H. J. BARKER.

TOGGLE GEAR.

APPLICATION FILED JAN. 10, 1916.

Patented Aug. 14, 1917.

4 SHEETS—SHEET 1.

1,237,150.

Fig. 1

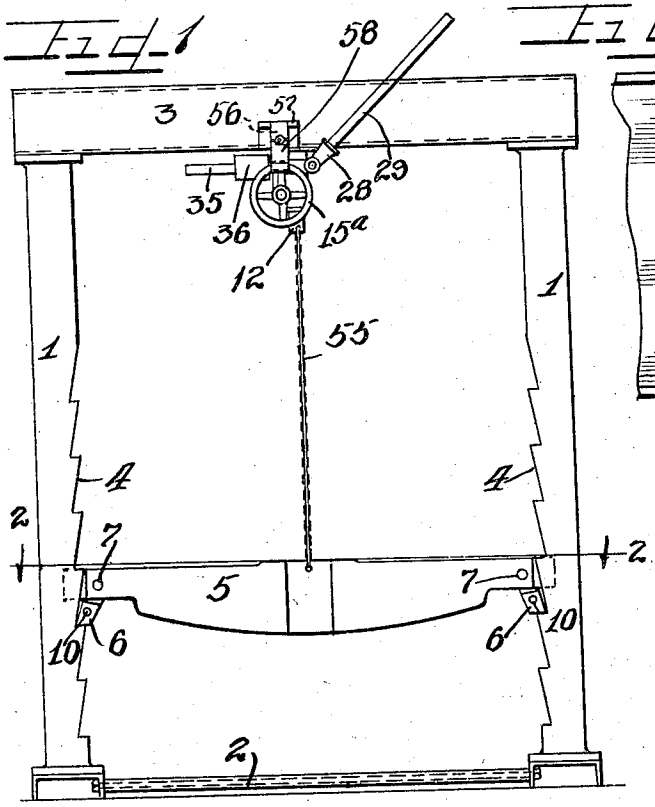


Fig. 5

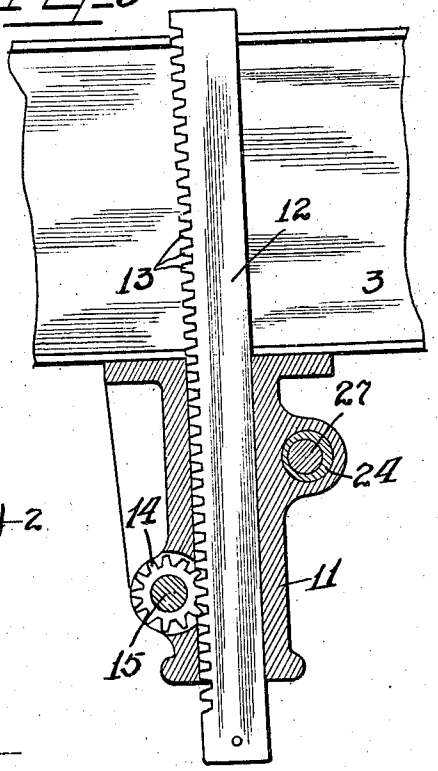


Fig. 2

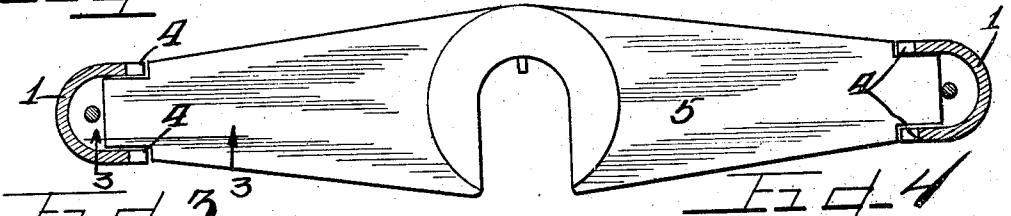
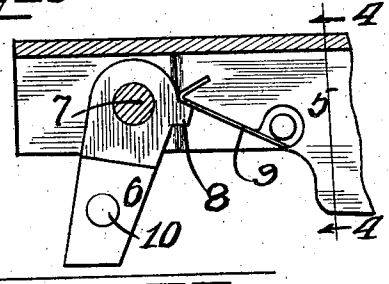
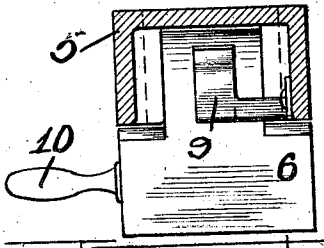


Fig. 3

Fig. 4





Witnesses

J. W. Angell

Charles W. Helsby

by

Inventor

Harry J. Barker

Charles W. Helsby Atty

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4 SHEETS—SHEET 2.

