No. 713,894. Patented Nov. 18, 1902.

W. W. MACFARREN.

METAL BENDING MACHINE.

(Application filed Jan. 7, 1902.)

(No Model.) 4 Sheets—Sheet 1.

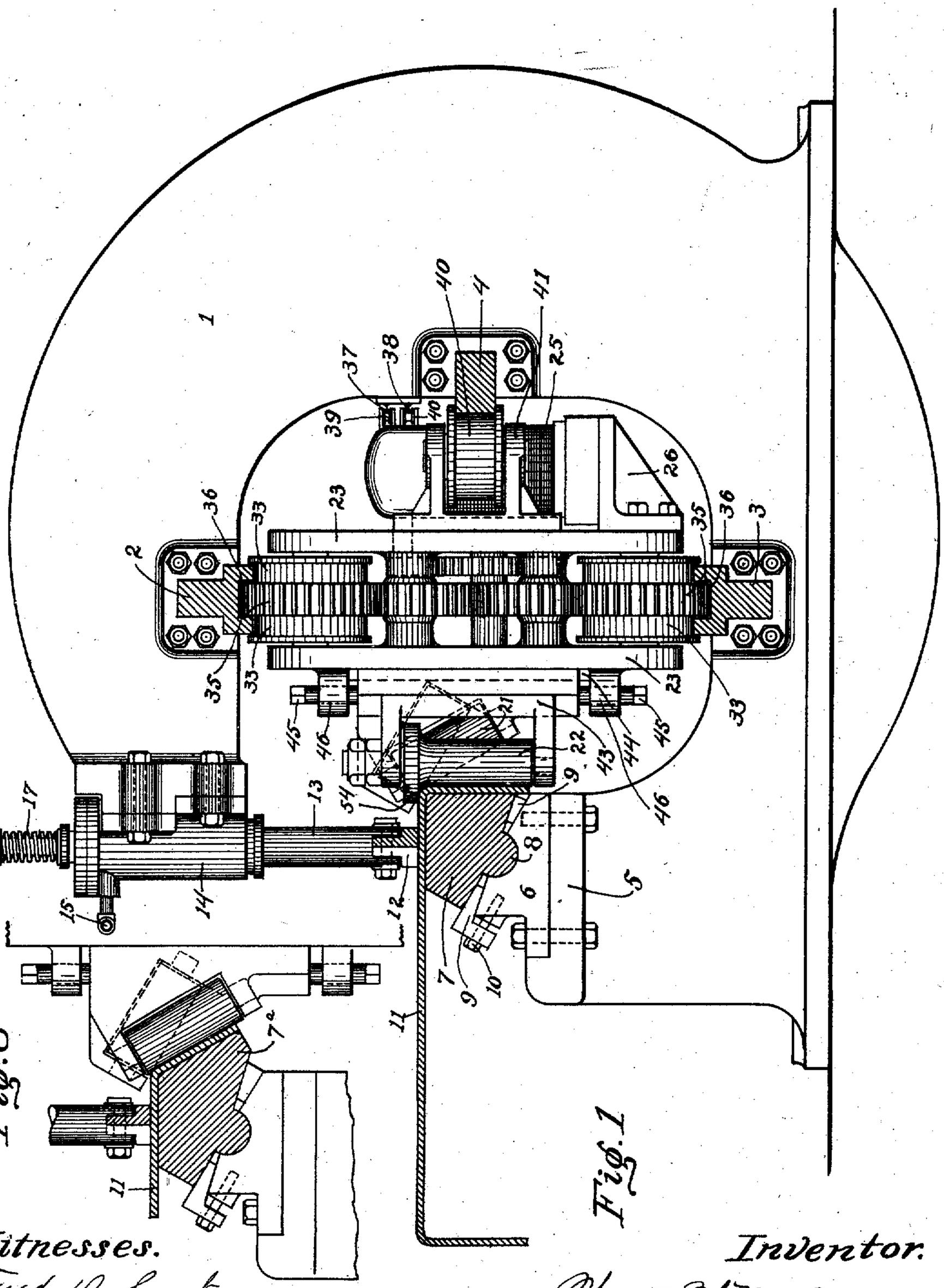

Fig. 8

Fig. 1

Witnesses.
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No. 713,894. Patented Nov. 18, 1902.

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METAL BENDING MACHINE.

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(No Model.) 4 Sheets—Sheet 2.

