Feb. 10, 1953 T. W. LLOYD ET AL 2,627,890

SHEET METAL BENDING APPARATUS

Filed Feb. 12, 1952 4 Sheets-Sheet 1

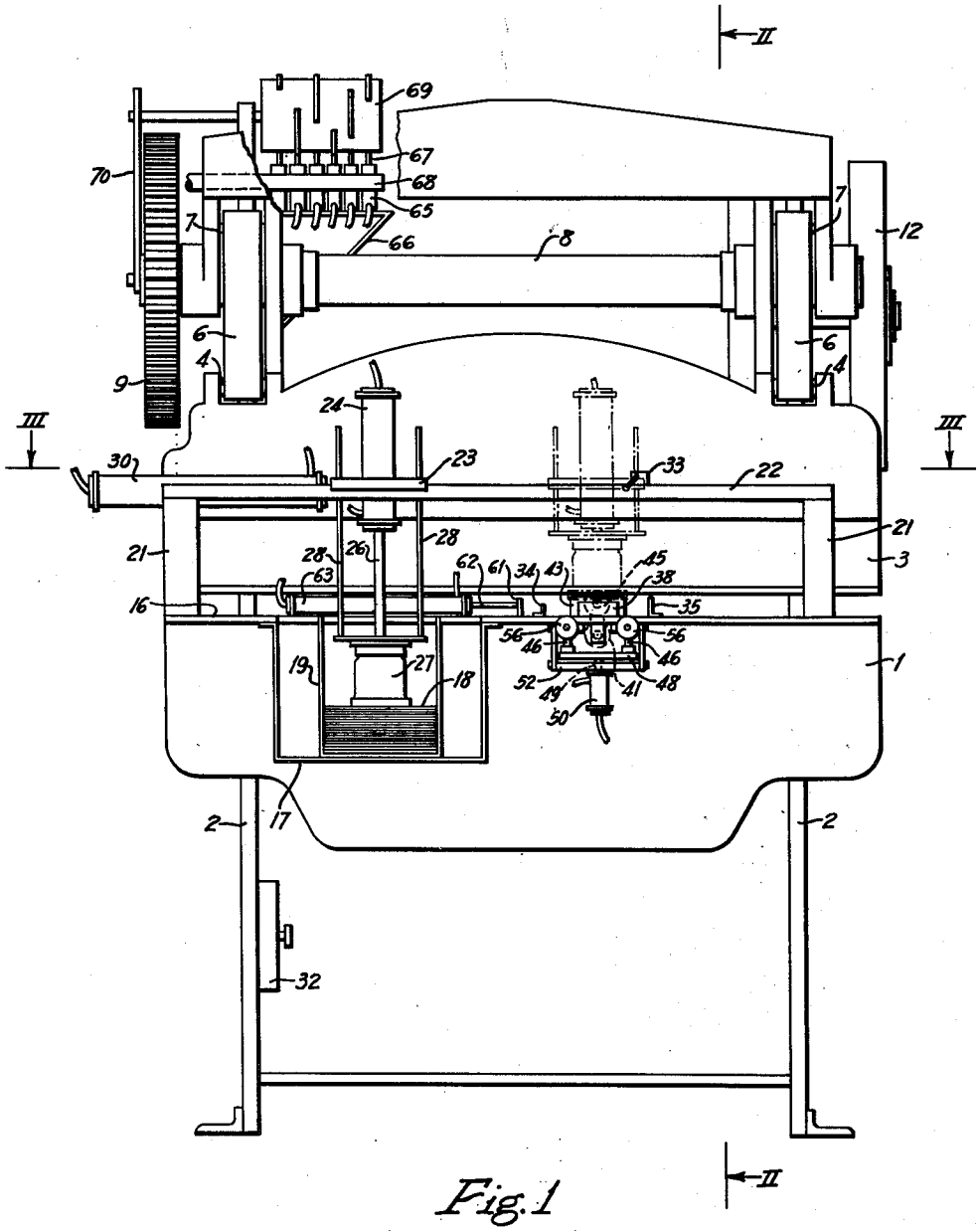


Fig. 1

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SHEET METAL BENDING APPARATUS

