No. 671,639. Patented Apr. 9, 1901.

E. SMALL, Dec'd.

M. SMALL, Administratrix.

MANUFACTURE OF SHEET METAL CANS.

(Application filed Sept. 5, 1900.)

(No Model.) 10 Sheets—Sheet 1.

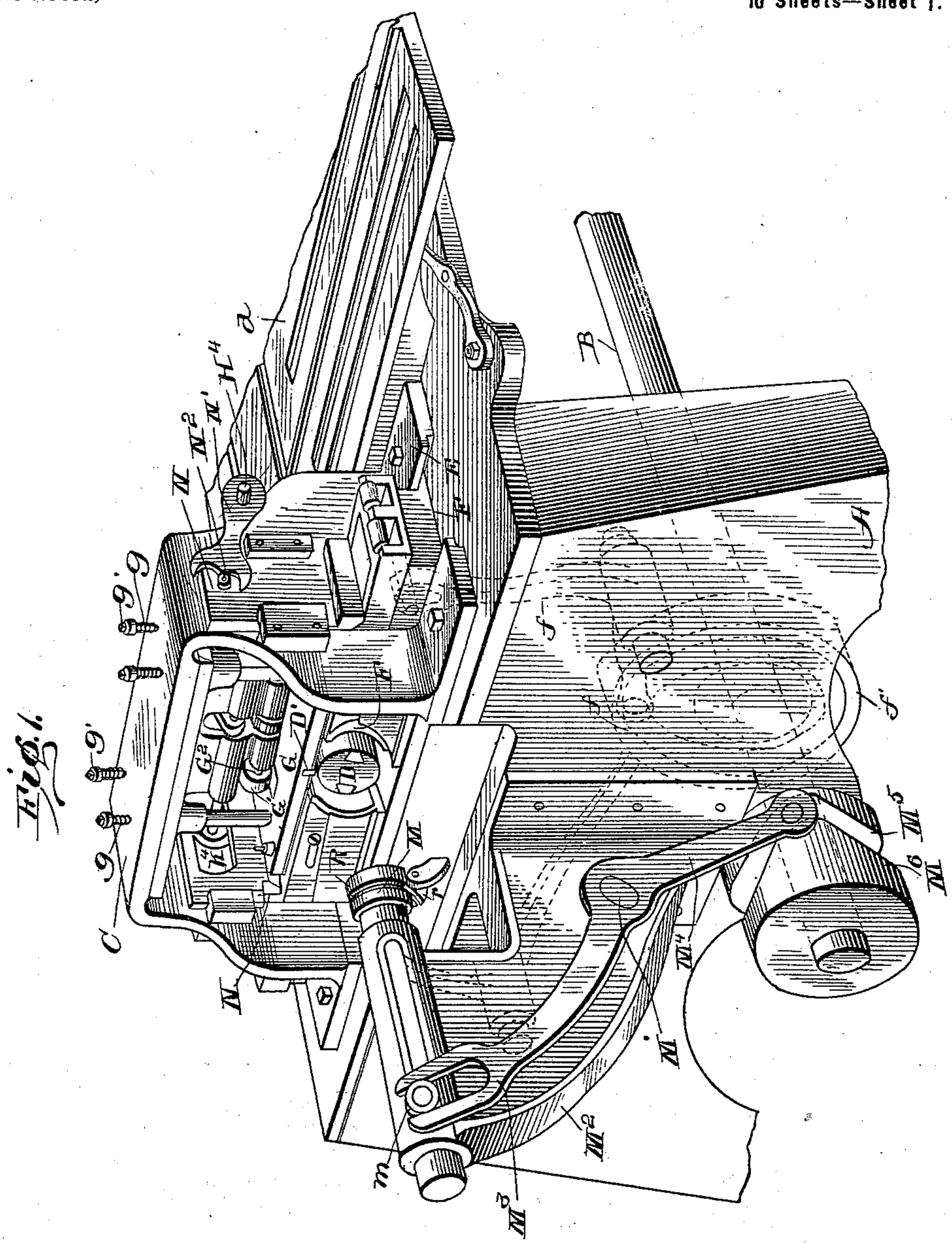

Fig. 1.

Witnesses:
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his Attys.

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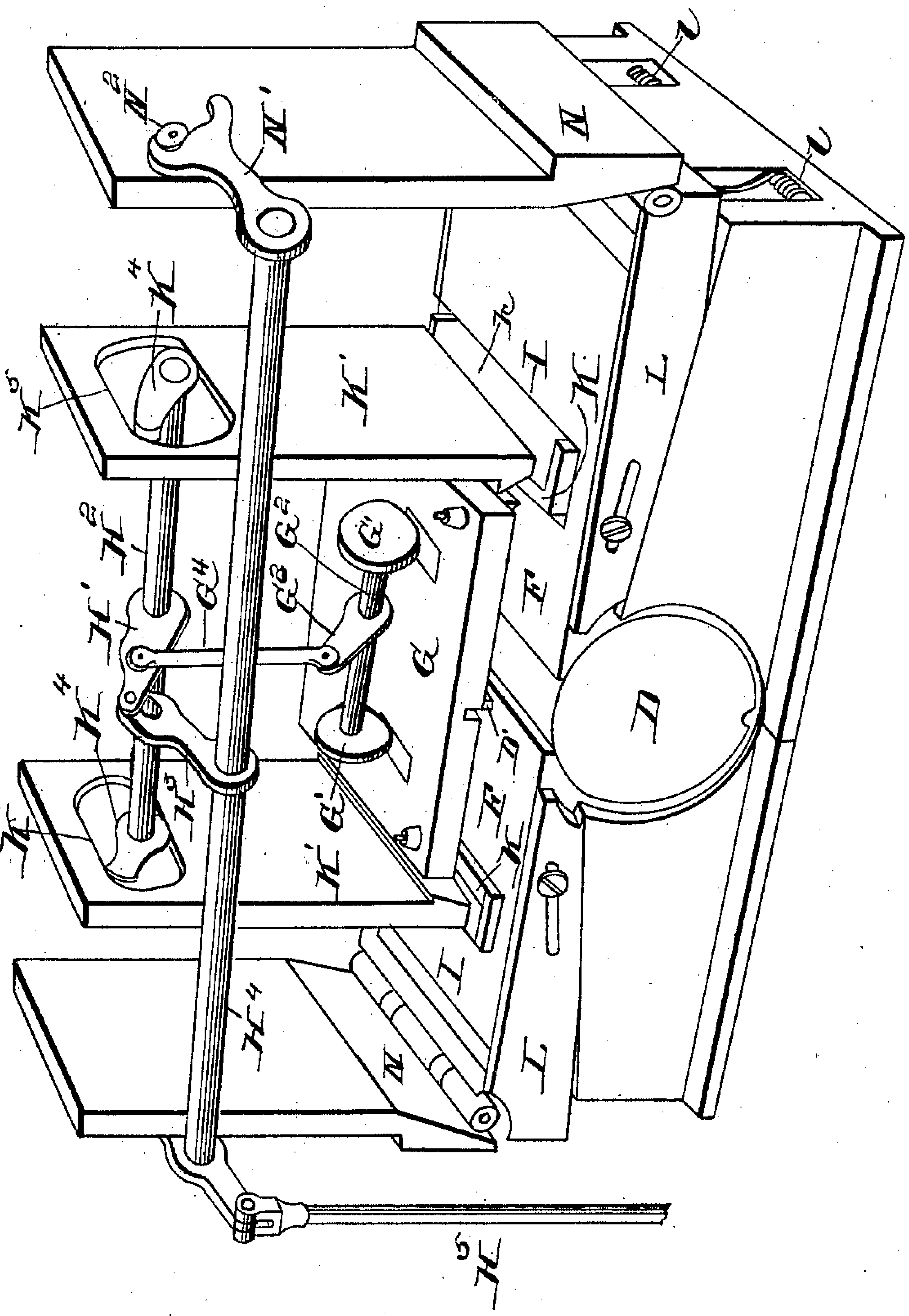
(No Model.) 10 Sheets—Sheet 2.

Fig. 2.



Witnesses
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No. 671,639. Patented Apr. 9, 1901.

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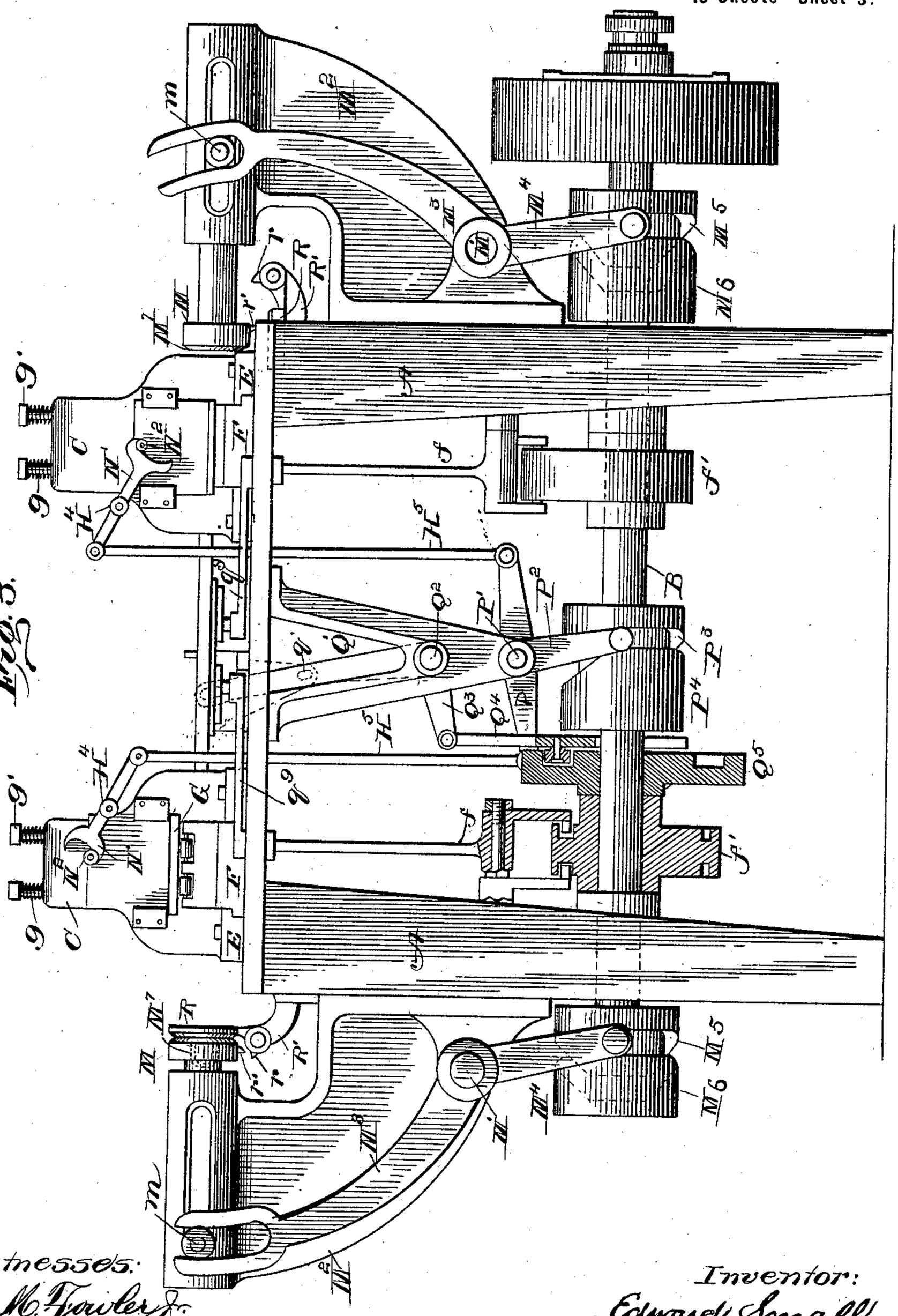
MANUFACTURE OF SHEET METAL CANS.

(Application filed Sept. 5, 1900.)

(No Model.) 10 Sheets—Sheet 3.

Fig. 3.



Witnesses:
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MANUFACTURE OF SHEET METAL CANS.

(Application filed Sept. 5, 1900.)

