(No Model.)

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No. 388,698. Patented Aug. 28, 1888.

Fig. 1.

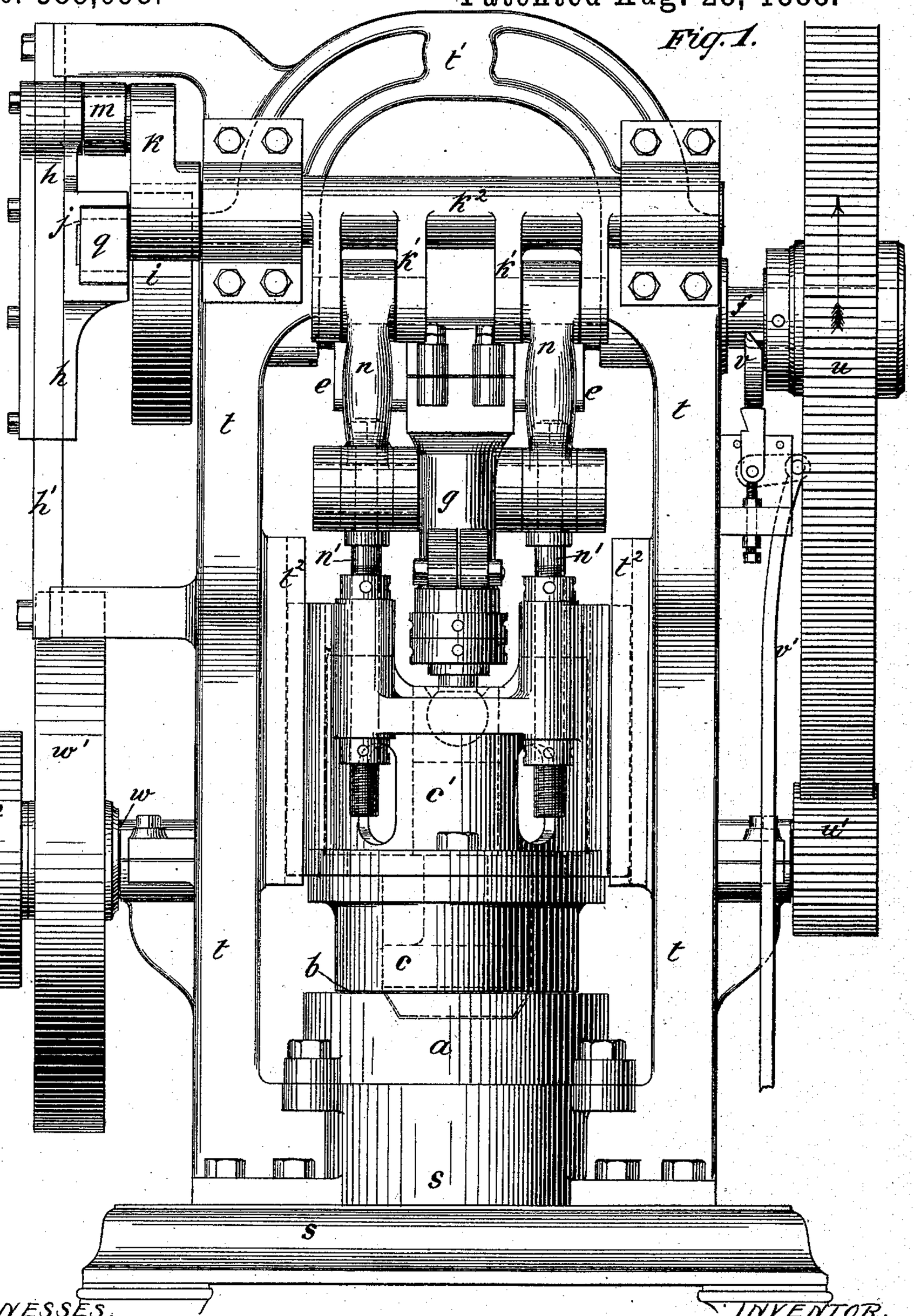

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Fig. 2.

