Aug. 6, 1957 T. C. KORSMO Re. 24,343

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Original Filed Aug. 11, 1954 6 Sheets-Sheet 1

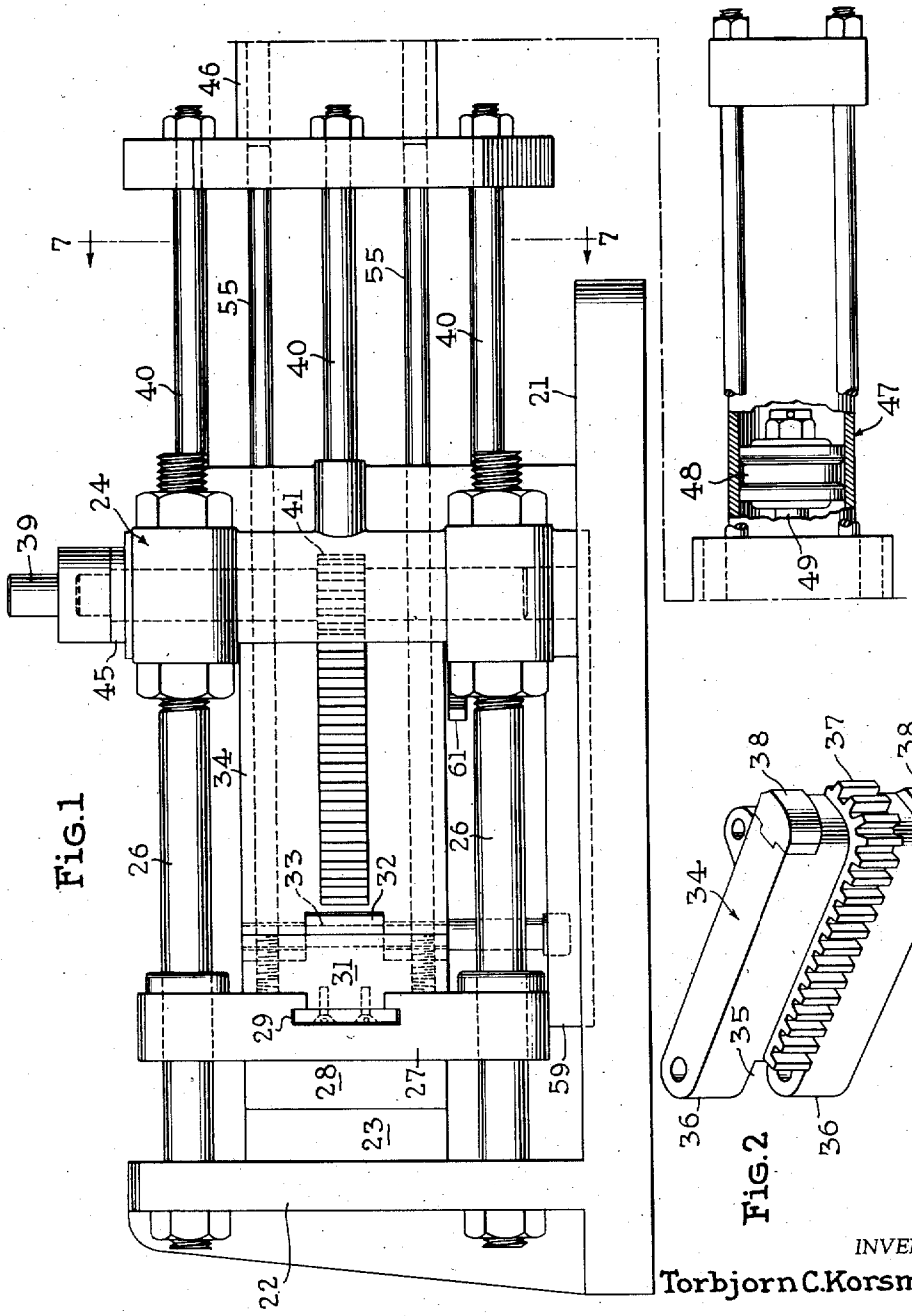


Fig. 1

Fig. 2