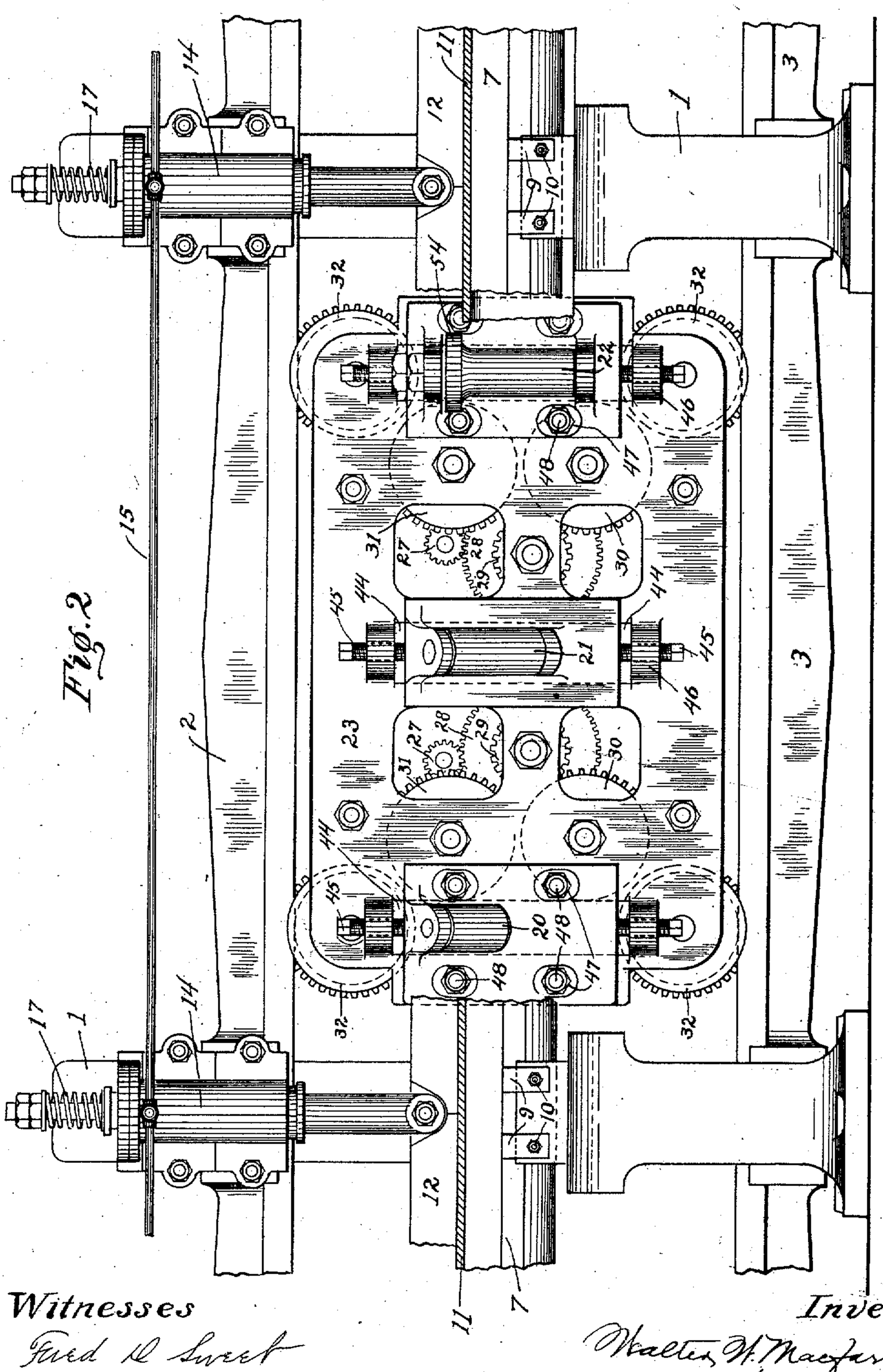

Fig. 2.

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(Application filed Jan. 7, 1902.)

(No Model.) 4 Sheets—Sheet 3.