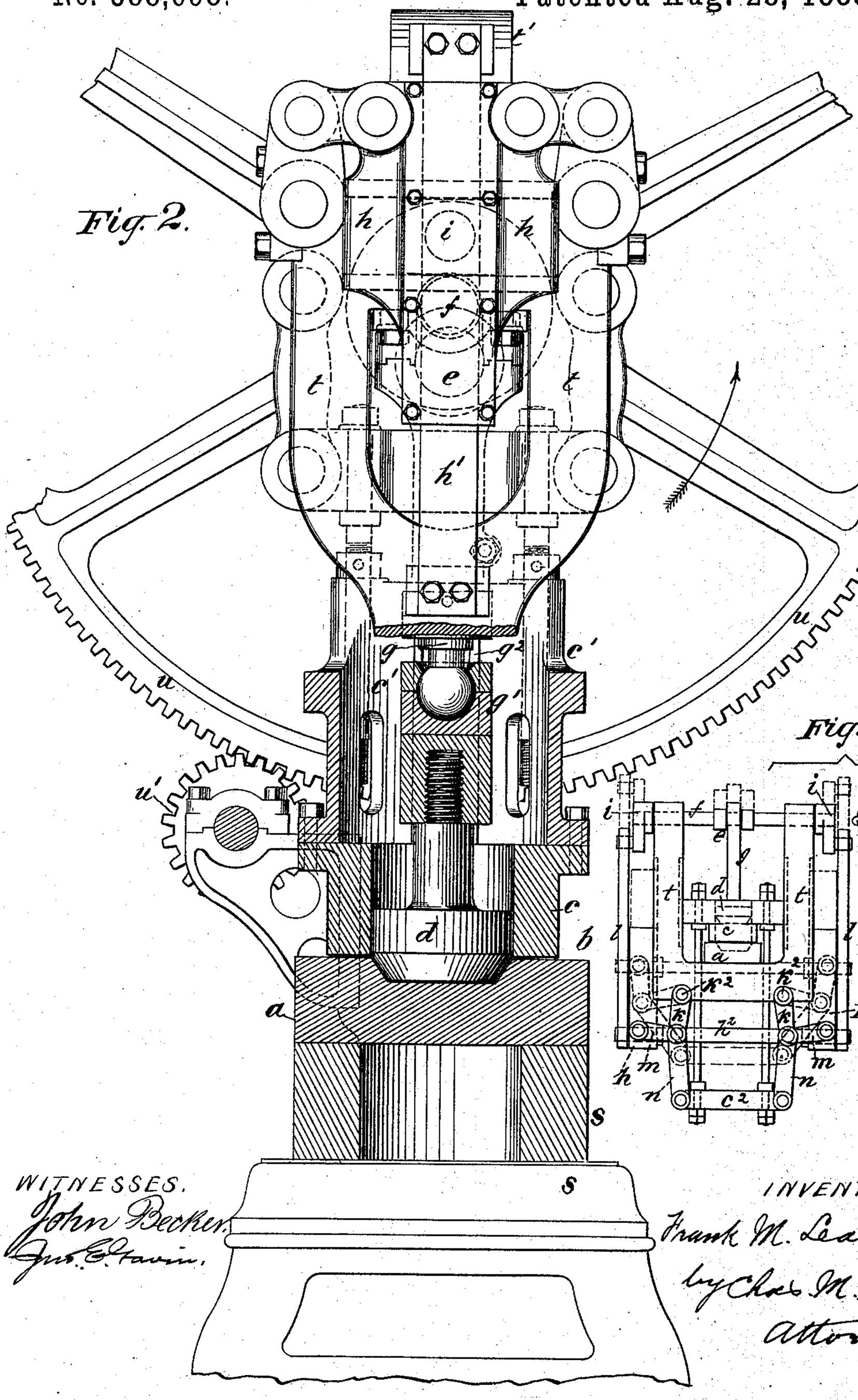

Fig. 8.

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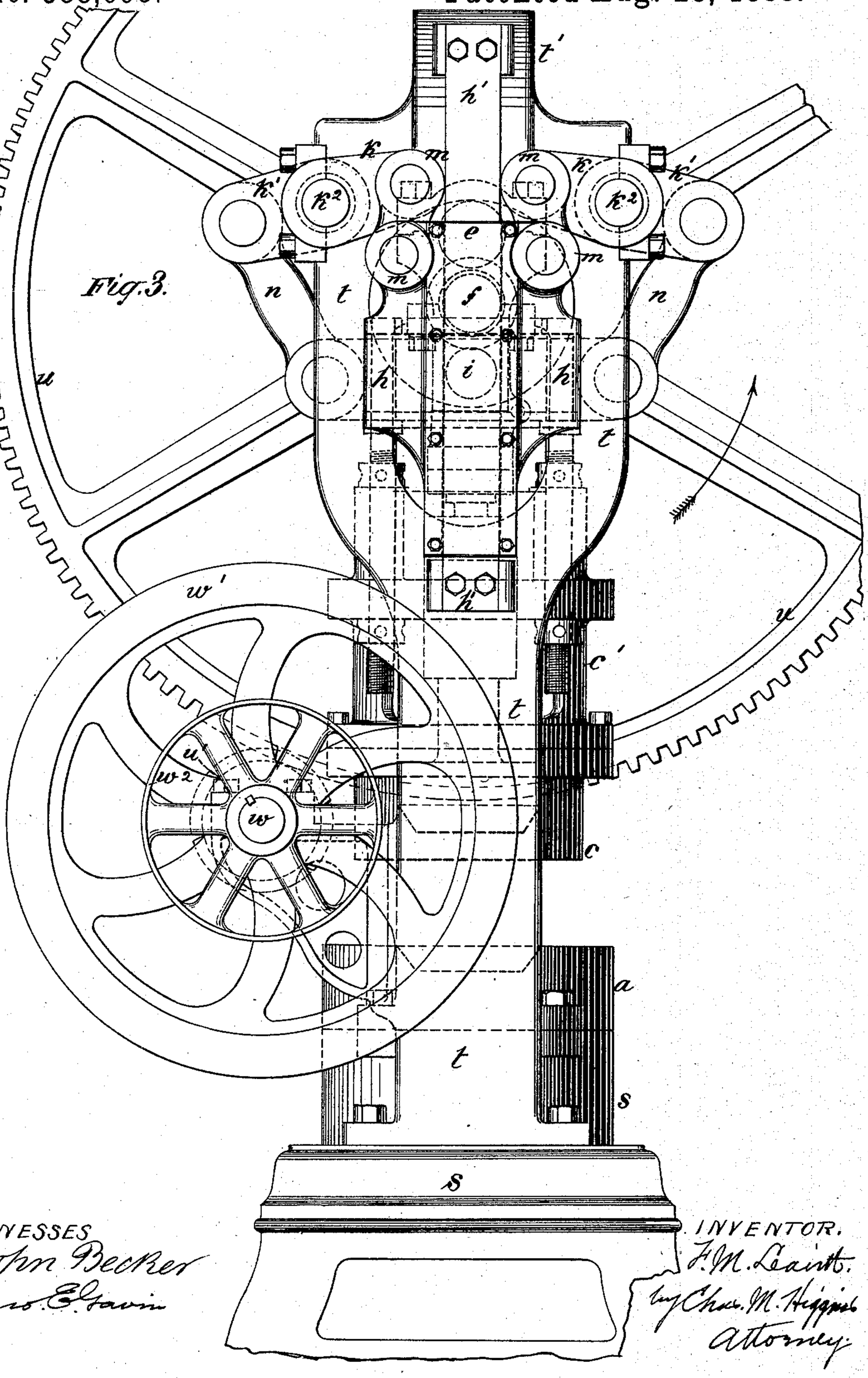
Fig. 3.