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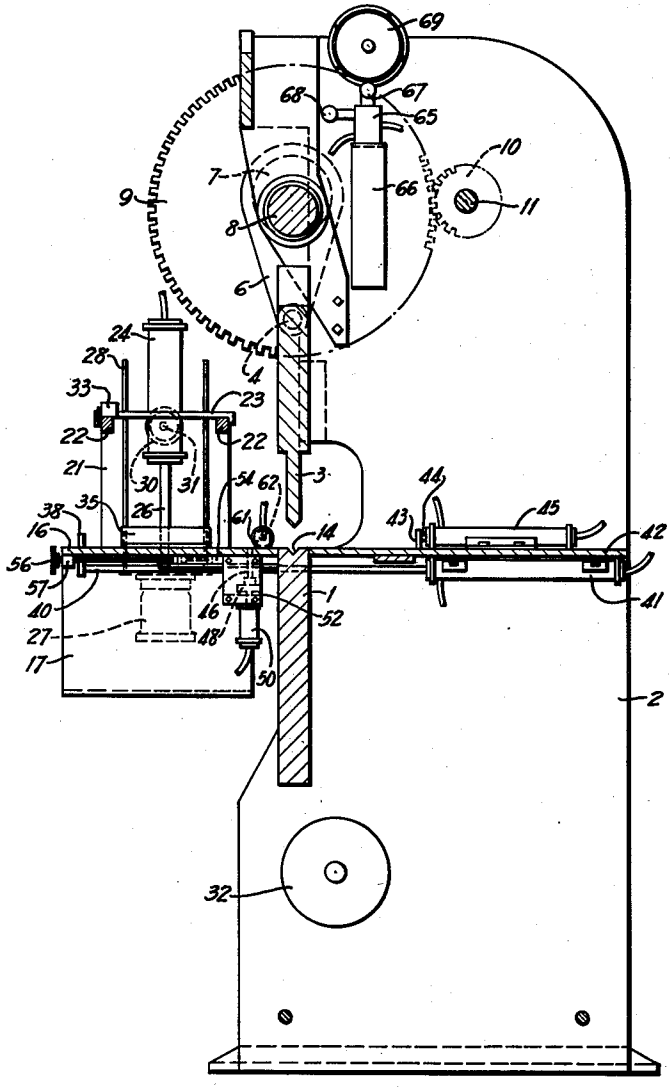


Fig. 2

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SHEET METAL BENDING APPARATUS

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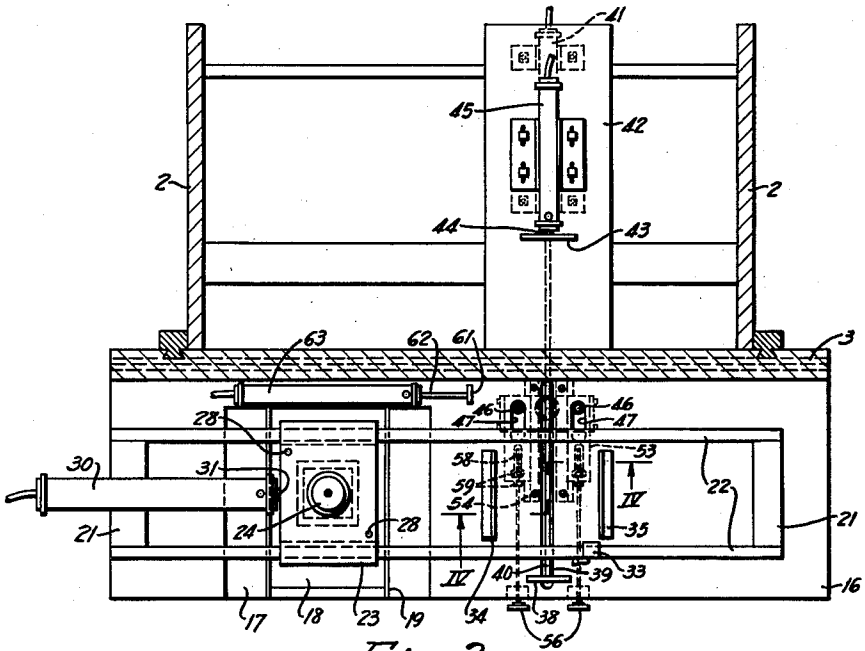


