No. 849,501. PATENTED APR. 9, 1907.

J. M. RUDE.

METAL SHAPING MACHINE.

APPLICATION FILED APR. 21, 1906.

4 SHEETS—SHEET 1.

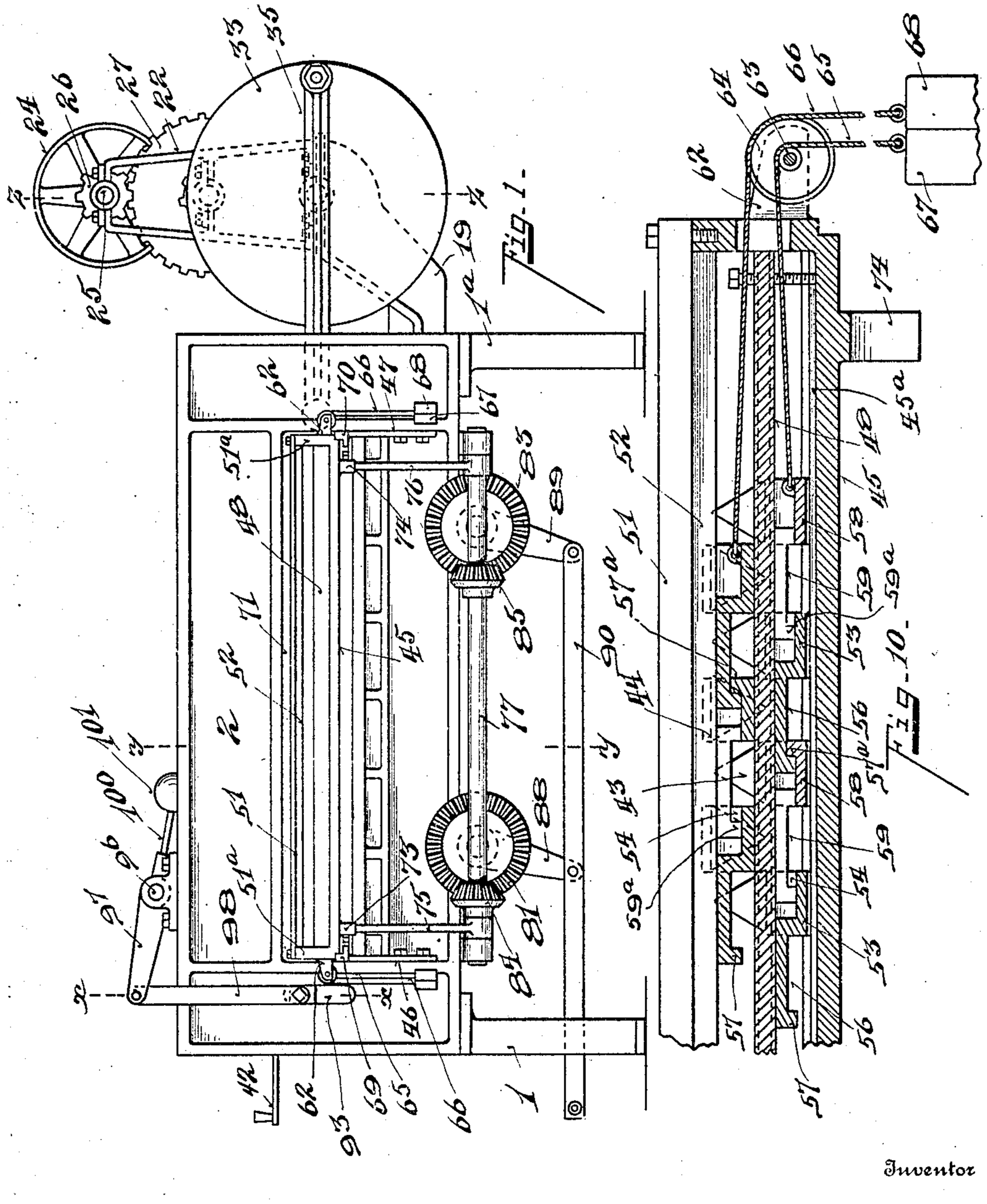

Fig. 1.

Fig. 10.

Witnesses
Louis B. Kaiser
Leo O'Donnell

Inventor
James M. Rude
By Wood & Wood
Attorneys

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4 SHEETS—SHEET 2.

