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F. V. M. MONNET & E. J. A. MOYNE.  
MACHINE FOR BENDING METALLIC TUBES.

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2 SHEETS—SHEET 2.

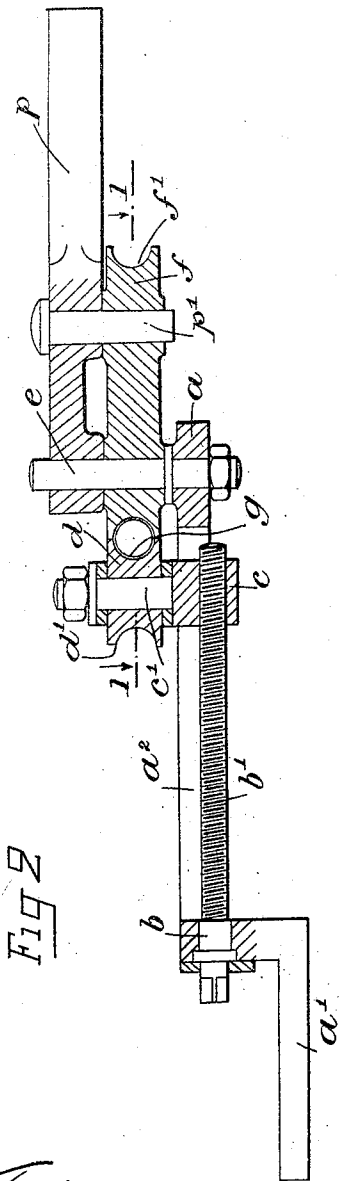


Fig 2

Fig 3

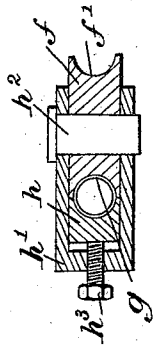
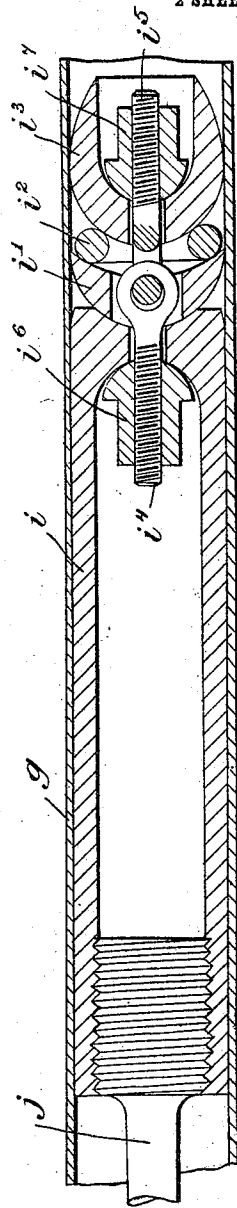


Fig 4



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By William & Fisher  
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# UNITED STATES PATENT OFFICE.

FLEURY VICTOR MARIUS MONNET AND EMILE JULIEN AUGUSTE MOYNE,  
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## MACHINE FOR BENDING METALLIC TUBES.

No. 847,094.

Specification of Letters Patent.

Patented March 12, 1907.

Application filed October 1, 1906. Serial No. 336,914.

To all whom it may concern:

Be it known that we, FLEURY VICTOR MARIUS MONNET, mechanical engineer, and EMILE JULIEN AUGUSTE MOYNE, mechanical engineer, citizens of the Republic of France, both residing at 11 Rue Torricelli, Paris, France, have invented new and useful Improvements in Machines for Bending Metallic Tubes, of which the following is a specification.

The present invention relates to the bending of metallic tubes, and more particularly thin tubes, to a short radius of curvature. Its object consists in a machine or apparatus of the kind wherein a mandrel placed inside the tube to be bent is utilized in effecting the bending.

In the apparatus herein described the tube to be bent is externally held by a former rotatable around a fixed center or axis and by a guide-piece rectangular in shape, which is stationary during the bending operation, the arrangement being such that the distance between the point of application of the resultant of pressures and the axis of rotation of the rotatable former can be varied according to the size of tube to be bent.

In the accompanying drawings, Figure 1 is a plan of the appliance, partly a section, on the line 1 1 of Fig. 2. Fig. 2 is a section on the broken line 2 2 of Fig. 1 looking in the direction of the arrows. Fig. 3 is a section on the line 3 3 of Fig. 1. Fig. 4 on a larger scale is a detail of the tube and the mandrel with jointed sections in longitudinal section on the line 4 4 of Fig. 1.