Fig. 3

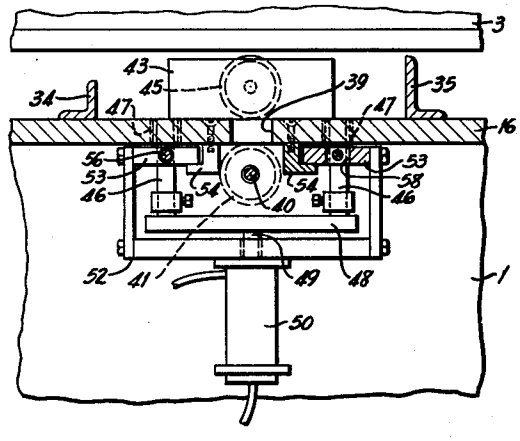


Fig. 4

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SHEET METAL BENDING APPARATUS

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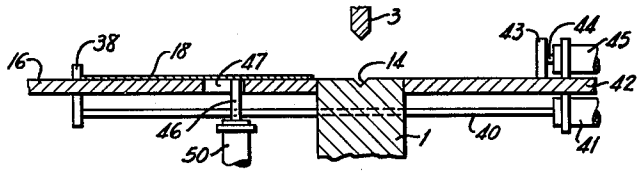


Fig. 5

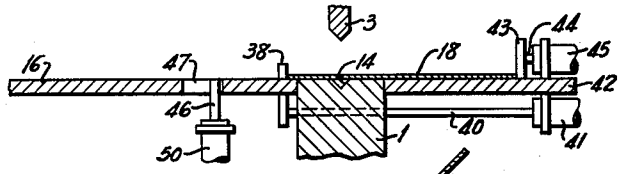


Fig. 6

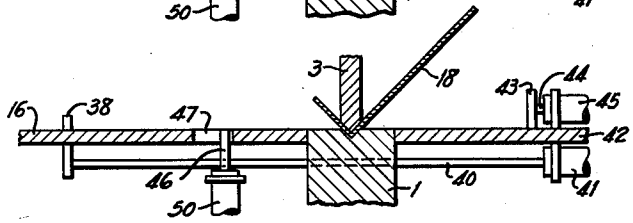


Fig. 7

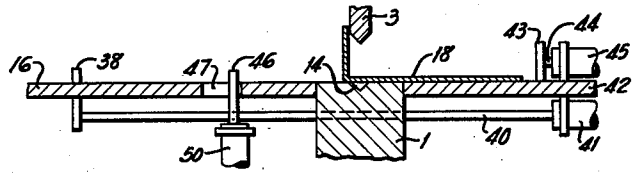


Fig. 8

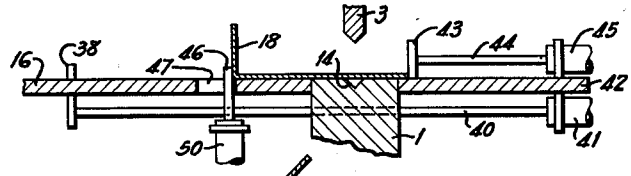


Fig. 9

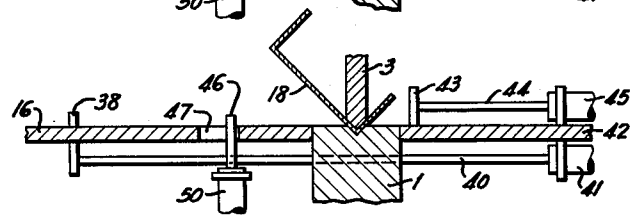


Fig. 10

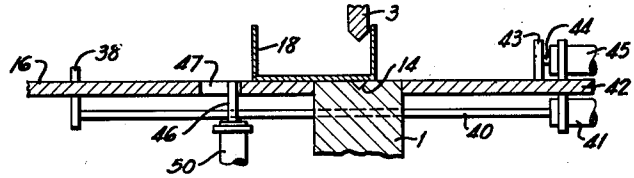


Fig. 11

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UNITED STATES PATENT OFFICE

2,627,890

SHEET METAL BENDING APPARATUS

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Application February 12, 1952, Serial No. 271,164

12 Claims. (Cl. 153—21)

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This invention relates to sheet metal bending apparatus, and more particularly to power bending brakes equipped with mechanical means for handling the sheets being bent.