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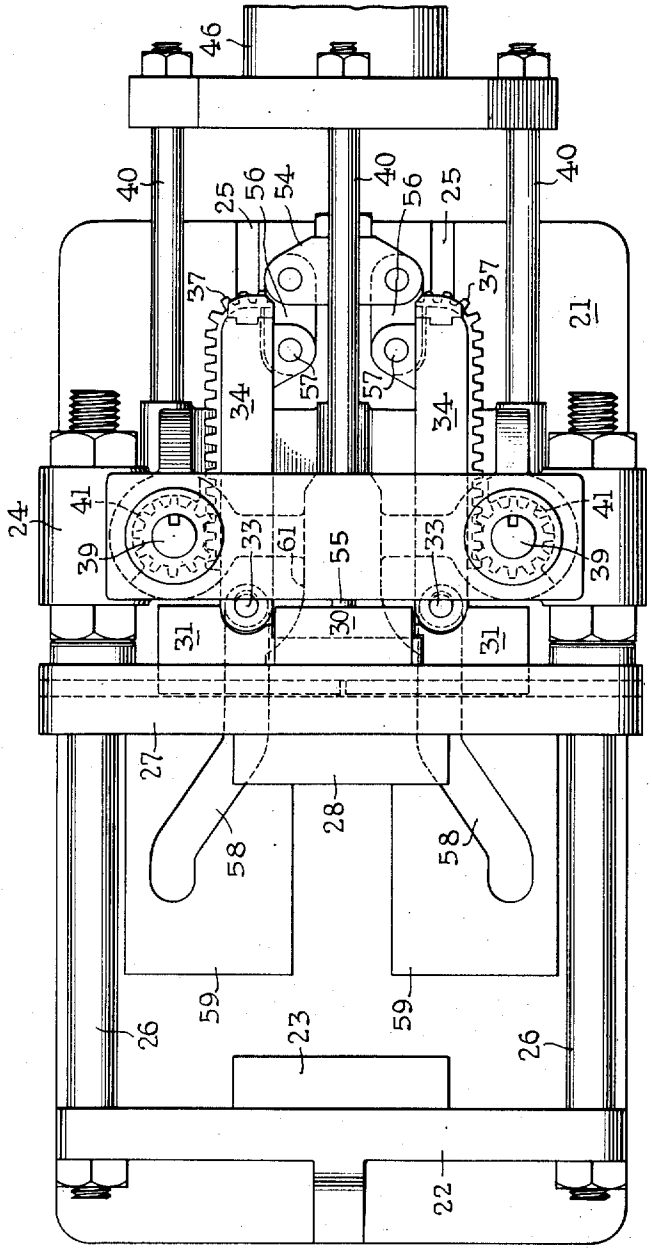


Fig. 3

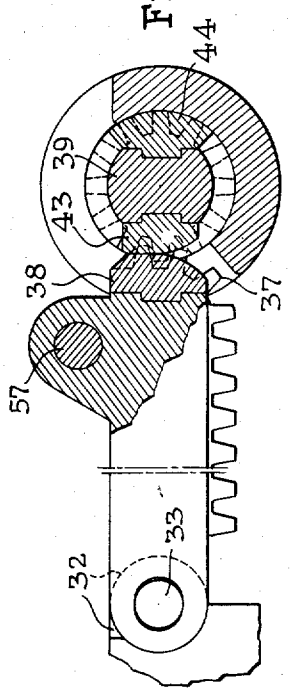


Fig. 4

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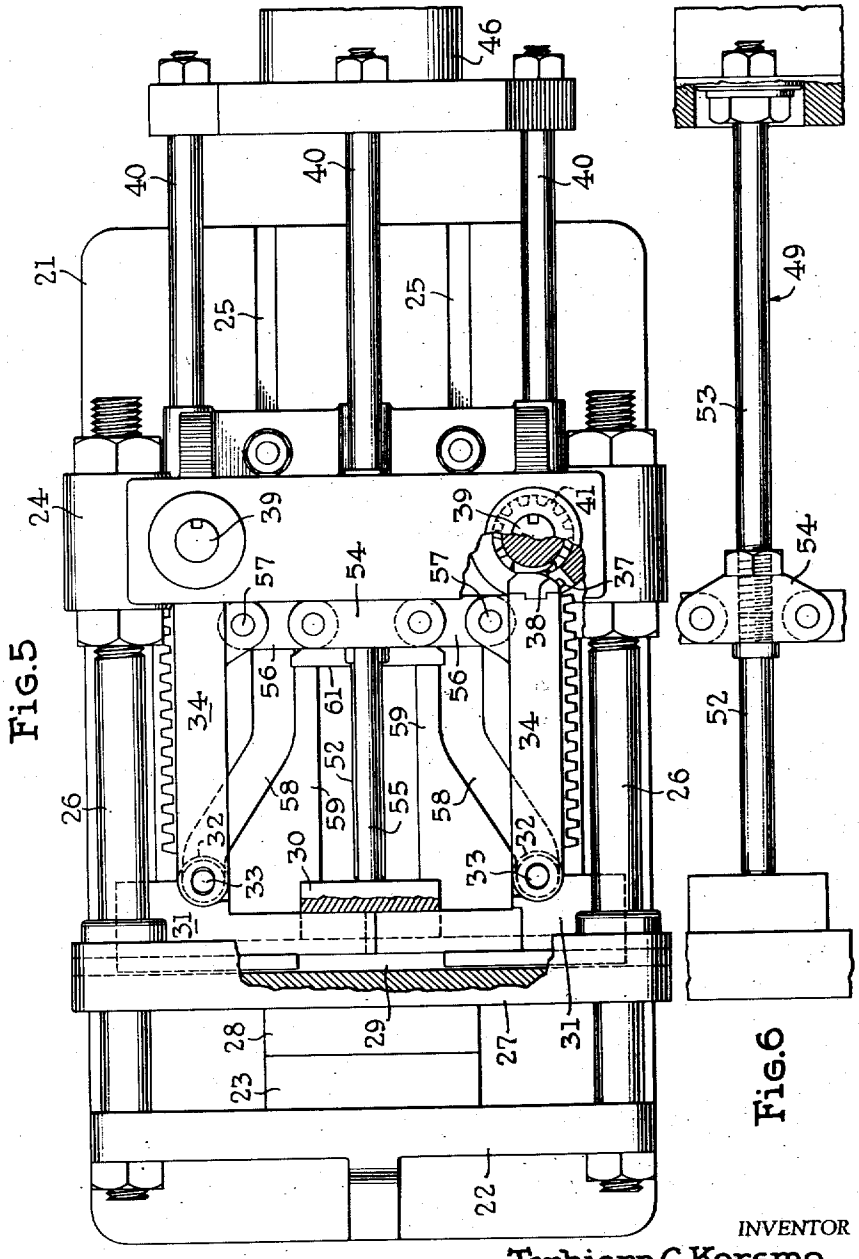