(No Model.) 10 Sheets—Sheet 4.

Fig. 4.

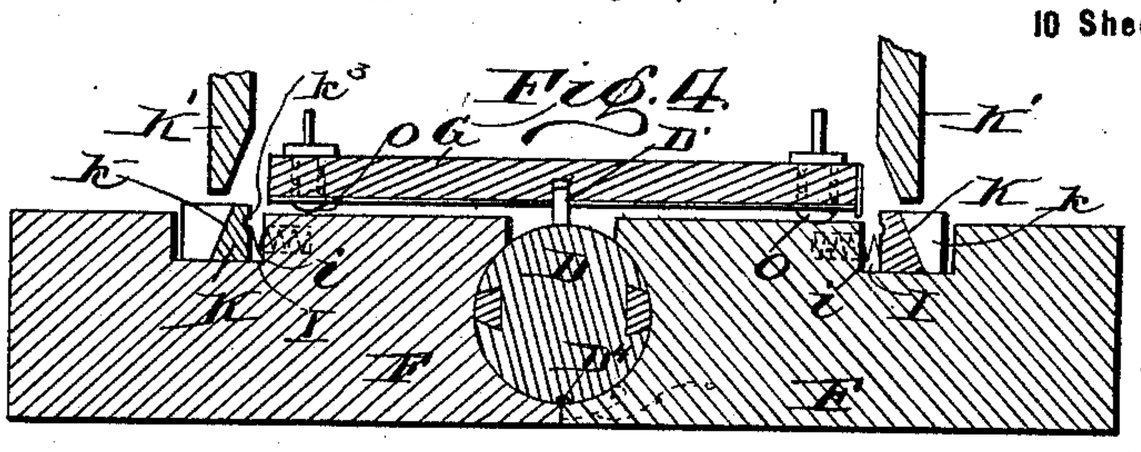


Fig. 4ª

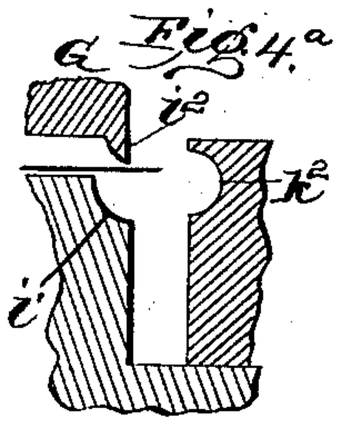


Fig. 4ᵇ

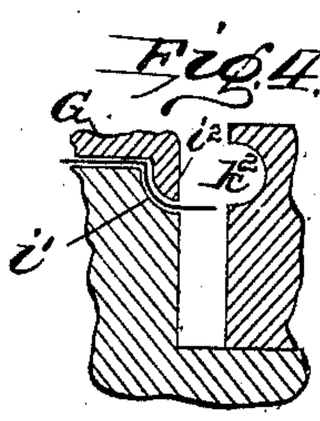


Fig. 5.

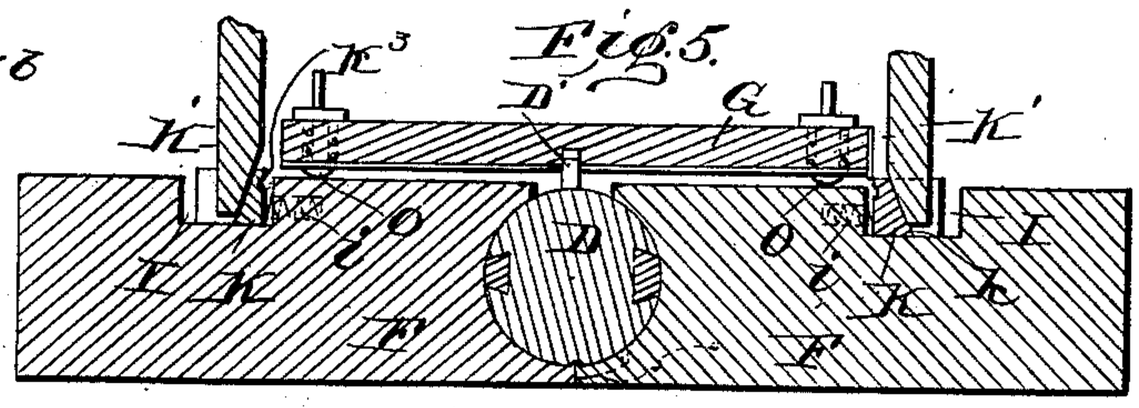


Fig. 4ᶜ

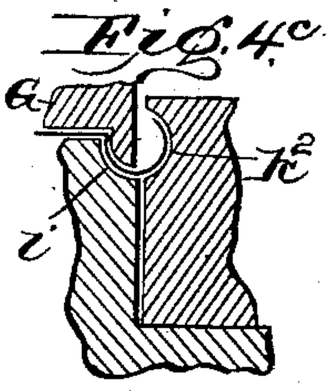


Fig. 6.

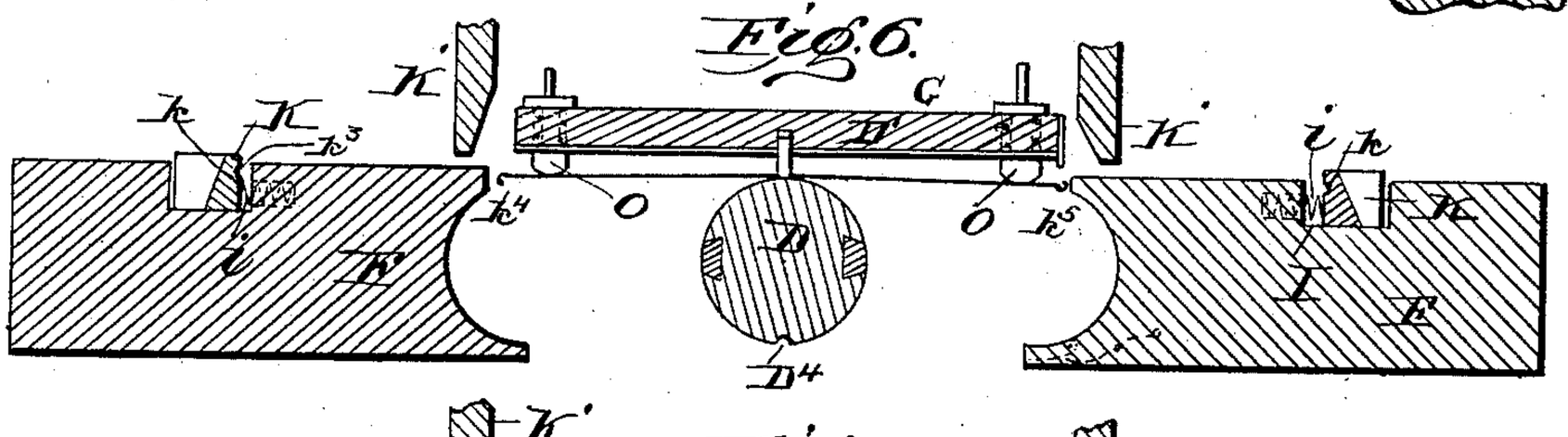


Fig. 7.

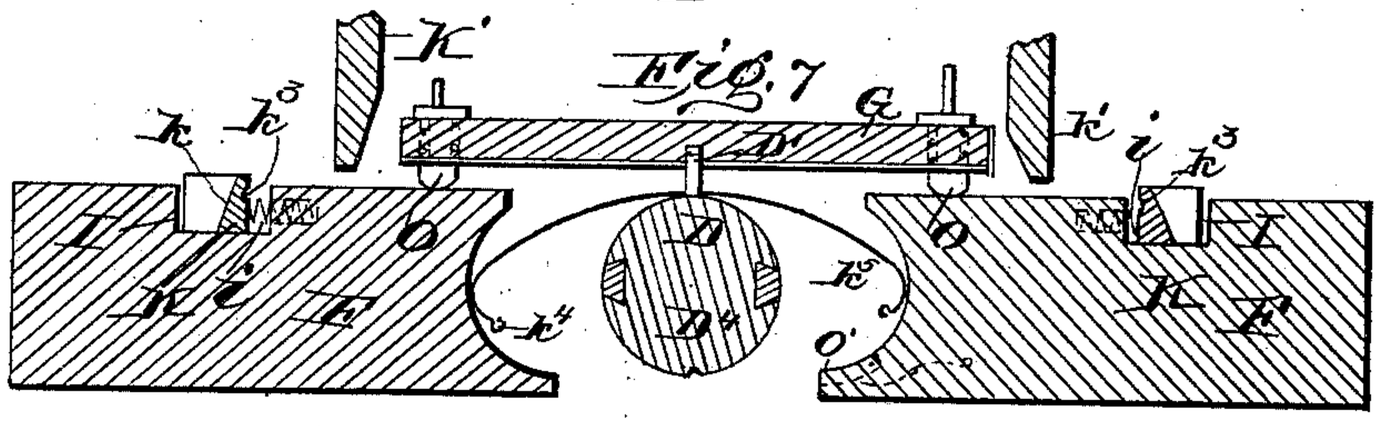


Fig. 8.

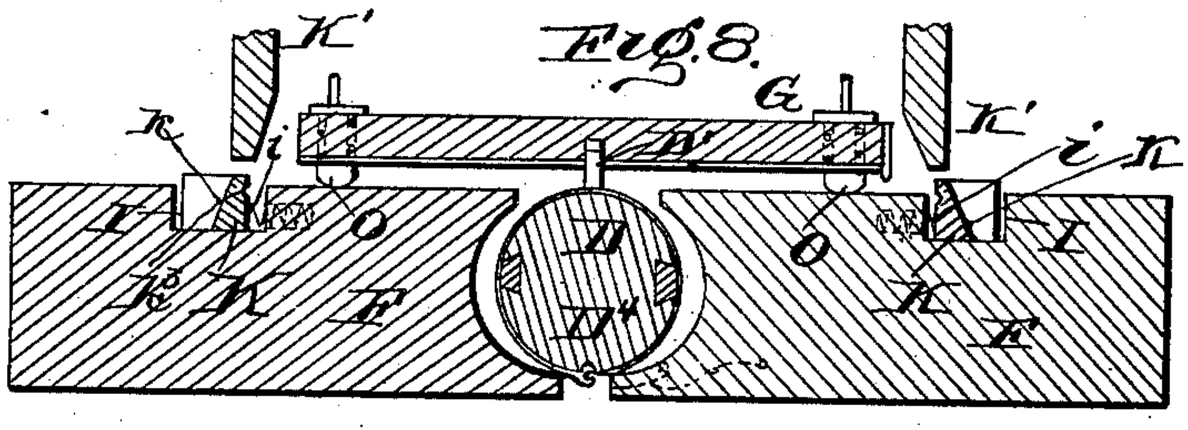
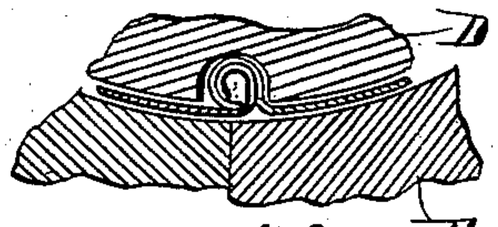


Fig. 9.



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No. 671,639. Patented Apr. 9, 1901.

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MANUFACTURE OF SHEET METAL CANS.

(Application filed Sept. 5, 1900.)

(No Model.) 10 Sheets--Sheet 5.

Fig. 10

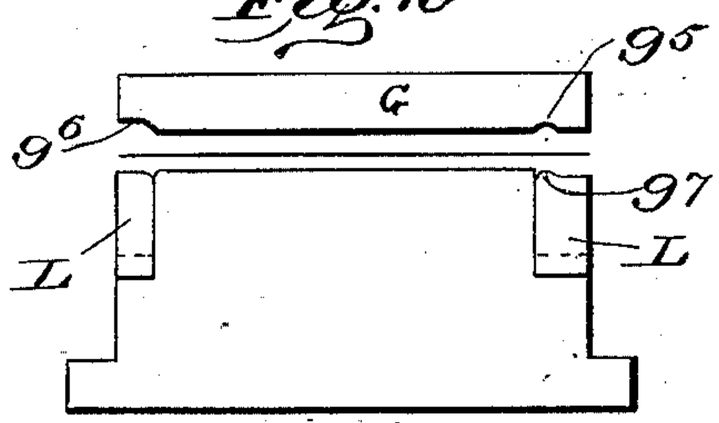


Fig. 10a

Fig. 11.

