Dec. 29, 1942. E. W. ALLARDT 2,306,374

BENDING MACHINE

Filed Oct. 5, 1939 4 Sheets-Sheet 1

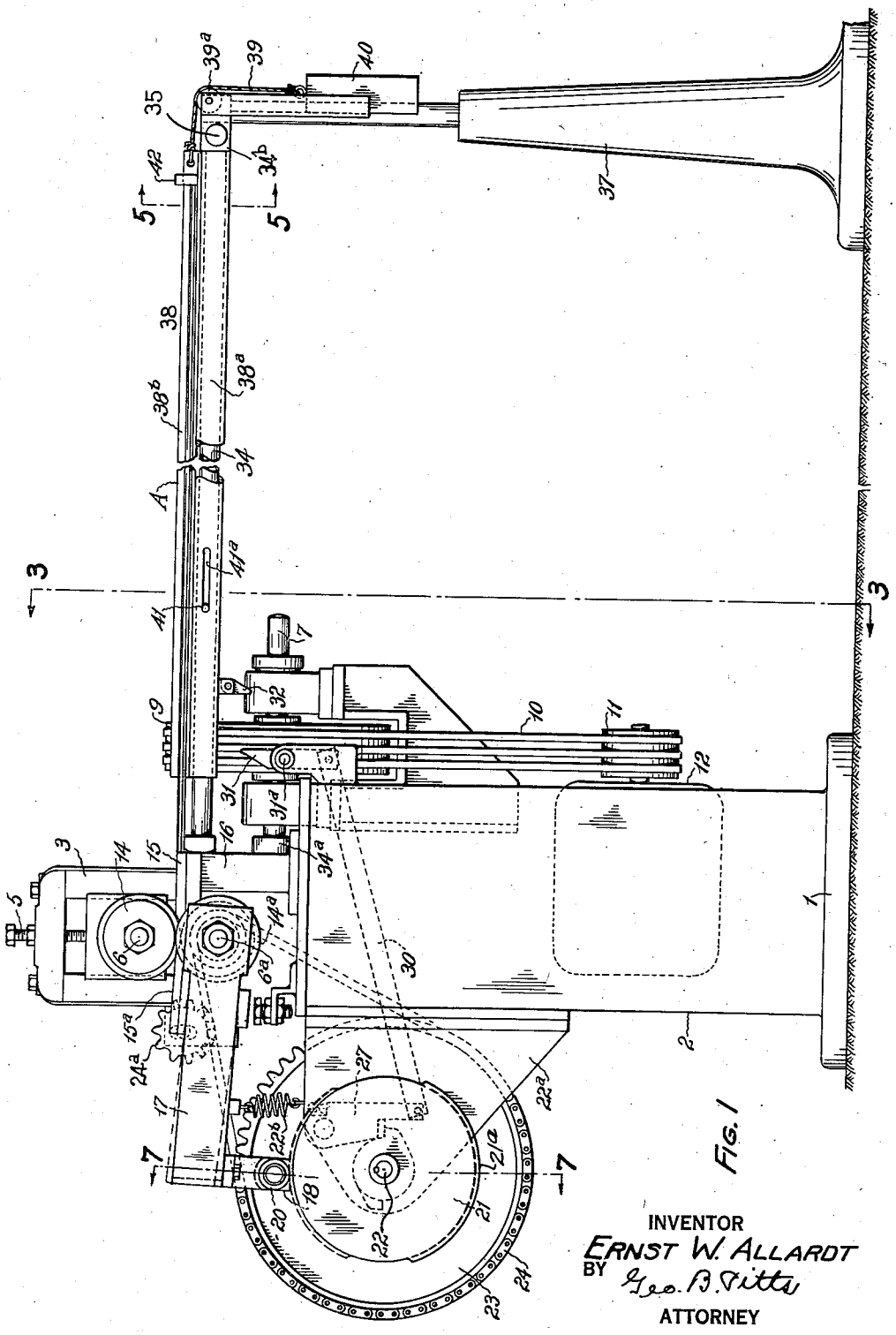


FIG. 1

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BENDING MACHINE

Filed Oct. 5, 1939 4 Sheets-Sheet 2

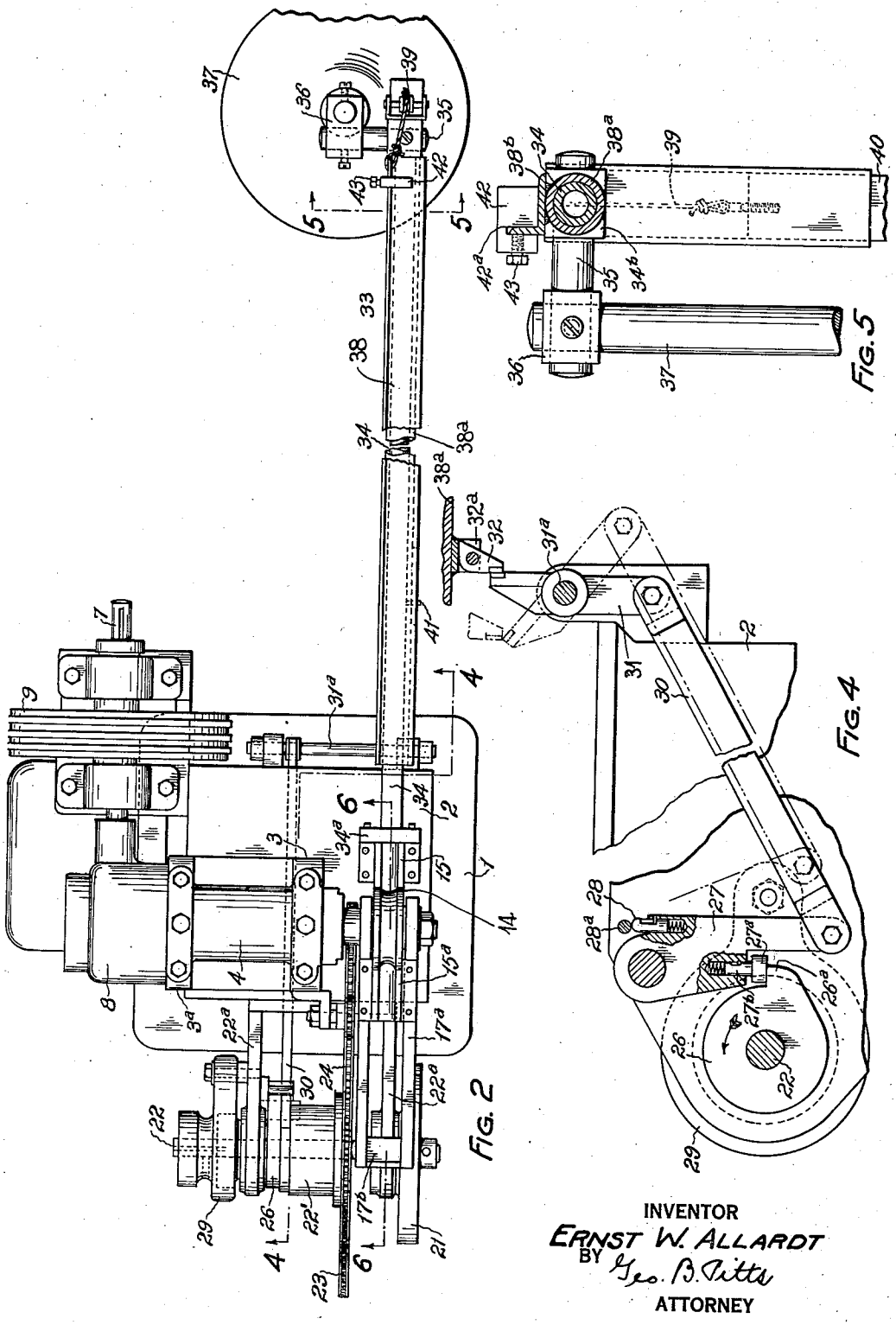


FIG. 2



FIG. 4



FIG. 5

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BENDING MACHINE

Filed Oct. 5, 1939 4 Sheets-Sheet 3

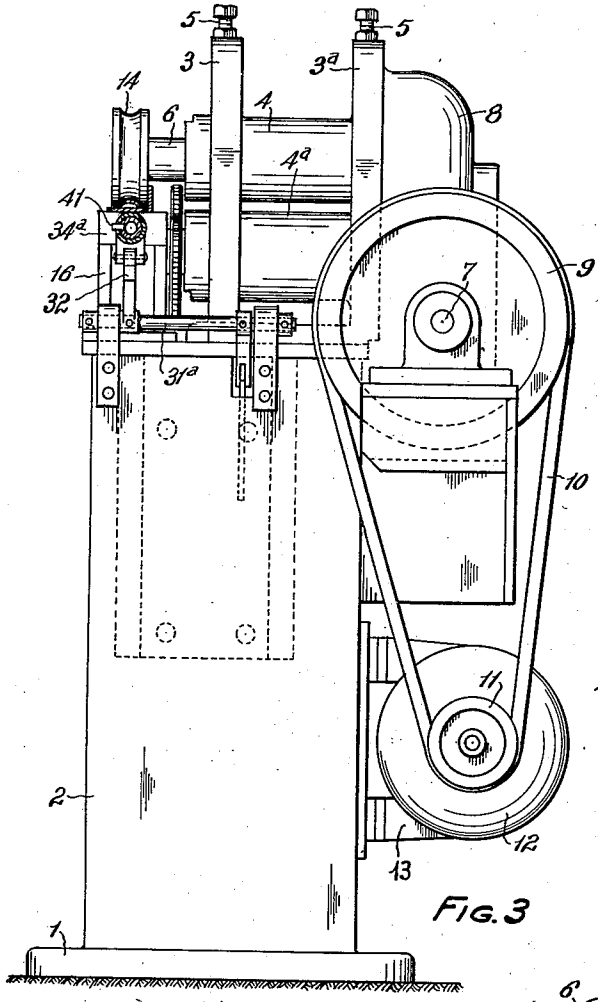



FIG. 3

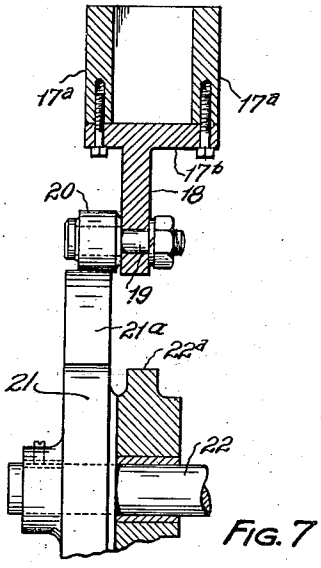



FIG. 7

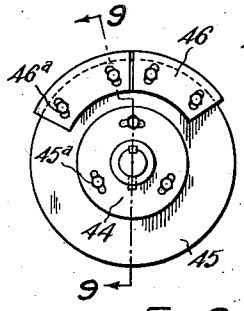



FIG. 8

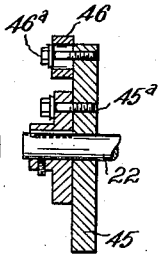



FIG 9

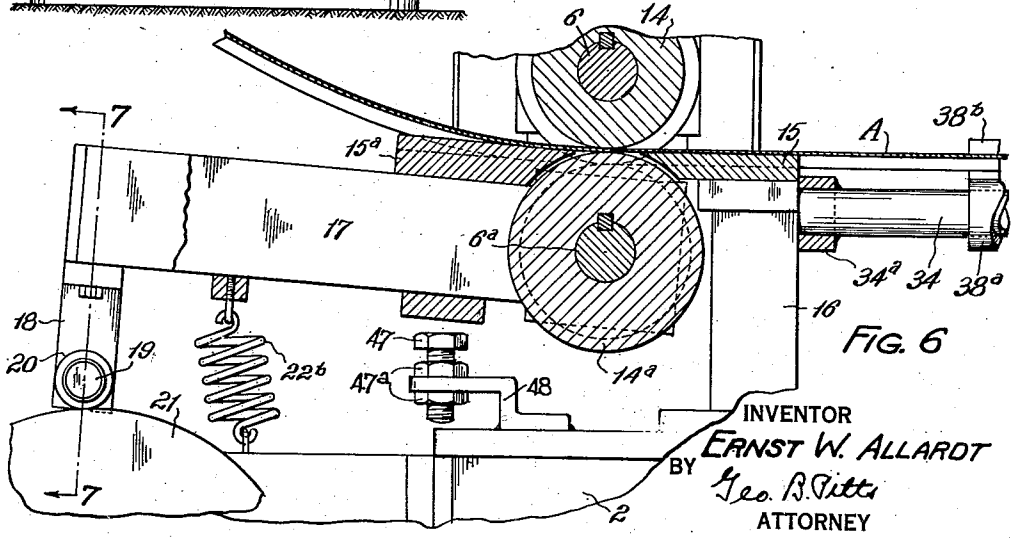


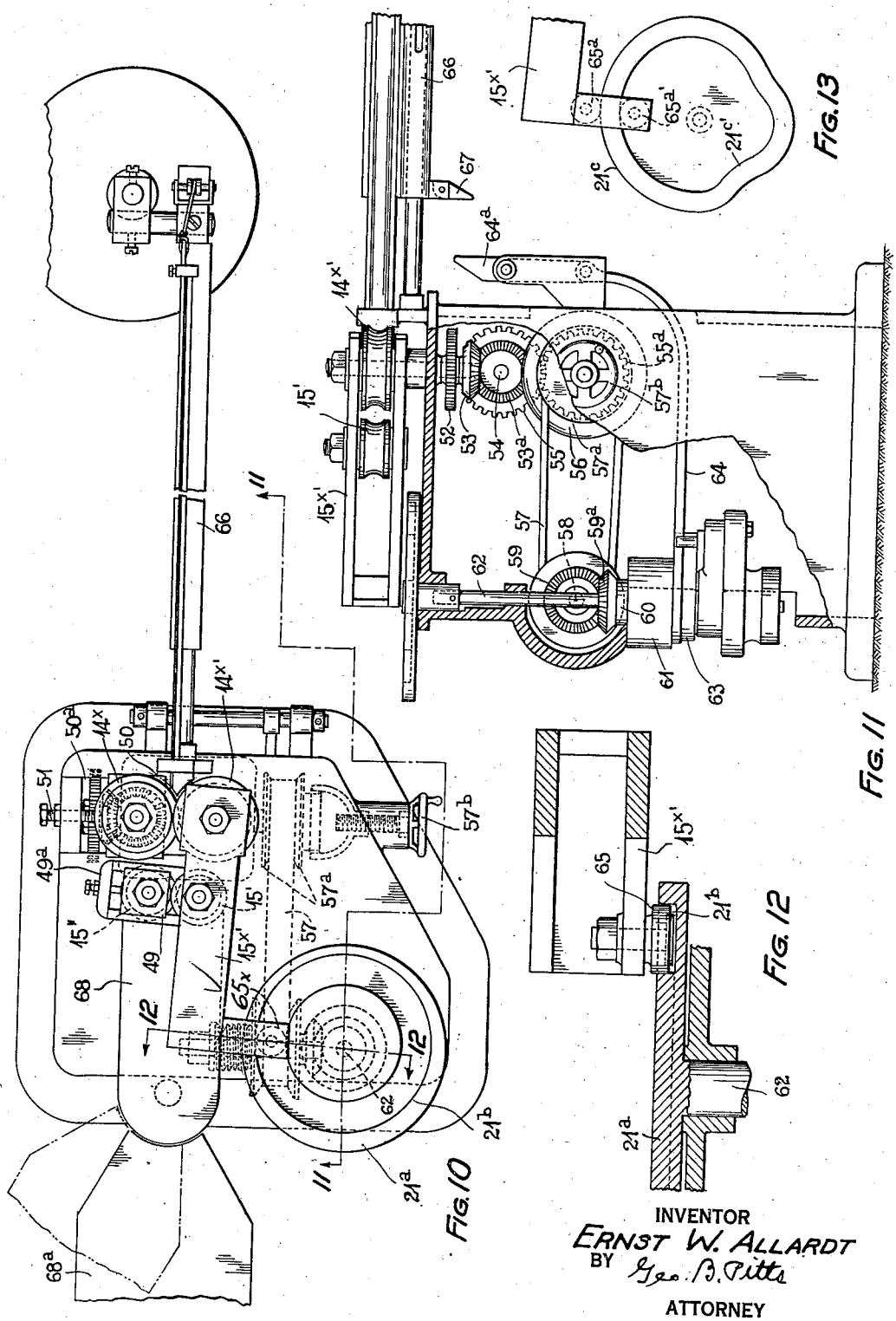

FIG. 6

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Dec. 29, 1942. E. W. ALLARDT 2,306,374

BENDING MACHINE

Filed Oct. 5, 1939 4 Sheets-Sheet 4




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2,306,374

# UNITED STATES PATENT OFFICE

2,306,374

## BENDING MACHINE

Ernst W. Allardt, Parma, Ohio, assignor to The Yoder Company, Cleveland, Ohio, a corporation of Ohio

