(No Model.) 9 Sheets—Sheet 1.

E. SMALL.

MACHINE FOR MAKING SHEET METAL VESSELS.

No. 509,456. Patented Nov. 28, 1893.

Fig. 1.

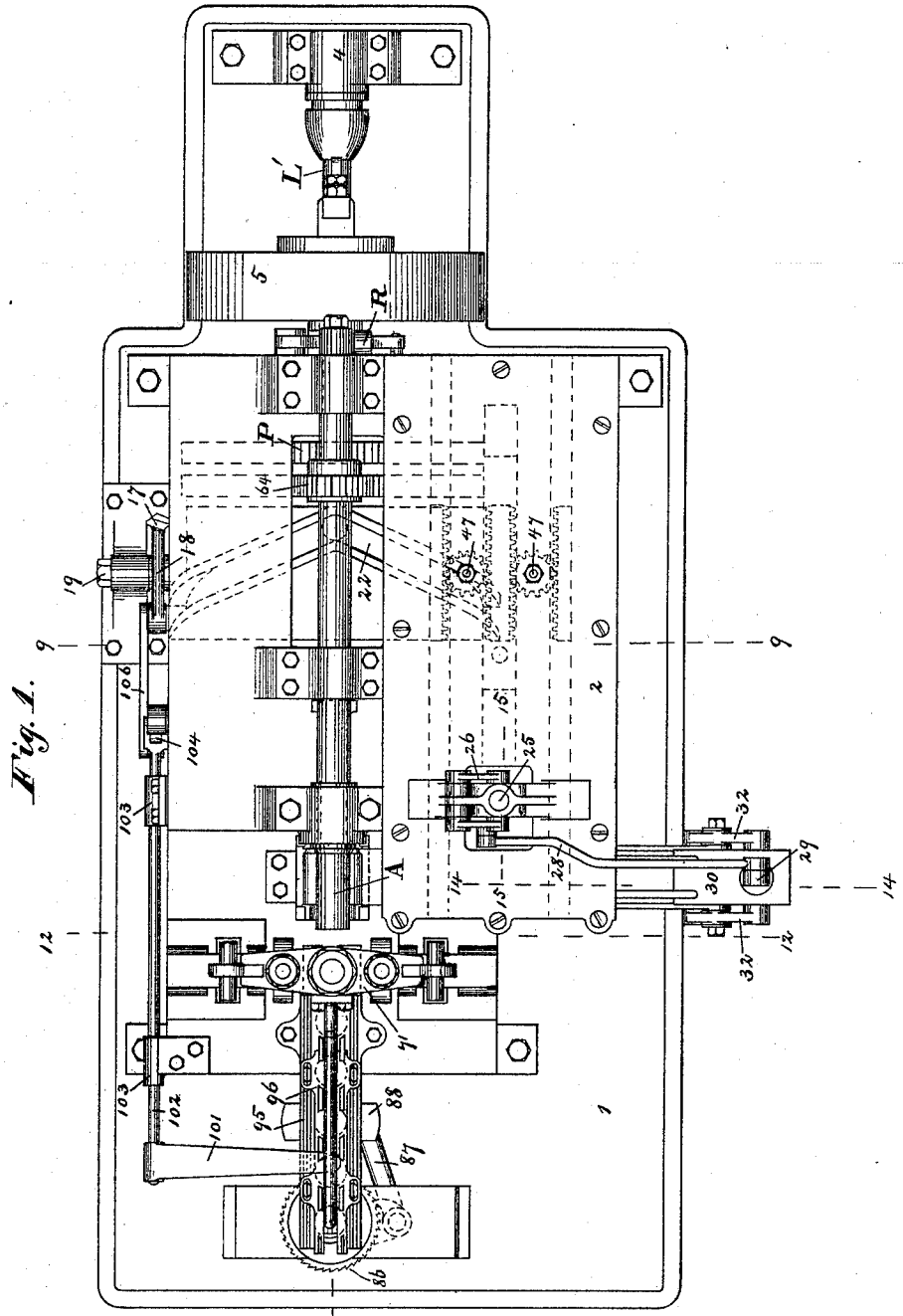

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Fig. 3.

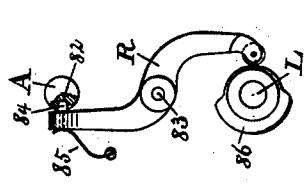

Fig. 2.

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Fig. 4.

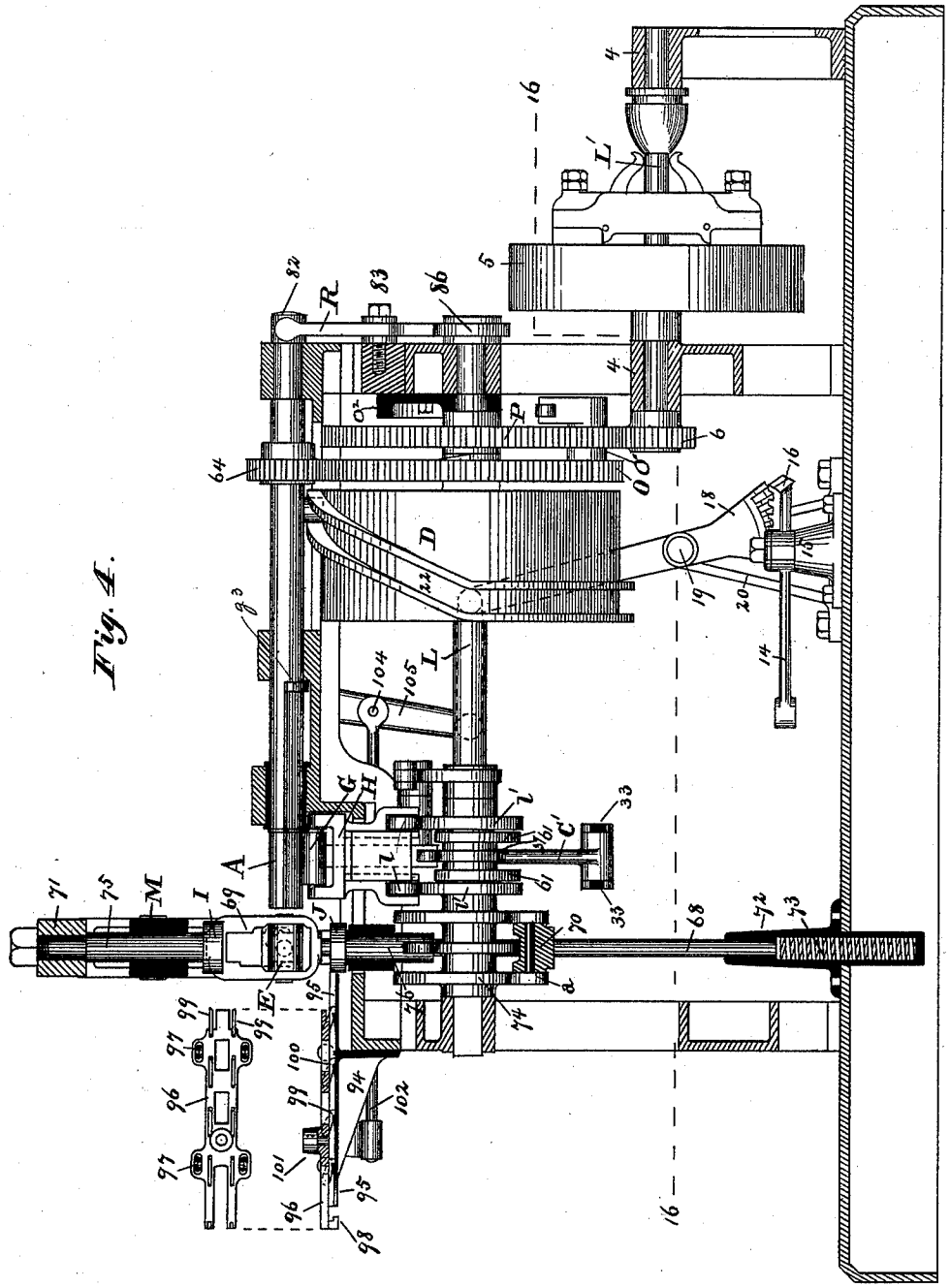

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Fig. 5.

