Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

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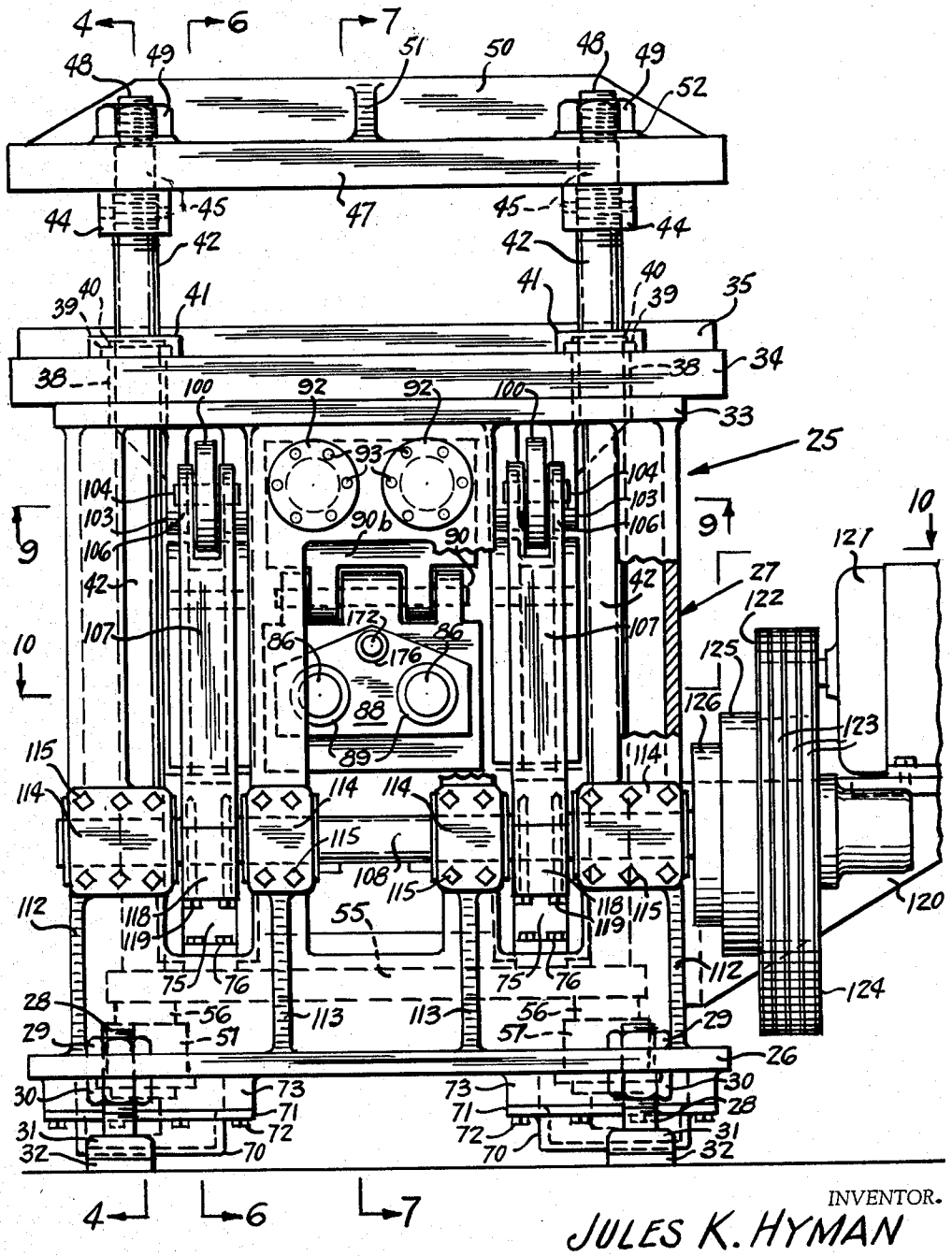

FIG. 1

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Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

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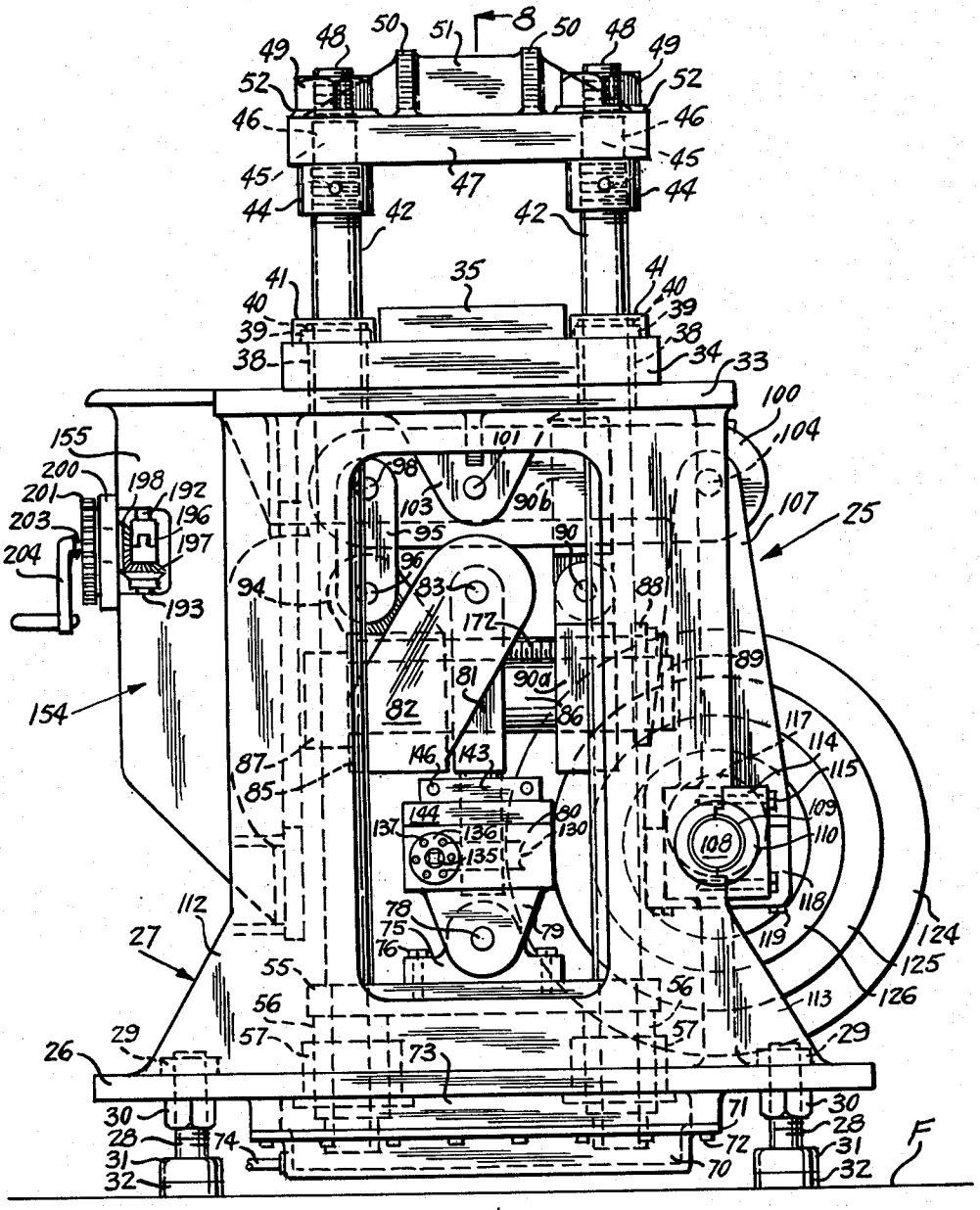