Fig. 6

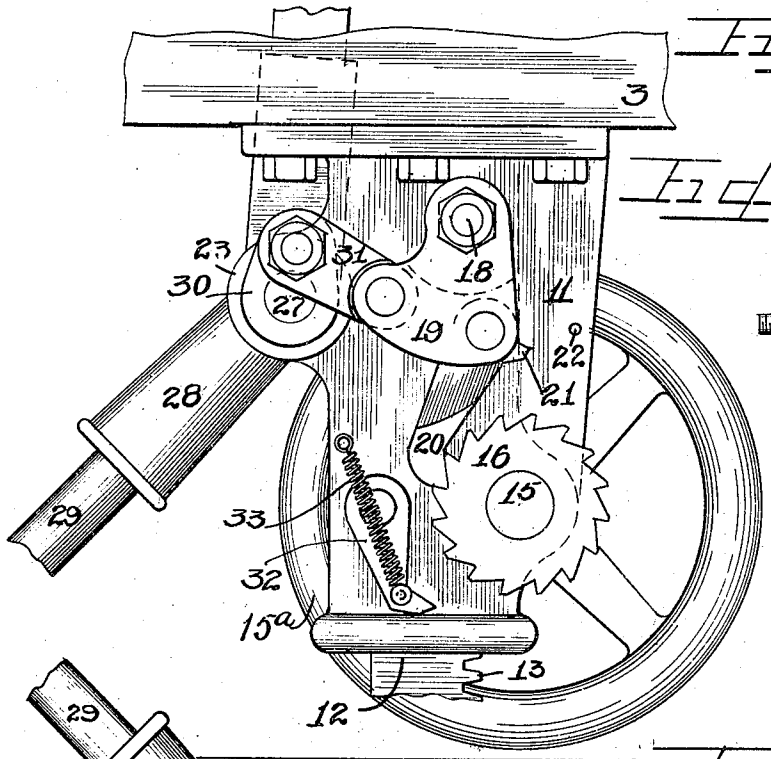


Fig. 18

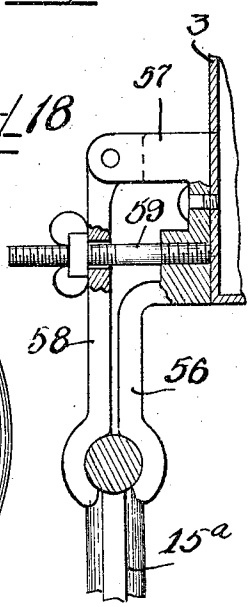
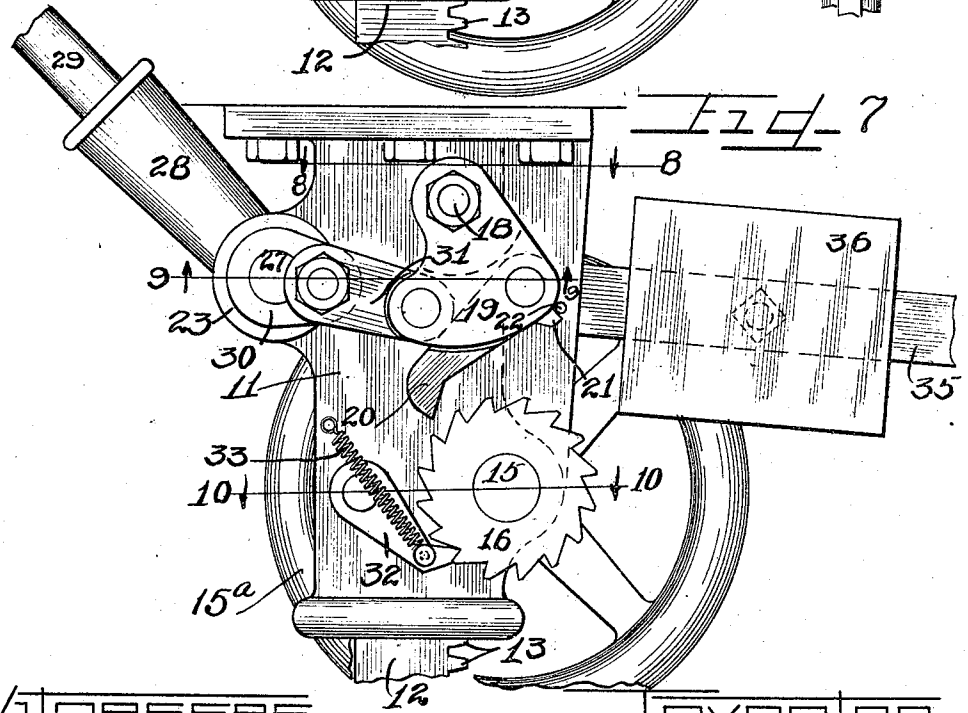


Fig. 7



Witnesses

J. W. Angell

Charles W. Hills Jr.

Inventor

Harry J. Barker

by Charles W. Hills Atty.

H. J. BARKER.

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4 SHEETS—SHEET 3.