Fig.5

Fig.6

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Fig.7

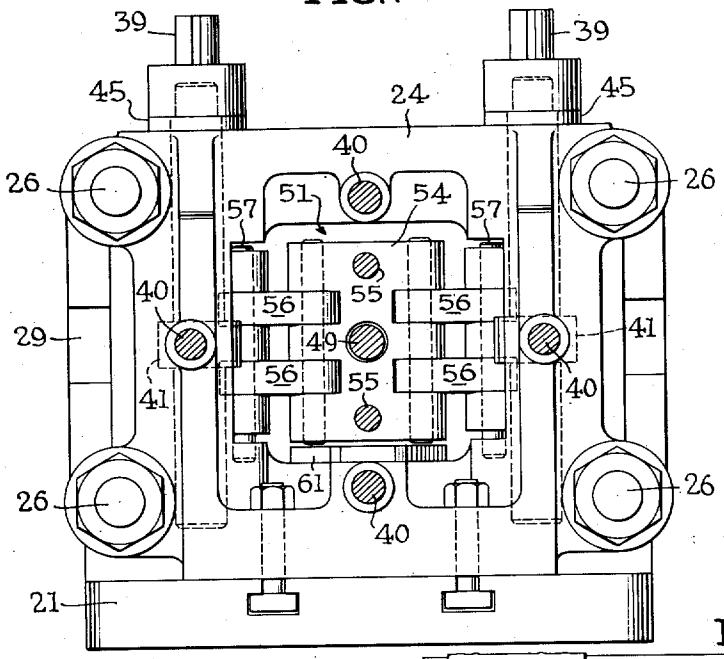


Fig.8

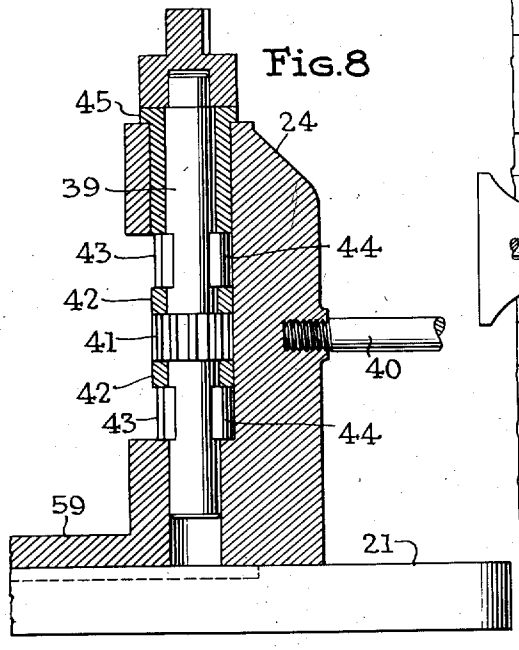
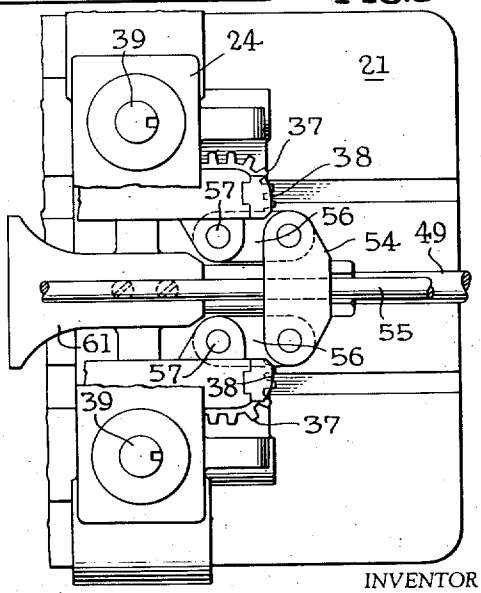