The appliance consists, essentially, of a support or frame *a* of angular shape, made of steel or wrought iron, which may be fastened by means of the base-plate *a'* either on a bench, a bed, or the like, or in the jaws of a vise. In this frame is fitted at *b* a screw *b'*, which engages a nut *c*, carrying a trunnion *c'*, the latter being moved by the screw *b'* after the fashion of a lathe-carriage in the guide *a<sup>2</sup>* of the frame *a*, so that the position of the trunnion *c'* may be varied as well as that of the guide-piece *d*, which pivots on the latter, in order to enable bends to be effected according to different radii. The guide-piece *d* is rectangular in shape and has an acting face *d'* in the form of a straight groove.

The frame *a* carries at its free end a trunnion *e*, which constitutes the center around

which the former *f* rotates. The drawing shows by way of an example a former adapted for two radii of curvature; but this is not absolutely necessary, and the former may according to practical needs and requirements have any sort of arrangement. It is formed on its circumference with a groove *f'*, which, as well as the lateral grooves *d'* of the guide-piece *d*, must have the same diameter as the tube *g* to be bent, the tube being applied to said groove *f'* by means of a bearing *h*, which is held against the former *f* by means of a stirrup *h'*, keyed at *h<sup>2</sup>*, and is provided with a set-screw *h<sup>3</sup>*.

Into the tube *g* is introduced a suitable mandrel, preferably consisting of a rigid cylindrical piece *i*, from which extend individually deformable rings or segments *i' i<sup>2</sup>*, having spherical bearing-surfaces, and is terminated in a knob *i<sup>3</sup>*, the whole being held together by threaded rods *i<sup>4</sup> i<sup>5</sup>*, so as to form a universal joint, and by nuts *i<sup>6</sup> i<sup>7</sup>*, having spherical bearing-surfaces and constituting a jointed system, (see Fig. 4,) which is capable of taking all required curvatures in all directions. This mandrel is inserted into the tube by means of a screw-threaded rod *j*, which engages the end of rigid piece *i*, and is held fast at its other end by a brace *k* (which itself is supported at one end on the trunnion *c'* of the carriage *c*) and by an adjustable rod *m*, which is jointed at one end at *m'* to the other end of the said brace and is formed at its other end with a slot *m<sup>2</sup>*, engaging a set-screw *n*, which is fixed to the base-plate *a'* of the frame *a*.

A regulating-nut *o*, which screws onto the threaded end of the rod *j* and bears on the brace *k*, allows of the position of said rod being regulated, and consequently also the position of the mandrel carried by it.

All being so arranged and rotary movement being imparted to the former *f* round the axis *e* in the direction of the arrow *z* (by means of the lever *p*, which pivots on the axis *e* and the stud *p'* of which engages a hole *f<sup>2</sup>* in said former) the tube *g* follows this rotary movement; but since precisely at the point where the bending begins—that is to say, in the plane *xy*—the tube is supported by the mandrel *i' i<sup>2</sup> i<sup>3</sup>* a drawing-out action of the exterior fibers and a compressing action of the inner fibers of the metal of the tube are produced, and the latter slides on the man-

drel as it is being bent, while the jointed rings of said mandrel in accompanying the tube *g*, during the operation beyond the plane *x y*, where the bending begins, prevent any flattening which without the intervention of the jointed rings might occur, especially in the case of thin tubes with short radii of curvature, owing to the traction strain exerted on the exterior fibers suspected to the drawing action, and retain the section of said tube without any deformation.

It is seen that owing to the rectangular form of the guide-piece *d* the tube *g* is in contact with said guide-piece all along the straight portion of the acting face *d'*, (instead of being in contact with its guide at one point, as would be the case if instead of using a rectangular guide-piece a roller were used, as in certain prior machines.) Now, this portion can always be made long enough so that its guiding action and support of the tube is carried to a point at which the drawing action (to which the metallic fibers of that part of the tube which is exterior to the curvature are subjected, owing to the tube *g* being bent round the former *f*) is hardly perceptible. The result obtained is that any crowding together of the metallic fibers is avoided as well as any rolling action or drawing of the metal on the exterior of the tube at the curvature as would be produced by using a roller as a guide, particularly in the case of thin tubes with small radii of curvature. A bent tube is thus obtained which is smooth and uniform and has no streaks or wrinkles either outside or inside. On the other hand, by means of the arrangement of apparatus described above it is possible by operating the screw *b'* in a suitable manner, so as to remove the trunnion *c'* of the rectangular guide-piece *d* from the axis of rotation *e* of the former *f*, and by making the slot *m*<sup>2</sup> slide on the set-screw *n* after having unscrewed the latter to deform the triangle *n m' c'* in such a manner as to bring the parts into a position in which the extreme surface of the guide-piece *d* instead of being in the position shown in Fig. 1—*i. e.*, in the plane indicated by the line *x y*—places itself on one side or the other of this plane. Consequently it is possible to displace the position of the guide *d* in one direction or the other along the tube *g* without changing the former *f* nor the guide-piece *d*. In other words, by means of this adjustment the distance between the point of application of the resultant of pressure to which the tube is subjected during the bending operation and the axis of rotation *e* of the movable former *f* may be varied according to the size of the tubes to be bent, according to the radius of curvature to be obtained, and according to the nature of the metal of the tube *g*. This variation is of great practical advantage, as it allows of excellent results being obtained

in all cases, even with very small tubes and small radii of curvature.