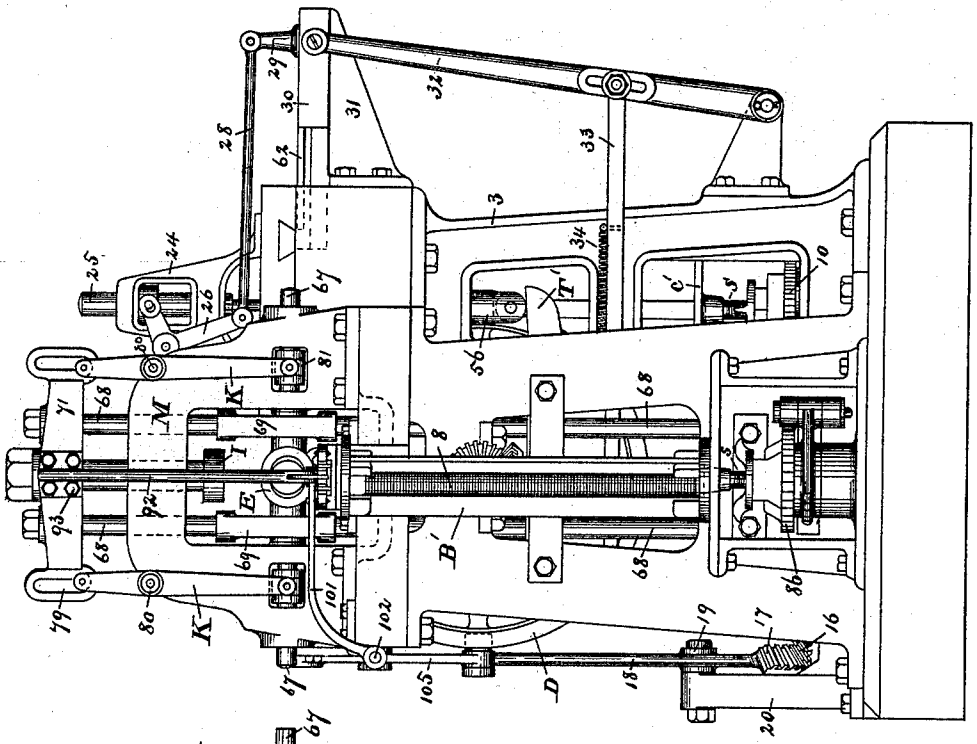

Fig. 6.

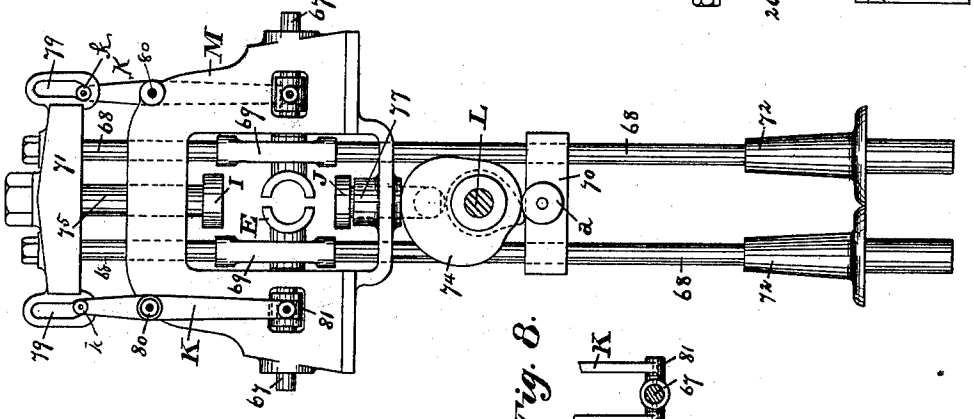

Fig. 8.

Fig. 7.

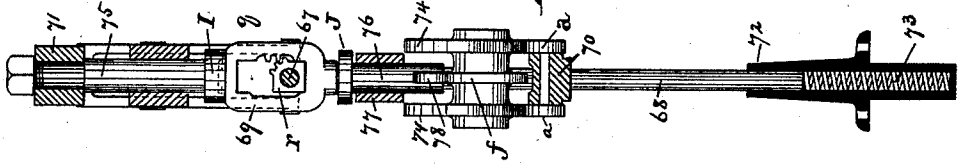

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Fig. 10.

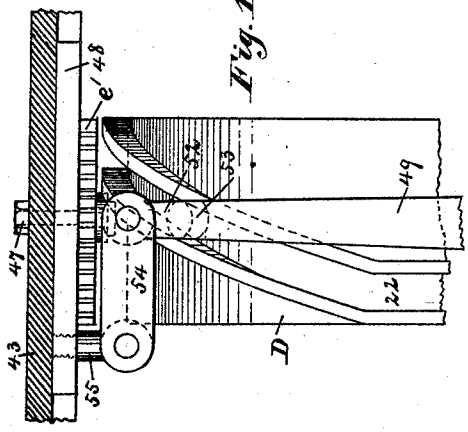
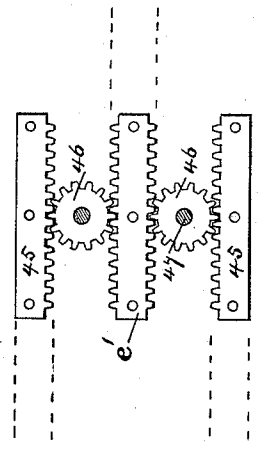


Fig. 11.



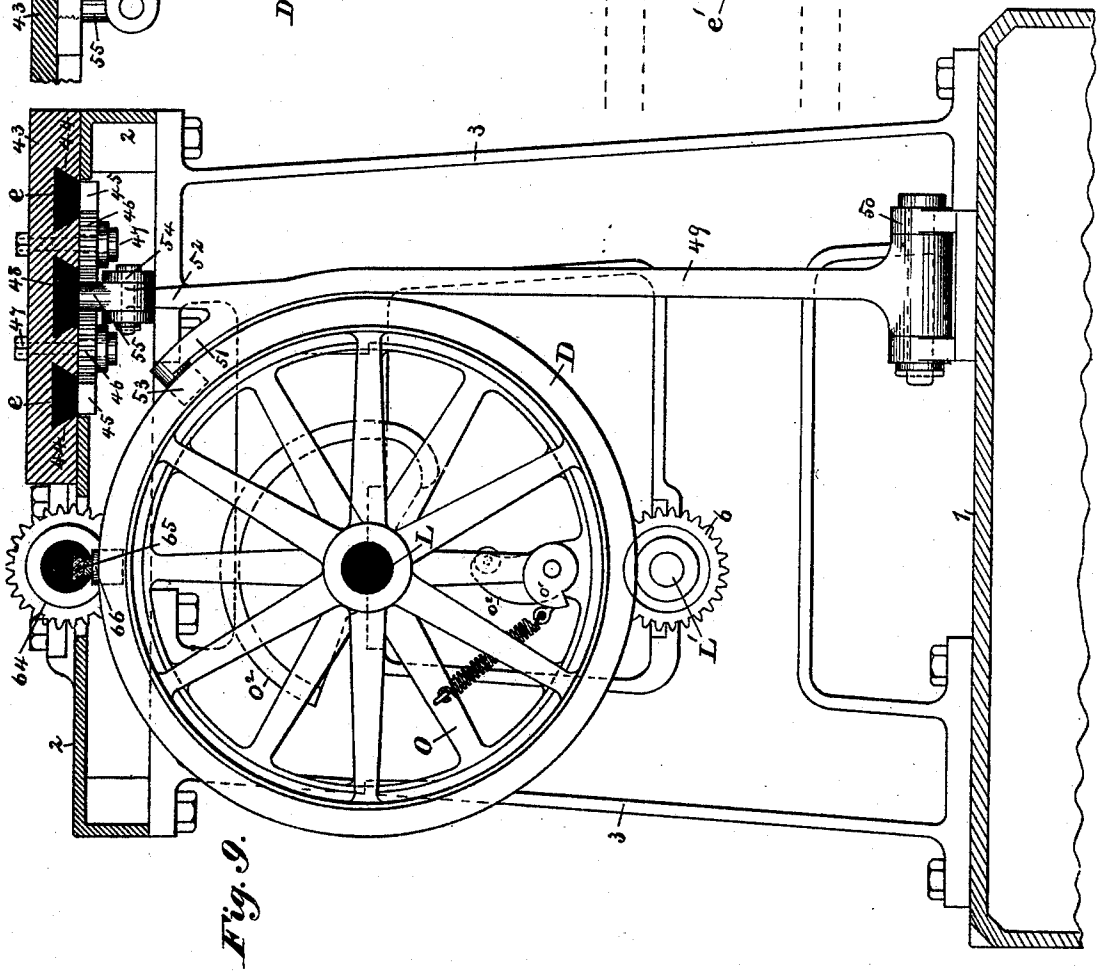


Fig. 9.

