

Nov. 22, 1949

C. J. BERTOLINI ET AL
DUAL PIVOTED BENDER FOR SIMULTANEOUSLY BENDING
TWO PARALLEL LENGTHS OF METAL TUBING

2,488,896

Filed June 14, 1946

5 Sheets-Sheet 1

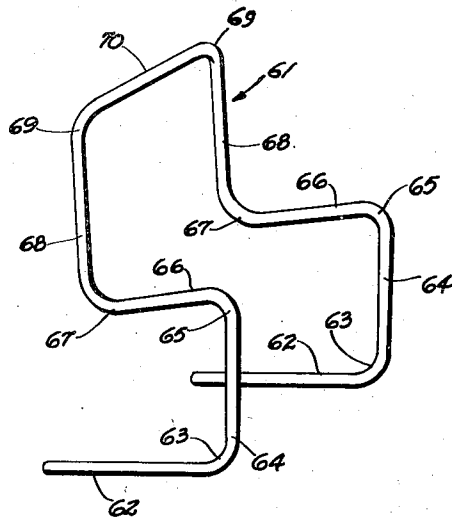


Fig. 1

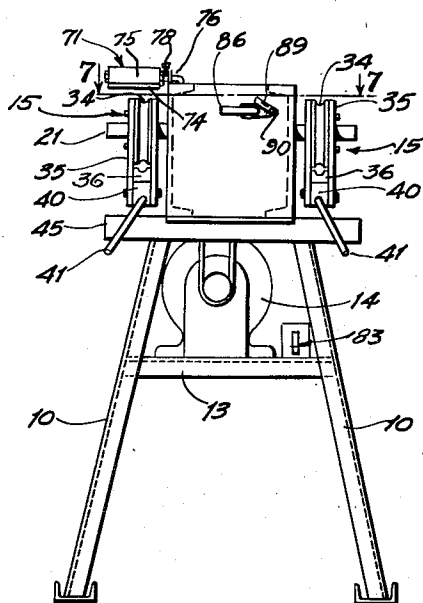


Fig. 2

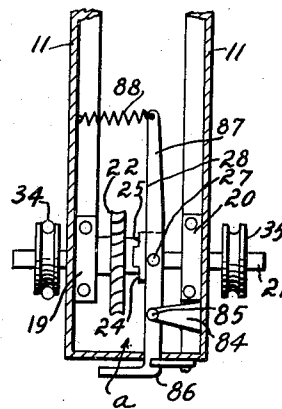


Fig. 7

INVENTOR.
CHARLES J. BERTOLINI
HENRY VAN DYKE
BY

James M. Abbott

ATTY.

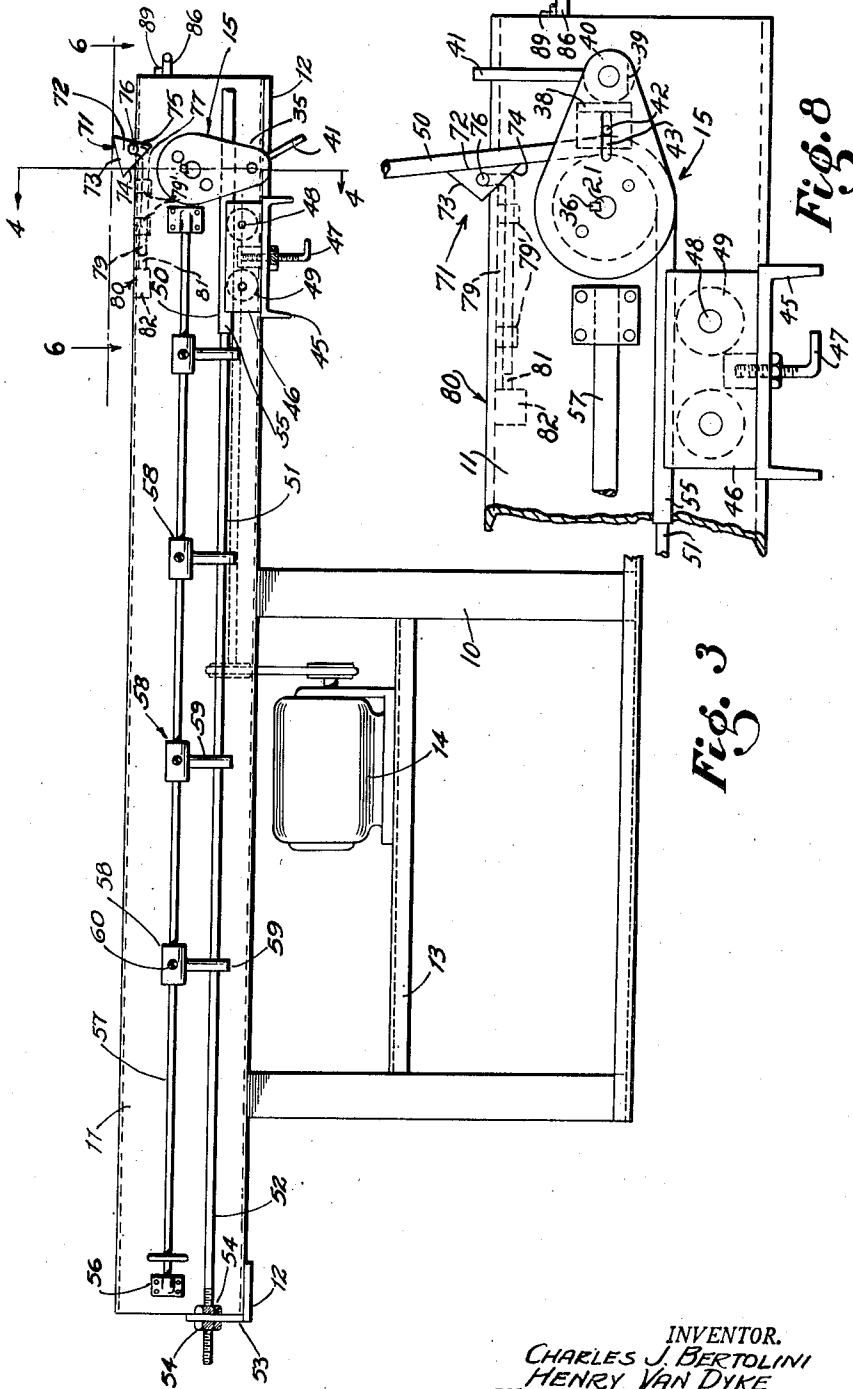
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INVENTOR.
CHARLES J. BERTOLINI
HENRY VAN DYKE
BY *James M. Abbott*