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(No Model.) 4 Sheets—Sheet 4.

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No. 388,698. Patented Aug. 28, 1888.

Fig. 4.

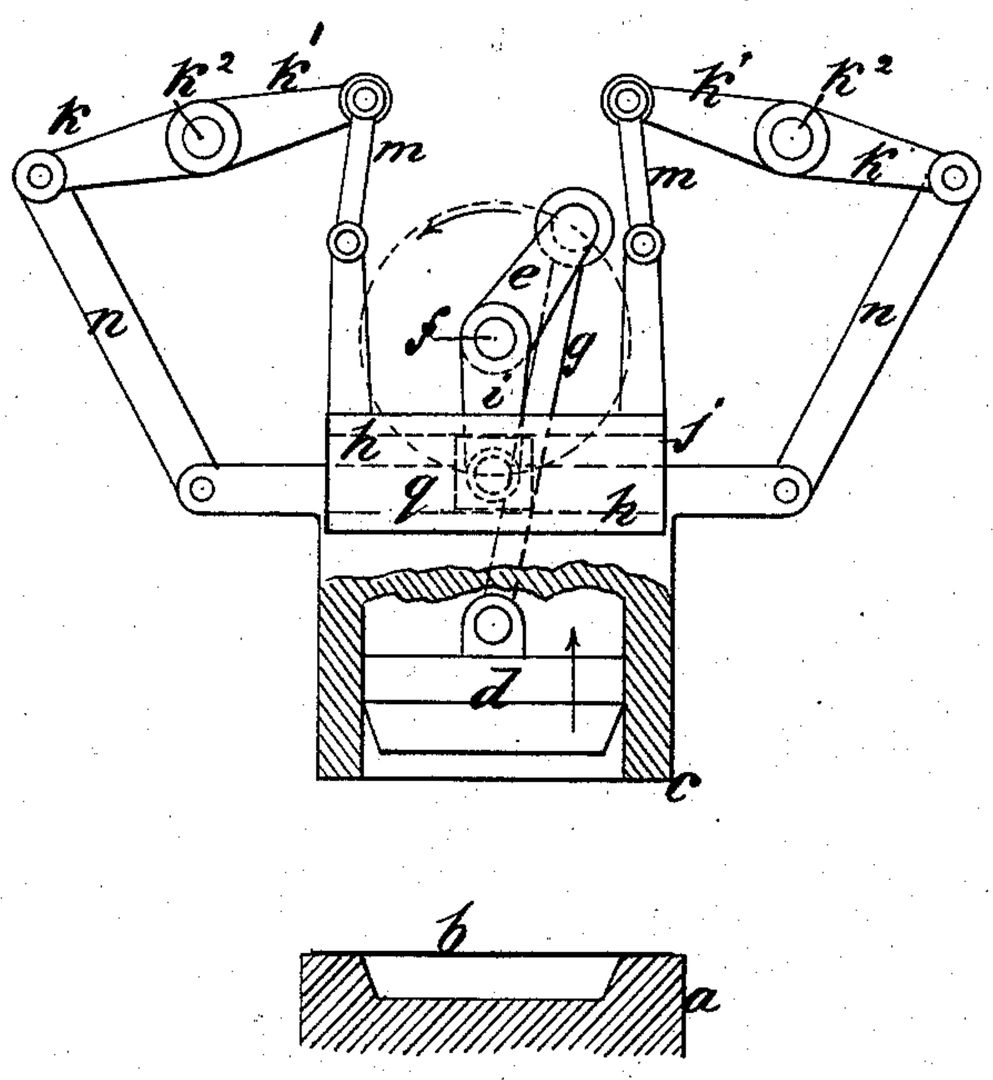


Fig. 5.