Fig. 8

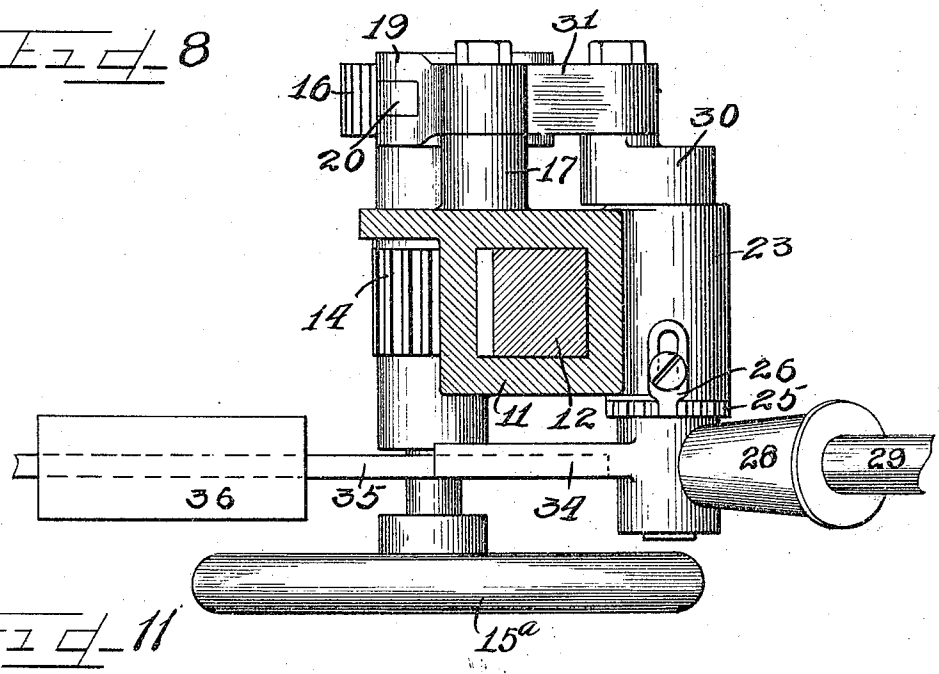


Fig. 11

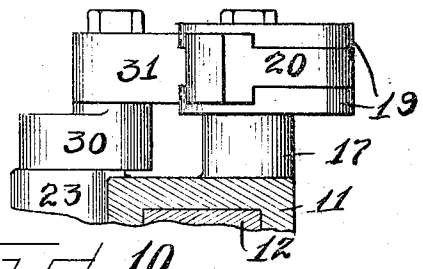


Fig. 10

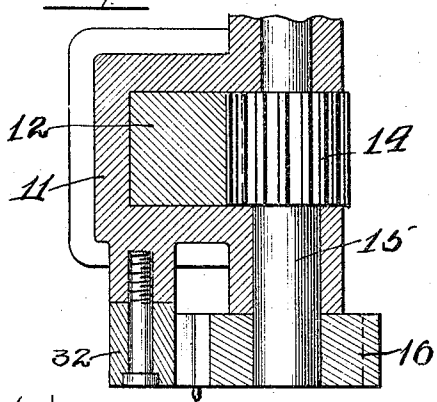
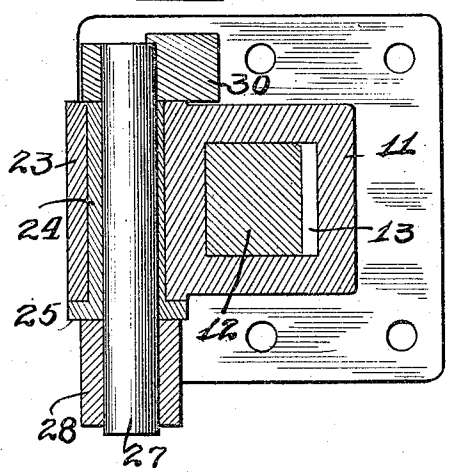


Fig. 9



Witnesses

J. W. Angell

Charles W. Kelly

Inventor

Harry J. Barker

by Charles W. Hill Atty.

H. J. BARKER.

TOGGLE GEAR.

APPLICATION FILED JAN. 10, 1916.

1,237,150.

Patented Aug. 14, 1917.