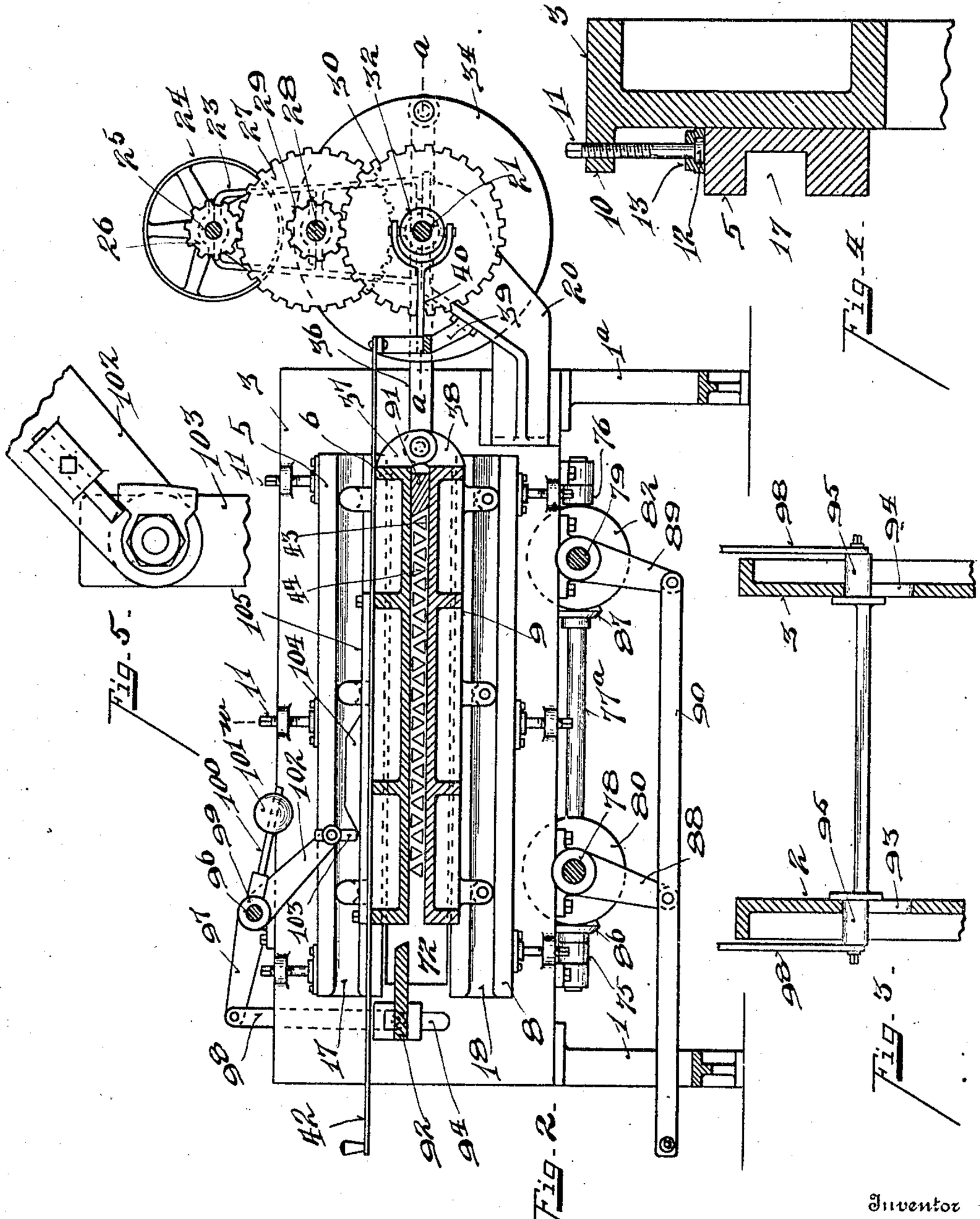

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Witnesses

Oliver B. Kaiser

Leo O'Donnell

Inventor

James M. Rude

By Woodworth

Attorneys

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4 SHEETS—SHEET 3.

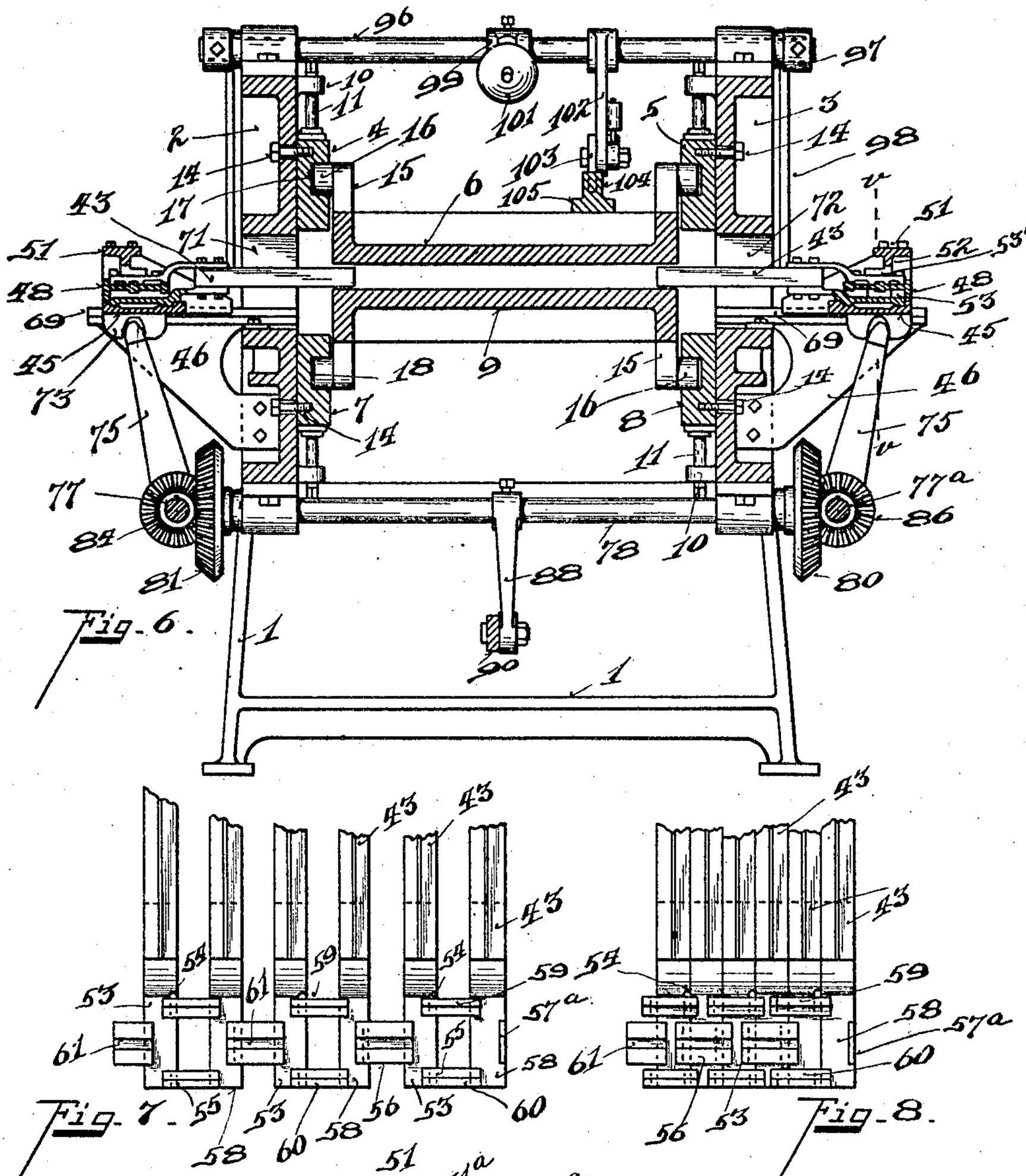

Fig. 6.

Fig. 7.

Fig. 8.