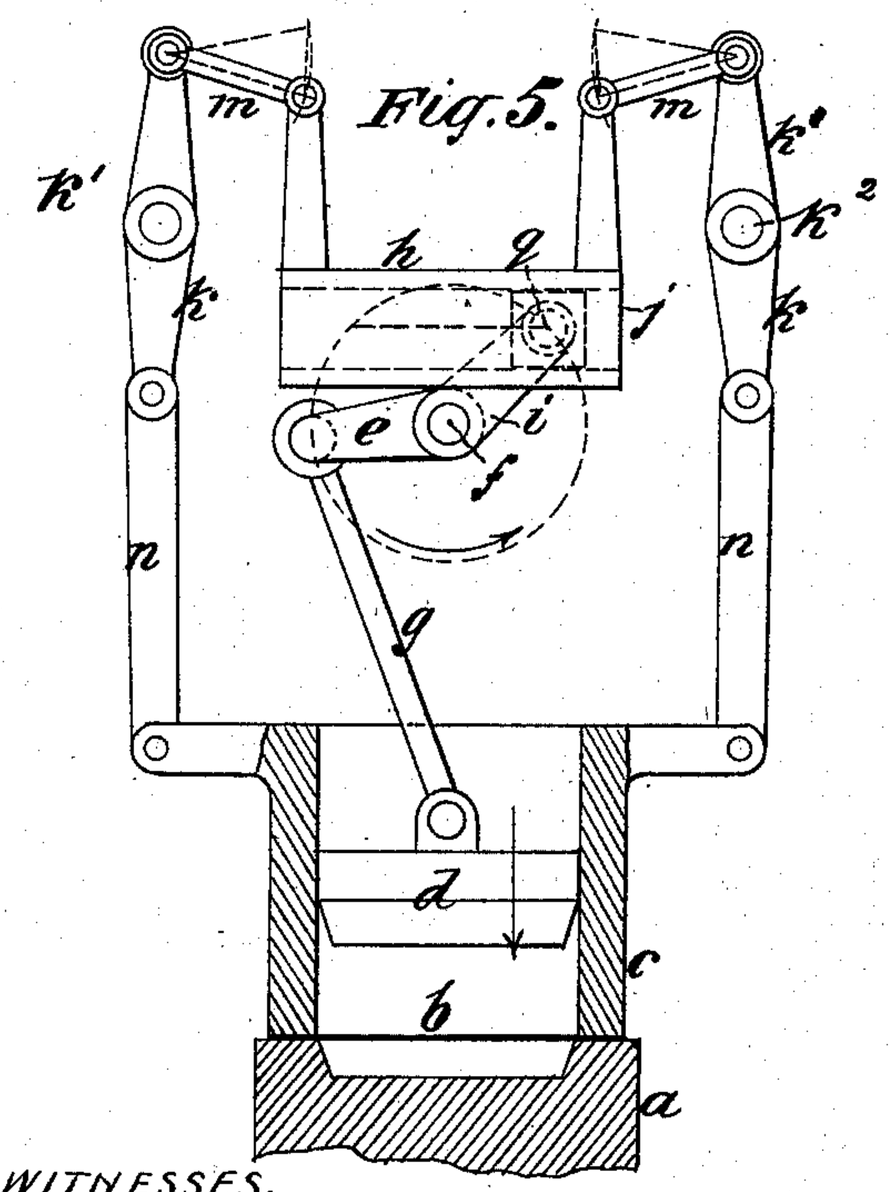


Fig. 6.