FIG. 2

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Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

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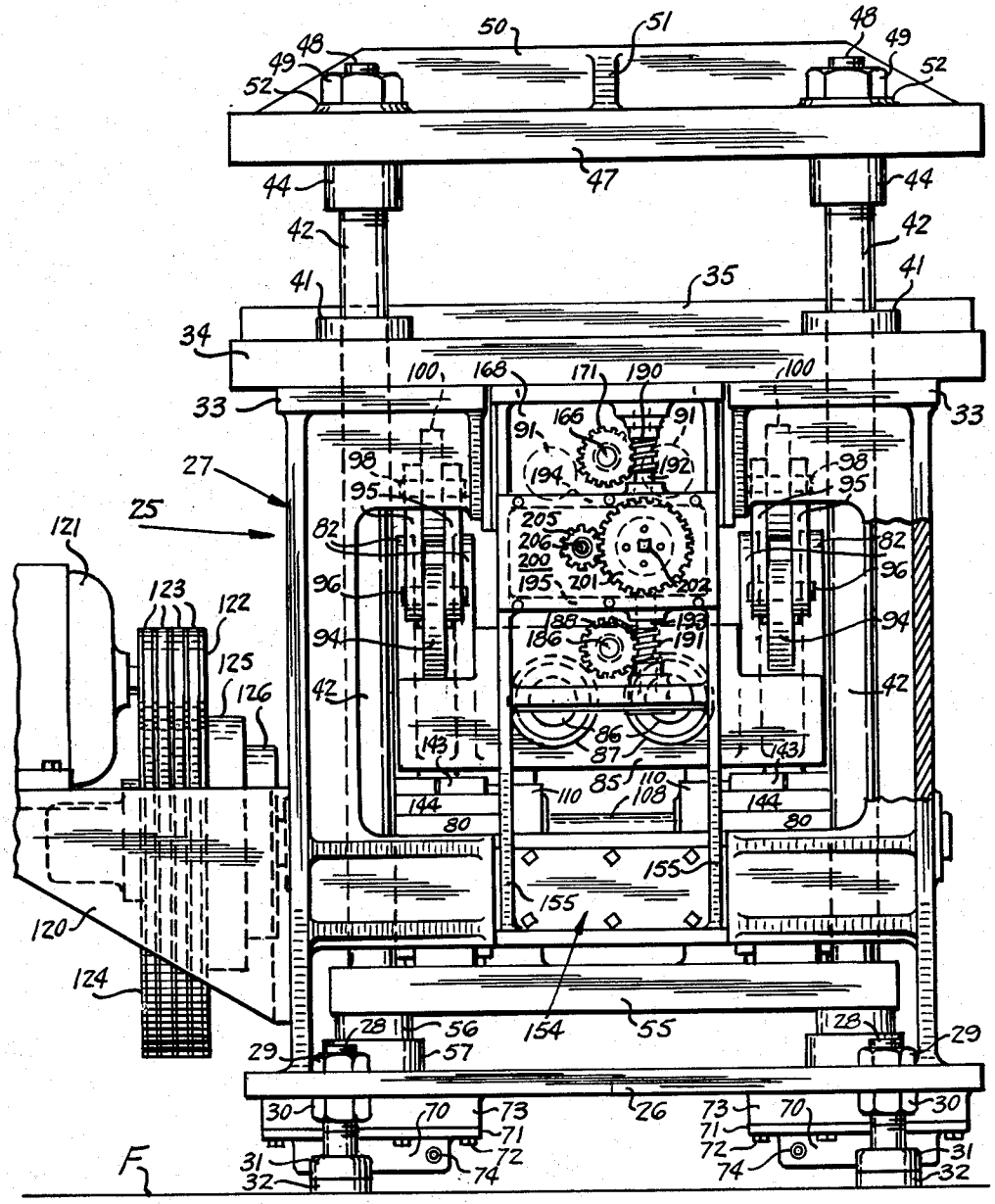

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FIG. 3

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Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