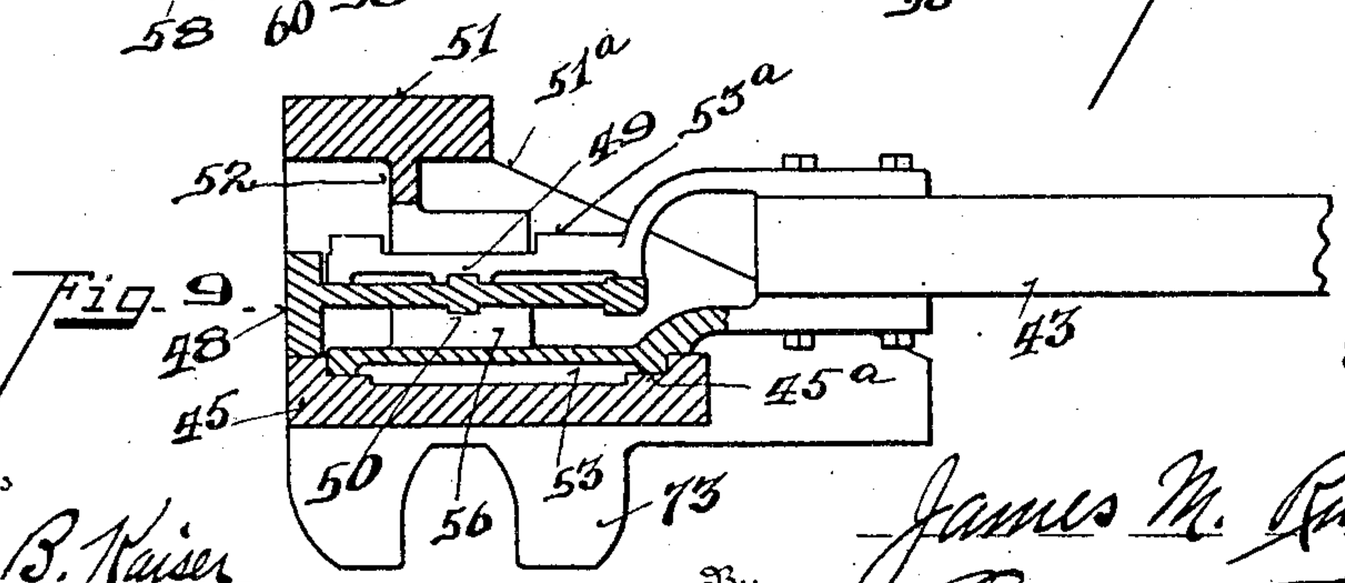

Fig. 9.

Witnesses
Louis B. Kaiser
Leo O'Donnell

Inventor
James M. Rude
By Brown & Ward
Attorneys

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4 SHEETS—SHEET 4.

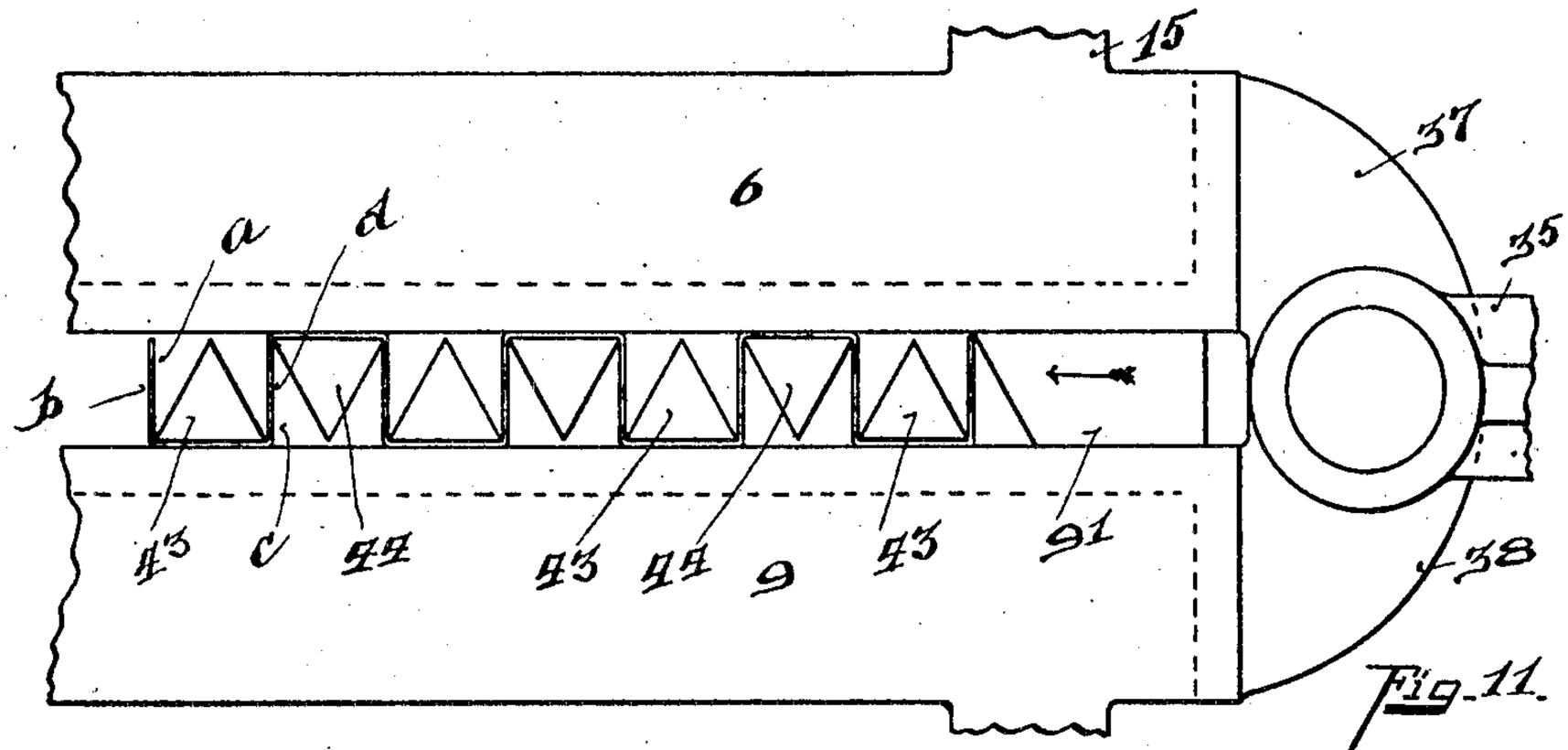

Fig. 11.