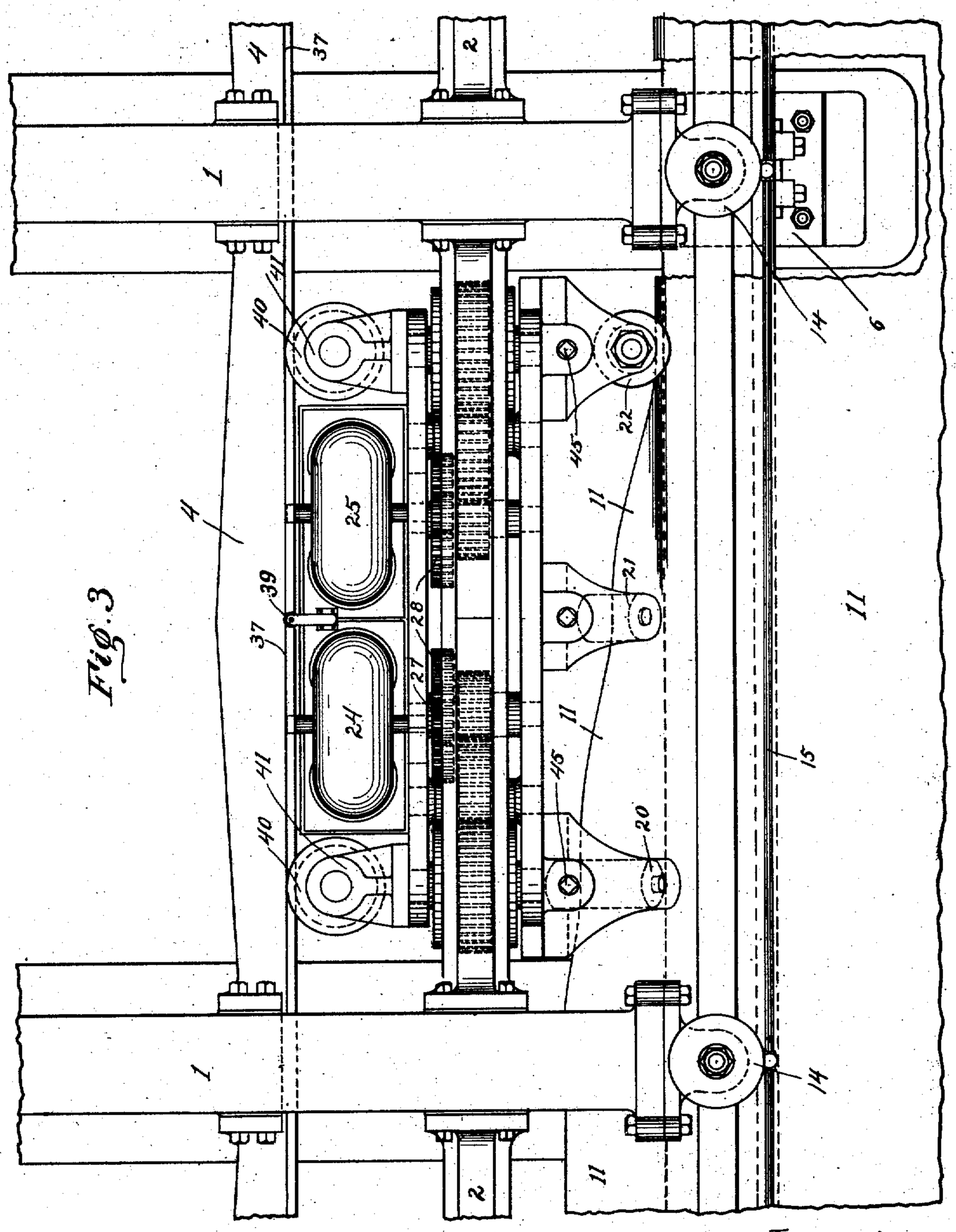

Fig. 3

Witnesses
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METAL BENDING MACHINE.

(Application filed Jan. 7, 1902.)

(No Model.) 4 Sheets—Sheet 4.