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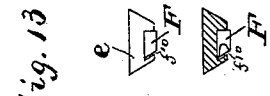
Fig. 13



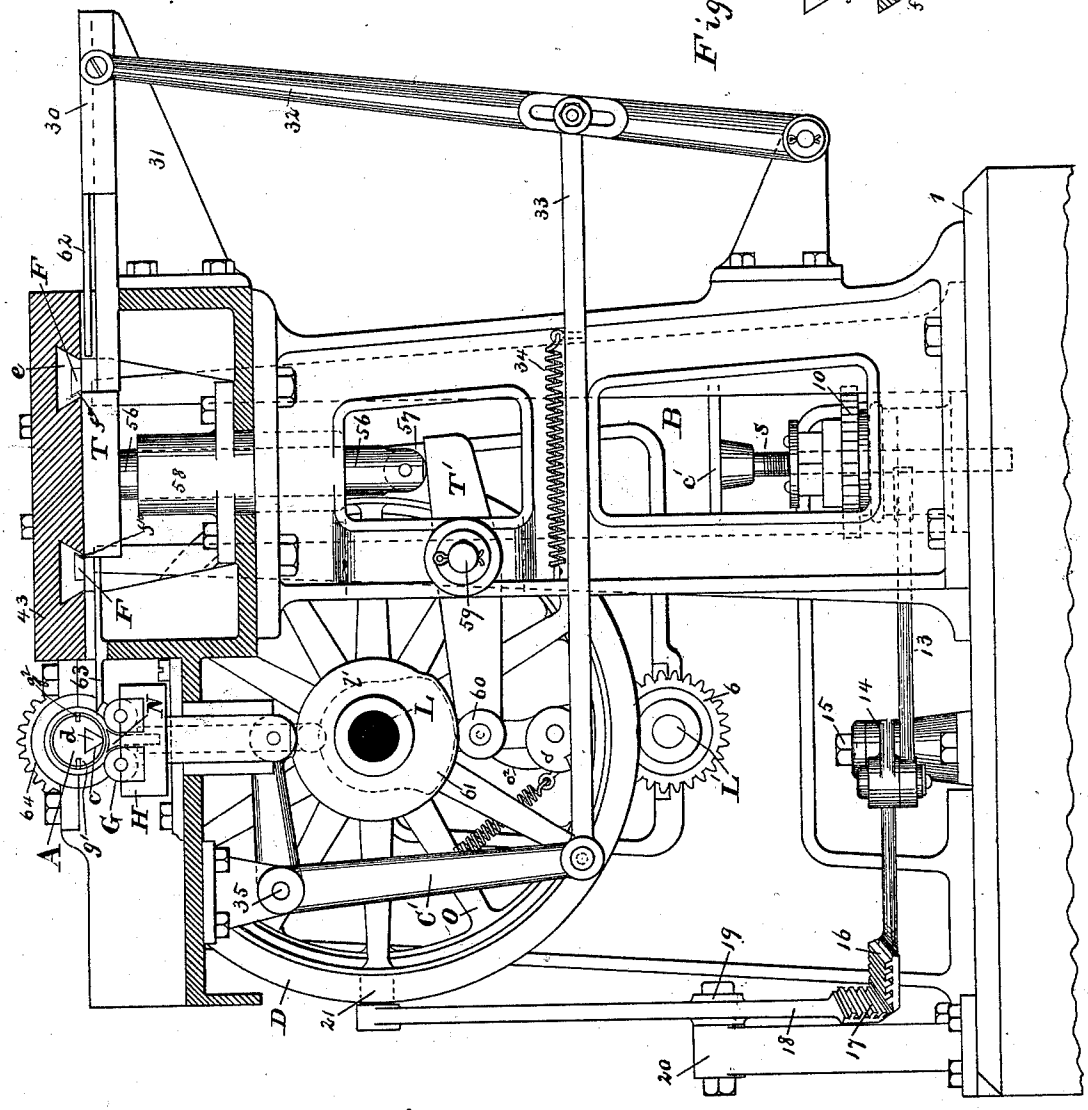


Fig. 12.

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Fig. 14.

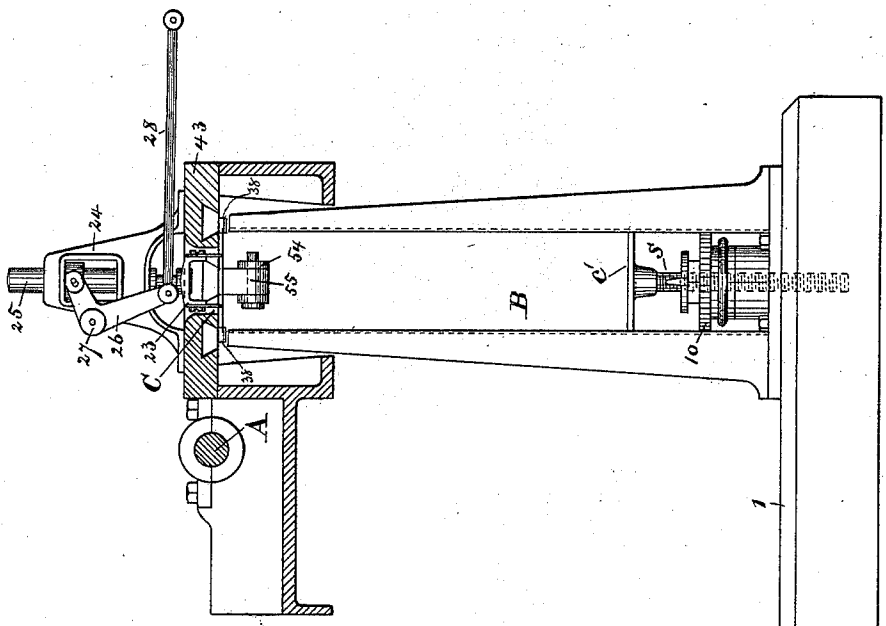

Fig. 15.

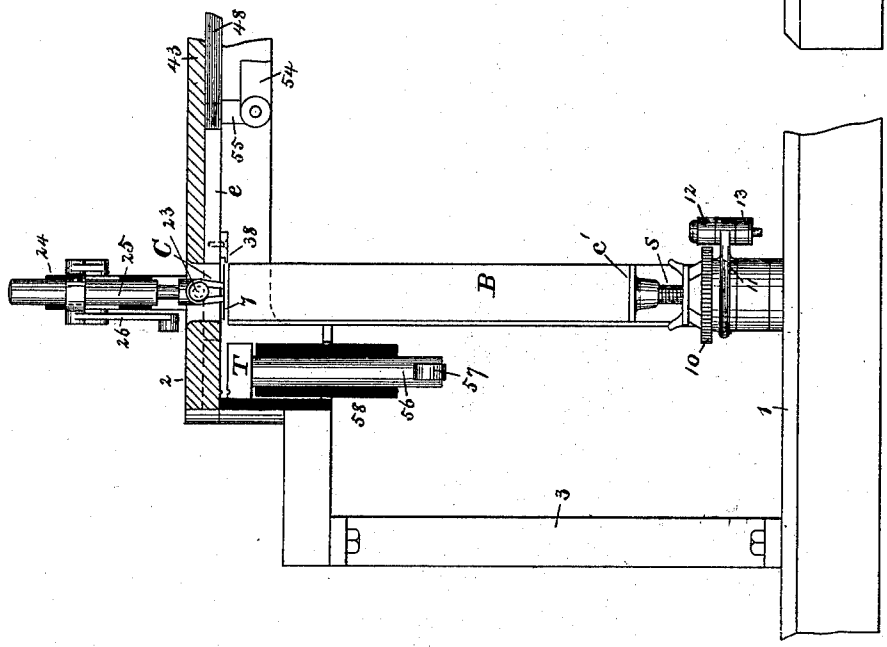

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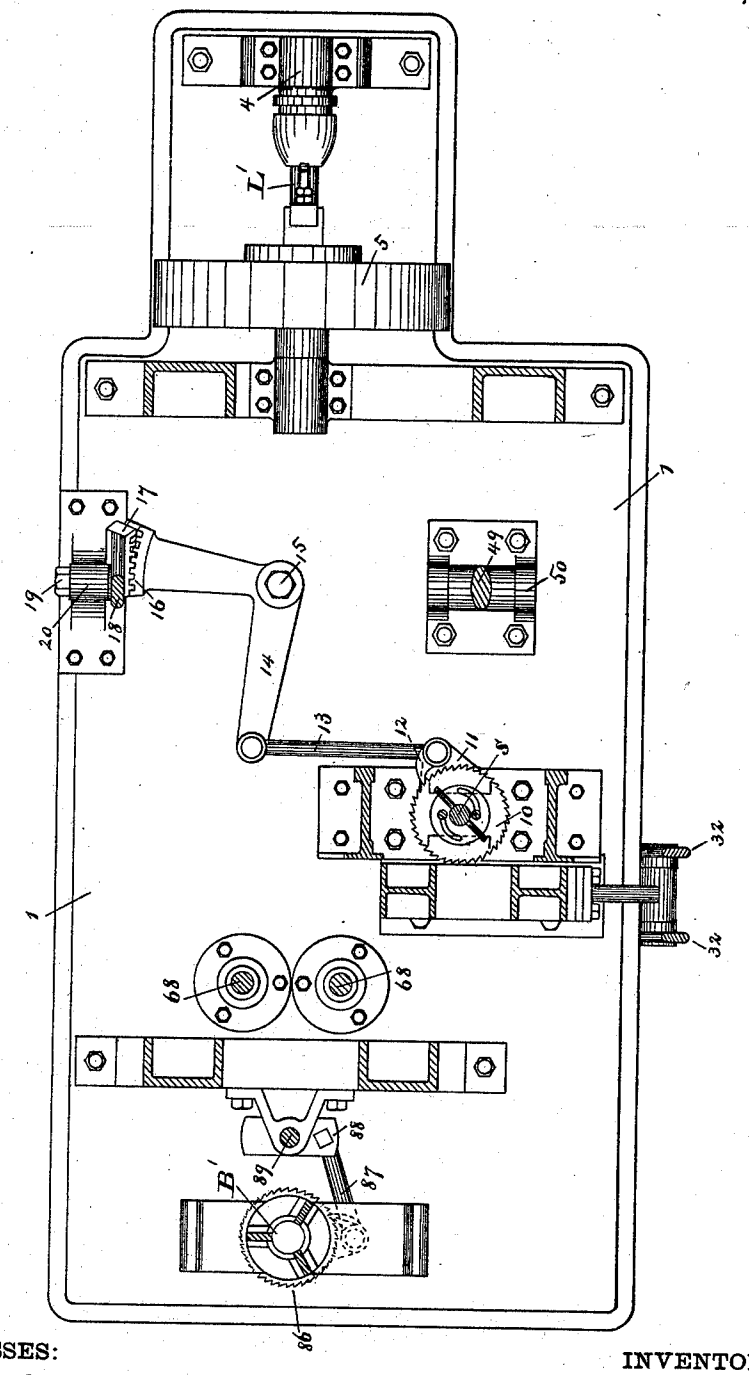
Fig. 16.