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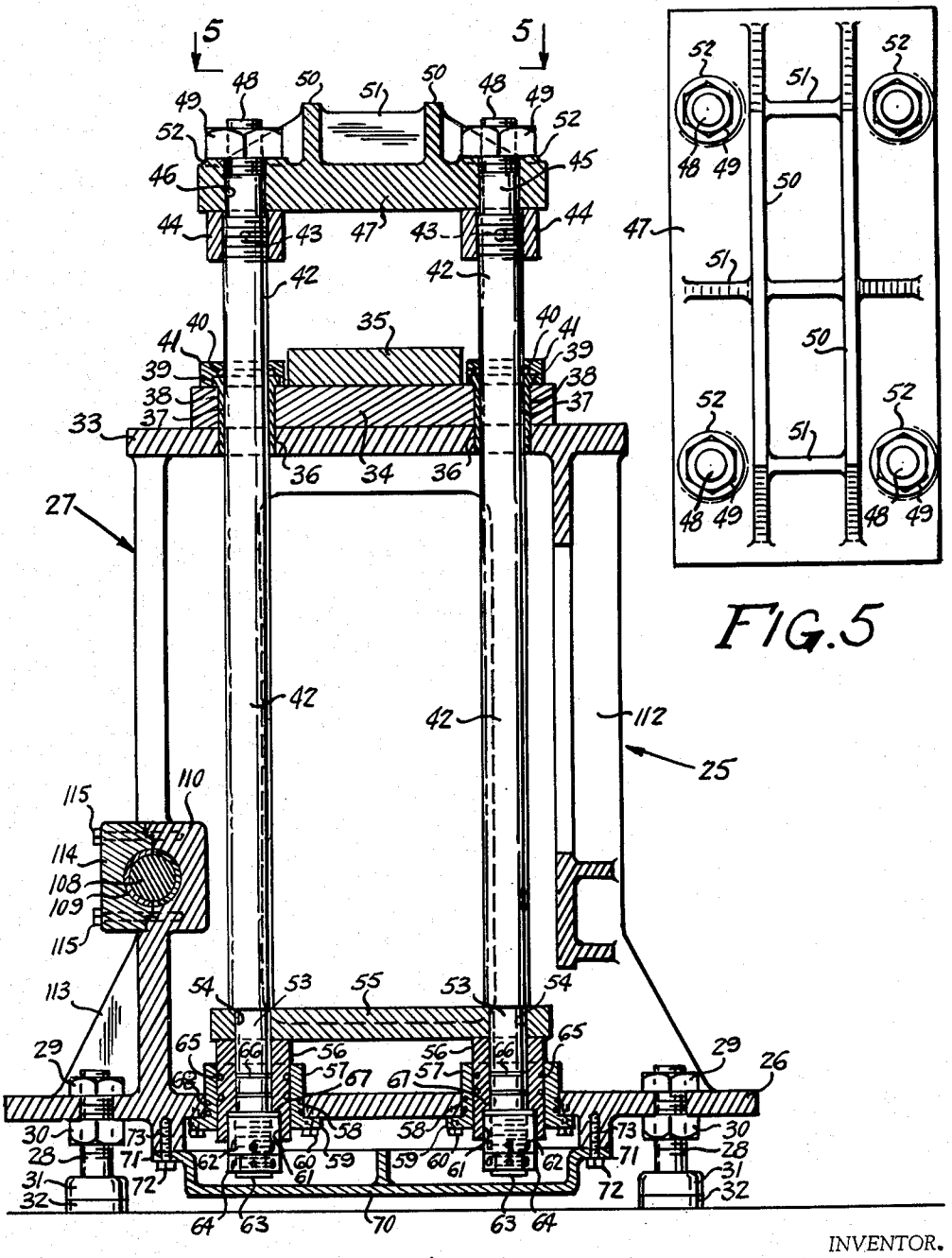

FIG. 5

FIG. 4

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ADJUSTABLE STROKE MECHANISM

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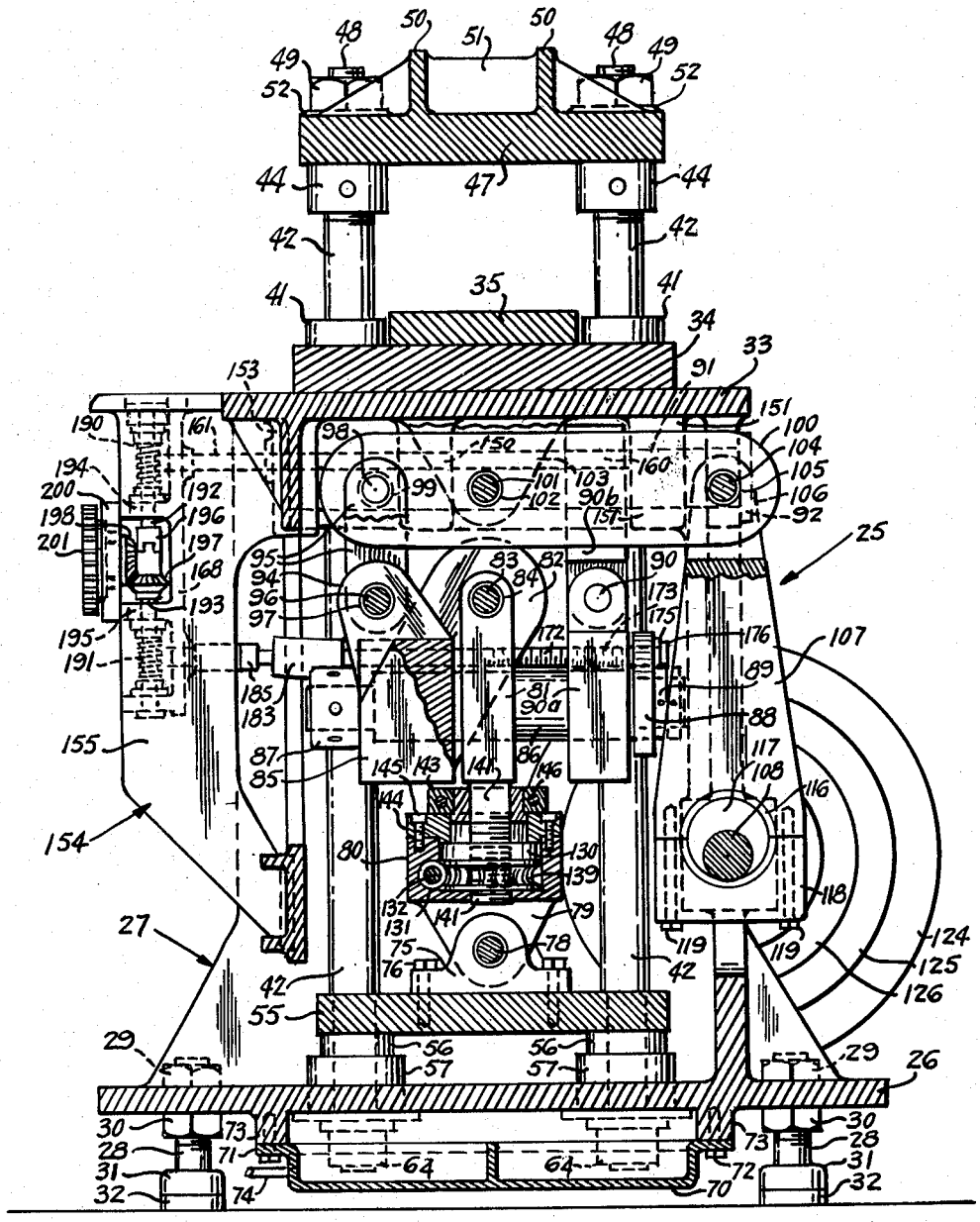