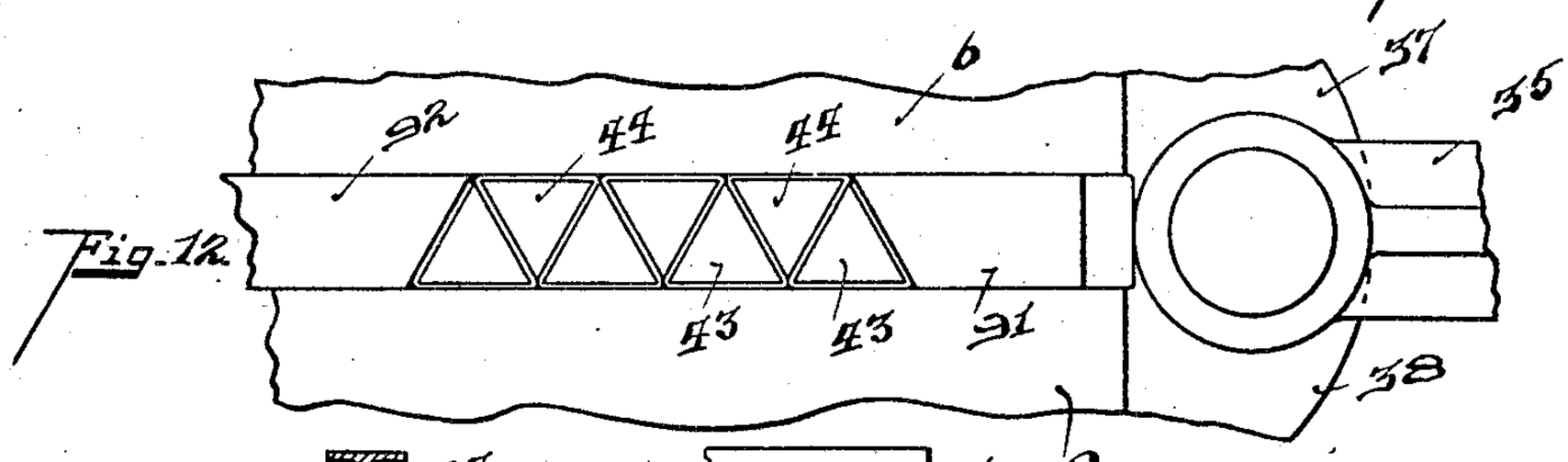

Fig. 12.

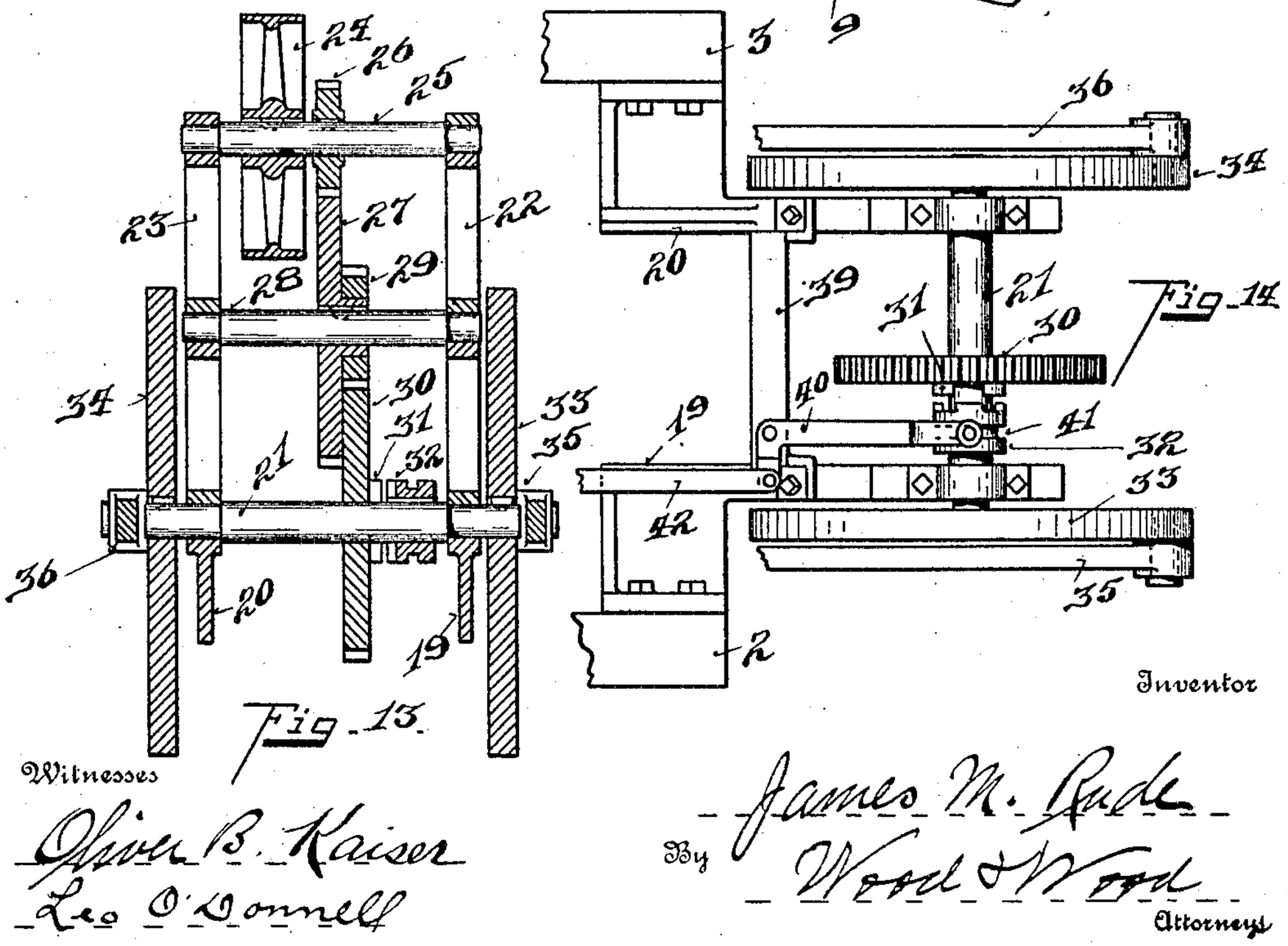

Fig. 13.