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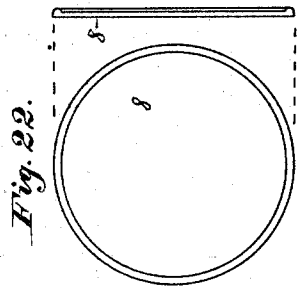

Fig. 22.

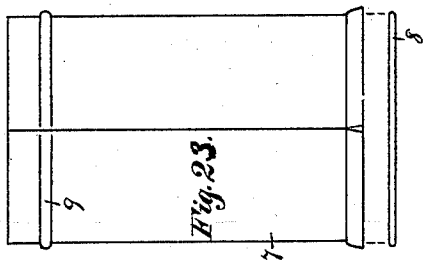

Fig. 23.

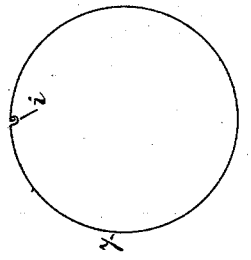

Fig. 21.

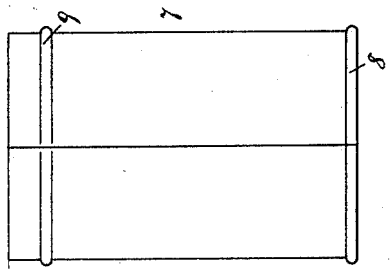

Fig. 17.

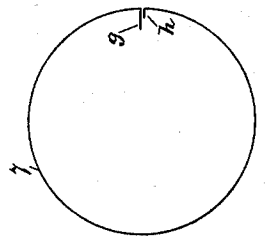

Fig. 20.

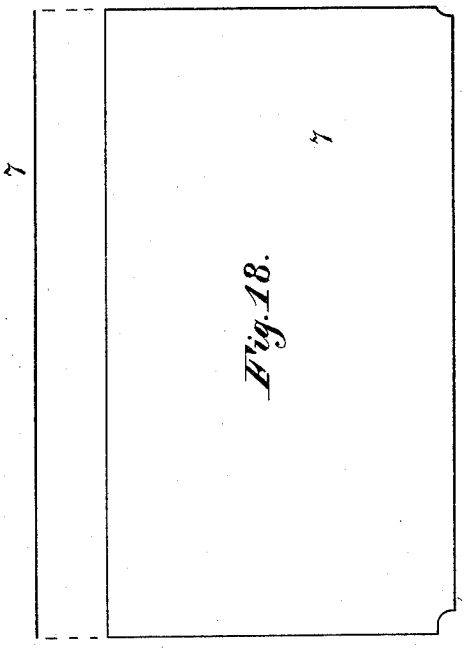

Fig. 18.

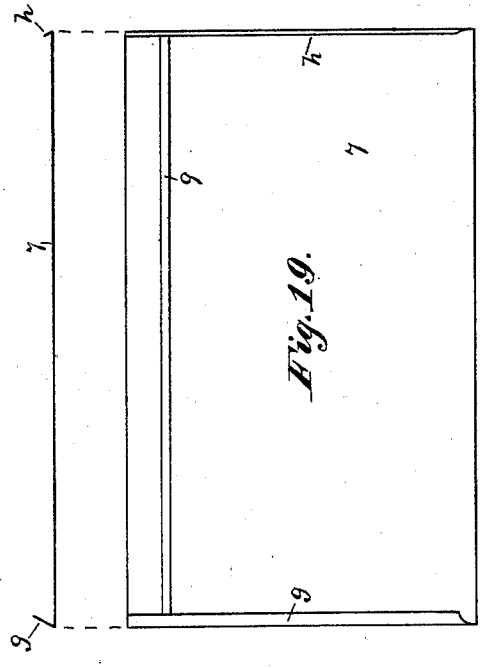

Fig. 19.

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UNITED STATES PATENT OFFICE.

EDWARD SMALL, OF BALTIMORE, MARYLAND.

MACHINE FOR MAKING SHEET-METAL VESSELS.

SPECIFICATION forming part of Letters Patent No. 509,456, dated November 28, 1893.

Application filed July 30, 1888. Renewed April 28, 1893. Serial No. 472,278. (No model.)

To all whom it may concern:

Be it known that I, EDWARD SMALL, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Automatic Machines for Making Sheet-Metal Vessels, of which the following is a specification.

This invention relates to a new and improved machine or combination of mechanisms for automatically converting a series of prepared body blanks and a corresponding series of head or bottom blanks into a series of headed vessels, by first forming the body blanks into cylindrical or other form and uniting the edges, and applying a head blank to the formed body and securing it in position thereon, all of said operations being automatically performed and in their proper sequence.

The complete machine comprises or includes the following co-operating parts or mechanisms: first, a body-blank holder or receptacle for receiving a series of prepared blanks; second, a blank selecting device or mechanism for removing the blanks one at a time; third, translating devices arranged to engage and advance the blank last acted upon by the selecting device; fourth, edging devices receiving the blanks from the translating devices and adapted to prepare the edges for the action of the side seaming devices; fifth, translating devices arranged and adapted to engage and advance the blanks last acted upon by the edging devices; sixth, body forming devices or mechanism receiving the blanks from the last mentioned translating devices and adapted to bend or shape it into the tubular form of the vessel or the body portion thereof; seventh, a side seaming device or mechanism for uniting or locking the edges of the blank to preserve the tubular form given the body by the body forming devices; eighth, translating devices arranged and adapted to engage and advance the formed and seamed body; ninth, clamps or holders for receiving the body, moving it into position to receive the head and sustaining it during the heading operation; tenth, a head-blank holder or receptacle for receiving and sustaining a series of prepared blanks; eleventh, a blank selecting device or mechanism for removing successive head-blanks; twelfth, translating devices arranged and adapted to engage and advance the blank last acted upon by said blank-selecting device; thirteenth, a heading device or mechanism arranged and adapted to receive the blanks as delivered by the last mentioned translating devices, and to co-operate with the body supported by the clamps or holder, and apply and secure upon said body the head-blank delivered by the said translating devices; fourteenth, connecting mechanism uniting said several mechanisms, to cause them to automatically and successively perform the several operations referred to.

In the accompanying drawings wherein I have shown one of the best forms in which I contemplate applying and embodying my invention, Figure 1 is a top plan view of the machine. Fig. 2 is a side elevation. Fig. 3 is a detail view of the mandrel and clutch-lever. Fig. 4 is a vertical longitudinal section of the machine. Fig. 5 is a rear elevation of the machine. Figs. 6, 7 and 8 are detail views of the heading mechanism or devices. Fig. 9 is a vertical cross-section on the line 9—9, Figs. 1 and 2. Figs. 10 and 11 are detail views of the mechanism for reciprocating the edges. Fig. 12 is a vertical cross-section of the machine on the line 12—12 Figs. 1 and 2. Fig. 13 illustrates details of the edging tool. Fig. 14 is a vertical cross-section on the lines 14 Figs. 1 and 2 showing the magnetic blank selecting device. Fig. 15 is a vertical longitudinal section on the line 15 Fig. 1 showing the blank selecting device, translating devices and a portion of the edging mechanism. Fig. 16 is a sectional plan view on line 16 Figs. 2 and 4. Fig. 17 is a side view of the completed can or vessel. Fig. 18 contains edge and top views of the body-blank. Fig. 19 contains edge and top views of the body blank after it has been edged. Fig. 20 is an end view of the tubular body or vessel preparatory to side-seaming. Fig. 21 is a sectional view showing the seam or joint. Fig. 22 contains edge and bottom views of the cap or bottom blank. Fig. 23 is a side view of the seamed tubular body and detached bottom blank.