FIG. 6

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Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

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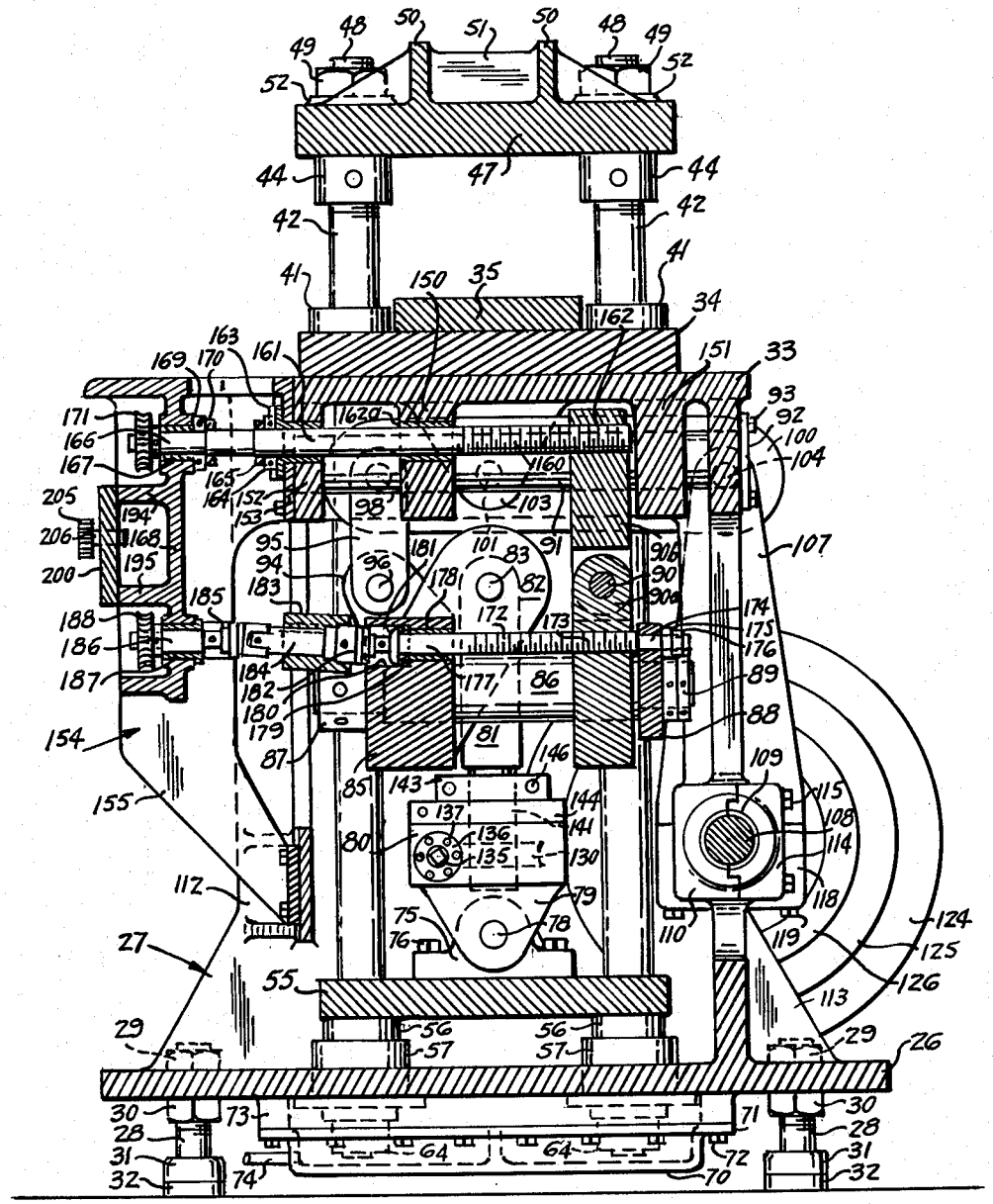

FIG. 7

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Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