ATTY.

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5 Sheets-Sheet 3

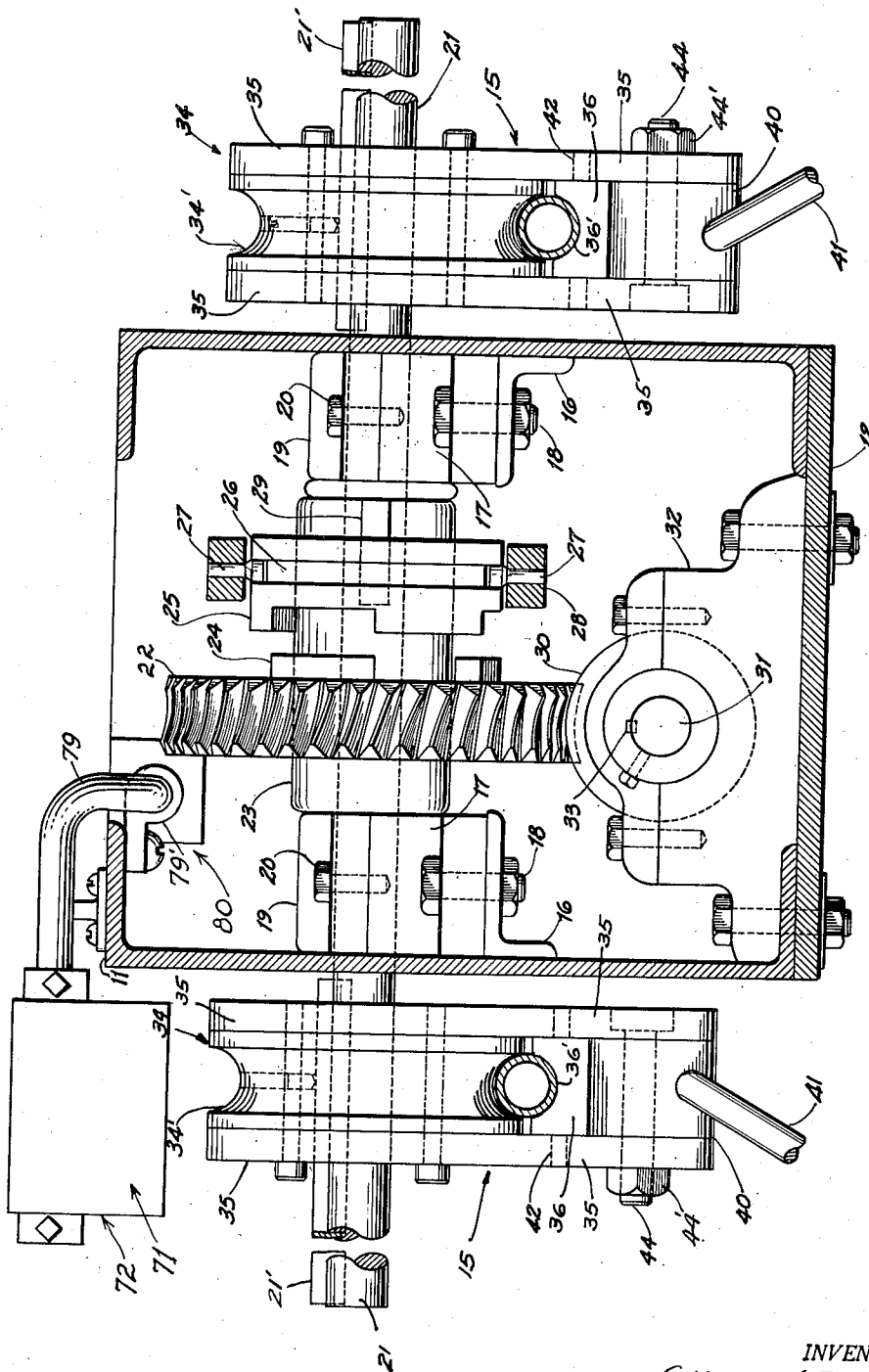


Fig. 4

INVENTOR.
CHARLES J. BERTOLINI
BY HENRY VAN DYKE
James M. Abbott