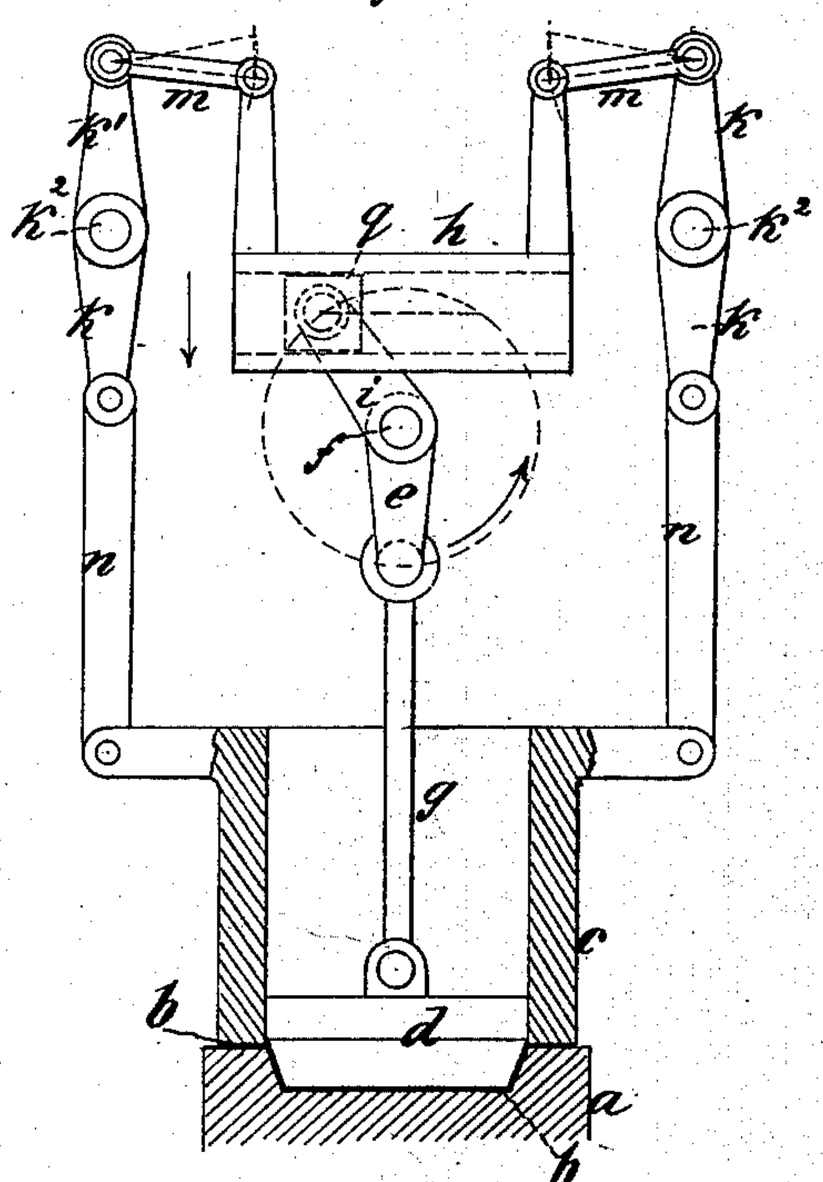
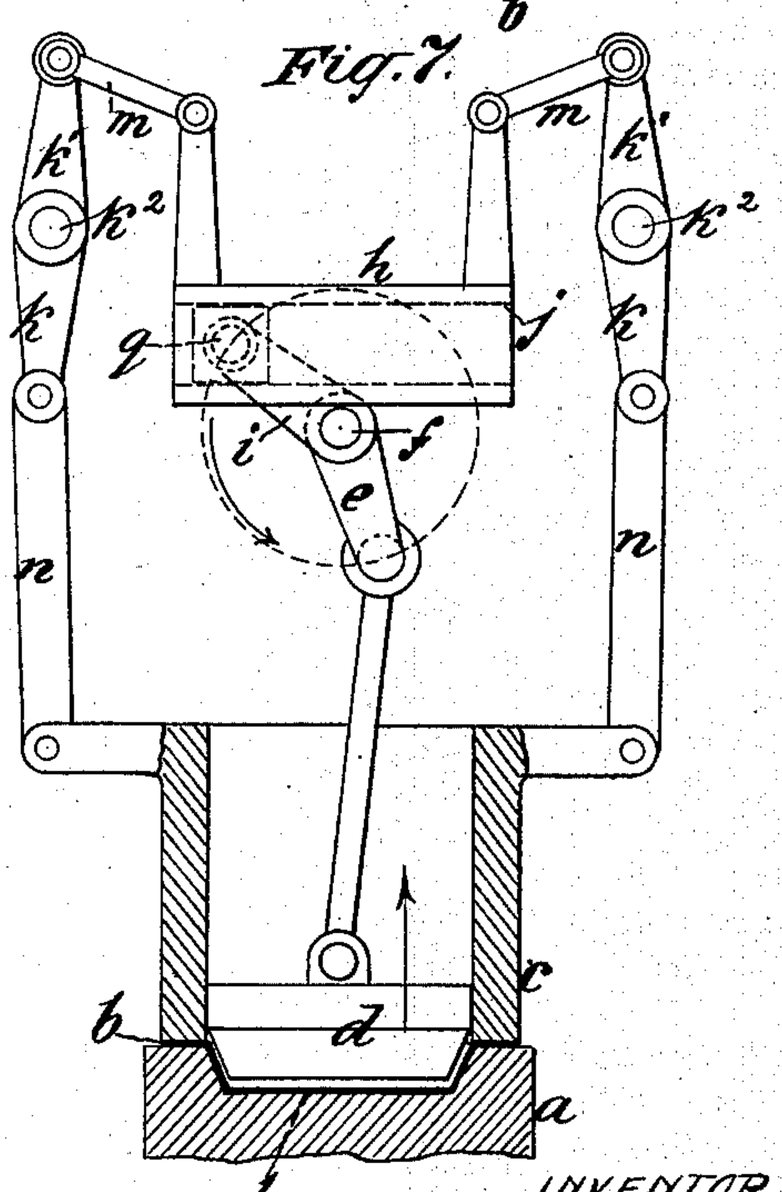


Fig. 7.



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UNITED STATES PATENT OFFICE.

FRANK M. LEAVITT, OF BROOKLYN, NEW YORK.

STAMPING-PRESS.

SPECIFICATION forming part of Letters Patent No. 388,698, dated August 28, 1888.

Application filed January 13, 1888. Serial No. 260,610. (No model.)

To all whom it may concern:

Be it known that I, FRANK M. LEAVITT, of Brooklyn, Kings county, New York, have invented certain new and useful Improvements in Stamping or Drawing Presses, of which the following is a specification.

My invention relates more especially to large and powerful presses for drawing sheet metal in large and deep forms, such as for large pans, kettles, and other vessels. In this class of presses the sheet-metal blank is placed over the mouth of the die and there held by an annular clamp or blank-holder while the plunger-die descends within the annular holder and forces the sheet metal into the lower die, thus stamping or drawing it into the desired form. These actions therefore require that the blank-holder should first descend forcibly against the margin of the blank and there pause, holding the blank firmly upon the die, while the plunger continues to descend within the holder and forces or draws the middle of the blank into the die, thus imparting the proper shape thereto. The holder still remains in its holding position during the upstroke of the plunger until the plunger is withdrawn, when the blank-holder rises with the plunger to release and permit the removal of the stamped article and leave the press ready to receive the next blank. Now, the stroke of the plunger is usually effected by a simple crank motion, while the motion of the blank-holder is usually effected by cams which are so formed as to give the desired pause in the action of the holder relatively to the action of the plunger. Cams can of course be readily formed to impart the proper motion and pause to the holder relatively to the motion of the plunger in a perfect manner; but a great objection which applies to cams is that, owing to the great strains exerted in machines of this class, the pressure and friction on the cam-surfaces are so great as to cause rapid and destructive wear, which soon renders the action of the cams inaccurate, so as to require frequent adjustment, repairs, or renewals, which are both troublesome and expensive.