Fig. 14.

Witnesses

Oliver B. Kaiser

Leo O'Donnell

Inventor

James M. Rude

By Wood & Wood

Attorneys

UNITED STATES PATENT OFFICE.

JAMES M. RUDE, OF COVINGTON, KENTUCKY, ASSIGNOR TO NATIONAL CELLULAR STEEL COMPANY, OF NEW YORK, N. Y., A CORPORATION.

METAL-SHAPING MACHINE.

No. 849,501. Specification of Letters Patent. Patented April 9, 1907.

Application filed April 21, 1906. Serial No. 313,017.

To all whom it may concern:

Be it known that I, JAMES M. RUDE, a citizen of the United States, residing at Covington, in the county of Kenton and State of Kentucky, have invented certain new and useful Improvements in Metal-Shaping Machines, of which the following is a specification.

My invention relates to a metal-shaping machine.

The principal object of the invention is to form in one operation a section of cellular steel structure comprising a number of individual cells. These cells are separate from one another, and therefore each cell has to be compressed around an individual mandrel. The sheet metal is first preferably corrugated, and the individual mandrels are placed alternately in the corrugations upon opposite sides of the blank. The mandrels have to be endwise inserted and removed in these corrugations from opposite sides of the machine, and therefore, preferably, the mandrel for a given corrugation is composed of two sections, which approximately meet at the middle of the blank when the sections are inserted. These mandrels on opposite sides of the machine have to be supported at their outer ends, and as the compressing is in a line at right angles to the direction in which the mandrels move when being inserted into and removed from the position between the compressing-surfaces the mandrels must be so mounted as to be capable of being moved to and from one another laterally.

The further object of my invention is to provide actuating mechanism and sliding mountings for the sectional mandrels, which will enable them to have both endwise and lateral movement for the purposes above described.

Another object of my invention is to provide suitable power-driven compressing mechanism which will crowd the mandrels together, shaping the corrugations into the cellular form desired. This cellular structure is illustrated in the patent to E. F. Baude, No. 596,010, patented December 21, 1897, for "Construction of walls, partitions, ceilings, &c., of sheet metal." The cross-section of this structure is illustrated in Fig. 12 of the accompanying drawings, from which it will be seen that a continuous sheet of metal is bent to form two parallel walls formed of the meeting bases of the triangles constituting the cells and that the sides of these triangles extend transversely between these parallel walls, dividing the space between the walls into individual cells.

Other features of my invention relate more particularly to details of the construction and organization, more fully set forth in the description of the accompanying drawings, forming a part of this specification, in which—

Figure 1 represents a front elevation of my machine. Fig. 2 is a central vertical section of the same. Fig. 3 is a section on line *x x*, Fig. 1. Fig. 4 is a section on line *w w*, Fig. 2. Fig. 5 is an enlarged detail side elevation of the lever connection controlling the movable ram-plate. Fig. 6 is an enlarged section on line *y y*, Fig. 1. Fig. 7 is a detail view showing a series of mandrels and their connecting-plates in their normal open position. Fig. 8 is a detail view similar to Fig. 7, showing the mandrels and their connecting-plates in their closed or compressing position. Fig. 9 is a detail sectional view through the mandrels, their supporting-plates, and carriages. Fig. 10 is an enlarged sectional view on line *v v*, Fig. 6, of the carriage and mandrel-support. Fig. 11 is an enlarged view of the compressing members, illustrating the sheet metal and mandrels in position for compressing. Fig. 12 is an enlarged view of the compressing members, illustrating a sheet of metal and mandrels in their compressed position. Fig. 13 is a section on line *z z*, Fig. 1. Fig. 14 is a detailed top plan view of the driving mechanism for actuating the compressing members, taken on a line *a a*, Fig. 2.

1 1ª represent the supports of the entire machine, upon which the frames 2 3 are secured. (See Figs. 1, 2, and 6.)

4 5 represent rails adjustably secured upon the side frames 2 3 for supporting the upper compressing member 6. (See Figs. 2 and 6.) 7 8 represent rails secured to the side frames 2 3, respectively, for supporting the lower compressing member 9. These rails 4, 5, 7, and 8 are secured upon their side frames and adjusted relatively to each other by the following instrumentalities: A number of these adjusting devices are used; but I will for convenience only describe one of them, the remainder being duplicated. 10 (see Fig. 4) represents a boss projecting from the interior

of the side frames. 11 represents the screw-rod, screw-threaded through the boss 10, the lower end of which is provided with the flange 12. 13 represents a cap-plate through which the screw-rod 11 passes and into which the flange 12 seats. This cap-plate is secured to the rail and affords means for vertically adjusting the rails, and after an adjustment is made the rails are locked into position by the lock-nuts 14.

The top and bottom compressing members are supported upon the rails as follows: 15 represents ears projecting from the opposite sides of the compressing members, to which ears the rollers 16 are journaled. The rollers 16 ride in the grooves 17 18 of the upper and lower rails 4, 5, 7, and 8, respectively. The rails are preferably adjusted so as to converge very slightly in the direction of the compressing movement, so as to secure compression from the top and bottom.

