(No Model.)

W. M. BAILEY.

APPARATUS FOR BENDING THE RIBS OR FRAMES OF METALLIC SHIPS.

No. 337,113. Patented Mar. 2, 1886.

Fig. 1.

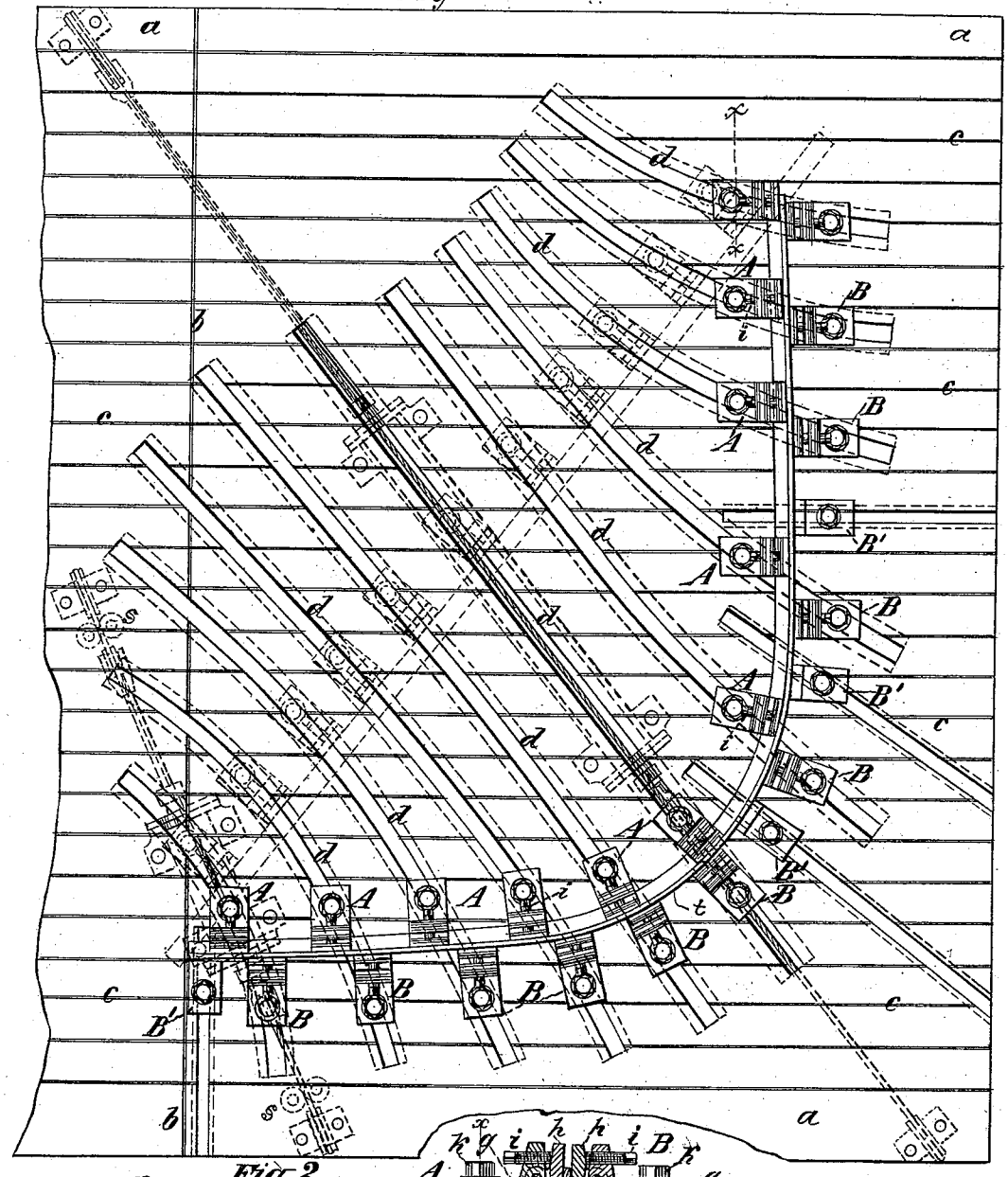


Fig. 2.