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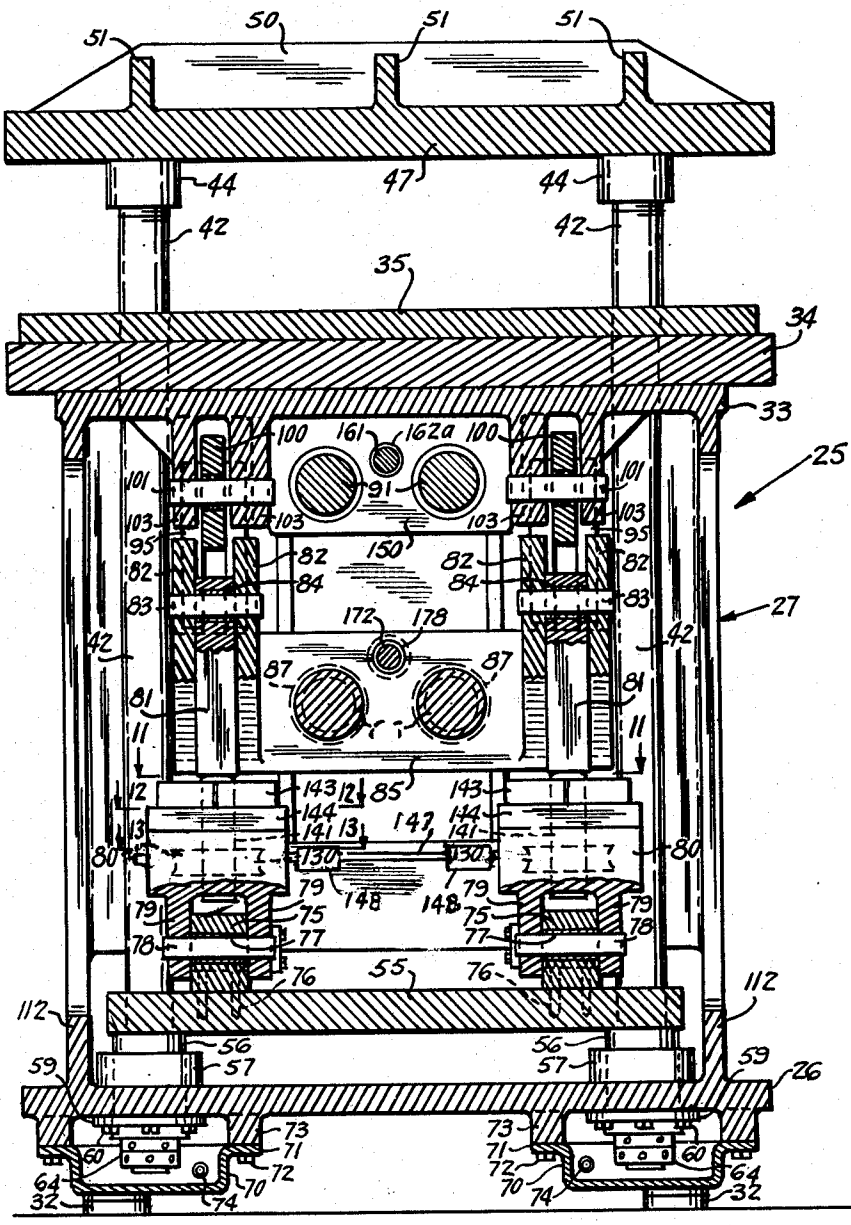

FIG. 8

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Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

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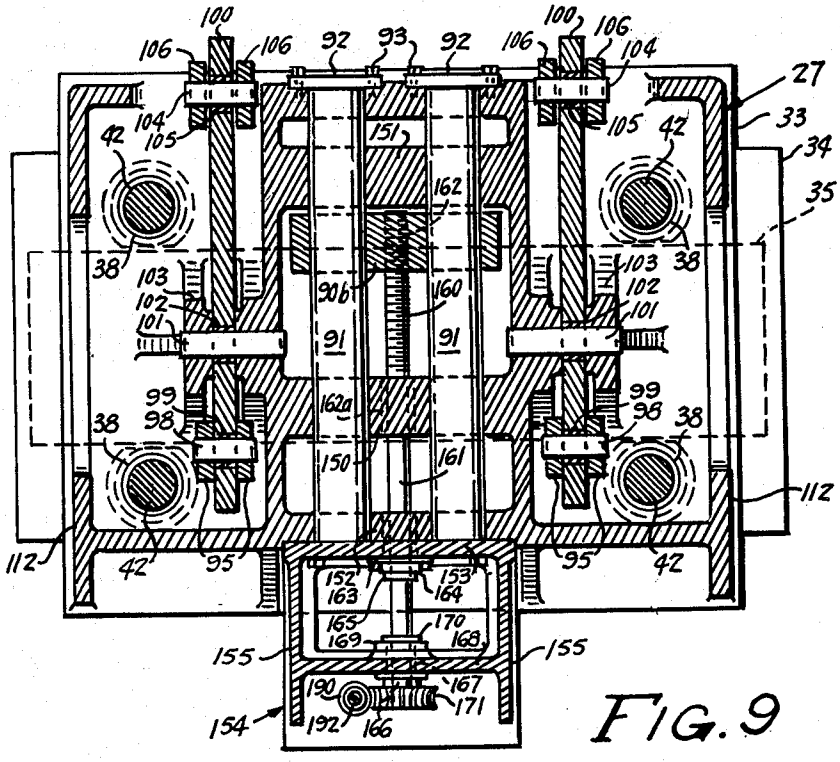

FIG. 9

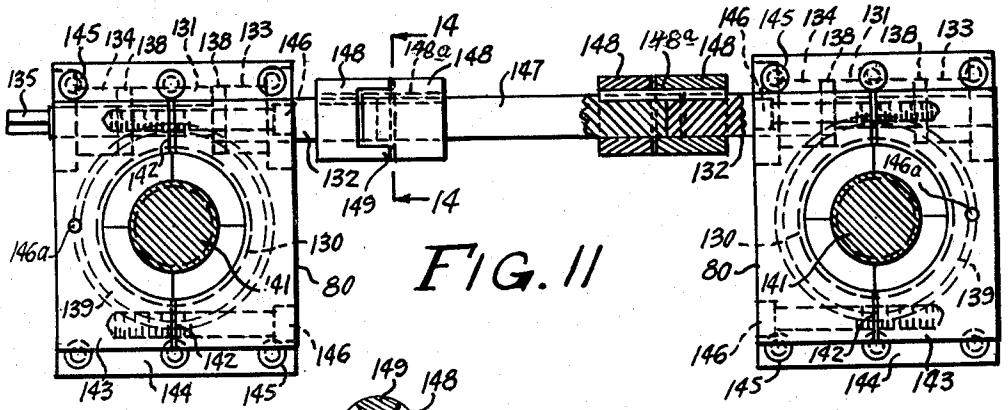

FIG. 11

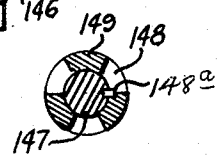

FIG. 14

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Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

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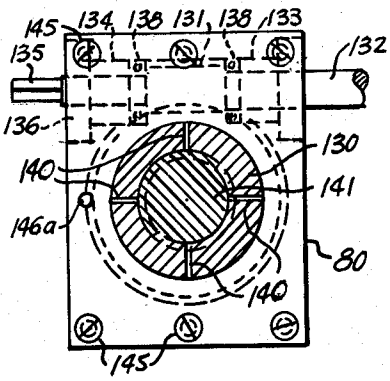