ATTY.

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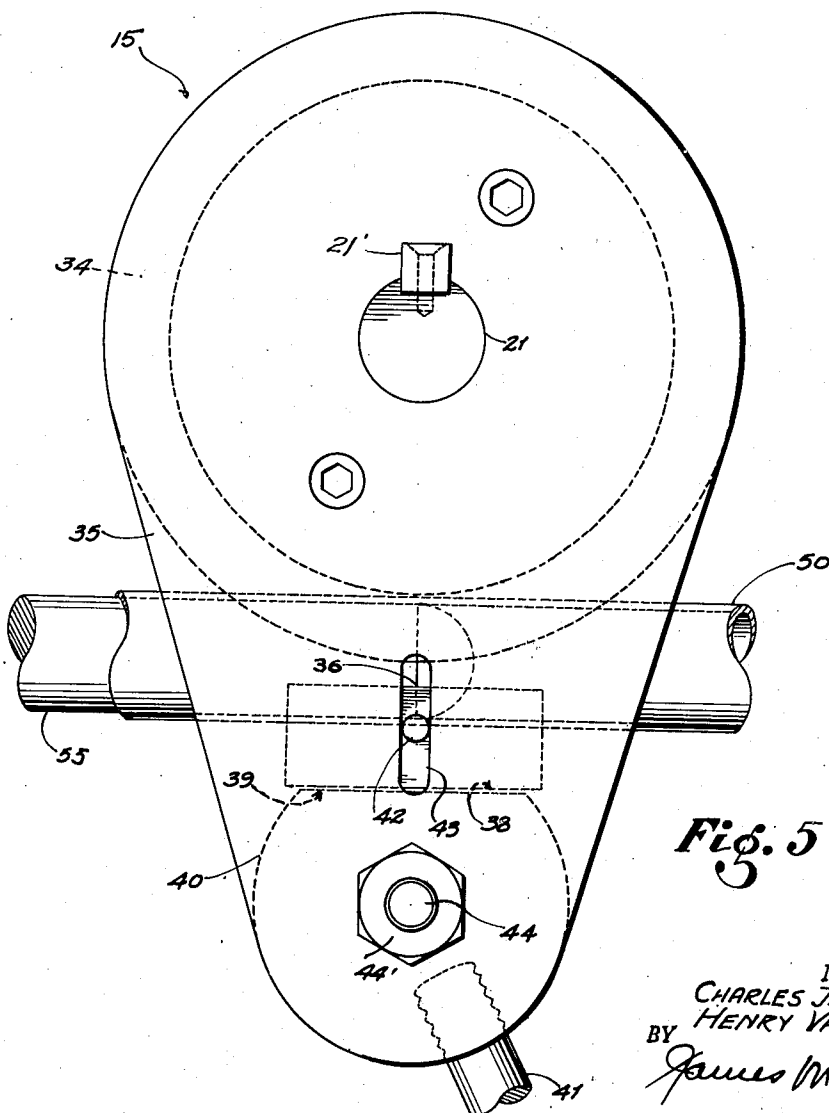


Fig. 5

INVENTOR.
CHARLES J. BERTOLINI
BY HENRY VAN DYKE.

James M. Abbott

ATTY.

