will be hereinafter more fully explained.

E E′ are struts which are each pivoted at its lower end to the main frame and extend up-

ward to near the mid-line of the bending-table and are arranged upon opposite sides of the presser-bar.

F F′ are bending-levers arranged upon opposite sides of the table and each having its inner end pivoted to one of the pivoted struts. The edge of the table is rigidly secured to each lever intermediate its ends, so that that portion of the lever beneath the table may swing out away from the table as the table is bent up around the former.

G G′ represent movable clamps which are made in sections corresponding to the sections of the bending-table and by means of bolt-holes *g g′* are rendered adjustable to accommodate the different width of boards to be bent. These clamps clamp the edges of the board to prevent the outer fibers from being strained and ruptured as the board is bent.

H H′ are continuous shafts, each of which is arranged to operate all the edge clamps upon its respective side of the bending-table. These clamps are operated by eccentrics *h h′* in the customary manner and do not require detailed description, since no specific claim is laid thereto.

I is a vertically-reciprocating former-frame which is arranged in suitable guides *i* in the main frame and adapted to reciprocate therein.

I′ is a counterbalance for holding the former-frame normally elevated.

J is a former which is arranged on the bottom of the former-frame. This former is made in sections *j j′*, &c., corresponding to the sections of the bending-table, and a corresponding space J′ is left between the opposing ends of the sections. This former is held in place by means of a dovetail groove in the former and a dovetail slide on the former-frame, so that the sections of one size can be easily removed and replaced with sections of different size when it is desired to change the diameter of the pipe produced.

K is a sheave-carrying shaft which is arranged in the former-frame and is provided with series of sheaves *k k′*, &c., which are free to rotate upon the shaft.

L L′ are winding-drum-carrying shafts which are journaled in the main frame upon opposite sides of the former-frame and below the sheaves in the former-frame. Upon these shafts are rigidly secured winding-drums *l l′*, &c., and to each winding-drum is secured a flexible connection, such as a chain M M′, respectively, each of which passes up over one of the sheaves in the former-frame, thence down and has its other end secured to links *m m′*, which are journaled upon shafts *m″ m‴*, which connect the bending-levers. Driving-wheels L″ L‴ are secured upon the drum-shaft and are operated by worms N N′, secured upon a worm-shaft O, which is operated by means of a power-wheel O′, connected by a belt or other means with suitable power. (Not shown.)

It will be seen that our improved machine is practically built up of independent sections, each section comprising a bending-table, bending-levers, a presser-bar, pivoted struts, presser-springs, a former-frame, a former, winding-drums, &c., the various sections being assembled to form a machine capable of handling boards of any length desired. The winding-drums are preferably arranged to rotate in reverse directions and to each wind the chain beneath the drum instead of on top thereof, so that each chain may pass from the bottom of its winding-drum up over its respective sheave in the former-frame, thence down and secured to that bending-lever shaft which is upon the same side of the former-frame as is the winding-drum to which the chain is secured. This brings the strain more in line with the line of motion of the former-frame and of the bending-levers and gives greater leverage power than would otherwise be obtained.

In practical operation the boards are first steamed or otherwise treated to render them pliable and less brittle than in their dry state. Then, the bending-machine being in its normal position, as indicated in Fig. 2, the board is placed upon the bending-table and between the clamps. Then the shafts H H′ are rotated by means of the cranks H″ H‴, thus by means of the eccentrics *h h′* to operate the movable clamps G G′ to clamp against the edges of the board. Then power is applied to the power-wheel O′ to operate the worm-shaft O, thus operating the driving-wheels L″ L‴ and rotating the winding-drum shafts L L′ toward each other, thus winding up the flexible connections or chains M M′ and pulling down upon such chains. The first result is to bring strain upon the sheaves, and as the chains wind upon the drums the former-frame is first forced downward until the former rests upon the board placed upon the flexible bending-table. As soon as the former is firmly seated upon the board the strain then operates to lift the bending-levers upward, and as the levers swing up toward each other they swing around the former, (which represents the load to be lifted,) the pivoted struts acting as a shifting or movable fulcrum or support. The strain is thus brought upon the wood only at the point of contact of the board with the former and is never in advance of the point of bending. This causes the wood at this point to be crowded together and forced in upon itself without any liability whatever of splitting. The operation continues until the bending-arms reach their utmost limit of stroke, the former being automatically pushed down to follow the bending-table as the levers are removed from beneath it. This downward movement is not very great, however, but is sufficient to make the difference between success and failure, it being necessary that the table be held firmly to its work without any rigidity thereof.