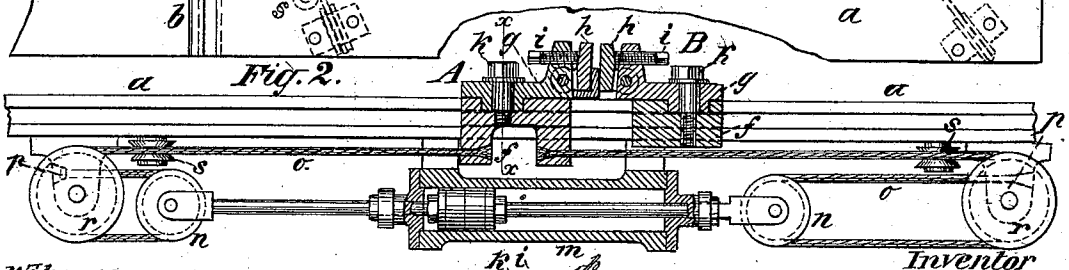
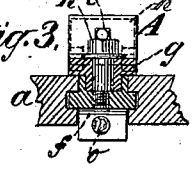


Fig. 3.



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UNITED STATES PATENT OFFICE.

WALTER M. BAILEY, OF NEW YORK, N. Y.

APPARATUS FOR BENDING THE RIBS OR FRAMES OF METALLIC SHIPS.

SPECIFICATION forming part of Letters Patent No. 337,113, dated March 2, 1886.

Application filed September 8, 1884. Serial No. 142,457. (No model.)

To all whom it may concern:

Be it known that I, WALTER M. BAILEY, of New York city, New York, have invented certain new and useful Improvements in Apparatus for Bending the Ribs or Frames of Metallic Ships, of which the following is a specification.

Usually the ribs of iron ships have been bent or formed up by a slow, laborious, and inexact method of hand-work, which usually consists in first forming a wooden pattern for the shape of each rib, then placing this pattern on the perforated iron floor of the forging-shop, and marking the form thereof on the floor, and afterward setting up metal pins or projections in the perforated floor to correspond or approximate to the marked line, after which the hot iron is bent up to the pins, and finally fitted to the pattern entirely by manual operations with sledges, pries, and swages. This method is not only crude and laborious but very slow, and is correspondingly expensive. Some attempts, however, have been heretofore made to produce machines for effecting these operations which are hereinafter referred to as distinct from my invention.

It is therefore the object of my invention to perform the bending operation by machinery in a more exact manner with less labor and with much greater rapidity, and also to enable the construction of the preliminary pattern for each frame to be entirely dispensed with.

To these ends I construct an apparatus consisting of an extended level metal platform having a perpendicular mark or groove thereon to represent the perpendicular or midship line in the cross-section of the vessel, and across the platform are scribed horizontal grooves transverse to the midship line to represent the different "water-lines" in the cross-section of the vessel; hence by reference to the drawings of the proposed vessel proper measurements can be determined for each particular frame or rib, and these measurements laid off on the water-lines of the platform, the distance from the midship line on each successive water-line being marked off, after which a flexible rule or tape is set to the said marks, and the curve which the tape thus presents is then drawn or scribed on the platform, which will give the correct form for the desired rib or frame without requiring a pattern therefor. In addition to these lines the said platform is provided with a series of slots running diagonally on the platform—that is, diagonal to the midship line and to the transverse water-lines—and curved divergently at the outer ends, and in these slots are fitted a corresponding series of movable presser-heads or formers impelled by hydraulic rams or equivalent motive devices, while at the outer ends of the slots are arranged fixed but adjustable heads, to form abutments to the action of the movable heads. The fixed heads are set up to the line of the proposed frame as drawn on the platform as before described, and are there fastened, while the movable heads are withdrawn far back in their slots away from the fixed heads to the opposite end of the slots, and the angle iron, being now heated red-hot and in the form of a long straight bar, is then dropped onto the platform in front of the movable heads, after which the hydraulic rams are set in motion, and the forming-heads are gradually moved up toward the fixed heads, thus bending the iron between them to the form of the desired frame as determined by the position of the fixed heads. The movable and fixed heads are each provided with a swiveled or adjustable face or jaw, which may be set to any desired inclination by a set-screw, and will thus give the desired bevel to the different parts of the frame in the act of bending the iron. In this way the straight angle-iron is bent rapidly to the form of the desired rib, both the curvature and bevel being imparted thereto, and the slow and laborious hand-work heretofore necessary is obviated, thereby accomplishing a great improvement.