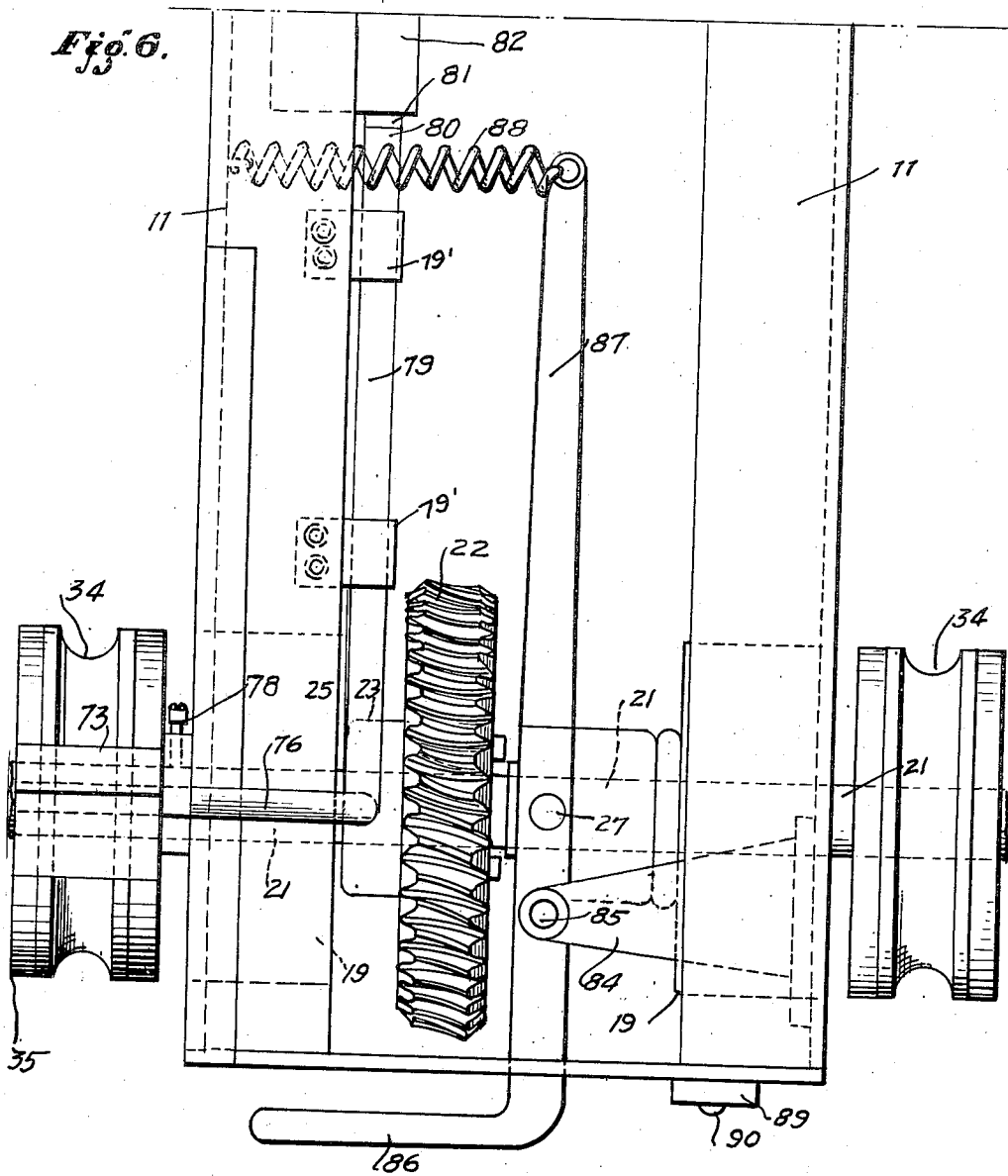
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INVENTOR.
CHARLES J. BERTOLINI,
BY HENRY VAN DYKE

James M. Abbott

ATTY.

UNITED STATES PATENT OFFICE

2,488,896

DUAL PIVOTED BENDER FOR SIMULTANEOUSLY BENDING TWO PARALLEL LENGTHS OF METAL TUBING

Charles J. Bertolini and Henry Van Dyke,
Pasadena, Calif.

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6 Claims. (Cl. 153—40)

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This invention relates to metal working machinery and particularly pertains to a bending machine.

At the present time tubular metal furniture is in vogue. This furniture is characterized as having a frame structure bent from a continuous length of metal tubing. For example, chairs may be made with a metal tubing frame. This frame comprises a cross member at the top of the back of the chair continuing in vertical uprights for the chair back, after which horizontal lengths are provided to support the seat of the chair. The frame then continues in downwardly extending vertical leg lengths and foot or base portions. It is obvious that the finish and attractive appearance of a chair of this construction depends upon the symmetry of the lines of the frame and the uniformity of the parts since the two sides of the chair frame are in duplicate and any variation in lines or bends may be noticed readily. In order to form a tubular bend satisfactorily, it is necessary to measure the metal accurately and to attempt to bend the metal so that complementary curves at opposite sides of the frame will be substantially identical. This requires skillful manipulation of the metal and accurate measuring, thus producing high labor costs.

It is the principal object of the present invention to provide a bending machine within which a loop of tubular material may be placed and by which complementary curved portions of the frame may be bent simultaneously, thus insuring that said complementary curves will be identical and may be performed rapidly and at low labor cost.

It is also an object of the invention to provide means whereby the tubular stock may be measured easily and set so that the position of the bends may be determined quickly and so that operation on successive pieces of material will be uniform.