Application October 5, 1939, Serial No. 298,043

14 Claims. (Cl. 153—3)

This invention relates to a machine for bending sheet metal in a rapid manner.

The machine may be applied to the bending of flat metal strips, angles, and metal sections of varying cross sectional shape, the example shown consisting of a preformed strip having a curvilinear cross section.

One object of the invention is to provide an improved machine of this type, having a work feeding device arranged to control the bending devices in relation to the supply of each work piece irrespective of the length thereof.

Another object of the invention is to provide an improved machine of this type wherein the bending device is cam controlled and operable in relation to the supply of each metal section, whereby the sections are uniformly bent.

Another object of the invention is to provide an improved machine of this type wherein the work support is of sectional form, one section of which is movable and operable during the feeding of each work piece, whereby the bending operation may be effected upon any portion of the work.

Another object of the invention is to provide an improved machine of this type wherein the work support is of sectional form, one section of which is movable and controlled by cam means, whereby one or more bends may be imparted to each work piece.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings, wherein

Fig. 1 is a side elevation of a machine embodying my invention.

Fig. 2 is a plan view.

Fig. 3 is a section on the line 3—3 of Fig. 1.

Fig. 4 is a fragmentary view showing the means for controlling the cam shaft, substantially on the line 4—4 of Fig. 2.

Figs. 5 and 6 are fragmentary sections on the lines 5—5 and 6—6, respectively, of Fig. 2.

Fig. 7 is a fragmentary section on the line 7—7 of Fig. 1.

Fig. 8 is a detail view showing a different form of cam.

Fig. 9 is a section on the line 9—9 of Fig. 8.

Fig. 10 is a plan view showing a different embodiment of the invention.

Fig. 11 is a fragmentary view partly in elevation and partly in section on the line 11—11 of Fig. 10.

Fig. 12 is a section on the line 12—12 of Fig. 10.

Fig. 13 is a fragmentary view showing a modified form of cam.

In the drawings, 1 indicates a base member provided with an upright support 2 of any desired construction. The support 2 is provided with suitable standards 3, 3a, forming supports for upper and lower sleeves 4, 4a, the upper sleeve being adjustable in a well known way by means of screws 5. The sleeves 4, 4a, house suitable anti-friction bearings for upper and lower shafts 6, 6a, the inner ends of which are geared together and one thereof is drivingly connected to a shaft 7. The driving means between the shafts 6, 6a, and the shaft 7 are contained in a casing 8, the walls of which are preferably formed integrally with the standard 3a. The shaft 7 is provided with a power element, such as a pulley 9, engaged by a suitable endless member 10, driven by a pulley 11 fixed to the shaft of a motor 12. The motor 12 is supported on a yoke member 13, which is fixedly secured to a pad 13a provided on the support 2, the securing devices permitting adjustment of the motor 12, whereby the endless member 10 may be maintained taut. The endless member 10 and pulleys 9 and 11 may be of a type which change the driving ratio of the shaft 7 to the motor shaft when the motor 12 is adjusted.