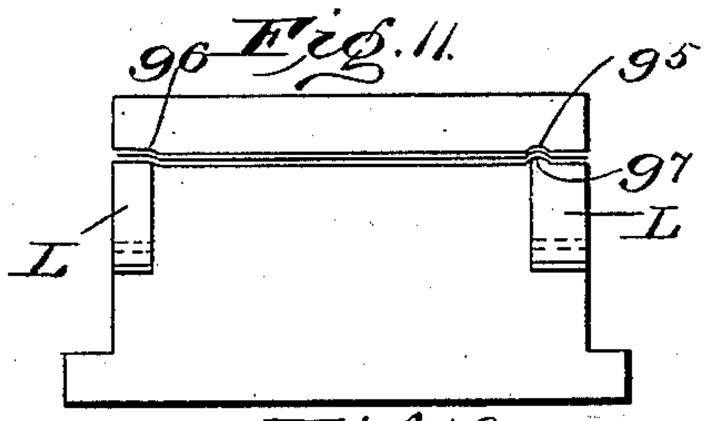


Fig. 11a

Fig. 12a

Fig. 12.

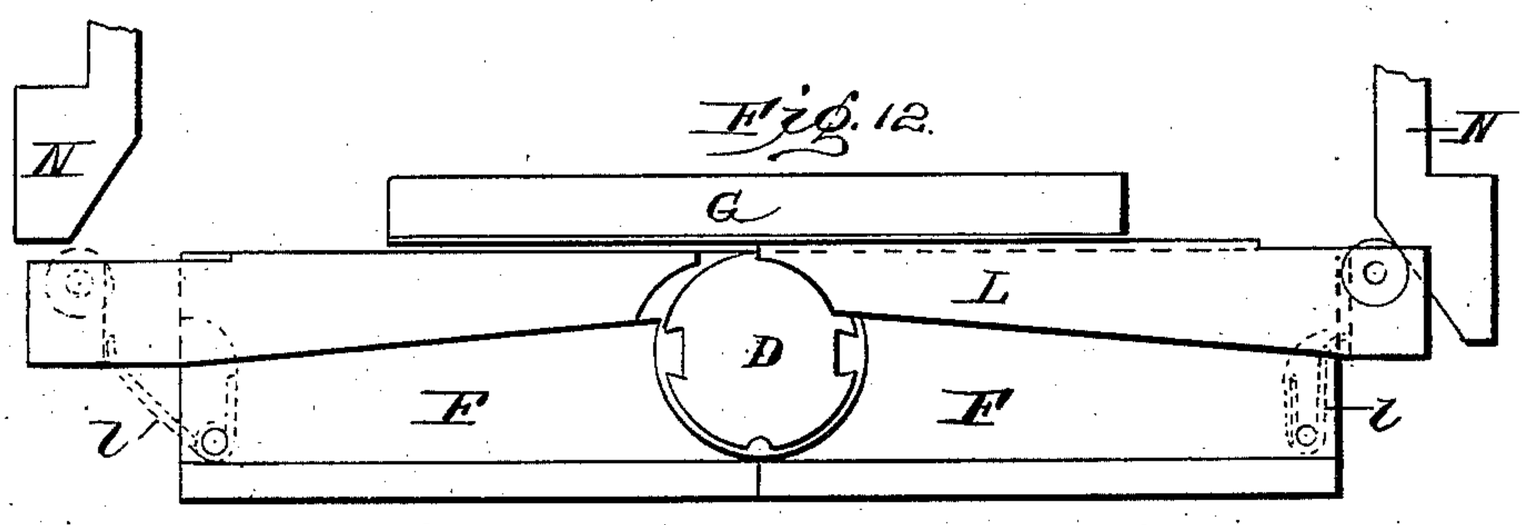


Fig. 13.

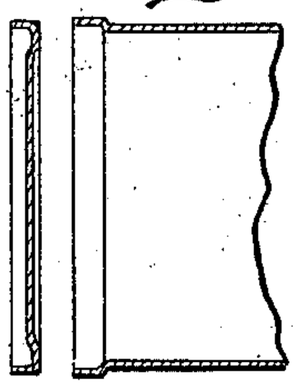


Fig. 14.

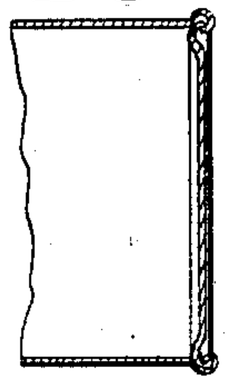


Fig. 16

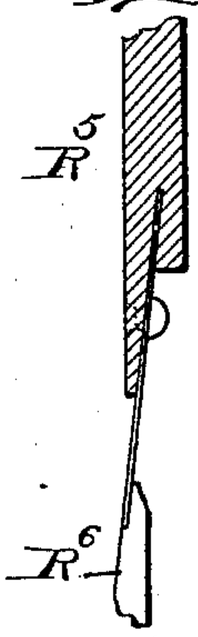
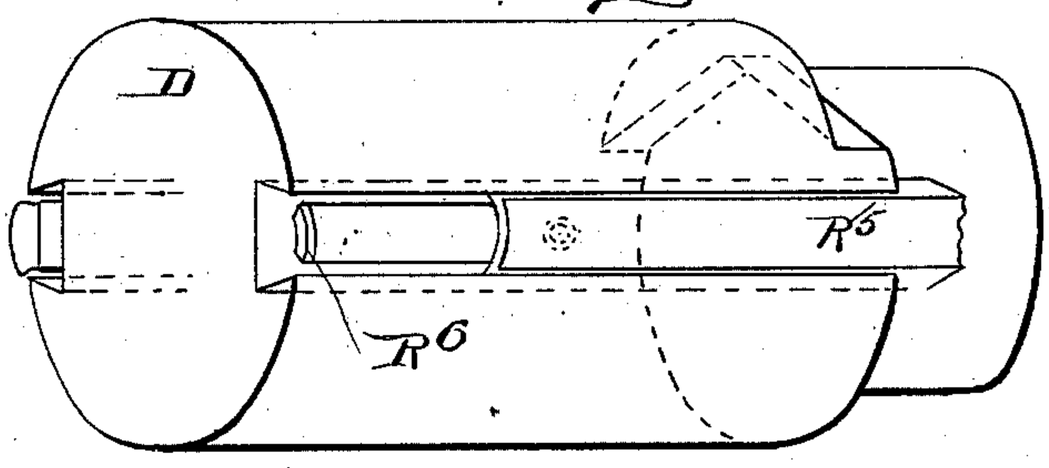


Fig. 15.



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MANUFACTURE OF SHEET METAL CANS.

(Application filed Sept. 5, 1900.)

(No Model.) 10 Sheets—Sheet 6.

Fig. 17.

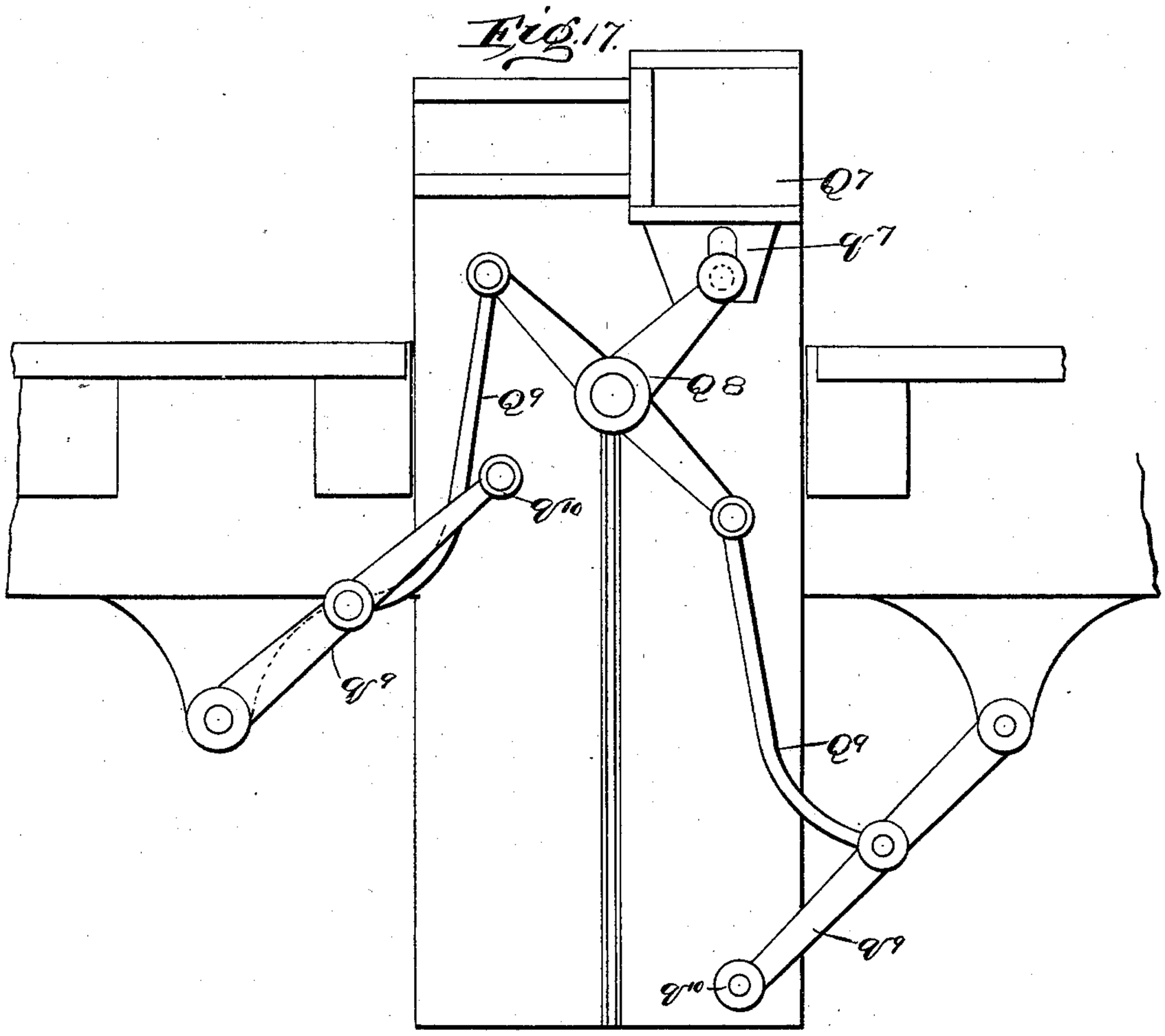

Fig. 27.

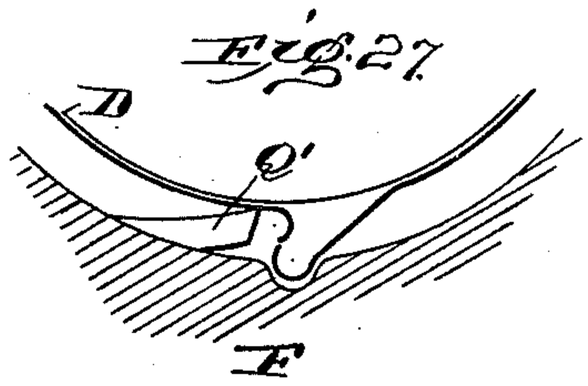

Fig. 27a.

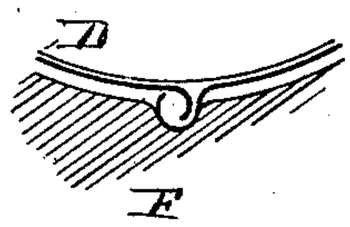

Fig. 27b.

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MANUFACTURE OF SHEET METAL CANS.

(Application filed Sept. 5, 1900.)

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Fig. 19.