The object of my invention is therefore to effect the relative motions of plunger and blank-holder in an accurate and durable manner without the use of cams at all, and this I effect by employing simple cranks and toggles or links which impart the desired relative motions and pauses to the blank-holder in a simple, durable, and accurate manner, as hereinafter fully set forth and claimed.

In the drawings annexed, Figure 1 gives a front elevation of my improved press, the holder and plunger being at the bottom of the stroke. Fig. 2 is a sectional side elevation of the press with the parts in the same position. Fig. 3 is an external elevation of the same side of the press, but with the plunger and holder at the top of the stroke. Figs. 4, 5, 6, and 7 are diagrammatic views showing the parts in their different successive positions to illustrate the actions of the mechanism. Fig. 8 is a diagram of a modification.

Turning to the drawings, I will first refer to the diagrammatic views in Figs. 4, 5, 6, and 7, which illustrate the principle and action of my invention in a simpler and more direct manner. In these views, *a* indicates the lower die or matrix, which is fixed to the bed or table of the machine in the usual way, and which contains on its face the cavity or recess adapted to the shape of the pan or vessel to be formed or drawn.

b, Fig. 4, indicates the flat blank of sheet metal placed on the die and to be stamped or drawn into the desired form.

c indicates the reciprocating blank-holder, which is of annular or hollow cylindrical form, and which is adapted to descend at the proper moment upon the edge of the blank, as seen in Fig. 5, to hold it firmly upon the die while the center of the blank is being stamped or drawn into the hollow of the die.

d indicates the reciprocating plunger or patrix, which moves within the interior of the hollow cylindrical blank-holder, and is adapted to descend at the right moment against the blank sheet and force it into the hollow of the die, while the blank is held forcibly at its margins by the blank-holder *c*, as shown in Fig. 6, thus drawing or stamping the sheet metal into the desired form. On the return or up stroke of the plunger, as seen in Fig. 7, the blank-holder still continues to hold until the plunger is retracted from the die and from the article formed therein, when blank-holder and plunger then rise together, as seen in Fig.

4, permitting the removal of the stamped article and the placing of another blank in position for a repetition of the actions, as shown in Fig. 4. It will therefore be seen that the described actions of the press require that the blank-holder have a considerable pause in its motion, so as to hold the blank firmly while the plunger is moving to force it into the die. This pausing and holding action of the holder relatively to the stroke of the plunger is effected in a simple and reliable manner by the mechanism best shown in the diagrammatic views. In these views, *f* indicates a crank-shaft, to which the power is applied and which makes but one revolution at a time, as usual in presses, each revolution producing one complete action of the press and forming one article, as is usual in this class of machinery. Now on this crank-shaft is a main crank, *e*, which is directly connected by a pitman, *g*, or other connection with the plunger *d*, the pitman being of course preferably adjustable in length in the usual maner, as illustrated in Fig. 1.

As seen best in Figs. 5, 6, and 7, *h* indicates what I may term a "reciprocating driver or cross-head," which reciprocates in line with the plunger, and is connected indirectly with the blank-holder *c* by a system of toggles or links and crank-lêvers, by which, chiefly, the peculiar pausing and holding action of the blank-holder relatively to the stroke of the plunger is effected. This reciprocating driver or cross-head is driven or reciprocated by a second crank, *i*, on the crank-shaft *f*, the crank-pin of which engages a square sliding block, *q*, which moves in a horizontal slot or groove, *j*, in the cross-head *h*, the cross-head being of course guided in vertical guides, so that the revolution of the crank *i* imparts a true vertical reciprocation to the cross-head, while the slot *j* and sliding block *q* allow the free horizontal swing of the crank without interfering with the vertical motion, as will be readily understood. The cranks *e i* are preferably arranged at a distance apart of about one-third the circumference, but they may be set exactly opposite; but I prefer their nearer position, as will be hereinafter shown.

Now, *k* indicates two toggle-links, which are pivoted alongside the cross-head on fixed axes k^2, and they are preferably made with opposite and equal arms *k k'*, as shown. The inner arms are connected by short links *m m* with rigid projections on the cross-head *h*, while the outer arms are connected by toggle-links *n n* with the blank-holder *c*. The toggle-links *n* should be provided with an adjustment for length, or their connection with the blank-holder should be adjustable, or the blank-holder should itself be adjustable in length to regulate the length of the effective stroke of the blank-holder, as will be understood, such adjustment being shown in Fig. 1 in a practical way.