Fig.9



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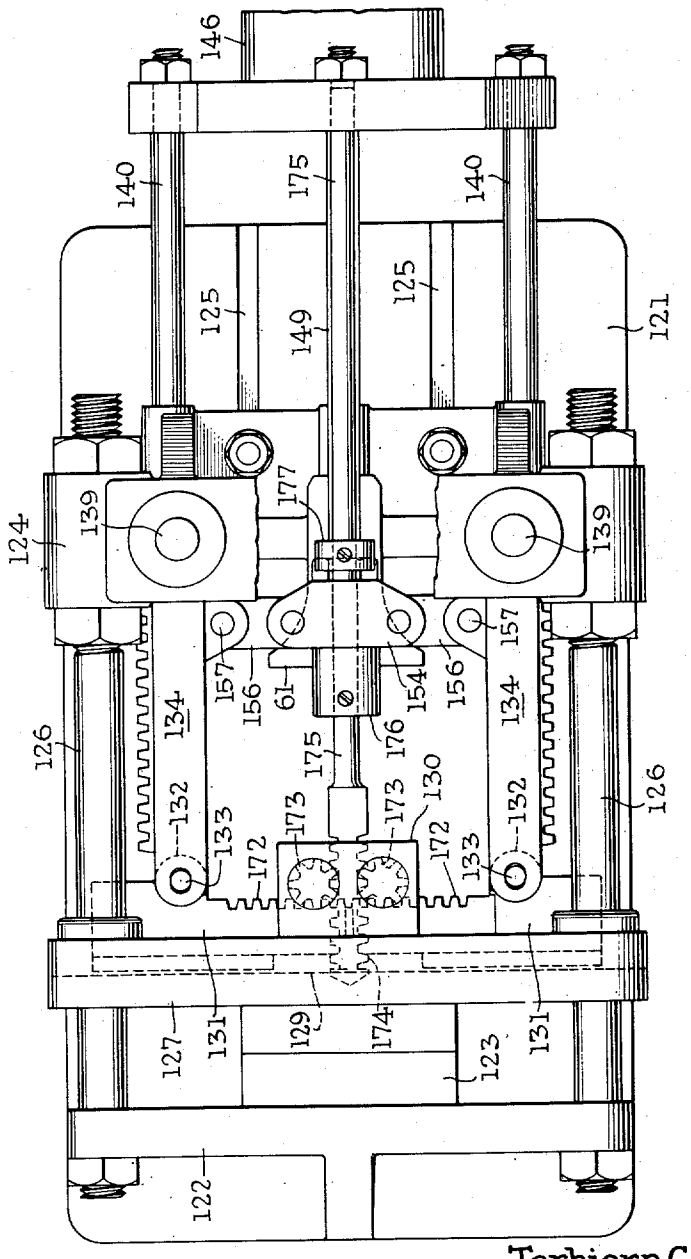


Fig.10

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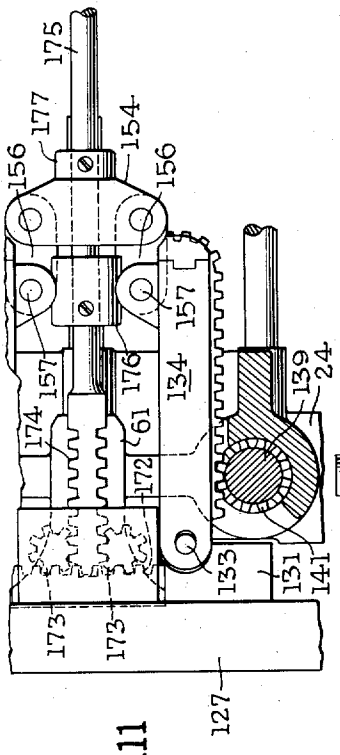