The outer ends of the shafts 6, 6a, are provided with work engaging rolls 14, 14a, respectively, which have peripheries complementary to the shape of the work and arranged to engage the work, whereby the latter will be fed forwardly. As the rolls 14, 14a, are continuously driven, upon the introduction of a work piece between them, the work piece, irrespective of its length, will be fed between and through the rolls 14, 14a. The rolls 14, 14a, are mounted between fixed and movable sections 15, 15a, of a table for the work, the fixed section 15 being mounted on a standard 16 supported on the support 2. The movable section 15a is carried by an arm 17 preferably consisting of spaced members 17a rigidly connected at their outer ends by a cross member 17b, the members 17a at their inner ends being pivotally mounted on the shaft 6a at opposite sides of the roll 14a, whereby the outer end of the arm may be swung about the axis of the shaft 6a, to operate the table section 15a in relation to the table section 15 and roll 14, as the work is fed by the rolls 14, 14a, forwardly, to effect bending or curving of each work piece. The cross member 17b is preferably approximately T-shaped, the depending leg 18 of which supports a stud shaft 19 (see Fig. 7). The shaft 19 is provided with a

roller 20 which engages a cam 21, the cam being detachably fixed to and driven by a shaft 22. The shaft is mounted in suitable bearings provided in brackets 22a which are secured to the support 2. An expansion spring 22b connected to the arm 17 and support 2 normally serves to maintain the roller 20 in engagement with the cam 21. The shaft 22 is normally held stationary with the cam 21 in a predetermined starting position and arranged to support the work engaging section 15a in position (preferably horizontally) to engage each work piece as it is fed forwardly. The shaft 22 is adapted to be connected to a one-revolution clutch 22' the driven member of which is driven by one of the roll carrying shafts 6, 6a, preferably the lower shaft 6a, so that the speed of the cam may be synchronized with the feed of each work piece by the rolls 14, 14a, relative to the table sections 15, 15a. In such construction, due to the fact that the connection of the cam shaft 22 to clutch 22' is controlled by the supply of each work piece A to the rolls 14, 14a, as later set forth, the cam 21 may be arranged to operate upon any predetermined portion of each work piece; that is, upon an end portion of each work piece or a portion intermediate its ends.

The one-revolution clutch 22' may be of any standard form of construction. One example of such a clutch is shown in the application of Alexander Borzym, Serial No. 193,957, on which Letters Patent No. 2,205,389 issued June 25, 1940. In that application the clutch elements are released by a cam, whereas the clutch elements 22' herein are released by a stop, as later set forth. The driven member of the clutch 22' is provided with a sprocket 23, which is engaged by an endless chain 24. The chain engages with and is driven by a sprocket 25 fixed to the roll shaft 6a. The chain 24 is maintained taut by an adjustable idler 24a. The connection of the shaft 22 to the driven member of the clutch 22' is controlled by a collar 26, rotatably fitting the shaft 22 and having a shoulder 26a normally engaged by a movable release device 27, which serves to hold the collar 26 stationary and the shaft 22 in disconnected relation to the driven member of the clutch, but upon release of the shoulder 26a by the device 27 (see dotted lines in Fig. 4), the collar connects the driven clutch member to the shaft 22 to rotate the latter. As the release device 27, following its release of the shoulder 26a, is returned to normal position under the influence of a spring operated plunger 28 mounted on the device and engaging a fixed stop or abutment 28a, with its shoulder engaging element 27a in the path of movement of the shoulder 26a, the rotation of the collar will be stopped, the effect of which is disconnect the shaft 22 from the driven clutch member at the end of one revolution of the shaft 22. The shaft 22 may be provided with a suitable magnetically operated brake, indicated as an entirety at 29, which stops the rotation of the shaft when it becomes disconnected from the clutch and releases it when the clutch is connected to the shaft. The release device 27 is connected by a link 30 to one arm of a rocker 31 fixed to a rock shaft 31a, which is mounted in bearings on the support 2, the other arm of the rocker being normally disposed in the path of movement of a trip 32 which operates the rocker, as later set forth. The rocker 31 being connected to the release device 27, it is returned to normal position after it is operated by the trip 32 under the influence of the spring for the plunger 28. The shoulder engaging device 27a of the release device 27 is preferably provided with a shank 27b slidably fitting a recess in the wall of the device 27, a compression spring being interposed between the inner end of the shank 27b and bottom of the recess to absorb the shock incident to the engagement of the shoulder 26a with the device 27a to stop the collar 26. A pin or other device is mounted in the recess for the shank 27b and is engaged by the end wall of a cut-away formed in the shank to limit its outward movement under the influence of the compression spring. The plunger 28 is mounted in the wall of the release member 27 similarly to that of the device 27a.