The compressing members 6 9 are actuated by the following power-driven means, (see Figs. 2, 13, and 14:) 19 20 represent bracket-arms secured to the side frames 2 3, respectively to the rear end thereof, the said brackets projecting outwardly to form journal-supports for the driving-shaft 21. 22 23 represent upwardly-projected journal-brackets secured to the brackets 19 20 for supporting the train of driving-gears for transmitting power to the shaft 21. 24 represents a pulley fixed to the shaft 25, said shaft 25 being journaled upon the journal-brackets 22 23. 26 represents a gear fixed to the shaft 25, in mesh with a gear 27, fixed to the shaft 28. 29 represents a gear fixed to turn with gear 27, in mesh with a gear 30, loosely mounted upon the shaft 21. The gear 30 is provided with a clutch member 31, adapted to be engaged by the clutch member 32, keyed to the shaft 21. The clutch member 32 is adapted to be shifted into and out of engagement with the clutch member 31 of gear 30 for transmitting power to shaft 21. 33 34 represent eccentric wheels fixed to the opposite ends of the shaft 21. 35 36 represent connecting-links or pitmen mounted upon the eccentric wheels 33 34, respectively, at one end. The opposite ends are pivotally connected to the ears 37 38, formed on opposite sides of the compressing members 6 and 9.

It is desirable to have the control of the driving mechanism at the front end of the machine, and this is accomplished as follows, (see Figs. 2 and 14:) 39 represents a transverse bracket spanning the brackets 19 and 20. 40 represents a yoke bell-crank lever, the yoke of which is provided with pins adapted to engage into the groove 41 of the clutch member 32 for shifting the same as the lever 40 is actuated. This lever 40 is pivotally supported upon the bracket 39. The bell-crank end of the lever 40 is projected above the upper compressing-plate 6. 42 represents an actuating-bar pivotally connected to the bell-crank lever 40 and extending forward to the feeding end of the machine for convenient access to the operator. For the present purpose it will be sufficient to say that when the operator manipulates the rod 42 the clutch 41 may be thrown to move the compressing members 6 9 forward as a part of the compressing operation. The members 6 9 form the bottom and top compressing-surfaces, and I will later describe the two end compressing-surfaces.

I will now describe the construction of mandrels, the actuating mechanism for inserting and removing them, and the mountings which permit these mandrels to move laterally together during the compression and to separate them when released. These elements and their relative organization are best seen by reference to Figs. 6 to 12. The mandrel-sections are the same upon each side of the machine, and when inserted endwise into the corrugations of the blank the inner ends of the mandrels meet at the middle of the blank to form mandrels extending from end to end of the corrugations, each mandrel acting as an independent unit. I will therefore only describe the mandrel-section upon one side of the machine.

43 represents a series of mandrels supported with their apexes uppermost, and 44 represents an alternating intermediate series of mandrels with their bases supported uppermost.

b represents the blank, the corrugations of which are open alternately on opposite sides.

In Fig. 11, *a* represents a rectilineal corrugation open at the top of the blank, and *c* represents the next adjacent corrugation open at the bottom. The mandrel 43 in the corrugation *a* has the apex upright, the base of the mandrel 43 extending from one side of the corrugation to the other on the bottom of the blank. In the next corrugation *c* the mandrel 44 is inverted, the apex being down and the base lying against the top of the corrugation. The vertical wall *d* of the blank is between the mandrels 43 44. As the mandrels are equilateral triangles, each angle will be sixty degrees, and therefore the angles formed between the wall *d* and the adjacent side of the mandrel 43 at the bottom of the corrugation *a* and between the wall *d* and the adjacent side of the mandrel at the top of the corrugation *c* will be thirty degrees each. When the compressing mechanism crowds these mandrels together in the direction indicated by the arrow, Fig. 11, the metal will be alternately bent at the top and bottom to meet upon the opposite sides of the apexes of the mandrels to form the triangular cells, (illustrated in Fig. 12,) in each of which one of the mandrels is inclosed.

46 47 represent brackets on opposite sides

of the machine, having guideways extending toward the machine or at right angles to the direction of compressing. Upon each guideway is slidably mounted a carriage 45, which constitutes the main support for the sectional mandrels, by means of which they are moved endwise into corrugations of the blank placed between the compressing-surfaces 6 9 and which permits them to be withdrawn endwise from the completed cells. I will later describe the mechanism by means of which the carriages 45 are reciprocated on their bed-plates.

I will now describe the mountings by means of which the outer ends of the sectional mandrels are attached to the carriage 45, and the supporting means which permit these sectional mandrels to be moved laterally to and from one another independent of the carriage 45 and at right angles to the carriage movement as the mandrels are governed by the compressing instrumentalities. Each carriage is a double-deck affair, as it were, on the lower deck of which the supports for the sectional mandrels 43 are slidably mounted and on the upper decks of which the supports for the mandrel-sections 44 are slidably mounted. This upper deck of the carriage 45 is formed by plate 48, (see Fig. 9,) extending the full length of the carriage and provided with the top and bottom longitudinal ribs 49 50, which are for the purpose of relatively alining the upper and lower supports for the mandrel-sections. The carriage is provided with upward extensions 51[a] at its opposite ends, across which is secured the tie-plate 51. (See Fig. 10.) 52 represents a rib on the under face of the tie-plate bearing downwardly upon the upper series of mandrel-supports 53[a], holding them in position on plate 48. The member 53[a] has a sliding bearing on the plate 48 at its outer end, and its inner end forms a bracket from which is suspended the sectional mandrel 44. 53 and 58 represent similar supporting-plates, the inner ends of which are attached to the under sides of the sectional mandrels 43, the outer ends having a sliding bearing on the lower deck 45[a] of the carriage 45.

I will describe now more particularly the construction of the supporting member 53 and its relation to the other supporting members mounted in the same plane—that is, on the lower deck of the carriage 45. (See Figs. 7, 8, 9, and 10.) The arrangement of the supporting-plates for the upper horizontal plane of supports on plate 48 is the same. Looking at the right-hand end of Fig. 7, it will be seen that the first plate 58 has a couple of arms 59 60, overhanging the next adjacent plate 53. The outer ends of these overhanging arms are provided with hooks 59[a], (see Fig. 10,) which engage over lugs 54 55, formed on the said second plate 53, so that the plate 58 is linked to the plate 53, but may move independently the distance permitted by the length of the overhanging arms 59 60. It will be noted that the plates 58 and 53 are alternately arranged in a series. The arms 59 60 are slightly separated to make room for the other link connections 56 between the next two adjacent plates 53 and 58, so that when the mandrels are crowded together these links 59, 60, and 56 may pass one another, as illustrated in Fig. 8. The plates 53 have the arm 56, overhanging the adjacent plates 58 and provided with the hooks 57, engaging over the lugs 57[a] on plates 58. This makes a sliding length connection between the plates 53 and 58, which allows them to move together and which allows them to be separated or spaced a given distance apart. The arms 56 are provided with the alined grooves 61, which engage with the rib 50 of the shelf 48. The upper tier of supports 53[a] have grooves on the lower surfaces engaging the rib 49 of the shelf 48. The mandrels are crowded together under the influence of the compressing mechanism, the construction of the supports just described permitting the closing movement.