4 SHEETS—SHEET 4.

Fig 12

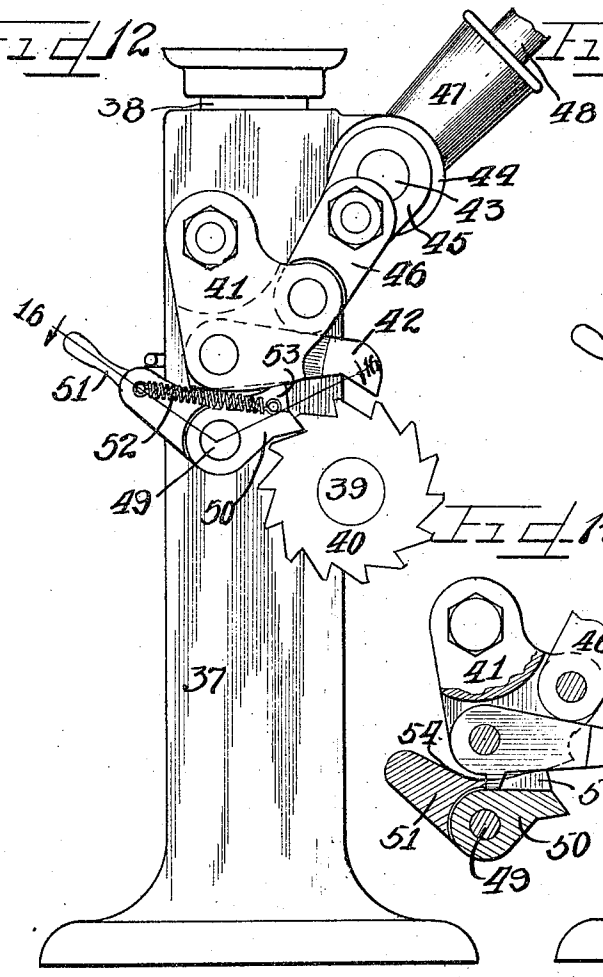


Fig 13

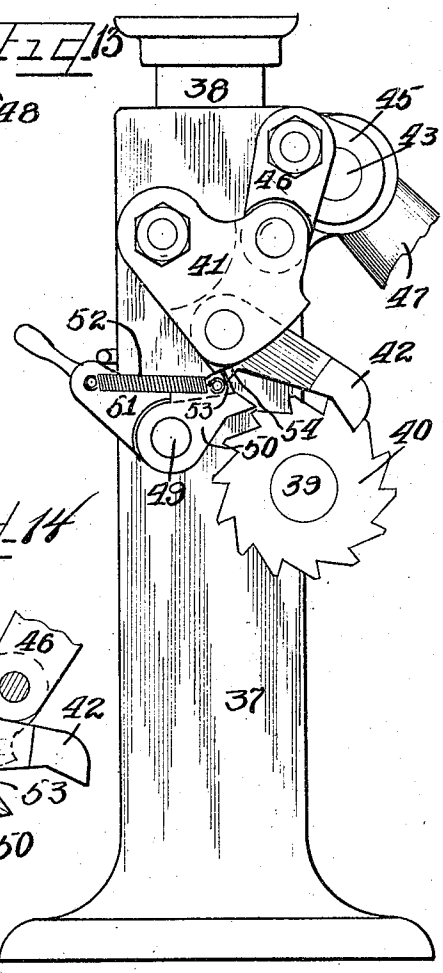


Fig 14

Fig 15

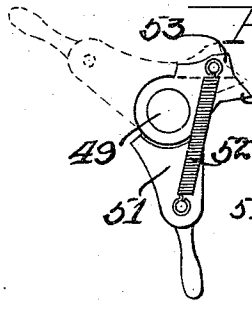


Fig 16

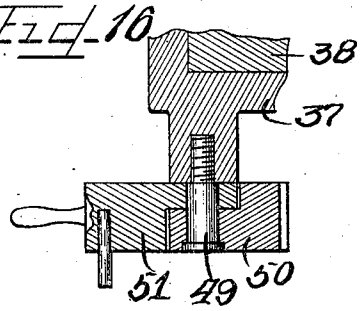
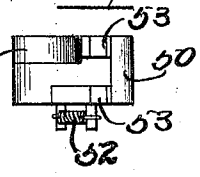


Fig 17



Witnesses

J. W. Angell

Charles W. Helm Jr.

Inventor

Harry J. Barker.

by Charles W. Hill Atty.

UNITED STATES PATENT OFFICE.

HARRY J. BARKER, OF OAK PARK, ILLINOIS.

TOGGLE-GEAR.

1,237,150. Specification of Letters Patent. Patented Aug. 14, 1917.

Application filed January 10, 1916. Serial No. 71,189.

To all whom it may concern:

Be it known that I, HARRY J. BARKER, a citizen of the United States, and a resident of the village of Oak Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Toggle-Gears; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the numerals of reference marked thereon, which form a part of this specification.

This invention relates to an improved toggle gear for use on various mechanisms, particularly presses and jacks, where a great multiplying power is desired without necessitating a multiplicity of parts and possibility of considerable lost motion.

It is an object therefore of this invention to construct a toggle gear for imparting movement to a ram or other device, wherein the relation and construction of the various links of the gear is such that a substantially uniform movement, as well as a uniform force, is transmitted to the ram or other device for a certain movement of the prime moving or actuating means.

It is also an object of this invention to provide an improved toggle gear for use on jacks, presses, and other similar devices wherein a substantially uniform application of power is obtained, and furthermore with an eccentric bearing provided for one of the members, by adjustment to vary the power co-efficient of the gear as desired, according to conditions of operation.

It is also an object of this invention to construct a power multiplying gear wherein, due to the design of the links of the gear, the power and movement received therefrom is constant for a given adjustment of the main actuating element, which is itself eccentrically journaled for adjustment to permit a change in the power co-efficient of the entire gear.

It is also an object of this invention to construct an improved type of multiplying gear comprising members toggled to one another and with one of the elements adjustable to change the power co-efficient of the gear, together with an improved type of pawl arrangement for transmitting the power of the gear to a driven member or mechanism.

It is furthermore an important object of this invention to construct an improved type of power multiplying mechanism with the parts adjustable to vary the power co-efficient thereof, and provided with an improved pawl and ratchet means particularly adapted for use on force presses, jacks and the like.

It is finally an object of this invention to construct an improved type of mechanism for constant power application having a substantially uniform movement, with the elements adjustable to change the power co-efficient according to conditions required.

The invention (in a preferred form) is illustrated in the drawings and hereinafter more fully described.

In the drawings:

Figure 1 is a front elevation of a mandrel press illustrating a mechanism embodying the principles of my invention adapted thereto.

Fig. 2 is a detail section taken on line 2—2 of Fig. 1, with parts omitted.