As the levers are swung upward in the operation of bending the pivoted struts are thus

carried outward away from the presser-bar, and this draws upon the links which operate the collar to slide it upward along the guide-rod and to compress the spring thereupon, thus automatically increasing the tension upon the presser-bar as the tension upon the former is increased. By means of the tension-nut this pressure can be adjusted with that degree of nicety which we have found to be necessary to success.

After the bending is completed clamps, each consisting of a spring or flexible clip P, bent into substantially semicircular shape, are inserted beneath the board in the spaces D′ between the ends of the sections of the table and the ends of the formers, suitable slots B′ being provided in the presser-bar to readily permit the passage of the clamps therethrough. The clip P is provided in each end with a longitudinal slot P′, and a yoke P″, formed of metal (preferably strap-metal) having its ends flattened to pass through the slots P′, is slipped edgewise into the slots and then turned flatwise, the yoke being provided with notches *p* to receive the body of the clip. Keys *p′* are driven into the slots above the yoke to bring the yoke firmly down upon the top of the edge of the bent board. When all the yokes are thus secured in place, the power is reversed, the former is lifted by the counterweights, and the parts resume their normal position. Then the bent board is removed from the machine and stacked away until it becomes thoroughly dried and set, after which the clamps may be removed and the sections formed into pipe.

By our improved arrangement of having compensating means connecting the bending-levers with the former and adapted to move the former down upon the bending-table before operating the levers to bend the table we are enabled to provide a machine of this character in which formers of different sizes may be used without any rearrangement of the machine other than the changing of the formers and clamps, the compensating connection taking up all the difference in motion and causing the bending-levers to snugly hug the former during the operation of bending, irrespective of the size of the former.

In the drawings we have shown each of the flexible connections M M′ attached, by means of links *m m′*, respectively, to the bending-lever shafts; but the effect is the same whether each connection operates one or more levers, and our invention is not limited thereto.

Now, having described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a wood-bending machine, the combination set forth of a movable former; a bending-table formed of a sheet of flexible metal, arranged beneath the former; a movable presser-bar arranged beneath the bending-table; bending-levers, each secured intermediate its ends to one edge of the table and pivoted at one end near the mid-line of the bending-table and adapted to bend such table upward around the former; winding-drums; and a flexible connection secured at one end to the winding-drum and at the other end to the outer ends of the bending-levers and having the intermediate portion passed around a sheave and adapted to operate the former.

2. In a wood-bending machine, the combination set forth of a main frame; a vertically-movable former-frame arranged in guideways in the main frame; a counterweight arranged to hold the former-frame normally elevated; sheaves journaled in the former-frame; winding-drums journaled in the main frame and arranged below the sheaves; a former secured to the former-frame; a flexible bending-table formed of sheet metal arranged beneath the former; a yielding presser-bar arranged beneath the mid-line of the bending-table; struts, each pivoted by one end to the main frame and extending upward to near the mid-line of the bending-table; bending-levers, each pivoted at one end to one of the pivoted struts and secured intermediate its ends to one edge of the bending-table; flexible connections, each having one end secured to one of the winding-drums, passed around one of the sheaves in the movable frame and extending thence downward and secured to the outer end of one of the bending-levers; and means for rotating the winding-drums.

3. In a wood-bending machine, the combination set forth of a main frame; a movable former-frame arranged in guideways in the main frame; sheaves journaled in the former-frame; a former secured to the bottom of the movable frame; two winding-drums journaled in the main frame below the sheaves; a flexible bending-table; bending-levers arranged beneath the flexible table and each having its inner end pivoted to a pivoted strut and secured intermediate its end to the edge of the bending-table; power for operating the winding-drums; flexible connections, each having one end secured to one of the winding-drums, passed over one of the sheaves in the movable frame and downward and having its other end secured to the outer end of one of the bending-levers.

4. In a wood-bending machine, the combination set forth of a main frame; a movable former-frame arranged to slide in guideways in the main frame; a former secured to the former-frame; sheaves journaled in the former-frame; winding-drums journaled in the main frame below the sheaves; a flexible bending-table arranged below the former; movable clamps arranged upon the bending-table; a presser-bar arranged beneath the mid-line of the table; springs arranged to yieldingly support the presser-bar; movable struts, each pivoted at its lower end to the main frame and having its upper end arranged normally near the mid-line of the table; bending-levers each having its inner end pivoted to one of the movable struts, ar-

ranged beneath the bending-table and secured intermediate its ends to one edge of the bending-table; flexible connections, each secured to one of the winding-drums, passed up over one of the sheaves in the former-frame and then down and having its other end secured to one of the bending-levers; and means for rotating the winding-drums.