Similar letters and numerals refer to the different parts of the invention wherever they occur.

Inasmuch as the particular embodiment of the invention represented in the drawings is designed for the manufacture of cylindrical vessels, such as cans, &c., the various operations performed will be described with reference to the formation of such vessels, although, as will be obvious, by slight changes in the form and construction of individual parts, and the proper adaptation of the means to the end, other forms of tubular vessels can as readily be produced without departing from the spirit of the present invention.

For convenience of description the several distinct mechanisms or combinations of devices forming the elements of the general combination or machine will be separately explained and their co-operative relations pointed out. Two series of blanks are first prepared, in any suitable manner and of the proper forms and dimensions to produce the desired vessel or can; thus in the present instance where a can Fig. 17 is to be made, the body-blanks 7 are prepared as shown in Fig. 18 and the head-blanks 8, as shown in Fig. 22. Each series of blanks—body and head—is properly located and held in position with relation to the selecting and translating devices by means of a specially prepared holder or receptacle. The body-blanks 7, superimposed one upon another to form a column of the requisite dimensions, are placed in the holder or receptacle B, provided with guides to retain the blanks in position and prevent lateral displacement, and having an elevator or movable support c' (Figs. 14 and 15) upon which the column of blanks rests and by which it is gradually elevated, as the uppermost blank is removed. In like manner the holder B′ (Figs. 2 and 3) for the head blanks is provided with guides and an elevator or movable support.

Near each holder or receptacle B B′ is arranged a blank selecting device or mechanism, adapted and arranged to remove the topmost blank, so as to isolate it from the column of blanks in the holder or receptacle, and sustain it in position to be acted upon by the translating devices. The blank selecting device appropriated to the body-blank holder B, consists essentially of a magnet or magnets C (two or more magnets are preferably employed to prevent the blank from tilting and to preserve its horizontal position) mounted to reciprocate vertically toward and from the top of the column of blanks, so as to engage and elevate the topmost blank at each reciprocation of the magnet or magnets. Between successive excursions of the magnetic selector, the column of blanks is elevated by the movement of the platen or elevator c', so that the topmost blank of the column will be maintained in proper co-operative relation with the magnetic selector at each succeeding excursion. A similar magnetic selector C^2 is arranged to reciprocate toward and from the column of head-blanks and operates to engage and elevate the topmost blank at each reciprocation of said magnet. The magnetic selector C serves merely to separate the topmost blank from the column and hold it suspended in position to be engaged and operated upon by the translating device, whose office it is to transfer the now isolated blank from the selector to the edging devices or mechanism. The translating devices referred to are represented by pushers 38 (Fig. 15) mounted to reciprocate laterally of the selector C, and so arranged that in their forward movement they engage the blank, and, removing it from the selector, deliver it in proper position to be acted upon by the edging mechanism. The edging mechanism is provided with a press or clamp into which the blank is delivered and upon which it is properly located by the translating mechanism referred to, said clamp serving to firmly hold the blank while its opposite edges g h are being bent or formed into shape by appropriate edging tools. Thus, in the example given, the blank is secured and held between a fixed horizontal platen on the under side of the table 2, and a movable presser-block T arranged below the fixed platen. See Figs. 12 and 15. The edging tools shown, consist essentially of two dies e, Figs. 12 and 13, properly shaped to form or bend the edges of the blank preparatory to the side-seaming operation, said dies being mounted to reciprocate upon opposite sides of the press or clamp and longitudinally of the edges of the blank, so as to engage the latter and flange or bend them, as represented in Fig. 19, the flange or bend formed along one edge g of the blank being made somewhat wider than that upon the opposite edge h. The blank may, if desired, be otherwise shaped or impressed during the clamping operation by providing the presser-block T and platen with appropriate dies or figures; thus in the illustration Fig. 15 the presser-block is shown provided with a groove suitable for producing a bead 9 on the blank. See Fig. 19.

The blank having been properly edged and the presser-block T retracted, the next operation performed is the removal of the blank from the edging devices to the body forming mechanism. To accomplish this a second set of translating devices is employed, the same comprising the prongs or pushers 62, (Figs. 5 and 12) mounted to reciprocate transversely of the edging dies. These pushers move between the platen and presser-block of the blank holder, and engage the blank lying upon the presser-block with its edges or flanges upturned. These translating devices, represented by pushers 62, advance the blank upon suitable supports 63 and present it in position to engage or be engaged by the body forming devices. The body forming mechanism is here represented as an intermitting rotating mandrel A (Figs. 1, 4, 9 and 12) grooved longitudinally to receive the turned or flanged edges of the blank, and two rollers G, supported in a frame H movable toward and from the man-

drel A. The blank acted upon by the translating devices 62 is advanced until the upturned edge next the mandrel enters the groove in the latter, where it is caught, and, the mandrel being rotated and the rollers G advanced, the blank is wrapped or bent into the cylindrical or tubular form of the body of the vessel to be produced, the opposite upturned edges g, h of the blanks being brought together and projecting within the groove of the mandrel. The body having thus been formed, the motion of the mandrel is arrested, and the side seaming devices are brought into action. The side seaming mechanism is designed to lock or seam together the proximate edges of the now tubular blank, and it comprises a seaming device tool d (similar to that described in Patent No. 355,108, dated December 28, 1886) reciprocating longitudinally of the mandrel A in the groove therein, and a stay bar N (Fig. 12) movable toward and from the mandrel and operating to sustain the body during the formation and completion of the seam by the seaming tool. The body portion of the can or vessel is now fully formed and completed, and it only remains to apply the head or bottom thereto, to finish the vessel. In effecting this a third translating device or mechanism is arranged to engage the body and carry it forward to the heading devices. A translating device of this kind is represented by a pusher or pushers g' (preferably two or more) arranged to move longitudinally of the mandrel A and engaging the body. The pushers g' are arranged to traverse in grooves formed in the mandrel, to insure their engagement with the body surrounding the latter, and they deliver or deposit the body within the clamps or holders of the heading mechanism, in position to be subjected to the action of the heading die or other devices for applying and securing the head in or upon one end of the tubular body. These body clamps or holders are arranged to receive the body from the translating devices last referred to, and serve to hold and maintain the body in proper relation to the heading mechanism during the heading operation. As shown the body clamp is formed in two sections E (Figs. 5 and 6), having their gripping faces concaved or otherwise suitably shaped to secure the body between them. The sections E are mounted to reciprocate toward and from a central line in the plane of the axis of mandrel A, being retracted, to open the clamp or holder as the body is advanced and delivered between the sections by the translating devices, and then advanced to close upon and clamp the body; said clamp is also mounted to oscillate or turn about an axis transverse to the mandrel, so that when the body has been grasped and while firmly held in the clamp or holder it may be turned and brought into position to be acted upon by the heading mechanism. The clamp or holder is thus brought in line with the mandrel on which the body is formed, and opened to receive the body from the translating devices, after which it is closed to clamp the body, carried around to submit the body to the action of the heading mechanism, and then returned to its first position in line with the mandrel, so that as the next succeeding body is advanced by the translating devices, it will discharge the finished or headed vessel from the clamp or holder.

The heading mechanism of the machine shown (Figs. 5, 6 and 7) is composed essentially of two opposed reciprocating dies I, J, the one arranged above and the other below the body clamp or holder when the latter is swung around to bring the body in line with said dies. The lower die J is concaved or suitably formed to receive the head blank and act upon the end of the body held in the clamp or holder to crimp the end of the body upon the head blank and form a secure joint or seam at that point. Between the lower heading die J and the selector B′ of the head-blank holder, is located a translating device arranged and adapted to engage the blank held by the selector C^2 and transfer it into position upon said die for application to the end of the body. This translating mechanism (Figs. 1, 2, and 4) comprises a suitable guide or way 95 provided with fixed abutments or detents 100; reciprocating pushers 98 engaging the blank held by the magnet C^3 and delivering it onto said guide; and a reciprocating plate 96 provided with a series of detents or pivoted fingers 99 and movable longitudinally of said guide or way 95. The separator and translating mechanisms for operating upon the head blank are timed to deliver a blank upon the head die J between the completion or heading of one vessel and the presentation of the next succeeding body by the clamps or holder. All the operations referred to, with the single exception of placing the head and body blanks in their respective holders, are automatically performed and although in describing the co-operative relations of the several mechanisms but a single blank has been followed through the machine, it will be understood that a number of blanks, one succeeding another, are being operated upon at the same time.