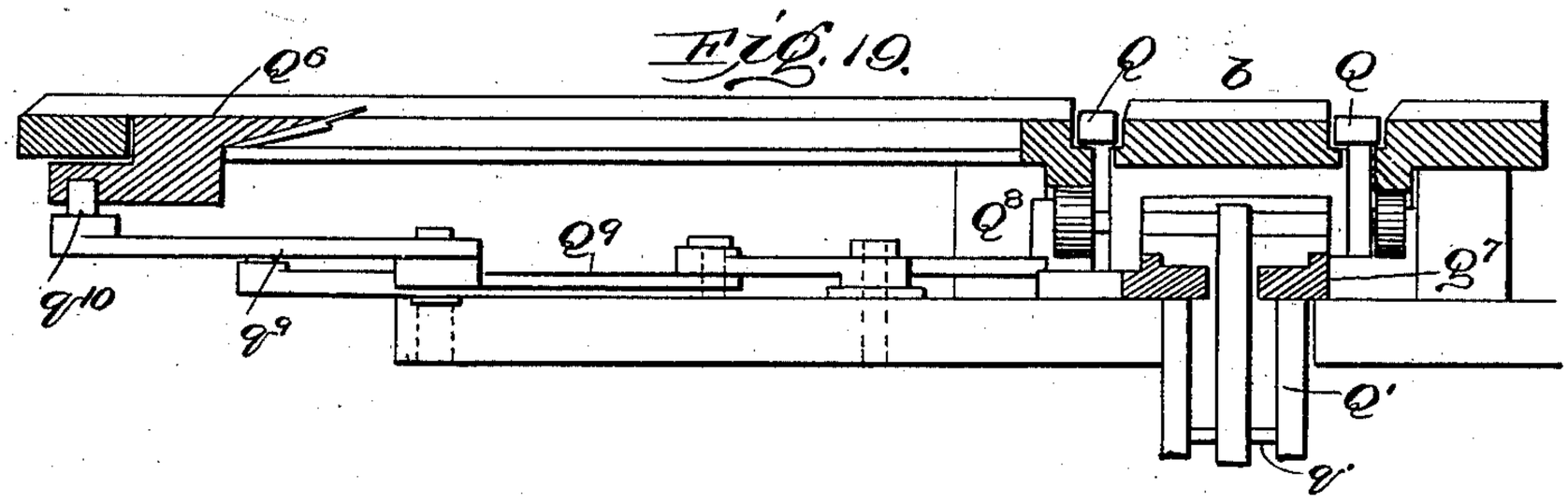

Fig. 18.

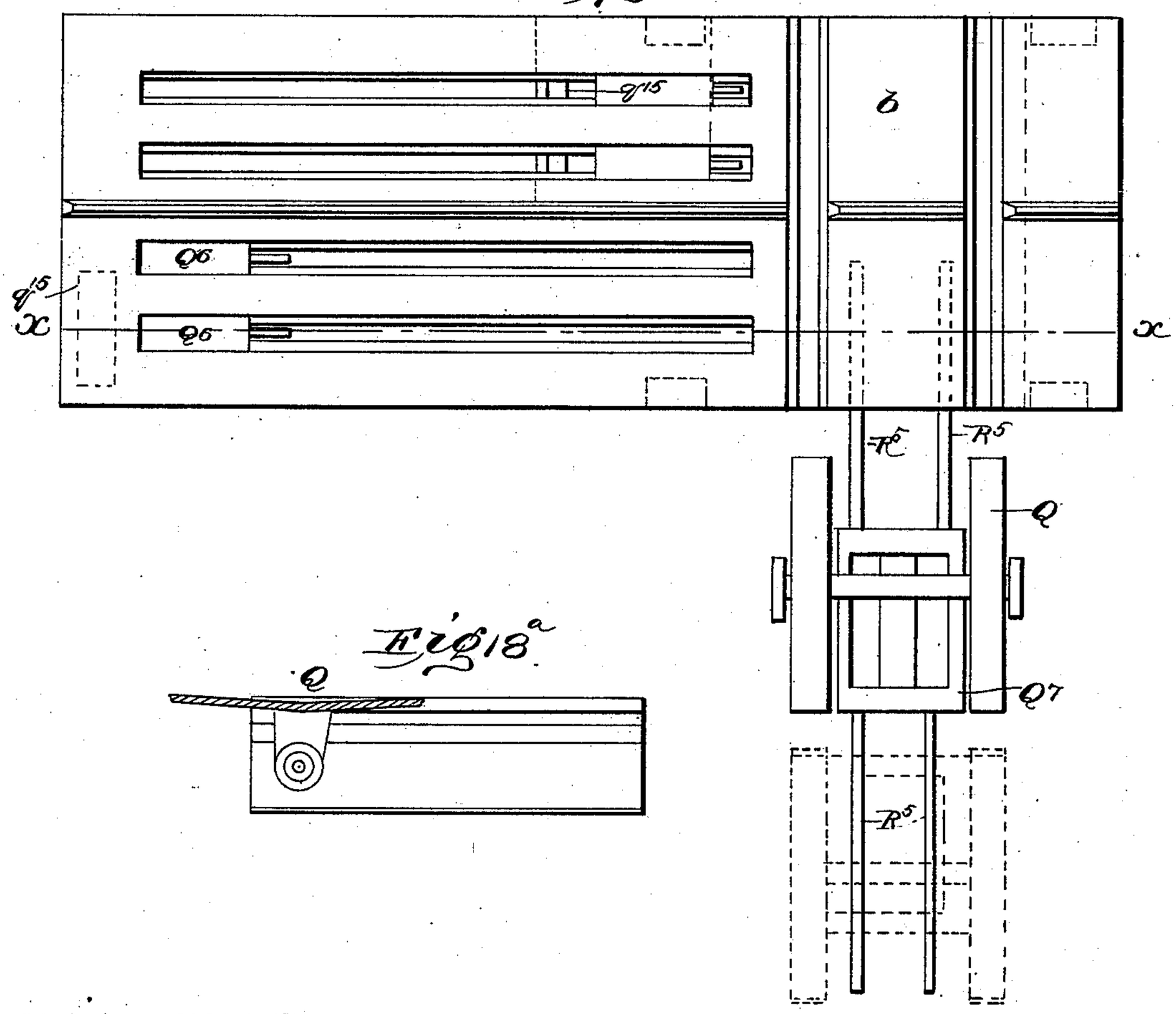

Fig. 18a.

Witnesses.

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Inventor

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his Attys.

No. 671,639. Patented Apr. 9, 1901.

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MANUFACTURE OF SHEET METAL CANS.

(Application filed Sept. 5, 1900.)

(No Model.) 10 Sheets—Sheet 8.

Fig. 20.

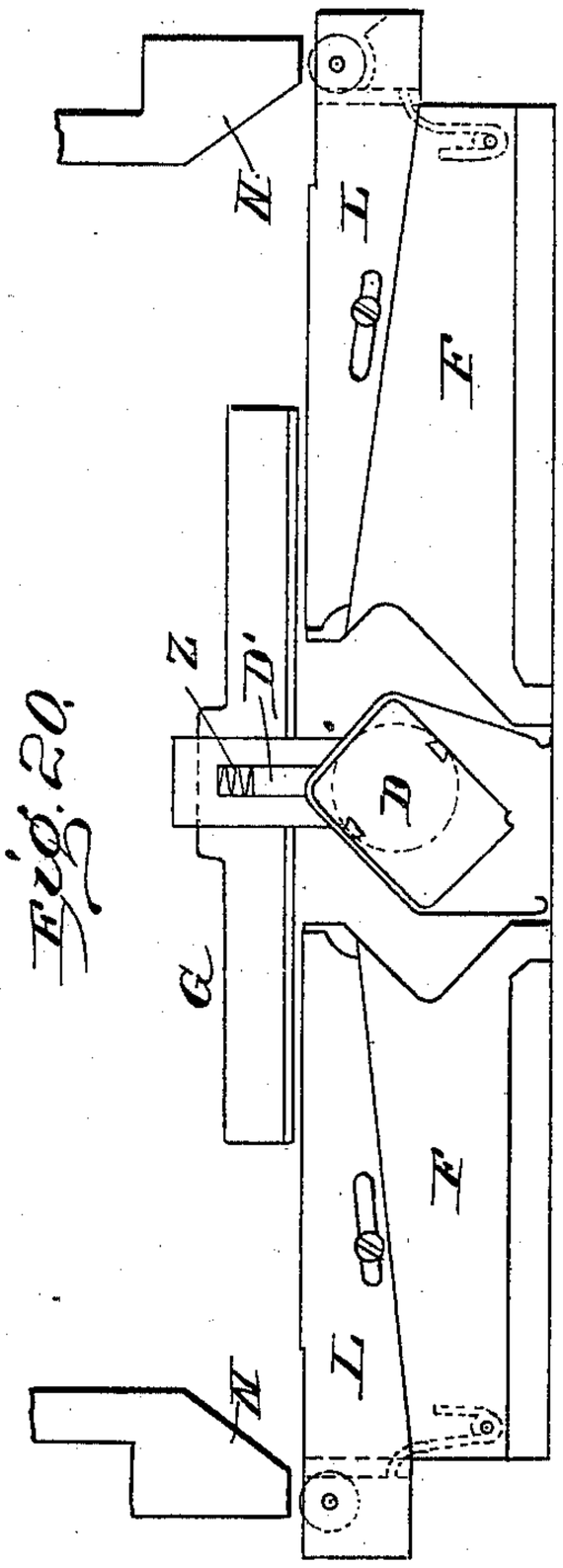
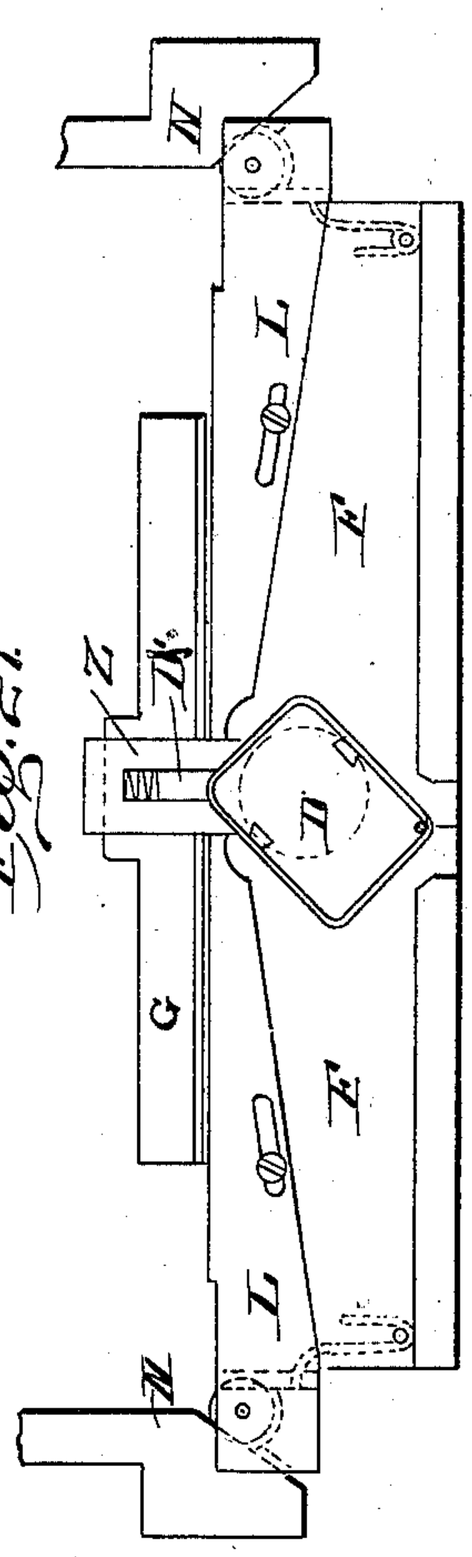


Fig. 21.



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MANUFACTURE OF SHEET METAL CANS.

(Application filed Sept. 5, 1900.)

(No Model.) 10 Sheets—Sheet 9.