5. In a bending-machine, the combination set forth of a main frame; a yieldingly-supported presser-bar; a bending-table formed of a sheet of flexible metal arranged above the presser-bar and supported thereby; two bending-levers, one arranged upon each side of the presser-bar and beneath the bending-table and having one edge of the bending-table secured thereto; movable supports, one arranged pivoting the inner end of each lever; a movable former arranged above the bending-table; means arranged to operate the bending-levers to bend the table around the former; and compensating means connecting the bending-levers with the former and adapted to operate the former when the levers are operated.

6. In a wood-bending machine, the combination set forth of a main frame; a presser-bar provided with guide-rods; springs arranged encircling the guide-rods; a bending-table arranged above the presser-bar; bending-levers, arranged upon each side of the presser-bar and beneath the table and having the edges of the table secured thereto; movable supports pivoting the inner ends of the bending-levers; a former-carrying frame arranged in guideways in the main frame; a former secured to the former-frame; sheaves journaled in the former-frame; winding-drums journaled in the main frame below the sheaves in the former-frame; flexible connections, each secured by one end to one of the winding-drums, passed over one of the sheaves in the former-frame, thence down and having its other end secured to the outer end of one of the bending-levers; and means for operating the winding-drums.

7. In a wood-bending machine, the combination set forth of a main frame; a presser-bar provided with a guide-rod arranged to reciprocate in the main frame; a tension-spring encircling the guide-rod; a collar arranged to slide upon the guide-rod to compress the spring; a flexible bending-table arranged upon the presser-bar; bending-levers, one arranged upon each side of the presser-bar and having one edge of the bending-table secured thereto; pivoted struts pivoting the inner ends of the bending-levers; links connecting the struts with the collar upon the guide-rod; a movable former arranged above the bending-levers; and means adapted to move the former down upon and cause it to follow the bending-table when the levers are actuated to bend the bending-table around the former.

8. In a wood-bending machine, the combination of a main frame; a presser-bar provided with a guide-rod arranged to reciprocate in the main frame; a tension-spring encircling the guide-rod; a collar arranged to slide upon the rod and to compress the spring; a flexible bending-table arranged upon the presser-bar; bending-levers, one arranged upon each side of the presser-bar below the bending-table and having one edge of the bending-table secured thereto; struts pivoted to the main frame and to the inner ends of the bending-levers; links connecting the collar with the pivoted struts; a former-frame arranged to reciprocate in the main frame; a former secured to the former-frame and arranged above the bending-table; sheaves journaled in the former-frame; winding-drums journaled in the main frame below the sheaves; and flexible connections, each having one end secured to one of the winding-drums, passed over one of the sheaves, thence down and secured to the outer end of one of the bending-levers.

9. In a wood-bending machine, the combination set forth of a yielding presser-bar; a flexible bending-table arranged above the presser-bar; bending-levers arranged beneath the bending-table and secured to the edges of the table; movable supports arranged pivoting the inner ends of the bending-levers; a movable former arranged above the bending-table; suitable means for operating the bending-levers to bend the bending-table around the former; and a yielding connection arranged between the presser-bar and the bending-levers and adapted to regulate the pressure of the presser-bar.

10. In a wood-bending machine, the combination set forth of a main frame; a presser-bar arranged in the main frame and provided with a guide-rod; a flexible bending-table arranged upon the presser-bar; two bending-levers, one arranged upon each side of the presser-bar beneath the bending-table and having one edge of the table secured thereto; pivoted struts pivoting the inner ends of the bending-levers; a collar arranged to slide upon the presser-bar guide-rod; links connecting the struts with the collar; a tension-nut arranged to regulate the tension of the spring; a movable frame; a former secured to the frame and arranged above the bending-table; sheaves journaled in the former-frame; winding-drums journaled in the main frame below the sheaves; flexible connections, each having one end secured to one of the winding-drums, passed around one of the sheaves, thence down and secured to the outer end of one of the bending-levers; and means for rotating the winding-drums.