Fig. 3 is a detail section taken on line 3—3 of Fig. 2, with parts omitted.

Fig. 4 is a detail section taken on line 4—4 of Fig. 3.

Fig. 5 is a central detail section with parts shown in elevation, taken through the mechanism shown at the upper end of Fig. 1.

Fig. 6 is an enlarged side elevation with parts omitted of the multiplying gear shown at the upper end of Fig. 1, with the parts at one limit of movement.

Fig. 7 is a similar view with the parts at the other limit of movement.

Fig. 8 is a detail section with parts in elevation taken on line 8—8 of Fig. 7.

Fig. 9 is a detail section taken on line 9—9 of Fig. 7, with parts omitted.

Fig. 10 is a detail section taken on line 10—10 of Fig. 7, with parts omitted.

Fig. 11 is a fragmentary bottom plan view with parts in section, of the mechanisms shown in Fig. 8.

Fig. 12 is a side elevation of a jack equipped with a multiplying gear embodying the principles of my invention.

Fig. 13 is a similar view thereof showing the parts in another position of adjustment.

Fig. 14 is a fragmentary detail view illustrating the arrangement of the pawls.

Fig. 15 is a detail side elevation of the pawl mechanism, illustrating the operation in dotted lines.

Fig. 16 is a detail section taken on line 16—16 of Fig. 12, with parts omitted.

Fig. 17 is a top plan view of the mechanism shown in Fig. 15.

Fig. 18 is a detail sectional view of the brake mechanism for the handwheel of the press.

As shown in the drawings:

As shown in Fig. 1, a mandrel press is provided consisting of side guides or uprights 1, mounted upon a base 2, and at their upper ends joined by a heavy cross member 3. Said uprights 1, as clearly shown in Fig. 1, are provided with a series of teeth 4, and slidably mounted between said uprights is a table or bed 5, provided at each of its ends with a pawl 6, on a pintle 7, adapted to swing into engagement with said teeth 4, to hold said table or bed at any desired adjusted position or height. A lug 8, is formed on each of said pawls 6, and disposed within the side walls of said table 5, are strong leaf springs 9, adapted when bearing on one wall of said lugs 8, to thrust said pawls 6, inwardly into engagement with the teeth 4, as shown in Fig. 3, but permitting said pawls to be retracted so that said springs 9, engage on the under surface of said lugs 8, to maintain the pawls retracted, as during a lowering operation of said table or bed 5. A handle 10, is provided on each of said pawls 6, for actuation thereof from locking to release position.

Bolted beneath said cross-piece 3, is a heavy cored out frame or casting 11, and slidable vertically therethrough is a ram 12, provided with a series of teeth 13, on the vertical face thereof. For the purpose of actuating said ram 12, to move the same upwardly and downwardly through said frame casting 11 a pinion 14, is provided rigidly secured upon a shaft 15, which is journaled transversely on said frame casting 11, and meshes with the teeth 13, of said ram, and on one end of the shaft 15, a ratchet wheel 16, is secured and on the other end, a hand wheel 15ª.

Secured into a boss 17, formed on one of the side walls of the frame casting 11, is a pintle bolt 18, on which is swingingly mounted a yoke-shaped crank plate 19. Pivotally mounted and normally depending from said crank plate 19, is a pawl 20, adapted to engage the teeth of the ratchet wheel 16, as shown in Fig. 6, and provided on and near the upper end of said pawl 20, is a lug 21, which, when said crank plate 19, is swung to one side, strikes a pin 22, fixed in the side wall of the frame 11, and thus causes retraction of the pawl into position out of use, such as shown in Fig. 7. Formed on one end of the frame 11, is a relatively large horizontal bearing boss 23, in which is adjustably journaled an eccentric bushing 24, having a toothed flange 25, at one end thereof, and slidably mounted on the upper side of said bearing boss 23, is a slotted latch 26, adapted to be projected into engagement with the toothed flange of said eccentric bushing to lock the same from movement. Journaled within said eccentric bushing 24, is a shaft 27, having rigidly secured on one of its ends a handle socket 28, in which a handle 29, is mounted, and at its other end provided with a short crank 30. Said crank 30, is toggled to the crank plate 19, by a short link or toggle bar 31, which is pivoted at its ends respectively to said crank 30, and to said crank plate 19. The distance between centers of the shaft 27, or crank 30, and the link 31, is such that the change in the leverage ratio from the lever 29, through said link 31, to the crank plate 19, is substantially the same as the change in the leverage ratio between the crank plate 19, and its pawl 20, but inversely with respect thereto, so that the loss in leverage in the gear at one point is gained or compensated for at the other, with a resulting uniform application of power, and furthermore with a substantially uniform movement of the prime actuating means or lever and power ram. The calculations relating to the design of the parts to secure the above result may also take into account the angularity of the pawl 20, with respect to the ratchet wheel 16, which, however, for practical purposes, is inconsiderable.