Fig. 22

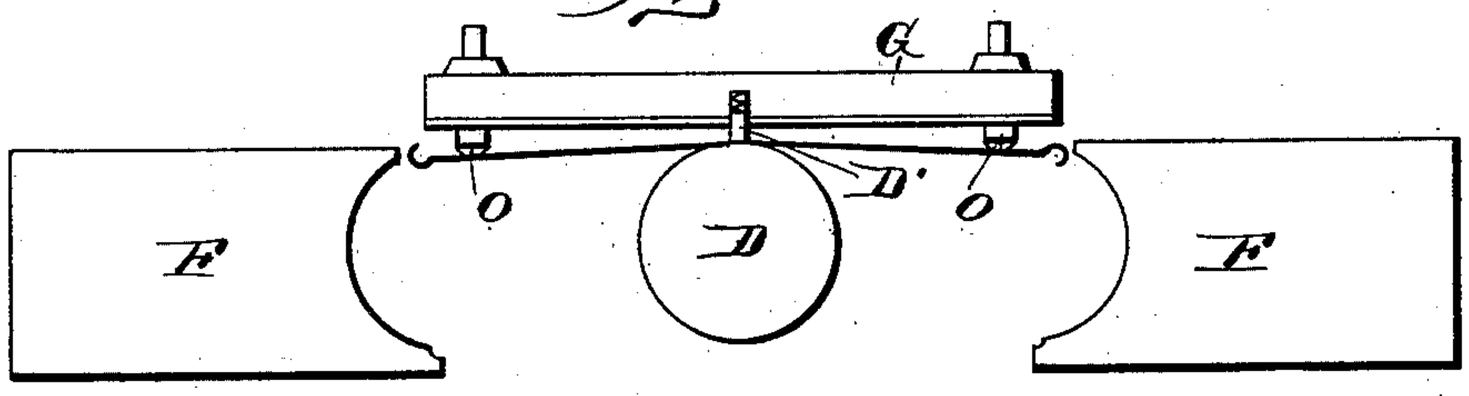


Fig. 23

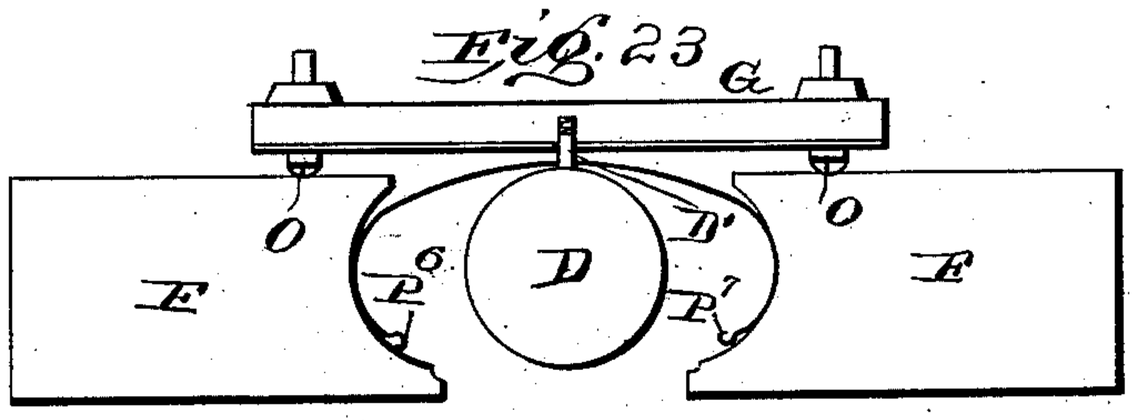


Fig. 24.

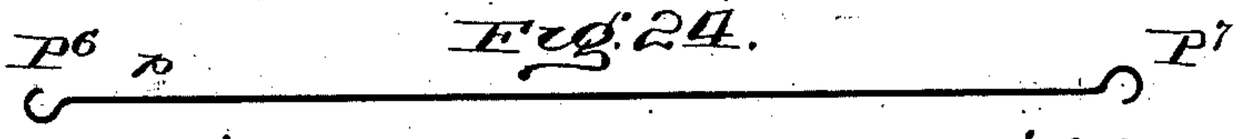


Fig. 25.

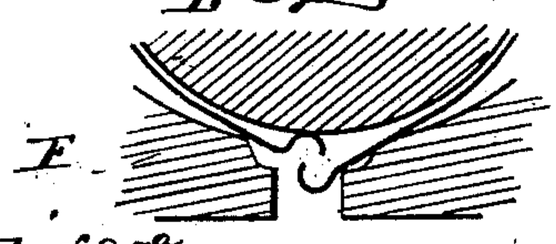


Fig. 25a

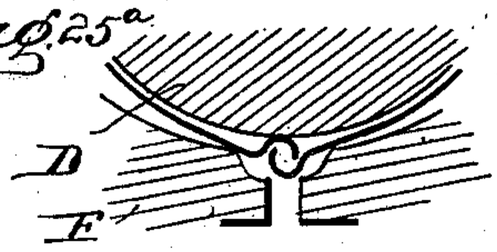


Fig. 25b

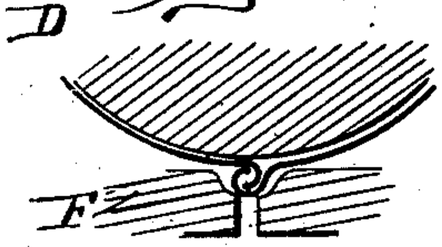


Fig. 25c

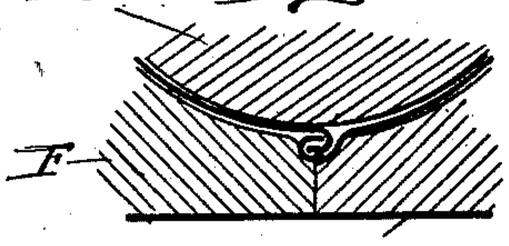


Fig. 26.

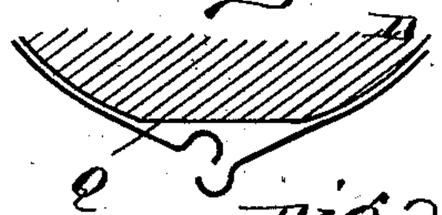


Fig. 26a

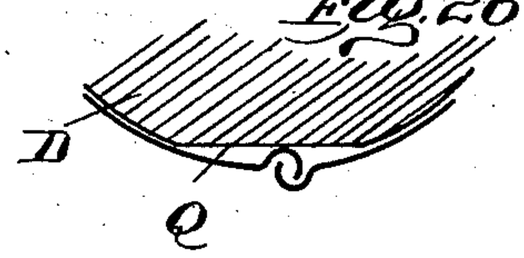


Fig. 26b

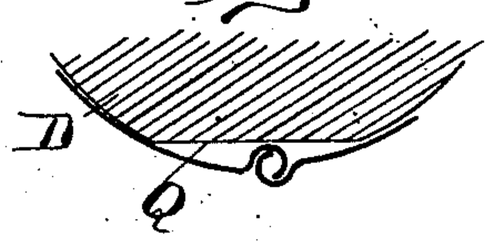
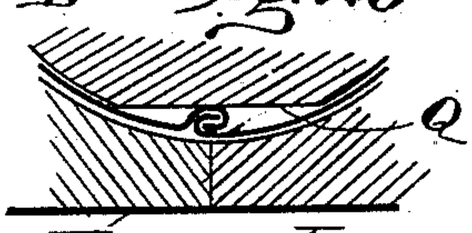


Fig. 26c



Witnesses:
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No. 671,639. Patented Apr. 9, 1901.

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MANUFACTURE OF SHEET METAL CANS.

(Application filed Sept. 5, 1900.)

(No Model.) 10 Sheets—Sheet 10.

Fig. 28a

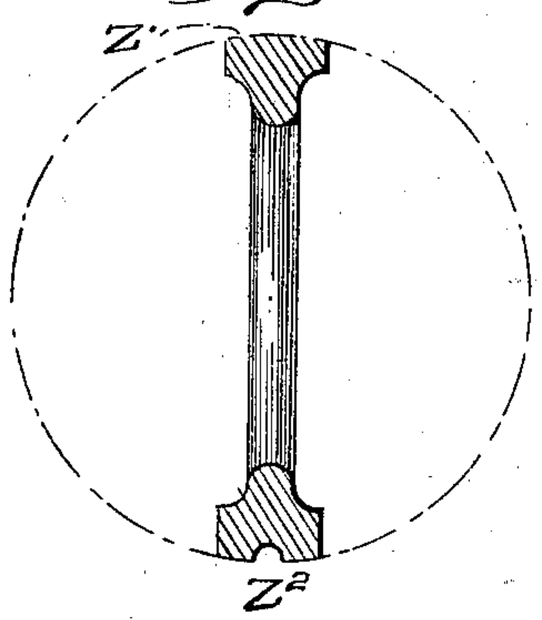


Fig. 28.