The present invention contemplates the provision of a machine which will receive a length of cylindrical or tubular metal bent upon itself to form two parallel lengths, the said machine being designed to simultaneously engage and operate upon both of said parallel lengths so that the material of both lengths will be formed with complementary bends of equal arcuate length. The invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a perspective view showing a chair frame of the type to be bent by the use of the machine with which the present invention is concerned;

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Figure 2 is a view in end elevation showing the machine and indicating the relative positions of the tube bending heads and the drive clutch therefor;

Figure 3 is a view in side elevation showing the complete machine and indicating the spacing members and their relation to the bending heads;

Figure 4 is an enlarged vertical view in end elevation and section as seen on the line 4—4 of Figure 3 and shows the bending heads, the drive therefor, and the throwout clutch connected therewith;

Figure 5 is an enlarged fragmentary view showing one of the bending arms in side elevation and also indicating the horizontally disposed supporting rollers upon which the tubing rests while being operated upon;

Figure 6 is a view in plan as seen on the line 6—6 of Fig. 3 and drawn at substantially the same scale as Fig. 4, showing the fragmentary portion of the machine including the bending heads, the drive, and the stop switch;

Figure 7 is a view in plan as seen on the line 7—7 of Fig. 2 and indicates the two bending heads, the drive, and the control clutch;

Figure 8 is an enlarged fragmentary view in side elevation showing the end of the frame structure, the bending head mounted thereon, and its relation to the stop when the piece of work has been bent to a desired angle.

Referring more particularly to the drawing, 10 indicates a sub-frame upon which a pair of horizontal frame members 11 are mounted. These frame members are shown in Fig. 4 of the drawing as being of channel section and as being secured together by tie plates 12. The length of the horizontal frame members 11 is appropriate to accommodate the developed length of each leg of a frame structure such as indicated in Fig. 1 of the drawing. The sub-frame 10 carries a transverse frame member 13 upon which a driving motor 14 is mounted. This motor is equipped with suitable connections to be hereinafter described, for the purpose of transmitting power to a bending head generally indicated at 15 in the drawing.

The details of construction of the bending head are shown more particularly in Fig. 4. Here it will be seen that the frame members 11 carry brackets 16 upon which bearing structures 17 are secured by bolts 18. The bearing structures 17 are fitted with the usual removable journal caps 19 held in place by cap screws 20. The bearing screws are disposed adjacent to the opposed inner faces of the webs of the channels 11 and receive

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a die shaft 21. The opposed faces of the bearing structures 17 are spaced a predetermined distance apart to accommodate a spiral gear 22. This gear is formed at one side with a hub section 23 which spaces the gear from the end of one of the bearings 17. The opposite side of the gear 22 is fitted with a jaw clutch element 24. It is to be understood that the gear 22 is mounted to rotate freely upon the die shaft 21. The gear 22 is held against longitudinal movement upon the shaft by suitable means not shown in the drawings. Splined upon the shaft 21 is a jaw clutch element 25 which is complementary to the jaw clutch member 24 carried by the gear 22. The jaw clutch member 25 is formed with a shifting ring 26 which receives pins 27 carried by the arms of a shifting fork 28. The spline structure is indicated at 29.

It will be obvious that when the jaws 24 and 25 are moved into mesh, the gear 22 will drive the die shaft 21. The spiral gear 22 is in mesh with a worm gear pinion 30. This pinion is carried upon a horizontally extending drive shaft 31 which is mounted in journal blocks 32. The blocks 32 are carried upon the tie plates 12 of the frame structure. The pinion 30 is keyed to the shaft 31 as indicated at 33. The shaft is conventionally connected to the motor 14 so that it will be driven thereby.

Mounted upon the die shaft 21 at opposite sides of the frame structure 11 are circular bending dies 34. These dies are keyed to and rotated by the shaft 21 and are formed with a circumferential groove which is substantially semi-circular in cross-section, said section being described by a radius representing one-half the outside diameter of a piece of material to be bent. Fixed upon the shaft 21 at opposite sides of the dies 34 and keyed to the shaft are bending arms 35. These arms, as shown in Fig. 5 of the drawing, are held in place by keys 21 which positively secure them with relation to the shaft 21. The arms are of a length to overhang the circumference of the bending dies 34 a sufficient distance to accommodate a bending shoe 36 and an eccentric adjusting member or cam 40 therefor. The bending shoe is mounted between the arms 35 and is formed with opposite flat sides which bear against the inner faces of the arms 35. A bottom face 38 rests against a flat portion 39 of said cam 40. This cam is fitted with a handle 41 and as it is rotated will move the shoe 36 in a manner to be hereinafter described. Extending oppositely from the outer flat faces of the shoe 36 are pins 42. These pins extend through slots 43 in the arms 35, the slots extending radially of the axis of the die shaft 21 and in the same axial plane as the shaft 21 and a pivot pin 44 upon which the cam 40 is supported rotatably.

The face of each of the shoes 36 which is presented toward the axis of the shaft 21 is formed with a central longitudinal groove complementary to the groove in the circumference of the bending dies 34. Thus when a shoe 36 is moved into proximity to the circumference of a die 34, a passageway will be formed which accommodates the circumference of a member to be bent and substantially agrees therewith. This insures that the circumference of the member to be bent will be embraced completely by a shoe 36 and a die 34 in a plane of contact, which plane lies radially of the axis of the die shaft 21 and will change as the arms 35 swing upwardly.