Pivoted adjacent the ratchet wheel 16, near the lower end of the frame 11, is a pawl 32, having connected thereto and to a fixed point on said frame, a tension spring 33, adapted when said pawl is swung beyond center in one position, as shown in Fig. 6, to maintain the same retracted from the ratchet wheel 16, and when moved beyond center in the other direction, as shown in Fig. 7, to impel the same into engagement with said ratchet wheel. When said pawl 32, is used in engagement with the ratchet wheel, it serves to lock the same from reverse movement, thereby affording a means of retaining the pressure on the ram for any length of time and for any purpose desired. Formed integral with the hub portion of said handle member 28, is an extension 34, in which is inserted a bar 35, having adjustably mounted thereon a counterweight 36, which acts to balance the handle 29, serving normally to move said handle 29, into upright or normal position, as shown in Fig. 7.

In the modification illustrated in Figs. 12 to 17 inclusive, I have shown a jack equipped with a power mechanism embodying the principles of my invention and further provided with an improved pawl arrangement. The frame of the jack is denoted as a whole by the reference numeral 37, and is cored out on its interior to receive a vertically movable lift or ram 38. A shaft

39, is journaled in said base or frame 37, at one side thereof, and has secured on the outer end thereof a ratchet wheel 40, and is also provided with a pinion (not shown) adapted to engage teeth (not shown) formed on the lift 38, to raise and lower the same, the construction being identical with that for the ram 12, shown in Fig. 10, and hence not illustrated. Pivoted at one side of the frame or base 37, is a crank plate 41, and pivoted to said crank plate is a pawl 42, adapted to engage the ratchet wheel 40. As in the construction previously described, a shaft 43, is journaled in an eccentric bushing which is adjustable in a bearing boss 44, formed on the side of the base 37, and at one end of said shaft 43, a crank 45, is secured, which is connected by means of a toggle bar or link 46, with said crank plate 41. A handle socket member 47, is rigidly secured on the other end of said shaft 43, and is provided with an actuating handle 48.

Pivotally mounted upon a stud 49, secured on the side of the base 37, of the jack, is a pawl 50, adapted to engage and lock the ratchet wheel 40, to retain the thrust on the lift 38, similar to the action of the described pawl 32, and ram 12, and slotted so as not to interfere with the pawl 42. Also pivoted upon said stud 49, is a handle 51, which has connected thereon one end of a tension spring 52, the other end of said spring being connected to one of the two extensions 53, formed on the upper surface of the pawl 50, said extensions co-acting with a rounded cam surface formed on the lower portion of the cam plate 41, in a manner hereinafter pointed out. As clearly shown in the detail view in Fig. 14, said handle 51, is provided with an abutment adapted to be contacted by a lug 54, formed on the inner end of the pawl 42, for a purpose hereinafter described.

The operation is as follows:

In the form of device illustrated in detail in Figs. 6 to 10 inclusive, the ram 12, receives its movement from the pinion 14, which is rotated on its shaft 15, by the ratchet wheel 16. Movement is imparted to the ratchet wheel 16, by the pawl 20, which is swingingly mounted upon the crank plate 19. It is apparent by reference to Fig. 6, that due to the position of the pivot centers, a toggle effect is gained between said crank plate 19, and pawl 20, when the crank plate 19, pivots in a clockwise direction. The pressure or thrust exerted between the pawl 20, and crank plate 19, increases as the pivot center of said pawl approaches dead center or line of alinement between the pivot 18, of the crank plate and the point of thrust of the end of the pawl with the ratchet wheel 16, but on the other hand the leverage ratio between the lever 29, and the link 31, decreases correspondingly, so that a uniform application of power as well as a corresponding uniform movement of the lever 29, and ram 12, is the result.

The actual amount of the thrust imparted to the ratchet wheel 16, is dependent upon the field of operation of the crank plate 19, and pawl 20, the thrust being greater when said crank plate and pawl operate in the neighborhood of the dead center position of said pawl, and less when said crank plate and pawl operate in a field remote therefrom. The amplitude of movement, however, imparted to the ratchet wheel 16, when said crank plate and pawl operate in the neighborhood of the dead center position of said pawl, is less than the extent of movement transmitted to said ratchet wheel when said pawl and crank plate operate in positions remote therefrom. A means is provided for adjusting the operation of said crank plate and pawl to practically any field of movement between the limits of movement thereof, and this is accomplished by the eccentric bushing 24, in which the shaft 27, is journaled, carrying the crank 30, on which the connecting link 31, which is connected to the crank plate 19, is secured. The angular swing of the actuating handle 29, is practically always the same, that is, substantially ninety degrees from one limit of movement to another, but the field of operation of said crank plate 20, may be changed by adjustment of said bushing 24. Although the field of operation of said crank plate 19, and pawl 20, is changed, the actual movement of the crank plate is always constant, due to the fact that the movement of the handle 29, is always the same. The effect of such movement of the crank plate 19, however, may be varied to increase the thrust imparted to the ratchet wheel 16, but by increasing the thrust the extent of movement transmitted to the ratchet wheel is reduced, while decreasing the thrust imparted to the ratchet wheel 16, increases the extent of movement imparted thereto.

The pawl 32, may be thrown into operating position such as shown in Fig. 7, to lock the ratchet wheel from reverse movement during a retracting movement of the pawl 20, such as shown in Fig. 7, or may be thrown out of operation completely, as illustrated in Fig. 6, if it is desired to adjust the ram 12, by rotating the hand wheel on said shaft 15. The pawl 20, is automatically thrown out of engagement with the ratchet wheel 16, to permit free movement thereof in either direction by the hand wheel when the actuating handle 29, is in the upright position shown in Fig. 7, due to the fact that the lug 21, on said pawl strikes against the pin 22, fixed on the frame member 11, of the mechanism.