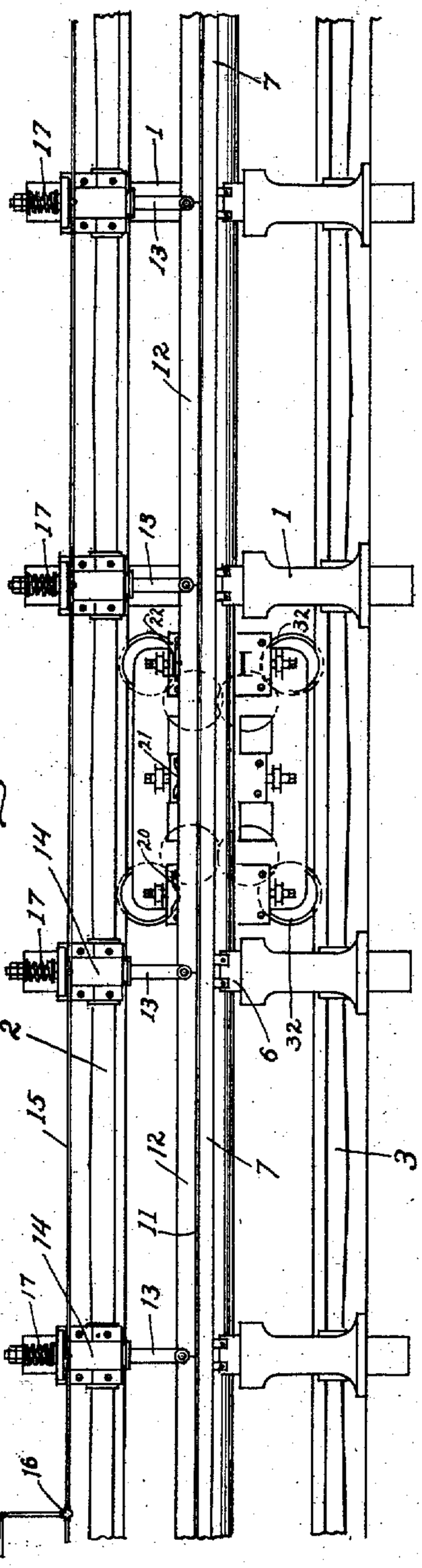

Fig. 4

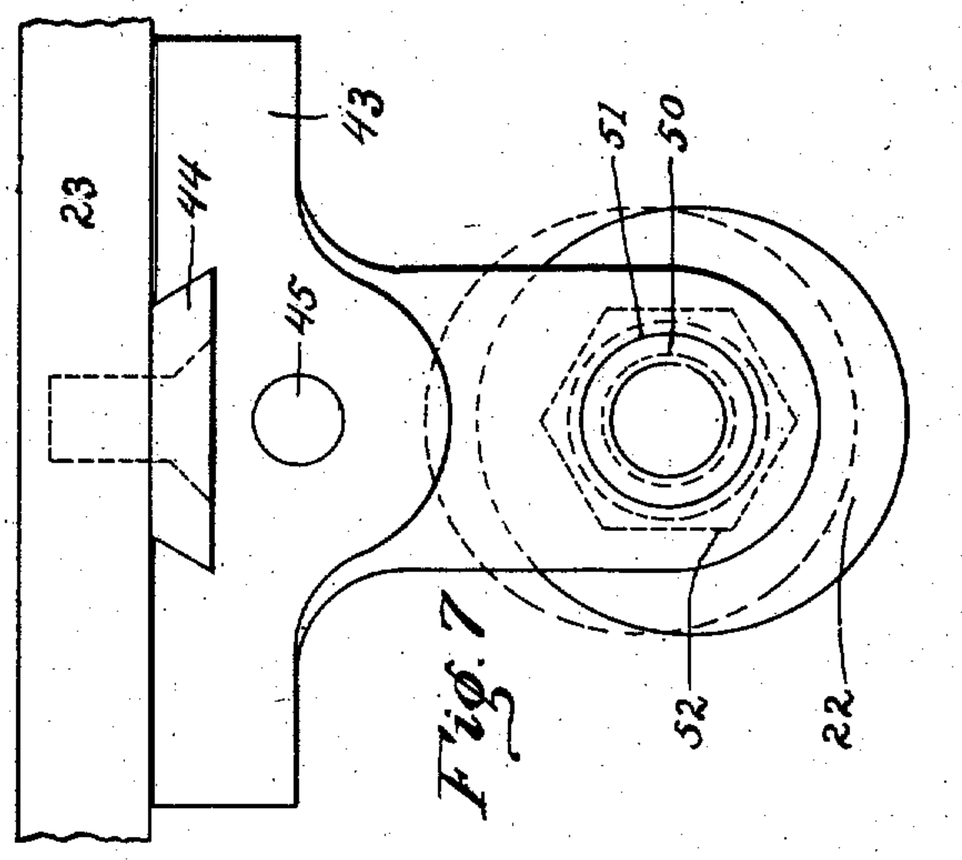

Fig. 7

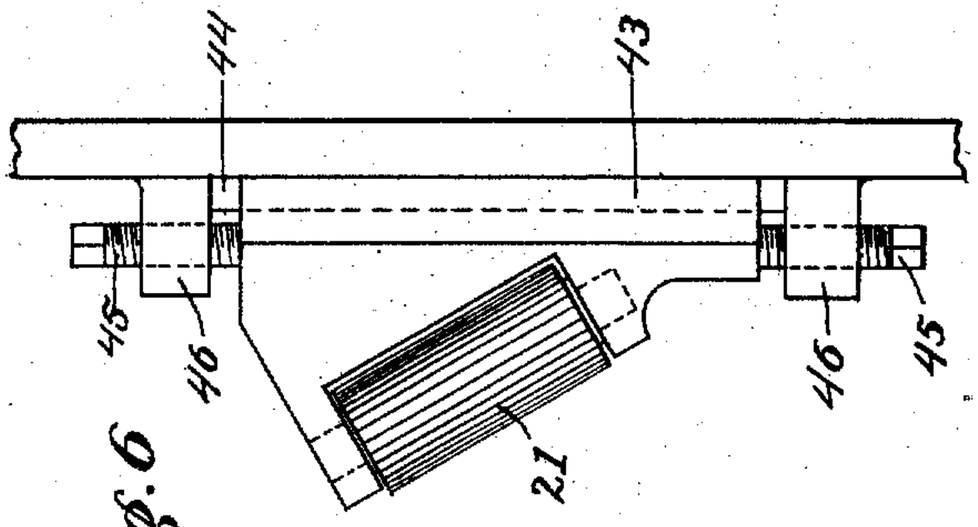

Fig. 6

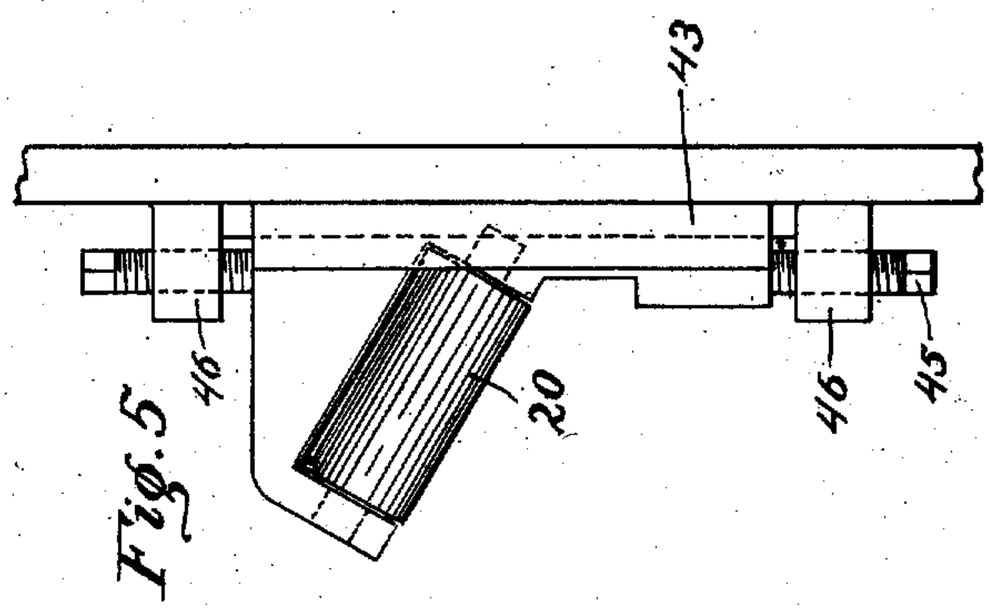

Fig. 5

Witnesses.
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Walter Famariss

Inventor.
Walter W. Macfarren
By Kay & Totten
Attorneys.