My invention therefore consists in the features above outlined, as hereinafter fully set forth.

In the drawings annexed, Figure 1 gives a plan view of my improved apparatus, and Fig. 2 a section taken diagonally of Fig. 1—that is, through one of the slots of the platform. Fig. 3 is a fragmentary cross-section of the platform across one of the slots and heads on the line *x x* in Fig. 1.

In the drawings, *a* indicates a strong extended iron platform, which is mounted on suitable pillars, and erected in proximity to

the furnace for heating the iron and to the launchway in which the ship is to be built. The platform is of course preferably made in sections, of cast-iron, suitably secured together, and the top is planed level to present an extended level surface, as will be readily understood from the drawings.

On the top of the platform is scribed a groove or other distinct line, *b*, which represents the perpendicular line or "midship" line in the cross section of the ship, and a series of parallel lines or grooves, *c c*, cross and extend at right angles to the midline *b*, representing the water-lines of the ship. Now, extending in a substantially diagonal direction across the platform are a series of slots, *d d*, which are, however, somewhat curved in their direction, the central or longest slot being straight, while the slots on each side are curved outward and somewhat divergent in opposite directions on the respective opposite sides of the straight central slot, as fully shown in Fig. 1. The proper curves for the slots will be determined by proper calculation and a proper averaging of the curvature of the different ribs in the vessel, so that the machine will be enabled to bend the different ribs with a nearer approximation to the absolutely correct curve and bevel. The slots might, however, all be made straight, were it not that a better approximation to correct curvature and bevel on all the frames are secured by giving the outer ends of the slots a divergent curved form, as described. The slots *d* have a dovetailed or T-shaped section on the under side of the platform, as shown in Fig. 3, and in these slots are fitted two sets of forming-heads, A B, the set A being movable and active in their function, while the set B is fixed, but adjustable and passive in its function. The sectional construction of both heads is similar, as shown in Fig. 2. Each has a base block, *f*, which fits the T-slot, as shown, and this is bolted to the top block, *g*, which carries at its front a swiveled or pivoted face or jaw, *h*, which forms the working-face of the head, and which may be tilted or set to any desired inclination or bevel by the adjusting-screws *i i*, as will be readily comprehended from the drawings. The top blocks of the heads are connected to the base-block by a single powerful stud, *k*, as shown, so that the top block can be freely turned or swiveled on the base to present itself at different inclinations on the top of the platform, as will be readily understood from Fig. 1.

In the fixed heads the top and base blocks are so fitted to the slots that by tightening up the studs the two sections can be brought firmly together, so as to grip the platform firmly between them, and thus fix the heads firmly on the platform in any position desired, as indicated in Fig. 1. In the movable heads, however, the sections are so fitted that the base-block is always free to move back and forth in its slot, while the top block is free to swivel on its stud on the top of the platform, as will be readily comprehended from the drawings.

Referring to Fig. 2 in connection with Fig. 1, it will be seen that under the platform is arranged a series of hydraulic ram cylinders, *m*, one being placed beneath each slot and in line therewith, or nearly so, and the piston of the ram is provided with a piston-rod, which protrudes from each end of the cylinder and connects to cross-heads provided with sheaves *n n*. Two cables, *o o*, each fixed at one end to the platform, as indicated at *p p*, pass in a loop around the sheaves *n n*, thence over a fixed sheave, *r*, on the under side of the platform, and connect at the opposite end to the base-blocks of the movable heads, as fully shown in Fig. 2. It will therefore be seen that the ram is double acting and has a positive connection with the movable head both on the forward and backward stroke, as will be readily understood.