FIG. 12

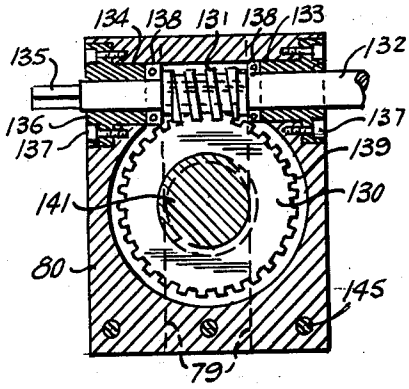

FIG. 13

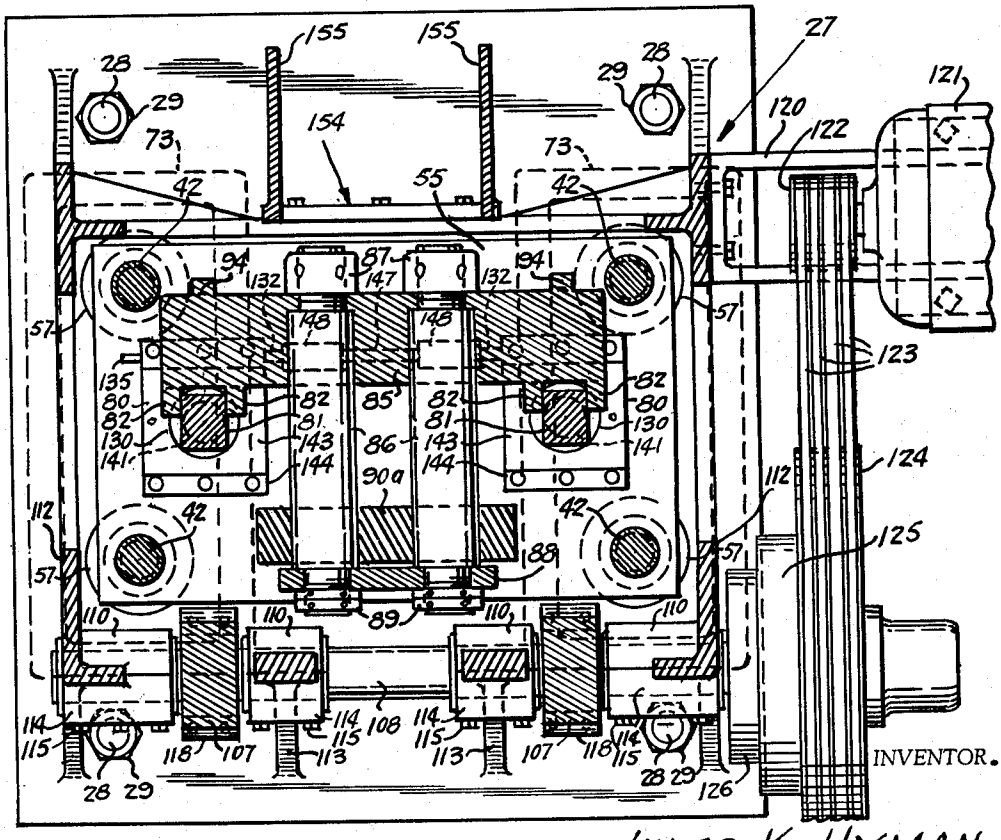

FIG. 10

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Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

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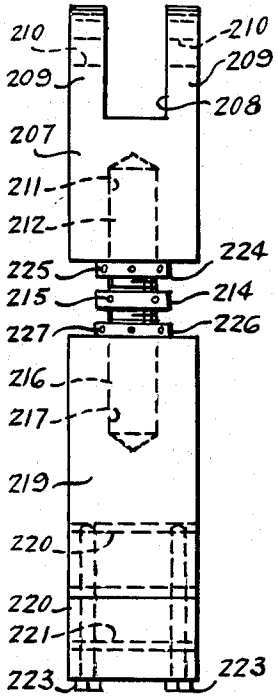

FIG. 16

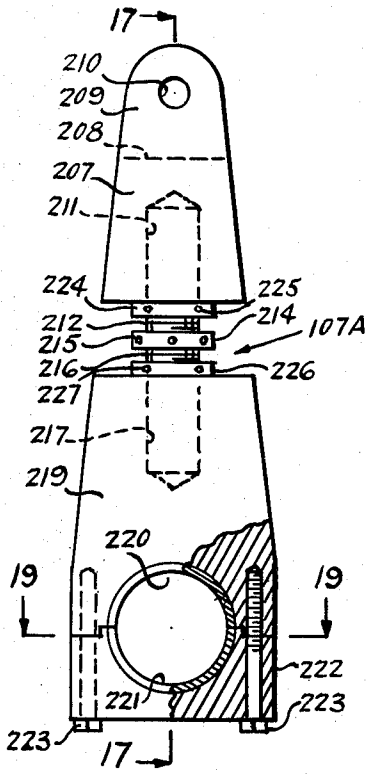

FIG. 15

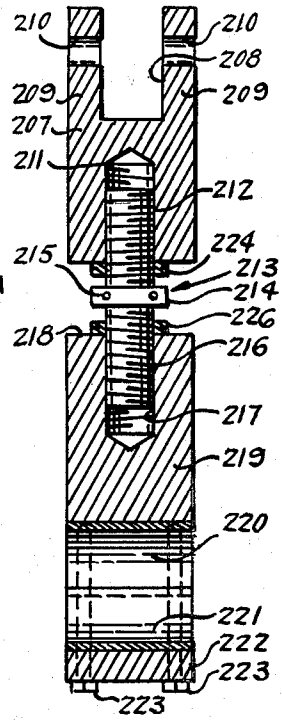

FIG. 17

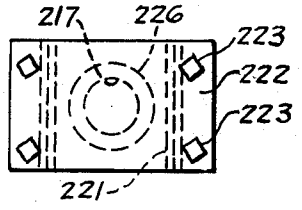

FIG. 18

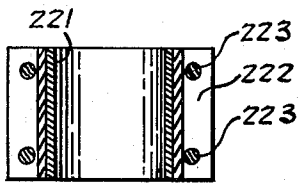

FIG. 19

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Sept. 8, 1964 J. K. HYMAN 3,147,695