UNITED STATES PATENT OFFICE.

WALTER W. MACFARREN, OF PITTSBURG, PENNSYLVANIA.

METAL-BENDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 713,894, dated November 18, 1902.

Application filed January 7, 1902. Serial No. 88,738. (No model.)

To all whom it may concern:

Be it known that I, WALTER W. MACFARREN, a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Metal-Bending Machines; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to metal-bending machines, and more especially to machines for forming a longitudinal bend in plate metal—such, for instance, as soft-steel plates.

The objects of my invention are to provide a machine for this purpose which is adapted to longitudinally bend plates of considerable length, which will bend such plates with a minimum amount of power, and which is adapted to bend plates of various thicknesses and to form a flange or flanges thereon of any desired width and at various angles.

Further objects of my invention are to provide a plate-bending machine which is simple in construction, strong and efficient in operation, and which can be easily operated.

In the accompanying drawings, Figure 1 is a transverse vertical section through the machine. Fig. 2 is a front view of one section thereof, parts being broken away. Fig. 3 is a plan view of one section thereof. Fig. 4 is an enlarged front view showing several sections of the machine. Fig. 5 is a side view of the first bending-roller and its supporting means. Fig. 6 is a similar view of the second roller. Fig. 7 is a top view of the third roller, and Fig. 8 is a detail section of a modified form of anvil.

My machine, as above stated, is especially designed for bending metal plates of considerable length, and as a consequence the machine will be built quite long, and in the accompanying drawings I have shown only a portion of such machine; but as the remainder is simply a duplication of the parts shown it will be readily understood.

The machine as a whole comprises a series of frames or housings 1, which in number will depend upon the length of the machine and which will be set a suitable distance apart, four such housings being shown in Fig. 4; but in a commercial machine probably never less than five such housings would be employed. These housings are substantially C-shaped, as shown in Fig. 1, and they are united by the top and bottom rack-rails 2 and 3 and the rear thrust or backing rail 4. These rails connect the various housings together longitudinally and also serve as guiding and feeding means for the bending devices, as will hereinafter appear.

On the forward lower arm of the housings is provided a suitable seat 5 for receiving the bearing-block 6, upon which the anvil 7 is mounted. This anvil 7 may be in a single piece running the entire length of the machine or in sections extending for one or more sections of the machine, so as to form practically a continuous anvil. As shown, the bearing or saddle blocks 6 are provided with concaved seats for receiving a convex lug 8 on the anvil 7, and between the saddle-blocks 6 and anvil both in front of and in the rear of the convex projection 8 are wedge-blocks 9, which are adjustable by any suitable means, such as the screw or bolt 10. By means of these adjustable wedges the position of the anvil 7 can be accurately regulated to compensate for the spring of the plate. This anvil 7 is readily removable, as shown, so that it can be replaced by an anvil of a different shape in order to permit the bending of plates to different angles. As shown in Fig. 1 of the drawings, the anvil is of such shape that a right-angle bend will be given to the plate; but by using an anvil having an angle of either more or less than ninety degrees bends of various angles may be given to the plate. In Fig. 8 the anvil 7^a is so shaped as to give a bend of sixty degrees.

The plate 11 to be bent is placed upon the top face of the anvil 7 with its edge projecting inward beyond the inner face thereof. To hold it in place, some suitable clamping device must be used, and for this purpose I have shown the clamping-bars 12, each of said bars being of such length as to extend from one housing to the next adjacent one in the machine and the adjacent meeting ends of two such bars being pivotally secured to the lower end of a power-plunger, such as the piston-rod 13 of a hydraulic or other power cylinder 14, secured to the upper arm of the housing. All of the cylinders are connected by a single pipe 15 to a convenient source of pressure, and a single valve 16 is placed at a

convenient place, so that all of the power-cylinders can be simultaneously actuated. As the action of these cylinders may not be exactly simultaneous, I prefer to pivot the clamping-bars to the piston-rods and make said clamping-bars in sections, as shown, instead of having a single bar extending for the full length of the machine. The power-cylinders 14 may, if desired, be made double-acting, so as to elevate as well as to depress the clamping-bars; but I prefer to make them single-acting and to elevate the clamping-bars by extending the piston-rods through the upper heads of the cylinders and surround the same by suitable helical springs 17, so that as soon as the water or other pressure in the cylinders 14 is released these springs will draw the piston-rods upward, and thus elevate the clamping-bars.