Fig.11

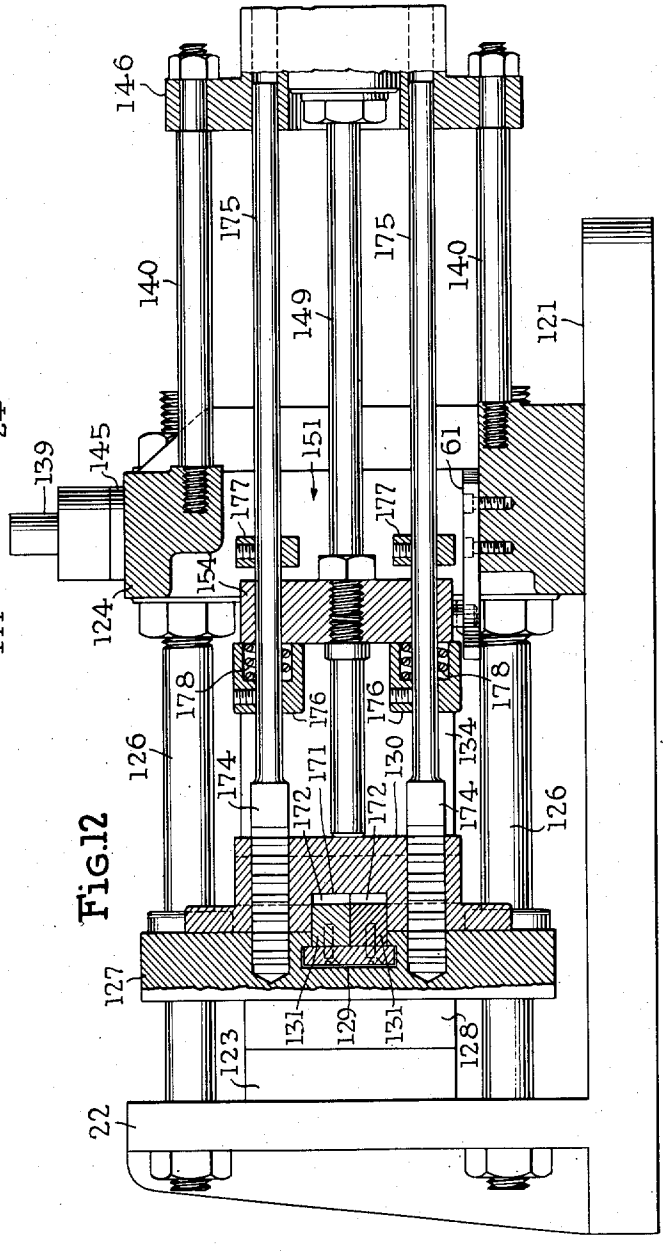


Fig.12

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TOGGLE

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Original No. 2,708,372, dated May 17, 1955, Serial No. 449,096, August 11, 1954. Application for reissue April 10, 1957, Serial No. 652,077

16 Claims. (Cl. 74—110)

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This invention relates to toggle mechanisms. Specifically it relates to a toggle mechanism in which the to and fro motion of the movable member carried and controlled by the toggle is not limited by the length of the back link of the mechanism.

Force multiplying toggle mechanisms are well known and have found many applications in the press art. While the present invention is particularly suited to use in the die casting industry, its use is by no means limited to this application.

The toggle mechanism according to the present invention comprises an adjustably positioned crosshead which supports two idler pinions which are carried by spaced parallel shafts. The axes of these shafts are transverse to the direction of motion of the movable platen which is mounted between the adjustable crosshead and the stationary platen. To and fro movement of the movable platen is controlled by a double-acting motor which is connected thereto by means of a linkage. This linkage comprises tumbling links connected to the piston rod and a front link pivotally connected to each tumbling link and to the movable platen. The connection between the front link and the platen is such that sliding movement of the pivot transverse to the direction of motion of the platen is afforded. The front link has a rack on its outer face which engages the idler pinions carried by the adjustable crosshead. This rack includes a long straight section and an arcuate rear section.

When the press is open the pivots between the front link and the platen are in retracted central position and the tumbling links are parallel with the motor piston rod and react in thrust relation against the front links. Movement by the motor toward the stationary platen causes corresponding movement of the movable platen. During initial movement of this platen, the pivots between the front link and the platen are caused to move outward to their operating position. As the pivots reach their outermost positions the tumbling links start to tumble and urge the other ends of the front links outward. This outward movement occurs while the arcuate portions of the racks are engaged with the pinions. The pinions at this time serve as the back links of the toggle mechanism and the desired force multiplication is achieved. In the fully closed position the axis of each pivot between the front link and the platen is alined with a corresponding pinion axis and with the point of contact between a corresponding rack and pinion.

In order to prevent overloading the teeth of the racks and pinions coacting cam surfaces are provided between the rack and pinion. Coaction between their surfaces occurs as the press approaches its closed and locked position and serves to separate slightly the pitch lines of the rack and pinions.

It will be apparent that the toggle of the present invention is similar in some respects to wedge toggles, but

it has the important advantage that rotary cam surfaces replace the sliding wedge surfaces. This eliminates the high static friction which must be overcome to open a wedge toggle. The idler pinions afford compact back links and rotate in timed relation to toggle movement at all times so that the shafts which carry them may be used to time other operations carried out during opening and closing of the press.

The invention will be better understood by reference to the accompanying drawings, in which:

Figure 1 is a side elevation of a press embodying the invention.

Figure 2 is a detail perspective view showing one of the front toggle links.

Figure 3 is a top plan view of the press in its open position.

Figure 4 is a detail view partly in section, showing the cooperation between the forward link and the pinion in the closed position of the press.

Figure 5 is a top plan view partly in section showing the press in closed position.

Figure 6 is a fragmentary view partly in section showing a detail of construction.

Figure 7 is a sectional view taken on the line 7—7 of Figure 1.

Figure 8 is a detail view partly in section showing the pinion mounting.

Figure 9 is a detail view showing the positions assumed by the parts just prior to outward movement of the outer ends of the forward links.

Figure 10 is a top plan view of a modified form of the invention.

Figure 11 is a detail view partly in section showing the parts in the open position of the machine of Figure 10.

Figure 12 is a side elevation partly in section of the machine shown in Figure 10.

Refer first to Figure 1. The die casting machine there shown comprises a bed plate **21** having a vertical stationary platen **22** connected thereto. Platen **22** sustains a die half generally indicated at **23**. Slidable on the bed plate **21** is a main crosshead **24** which is guided during sliding movement by the ways **25**, see Figures 3 and 5. Guide bars **26** extend between the platen **22** and the main crosshead. The outer ends of the guidebars **26** are threaded and sustain nuts which are arranged to react against opposite faces of the crosshead **24** to secure it in its adjusted position. A movable crosshead or platen **27** is also sustained by the guidebars **26**, and it carries a second die half **28**. Formed in the rear face of platen **27** is an undercut groove or guideway **29** in which two hinge blocks **31** are reciprocable. A generally U-shaped guide block **30**, located at the center of the rear face of platen **27**, receives the inner ends of two blocks **31** which overlap one another when the blocks are retracted, see particularly Figure 3.