ADJUSTABLE STROKE MECHANISM

Filed July 31, 1962 11 Sheets-Sheet 11

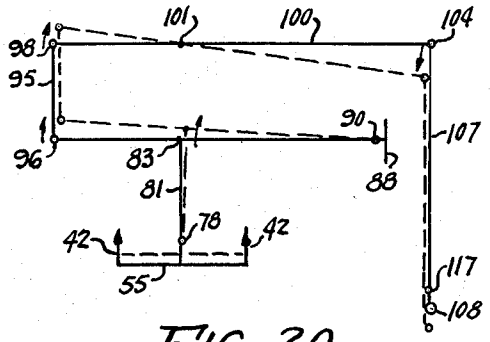

FIG. 20

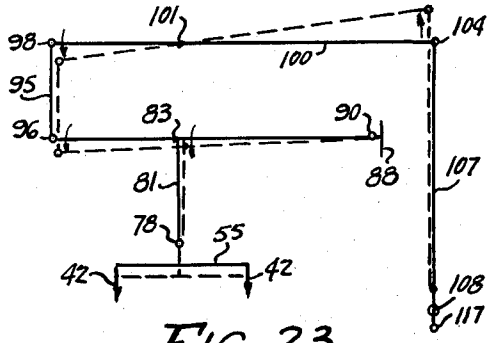

FIG. 23

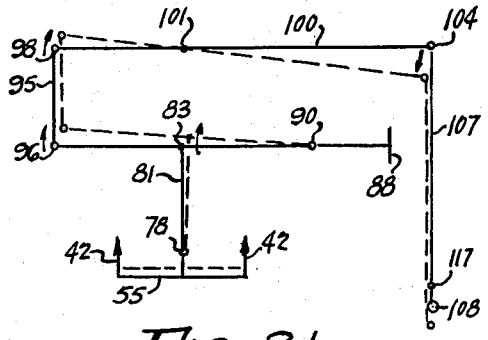

FIG. 21

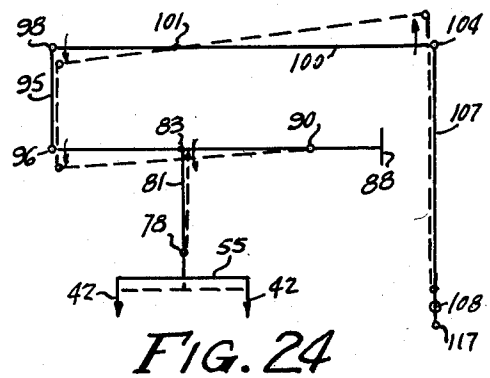

FIG. 24

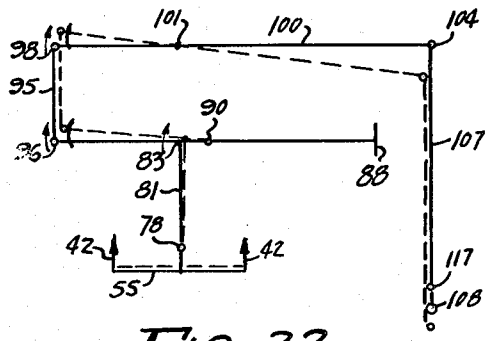

FIG. 22

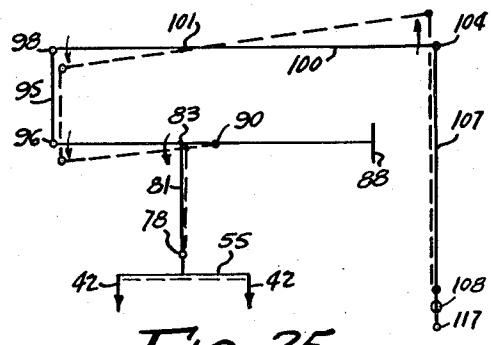

FIG. 25

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ATTORNETS.

United States Patent Office 3,147,695 Patented Sept. 8, 1964

3,147,695

ADJUSTABLE STROKE MECHANISM

Jules K. Hyman, 625 Burnham Road, Philadelphia, Pa.

Filed July 31, 1962, Ser. No. 213,694
20 Claims. (Cl. 100—257)

This invention relates to an adjustable stroke mechanism and although hereinafter described and shown in conjunction with a metal stamping press, has broad applicability to any mechanism wherein a variation in the stroke of a reciprocating member is desirable, as for example, all types of reciprocable presses, punches, stamping machines, pumps, piston driven engines, as well as other piston actuated types of mechanism and the like.

A primary object of this invention is the provision of a stroke adjusting mechanism for a reciprocating member whereby the length of the stroke may be varied from zero or any other minimum length through an unlimited or infinite number of lengths of strokes to the maximum capacity of the particular installation wherein the device is employed.

A further object of this invention is the provision of a mechanism of this character which requires only rotational relative movement between cylindrically shaped parts which exert pressure on each other through appropriately shaped bearings when the machine which has the adjustable stroke mechanism incorporated therein is required to exert a pressure or other force, thus obviating any linear sliding relative movement between stressed parts.

An additional object of the invention is the provision of such a mechanism wherein the mid stroke position or either stroke end position of the driven parts may be precisely duplicated with any stroke as adjusted, for an unlimited number of strokes, since the adjustable portion of the mechanism remains stationary relative to whichever position has been selected to be duplicated during the actual adjustment of the stroke.

A further object of the invention is the provision of a mechanism of this character wherein the maximum force transmitted by the driving mechanism is always transmitted through the stroke adjusting mechanism in a direction approximating almost exactly the required guided direction of travel of the driven parts.

A still further object of the invention is the provision of a mechanism of this character which is so designed that the locking of the adjustable parts in position through positive locking means is not mandatory since the force vectors of the stresses in the apparatus constructed in accordance with the instant invention are calculated in directions such that none tend to exert force on the mechanism in a direction tending to change the setting.