To automatically return the mandrels to their initial or spaced positions after they are withdrawn from the completed cells, I provide the following instrumentalities: 62 represents a bracket projecting from each side of the carriage 45, in each of which is journaled the sheaves 63 64. (See Fig. 10.) 65 represents a cable passing over sheave 63 and attached to the end support 58 on the lower deck of the carriage, there being a weight 68 suspended from said cable. 66 represents a similar cable passing over sheave 64, having a weight 68 at one end, the other end being attached to the end of the mandrel-supports 53[a] on the upper deck of the carriage. It is obvious that when the mandrel-supporting plates are released from the influence of the compressing mechanism that the weight 68 will separate the mandrel-supporting plates 53[a] from one another a distance permitted by the sliding connections between these plates and that a similar weight 67 will separate the plates 53 58, returning the mandrels to initial position.

When the corrugated blank is placed between the compressing members 6 9, the open ends of the corrugations are opposite the inner ends of the sectional mandrels. In order to move these sectional mandrels inward toward one another to place them within the corrugation, I provide the following instrumentalities: The carriages 45 are slidable on guides 69 70 on brackets 46 47. The frames 2 3 are provided with mandrel-openings 71 72, through which the guides 69 70 extend, so that the sectional mandrels can be moved in endwise from opposite sides of

the machine to positions upon opposite sides of the compressing members 6 9. 73 74 represent depending lugs formed integral with the carriage at each end thereof, provided with a notch for receiving the rocking arms 75 76. 77 77ª represent shafts suitably journaled in bearings fixed to the side frame. These actuating-levers 75 76 are fixed to these shafts and are rocked thereby. The rotation of shafts 77 77ª is effected as follows: 78 79 represent shafts suitably journaled in bearings fixed to the under face of the side frames and spanning the same, the ends of said shafts being provided with bevel-gears 80, 81, 82, and 83, fixed thereto for operating the carriages upon each side of the machine simultaneously. 84, 85, 86, and 87 are bevel-gears fixed to the ends of the shafts 77 77ª and in mesh with bevel-gears 80, 82, 81, and 83. 88 89 represent levers fixed to the shafts 78 and 79, respectively, to the free ends of which levers is pivoted the actuating-bar 90, projecting forward to the feeding end of the machine. Thus a forward or backward movement of the bar 90 will rock the shafts 78 79, transmitting motion to the actuating-levers 75 76 and causing the carriages to move in and out from between the compressing members 6 and 9, as desired.

To coöperate with top and bottom members 6 and 9 in effecting a compression operation, it is necessary to provide rams at opposite ends of the mandrel series, and in order to afford access to the compressing members it is essential that one of these rams be movable. 91 represents a stationary ram fixed to the lower compressing member 9 and movable therewith. This ram is preferably of a width equal to the width of the compressing member. 92 represents the movable ram supported at the front of the machine. The actuation of said ram is as follows: 93 94 represent slots formed in the frames 2 3, through which the bosses 95 of the ram 92 project. 96 represents a shaft supported in bearings fixed to the frames 2 3 and spanning the same. 97 represents levers upon the free ends of said shaft 96, to which are pivoted the depending links 98. The opposite ends of the links 98 are pivoted to the bosses 95 of the ram 92. (See Figs. 2 and 3.) 99 represents a sleeve fixed to the shaft 96, provided with a rod 100, upon which is secured a weight 101 for automatically actuating the shaft 96 to return ram 92 to its initial position.

In order to automatically move the ram into position between the compressing members 6 9, the following instrumentalities are employed: 102 represents a lever fixed to the shaft 96, the free end of which is provided with a dog 103, adapted to engage the cam 104 of the cam-plate 105, secured upon the compressing member 6. This dog has free pivotal movement in one direction and is locked against movement in the opposite direction. Thus as the compressing members are moved forward the dog will engage the cam 104 and ride over the same, actuating the shaft 96, and thereby causing the ram-plate 92 to be moved down, enabling the compressing members to pass over the ram, so that it will engage against and arrest the movement of the first of the series of mandrels. When the first mandrel is arrested in its movement toward the front of the machine, the next adjacent mandrel will crowd up against the first until the equilateral sides of the mandrels practically lie together, and this movement will continue throughout the series until the structure is formed. The mandrels are withdrawn from the completed cells and automatically spread or spaced to initial position, as before explained, the compressing members are returned to initial position, the completed structure is removed, and the machine is ready for another operation.

It will be seen that this machine not only produces a powerful compression, but is capable of a very rapid operation.

Having described my invention, I claim—

1. In a machine for shaping metal from a corrugated blank, compressing members between which the blank is compressed, means for actuating the same, a series of mandrels supported opposite to the end openings of the corrugations, means for inserting and removing the mandrels endwise into and out of the corrugations, and means permitting the mandrels to be moved together laterally under the influence of the compressing mechanism, substantially as described.

2. In a machine for shaping metal from a corrugated blank, compression members between which the blank is compressed, means for actuating the same, a series of mandrels supported opposite to the end openings of the corrugations, means for inserting and removing the mandrels endwise into and out of the corrugations, means permitting the mandrels to be moved together laterally under the influence of the compressing mechanism, and means for automatically returning the mandrels to their initial relative spaced positions when released from the said influence, substantially as described.