The hinge blocks are provided with projecting bosses **32** which receive the hinge pins **33**. On each side of the boss **32**, the hinge block is provided with an arcuate bearing surface. Hinged to each block **31** is a front link **34**. One of the links **34** is best shown in Figure 2. The forward end of the link **34** is forked as shown at **35**. The bosses **32** are received therein and secured by pins **33**. The holes in the lugs **36** on links **34** are oval so that, when loaded, the arcuate faces on either side of bosses **32** carry the load by engaging these lugs **36**. A rack or gear segment **37** of the contour shown in provided on the outer face of the link **34**. Camming surfaces **38** are provided adjacent the arcuate portion of the rack **37**.

Journalled in the main crosshead **24** are two shafts **39** each of which has a pinion **41** keyed thereto. See particularly Figure 8. On either side of each pinion **41** is

bearing bushing **42**. As shown in Figure 4, cams **43** are fastened to shafts **39**, there being one cam adjacent each bearing bushing. To the diametrically opposite side of the shafts **39** are attached spacers **44**. Bushings **45** are provided in the main crosshead **24** (Figure 8). The cam surfaces **38** and **43** appear to coincide with the pitch lines on the rack and pinion, actually their radii are slightly greater than the pitch radii.

Four sustaining rods **40** extend rearward from the crosshead **24** and sustain the flanged cylinder head **46** of a double-acting motor **47**. Attached to the motor piston **48** is a piston rod **49** which is aligned with the rectangular opening **51** in the crosshead **24**. As shown in Figure 6 the piston rod is made in two sections **52** and **53** which are threaded into cross-member **54**. The forward end of the section **52** is spaced from the guide block **30** except in the closed position of the mechanism.

Two guide members **55** are attached to and extend between the guide block **30** and the flanged cylinder head **46**. The cross-member **54** is guided thereby. Hingedly interconnecting the front link and the cross-member **54** are tumbling links **56**. The pins **57** which interconnect links **56** and front links **34** project beyond the lower face of link **34** and are arranged to be moved outward by cam **61**, see Figures 3 and 5. Cam slots **58** are formed in horizontal extensions **59** of the crosshead **24** and are engaged by extensions of the pins **33**. Slots **58** control lateral movement of the hinge blocks **31**. Cam **61** assures initial outward movement of pins **57**.

Referring now to the embodiment illustrated in Figurges 10, 11, 12, similar parts are identified by reference numerals to which **100** has been added. Reference numerals higher than **170** have no counterpart in the other embodiment. The two embodiments are in the main identical, the difference being the manner of causing and controlling lateral motion of the hinge blocks **31** and **131**.

Mounted on the rear face of platen **127** is a guide block **130**. The block **130** is provided with a central guideway **171** which embraces opposite sides of the overlapping inner ends of the hinge blocks **131**. As shown in Figures 10 and 11, racks **172** are formed on the edge faces of the hinge blocks **131** and are engaged by pinions **173** mounted on a shaft carried in the hinge blocks **131**. The pinions **173** are in turn engaged by a rack **174** formed on rod **175** carried by the cross-member **154**. The rod **175** is free to slide a controlled amount in the member **154**. This sliding motion is limited by collars **176** and **177**. A spring **178** reacts between the collar **176** and cross member **154** and biases the member **154** against collar **177** except when the die halves are closed. The outer ends of rods **175** are guided in the cylinder head **146** of the motor (not shown).

The operation of the device will be generally apparent from the description of the parts. Closing movement of the die press commences with the parts in the positions shown in Figure 3, i. e., with the hinge blocks **31** retracted and the tumbling links **56** generally parallel to the piston rod **49**. As the platen **27** moves forward, pins **33** are engaged by the divergent portions of cam slots **58**, which causes the blocks **31** to move laterally outward. As the pins **33** reach the outer parallel portions of slots **58**, the pins **57** are engaged by the cam **61** and links **56** are rotated outward. Outward movement of the end links **56** is accompanied by outward movement of rearward ends of links **34**, which at this time engage the pinions **41** along the arcuate portions of racks **37**. As outward movement continues the cam surfaces **43** and **38** engage one another with substantially rolling contact. The cam surfaces are arranged to separate the pitch lines of the racks and pinions, thus transferring the load to the cam surfaces as the links **56** reach the limit of their motion. In this position the axis of pins **33** and shaft **39** lie in a common plane which also includes elements of the cam surfaces **38** and **43** which lie in the flat portions thereof, see Figure 4. As the links **56** reach the limit of their motion the section **52** of the piston rod **49** strikes the guide block **30**

and thus augments the closing force exerted by the toggle mechanism.

It is important to notice during both opening and closing movement of the press the racks **37** and pinions **41** are engaged causing rotation of shafts **39**. It will be seen that rotation of shafts **39** has a constant timed relationship to motion of the movable platen **27**. This timed rotary motion of shafts **39** can be used to control the operation of auxiliary apparatus used in the die casting or pressing operation.