It may now be seen on reference to Fig. 4 that the operative connections of the plunger and blank-holder with the crank-shaft are such that when the machine is in repose both plunger and blank-holder will be at or near the top of their stroke and the cross-head *h* will be at the bottom of its stroke, the toggle-links *k k* being nearly horizontal, while the short links *m* are vertical and the toggle-links *n* inclined to the vertical. It will therefore be noted that if the crank-shaft now revolves in the direction of the arrow the cross-head *h* will move upward, thus causing the links *m m* to force or swing the toggle-links *k k* around toward their vertical position, which will of course depress the toggle-links *n n* and force down the blank-holder *h*. As the blank-holder descends, the crank *e* will also now force down the plunger *d*, the two moving together; but the blank-holder will move in advance of the plunger, as seen in Fig. 5, until the blank-holder reaches and bears upon the blank *b* upon the die *a*, when it will be pressed firmly thereon and now remain at rest, holding the blank firmly on the die while the plunger continues to descend rapidly within the stationary holder and against the blank, as seen in Fig. 5. At this instant it will be seen that the crank *i* will be passing through its arc of least effect at its upper dead-point, while the cross-head *h* is in the position of a tangent or chord to this arc of least effect, and hence during the swing of the crank through this arc (about one-quarter of the circle) very little motion will be imparted to the cross-head. It will be further seen that what little motion is imparted at this time to the cross-head will be neutralized so far as its transmission to the blank-holder is concerned by the effect of the toggle-links *n* and links *m*, for in this position it will be seen that the links *m* will be at right angles to the stroke of the cross-head *h*, and hence their arc of motion will be tangent to the stroke of the cross-head while the toggle-links *k k* will be parallel to the stroke of the cross-head, and the toggle-links *n n* in line with the crank-levers; hence after the blank-holder reaches and bears firmly upon the blank the only motion imparted to the cross-head *h* by the further rotation of the crank *i* (see Fig. 5) will be that equal to the sine of the crank's arc to which the cross-head is the chord, as indicated by the dotted lines, and while the cross-head is moving through this sine the only motion imparted thereby to the toggle-links *k k* through the connecting-links *m* will be that represented by the sine of the arcs in which the links *m* swing, as shown by dotted lines, which is practically nothing, and even if very slight will be actually reduced to nothing at the joint between the toggle-link *k* and toggle-link *n*, which are in line and will therefore have no effect on the blank-holder except to hold it more firmly in its pausing and holding position; hence while the crank *i* is at its position of least effect and moves through about one-quarter of its circle at its upper dead-point no further motion will be imparted to

the blank-holder while the other crank, *e*, is moving through its arc of greatest effect—that is, from the position shown in Fig. 5 to the position shown in Fig. 6, or about one-quarter of the circle—so that hence as soon as the blank-holder reaches and bears firmly upon the blank it remains at rest in said position, as seen in Fig. 5, while the plunger now descends rapidly, as shown in Fig. 6, and forces the middle part of the blank into the die, thus drawing or stamping the metal into the desired shape. As the rotation of the cranks continues, as shown in Fig. 7, it will be seen that the plunger will rise out of the die a little before the blank-holder relaxes its hold on the work, thus causing the plunger to retract itself from the work, after which blank-holder and plunger rise together until they reach the position of repose or starting, (shown in Fig. 4,) where the revolution is supposed to end, thus completing one action of the press, and thus allowing the removal of the work and the placing of another blank in position for the next action. It will therefore be seen that by this mechanism the desired relative motions of the plunger and blank-holder are produced in a very simple and efficient manner, the pausing and holding action of the blank-holder while the plunger is entering the die being produced without any cam action whatever, but solely by cranks and jointed toggle links or bars, whose joints are constantly engaged or connected, and in which there is comparatively little friction or wear, and which therefore has the great advantages of being strong and simple in construction, durable and efficient in action, and having a great range of wear without requiring repairs or adjustment, which is not the case with cam mechanism.

It will be noted that by having the cranks *e i* set nearer than a diametrical position the plunger-crank *e* will have a longer and more effective stroke when the other crank, *i*, is passing through its arc of least effect; but the cranks may of course be set directly opposite or at any other distance apart, according to the particular extent of stroke desired, as will be readily comprehended.

By now referring to Figs. 1, 2, and 3, the practical construction of a press embodying the principles illustrated in the diagrams will be readily understood. In these views Figs. 1, 2, and 3, like parts are of course lettered similarly to the corresponding parts in the diagrams, which parts will be found practically identical in both cases. Turning, therefore, to Figs. 1, 2, and 3, it will be seen that the die *a* is fixed upon the bed or table *s* of the press, from which table arise the strong side standards, *t t*, connected at the top by the arched head *t'*. The main crank-shaft *f* is mounted in bearings in the top of the standards *t t*, and extends centrally and transversely through the said standards. The crank *i* on the middle of the crank-shaft between the standards is connected by an adjustable pitman, *g*, of well-known kind, as seen best in Fig. 1, with a short cross-head, *g'*, which moves in guides g^2 on the interior of the hollow cylindrical cross-head *c'*, connected to the blank-holder *c*, as best seen in Fig. 2, and to this short cross-head *g'* is connected the plunger or patrix *d* in the manner shown in Fig. 2, or in any other suitable way. On one end of the crank-shaft *f*, as best seen in Fig. 1, is mounted a large driving gear-wheel, *u*, which is preferably engaged with the shaft by any of those clutching devices which engage for one complete revolution on the depression of a treadle and then stop automatically at the end of the revolution—such, for example, as that shown in my patent, No. 370,198, of September 20, 1887. This clutch device is shown partly at *v'* in Fig. 1, *v'* being the operating treadle-rod; but I have not, of course, shown any detail views of this clutch, as it forms no part of my invention and is well understood in the art.