Mounted upon the main frame members 11 is a transverse frame element 45. This element

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carries a bearing block 46. This block is mounted for vertical adjustment on the member 45 by an adjusting screw 47. The block carries a pair of trunnions 48 upon which rollers 49 are mounted. The axes of the trunnions 48 are parallel to each other and lie in a common horizontal plane. Mounted upon the trunnions 48 are guide and supporting rollers 49. The rollers 49 are formed with a circumferentially extending groove identical with that previously described as being formed around the circumference of the dies 34. In the present instance the rollers are disposed beneath a length of tubing stock 50 upon which bending operations are to be performed. The adjusting screw 47 makes it possible to raise and lower the rollers 49 so that the length of material 50 will be properly supported and guided to and beneath the circumference of the bending dies 34.

In order to properly guide the piece of tubular stock 50 and to insure that the tubing will be bent without crinkling or scratching, mandrels 51 are provided. These mandrels extend longitudinally of the outer sides of the frame members 11. Each of the mandrels has a rod portion 52 which extends through a plate 53 and is held in position by nuts 54. The opposite end of the mandrel 51 is formed with a large cylindrical portion 55. The outside diameter of this portion agrees substantially with the inside diameter of the tubular stock 50. The length of the large mandrel portion 55 is sufficient to extend across the tops of both of the rollers 49 and to terminate slightly beyond the radial vertical plane occupied by them. The outer end of the portion 55 of the mandrels 51 is hemispherical so that sufficient clearance will be provided for the tubular stock as it is wrapped around the dies 34.

Disposed parallel to the mandrels 51 and supported in bearings 56 are measuring rods 57. These rods are fitted with a plurality of adjustable stop members 58. The stop members are formed with fingers 59 which extend downwardly to a point beneath the level of the mandrels 51 and lie thereagainst to provide an adjustable abutment for a piece of stock 50 which telescopes over the mandrels 51. The stops 58 are mounted slidably upon the measuring rods 57 and may be held in position by set screws 60 and may be swung selectively into the path of travel of the end of the piece of stock 50.

A chair frame structure generally indicated at 61, made from tubular stock 50, is shown in Fig. 1. While it is to be understood that various articles might be formed by a machine embodying the present invention, a chair frame will be described by way of example. Such a frame may have feet or runner portions 62 which rest upon the floor and which at their forward ends continue in curved portions 63. These curved portions represent substantially one-quarter of a circle. The tubular stock is then bent upwardly to form legs 64. These legs are preferably at right angles to the portions 62. At the upper end of the legs are curved portions 65 which continue in seat lengths 66. These lengths are parallel to each other and lie in the same vertical plane as the runners 62. They are also disposed above these runners. The seat lengths of the frame continue in curved portions 67 upwardly from which the back portions 68 extend. The back portions 68 are curved at their upper ends as indicated at 69, the curves being connected by a transverse back member 70. It is to be understood that fabric panels may be stretched be-

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tween the back members 68 and also between the seat members 66. It will also be recognized that while the runners 62 and the legs 64 are here shown as disposed at right angles to each other, the angular relationship of the legs 64 to the seat members 66, as well as the seat member 66 to the back member 68, may be varied so that the arcs describing the curves 65 and 67 may be greater or less than 90°.

When a length of material is bent to form a frame structure, such as shown in Fig. 1, it has heretofore been common practice to make each of the bends separately. It is obvious that in view of the variations which might be required in the radius of the bends as well as the arcuate lengths of the bends, care and considerable time is required in order to insure that the bends are of proper configuration, and furthermore that the complementary bends at opposite sides of the chair are identical. It will also be recognized that in the event these bends are not identical in angle and in length, the intermediate straight lengths of material will vary so that the frame will lack symmetry. In the machine with which the present invention is involved, the lengths for the various portions of the frame are readily established by the stops 58. In order to insure that the arcuate lengths of the bends shall be uniform and of desired configuration, novel measuring means have been provided. This includes a stop member 71 shown in Fig. 3 of the drawing as comprising a triangular block 72 having stop faces 73, 74 and 75. The block is mounted to rotate upon a horizontal shaft 76, the axis of the shaft being in such a relation to the faces of the block 72 as to cause each of the faces to be spaced a different selected distance from the axis. Thus, when the block 72 is rotated upon its horizontal axis, to dispose one of its faces in a vertical plane, that face will have a definite spaced relationship to the axis of the shaft 21. Since the stop block 72 is disposed in the path of travel of the tubing stock as it is bent upwardly and around the bending dies 34, the stop structure 71 will act to determine the amount of bend which is given in each bending operation. When the stop block 72 is encountered by the swinging length of stock 50, it is intended that driving operation of the motor 14 shall be instantaneously interrupted. The structure for accomplishing this is a lever arm 77 which is fixed to the pivot shaft 76. This shaft is in turn locked to the stop block 72 by means such as a set screw 78. The lever arm 77 extends downwardly and carries a horizontally extending arm portion 79 the arm portion being guided through bearings 79' which permit the lever arm 77 and the arm to move longitudinally. At the free end of arm portion 79 is a saddle 80. The saddle 80 rests upon an actuating lever 81 of a micro-electric switch 82. The switch 82 is included within the electric circuit of the motor 14 to interrupt the same instantaneously. A main control switch 83 is also placed in the circuit so that the electric circuit may be completely broken when required.