Operation of the embodiment shown in Figures 10, 11 and 12 is substantially identical with that already described except that outward movement of the blocks **131** is controlled by interengagement of the racks **174** and **172** and pinions **173**. It will be apparent that outward movement of the hinge blocks **131** is commenced when forward motion of the movable platen **127** is arrested by closure of the die halves. The continuing forward movement of the rack **174** causes rotation of the pinions **173** in opposite directions whereby the hinge blocks **131** are moved outward. Movement of the links **156** occurs at the same time. During the final outward movement of the rearward ends of links **134**, the hinge blocks **131** will have reached the limit of their motion. Spring **178** is then compressed and continued movement of piston rod **149** causes it to strike the guide block **130** and assist in forcing the die halves closed.

It will be seen that the linkage motion on opening of the dies in either embodiment is the reverse of closing movement.

In their open position the forward links are retracted from the outer edge of the movable platen and lie close together. In this way it is possible to draw the links backward through the central opening in the main crosshead, whereby substantially the entire interval between the main crosshead and the movable platen is available for opening movement of the press. In conventional linkages the pivots **33** and **133** are fixed and limit the opening movement of the die halves even in toggle linkages in which there is an automatically released back link or those in which the back link is replaced by a wedging surface.

The rolling contact between the cam surfaces **38** and **43** is an important feature of the invention, as it permits a greater closing force to be exerted without creating excessive friction forces. It also contributes to the easy opening of the press, because the force required to cause this rotary motion is notably less than the forces required to overcome the static friction forces between the wedge surfaces.

The use of a gear train to time motion of the two cam surfaces is advantageous because of its simplicity as contrasted to automatically releasable hook members.

The elimination of the back link of the toggle and the two pivots associated therewith is itself an advantage, because it ensures sustained accuracy of adjustment even after long periods of use. The present linkage has many of the advantages of a wedge type toggle, but is not subject to the disadvantage of high friction forces and consequent low force multiplication.

It should be noted that the cam tracks **58** and the motor **47** are both fixed relatively to the crosshead **24**. Hence they move therewith when it is adjusted so that different sized dies may be used in the machine. This means that the toggle linkage once properly adjusted need not be readjusted when different dies are used.

The lost motion provided between the rods **175** and the cross-member **154** assures that final movement of the tumbling links during closure of the dies occurs after the hinge blocks **131** have reached their limiting position. In this way high friction forces need not be overcome to move the blocks **131** to their extreme positions. Similarly the load on the hinge blocks **131** is partially relieved during opening movement of the dies before the hinge blocks are retracted.

I claim:

1. A toggle mechanism comprising a support having guides; a fixed carrier mounted on said support; a reciprocable carrier guided on said support to move toward and from said fixed carrier; an actuator reciprocably guided on said support to move in a path alined with that of the reciprocable carrier; a pair of front links; a pair of shiftable connectors guided on the reciprocable carrier in paths transverse to the reciprocation path of the carrier, each connector being hinged to one end of a corresponding front link; shifting means reacting against said shiftable connectors and serving to move them toward and from each other as the carrier reciprocates; tumbling links hinged to the swinging ends of respective front links and to said actuator, the effective length of said tumbling links corresponding with the range of transverse motion of corresponding shiftable connectors; and means affording back links, one for each front link, comprising rack teeth on each front link the pitch line of said teeth extending along the side of the link and curving so as to extend across the swinging end thereof, and a pair of toothed pinions each pinion meshing with the rack teeth of a corresponding front link, said pinions turning in bearings on said support on axes parallel with each other and with the hinge axes of the tumbling links and of said shiftable connectors.

2. The combination defined in claim 1 in which thrust surfaces approximating the pitch lines in the pinion and on the swinging end of the front link are mounted on said parts and serve to limit the meshing engagement of the teeth.

3. The combination defined in claim 1 in which said shifting means are fixed cams carried by the support, and cam followers carried by the shiftable connectors.

4. The combination defined in claim 1 in which the actuator overtakes and engages the reciprocable carrier at the limit of the latter's approach to the fixed carrier.

5. The combination defined in claim 1 in which the actuator overtakes and engages the reciprocable carrier at the limit of the latter's approach to the fixed carrier and the tumbling links then being alined and perpendicular to the front links.

6. The combination defined in claim 1 in which said shifting means comprises a toothed rack formed on each shiftable connector; two pinions each engaging one of said toothed racks and carried by the movable carrier; and a member connected with said actuator and having two racks formed thereon, one engaging each of the pinions carried by said movable carrier and serving to rotate said pinions in directions to cause motion of said shiftable connectors in opposite directions.

7. A toggle mechanism for opening, closing and locking a movable platen press comprising in combination; a support, a reciprocable platen guided thereon and a fixed platen; hinge members carried by and transversely slidable on the reciprocable platen; reciprocable actuating means; a thrust linkage reacting between said means and said members and including front links hingedly connected at one end to said members, and tumbling links each having one end connected with said means and the other end pivotally connected with a corresponding front link; a rack formed on a lateral face of each front link, said rack including a straight portion and an arcuate portion adjacent the swinging end of the link; pinions carried by said support and each engaged by one of said racks and rotatable about an axis transverse to the direction of movement of said platen; means serving during closing of the press to move said hinge members outward from an initial position to a limiting position; and a cam carried by the support and reacting against the tumbling links and arranged to cause tumbling motion of said links, said cam being effective, when said members move to said limiting position, to rotate said front links to a locking position in which the axis of rotation of the pinion, the line of contact between said racks and pinions and the axis of the hinge connection are substantially coplanar.