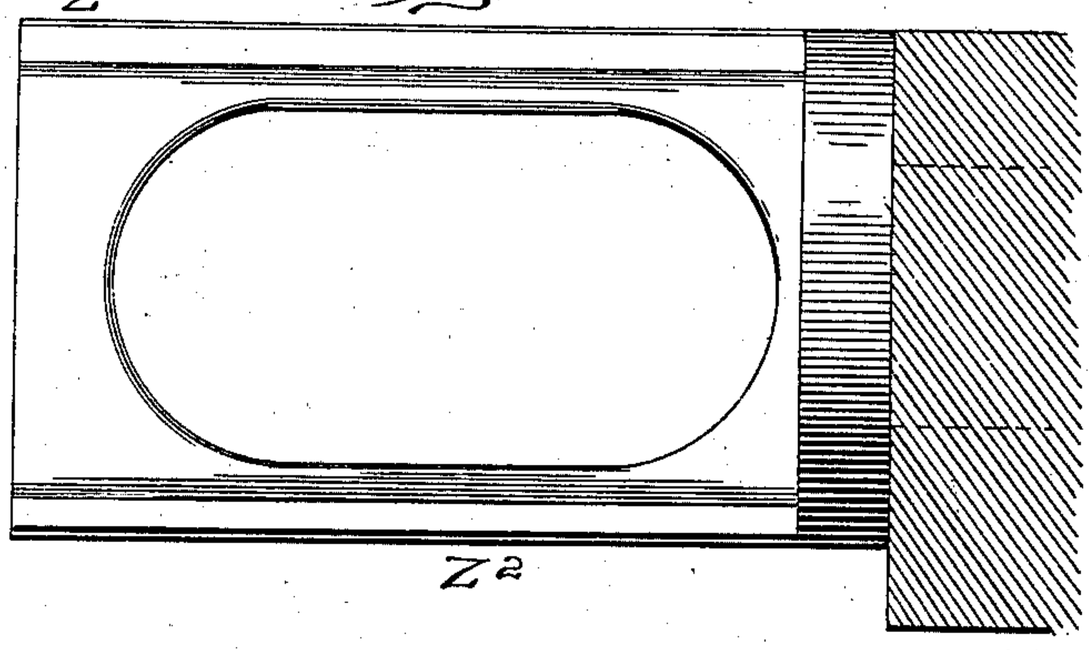


Fig. 29a

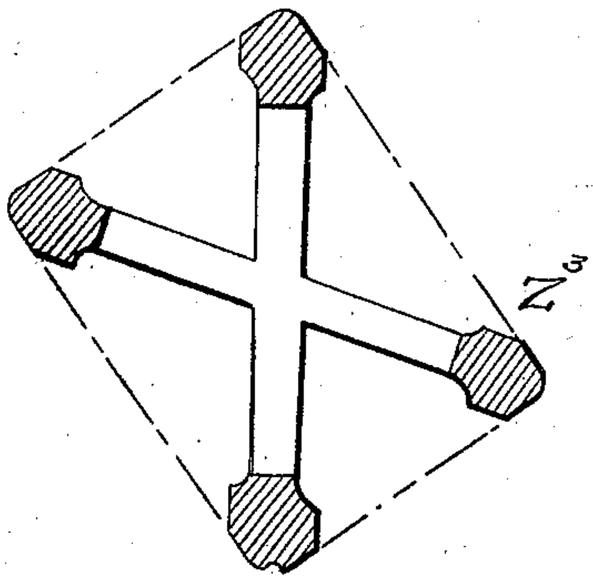
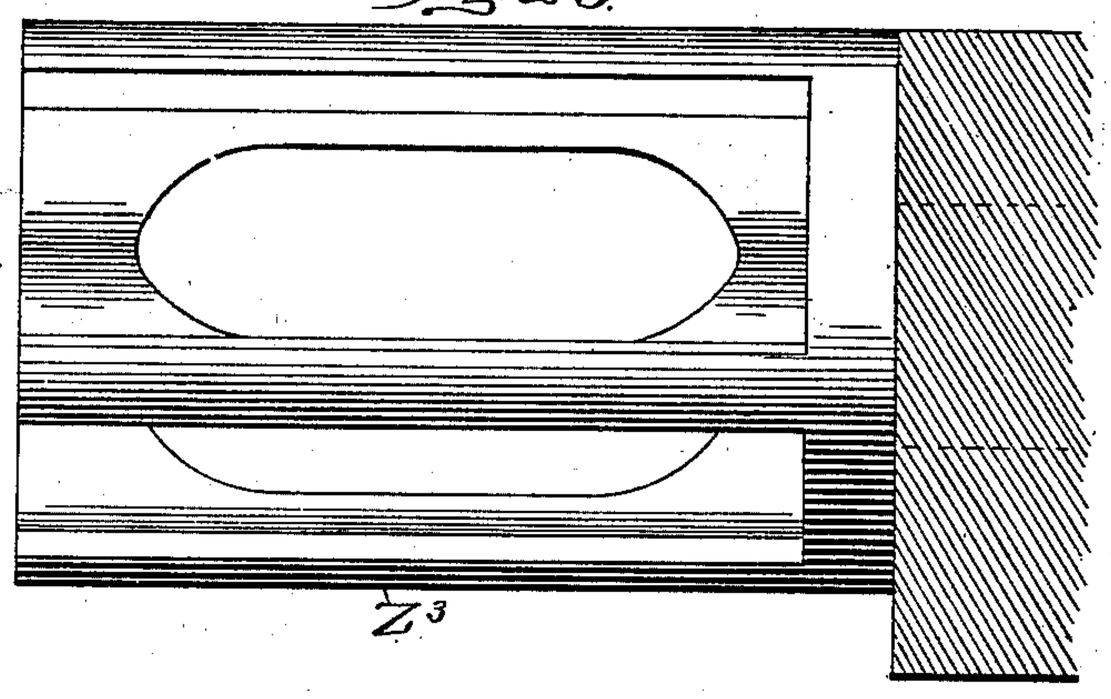


Fig. 29.



Witnesses:
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UNITED STATES PATENT OFFICE.

EDWARD SMALL, OF BALTIMORE, MARYLAND; MARY SMALL ADMINISTRATRIX OF SAID EDWARD SMALL, DECEASED.

MANUFACTURE OF SHEET-METAL CANS.

SPECIFICATION forming part of Letters Patent No. 671,639, dated April 9, 1901.

Application filed September 5, 1900. Serial No. 29,076. (No model.)

To all whom it may concern:

Be it known that I, EDWARD SMALL, a citizen of the United States, residing at the city of Baltimore, in the State of Maryland, have invented certain new and useful Improvements Relating to the Manufacture of Sheet-Metal Cans and Like Articles; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the letters of reference marked thereon.

This invention relates to improvements in the manufacture of sheet-metal vessels, cans, and like articles usually having a body portion formed up from a sheet of metal and its edges united, forming what is known as the "side seam," the said body portion being adapted to receive heads or ends for closing the same; and the invention has for its objects to simplify the manufacture of such articles, to reduce the number of steps required in manipulating the sheet metal, and to provide a compact simple mechanism for performing the various steps automatically.

Briefly stated, in carrying the invention into practice each of the sheets of sheet metal intended for the formation of the body portion is while in its substantially flat state operated upon to form interlocking hooks on its side edges and, if desired, flanges upon its top and bottom edges, and then by a single subsequent operation of two coöperating formers the sheet is given its form, the hook edges joined, and the seam formed and given its ultimate and final set without the employment of other mechanical appliances, and finally the head is inserted without the necessity of moving the body, all as will be hereinafter described.

Referring to the accompanying drawings, Figure 1 is a perspective view of one side of a machine for forming cans in accordance with my present invention. Fig. 2 is a similar view showing the movable parts of the body-forming mechanism without the supporting-frame and bearings. Fig. 3 is a side elevation of the complete machine, partly in section. Fig. 4 is a transverse section through the mandrel, the formers, the clamp, and hook-forming dies. Figs. 4^a, 4^b, and 4^c show the hook-forming dies in their various positions for forming up the deep hook at one edge of the sheath. Fig. 5 is a view corresponding to Fig. 4, showing the hook-forming dies advanced, as shown in detail in Fig 4^c. Fig. 6 is a similar view showing the formers retracted and the hooked sheet in position to be operated upon by said formers. Fig. 7 is a similar view showing the formers advancing and operating upon the sheet to curl the same around the mandrel. Fig. 8 is a similar view with the formers in a somewhat more advanced position and with the hooked edges about to engage. Fig. 9 is a detail of the seam which is made by the formers advancing so as to embrace the mandrel tightly and meet at a point opposite the seam, thereby causing the hooks to curl up in the manner shown. Fig. 10 is a view of the clamp and the flanging-dies carried by the former. Fig. 10^a is a view of the sheet of metal adapted to be operated upon. Fig. 11 is a view corresponding to Fig. 10, with the clamp depressed and the dies advanced to flange the sheet. Fig. 11^a is an edge view of the sheet after being flanged, beaded, and hooked. Fig. 12 is a front elevation of the clamp, formers, and dies, with the operating mechanism for the latter. Fig. 12^a is an edge view at right angles to Fig. 11^a, showing the form of the hooks at the edges of the sheet. Fig. 13 is a cross-section through the can-body and the bottom or permanent head before the parts are united. Fig. 14 is a similar view after the parts are united. Fig. 15 is a detail perspective view of the mandrel. Fig. 16 is a detail sectional view of one of the pushers for discharging the can-body from the mandrel. Fig. 17 is a plan view of the blank-pusher-operating mechanism. Fig. 18 is a plan view of the table over which the blanks are moved to the mandrels and formers. Fig. 18^a is a detail of the intermediate pusher. Fig. 19 is a vertical section on the line $x\,x$, Fig. 18. Figs. 20 and 21 are front elevations of a mandrel and formers for making rectangular vessels or cans. Figs. 22 and 23 are similar views of apparatus designed for the formation of outside side seams. Fig. 24 is a sectional view through a flat blank with the seam-hooks formed at the edges. Figs. 25, 25^a, 25^b, and

25[c] are detail views illustrating different successive phases in the formation of an outside seam. Figs. 26, 26[a], 26[b], and 26[c] are similar views illustrating the formation of an inside seam. Figs. 27, 27[a], and 27[b] are similar views illustrating the formation of another outside seam. Figs. 28, 28[a], 29, and 29[a] are side elevations and cross-sections of different forms of mandrels.

Like letters of reference in the several figures indicate the same parts.

The particular machine shown for the purposes of illustrating my present improvements is designed for the formation of sheet-metal cans having one permanent end or a bottom and one open end adapted to receive a removable cover, and while I shall describe my improvements specifically in connection with such a machine it is obvious that features of the invention may be embodied in other machines and the invention carried into practice in the manufacture of cans having either round or cornered bodies and with either inside or outside seams, and hence I do not wish to be limited in these particulars.

In the accompanying drawings, Figs. 1 and 3, the letter A indicates a framework for the operative parts of the machine, which may be of any desired formation, but is preferably adapted for the reception of a main drive-shaft B at a point near the floor, and at the top is adapted to support a housing C, or where the machine is a double machine, as illustrated, two housings C, carrying the parts of the mechanism which are adapted to cooperate directly with the sheet of metal to be formed into a can-body.

When the machine is a double machine, the actual forming mechanisms are arranged "back to back," so to speak, and a single feeding mechanism is adapted to feed the blanks or sheets first to one and then to the other. Thus the mechanisms alternate in the formation of the cans, and it will be sufficient for the purposes of the present specification to describe one of the mechanisms in detail.

Referring to Figs. 1 and 2, it will be seen that a mandrel D is supported in a horizontal position immediately above the top of the supporting-frame, but with its upper portion in substantial alinement with the guides *d*, over which the blanks are fed to a point immediately above the mandrel. Sliding on the top of the frame or in guides E, formed or mounted thereon, are oppositely-arranged reciprocatory formers F, each having a semi-cylindrical concavity adapted to surround one-half, or approximately one-half, of the mandrel and at their lower edges to come approximately together, so as to crowd all of the metal in the sheet which is wrapped around the mandrel forward to a single point, as will be hereinafter explained. These formers are adapted to be reciprocated toward and from each other and the mandrel D by bell-crank levers *f*, journaled in the frame, connected with the formers at one end, and having at their opposite ends projections or anti-friction-rollers adapted to coöperate with a grooved cam *f'* on the drive-shaft B.

The housing C, extending over and about the mandrel and former, supports the vertically-movable clamp or initial former G, adapted to be raised by springs *g*, surrounding the upper ends of the clamp-supporting rods *g'*, and to be depressed by cams G', mounted on a shaft G[2], journaled in the housing. The shaft G[2] is rocked by a crank-arm G[3], connected by a link G[4] with a crank-arm H' on the rock-shaft H[2]. The latter shaft is in turn rocked by a crank-arm H[3] on a secondary drive-shaft or rocker H[4], receiving its motion from the main drive-shaft through a connecting-rod H[5]. The clamp G carries a central movable clamp-bar D', preferably spring-pressed and lying horizontally in vertical line with the axis of the mandrel and in position to press upon the top of the mandrel and clamp a blank or plate thereto whenever the clamp G is depressed. Thus, assuming that a blank has been passed in between the clamp and mandrel, when the clamp descends the blank will be held firmly against the mandrel and with its lateral extensions projecting over the formers F, as shown clearly in Figs. 4[a] and 4[b]. Dies for bending up the edges of the blank when clamped in this manner are carried by the formers themselves and consist, essentially, of two oppositely-operating dies for giving curved hook-like shapes to the opposite edges of the blank, as will be presently described in detail, which are adapted to be united to form the side seam and when desired the flange for the top and bottom of the can-body for the reception of the caps or heads. Extending across or partly across the formers F, on each side of the mandrel, are two grooves I for the reception of the dies proper, which are lettered K and work transversely of the grooves, being retracted by springs *i*, Fig. 4, and advanced by vertically-movable wedges K', coöperating with inclined faces *k* on the dies, as shown clearly in Figs. 4 and 5. Referring to Figs. 4[a], 4[b], and 4[c], it will be seen that the edge of the groove I in the former is cut away at *i'* to form a concave, into which the edge of the blank is forced by a projection *i*[2] on the clamp or initial former G, causing said edge to assume a position shown in Fig. 4[b]. Then when the die K is advanced said edge will be given a circular hook formation by being turned in the groove *k*[2] in the die, as illustrated in Fig. 4[c]. On the left-hand side the die K has a groove *k*[3], which is adapted simply to turn the edge of the blank downwardly into a hook *k*[4], Fig. 6, of less radius than the hook *k*[5] on the right-hand edge.

Simultaneously with the formation of the hook edges on the blank or sheet it may be desirable to prepare the top and bottom edges for the reception of the top and bottom of the can or vessel, and for this purpose the clamp G is provided with grooves or recesses *g*[5] *g*[6], Figs. 10 and 11, and the formers F are pro-

vided on their ends with inclines f^4, upon which dies L may be reciprocated. The dies L at the rear end are provided with beads g^7, adapted to coöperate with the groove g^5 to form a bead around the open end of the can, and the die L at the opposite end is adapted to coöperate with the recess g^6 to form a flared mouth or flange, as shown clearly by the edge rim of the blank, Fig. 11ª, for the reception of the bottom, which is united thereto by having the edges of the bottom and said flange curled together or seamed by a die-seamer M, Fig. 1, as will be presently explained. The dies L are preferably connected across the outer sides of the formers F and are adapted to be advanced by wedges N, which are held in suitable slideways and move vertically, the reverse movement of the dies L being secured by springs *l*. (Shown clearly in Fig. 12.)