In many instances refractory bricks are placed in metal cases which generally are in the form of channels. Power bending brakes are used for producing the channels from rectangular metal sheets. In the past, it has been customary to place the sheets in the necessary positions between the dies of the bending brake by hand. This is rather dangerous, because the operator may have his fingers between the dies when they come together.

It is among the objects of this invention to provide sheet metal bending apparatus in which flat sheets are fed to the dies automatically, in which each sheet can be placed in two different positions between the dies automatically so that it can be bent twice, which is adjustable to vary the spacing between the bends in a sheet, and which ejects the bent sheets from the machine.

In accordance with this invention, a lower die of a bending brake has tables on its opposite sides for supporting a metal sheet on the die. There also is a vertically movable upper die for bending the sheet. In front of the dies there is a feeder for pushing a sheet back against a stop behind the dies, so that the sheet will be bent at the desired point. It is preferred to deliver the sheets to the feeder in front of the dies by a movable magnet, either permanent or electromagnetic, which lifts one sheet at a time from a pile and transfers it to the feeder. To permit a second bend to be made in the sheet, a gauge normally is located below the top of the table in front of the dies, but means is provided for periodically projecting the gauge above the table. When the gauge is up, the stop behind the dies can be moved forward to push a bent sheet against the gauge so that the rear portion of the sheet also will be bent by the dies. Means can be provided at one end of the bent sheet for ejecting it lengthwise from between the dies. All of the movements of the apparatus can be timed from the shaft that reciprocates the upper die.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in

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which Fig. 1 is a front view of the bending apparatus with a portion broken away to show the timing mechanism; Fig. 2 is a vertical section taken on the line II—II of Fig. 1; Fig. 3 is a horizontal section taken on the line III—III of Fig. 1; Fig. 4 is an enlarged fragmentary vertical section taken on the line IV—IV of Fig. 3; and Figs. 5 to 11 are enlarged fragmentary cross sections of the apparatus illustrating different steps in its operation somewhat schematically.

Referring to Figs. 1 to 4 of the drawings, a conventional bending brake is shown, which includes a lower die 1 rigidly supported by a pair of end frames 2. Above the die there is a vertically movable upper die 3 that is supported by pins 4 journaled in the lower ends of a pair of arms 6. In the upper ends of the arms eccentrics 7 are rotatably mounted for reciprocating the upper die. The eccentrics are rigidly mounted on a shaft 8 that is journaled in the upper part of the machine and driven at one end by a gear 9 from a pinion 10 on a drive shaft 11. The drive shaft is rotated continuously by a fly wheel 12 that can be driven by a belt from an electric motor (not shown). The top of the lower die is provided with a longitudinally extending V-shape recess 14, and the bottom of the upper die is provided with a tapered lower edge adapted to fit in the recess. When the dies come together, they will form a bend of the desired angle in a metal sheet between them.

Extending along the front of the lower die, flush with its upper edge, is a front table 16. The table is provided near one end with a rectangular recess, from the back and opposite sides of which a magazine 17 with an open front and top is suspended for reception of a pile of flat metal sheets 18 that are to be bent into channels by the dies. If the sheets are narrower than the magazine, they can be held in a U-shape guide 19 resting on the bottom of the magazine.

Supported above the table by end blocks 21 is a pair of spaced parallel bars 22 that extend lengthwise of the table to form a track which passes over the magazine. Slidably mounted on this track is a carriage 23, in the central portion of which a vertical air cylinder 24 is rigidly mounted. The piston rod 26 extending down out of this cylinder supports a magnet 27 which can be lifted by the rod when air pressure is de-

livered to the lower end of the cylinder. To help guide the magnet in its vertical movements, a pair of vertical guide rods 28 connected to its top extend slidably through diametrically opposite corners of the carriage. When the magnet is raised above the top of the table, the carriage is moved toward the opposite end of the table to the broken line position shown in Fig. 1 by means of a horizontal air cylinder 30 mounted between the tracks on one of the end blocks 21. A piston rod 31, extending out of the cylinder, connects it with the carriage.