3. In a machine for shaping metal from the corrugated blank, compressing members between which the blank is compressed, means for actuating the same, a series of sectional mandrels supported on opposite sides of the compressing mechanism adjacent to the opposite open ends of the corrugations, means for inserting the sectional mandrels, into the corrugations, means permitting the mandrels to be moved together laterally under the influence of the compressing mechan-

ism, and means for withdrawing the sectional mandrels from the corrugations, substantially as described.

4. In a machine for shaping metal from the corrugated blank, compressing members between which the blank is compressed, means for actuating the same, a series of sectional mandrels supported on opposite sides of the compressing mechanism adjacent to the opposite ends of the corrugations, means for inserting the sectional mandrels, into the corrugations, means permitting the mandrels to be moved together laterally under the influence of the compressing mechanism, means for withdrawing the sectional mandrels from the corrugations, and means for automatically returning the mandrel-sections to their initial relative spaced positions when withdrawn, substantially as described.

5. In a machine for shaping metal from a corrugated blank, compressing members between which the blank is compressed, means for actuating the same, a series of triangular-shaped mandrels supported at their outer ends with their apexes uppermost, the inner ends extending adjacent to the open ends of the corrugations when the blank is placed in initial position between the compressing members, an alternating intermediate set of mandrels supported in like manner, but with their bases uppermost, means permitting the mandrel-supports to be moved together when the mandrels are under the influence of the compressing members, whereby the uppermost apex of one mandrel is brought against the uppermost base of its adjacent mandrel conforming the corrugations to the triangular shapes of the mandrels, means for inserting the mandrels endwise into the corrugations, and means for removing them from the completed cells after the compressing operation, substantially as described.

6. In a machine for shaping metal from a corrugated blank, compressing members between which the blank is compressed, means for actuating the same, a carriage mounted on one side of the compressing members adjacent to the open ends of the corrugations of the blank when it is in position between the compression members, a bracket having a guideway for the carriage extending in the direction of the corrugations, means for reciprocating the carriage on the said way, a series of supports having longitudinal guides on the carriage, the said supports having connecting-links permitting them to be spaced at intervals and to be crowded together, and a series of mandrels, the outer ends of which are attached to said supports, the inner ends extending adjacent to the open ends of the corrugations, substantially as described.

7. In a machine for shaping metal from a corrugated blank, compressing members between which the blank is compressed, means for actuating the same, a bracket at one side of the compressing mechanism having a guideway extended in the direction of the corrugations, a carriage slidably mounted on said way, means for reciprocating the said carriage, said carriage being formed with a lower and upper deck each having longitudinal guides, a series of mandrels having supports at their outer ends mounted upon the guides of the said carriage-decks, and links connecting the said supports permitting them to move laterally a predetermined distance, substantially as described.

8. In a machine for shaping metal from a corrugated blank, compressing members between which the blank is compressed, means for actuating the same, a bracket at one side of the compressing mechanism having a guideway extended in the direction of the corrugations, a carriage slidably mounted on said way, means for reciprocating the said carriage, said carriage being formed with a lower and upper deck each having longitudinal guides, a series of mandrels having supports at their outer ends mounted upon the guides of the carriage-decks, and links connecting the said supports permitting them to move laterally a predetermined distance, the mandrels being substantially triangular-shaped in cross-section and alternately placed with their apexes and bases uppermost, the supports for the two series being mounted respectively on the upper and lower deck of the carriage, substantially as described.

9. In a machine for shaping metal from a corrugated blank, compressing members between which the blank is compressed, means for actuating the same, a bracket at one side of the compressing mechanism having a guideway extended in the direction of the corrugations, a carriage slidably mounted on said way, means for reciprocating the said carriage, said carriage being formed with a lower and upper deck each having longitudinal guides, a series of mandrels having supports at their outer ends mounted upon the guides of the said carriage-decks, and links connecting the said supports permitting them to move laterally a predetermined distance, the mandrels being substantially triangular-shaped in cross-section and alternately placed with their apexes and bases uppermost, the supports for the two series being mounted respectively on the upper and lower deck of the carriage, means for automatically returning the mandrels to their relative spaced positions when they are released from the influence of the compressing mechanism, substantially as described.

10. In a machine of the class described for shaping a corrugated blank, a frame, top and bottom compressing members between which the blank is placed, mounted upon guides on

the frame slightly converging in the direction of the compressing movement, a ram for the rear of the blank, and an opposing ram for the front of the blank, and means for actuating said compressing mechanism, substantially as described.

11. In a machine for shaping metal employing a corrugated blank and mandrels placed in the corrugations, a top and bottom compressing member between which the blank and mandrels are placed, rams for the front and rear of the blank between the top and bottom members, and means for actuating the compressing members to crowd said mandrels together, and shape the corrugations to the mandrels, substantially as described.

12. In a machine for shaping metal employing a corrugated blank, with mandrels placed in the corrugations, a top and bottom compressing member mounted on guides on the frame, a ram in the rear of the blank between the top and bottom members, means for moving the said members forward, and an opposing ram for the front of the blank, substantially as described.

13. In a machine for shaping metal employing a corrugated blank with mandrels placed in the corrugations, a top and bottom and end compressing member mounted on guides on the frame, means for reciprocating said members on the guides, a ram for the front of the blank normally supported out of line with its coöperating compressing members, and means actuated by the forward movement of the compressing members to insert the front ram in position between the top and bottom members to form a resisting abutment for the compression of the blank, substantially as described.

14. In a machine for shaping metal from a corrugated blank, compressing members between which the blank is placed, a series of mandrels and means for inserting them endwise into the corrugations, means for bringing said compressing members together, means permitting the mandrels to move laterally, means for removing the mandrels endwise, meanstfor retuı ning the mandrels to initial position, and means for returning the compressing mechanism to initial position, substantially as described.

15. In a machine for shaping metal employing a corrugated blank, mandrels in the corrugations, compressing members surrounding the blank, the top and bottom compressing members being mounted on converging guides, and means for actuating the compressing mechanism, substantially as described.

16. In a machine of the class described, compressing mechanism, a carriage movable to and from the said mechanism, supports laterally slidable on the carriage, and mandrels attached at their outer ends to said supports, substantially as described.

In testimony whereof I have hereunto set my hand.

JAMES M. RUDE.

Witnesses:
OLIVER B. KAISER,
LUISE BECK.