For the purpose of raising and lowering the wedges or inclines K′ the shaft H^2 is provided with cam-arms K^4, coöperating with suitable bearing-surfaces formed by openings K^5 in the body of the wedges, and for the purpose of raising and lowering the wedges N the shaft H^4 is provided with arms N′, which coöperate with studs or projections N^2 on the wedges. In each instance, however, the connection between the cam or arm and the wedges is a loose connection, so as to allow the cams or wedges to remain or rest in either their retracted or advanced position while the cams or arms move part of the way back. This, however, may be compensated for in other ways and, except as illustrating a means for accomplishing the desired end, it is not considered essential in carrying out the invention.

Having formed the edge hooks and, when desired, the bead at the top and flange at the bottom, as described, the clamp-plate G is raised slightly, the formers F are retracted, as shown in Fig. 6, and the edges of the blank dropping into the space between the formers will be depressed slightly by pushers O, which are preferably spring-pressed and will deflect the ends of the blank a sufficient distance to cause them to pass into the concavities in the faces of the formers when the formers are next advanced, and said pushers having their edges beveled will then ride up upon the top surface of the formers, as indicated in Fig. 7. The edges of the blank having been started into the concaves, the blank will be bent around substantially as indicated in Fig. 7, and as the formers continue to advance it will be wrapped completely around the mandrel. As the edges come together it is essential that one should pass within the other in order that the hooks may properly engage in every instance, and while this result is assured by the oppositely-curved formation of the hooked edges in most instances, yet I prefer to provide one of the formers with a finger or plate O′, which will cause that side of the blank to advance somewhat more rapidly than the opposite side and at the same time be directed more closely against the body of the mandrel. The circular shape of the hooks formed in the manner described when they come to the position indicated in Fig. 8, or so as to interlock, will cause the edges when the formers continue to advance to curl or coil together, as indicated in Figs. 9 and 21, and the pressure exerted by the formers in closing across the seam will give the seam a permanent set, thereby dispensing with the necessity of employing a separate presser for forming the seam after the formers have completed their stroke.

The shape of the hook edges of the sheet-metal blank is a very important factor in the formation of seams in sheet-metal vessels in accordance with the principles of my present invention, and I have deemed it expedient to illustrate the same in several different combinations for forming either inside or outside seams. It will be noted that the hooks at each of the edges (see particularly Fig. 24) are turned in opposite directions—that is to say, one of the hooks curves downwardly and the other curves upwardly if the blank be held in a horizontal plane—and both hooks are so formed as to avoid any angular formation or corners, the effect sought being to cause each of the extreme edges of the blank to slide upon or coil into the coöperating edge when pressure is applied in a direction tending to force the edges together in a plane substantially radial to the center of the can and seam being formed and whether such pressure be due to the force resulting from the approach of the formers at right angles to the line indicated or the direct pressure of a former approaching in said lines. In the constructions heretofore indicated the formers have been arranged so as to approach the mandrel and vessel from opposite directions and at right angles to the direction of ultimate pressure upon the seam; but in Figs. 27, 27ª, and 27ᵇ a former is indicated which will approach the mandrel and vessel in a line radial to the center of the mandrel and seam, and the seam illustrated in these figures is an outside seam which conforms to the shape of the inside seam before described, the groove in this instance being in the former instead of in the mandrel. One of the hooks is formed to extend throughout a greater circumference of a circle than the other, and in the formation of the seam, whether it be an inside or an outside seam, the hook having the greatest circumference should form the periphery or outside of the seam proper, inasmuch as the edge of this hook must turn at such an angle as to crowd into the seam rather than spread out along the surface of the blank, as would be the case if it were not extended around a sufficient distance. The substantially cylindrical shape given each edge of the blank causes each edge to operate as a die or guide for the coöperating edge and to turn the same inwardly when the

blank is held on each side of the edge or seam and transverse pressure applied to the overlapped and hooked edges.

Referring again to Fig. 24, it will be seen that the edge of a hook (lettered P^6) at the left-hand side of the blank preferably extends only up into substantially the plane of the body of the blank, the hook as a whole therefore lying below the plane of the blank and forming at its juncture with the body of the blank a shoulder *p*. The opposite hook P^7 has its edge extended in the opposite direction to a point below the plane of the blank, the latter hook being therefore extended throughout a greater radius than the former hook. One of the results of this formation is that when the blank is curled around the mandrel, as indicated in Figs. 22 and 23, the shoulder *p* will cause the hook P^6 to stand in against the surface of the mandrel, as indicted in Fig. 25^a, and the hooks will be caused to engage properly without the employment of any special mechanism other than the formers and mandrel themselves, because the two edges of the blank will approach each other in slightly different planes, and the curvature of the ends of the hooks will cause them to snap past each other, even though they should contact before the edges have actually passed. This effect will be readily appreciated from Figs. 25 to 25^c, and from these figures it will be seen that as the formers continue to approach the hook edges of the blank will first assume the position indicated in Fig. 25^a, and upon the further movement they will be pressed into the position indicated in Fig. 25^b, and finally as the formers reach their ultimate position the seam will be pressed down into the shape or substantially the shape indicated in Fig. 25^c.

In the formation of the seam as thus far described I have shown a groove either in the mandrel or in the former or formers for giving the ultimate shape to the seam, (either round or slightly flattened;) but it is not necessary in the formation of a practical seam that grooves should be employed to give the ultimate shape to the seam, inasmuch as the formation of the hooked edges is such, as before stated, that they will each operate as a guide or die for the other, and in Figs. 26, 26^a, 26^b, and 26^c I have illustrated a mandrel having simply a flattened face Q to form a space in which the seam may lie, the formers in this instance simply operating to wrap the blank around the mandrel, as indicated in Fig. 26, and as they continue to approach to cause the edges to overlap, as in Fig. 26^a, and as the pressure is continued said edges will commence to curl together, as in Fig. 26^b, and as the formers reach their ultimate positions the seam will be slightly flattened down against the flat surface of the mandrel and given its ultimate set, as in Fig. 26^c.

While the can-body is held on the mandrel, the bottom is applied by the die M, which is mounted to reciprocate in a bracket M^2, the mechanism for reciprocating it consisting of a pair of arms M^3, having forked upper ends engaging rollers *m* on the shank of the die and mounted on a shaft M′, journaled in the bracket and adapted to be oscillated by an arm M^4, the lower end of which is provided with a stud working in the groove M^5 of a cam M^6 on the main drive-shaft B. The die M is made magnetic or provided in its face with a magnet—such, for instance, as indicated in dotted lines at M^7—for the purpose of holding the heads or ends of the can in the face of the die while it is advancing to place the same in the end of the can-body and form the seam uniting the two.

In order to facilitate the placing of the heads in the die M, a head-feeder R is provided on a bracket R′ immediately in front of the die and in such position as to swing from a horizontal to a vertical position, as indicated by the dotted and full lines in Fig 3. For the purpose of giving it this movement it is provided with a projection or tooth *r*, with which a corresponding projection or tooth *r*′ on the die is adapted to come in contact as the die retreats to the position indicated in Fig. 3 on the left-hand side. The feeding of the heads is therefore a practically simple matter, inasmuch as they may be placed in the feeder R by hand or automatically one at a time, and as the die retreats the feeder will turn upwardly and bring the head into contact with the die and its contained magnet, by which it will be held, and as the die advances at the next operation the feeder will be turned down into horizontal position ready for the reception of another head.

The particular formation of the seam for attaching the bottoms or heads in the can-body need not be described specifically herein, inasmuch as it is similar to that described in my prior patent, No. 509,466.

The connecting-rod H^5 for oscillating the shaft H^4 may extend down, as indicated in Fig. 3, and be connected by an arm P with a shaft P′, which latter shaft is in turn oscillated by an arm P^2, having a stud projecting into a groove P^3 in a cam P^4 on the main drive-shaft B, and when the machine is made in the form of a double machine the shaft P′ is provided with a second arm P, projecting in the opposite direction and connected by a second rod H^5 with the corresponding parts of the other body-forming mechanism.

The flat metal blanks from which the body of the cans are formed having one corner clipped off, as in Fig. 11^a and in my prior patented machines referred to, are fed into the space between the two body-forming mechanisms from the side of the frame, and from this space they are pushed alternately to the said body-forming mechanisms by automatic means, to be now described. Referring particularly to Figs. 18, 19, 18^a, and 17, which illustrate the feeding mechanism, it will be seen that a pusher Q, made in the form of a

cantaliver, is provided in the space between the two body-forming mechanisms and adapted to be reciprocated back and forth between said mechanisms by the upper end of an arm Q′, Fig. 3, carried by a rock-shaft Q^2 and operated by a second arm Q^3 through the medium of a link Q^4, coöperating with a cam Q^5, mounted on the main drive-shaft. The cantaliver form of the pusher Q causes the same to be tilted with the front edge upwardly in position to engage the blank lying on the table when the pusher is moved in either direction, the pusher being therefore, in effect, a double-acting one. In order to feed the blanks into the space between the body-forming mechanism and in a position for being advanced by the pusher Q, the guides *d* are extended out to one side of the frame, and two transversely-operating pushers Q^6 are adapted to work through between the guides or table *b* to advance the blanks, as before stated, the blanks being placed in front of the pushers Q^6 by an operator. It is of course desirable that the blanks should be advanced alternately, and for this purpose the driving mechanism or operating devices for the pushers Q^6 are arranged as follows: Both the pushers Q and frame Q^7 are adapted to slide on the top plate of the machine, and the frame Q^7 is reciprocated in unison with the pushers, but through a somewhat less range of movement, by being connected with the arm Q′ by a pin *q*′, located nearer the fulcrum of the arm than the connection between said arm and pusher, as shown clearly in Fig. 3. This casting Q^7 is provided with a lateral extension q^7, slotted for coöperation with a stud or antifriction-roller on the center arm of a double bell-crank or T lever Q^8, arranged horizontally on the top plate of the machine-frame, Fig. 17. The two oppositely-extending arms of the lever Q^8 are connected by links Q^9 with swinging arms q^9, the ends of which in turn are provided with stud projections q^{10}, working in slots q^{15} in the under faces of the pushers Q^6. The result of this arrangement is that when the arm Q′ is oscillated the intermediate pushers are reciprocated between the two body-forming mechanisms and the pushers Q^6 are alternately advanced to deliver a blank on the appropriate side in front of the pushers Q for delivery to one of the body-forming mechanisms as the pusher Q makes another movement.

From the foregoing the sequence of operations in the formation of a can-body in accordance with my present invention will be readily understood. Blanks taken from a pile by an operator are presented to the pushers Q^6, which will move them into the space between the two body-forming mechanisms, or they may be placed in position by the operator if the pushers Q^6 are not used, and the pusher Q will then advance the blanks to one or the other of the forming mechanisms at the proper instant or when the clamp G is elevated and the formers F advanced. As the blank reaches its proper position beneath the clamp the latter descends, the center bar clamps the center of the blank against the mandrel, and the die i^2 bends one of its edges down to the position indicated in Fig. 4^b. Then the dies L are advanced by the depression of the wedges N to bead and flange the blank. The dies K are advanced to form the curved downturned and upturned hooks on the edges of the sheet, respectively, by the depression of the wedges K′. These operations having been completed, the wedges are elevated and the clamp raised slightly, leaving the center clamping-bar against the blank to hold it. The formers F are then free to be retracted, which operation is performed by the arms *f* and cams *f*′, the said formers being immediately advanced again, so as to curl the blank down around the mandrel, the operation of advancing being continued until the formers are tight against the mandrel and their lower edges substantially across the meeting edges of the blank, whereby the metal in the hooked edges is crowded together and is caused by the circular initial formation given to the hooks to curl up into a relatively tight and strong seam. The complete can-body having been headed is discharged from the mandrel by reciprocating pushers R^5, Fig. 15, which may be reciprocated by any preferred mechanism, but are preferably connected directly with the casting Q^7, and in order to insure the engagement of the pushers R^5 with the body of the can each of the pushers is provided with a spring-pressed engager R^6, Fig. 16, which tends to stand out a slight distance beyond the periphery of the mandrel; but at the same time the springs which hold the engagers R^6 outwardly are comparatively light and do not interfere with the forming of the can-body around the mandrel by the formers during their advance movement.

Any suitable mechanism may be employed to conduct the can-bodies away from the machine as they are discharged from the mandrel.