The mechanism described in the foregoing may be utilized by use of the handwheel

15ª, to lower or raise the table bed 5, of the mandrel press illustrated in Figs. 1 to 5 inclusive, and for this purpose the ram 12, of the mechanism is retracted as shown in Fig. 1, and a chain 55, or other suitable means, is connected thereto and to the bed 5, and after throwing the pawls 6, into retracted position, the bed 5, is slowly lowered by allowing slow rotation of the hand wheel, using a brake hereinafter described, if desired. The pawls 6, are then thrown into engaged position with the teeth 4, of the uprights 1, to support said table, and if it is desired to lower the same an additional amount an additional length of chain is connected in and the operation repeated. Of course, in raising the bed 5, it is only necessary to rotate the hand wheel 15ª, of the ram mechanism to successively raise the ram and the table 5, therewith, the pawls 6, acting automatically to interlock with the teeth 4, of the uprights to retain the bed in position after each upward movement thereof, but of course the chain 55, must be shortened successively with each upward adjustment of said table.

In the form of device illustrated in Figs. 12 to 17 inclusive, I have shown a jack adapted for any purpose wherein the mechanism embodying the principles of my invention is employed for movement of the lift or ram 38, of the jack. In this construction, as in the previous one described, the ram 38, receives its movement by a rack and pinion construction, the pinion being driven by the ratchet wheel 40. The ratchet wheel 40, receives its movement from the pawl 42, which is pivoted upon the crank plate 41, which in turn is linked by means of the toggle bar 46, to the crank 45, on the main actuating shaft 43. In this construction, as in the previous one described, the toggle effect is gained between the crank plate 41 and pawl 42, whereby the thrust imparted to the ratchet wheel 40, is substantially uniform. The extent of movement of said crank plate 41 and pawl 42, to secure greater or less amounts of thrust with an inverse extent of movement, is obtained by adjustment of the eccentric bushing in which the shaft 43, is journaled, the eccentric bushing not being shown in the present construction, but being identical with the construction illustrated in Fig. 9.

An improved arrangement of pawls is provided in the present construction to facilitate elevation as well as lowering of the lift 38, of the jack. For this purpose the pawl 50, is provided, connected by a tension spring 52, to the handle 51, so that when the handle 51, is thrown into the upper position illustrated in Figs. 12 and 13, the spring acts normally to withdraw the pawl 50, out of engagement with the ratchet wheel 40. When used in this position of the handle 51, the jack is adapted for lowering heavy bodies upon the lift 38. Consequently the handle is swung downwardly into the position illustrated in Fig. 13, whereby the pawl 42, is in engagement with the ratchet wheel 40, and as the handle is allowed to move slowly upwardly with a consequent lowering of the lift 38, as said handle member 47, approaches its limiting position, such as shown in Fig. 12, the rounded cam surface on the crank plate 41, strikes over the extension 53, on the pawl 50, thrusting the same against the tension of the spring 52, into engagement with the ratchet wheel 40. With a further movement of said handle and consequently said crank plate 41, the pawl 42, which is provided with the lug 53, shown in Fig. 14, strikes the abutment on the handle 51, thereby retracting the pawl 42, out of engagement with the ratchet wheel 40. The handle 47, may then be swung downwardly, the pawl 42, swinging forwardly to engage the next tooth of the ratchet wheel 40, and as the pawl 42, finally seats into engagement with said ratchet wheel the cam portion of the crank plate 41, having moved upwardly a sufficient amount, the pawl 50, is drawn out of engagement with the ratchet wheel by its spring 52.

A brake for the hand wheel 15ª, is shown in detail in Fig. 18, and consists of a bracket 56, secured on the frame member 3, projecting down close to the periphery of the hand wheel and pivoted to an extension 57, on the upper end of said bracket is a clamping arm 58, adapted to be clamped against the periphery of the hand wheel. For this purpose a threaded bolt 59, is secured in the bracket 56, extending loosely through an aperture or slot in the arm 58, and is provided with a wing nut 60, which, when threaded inwardly on said bolt, forces the arm 58, into frictional contact with the wheel 15ª, and if there is a slight play in the wheel 15ª, it will of course be forced frictionally against the bracket 56.

In utilizing the jack to elevate a body, the handle 51, of the pawl 50, is swung downwardly into the position shown in Fig. 15, whereby the tension of the spring 52, acts normally to retain said pawl 50, normally engaged with the ratchet wheel to prevent reverse movement thereof. The handle member 47, is then actuated successively to cause rotation of the ratchet wheel 40, by the pawl 42, in a usual and well known manner. The thrust leverage imparted to the pawl 42, varies inversely with the extent of movement thereof, and this may be changed by shifting the eccentric bushing in which the shaft 43, is journaled in the manner already described.