11. In a wood-bending machine, the combination set forth of a main frame; a yielding presser-bar; a flexible bending-table arranged upon the presser-bar; bending-levers arranged beneath the bending-table and secured to the edges thereof; movable supports ar-

ranged pivoting the inner ends of the bending-levers; movable clamps arranged upon the bending-table; a tension device connecting the presser-bar with the bending-levers; a movable former arranged above the bending-table; suitable means connecting the former with the levers and adapted to move the former down upon the bending-table and to actuate the levers to bend the bending-table around the former.

12. In a wood-bending machine, the combination set forth of a main frame; a yielding presser-bar; a flexible bending-table arranged upon the presser-bar; bending-levers arranged beneath the bending-table and secured to the edges thereof; movable supports pivoting the inner ends of the bending-levers; a tension device connecting the presser-bar with the bending-levers; a former-frame arranged to reciprocate in the main frame; a former secured to the former-frame and arranged over the bending-table; and automatic means arranged to first force the former down against the bending-table and then to actuate the levers to bend the bending-table around the former.

13. In a wood-bending machine, the combination set forth of a series of sections arranged in line with each other and each section comprising a movable presser-bar; a flexible bending-table; bending-levers secured to the edges of the bending-table and adapted to bend such table around the former; movable supports pivoting the inner ends of the bending-levers; movable clamps arranged upon the bending-table; a movable former arranged above the bending-table; and means connecting the former with the levers and adapted to first operate the former to carry it toward the bending-table and to next operate the levers to bend the bending-table around the former.

14. In a bending-machine, the combination set forth of a main frame; series of sections arranged in the main frame and each composed of a presser-bar; a flexible bending-table; bending-levers secured to the edge of the bending-table; pivoted struts pivoting the inner ends of the bending-levers; an adjustable connection between the bending-levers and the presser-bar; movable clamps upon the bending-table; a reciprocating former-frame; a counterbalance for the former-frame; a former carried by the frame; sheaves journaled in the former-frame; winding-drums journaled in the main frame; and flexible connections, each secured to one of the drums, passed over one of the sheaves, thence down and having its other end secured to the outer end of one of the bending-levers.

15. In a bending-machine, the combination of a presser-bar; a flexible bending-table; bending-levers arranged beneath the table and having the edges of the table secured thereto; pivoted struts pivoting the inner ends of the levers; an adjustable tension connection between the levers and the presser-bar; a movable former; means for operating the former; and means for operating the levers.

16. In a bending-machine, the combination set forth of a yielding presser-bar; a flexible bending-table; bending-levers arranged beneath the bending-table and secured to the edges thereof; movable supports pivoting the inner ends of the bending-levers; movable clamps arranged upon the bending-table; a tension device connecting the presser-bar and the bending-levers; and compensating means arranged connecting the former with the levers.

17. In a bending-machine, the combination set forth of a main frame; a yielding presser-bar; a flexible bending-table; bending-levers arranged beneath the bending-table and secured to the edges thereof; pivoted struts pivoting the inner ends of the bending-levers; a tension device connecting the bending-levers with the presser-bar; a movable former arranged above the bending-table; and an automatic compensating connection connecting the former with the levers and adapted to operate the former and the levers.

18. A wood-bending machine having series of formers arranged in line with each other and with a space between the ends thereof; and means for simultaneously bending the material to be formed, about the series of formers, substantially as and for the purpose set forth.

19. A wood-bending machine having its bending-table made in sections, and its former made in sections, the ends of the sections being separated from each other; and means for simultaneously operating the sections, substantially as set forth.

20. A wood-bending machine comprising a frame; a yielding presser-bar; a flexible bending-table made in sections and arranged upon the presser-bar; bending-levers adapted to operate each section of the bending-table; a movable former made in sections corresponding to the sections of the bending-table, the ends of the former-sections and the sections of the bending-table each being arranged with spaces between them; and suitable means for simultaneously operating the former and the levers.

21. In a wood-bending machine, the combination set forth of a frame; a yielding presser-bar; a flexible bending-table arranged in sections having spaces between them and supported by the presser-bar; bending-levers adapted to bend each section of the bending-table; a movable former arranged in separate sections corresponding to the sections of the bending-table; movable clamps secured to the edges of the bending-table and made in sections corresponding to the sections of the bending-table; continuous shafts each adapt-

ed to operate all the clamps upon one side of the bending-table; and suitable means for operating the bending-levers.

22. In a wood-bending machine, the clamp set forth comprising a band formed in an arc of a circle and provided in each end with a longitudinal slot; a yoke having its ends flattened and adapted to pass edgewise through the slots in the band and provided with gains to seat the edges of the bands when the yoke is turned flatwise; and keys adapted to key the yoke in the slots.

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