33 indicates as an entirety the supporting and supply means for each work piece, preferably comprising the following: 34 indicates a bar (which may consist of a tubular member) fixedly fitting into an opening formed in a plate 34a on the side wall of the standard 16. The outer end of the bar 34 is provided with a block 34b which is connected to one end of a laterally projecting rod 35, the other end of the rod, through a block 36, being detachably connected to the upper end of a pedestal 37. 38 indicates a slide member on which each work piece A is positioned and then moved forwardly to engage the advancing end thereof with the rolls 14, 14a, this member consisting of a tube 38a slidably fitting the bar 34 and an angle 38b suitably secured to the tube 38a. The rear end of the angle 38b is connected by a flexible member, such as a chain or section of rope 39, running over a sheave 39a, with a weight 40, which normally maintains the slide member 38 in its rearmost position with the tube 38a in engagement with the block 34b, the block serving as a stop for the member 38. Where the angle 38b is fixed to a tube and the latter slides on a correspondingly shape guide, as above set forth, I provide the guide bar with a laterally projecting pin 41 which slides in an elongated slot 41a formed in the tube 38a to prevent the latter from rotating on the bar 34 and thus maintain the angle 38b in operative relation to the table sections 15, 15a, and rolls 14, 14a. The trip 32 consists of a dog pivoted on a bracket 32a which is secured to the underside of the tube 38a in spaced relation to the rocker and moves with the tube to operate the rocker 31 as shown in dotted lines in Fig. 4. The tail portion of the dog 32 is arranged to engage the bracket to lock it against rotation so as to be effective to operate the rocker 31 in the forward movement of the member 38, but is free to swing about its pivot to ride the rocker in the return movement of the member 38. 42 indicates a guide for each work piece when positioned on the supporting angle 38b. The guide consists of a plate arranged transversely of the angle 38b. The plate may be adjustably secured to the angle 38b in any desired manner, but preferably it is formed with a slot 42a which receives the up-standing wall of the angle 38b, and by means of a set screw 43 threaded through its end wall, the plate is removably and adjustably secured thereto. The position of the guide 42 on the angle 38b depends upon the length of the work pieces A and that portion of each work piece that is to be bent by the table section 15a, so that when the supporting member 38 has moved a distance equal to the spacing between the trip 32 and rocker 31, plus the excess distance required to effect a release of the device 27a from the shoulder 26a and movement of the arm 17 into operative position, that portion of the work piece A, namely, its advancing end or that inter-

mediate portion which is to be bent, has been fed into engagement with the table section 15a.

While the trip 32 is shown as fixed to the slide member 38, it may be adjustably mounted thereon to increase or decrease its spaced relation to the rocker 31.

The cam 21 is removably secured on the shaft 22, so that it may be replaced by a cam having a different contour, the securing means also permitting the cam to be angularly adjusted on the shaft to insure its operation in any predetermined relation to the feed of each work piece.

*Operation.*—In Fig. 1 the guide 42 is shown at the rear end of the slide member 38 so as to take a section of material A of maximum length and the cam 21 is provided with a wall 21a the radius of which determines the curvature to be imparted to a portion of each section. The length of the curved portion will depend upon the speed of the cam 21 relative to the speed of the sections. Each section of material is placed on the slide member 38 with its rear end against the guide 42. The slide member 38 is then moved forwardly to engage the advancing end of the section A between the rolls 14, 14a, which feed the section forwardly relative to the table sections 15, 15a. As soon as the advancing end of the section A is engaged by the rolls 14, 14a, the slide member 38 is returned to its starting position or allowed to return under the influence of the weight 40. In the forward movement of the slide member 38 the trip 32 engages with and operates the rocker 31, which effects a connection of the clutch 22' with the shaft 22 to rotate the cam 21; the wall 21a of the cam 21 in turn swings the arm 17 upwardly to position the table section 15a in a predetermined angular relation to the wall 15 and slide member 38, the table section 15a in this position serving to curve the section upwardly (see Fig. 6), until the cam wall 21 moves beyond the roller 20 to permit the arm 17 to swing downwardly to its normal position, following which the remaining portion of the section is fed forwardly by the rolls 14, 14a. The guide 42 is positioned on the slide member 38 at a predetermined distance from the rolls 14, 14a, dependent upon the length of each section. In the arrangement illustrated, the guide 42 may be positioned so that the trip 32 will effect operation of the arm 17 to curve the end portion of the section or a portion inwardly of its advancing end. The portion of each section to be curved may also be varied by substituting a cam having a cam wall arranged to operate the arm 17 at any desired angular position of the cam as it rotates.

Figs. 8 and 9 illustrate a modified construction of cam consisting of a hub member 44 fixed to the shaft 22, a disk 45 adjustably fixed to the hub member by bolts 45a extending through elongated slots, whereby the disk and hub member may be angularly adjusted one relative to the other, and a camming device 46 mounted on the disk and adjustable radially, its outer wall serving as a cam to operate the roller 20. The cam 46 is formed with elongated openings for bolts 46a, which secure the device to the disk 45, the openings for the bolts 46a being parallelly related and disposed on opposite sides of an imaginary radius extending midway between them. The outer or roller engaging cam wall may be of any desired shape. A plurality of cam devices 46 may be employed as shown. When two cam devices 46 are employed any existing space between them may be closed by a spacer to provide a continuous outer wall.