If the magnet is an electromagnet, its lifting power can be controlled by a rheostat 32 mounted on the inside of one of the end frames. The electric circuit is opened when a limit switch 33, mounted on the track, is struck by the carriage. When this occurs, the sheet held by the magnet will drop onto the table below it, ready to be fed between the dies. Before it is released in this manner, or by a stripper in the case of a permanent magnet, the sheet is carried across the top of an angle 34 mounted transversely of the table to serve as a guide for one side of the sheet. The other side of the sheet is guided by a taller angle 35 which the sheet is carried against by its momentum at about the time it is released from the magnet. The height of this guide keeps the sheet from bouncing up onto it and insures that the sheet will lie on the table between the two guide angles.

When a sheet drops on the table it falls behind a vertical feed bar 38 projecting above the table. The bar has a depending central portion that extends down through a slot 39 extending across the table, and is mounted on the front end of a long piston rod 40 that extends slidably through a hole through the lower die and back into a feed cylinder 41 attached to the bottom of a small table 42 behind the lower die. When air pressure is admitted to the front end of this cylinder, the feed bar is pulled toward the dies and thus pushes the metal sheet back across the top of the lower die until it strikes a stop 43 on the front end of a piston rod 44 in an air cylinder 45 adjustably mounted on the back table. The position of this cylinder is such that the stop will stop the sheet at a point where its front portion that is to be bent will be directly above the center of the lower die. The upper die then moves down to bend the sheet, and then the feed bar is moved forward to the front of the table again. When the upper die is raised, the main portion of the bent sheet will drop back onto the back table, whereupon the back stop cylinder is energized to move the sheet forward if it is to be provided with another bend, which it usually is.

In order to stop the forward movement of the bent sheet in the correct position for bending its rear portion, a pair of gauge pins 46 are projected above the front table. These pins are slidable vertically and laterally in slots 47 through the table. The slots extend crosswise of the table, and the pins normally do not extend above its upper surface. Their lower ends are supported by the opposite ends of a horizontal bar 48 mounted on the upper end of a piston rod 49 projecting from the top of a short air cylinder 50. This cylinder is attached to the bottom of a yoke 52, the upper ends of which are bolted to blocks 53 slidably mounted in a pair of slotted guides 54 fastened to the bottom of the front table. The gauge pins extend up through holes in the rear ends of these blocks. Adjustment screws 56 are threaded in blocks 57 attached to the bottom of the front portion of the table, and have unthreaded inner ends that extend through holes in the front ends of the blocks and into slots 58 extending lengthwise of the blocks. Collars 59 are rigidly mounted on each screw in front of the adjoining block and in the front end of its slot to keep the screw from moving lengthwise relative to the block, while permitting it to rotate therein. Consequently, when the screws are turned the yoke will be moved forward or backward to change the distance between the gauge pins and the dies.

After stop 43 pushes the bent sheet forward against the gauge pins, the upper die descends to bend the sheet again so that it will be channel shape with a pair of flanges. When the die rises, the bent sheet or channel drops back on the front table, from which it then is ejected lengthwise by the sudden impact of an ejector plate 61 against one end of it. This plate is mounted on the outer end of a piston rod 62 projecting from an air cylinder 63 mounted on the front table between the back of the magazine and the lower die.

The admission of air pressure to the opposite ends of the various cylinders is controlled by a series of double acting valves 65 in the air lines. These valves are mounted in a row on a bracket 66 attached to the inner surface of one of the end frames 2. The vertically movable valve stems 67 are spring-pressed upward, in which position air pressure from supply pipe 68 is admitted to one end of each cylinder to hold its piston rod in a normal position, either projected or retracted, depending on the particular cylinder. To connect the opposite end of each cylinder with the source of air pressure, the valve stems are periodically depressed by a cam drum 69 which is rotatably supported above them and driven by a belt and pulley drive 70 from the adjacent end of shaft 8. The cam makes one rotation for every two rotations of the shaft, so that the cam makes one revolution for every two strokes of the upper die. Thus, a bend is formed in a sheet at each stroke of the die, and a finished three-sided or channel shape case is produced by each two strokes of the die. The valve-actuating members on the barrel cam are arranged to operate the several air cylinders in the proper sequence. That sequence now will be reviewed.