It only remains to supply competent connecting mechanism or actuating devices uniting the several devices or mechanisms referred to, and properly time the movements of the parts. Such a connecting mechanism is illustrated and will now be described, together with the details of construction whereby the several devices are adapted thereto. The several co-operating mechanisms, are preferably mounted upon a connected frame, of which 1 is the base, 2 the top-plate and 3 the legs or supports. L is the main driving shaft or prime mover from which all the devices derive their motions. Instead of applying power directly to this shaft L it is transmitted thereto through suitable gearing P, 6,

from a counter-shaft L′ mounted in bearings 4 and provided with a clutch and pulley 5. The elevator c' for elevating the columns of body blanks after the topmost one has been withdrawn by the selector C, is supported upon a non-rotating screw s whose threads are engaged by the threads in a separable or two part nut attached to a ratchet wheel 10. An intermitting rotatory motion is given the ratchet wheel 10 by an arm 11 (see Fig. 16) pivotally supported upon the hub of said wheel, and carrying a pawl 12 in engagement with the teeth on the ratchet wheel. The free end of arm 11 is connected, by a rod 13, with one arm of a bell crank lever 14, fulcrumed at 15. The other arm of the lever 14 is furnished with a toothed segment 16 in gear with a like segment 17 on a lever 18, the latter pivoted at 19 upon a standard 20 and carrying a friction roller (indicated by dotted lines 21 in Fig. 12) engaging the walls of groove 22 in cam wheel D on shaft L. At each revolution of the main drive-shaft the arm 11 carrying pawl 12 will be reciprocated one or more times, thereby turning the nut and raising the screw s and elevator c' a distance equal to the thickness of one blank. The magnets C of the body blank selector are attached to and carried by a holder 23 (Figs. 14 and 15) guided to reciprocate in guides 24. The shank 25 of the holder is connected to a bell-crank lever 26, pivoted at 27; and a rod 28 connects the other arm of the lever 26 with a stud 29 (Figs. 2 and 5) on a plate 30, the latter guided to reciprocate upon a bracket 31. The plate 30 receives motion from a cam 37 on main drive shaft L, through a lever C′ rods 33 and levers 32. The lever C′ is pivoted at 35 and its short arm carries a roller 36 in engagement with cam 37 while its longer arm is connected by rods 33 with levers 32 engaging the plate 30. A spring 34 connected to rod 33 serves to hold the plate 30 projected and the roller 36 in engagement with cam 37, the latter operating to retract the plate. Hence the movement of said plate in a direction to cause the magnets to approach and make contact with the blanks is produced by the spring; whereas the movement in the opposite direction is positive, being effected by the cam. The pushers 38 of the first translating device are attached to and partake of the motions of shanks e carrying the edging tools or dies, and their movements as derived from the main-shaft will be explained in connection with the edging mechanism. The presser-block T of the edging mechanism is provided with a shank or stem 56 (Figs. 12 and 15) working in guides 58 and carrying a roller 57, which latter rests on a lever T′ pivoted at 59 and carrying rollers 60 in contact with cams 61 on main drive shaft L. Thus at each revolution of the driving shaft the presser-block is caused to make one or more reciprocations, each time clamping a blank and holding it firmly while the edges are being turned. The cams 61 are so shaped as to hold the presser-block in its elevated position while the edging tools are operating upon the blank, and then to lower the presser-block and permit it to remain for a short interval in its retracted position while one set of translating devices is removing the edged blank, and the other set is inserting a new blank.

The devices for operating the edging tools are shown in detail in Figs. 9, 10 and 11. A plate or block 43, detachably secured to the top plate 2 is provided, on its under side, with under-cut or dove-tail ways 44 to receive the correspondingly shaped tool-shanks e. Each shank e is provided with a rack-bar 45, in engagement with a pinion 46 mounted upon a bolt 47 fixed to the plate 43. Between the two pinions 46 is a double rack-bar e' secured to a slide bar 48 supported in ways on the plate 43. As thus arranged, when motion is communicated to the central rack-bar e' in one direction it will effect a simultaneous movement in an opposite direction of both tool shanks e.

Motion is transmitted to the rack-bar e' from the main drive shaft L by the following devices (see Figs. 2 and 9): A link 54 engaging a stud 55 on rack-bar e' is connected to one arm 52 of a lever 49, the latter pivoted in bracket 50 and provided with another arm 51 carrying a roller 53 engaging the walls of a groove 22 in cam D on the main driving shaft. The edging tools or dies F are formed or provided with turning dies f^{10} having expanded curved walls at their front end and terminating in inclined vertical slots or openings as shown in Figs. 12 and 13. These dies are secured to the under side of the shanks e, and are caused to operate upon the projecting edges of the blank held in the press as the dies are retracted, that is to say, when they are moved from the left toward the right hand of the machine represented in Figs. 1 and 2. The pushers 38 (Figs. 14 and 15) are attached to the shanks e, at points intermediate the dies F and pinion 46, and are so arranged relatively to the lifting magnets C, that the latter will raise the blank and hold it between the pushers 38 and dies F, in position to be engaged by the said pushers as the shanks e move to the left, thus carrying the blank between the members of the press. It is upon the return movement, to the right, that the edging tools F engage the blank previously brought to position by the pushers 38, and it is after said blank has been completely edged and during an interval while the tools F remain stationary, that the magnets C are caused to elevate the next succeeding blank into position in front of pushers 38. While the shanks e are held retracted, after the dies F have been drawn along the edges of the blanks and have completed the edging of the latter, the second translating device is brought into action, to remove the edged blank, (released by the descent of the presser-block T) and transfer it to the body forming devices. This translating device or mechanism comprises two

pushers 62 attached to the reciprocating plate 30, through which motion is transmitted to the magnet holder 23. As the plate 30 is advanced to cause the descent of the magnet-holder, the pushers 62 moving transversely to the edging tools, slide the edged blank from the presser-block onto the supports 63 into position to be engaged by the mandrel of the body forming mechanism.

The mandrel A of the body forming mechanism is mounted in bearings on the frame and is provided with a pinion 64 in gear with a wheel O loosely supported upon the main-driving shaft and connected thereto at intervals by an automatic clutch device O′ carried by wheel P and operated by a cam O^2 on the frame. This clutch mechanism is constructed and operated as follows: The teeth on wheel O are, in numbers, a multiple of those on pinion 64, and said wheel is provided with two or more abutments or shoulders *o* dividing the wheel into equal sections, each of which represents one or more diameters of the pinion 64. On the wheel P is mounted a pivoted dog *o′*, in position, when projected, to engage the abutments on wheel O; said dog is mounted upon a pin or shaft carrying an arm o^2 projecting in the plane of a fixed cam O^2. The dog *o′* is normally held retracted by a spring. The wheel P carrying dog *o′* rotates continuously with shaft L, and as the arm o^2 rides upon cam O^2 the dog is projected and caused to engage one of the abutments *o* on wheel O, thereby connecting said wheels O, P, and causing their simultaneous movement. The cam O^2 holds the two wheels locked together while the mandrel is making one or more complete rotations, after which the dog passes off the cam and is retracted by its spring to release wheel O. After the wheel O is thus released from the driving mechanism, an automatic clamping or holding device is applied to the mandrel to center and hold it stationary while the side seaming operation is being performed. Such a clamping device is represented in detail, in Fig. 3. The mandrel A is provided with a socket 82 with which a pin 84 on lever R is caused to engage, to hold the mandrel and prevent rotation thereof. The lever R is pivoted at 83 and actuated in one direction, to engage the mandrel, by a spring 85, and in its opposite direction, to release the mandrel, by a cam 86 on main drive shaft L. The cam 86 is of proper form to retract the pin 84 at the time or slightly in advance of the movement of the mandrel, and to permit the forward motion of the lever before the rotary motion of the mandrel ceases, so that the pin 84 will be held by the spring pressed against the mandrel, to insure the entrance of the pin in the groove as the mandrel is released by the driving mechanism. The mandrel A is furnished with a longitudinal groove *c* within which the upturned edge of the blank is received when the latter is advanced by pushers 62. The two rollers G which press and hold the blank upon the mandrel as the latter is rotated to form the body, are journaled in a frame H, (Figs. 4 and 12) guided to reciprocate toward and from the mandrel, and carrying friction rollers *l* resting upon cams *l′* on main drive-shaft L. The cams *l′* are of suitable form to elevate and sustain the rollers during the body forming operation.