47 indicates a stop carried by the support 2 below the arm 17 for limiting the downward movement of the latter at any desired position. The stop 47 preferably comprises a suitable bolt threaded through and adjustably secured by jam nuts 47a to a bracket 48 on the support 2. By adjusting the stop 47 to so limit the downward movement of the arm 17 that the position the table section 15a will be at an angle to the section 15, during engagement of the roller 20 with the inactive portion of the cam 21, the latter will bend each work piece on one radius and the remaining portion thereof on another radius.

Figs. 10, 11 and 12 illustrate a modified form of construction wherein the driven feed rolls, indicated at 14x, 14x' are mounted on vertically disposed shafts and the work engaging members or sections, indicated at 15x, 15x', at opposite sides of the rolls 14x, 14x', are disposed vertically, the latter member being swingable laterally on the shaft for the roll 14x'. By preference, the swingable section 15x' is provided with a pair of rollers 15', 15'', which engage the work to reduce the friction thereon, and cooperate with a cam 21a to bend portions of each work piece in opposite directions. The rollers 15', 15'', freely rotate on their supporting shafts. The shaft for the roller 15'' is mounted in a bearing box 49, which is adjustably mounted in a standard 49a. The shaft for the feed roll 14x is mounted in a bearing box 50 which is adjustable in ways 50a by a screw 51. The shafts for the feed rolls 14x, 14x', are geared together, as shown at 52, and one of said shafts is drivingly connected by bevel gears 53, 53a, to a shaft 54. The shaft 54 is provided with a gear 55 in mesh with a gear 55a fixed to the shaft of a motor 56. The motor shaft through an endless member 57 drives a countershaft 58, which through bevel gears 59, 59a, drives a sleeve shaft 60, the latter being connected to and driving the rotary member of a one-revolution clutch, indicated as an entirety at 61. The driving element for the endless member 57 consists of relatively movable members 57a which may be adjusted toward and from each other by a hand wheel 57b to change the speed ratio of the motor shaft and shaft 58, the endless member 57 being shaped to co-act with the members 57a. As this form of change speed is well known, it is not illustrated in detail. The connection of the driven member of the clutch 61 to a shaft 62, on which the cam 21a is removably mounted, is controlled by the release of a collar (similar to the collar 26 shown in Fig. 4) by a release device 63, the latter being operated to release the collar by a link 64 connected to and operated by a rocker 64a. The cam 21a in this form of construction controls the swinging movement of the member 15x' to bend portions of each work piece in opposite directions. In the form of construction shown in Fig. 10, the face of the cam 21a is provided with an eccentric groove 21b in which a roller 65, carried by a device 65x extending from the member 15x', is guided as the cam rotates. Accordingly, as each work piece is fed by the rolls 14x, 14x' through the rollers 15', 15'', the member 15x' will be operated in one direction throughout a portion of the cam groove 21b and in the opposite direction throughout another portion of the cam groove 21b. The groove 21b may be otherwise shaped. Fig. 13 illustrates a cam of different contour and having exterior and interior cam walls 21c, 21c' engaged respectively

by rollers 65a, 65a', mounted on the member 15x', to operate the latter about its axis first in one direction and then in the opposite direction, and bend portions of each work piece in opposite directions. It will be understood that the throw of each cam or cam wall determines the amount of curvature imparted to each work piece. Each of the work pieces is mounted on a slidable member 66, which is preferably similar in construction and operation to the member 38 already described. The member 66 is provided with a trip 67, which engages with and operates the rocker 64a, in each forward movement of the slide member 66, the rocker in turn, through the link 64, serving to release and then reengage the collar, whereby the clutch rotates the shaft 62 one revolution to operate the cam 21a. A table 68 is provided to support each of the work pieces as it leaves the rolls 15', 15'', the outer end of the table being provided with a swingable section 68a which may be adjusted to different positions (as shown in dotted lines) dependent upon the curvature of the bent work pieces. The section 68a may be of any desired length.

It will be noted that in my form of construction the cam is connected to the power means by the slide member 38 in its forward movement to deliver a work piece to the feed rolls and automatically disconnected from the power means when it has moved a predetermined distance, so that the work pieces of any desired length may be operated upon.

To those skilled in the art to which my invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. My description and the disclosure herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

1. In a bending machine, the combination of a reciprocatable support for work pieces, a pair of driven rolls to which each work piece is delivered by said support, a work piece engaging member disposed on that side of said rolls remote from said support, said member being pivoted on an axis co-incident with the axis of one of said rolls, power means, a cam normally disconnected from said power means but arranged when connected thereto to swing said pivoted member about its axis toward the other roll, and means actuated by said support as it delivers a work piece to said rolls for connecting said power means to said cam.

2. In a bending machine, the combination of a slidable support for work pieces, a pair of driven rolls to which each work piece is delivered, a work piece engaging member disposed on that side of said rolls remote from said support, said member being pivoted on an axis co-incident with the axis of one of said rolls, a cam arranged to swing said pivoted member about its axis, power means, a clutch interposed between said power means and the shaft for said cam, and means controlled by said support for connecting said clutch to the cam shaft and disconnecting it therefrom.