It is apparent that the power factor or power co-efficient of the mechanism may be changed by adjustment of the eccentric

bushing 24, due to the fact that by such adjustment the field of operation of the crank plate and pawl pivoted thereon tends to bring the same toward or away from the position of alinement of the line of thrust through said pawl, its pivot center and the pivot center of the crank plate, whereby the toggle effect, in transmitting movement to the ratchet wheel, is obtained. Of course, as the mechanism is adjusted to secure an increased power co-efficient the extent of movement of the parts is decreased, and conversely, when the parts are adjusted whereby a less power co-efficient is obtained, the extent of movement of the parts is increased.

I am aware that various details of construction may be varied through a wide range without departing from the principles of this invention, and I therefore do not purpose limiting the patent granted otherwise than necessitated by the prior art.

I claim as my invention:

1. In a device of the class described, the combination with a ratchet wheel and pawl for actuating the same, of a plate on which said pawl is pivoted, said plate pivotally mounted to afford a toggle action between said plate and pawl to drive the ratchet wheel, and means connected to said plate to swing the same and adjustable to change the field of operation thereof to change the power factor of operation of said plate and pawl on said ratchet wheel.

2. In a device of the class described, a ram, a rack and pinion mechanism for moving said ram, a pawl and ratchet gear for driving said rack and pinion mechanism, a crank plate to which said pawl is toggle-connected, a link to which said crank plate is toggle-connected, a crank to which said link is toggle-connected, and means for imparting movement to said crank to cause actuation of said pawl through the respective toggle-connected crank and link; link and crank plate; and crank plate and pawl, to operate said ratchet gear.

3. In a device of the class described, a ram, a gear rack formed thereon, a pinion meshing with said rack to operate said ram, a ratchet wheel for operating said pinion, a pawl for operating said ratchet wheel, a pivoted crank plate on which said pawl is mounted at one point thereon whereby a toggle effect is obtained between said crank plate and pawl to actuate the ratchet wheel, and toggle operated means pivoted at another point on said crank plate for swinging said crank plate to impart a thrust to said ratchet wheel through said pawl.

4. In a device of the class described, a ram, means for operating the same, a toggle gear for operating said means, an actuating mechanism limited to a certain field of movement, and means connecting said mechanism with said toggle gear and adjustable to change the field of operation of said toggle gear to vary the power co-efficient thereof.

5. In a device of the class described, the combination with a ratchet wheel, of a toggle mechanism for imparting thrust to said ratchet wheel to move the same, and means connected to operate said toggle gear and adjustable to change the field of operation of said toggle gear to vary the power co-efficient of thrust on said ratchet wheel.

6. In a device of the class described, a power element, a toggle gear for operating the same, means for actuating said toggle gear limited to a certain field of movement, and adjustable mechanism for transmitting movement from said means to said toggle gear adapted to change the field of operation of said toggle gear to vary the power co-efficient thereof for operation on said power element.

7. In a power mechanism of the class described, a crank plate, toggle operated actuating means therefor at one point thereon, a pawl pivoted at another point thereon, and a ratchet wheel to be driven by said pawl so disposed with respect to said crank plate and pawl as to receive a thrust therefrom due to a toggle action between said crank plate and pawl.

8. In a multiplying gear of the class described, a pivoted crank plate, a pawl pivoted at one point thereon, a ratchet wheel disposed for actuation by the pawl whereby a toggle effect is gained between said crank plate and pawl, a link pivoted to said crank plate, at another point thereon offset from the pivot center of said pawl, a crank connected to move said link, the leverage effect between said crank and link changing inversely with respect to the leverage effect between said crank plate and pawl, and a shiftable center bearing for said crank.

9. In a multiplying gear of the class described, a crank plate and pawl pivotally connected to secure a toggle effect of increasing leverage, a toggle connected crank and link with said link toggle connected to said crank plate, at a point offset from the pivot center of said pawl, the leverage ratio between said crank and link decreasing simultaneously with the increasing leverage ratio of said crank plate and pawl, means for applying a pressure to an object disposed to receive movement from said pawl, and mechanism for actuating said crank whereby substantially uniform movement and power is applied to said means by substantially uniform movement and application of power to said mechanism.

10. In a multiplying gear of the class described, two members toggled to one another, a third member toggled to one thereof and means for actuating said third member to

actuate said toggled members with the leverage ratio of said means to said third member decreasing with the increasing leverage ratio of said toggle members.

11. In a toggle gear mechanism, the combination with members toggled to one another, of an actuating lever and link connected thereto with said links also forming a toggle with one of said members to operate the same whereby as the leverage effect of the toggle members increases the leverage effect of said lever and link decreases, and vice versa, and a locking device to lock the gear in an adjusted position to hold the various elements under a power stress.

12. In a toggle gear of the class described, the combination with a ratchet wheel, a ram associated therewith connected to be operated when said wheel is rotated, a pivotally mounted member, a pawl toggled thereto for coaction with said ratchet wheel, a lever mechanism of decreasing leverage for operating said toggle connected member and pawl to impart rotation to said ratchet wheel, and means for co-action with said ratchet wheel to lock the same against the reverse rotation to retain a power stress imparted to said wheel by said pawl on said ram.

In testimony whereof I have hereunto subscribed my name in the presence of two subscribing witnesses.

HARRY J. BARKER.

Witnesses:
CHARLES W. HILLS, Jr.,
ELMER E. PETERSON.