The side seaming devices, which, in this instance, are constructed and arranged to operate upon the body immediately after it has been formed into shape, and while still remaining upon the mandrel, are arranged for operation as follows: The side-seam stay-bar N extending longitudinally of the mandrel is mounted in a vertically guided frame and is acted upon by cam 37 on the shaft L; the stay-bar is advanced by the cam and holds it firmly in contact with the body, in line with the meeting edges, while the mandrel is at rest and the seaming tool in operation. The seaming tool *d* attached to a tool-bar 65 (Fig. 9) is guided to reciprocate longitudinally of the mandrel within the groove *c* therein, and operates upon the edges of the blank to form an interlocking or coil seam *i*. The reciprocating movement is imparted to the tool-bar 65 by a grooved cam wheel D on the main drive shaft L, co-operating with the roller 66 on the tool-bar, said roller standing in groove 22 when the main shaft is brought to a state of rest. The seaming tool *d* employed in this machine is preferably of substantially the construction described in my Patent No. 355,108, and is arranged with the flaring open end facing the cam wheel D. While the body is being formed by wrapping or bending the blank about the mandrel the seaming tool is held near the end of the mandrel beyond the blank, and after the body has been formed, the mandrel brought to rest, and the stay-bar elevated, the tool bar is retracted by cam D and the seaming tool *d* is thus drawn along the two edges of the blank projecting within groove *c* to form the seam or joint and complete the body, Fig. 23. The translating devices or pushers *g′* for advancing the finished body to the heading clamps are brought into action simultaneously with the return of the seaming tool after it has completed the body. To effect this the mandrel A is furnished with longitudinal grooves for the accommodation of bars g^2 filling said grooves and standing flush with the surface of the mandrel. These bars carry at one end springs constituting the pushers and are connected to a collar or cross-head g^3 secured to the tool bar 65, and partaking of the movements thereof. It will thus be seen that when the tool bar is retracted and the seaming tool finishes its work, the bars g^2 will also be retracted until the springs *g′*, which are depressed while passing through the body, project again beyond the end of the body of the mandrel. As the seaming tool is returned to the opposite end of its stroke, in position to act upon the next succeeding body, the pushers *g′* are also advanced and shove

the finished body off longitudinally of the mandrel and deposit it in the clamps (Figs. 5, 6, and 7). The clamp sections E are each secured to the inner end of a shaft 67 supported in bearings in a frame M located beyond and extending on opposite sides of the end of mandrel A. The opening between the clamp sections E is in line with the mandrel A so that the finished body is advanced by the pushers g' directly between said clamp sections, and as the stroke of the pushers is uniform the bodies will always be carried forward the same distance, thereby insuring the proper location of the body within said clamp. The shafts 67 are simultaneously reciprocated but in opposite directions, to clamp and release the body, by means of levers K, pivoted at 80 and provided at one end with collars 81 loosely fitting the shafts 67 but held from longitudinal motion thereon by collars or stops fixed to said shafts, and the opposite ends of said levers R are each provided with a pin or roller k resting in a slot 79 in cross-head 71, said slots being provided with substantially parallel vertical upper portions, and curved or converging lower portions, so that when the cross-head 71 is at one extreme of its movement, the shafts 67 will be retracted, to open the clamp, and at all other positions of said cross-head they will be held projected and the clamp closed. When the finished body is delivered by pushers g' between the clamp sections, the curved portions of the slots 79 are in engagement with the levers R and the clamp sections are retracted, but as soon as the body has been properly located, the cross-head 71 begins to descend forcing the shafts 67 inward and closing the clamp on the body between them. The shafts 67 form axes about which the clamp sections turn, to bring the body in line with the heading dies, to effect which the yokes 69 connected by rods 68 to cross-head 71 are provided with gear teeth q, engaging gear teeth r on the shaft 67, so that as said yokes and the cross-head are reciprocated, the clamp will be closed and then given a quarter turn, to bring them opposite the heading dies; and after the heading operations have been completed, the clamp will be turned back in line with the mandrel, and the clamp-sections separated, whereupon the next succeeding body will be advanced to push out the completed vessel and occupy its place in the clamp. The yokes 69 are carried by rods 68 movable vertically in guides and connected by cross-heads 70, 71, the first below the drive shaft and the second above the press-frame M. The rods and cross-heads are moved in one direction by springs 73 supported in tubular sockets 72, while a cam 74 on shaft L, acting through a roller a on cross-head 70, moves them in the opposite direction, that is downward. The shank 75 of the upper head-die I is secured in the cross-head 71, and moves with the latter, while the shank 76 of the lower head-die J moves in guides 77, and carries a roller 78 resting upon a cam f on main drive-shaft L. As the cross-head 71 descends the clamps are closed upon the body, and turned a quarter around, to bring the body in line with the head dies I, J; the continued downward movement of the cross-head brings the upper die I down upon the end of the clamp-sections and the end of the body held thereto. The lower head die J, containing a head-blank is now forced up against the lower end of the body, inserting the head and bending the edges down so as to overlap and confine the head in place, after which the lower die is retracted, and the cross-head yokes and upper die elevated, thereby turning the clamps back in line with the mandrel and separating the clamp sections to release the finished vessel and admit the next body.

Turning now to the devices for supplying the heading mechanism with head blanks (Figs. 2, 4, 5 and 16), s is the non-rotating screw supporting the elevator upon which the column of head or bottom blanks 8 rests; 86 is the ratchet wheel carrying the separable nut for elevating screw s; 87 is a connecting rod uniting the arm carrying the pawl to a crank 88 on lower end of shaft 89, and 90, 91 are pinions connecting the main drive shaft L with shaft 89. To the cross-head 71 is secured by bolts 95, an arm 92 carrying the magnet C^2 of the head-blank selector, said magnet being suspended above the upper end of holder B', whereby, at each reciprocation of the cross-head 71, marking the completion of a vessel, the magnet will be brought into engagement with and elevate the topmost blank. Upon a bracket 94 is formed a guide or way 95 along which the blanks travel and from which they are delivered onto the lower die J. Upon a plate 96 guided and reciprocating on roller 97 resting upon bracket 94 are mounted two hooks or pushers 98 which engage the head-blank suspended on the magnet C^2 and push it onto the way 95. Depending from the plate 96 is a series of dogs or pawls 99 standing with their free or engaging ends inclined toward the head-die J, and resting upon the way 95, which latter is provided with lugs 100. The plate 96 is reciprocated by an arm 101 attached to a rod 102; said rod is supported to reciprocate longitudinally in bearing 103 and is pivotally connected at 104 to a lever connected by a link 106 to the lever 18 controlled by cam D. At each reciprocation of plate 96 a blank will be deposited upon the way 95, and these blanks previously deposited and lying upon said way will each be advanced beyond the lug 100 in front of it, while the foremost blank will be pushed onto the head-die J.

From the foregoing description and explanation it plainly appears that the machine as a whole constitutes a complete organization made up of separate mechanisms, each competent to perform a complete act or operation with respect to the blank, but so connected and combined that each is dependent upon

all the others to effect the ultimate purpose of the combination, *i. e.* automatically converting prepared blanks into finished vessels. Inasmuch, however, as the several mechanisms possess in themselves novel and valuable features which render them valuable for use alone or in other combinations, I have made them the subjects of separate applications for patents. Thus the devices for elevating a column of blanks and selecting and feeding the top most blank therefrom, may be employed to advantage for feeding blanks to various kinds of machines; hence it is made the subject of a separate application, Serial No. 342,614, filed March 4, 1890.

The mechanism for edging the blanks, may be employed alone or in connection with other mechanism, and, with the exception of the special devices for reciprocating the edging tool, it is made the subject of a separate application, Serial No. 269,613, filed April 4, 1888. So, too, the mechanisms for forming and side seaming the body, and the heading mechanism are made the subject of separate applications, Serial No. 245,190, filed July 25, 1887, and Serial No. 281,393, filed July 30, 1888. All matters relating to the special construction of each of said separate mechanisms and claimed in the said pending applications are herein disclaimed, the present invention embracing more especially the described general combination and sub-combinations existing between the several elements.

Although in illustrating my invention I have shown and described the machine as adapted to form cylindrical vessels only, I wish it to be clearly understood, that I do not intend to limit myself thereto, as other forms of tubular vessels composed of a body having a longitudinal or side seam and a head or bottom attached thereto can in like manner be produced.

Having thus fully described my invention, what I claim is—

1. In an organized machine such as described, the combination of the following elements: a body forming mechanism; a heading mechanism provided with movable clamps; and translating devices intermediate the body-forming and heading mechanisms and engaging the body, to advance it into position to be engaged by the clamps of the heading mechanism.

2. In an organized machine such as described the combination of the following elements: a body forming mechanism; a heading mechanism provided with movable clamps to receive the body when formed; translating devices engaging the finished body and transferring it to the clamps of the heading mechanism; and actuating devices connecting and operating upon said several mechanisms as set forth.

3. In an organized machine such as described the combination of the following elements: a body forming mechanism; a heading mechanism provided with movable body-clamps; translating devices intermediate the body forming devices and the clamps of the heading mechanism; and a head-blank feeding mechanism, as set forth.

4. In an organized machine such as described the combination of the following elements: a body forming mechanism; a heading mechanism independent of the body forming mechanism and provided with body holding clamps; translating devices intermediate the body forming and heading mechanisms for transferring the bodies from one of said mechanisms to the other; a head blank receptacle; translating devices engaging the blanks to transfer them one at a time to the heading mechanism and actuating devices connecting all of said mechanisms substantially as described.