It is to be understood that the invention is not exclusively limited to the arrangement shown in the drawing and herein described merely by way of example, because the appliance might just as well be devised in such a manner that the former *f* be made to be stationary and that the whole system *a i j k m* be made to revolve round the trunnion *e*.

What we do claim as our invention, and desire to secure by Letters Patent, is—

1. In an appliance for bending tubes, the combination of a base, a guide adjacent said base, means for adjusting said guide horizontally, means for adjusting said guide angularly, means for holding said guide stationary during the bending operation, a mandrel, a former mounted on said base, a clamping member attached to said former, and means for rotating said former, substantially as described.

2. In an appliance for bending tubes, the combination of a base, a guide, means carried by said base for adjusting said guide horizontally, a front supporting-arm connected to said guide, a back supporting-arm pivotally mounted at one end to said front supporting-arm and having a slot-and-pin connection adapted to hold said guide stationary during the bending operation, a mandrel supported by said front supporting-arm, a former mounted on said base, a clamping member attached to said former, and means for rotating said former, substantially as described.

3. In an appliance for bending tubes, the combination of a base, a guide adjacent said base, a screw and block mounted in said base adapted to adjust said guide horizontally, a front supporting-arm connected to said guide at one end, a back supporting-arm connected at one end to said front supporting-arm and at the other end to said base, a slot-and-pin connection for said base and back supporting-arm, a mandrel comprising a cylindrical body having deformable segments pivotally connected thereto by means of a jointed bolt and nuts, a rod connected at one end to said mandrel and at the other end to said front supporting-arm, a former pivotally mounted of said base, a clamping member rigidly attached to said former, and a handle attached to said former and adapted to actuate the same, substantially as described.

4. In an appliance of the kind described, in combination: a base-plate, a triangular deformable frame mounted on said base-plate, a former capable of rotating on a pivot supported by said base-plate, means for turning said former, means for clamping the tube to be bent on the former, a mandrel fastened at one end near one of the apices of the deformable frame and entering at its other end the tube to be bent, means for adjusting said mandrel longitudinally, a rectangular guide

5 piece pivoting on an axis coinciding with another apex of the deformable frame, said  
 guide-piece having a straight active surface  
 to support the tube to be bent, on the outside,  
 means for shifting at will the axis on which  
 10 said guide-piece is pivoted to and from the  
 center of rotation of the former and means  
 for deforming the deformable frame in order to  
 vary the inclination of the axis of the man-  
 15 drel and of the tube to be bent with regard to  
 the base-plate in order to allow, concurrently  
 with the movement of displacement of the  
 axis of oscillation of the guide-piece, the  
 20 shifting of the same to or from the center of  
 rotation of the former, and the distance be-  
 tween the point of application of the resultant  
 of pressure applied to the tube and the center  
 of rotation of the turning former to be varied,  
 substantially as described and as shown in the  
 accompanying drawings.

25 justable joint to the other end of said base-  
 plate, a bar pivoted at one end at the other  
 end of said rod, a carriage which is longitudi-  
 nally movable on the base-plate and is pivot-  
 ally mounted at the other end of said bar,  
 30 means for shifting the carriage along the base-  
 plate, a mandrel adjustable in the direction  
 of its length fastened at one end at the ex-  
 treme end of said bar near the point where it  
 is jointed at said rod and entering, at its  
 35 other end, the tube to be bent and a guide-  
 piece having a straight active surface in  
 order to support the tube on its exterior, said  
 guide-piece being mounted in such a manner  
 that it can oscillate on the pivot connecting  
 40 the carriage with the bar, substantially as de-  
 scribed and for the purposes set forth and as  
 shown in the accompanying drawings.

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 EMILE JULIEN AUGUSTE MOYNE.

Witnesses:

LOUIS RINERY,  
 FRANK H. MASON.

5. In an appliance of the kind described in  
 combination: a base-plate, a former pivoted  
 on a stud at one end of the base-plate, a rigid  
 rod connected at one end by means of an ad-