3. In a bending machine, the combination of a slidable support for work pieces, a pair of driven rolls to which each work piece is delivered, a work piece engaging member disposed on that side of said rolls remote from said support, said member being pivoted on an axis co-incident with the axis of one of said rolls, a cam arranged to swing said pivoted member about its axis, power means, a one-revolution clutch interposed between said power means and the shaft for said cam and normally disconnected from the latter, and trip means operated by said support for connecting said clutch to the shaft for said cam.

4. In a bending machine, the combination of a slidable support for work pieces, a pair of driven rolls to which each work piece is delivered, a work piece engaging member disposed on that side of said rolls remote from said support, said member being pivoted on an axis co-incident with the axis of one of said rolls, a cam arranged to swing said pivoted member about its axis, a clutch having a member drivingly connected to the shaft for one of said rolls, and means controlled by said support for connecting said clutch to the shaft for said cam and disconnecting it therefrom.

5. In a bending machine, the combination of a support, a member for work pieces slidable on said support, an adjustable guide on said slidable member for each work piece, a trip carried by said member, a pair of driven rolls to which each work piece is delivered by said slidable member, and arranged to feed each work piece endwise, a work piece engaging member on that side of said rolls remote from said slide member normally disposed in the plane of said slidable member and swingable about the axis of one of said rolls toward the other roll into position to bend each work piece as it is fed endwise by said rolls, and means controlled by said trip for swinging said work piece engaging member into and out of operating position in a predetermined relation to the feed of each work piece.

6. In a machine of the class described, the combination of a pair of driven feed rolls, a slidable support for a work piece arranged to deliver it to said feed rolls, a work piece engaging member on that side of said feed rolls remote from said slidable support, pivotally mounted at its inner end to swing relative to the plane in which the work piece is delivered to said feed rolls, and means controlled by said slidable support for swinging said work piece engaging member.

7. A machine as claimed in claim 6 wherein said swinging means includes a one revolution clutch.

8. In a machine of the class described, the combination of a pair of rolls for feeding work pieces, means for driving said rolls, a slidable support for work pieces arranged to deliver each thereof to said feed rolls, a member on that side of said feed rolls remote from said slidable support, pivotally mounted at its inner end to swing relative to the plane in which each work piece is delivered to said feed rolls, a cam for swinging said member during movement of the work piece between said feed rolls, and a variable drive means between said driven shaft and the shaft for said cam.

9. In a bending machine, a slidable support for work pieces, a pair of driven rolls to which each work piece is delivered by said support, a work piece engaging member disposed on that side of said rolls remote from said support, said member being pivoted on an axis co-incident with the axis of one of said rolls, means for supporting said member in a predetermined inclined position to curve each section on one radius dur-

ing feeding thereof, a cam arranged to swing said member about its axis toward the other roll into a different inclined position for bending a portion of each work piece intermediate its length on a shorter radius, and means controlled by said support for rotating said cam.

10. In a bending machine, a slidable support for work pieces, a pair of driven rolls to which each work piece is delivered by said support, a work piece engaging member disposed on that side of said rolls remote from said support, said member being pivoted on an axis co-incident with the axis of one of said rolls, a cam having an inactive portion and an active portion which is arranged to engage and swing said member about its axis toward the other roll to bend one portion of each work piece, means for rotating said cam, a spring normally tending to swing said member in the opposite direction, and a device for limiting the movement of said member under the influence of said spring at a predetermined position, whereby said member, during the disengagement of the active portion of the cam therewith, bends another portion of each work piece.

11. In a bending machine, a slidable support for work pieces, a pair of driven rolls to which each work piece is delivered by said support, a work piece engaging member disposed on that side of said rolls remote from said support, said member being pivoted on an axis co-incident with the axis of one of said rolls, separate devices arranged to be engaged by said member and support it at angles relative to the plane of said support, a spring normally tending to swing said member toward said devices, one of said devices being movable relative to the other device and arranged when operated to support said member at an angle different from the angle thereof when said member engages with the other device, and means for operating said movable device to support said member at one predetermined angle during engagement of one portion of each work piece therewith and during the engagement of another portion of each work piece with said member to permit the other device to support said member at another predetermined angle.

12. A machine as claimed in claim 11 wherein said operating means are controlled by the delivery movement of said support.

13. In a bending machine, the combination of a slidable support for work pieces, a pair of driven rolls to which each work piece is delivered by said support, a work piece engaging member disposed on that side of said rolls remote from said support, said member being pivoted on an axis co-incident with the axis of one of said rolls, a cam arranged to swing said pivoted member about its axis toward the other roll, means for rotating said cam, and a device on said support arranged to control said cam rotating means as said support is operated to deliver a work piece to said rolls.

14. In a bending machine as claimed in claim 13 wherein said support is provided with a guide adjustable longitudinally thereof to provide a predetermined relation between it and said control device, whereby the latter controls said rotating means in relation to the feed of the work piece.

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