8. Opening and closing means for movable platen presses comprising in combination two hinge blocks carried by the movable platen and slidable transversely thereof; a double-acting motor; a thrust linkage reacting between said motor and said hinge blocks, said linkage including two front links and at least two tumbling links, each tumbling link being pivotally connected at its opposite ends with a corresponding front link and with said motor, the other end of each of said front links being pivotally connected with a corresponding hinge block; a crosshead adjustably positioned relatively to the fixed platen and having a central opening through which said linkage extends, said motor means being carried by said crosshead; a rack formed on a lateral face of each front link, said rack including an arcuate portion at the swinging end of the front link, two spaced pinions carried by said crosshead and rotatable about an axis transverse to the direction of motion of the platen, each pinion engaging a corresponding rack; guide means effective to move said hinge blocks apart to a final position during closing movement of the press; a cam effective, after said blocks move to their final position, to cause tumbling motion of the tumbling links whereby said arcuate portions of the racks are engaged by the pinions and the lines of contact therebetween are caused to move away from each other to a position in which they are coplanar with the pinion axis and the axis of the connection between the front links and the hinge blocks; and a thrust member extending between said platen and said motor and spaced therefrom prior to tumbling of the links by a distance slightly less than the projected distance between the pivots of the tumbling links measured in the direction of motion of the platen prior to tumbling of the links.

9. The combination defined in claim 8 and coacting camming surfaces formed adjacent said pinions and said racks and serving to separate the pitch lines of the racks and pinions, when the tumbling links are arrested by engagement between said thrust member, the motor means and the movable platen.

10. The combination defined in claim 9, including bearings in said crosshead; and shafts carried by said bearings, said shafts having said pinions fixedly mounted thereon, whereby said shafts rotate in timed relation to movement of said platen.

11. In a press of the type including a bed-plate, a fixed platen secured thereto and a guided movable platen reciprocable thereon, a toggle mechanism comprising in combination a crosshead carried by the bed-plate and adjustable relatively thereto; a double-acting piston motor sustained by said crosshead, said crosshead having an opening therein through which the piston rod of said motor extends toward said movable platen; a linkage reacting in thrust between said piston rod and said movable platen and including tumbling links pivotally connected with said piston rod, and two front links pivotally connected with said tumbling links, and two hinge blocks carried by said movable platen and slidable thereon in a direction transverse to the reciprocating movement thereof, said blocks being pivotally connected to said front links; a rack formed on a lateral face of each front link and having an arcuate portion extending around the swinging end thereof; two pinions carried by said crosshead and rotatable on a transverse axis, said pinions engaging said racks, said hinge blocks having racks formed thereon; rack means connected with the piston; a pinion carried by said platen and engaging the rack means and the racks formed on said hinge blocks and serving, when movement of the movable platen is arrested, to move said hinge blocks apart; and a cam engaging said tumbling links during separating movement of said hinge blocks, whereby said front link is moved to a position in which the arcuate portion of the rack formed thereon engages its corresponding pinion and in which position the axis

of rotation of the pinions, the lines of contact between these pinions and the racks formed on the front links, and the axis of the pivots between the hinge blocks and the front links are substantially coplanar.

12. The combination defined in claim 11; and a lost-motion connection between the motor and the rack means connected therewith, said lost motion permitting said piston rod to complete the tumbling motion of the links after the hinge blocks have reached the limit of their outward movement.

13. In a movable platen press of the type including a press bed, and platens movable relatively to each other and carried by said bed, said motion being reciprocatory and guided by the bed, a toggle mechanism comprising in combination, a support carried by said bed; an actuator for one of the platens carried by said support and reciprocable in a path aligned with the path of movement of that platen; a pair of fulcrum blocks carried by that platen and guided to slide thereon transversely to the path of that platen's movement; means to shift said blocks toward and from each other as an incident to reciprocation of that platen; a pair of thrust links, each link pivotally connected at one end with a corresponding fulcrum block; a tumbling link connected between the swinging end of each thrust link and said actuator, the effective length of the tumbling links corresponding with the range of transverse fulcrum block movement; and reaction surfaces carried by said bed and each arranged to be engaged by the swinging end of a corresponding one of the trust links when the platens reach the limit of their approach toward one another.

14. The combination defined in claim 13 in which the means to shift said fulcrum blocks comprises fixed cams carried by the support and cam followers carried by the shiftable fulcrum blocks.

15. The combination defined in claim 13 in which the means to shift the fulcrum blocks comprises a toothed rack formed on each fulcrum block; two pinions, each engaging one of said toothed racks and carried by the corresponding platen; and two rack means formed on said actuator, one of said rack means engaging each of the pinions and serving to rotate said pinions in directions to cause motion of said fulcrum blocks in opposite directions.

16. The combination defined in claim 13 in which the actuator overtakes and engages the corresponding platen at the limit of its approach toward the other platen, the tumbling links then being aligned and perpendicular to the thrust links.

No references cited.