Assuming that all of the air cylinders are in their normal positions, with stop 43 retracted, feed plate 38 forward, gauge pins 46 lowered, carriage 23 above the magazine, and electromagnet 27 raised, the first thing that happens is that the cam drum opens the valve that admits air pressure to the upper end of pick-up cylinder 24 and releases air from its lower end. This lowers the magnet into engagement with the top sheet 18 on the pile below it. The cylinder then is reversed to raise the magnet and the sheet adhering to it. As soon as the sheet is a short distance above front table 16, air pressure is admitted to the outer end of carriage cylinder 30 to move the carriage to the right to the broken line position shown in Fig. 1. This carries the metal sheet to a point above the space between guides 34 and 35. As the carriage reaches that position, it trips limit switch 33 and thereby opens the electric circuit to the magnet so that the sheet is dropped onto the front table between the guides. Actually, the switch may be tripped shortly before the carriage comes to rest, because momentum will carry the released sheet ahead until it strikes

guide 35, whereupon it will drop onto the table behind feeder plate 38.

As the carriage is returned to the magazine end of the table, air pressure is admitted to the front end of feed cylinder 41 so that plate 38 will move toward the dies to engage the front edge of the metal sheet, as shown in Fig. 5, and push it back between the separated dies until it strikes backstop 43, as shown in Fig. 6. Cylinder 45 has previously been adjusted on rear table 42 to locate the retracted backstop in the correct position for locating the forward portion of the sheet, that is to be bent first, directly over recess 14 in the lower die. Feeder plate 38 then is moved back to the front of the machine and the upper die comes down and bends the sheet, as shown in Fig. 7. This kicks up both sides of the sheet, but as soon as the upper die rises, the main body of the sheet falls back onto the rear table 42, as shown in Fig. 8. At about this time air is admitted to the lower end of gauge cylinder 50, which thereupon raises gauge pins 47 so that they project a short distance above the front table. At substantially the same time air pressure is admitted to the rear end of backstop cylinder 45 to cause the backstop to push the bent L-shape sheet forward until its upright portion engages the gauge pins, as shown in Fig. 9. The distance between the gauge pins and the lower die recess has previously been adjusted, by turning screws 56, so that the rear portion of the sheet that now is to be bent will be directly above the recess. The upper die then descends again, as shown in Fig. 10, to form the second bend in the sheet, parallel to the first one. This tilts the bent sheet up off the front table, but as soon as the upper die rises the finished bent sheet or channel falls back onto the front table. At about this time the gauge pins are lowered and backstop 43 is retracted, as shown in Fig. 11, and air pressure is admitted to the rear end of ejector cylinder 63. This causes ejector plate 61 to be thrust forward quickly in order to strike the adjacent end of the channel and thereby project the channel from the right-hand end of the feed table. As soon as this has happened, magnet 27 which in the meantime has picked up another sheet 18 from the pile in the magazine, is moved laterally to the feeding area and drops the sheet between guides 34 and 35 ready to be pushed by feed plate 38 back against stop 43 so that the front portion of the sheet can be bent by the dies.

It will be seen that this machine is entirely automatic, that its operation is rapid and accurate, and that there is no danger of an attendant catching his fingers between the dies.

According to the provisions of the patent statutes, we have explained the principle of our invention and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, feeding means in front of the dies for pushing a sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, means for periodically projecting said gauge above the table, and means for periodically moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies.

2. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, feeding means in front of the dies for pushing a sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, means for periodically projecting said gauge above the table, means for periodically moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies, and means for ejecting the bent sheet from between the dies.

3. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, feeding means in front of the dies for pushing a sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, means for periodically projecting said gauge above the table, means for periodically moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies, and means operated by said die-reciprocating means for timing the operation of said feeding means and gauge-projecting means and stop-moving means.

4. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, feeding means in front of the dies for pushing a sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, means for periodically projecting said gauge above the table, means for periodically moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies, rotatable cams, means driven by said die-reciprocating means for continuously rotating said cams, and means controlled by said cams for operating said feeding and gauge-projecting and stop-moving means in timed relation with the movements of said upper die.

5. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, feeding means in front of the dies for pushing a sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, means for adjusting the gauge toward and away from the lower die, means for periodically projecting said gauge above the table, means for periodically

moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies, and means for adjusting the rear position of the stop toward and away from the lower die.

6. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, means for supporting a pile of sheets adjacent the dies, means for transferring one sheet at a time from the pile to a position in front of said stop, feeding means in front of the dies for pushing a sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, means for periodically projecting said gauge above the table, and means for periodically moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies.

7. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, means for supporting a pile of sheets adjacent the dies, a magnet above the pile, means for reciprocating the magnet vertically to lift a sheet from the top of said pile, means for moving the magnet laterally to transfer the sheet to an area of the front table in front of said stop, feeding means in front of the dies for pushing a sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, means for periodically projecting said gauge above the table, and means for periodically moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies.

8. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, means for supporting a pile of sheets adjacent the dies, a track extending from above the pile to an area of the front table in front of said stop, means movable along said track for lifting the top sheet from the pile and delivering it to said table area, feeding means in front of the dies for pushing a sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, means for periodically projecting said gauge above the table, and means for periodically moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies.

9. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, means for supporting a pile of sheets adjacent the dies, a track extending from above the pile to an area of the front table in front of said stop, a carriage movable along the track, an electromagnet suspended from the carriage, means on the carriage for reciprocating the magnet vertically to lift a sheet from the top of said pile, means for reciprocating the carriage on the track to move the magnet and attached sheet to a point above said table area, an electric switch in the path of the carriage for opening the circuit to the electromagnet to release the sheet carried thereby, feeding means in front of the dies for pushing the released sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, means for periodically projecting said gauge above the table, and means for periodically moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies.

10. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, means for supporting a pile of sheets adjacent the dies, a track extending from above the pile to an area of the front table in front of said stop, a carriage movable along the track, a magnet suspended from the carriage, a fluid pressure cylinder on the carriage for reciprocating the magnet vertically to lift a sheet from the top of said pile, a fluid pressure cylinder for reciprocating the carriage on the track to move the magnet and attached sheet to a point above said table area, means for releasing the sheet from the magnet, a fluid pressure cylinder for pushing the released sheet back against said stop so that the front portion of the sheet will be bent by the dies, a gauge normally below the top of the table in front of the dies, a fluid pressure cylinder for periodically projecting said gauge above the table, a fluid pressure cylinder for periodically moving said stop forward to push a bent sheet against said gauge so that the rear portion of the sheet will be bent by the dies, valves controlling fluid pressure to said cylinders, and timing means operated by said die-reciprocating means for controlling said valves to cause said cylinders to operate in the proper order.

11. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, means for supporting a pile of sheets adjacent the dies, a magnet above the pile, means for reciprocating the magnet vertically to lift a sheet from the top of said pile, means for moving the magnet laterally to transfer the sheet to an area of the front table in front of said stop, and feeding means in front of the dies for pushing a sheet back against said stop to a position where it will be bent by the dies.

12. Sheet metal bending apparatus, comprising a lower die, tables on opposite sides of the die at substantially the level of the top of the die for supporting a metal sheet on the die, a vertically movable upper die, means for reciprocating the upper die to bend the sheet between the dies, a stop behind the dies, means for supporting a pile of sheets adjacent the dies, a track

extending substantially parallel to the dies from above said pile to an area of the front table in front of said stop, a carriage movable along the track, a magnet suspended from the carriage, a fluid pressure cylinder on the carriage for reciprocating the magnet vertically to lift a sheet from the top of said pile, a fluid pressure cylinder for reciprocating the carriage on the track to move the magnet and attached sheet to a point above said table area, means for releasing the sheet from the magnet, and a fluid pressure cylinder for pushing the released sheet back against said stop to a position where it will be bent by the dies.

THOMAS W. LLOYD.
DONALD W. MASON.

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