When it is desired to disconnect the driving head from the motor 15 mechanically, the shifting fork 28 is actuated. The shifting fork 28 is mounted upon a bracket 84 carried by one of the frame members 11. The fork is pivoted at 85 and is formed with an operating handle 86 which extends forwardly and then transversely of the end of the frame members 11. Thus by pushing on the handle 86 in the direction of the arrow *a*, as shown in Fig. 6, the clutch may be

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thrown out of engagement. An arm 87 is formed as a continuation of the shifting fork 28 and extends horizontally therefrom upon the opposite side of the handle 86. This arm is fitted with a tension spring 88 which tends to hold the clutch member 25 into engagement with the clutch member 24. A latch 89 is provided at the forward end of the frame structure 11 and is mounted upon a pivot pin 90. This latch may swing into the path of the shank of the clutch handle 86 and will act to hold the clutch 25 in its disengaging position after the lever 86 has been depressed.

In operation of the present invention, the structure is assembled as shown in the drawing. An article, such as the chair frame indicated at 61, is to be made and a suitable piece of tubular stock 50 is selected for the purpose. The machine is then set up for operation. Before doing this, the character of the metal stock must be considered, as well as its wall thickness and its ductility. When these factors have been determined, the mandrels 55 are adjusted by the nuts 54 which are threaded onto the outer end of the rod 51. This longitudinal adjustment places the spherical ends of the mandrels 55 in a desired relationship to the vertical center plane of the bending head. The piece of stock 50 has been bent previously to form the complementary bends 69 at the opposite ends of the transverse back portion 70. It is to be understood that the two lengths of stock continuing from the bends 69 are equal in length and are straight and parallel. The free ends of these lengths are then slipped over the mandrels 55 and moved to an abutting position against a selected one of the stop fingers 59, the other stop fingers between the selected one and the bending arm being swung out of the path of said lengths of stock. The adjusting screws 47 are then moved to place the supporting rollers 49 in proper position beneath the tubular stock, and so that the upper face of the tubular stock will seat within the arcuate groove 34' of the bending dies 34. Thereafter the lever arms 41 are swung to rotate the cam members 40 around the axes of their bolts 44. As these cam members rotate, they will lift the shoes 36 and force them upwardly so that their arcuate grooves 36' will conform to the under face of the tubular stock 50. When this adjusting has been completed, the nuts 44' are tightened to hold the shoes 36 in their set positions. It will be recognized that when the tubular stock 50 has been properly mounted upon the mandrels with the ends of the stock abutting against suitable stop fingers 59, a desired length of the frame will project beyond the end of the machine a distance representing approximately one-half of the bend to be formed plus the length of a straight portion associated therewith. The stop unit 71 is then adjusted to rotate a suitable face 73, 74, or 75, into a plane slightly inclined to the vertical, after which the motor circuit is closed through control switch 83. This will cause the shaft 51 to be driven and it in turn will drive the worm gear 30 and the worm pinion 22 in mesh therewith. The clutch members 24 and 25 may then be placed in engagement by lifting the latch member 89 so that the spring 88 will urge the clutch member 25 into engagement with the clutch member 24. Thus the shaft 21 will be rotated and will swing the arms 35 in the direction of the arrow *c* as shown in Fig. 3. As these arms swing upwardly, they will wrap the stock 50 around the bending dies 34 until the free length of stock encounters a face on the block 72 of the

stop structure 71. When that takes place the face of the block 74 which has been engaged will be moved towards a true vertical plane and the lever arm 77 will be moved longitudinally to operate the micro-electric switch 82 and break the motor circuit. This circuit cannot be again established until a relay switch is closed. Such a structure may be associated with the cut-off switch 83. When the next bend is to be made, the stock 50 is moved longitudinally of the members 51 until the ends of the stock encounter the stop fingers 59. In the event that a different degree of bend is required, the stop block 72 is rotated upon the pivot shaft 76 and is set so that it will be fixed with relation to the shaft. Another bending operation may then take place and these operations may be continued until the frame has been formed completely.

It will be obvious that the width of the structure as represented from the distance between centers of the grooves in the bending dies 34 may be selected to accommodate a desired piece of work, since the bending dies perform a duplicate operation at each side of the machine.

It will thus be seen that the machine here disclosed is compact in design and construction and that it provides means whereby duplicate bends of a desired radius and degree may be made simultaneously and the entire operation carried on in a semi-automatic manner.