It will be readily perceived that if it were attempted to bend the full length of a long plate at a single stroke or operation it would require a great amount of power. To enable this to be done with less power and by a less costly machine, I bend only a portion of the length of the plate at one time and continue this bending progressively and practically continuously from end to end of the plate. For this purpose I provide a bending device or devices which will engage the projecting edge of the plate and bend the same at an angle to the body thereof and cause such bending device or devices to travel along the length of the plate to progressively bend the same from end to end. I have shown for such bending device a series of bending-rollers, three such rollers being shown, although either more or less might be employed, as necessary or desired. These rollers are shown on the drawings at 20, 21, and 22, and they are mounted upon a carriage 23, which travels on the rails 2, 3, and 4. This carriage may be propelled along the machine by any suitable mechanism—as, for instance, by a powerful hydraulic or other power cylinder—having its piston-rod connected to said carriage or by having a rack-bar connected thereto which is engaged by a gear driven by a powerful engine or motor. I prefer, however, to make the carriage entirely self-contained, and I therefore mount the motors directly on the carriage. Any suitable form of motor might be used; but an electric motor possesses various advantages and conveniences that make it especially desirable for this purpose. I have shown in the drawings two such motors 24 and 25, although a single motor might be employed. These motors are mounted upon the carriage in any preferred manner, as by being set upon the ledge or shelf 26. The armature-shaft of each of these motors is provided with a pinion 27, which is connected by means of gears 28, 29, 30, and 31 to the driving-wheels 32. These wheels 32 are provided with plain faces 33, which bear upon the smooth portions of the rack-rails 2 and 3, and having between said faces the gear-teeth 35, which mesh with similar teeth 36 on the rack-rails. It will be readily understood that the electric motors through the gearing described will propel the carriage along the rack-rails. The gearing between the motor and the driving-wheels is of a compound type, so that a very large increase of power is obtained. Current may be conducted to the motors by any suitable means—such, for instance, as a flexible cord; but I prefer to use practically a trolley, and for this purpose have shown conducting wires or rails 37 and 38, extending longitudinally of the machine and suitably insulated from the housings 1, upon which bear suitable trolleys or brushes 39, electrically connected to the motors.

To hold the bending devices firmly against the anvil, I secure to the rear of the carriage one or more wheels or rollers 40, which bear against the thrust or backing rail 4 and prevent the carriage from yielding or moving away from the anvil. These wheels 40 are journaled in suitable bearings or housings 41 and are preferably flanged, as shown, so as to straddle the thrust-rail 4. The bending-rollers 20, 21, and 22 are each mounted in a suitable bearing or bracket 43, and said rollers are set at different angles, so as to progressively bend the plate to the desired extent. As shown in the drawings, the first roller 20 is set at an angle of thirty (30°) degrees from the horizontal, the second roller 21 at an angle of sixty (60°) degrees, and the third roller 22 at an angle of ninety (90°) degrees. These rollers when arranged as shown in the drawings will bend the projecting edge of the plate at an angle of ninety (90°) degrees to the body thereof; but of course the degree of this bend can be varied as desired by having the rollers set at the desired angles. For instance, should it be desired to bend the projecting edge of the plate to an angle of but sixty (60°) degrees the third roller 22 could be dispensed with and the other two rollers made to bend the plate to the desired degree. The same result may be secured by using three rollers, set respectively at angles of twenty, (20°,) forty, (40°,) and sixty (60°) degrees. It will be understood that in case the plate is to bend at an angle of sixty degrees the anvil 7, shown in the drawings, will be replaced by one having the proper shape, as shown in Fig. 8. The bearings or brackets 43 in which the bending-rollers are mounted are readily removable, so that they can be replaced by others which will hold the rollers at the desired angles, and they furthermore are made adjustable, so as to adapt the machine to plates of different thicknesses. For this purpose the first two rollers 20 and 21 need be adjusted only vertically, while the rear rollers 22 must be adjusted both vertically and horizontally. The vertical adjustment of all these brackets is secured by mounting them on suitable ways or slides 44, preferably beveled, as shown, and adjusting the brackets up and down on said ways by means of suitable

screws 45, passing through ears or lugs 46. To clamp brackets in the adjusted position, they are provided with slots 47, preferably four in number, through which pass clamping-bolts 48. The horizontal adjustment of the roller 22 is secured, preferably, by providing the pin 50, on which said roller is journaled, with top and bottom portions 51, which are eccentric to the body thereof, said eccentric portions being mounted in suitable openings in the bracket 43. Suitable clamping-nuts 52 are used for holding said journal-pin in its adjusted position. By merely turning this pin the axis of the roller 22 will be moved toward or from the anvil 7, so as to allow a space between said roller and the anvil equal to the thickness of the plate to be bent. The roller 22 is also preferably provided at its upper end with the flange 54, the face of which is preferably round, so as to give a curve to the angle in the plate.

The machine, as above described, is suitable for bending metal plates of various thicknesses and lengths and to various angles, the bends being either straight lines or combinations of straight lines. By a slight variation in the construction of the machine it will be possible and practicable to bend plates to curved lines or combinations of curved and straight lines. For instance, if the anvil be made with a flat top, as described, and its inner vertical face a section of the convex surface of a vertical cylinder and the rack and thrust rails be curved to be concentric therewith and maintained an even distance from the inner face of the anvil throughout the length of the machine, then flanges or parts of the plate being bent will be curved. In short, if the anvil and the thrust and rack rails are always parallel or concentric almost any curve or outline may be bent within practical limits.