The gear-wheel *u* (see also Figs. 2 and 3) is driven by a pinion, *u'*, on the end of a driving-shaft, *w*, which is mounted in bearings near the base of and at the back of the standards *t*, and on the opposite end of this shaft is fixed a fly-wheel, *w'*, and a driving-pulley, w^2, to which the power is applied to constantly revolve the fly-wheel and driving-shaft and the gears *u u'*, while the crank-shaft *f* is revolved only once at a time to produce the stamping action, when the treadle-rod *v'* is depressed according to the method usual in operating machines of this class. On the opposite end of the crank-shaft *f* is fixed the crank or crank-disk *i*, which actuates the blank-holder. The pin of this crank *i* engages the sliding block *q*, as seen best in Fig. 1, which slides in the horizontal groove *j* in the cross-head *h*, which is guided vertically in the upright guide-bars *h'*, standing out from and secured to one of the standards *t*, as fully shown in Figs. 1, 2, and 3. These standards have a forked or U shape at the top in the region of the cross-head *h*, as fully shown in Figs. 3, 2, and 1, to better accommodate the moving parts. At the top of the standards, upon each side, are journaled the rock-shafts k^2, (see Figs. 1, 2, and 3,) from which the two arms of the toggle-links *k k'* radiate. The arms *k* on the outer end of the rock-shaft are connected with the top of the cross-head *h* by the links *m*, while the arms *k'* on the middle or inner part of the rock-shaft are connected by the toggle-links *n*, preferably four in number, with four adjustable screws, *n'*, secured to a hollow cylindrical cross-head, *c'*, to which the blank-holder or blank-holding die *c* is secured, as fully shown in Figs. 1 and 2. The cylindrical cross-head *c'* is guided in guides t^2 on the inner faces of the standards *t*, as best seen in Fig. 1.

The elements shown in Figs. 1, 2, and 3 are of course identical in arrangement and action with those shown diagrammatically in Figs. 4, 5, 6, and 7, and hence no further description of the operation or action of Figs. 1, 2, and 3 is necessary, as it is identical with that already given in referring to the diagrams.

It may be seen on reference to Fig. 5 that the parts *m k'* may be regarded as one set of toggles or knee-joints, and the parts *n k* another set of toggles, and that the toggles *m k'* are bent at right angles when the blank-holder is in its holding position and the crank *i* moving through its arc of least effect, while the toggles *k n* are in line at the same time. It will be further seen that the two pairs of toggles are duplicated on opposite sides of the center of the dies, in order to produce a balanced mechanical arrangement; but the principle of my invention is of course embodied in one set of the toggles, and the duplication may be more or less, according to mechanical convenience without altering the principle of my machine, so that I do not, of course, confine myself to any particular number of the sets of toggles beyond the least practical number indicated.

In Fig. 8, where the system of toggles is placed at the bottom of the press, only single-armed toggle-links *k* are used, and both link *m* and toggle-link *n* are jointed to the ends of said toggle-links. In this modification the crank-shaft *f* is at the top of the press, as usual, and the cranks *e i* are set in an equivalent position to that already described, as will be understood from the diagram in Fig. 8. The toggle-links *k* are pivoted on the base or table of the press-frame at each side, and two sliding cross-heads *h* are used—one on each side—guided in vertical guides on the side frames, *t*, adjacent to the toggle-links *k*, each of these cross-heads *h* being connected by a pitman, *l*, to the cranks or eccentrics *i i* on the ends of the crank-shaft *f*. The cross-heads *h* are operatively connected to act in unison by a strong cross-connecting tie-rod, h^2, the ends of which project to engage the pitmen *l*. The cross-heads *h* are connected by the links *m* directly to the toggle-link *k*, as before; but the toggle-links *n* also connect directly to the toggle-link *k*, while the opposite ends thereof connect to a rigid cross-bar, c^2, which is guided in a true vertical position and connected to the blank-holder *c*. The action is substantially the same as that described in referring to the other figures, and is identically the same in principle and result.

In Fig. 8 the dotted lines show the position of parts when the blank-holder and plunger are at the top of their strokes or corresponding to Fig. 4, while the full lines show the parts in the holding and stamping position corresponding to Fig. 5. It will therefore be seen on referring to the full lines in Fig. 8 that when the blank-holder reaches the die the cranks *i* will be at their lower dead-points or passing through their arc of least effect, the toggle-links *k* will be parallel with the cross-heads *h*, and the links *m* at right angles to both, and therefore in the tangent position of no effect, while the toggle-links *n* are in line with the toggle-links *k* in the position of no effect, so that the action and result will be precisely the same as that shown in the main figures.

What I therefore claim as my invention is—

1. In a press of substantially the described kind, the combination, with a fixed die, a reciprocating plunger, and a reciprocating and pausing blank-holder, of a toggle-link, *k*, a link connected to the toggle-link, a driving-crank connected by a reciprocating bar to the link, and a second toggle-link connected to first toggle-link and to the blank-holder, arranged and operating substantially as and for the purpose herein shown and described.

2. In a stamping or drawing press, the combination, with a fixed die and a reciprocating plunger and a reciprocating and pausing blank-holder, of a toggle-link, *k*, a toggle-link, *n*, connecting said blank-holder with said toggle-link *k*, a reciprocating driver or cross-head, *h*, a link, *m*, connecting said cross-head to said toggle-link *k*, and two driving-cranks, *e i*, set in opposite or nearly opposite positions, and one connected to said plunger and the other to said cross-head, arranged and operating substantially as and for the purpose herein set forth.

3. In a press, the combination, with the fixed die *a*, reciprocating plunger *d*, and reciprocating and pausing blank-holder *c*, of a centrally-arranged driving crank-shaft, *f*, and two cranks, *e i*, pitman *g*, connecting crank *e* and plunger *d*, cross-head *h*, connected to crank *i*, with the toggle-link *k*, toggle-link *n*, connecting said toggle-link *k* to the blank-holder, and link *m*, connecting the toggle-link *k* to the cross-head, substantially as herein shown and described.

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