Each end of each ram-cylinder is connected by suitable pipes with hydraulic accumulators or pumps or other sources of water under pressure, and the pipes are provided with suitable valves and valve mechanism as common in hydraulic machinery, which details for sake of simplicity I have not here shown, as the same are well known, and may be varied in many ways. I prefer, however, to have the valves of each ram independently controlled, so that the movement of each head may be controlled independently on the top of the platform, and made to move at any relative speed desired. It will therefore be seen that when the water is admitted to one end of the ram the piston will be forced in one direction and the movable heads B moved back in the slots away from the fixed heads, as indicated by dotted lines in Fig. 1; whereas, if the valves are shifted to admit the water in the reverse direction the movable heads will be moved in the opposite direction up toward the fixed heads, as shown by full lines in Fig. 1.

I prefer to have the valves of each cylinder controlled independently from the top of the platform—say by chains or cords extending thereto—so that men on the top of the platform by managing the valves can cause the separate heads to move at different speeds, as may be required, and to arrest them or reverse their motion at any point, as will be readily understood. It will be obvious, however, that instead of hydraulic mechanism for moving the heads any other motive fluid, engines, or mechanical movements—such as capstans, windlasses, &c., or any equivalent impelling devices—may be employed to operate the movable heads, as the impelling device itself forms no part of my invention.

It will be seen that as most of the slots *d* in which the heads A move are slightly curved, and as the ram-cylinders are arranged in a straight line in the direction of a chord to the curve, there will be a slight lateral deflection of the cables as the heads are moved through their curved slots; and in order to support the

cables against this lateral deflection and prevent their running off the sheaves *r*, small guide-sheaves *s s* are pivoted on the bottom of the platform on each side of the cable, as fully shown in Figs. 1 and 2.

The general construction of the apparatus having been thus set forth, its operation will now be made apparent.

The form of any particular frame or rib of the proposed vessel is first found by measurements made from the drawings or model of the vessel, these measurements being of course made by determining the distance from the periphery of the rib to the midship line on each water-line. These distances are then laid off on the corresponding water-lines, *c c*, on the platform *a*, and marked thereon in successive order. A steel tape or long flexible rule is then laid on the platform, and bent around until it intersects the water-lines at the marked points, which will thus give the correct curve or shape for the desired rib, which curve is then marked distinctly on the platform by following the bent rule with a chalk-marker or other scriber, which line will then represent the correct shape of the desired rib. The adjustable heads B B are then set up and adjusted to this line and there fastened, as shown in Fig. 1, and their position will therefore serve as a pattern for the desired frame, thereby enabling the construction of the usual wooden pattern to be entirely dispensed with, which is a most important advantage. The bevel or twist of the rib at different points along the bottom or side is next determined, and the pivoted jaws *h h* on the several heads A B are then adjusted to this bevel. The heads being now all adjusted, as described, the movable heads are moved far out from the fixed heads, as indicated by dotted lines in Fig. 1, and the angle-iron *t* to form the rib is then taken from a long heating-furnace in proximity to the platform, and deposited on the platform in front of the heads, as indicated by dotted lines, the iron of course being in a straight bar of a length sufficient to form the rib and uniformly heated to a proper forging-heat. Everything being now ready, as just described, and indicated by dotted lines in Fig. 1, the movable heads are advanced against the hot iron bar, which will press the bar gradually up against the fixed heads, as shown by full lines in Fig. 1, thus bending the iron in the shape of the desired rib with both the desired curvature and bevel, as will be readily comprehended, and thereby performing in a rapid mechanical manner what has heretofore required slow and laborious manual operations.

During the bending operation, as described, the movements of the different heads A are of course properly controlled by the men on the platform, so that those which require to move a longer distance are moved at a faster speed, and the movement of each head properly arrested when it arrives near its corresponding fixed head, so as to put only the necessary pressure on the metal to form it properly, as will be readily comprehended.