The sequence of movements of the various parts is of course regulated by the proper formation of the cams on the main drive-shaft B and should be such as to enable all the operations described to be carried on automatically and without attention on the part of the attendant.

In the embodiment of the invention which I have illustrated for the formation of angular-bodied or rectangular vessels, Figs. 20 and 21, the formers are made to conform to the contour of the mandrel, with the line of division between the formers at one corner of the mandrel, and the operation of the parts is identical in all respects with the operation of the parts heretofore described in connection with the cylindrical mandrel; but in order that the sides of the blank may be depressed a sufficient distance to insure their being turned in around the mandrel as the formers

advance the depressors in this instance are made, as shown at Z, to conform to the upper angle of the mandrel, and when the mandrels retreat after the blank has been edged they press the blank down over the upper angle of the mandrel. The consequence is that the edges of the blank will be struck by the lower portion of the formers in their advance movement and will be turned or wrapped around the mandrel, as before described.

In the foregoing specification the word "mandrel" I wish to be understood as being used in the broadest sense and to include any device about which the can-body may be formed and as illustrating some of the different forms which the mandrel may take. I have shown in Figs. 28 and 28ª a mandrel in which the effective surfaces are located at diametrically opposite points, one of the said surfaces Z^2 containing the groove for the seam and the other of said surfaces Z′ forming the coöperating surface against which the clamp works. So, too, in Figs. 29 and 29ª I have illustrated a skeleton mandrel for forming rectangular-bodied vessels. The corner-bars Z^3, it will be seen, constitute the effective surfaces, and the seam is formed against one of these corner-bars.

It will appear from the foregoing specification that by this invention a sheet-metal body-blank is gripped and made into a complete sheet-metal can or vessel without changing or releasing the grip. While this plan of manipulating a blank is shown in the drawings in its application to but two forms of vessels—viz., round and square—it is nevertheless capable of much wider application. With suitable modifications vessels of conical, pyramidal, and other shapes may be readily produced, and the invention is, in fact, applicable in the production of all sizes, shapes, and kinds of seamed sheet-metal wares, vessels, utensils, and packages.

The blank herein illustrated and described is not claimed in this application, the same being reserved for a divisional application.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent of the United States of America, is—

1. In can-making machinery for forming can-bodies from blanks having edges formed into hooks curved in cross-section, a mandrel around which the body is formed combined with formers, movable relatively thereto, for wrapping the blank around the mandrel and simultaneously seaming the curved hook edges together, whereby the employment of a seaming mechanism independent of the formers is obviated.

2. In can-making machinery for forming can-bodies from blanks having edges formed into hooks curved in cross-section, a mandrel around which the body is formed, formers, movable relatively thereto, having faces conforming to the contour of the mandrel for wrapping the blank around the mandrel and simultaneously seaming the curved hook edges together, with a space between the faces of the mandrel and formers at the seaming-point for the accommodation of the seam, whereby the employment of seaming mechanism independent of the formers is obviated.

3. In can-making machinery for forming can-bodies from blanks having edges formed with hooks curved in cross-section, a mandrel around which the body is formed, formers, movable relatively thereto, having faces conforming to the contour of the mandrel for wrapping the blank around the mandrel and simultaneously seaming the curved hook edges together, the proximate faces of the mandrel and formers at the seaming-point being separated a distance equal to the thickness of the seam, whereby the employment of seaming mechanism independent of the formers is obviated.

4. In can-making machinery for forming can-bodies from blanks having hook edges, a mandrel around which the blank is wrapped, combined with formers movable in opposite directions to form the blank and having edges adapted to come together across the seaming-point whereby the edges of the body are secured together; substantially as described.

5. In can-making machinery for forming can-bodies from blanks having hook edges, a mandrel around which the blank is wrapped, formers movable in opposite directions for wrapping the blank around the mandrel, the proximate faces of the mandrel and formers at the meeting-point between the formers being separated for the accommodation of the same.

6. In can-making machinery a mandrel having a longitudinal groove in one side, combined with can-body formers for wrapping the body-blank around the mandrel, said formers being adapted to meet across the said groove whereby the hooked edges of the blank will be forced into the groove by the formers to form the side seam of the body.

7. In can-making machinery, a mandrel and a clamp working against the mandrel on one side, combined with formers having faces for embracing the mandrel and edges adapted to come together on the side of the mandrel opposite the clamp to seam the edges of a hooked-edge blank.

8. In can-forming machinery, the combination with means for forming reverse hooks on opposite edges of the blank, a mandrel and a clamp for clamping the blank to the mandrel, of oppositely-arranged formers having faces for embracing the mandrel and having projecting edges adapted to come together on the side of the mandrel opposite the clamp to seam the hooked edges of the blank together.

9. In can-forming machinery, the combination with a mandrel having a groove in one side, dies for forming reverse hooks on opposite edges of a body-blank of substantially the cross-sectional contour of the groove and a clamp for holding the blank against the side

of the mandrel opposite the groove, of oppositely-arranged formers for wrapping the blank around the mandrel, said formers having extended edges adapted to meet across the groove to force the hooks together and form the seam; substantially as described.

10. In can-making machinery, a mandrel having a longitudinal groove, the wall of which is substantially smooth and curved in cross-section combined with means for forcing the meeting edges of a blank transversely into said groove whereby said edges are caused to curl up into a seam approximately round in cross-section; substantially as described.

11. In can-making machinery, the combination with a mandrel, dies for forming hook edges on the blank arranged on each side of the mandrel and formers for wrapping the edged blank around the mandrel, arranged in the same plane transversely of the mandrel, of a clamp also arranged in the same plane transversely of the mandrel and means for moving the clamp into engagement with the blank prior to the engagement of the dies therewith, for holding the blank both while being edged and wrapped; substantially as described.

12. In can-making machinery, the combination with a mandrel around which the body-blank is bent and a pair of oppositely-arranged reciprocating formers having operative faces for embracing the mandrel, of a clamp for holding the blank against the mandrel and depressors for depressing the ends of the blank into position to engage with the operative faces of the formers; substantially as described.

13. In can-making machinery, the combination with a mandrel and oppositely-arranged reciprocating formers adapted to bend the blank around the same, of a clamp arranged above said mandrel, spring-pressed depressors carried by said clamp on each side of the mandrel for depressing the edges of the blank and means for reciprocating said clamp as set forth.

14. In can-making machinery, the combination with a mandrel, oppositely-arranged reciprocating formers adapted to embrace said mandrel and mechanism for reciprocating the same simultaneously in opposite directions, of dies carried by said formers for coöperating with the edges of the blank and mechanism coöperating with said dies for advancing the same to bend the edges of the blank; substantially as described.

15. In can-making machinery, the combination with a mandrel, and oppositely-arranged reciprocating formers, dies mounted in ways on said formers and adapted to coöperate with the edges of the flat blank and a clamp for holding said blank against the surface of the formers, substantially as described.

16. In can-making machinery, the combination with the mandrel and the oppositely-arranged reciprocatory formers having recesses formed in their upper surfaces, of dies mounted in said recesses and adapted to coöperate with the edges of the flat blank, wedges cooperating with said dies intermittently to advance the same when the formers are stationary and a clamp for holding the body-blank while being operated on by the dies; substantially as described.

17. In can-forming machinery, the combination with the mandrel and oppositely-arranged reciprocatory formers having transverse recesses in their upper faces, of dies working in said recesses and having grooves approximately on a level with the top surface of the formers, a clamp for holding the body-blank in position for coöperating with said dies and operating mechanism adapted to engage with said dies for moving them independently of the movement of the formers; substantially as described.

18. In can-making machinery, the combination with a mandrel, formers coöperating with said mandrel and having a substantially flat upper surface, and a clamp for holding the blank against said mandrel and upper surface of the formers having grooves or recesses therein, of wedge-shaped dies working between said clamp and formers for setting the metal of the blank into said grooves or recesses and means for operating said wedge-shaped dies independently of the movement of the formers; substantially as described.

19. In can-forming machinery, the combination with the mandrel, and opposite reciprocatory formers having transverse and longitudinal recesses in their upper faces, of horizontally-working dies mounted in said transverse recesses and wedge-shaped longitudinally-working dies mounted in said longitudinal recesses with means for advancing said dies and a clamp for holding the body-blank against the surface of the mandrel and formers intermediate the dies; substantially as described.

20. In can-making machinery, the combination with the mandrel, and oppositely-reciprocating formers for bending the blank around the mandrel, of dies movably mounted on said formers for edging the blank, a clamp for holding the intermediate portion of the blank and vertically-movable wedges moving into and out of engagement with said dies for advancing the same independently of the formers and whereby when said wedges are out of engagement the formers may be moved without interference.

21. In can-making machinery, the combination with two body-forming mechanisms arranged back to back, of a pusher intermediate said body-forming mechanisms for delivering body-blanks alternately to the body-forming mechanisms, and a common drive-shaft for operating said pusher and both of the body-forming mechanisms; substantially as described.

22. In an organized machine for making vessels from sheet-metal blanks, a blank-clamping and body-forming mechanism com-

bined with a vessel-heading mechanism coöperating with the body while held by the blank-clamping and body-forming mechanisms.

23. In can-making machinery, a mandrel, means for clamping a sheet-metal blank on the mandrel, means for wrapping the blank around the mandrel to form a vessel-body and means for applying a head to the body while still clamped on the mandrel; substantially as described.

24. In can-making machinery, a fixed mandrel, and a clamp for holding a sheet-metal blank against said mandrel, of formers for embracing the mandrel and forming the vessel-body and a heading-die arranged in the axial line of the mandrel for coöperation with the body while clamped on the mandrel, whereby a vessel is formed without a bodily movement of the blank; substantially as described.

25. In can-making machinery, the combination with the mandrel, and oppositely-arranged reciprocatory formers for bending the body-blank around the mandrel, of a heading-die arranged in the axial line of the mandrel and adapted to coöperate with the end of the can-body while said body is held by the formers; substantially as described.

26. In can-forming machinery, the combination with the mandrel, the oppositely-arranged reciprocating formers coöperating with said mandrel for clamping the body-blank thereto and forming a seam, of a heading-die arranged and reciprocating in the axial line of the mandrel to head the blank while held by the formers and having a range of movement greater than the length of the can-body, whereby when said heading-die is retracted the can-body may be discharged endwise from the mandrel; substantially as described.

27. In can-forming machinery, the combination with the body-forming mechanism, of dies for hooking the edge of the body-blank having the groove i', projection i^2 and recess k^3; substantially as described.

28. In can-forming machinery, the combination with the mandrel, of the oppositely-arranged reciprocatory formers provided with concave faces adapted to embrace said mandrel, one of said formers carrying a movable finger projecting inwardly from its concave face whereby one of the edges of the blank is caused to curve inwardly ahead of the other; substantially as described.

29. In can-forming machinery, the combination with the fixed mandrel having a longitudinal groove in one of its sides, of the oppositely-arranged reciprocatory formers having concave faces adapted to embrace said mandrel and projecting edges adapted to extend over said groove when the formers are advanced and a movable finger projecting within the concavity of one of said formers for directing one of the edges of the blank inside of the other edge of the blank; substantially as described.

30. In can-forming machinery, the combination with the body-forming mechanism and drive-shaft, of a pusher for advancing the blanks to the body-forming mechanism, a lever operated by the drive-shaft for moving said pusher and pushers for discharging a completed body connected with said lever at a point between its fulcrum and its connection with the blank and pusher; substantially as described.

31. In can-forming machinery, the combination with the body-forming mechanism and pusher for feeding the blanks thereto, with mechanism for reciprocating said pusher, of a transversely-operating pusher for advancing the blanks into line with the body-forming mechanism and connections between said pushers, embodying a bell-crank lever, whereby one pusher is operated by the other and at right angles thereto.

32. In an organized machine for making sheet-metal vessels from flat metal blanks, a fixed mandrel around which the blank is bent, means for clamping the blank against the mandrel, means for hooking the edges of the flat blank while so clamped against the mandrel, and means for wrapping the blank around the mandrel and forming the seam while still clamped against the mandrel, whereby the body is formed without a bodily movement of the blank; substantially as described.

EDWARD SMALL.

Witnesses:
ALEXANDER J. STEUART,
THOMAS DURANT.