While we have shown the preferred form of our invention as now known to us, it is to be understood that various changes may be made in the combination, construction and arrangement of parts, by those skilled in the art, without departing from the spirit of the invention as claimed.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. A machine for bending a tubular metal blank, which blank is initially bent upon itself to form equal parallel leg sections, said machine comprising, a main frame, a pair of mandrels extending longitudinally thereof and fixed at one end thereto and over which the parallel portions of the blank telescope, means for adjusting the effective length of said mandrels, the opposite ends of said mandrels being free, supporting means for the blank adjacent the free ends of the mandrels, a pair of die heads, one supported by the frame in a plane to receive the tubular stock of a leg of said blank, each of said die heads comprising a circular die having an arcuate groove, the bottom of which groove lies tangentially with the surface of the tubular blank, a shaft upon which said dies are mounted, bending arms associated with each of said dies and adapted to swing around the axis of said shaft, a bending shoe carried by each of said arms and being formed with a longitudinal groove of arcuate section complementary to the circular groove on the bending dies whereby the tubular metal stock may be embraced in said complementary grooves, means for setting said shoes in a desired fixed position upon the bending arms, means for rotating the shaft upon which the bending dies are mounted and a manually actuated clutch disposed between said rotating means and the shaft.

2. A machine for bending a tubular metal blank which blank is initially bent upon itself to form equal parallel leg sections, said machine comprising, a main frame, a pair of mandrels extending longitudinally thereof and fixed at one end thereto and over which the parallel portions of the blank telescope, means for adjusting the

effective length of said mandrels, the opposite ends of said mandrels being free, supporting means for the blank adjacent the free ends of the mandrels, a pair of die heads, one supported by the frame in a plane to receive the tubular stock of a leg of said blank, each of said die heads comprising a circular die having an arcuate groove, the bottom of which groove lies tangentially with the surface of the tubular blank, a shaft upon which said dies are mounted, bending arms associated with each of said dies and adapted to swing around the axis of said shaft, a bending shoe carried by each of said arms and being formed with a longitudinal groove of arcuate section complementary to the circular groove on the bending dies whereby the tubular metal stock may be embraced in said complementary grooves, means for setting said shoes in a desired fixed position upon the bending arms, power driving means for said die heads and a manually operable clutch between said power driving means and the die head shaft.

3. A machine for bending a tubular metal blank which blank is initially bent upon itself to form equal parallel leg sections, said machine comprising, a main frame, a pair of mandrels extending longitudinally thereof and fixed at one end thereto and over which the parallel portions of the blank telescope, means for adjusting the effective length of said mandrels, the opposite ends of said mandrels being free, supporting means for the blank adjacent the free ends of the mandrels, a pair of die heads, one supported by the frame in a plane to receive the tubular stock of a leg of said blank, each of said die heads comprising a circular die having an arcuate groove, the bottom of which groove lies tangentially with the surface of the tubular blank, a shaft upon which said dies are mounted, bending arms associated with each of said dies and adapted to swing around the axis of said shaft, a bending shoe carried by each of said arms and being formed with a longitudinal groove of arcuate section complementary to the circular groove on the bending dies whereby the tubular metal stock may be embraced in said complementary grooves, means for setting said shoes in a desired fixed position upon the bending arms, an electric motor for driving said die heads, a gear train between the electric motor and the die head shaft, and a normally set clutch for establishing a driving connection between said gear train and said die head shaft.

4. The combination of parts as set forth in claim 3 including, manually controlled lock means for holding the clutch in its disengaged position.

5. The structure as set forth in claim 3 including, stop means interposed in the path of travel of the stock being bent whereby the electric motor circuit will be broken.

6. A machine for bending a tubular metal blank which has been formed by bending a length of tubular material upon itself to form parallel straight legs of equal length, which machine comprises, a horizontal elongated main frame to be straddled by the tubular blank with the leg portions extending along opposite sides of said frame and the end bend extending around the forward end of the frame, a pair of longitudinally extending guide rods secured at the rear end of the frame and extending horizontally to terminate adjacent the forward end of the frame, cylindrical mandrel sections carried upon the free ends of said rods, said mandrel sections ter-

minating in a hemispherical end and agreeing substantially in diameter with the inside diameter of the tubular stock, a transverse horizontal shaft rotatably carried by the main frame adjacent its forward end, the longitudinal axis of said shaft lying substantially in an equatorial plane of the hemispherical ends of said mandrels, bending dies mounted upon the ends of said shaft and being formed with a circumferential groove, the sectional contour of which substantially agrees with the upper portion of the tubular stock, bending arms mounted upon said transverse shaft, adjacent to said circular bending dies, adapted to oscillate around the axis of said shaft, bending shoes carried by said bending arms, said shoes being formed with a semi-circular groove complementary to the semi-circular groove in the bending dies whereby the tubular blank may be substantially embraced by a shoe and a die, means carried by said arms for adjusting the shoes radially on the arms, supporting means carried by the main frame adjacent to the normal lowermost positions of said arms and upon which the legs of said tubular blank rest and are guided, and means for simultaneously swinging the bending arms around the axis of the bending dies whereby engaged lengths

of the legs of the tubular blank will be simultaneously wrapped around the circular bending dies for a desired angular distance, and stop means for determining said angular distance.

CHARLES J. BERTOLINI.
HENRY VAN DYKE.

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