The operation of the machine is as follows: The anvil 7 and bending-rollers having been adjusted to the desired thickness of plate to be bent and to the desired angle to be given to said plate, the plate, either cold or heated, as desired or necessary, is placed on the anvil 7 with its inner edge projecting beyond said anvil a distance equal to the desired width of the flange. Power is then applied to the cylinders 14 to bring the clamping-bars 12 down upon the plate and firmly clamp the same on the anvil. The carriage 23 will of course be to one side of the forward end of the plate and the projecting edge at this end of the plate will, if necessary, be bent down by hand to a slight extent, so as to enable the bending-rollers to more easily run onto the same. Current is then applied to the motors 24 and 25, and these through the gearing shown propel the carriage along the rack-rails 2 and 3, thus carrying the bending-rollers along the length of the plate and progressively bending the projecting edge of the plate down against the anvil. The rollers 40, bearing against the thrust-rail 4, will hold the bending-rollers close up to the anvil, so as to bend the plate at just the proper line and to the desired extent. During this bending the rollers will each bend the plate a portion of the distance, and as this pressure is being applied at only three points along the length of the plate it will be readily seen that by a comparatively small amount of power applied during a considerable time—that is, the time that it takes the carriage 23 to travel the length of the plate—a plate of considerable thickness can be bent. The machine will of course have to be made long enough so that a space equal to the length of the carriage 23 is left at each end beyond the ends of the plate being bent.

The machine as above illustrated and described is adapted for bending either hot or cold plates. It is desirable whenever possible to do the bending while the plates are cold, so as to save the expense of heating the same and to facilitate their handling; but if very heavy plates are to be bent they may be heated in order to reduce the amount of power necessary to do the bending, and thus enable the same machine to bend plates having a great range of thicknesses, it being built, for instance, with capacity to bend up to a certain thickness on cold plates and a much greater thickness on hot plates. It will be readily understood that the amount of power required to bend a plate of any given thickness depends on the degree of the bend, or, in other words, the distance through which the force is applied. In other words, it will require approximately double the power to bend a plate to an angle of ninety degrees that it will require to bend the same plate to an angle of forty-five degrees. The machine is so constructed that it will complete the bend along the whole or that portion of the length of the plate to be bent at a single stroke of the carriage. However, from the above considerations with regard to power it will be apparent that when it is desired to bend very heavy plates while cold, which the capacity of the machine would render impossible to bend at one stroke of the carriage, such plates may be bent by several consecutive strokes, each stroke bending the plate through a part of the required distance only, and thus requiring only a fraction of the power required to complete the bend at one stroke. This may be done by several strokes all in one direction, the carriage returning idly to the starting-point between such strokes or, preferably, it may be done by alternate strokes in opposite directions, the carriage working to and fro along the plate, so that no time is lost. In these cases it will be necessary to provide the bending devices or rollers with power-adjustments which will bring them closer to the anvil after each working stroke before the next one is commenced.

The machine as constructed is strong, efficient, and very simple to operate. I do not wish to be limited to the precise means shown

for moving the bending devices along the plate, nor to the precise form of clamping means shown, nor to the precise form of bending devices shown, as the rollers might be displaced by suitable fixed abutments.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a plate-metal-bending machine, the combination with a longitudinal anvil and clamp for holding the plate with its edge projecting beyond the anvil, of a device arranged at the side of the anvil for engaging the projecting edge of the plate and bending it against the side of the anvil at an angle to the body of the plate, and mechanism for moving said bending device longitudinally along the machine to progressively bend the plate.

2. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate with its edge projecting beyond the anvil, of two or more devices arranged at different angles at the side of the anvil to engage the projecting edge of the plate and bend it against the side of the anvil at an angle to the body of the plate, and mechanism for moving said bending devices along the plate to progressively bend the same.

3. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate with its edge projecting beyond the anvil, of ways parallel to the anvil, a carriage traveling on said ways, mechanism for moving said carriage along the ways, and a device on said carriage arranged to engage the projecting edge of the plate and progressively bend it against the edge of the anvil at an angle to the body of the plate.

4. In a plate-metal-bending machine, the combination with a longitudinal anvil and clamp for holding the plate with its edge projecting beyond the anvil, of a roller arranged at the side of the anvil for engaging the projecting edge of the plate and bending it against the side of the anvil at an angle to the body of the plate, and mechanism for moving said roller longitudinally along the plate to progressively bend the same.

5. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate with its edge projecting beyond the anvil, of two or more rollers mounted at different angles and arranged to engage the projecting edge of the plate and bend the same against the side of the anvil at an angle to the body of the plate, and mechanism for moving said rollers along the plate to progressively bend the same.

6. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate with its edge projecting beyond the anvil, of ways parallel to the anvil, a carriage traveling on said ways, mechanism for moving said carriage along said ways, and two or more rollers mounted on said carriage at different angles and arranged to engage the projecting edge of the plate and progressively bend the same against the edge of the anvil at an angle to the body of the plate.

7. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate with its edge projecting beyond the anvil, of two or more devices arranged at different angles at the side of the anvil to engage the projecting edge of the plate and bend the same against the side of the anvil at an angle to the body of the plate, means for adjusting said devices, and mechanism for moving said devices along the plate to progressively bend the same.

8. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate with its edge projecting beyond the anvil, of two or more rollers arranged at different angles and adapted to engage the projecting edge of the plate and bend it against the side of the anvil at an angle to the body of the plate, mechanism for moving said rollers along the plate, and means for adjusting said rollers to adapt them to plates of various thicknesses.

9. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate, of ways parallel to the anvil, a carriage mounted on said ways, mechanism for moving said carriage along said ways, two or more bending devices mounted on said carriage and arranged to engage the projecting edge of the plate and bend the same progressively at an angle to the body thereof, means for adjusting said devices vertically, and means for adjusting the last of said devices horizontally.

10. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate, of ways parallel to the anvil, a carriage mounted on said ways, mechanism for moving said carriage along said ways, two or more rollers mounted on said carriage and arranged to engage the projecting edge of the plate and bend it at an angle to the body thereof, means for adjusting said rollers vertically on said carriage, and an eccentric-pin on which the last of said rollers is journaled for adjusting the same horizontally.

11. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate, of ways parallel to the anvil, a carriage mounted on said ways, mechanism for moving said carriage along said ways, a device on said carriage arranged to engage the plate and bend it at an angle, a backing rail or way on the frame of the machine, and backing or thrust rollers on the carriage opposite the bending devices and bearing against said rail.

12. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate, of ways parallel to the anvil, a carriage mounted on said ways, a device on the carriage arranged to engage the plate and bend it at an angle, a motor on the carriage,

a rack or racks secured to the frame, and gearing between said motor and rack.

13. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate, of ways parallel to the anvil, a carriage on said ways, a device on the carriage arranged to engage the plate and bend it at an angle, a backing rail or way on the frame, a pressure-roller on the carriage opposite the bending devices and bearing against said rail, a motor on the carriage, a rack or racks secured to the frame, and gearing between said motor and rack.

14. In a plate-metal-bending machine, the combination with an anvil and clamp for holding the plate, of top and bottom rack-rails secured to the frame, a rear pressure or backing rail on said frame, a carriage moving on said rails and provided with rollers for engaging the backing-rail and with toothed wheels for engaging the rack-rails, a motor on said carriage, gearing intermediate the motor and toothed wheels, and two or more devices on the carriage opposite the backing-roller arranged to engage the projecting edge of the plate and progressively bend the same at an angle to the body thereof.

15. In a plate-metal-bending machine, the combination with a removable and interchangeable anvil and a clamp for holding the plate with its edge projecting beyond the anvil, of a device arranged at the side of the anvil for engaging the projecting edge of the plate and bending it against the side of the anvil at an angle to the body of the plate, and mechanism for moving said bending device along the plate to progressively bend the same.

16. In a plate-metal-bending machine, the combination with an anvil, of means for adjusting the same, a clamp for holding the plate against the anvil with its edge projecting beyond the same, a device arranged to engage the projecting edge of the plate and bend it against the side of the anvil at an angle to the body of the plate, and mechanism for moving said bending device along the plate to progressively bend the same.

17. In a plate-metal-bending machine, the combination with an anvil, of means for adjusting the same, a clamp for holding the plate against said anvil with its edge projecting beyond the same, an adjustable roller arranged to engage the projecting edge of the plate and bend the same against the side of the anvil at an angle to the body of the plate, and mechanism for moving said roller along the plate to progressively bend the same.

18. In a plate-metal-bending machine, the combination with a removable and interchangeable anvil and clamp for holding the plate with its edge projecting beyond the anvil, of a carriage carrying two or more rollers at different angles for engaging the projecting edge of the plate and bending the same against the side of the anvil at an angle to the body of the plate, and mechanism for moving said carriage along the plate.

19. In a plate-metal-bending machine, the combination with an anvil, of a clamping-bar for clamping the plate against the anvil with its edge projecting beyond the same, power-cylinders for actuating said bar, a controlling-valve common to all said cylinders, a device for engaging the projecting edge of the plate and bending it against the side of the anvil at an angle to the body of the plate, and mechanism for moving said device along the plate to progressively bend the same.

20. In a plate-metal-bending machine, the combination with a series of frames or housings, an anvil mounted thereon, a sectional clamping-bar, power devices on each of the housings and pivotally connected to the ends of the sectional clamping-bars, means for simultaneously actuating all of said power devices, and a device to progressively bend the plate.

21. In a plate-metal-bending machine, the combination with an anvil, of a clamping-bar for holding the plate, power-cylinders connected to said clamping-bar, springs for lifting said clamping-bar, a device for engaging the projecting edge of the plate and bending the same at an angle to the body thereof, and mechanism for moving said device along the plate to progressively bend the same.

In testimony whereof I, the said WALTER W. MACFARREN, have hereunto set my hand.

WALTER W. MACFARREN.

Witnesses:
F. W. WINTER,
ROBERT C. TOTTEN.