5. In an organized machine such as described the combination of the following elements: a body forming mechanism provided with a mandrel or former around which the sheet is wrapped to form the body; side seaming devices cooperating with the mandrel to form the side seam while the body is retained upon the mandrel; a heading mechanism removed from the mandrel and provided with body clamps; and translating devices engaging the body to remove the latter from the mandrel and advance it in position between the body clamps; with actuating devices operating said mechanisms in regular succession as set forth.

6. In an organized machine such as described the combination of the following elements: a mandrel and side seaming devices for forming the body; a heading mechanism beyond the free end of the mandrel; and translating devices movable toward the heading mechanism and engaging the body on the mandrel to advance said body and properly locate it within the heading mechanism; with actuating devices connecting said mechanisms; as set forth.

7. In an organized machine such as described the combination of the following elements: a body forming mechanism provided with a rotating mandrel and a reciprocating seaming tool cooperating to form the body; a heading mechanism provided with movable clamps and located beyond the end of the mandrel; translating devices operating upon the body surrounding the mandrel, to transfer it from the latter to the clamps of the heading mechanism; and actuating devices connecting the said mechanisms, to cause them to operate automatically in the proper order as set forth.

8. In an organized machine such as described the combination of the following elements: a body-blank receptacle; blank edging mechanism; translating devices intermediate the body-blank receptacle and the edging mechanism; a body forming mechanism provided with a rotating mandrel; translating devices intermediate said body forming and edging mechanism for advancing the

edged blank to the body forming mandrel; and actuating devices connecting said edging and forming mechanisms and the translating devices as set forth.

9. In an organized machine the combination of the following elements: a body blank feeding mechanism; a blank edging mechanism; a body forming mechanism; translating devices between said edging and body forming mechanisms; a heading mechanism; translating devices between said body-forming and heading mechanisms; a head-blank feeding mechanism; and actuating devices connecting all of said mechanisms substantially as described.

10. In an organized machine the combination of the following elements: a blank feeding mechanism; an edging mechanism provided with a blank holding press to which the blanks are delivered by the feeding mechanism; a body forming mechanism provided with a mandrel around which the blanks are bent; translating devices between the edging and body-forming mechanisms for transferring the blanks from the former to the latter; and actuating devices connecting said mechanisms to effect their movements in the proper sequence substantially as described.

11. In an organized machine the combination of the following elements: an edge turning mechanism; a body forming mechanism provided with a rotatable mandrel longitudinally grooved and carrying a reciprocating seaming tool; translating devices intermediate the edging and body forming mechanisms; and actuating devices connecting said mechanisms; substantially as described.

12. In an organized machine the combination of the following elements: a body forming mechanism provided with an intermittingly rotating and longitudinally grooved mandrel; translating devices for advancing the blanks one at a time to said mandrel; a heading mechanism removed from said mandrel, and provided with body clamps and head-blank feeding devices; translating devices for engaging the body and transferring it to the heading mechanism; and actuating devices connecting said mechanisms, substantially as described.

13. In an organized machine the combination of the following elements: a body forming mechanism provided with a mandrel; a heading mechanism arranged beyond and operating in a plane transverse to the axis of the said mandrel and provided with movable clamps; translating devices for transforming the body from the mandrel to said clamps; and actuating devices connecting said mechanisms substantially as described.

14. In an organized machine the combination of the following elements: a body forming mechanism provided with an intermittingly rotating mandrel; a side seaming device; a heading mechanism whose heading die reciprocates in a plane at an angle to the axis of the mandrel; body clamps movable from the plane of the mandrel into that of the heading die; translating devices engaging the body on the mandrel to transfer it to the body clamps; and actuating devices connecting said several mechanisms substantially as described.

15. In an organized machine the combination of the following elements: a body forming mechanism provided with an intermittingly rotating mandrel or former and a side seaming tool; a heading mechanism located beyond the end of the mandrel and provided with an oscillating body holder movable from the plane of the mandrel to that of the heading devices; translating devices mounted upon the mandrel and engaging the body thereon; to advance it into the holder; and actuating devices connecting said mechanisms to cause them to operate in succession, substantially as described.

16. In an organized machine the combination of the following elements: a body forming and side seaming mechanisms provided with a horizontally arranged mandrel upon which the bodies are formed; a vertical heading mechanism located beyond the end of the said mandrel; a body holder or carrier intermediate the mandrel and heading devices and movable from the one to the other; translating devices engaging the body on the mandrel and transferring it to the body holder or carrier; and actuating devices connecting said mechanisms substantially as described.

17. In an organized machine the combination of the following elements: a body forming mechanism provided with a longitudinally grooved and horizontally disposed mandrel; a blank edging mechanism located to one side of the body forming mechanism; translating devices for advancing the edged blanks in cooperative relation with the mandrel; a heading mechanism located beyond but in proximity to the mandrel and provided with a vertically movable holder for receiving the body and transferring it into position in line with the heading die; translating devices for advancing the body from the mandrel to the body holder; and actuating devices connecting said several mechanisms, substantially as described.

18. In an organized machine the combination of the following elements: a heading mechanism provided with a vertically reciprocating heading die and an opposing die; an automatic head-blank feeding mechanism; a body forming mechanism provided with a horizontally disposed mandrel; an oscillating clamp or body holder located in line with the mandrel and movable about an axis transverse thereto and between the heading die and its opposing surface or die; translating devices engaging the body while on the mandrel and advancing it into the clamp-holder; and actuating devices connecting said mechanisms, substantially as described.

19. In an organized machine such as de-

scribed the combination of the following elements: a blank edging mechanism provided with a press or clamp for holding the blank and an edging tool reciprocating longitudinally of and engaging the edge of the blank; translating devices connected to and reciprocating with said edging tool, to insert the blank in the press; translating devices movable at an angle to said first mentioned translating devices and engaging the edged blank, to remove it from the press; and actuating devices connecting said mechanisms.

20. In an organized machine the combination of the following elements: a body forming mechanism provided with a longitudinally grooved mandrel, and pressing rolls movable laterally of the mandrel; a blank feeding device movable laterally of the mandrel, to advance a blank and insert one edge within the groove in the mandrel; a seaming tool movable longitudinally of the mandrel; translating devices movable longitudinally of the mandrel; and actuating devices connecting and operating said mechanisms.

21. In a machine such as described the combination of the following elements: a blank holding press having lower movable presser-block; edging tools movable in guides above said presser-block; and translating devices above the presser-block when the latter is retracted and operating to remove or advance the edged blank.

22. In a body forming mechanism the combination of the following elements: an intermittingly revolving mandrel carrying a longitudinally reciprocating seaming tool; a stay bar movable laterally of the mandrel; and a clutch device operating to hold the mandrel.

23. In an organized machine such as described, the combination of the following elements: a revoluble mandrel; a seaming tool reciprocating longitudinally of the mandrel; bending rolls and a side-seam stay bar movable laterally of the mandrel; intermitting driving mechanism between the mandrel and main driving shaft; and a clutch, actuated from the main driving shaft and engaging the mandrel.

24. In an organized machine such as described the combination of the following elements: a body forming and a side seaming mechanism provided with a mandrel common to the two said mechanisms; a heading mechanism provided with a body clamp or holder; translating devices cooperating with the mandrel to advance the body and locate it within said clamp or holder; and actuating devices connecting and operating said mechanisms.

25. In an organized machine such as described, the combination of the following elements: a heading mechanism; a body forming mechanism arranged adjacent said heading mechanism with its delivery end next the latter; translating devices intermediate the body forming and heading mechanisms; and actuating devices connecting said mechanisms.

26. In an organized machine such as described the combination of the following elements: a heading mechanism; a body forming mechanism adjacent said heading mechanism and with its delivery end next the latter; translating devices intermediate said heading and body-forming mechanisms; an edging mechanism adjacent the body forming mechanism with its delivery side next the latter; translating devices intermediate the edging and body-forming mechanisms; a main drive shaft, and actuating devices connecting said shaft and the said several mechanisms to cause their automatic action as set forth.

27. In a machine such as described the combination of the following elements: an edging mechanism; a body forming mechanism; and a translating device for moving the blank from its edging to the body forming mechanism and provided with elastic or yielding impelling means and devices acting to positively retract said translating device.

28. In an organized machine such as described, the combination of the following elements; an edging mechanism provided with reciprocating edging tools; a blank holder; a translating device or pusher connected to and reciprocating in unison with the edging tool and supported in position to engage the blank on the holder; a translating device or pusher guided to move transversely to the first named pusher; and actuating devices connecting said mechanisms.

In testimony whereof I affix my signature in the presence of two witnesses.

EDWARD SMALL.

Witnesses:
JOHN E. MORRIS,
JNO. T. MADDOX.