At intervals where the spaces between the fixed heads B are wide, extra heads B′ may be introduced, as shown in Fig. 1, being temporarily bolted in holes or slots in the platform, so as to present a better abutment for the action of the movable heads, and to better fill out the line of the rib, as will be appreciated. It will also be understood that any slight imperfections in the form of the rib which may occur at points between the heads may be easily corrected by hammering the iron in or out at these points, assisted by suitable swages.

In the drawings I have shown in fact but one-half of the machine for forming the ribs on one side or half of the vessel, and in practice the machine will be duplicated on the other side of the line *b* to form the ribs for the other half of the vessel, as will be readily understood, which duplication it is not of course necessary to here illustrate.

Instead of having each movable head B move independently in a distinct slot, one large movable head or carriage might be arranged to move in the middle slot, with all the heads B fixed to and adjusted on its periphery to correspond to the contour of the fixed heads representing the contour of the rib; but the arrangement illustrated is thought to be preferable.

It may now be appreciated that this invention will accomplish a great improvement in the building of iron ships, as it not only enables the preliminary patterns to be dispensed with, but also enables each rib to be bent up to the correct shape at one operation of a machine, and thus not only renders the construction of the vessel quite rapid, with a great saving of time and labor, but also conduces to greater accuracy of form, which are important advantages.

I am aware that bending-machines have been proposed having a series of fixed jaws and a series of movable jaws, and that the jaws have been provided with swiveling faces; but their special construction differs from that shown and claimed by me.

I am also aware that a bending-machine has been proposed with an extended platform having a series of straight diagonal or radiating slots; but this is distinct from my machine in which the slots are not only diagonal, but divergently curved at the outer ends, which is necessary to enable both the bow and stern frames of the ship to be properly bent to the correct curve.

My machine is further distinguished by the ruling of the perpendicular and the transverse water-lines on the face of the platform in connection with the heads and slots, as set forth.

What I claim as my invention is—

1. In a ship-building apparatus, the combination, with an extended platform marked with a perpendicular line, and with a series of parallel water-lines at right angles thereto, of

a series of adjustable abutting heads adapted to be adjusted on the platform to the contour of the rib of the vessel, as determined by measurements made on the aforesaid lines, and there fastened, substantially as and for the purpose set forth.

2. In a ship-frame-bending apparatus, the combination of an extended platform, a series of diagonal slots in said platform divergently curved, with a series of abutting heads adapted to be adjusted and fixed in said slots, and a movable head or series of heads adapted to be moved in said slots to and from the fixed heads, and motor mechanism to propel said heads, substantially as set forth.

3. In a ship-frame-bending apparatus, the combination of a level extended platform, a series of parallel water-lines marked thereon, a series of slots extending diagonally to said lines, with a series of abutting heads adjustable and fixable in said slots, a series of movable heads movable to and from the same, and motor mechanism to propel the latter, arranged and operating substantially as set forth.

4. The combination, with the slotted platform *a*, of the fixed head B, formed with the base-block *f*, adjustable in the slot, and the top block, *g*, adapted to swivel thereon on the top of the platform, with a clamping device to hold the two sections firmly at any desired adjustment on the platform, substantially as herein set forth.

5. In combination with the platform *a*, the fixed head or heads B, provided with the tilting jaw or face *h* and set-screw *i*, substantially as and for the purpose set forth.

6. The combination, with the platform *a*, of the movable head A, having the tilting face or jaw *h*, and the set-screw *i*, substantially as and for the purpose set forth.

7. The combination, with the platform *a*, fixed heads B, and movable heads A, of the rams *m* and flexible connections *o* between the movable heads and the pistons of the rams, and pulleys over which said connections pass, substantially as herein shown and described.

8. The combination, with the platform *a*, having slots *d* arranged diagonally and curved divergently at the outer ends, with fixed heads B, adapted to be fixed in the curved ends of said slots to correspond with the contour of the ship-frame on the outer or convex side thereof, and the movable heads A, free to move in the slots to and from the fixed heads on the inside of the same, with mechanism to propel said heads, substantially as herein set forth.

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