A still further object of the invention is the provision of a mechanism of this character so arranged that in all positions of adjustment the power output of the apparatus with which the mechanism is associated is characterized by a mechanical multiplication rather than a diminution of the initial power input, since the diminution of the stroke by the mechanism of the instant invention tends to increase the power capacity of the apparatus with which it is associated.

A more specific object of the invention is the provision of a device of this character having particular utility in conjunction with a cam or eccentric driven reciprocatory member wherein the stroke adjustment is effectuated by varying the location of the fulcrum of a driving lever to lengthen or shorten the stroke and decrease or increase, by mechanical multiplication the input force exerted by the driving mechanism for the cam without the necessity of altering or changing the length of the crankshaft or the lever by which the stroke is performed.

Still another specific object of the invention is the provision of an adjusting mechanism of this character which may be employed in conjunction with presses, stamping machines, or similar apparatus which will vary the capacity of the machine in tons of pressure by such minute alteration of the length of the power stroke as to render the range of the machine within the limits of its capacity variable substantially to an infinite degree thus permitting the use of a wide variety of dies, stamps, punches, and the like, for operation upon an unlimited variety of materials offering a wide range of resistance without altering either the crankshaft or the driving lever.

A further and more specific object of the invention is the provision of a mechanism of this character which has particular applicability to metal stamping presses operable at a wide range of speeds from extremely slow to extremely fast incorporating a stationary bed or platen and a parallel reciprocating ram or piston which will press, squeeze, push, pull, impart a blow or exert any other reciprocably applied force for the purpose of forming, shaping, compressing, stretching, expanding, contracting, shearing, severing or otherwise similarly treating any desired article of any shape, size, or material susceptible to such treatment within the capacity of the machine, by appropriate variation of the stroke length, and the consequent force exerted thereby through a virtually infinite range.

A further important object of the invention is the provision of a mechanism in association with such a press wherein the reciprocable element may be adjusted so that the reciprocating member is always in identical position at the bottom of its stroke regardless of the variation in the length or the stroke, or, alternatively, in precisely the same location at the top of its stroke regardless of the adjustment and the consequent force exerted by change in the length of the stroke, thus rendering the apparatus of the instant invention readily applicable to mechanism wherein the reciprocating member is either above or below the adjusting mechanism.

A still further object of the invention is the provision of a mechanism of this character which can vary the length of the stroke of a reciprocating member of a machine while the machine is operating and the member is in motion, because the adjusting controls for the mechanism are not fastened directly to any parts of the mechanism which are moved by any movable parts of the machine, because the adjusting controls can be located on the exterior of the machine and because the adjusting controls do not need to be locked in position through positive locking means since the force vectors of the stresses in the mechanism constructed in accordance with the instant invention are calculated in directions such that none tend to exert force on the controls in a direction tending to change the setting.

A further specific object of the invention is the provision, in association with a metal stamping press of the character hereinafter described embodying the stroke adjusting mechanism of the instant invention, of a pneumatic counterbalance incorporated directly into the press and comprised of basic parts of the press modified so that, in effect the normal operating mechanism forms its own counterbalance.

Still other objects of the invention reside in the combinations of elements, arrangements of parts, and features of construction.

Other objects will in part be obvious and in part be pointed out hereinafter and shown in the accompanying drawings wherein there is illustrated one embodiment of the instant inventive concept.

In the drawings:

FIGURE 1 is a front elevational view of one form of a metal stamping press embodying a stroke adjusting

mechanism illustrative of the principles of the instant inventive concept, and including a self-contained counterbalance feature, certain concealed parts thereof being indicated in dotted lines.

FIGURE 2 is a side elevational view of the structure of FIG. 1, as viewed from the left, certain concealed parts also being indicated in dotted lines.

FIGURE 3 is a rear elevational view, portions of the mechanism being broken away for the sake of clarity of illustration, and certain concealed parts being shown in dotted lines.

FIGURE 4 is a sectional view taken substantially along the line 4—4 of FIGURE 1 as viewed in the direction indicated by the arrows.

FIGURE 5 is a top plan view taken substantially along the line 5—5 of FIGURE 4, showing certain constructional details, and omitting parts of the mechanism.

FIGURE 6 is a sectional view taken substantially along the line 6—6 of FIGURE 1 as viewed in the direction indicated by the arrows.

FIGURE 7 is a sectional view taken substantially along the line 7—7 of FIGURE 1 as viewed in the direction indicated by the arrows.

FIGURE 8 is a sectional view taken substantially along the line 8—8 of FIGURE 2 as viewed in the direction indicated by the arrows.

FIGURE 9 is a sectional view taken substantially along the line 9—9 of FIGURE 1 as viewed in the direction indicated by the arrows.

FIGURE 10 is a sectional view taken substantially along the line 10—10 of FIGURE 1 as viewed in the direction indicated by the arrows.

FIGURE 11 is an enlarged fragmentary sectional view taken substantially along the line 11—11 of FIGURE 8 as viewed in the direction indicated by the arrows.

FIGURE 12 is an enlarged detailed sectional view taken substantially along the line 12—12 of FIGURE 8 as viewed in the direction indicated by the arrows.

FIGURE 13 is an enlarged detailed sectional view taken substantially along the line 13—13 of FIGURE 8 as viewed in the direction indicated by the arrows.

FIGURE 14 is a detailed sectional view taken substantially along the line 14—14 of FIGURE 11 as viewed in the direction indicated by the arrows.

FIGURE 15 is a side elevational view partly in section showing a modified form of crank arm construction.

FIGURE 16 is a front view of the crank arm of FIGURE 15.

FIGURE 17 is a sectional view taken substantially along the line 17—17 of FIGURE 15 as viewed in the direction of the arrows.

FIGURE 18 is a bottom plan view of the crank arm of FIGURE 15.

FIGURE 19 is a sectional view taken substantially along the line 19—19 of FIGURE 15 as viewed in the direction indicated by the arrows.

FIGURES 20, 21, and 22 are diagrammatic views illustrative of certain stroke lengths obtainable by the apparatus illustrating the principle of operation thereof; and

FIGURES 23, 24 and 25 are diagrammatic views similar to FIGURES 20, 21, and 22 disclosing certain other operative positions of the adjusting mechanism which may be obtained by changing the effective length of the crank arm.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Having reference now to the drawings in detail, there is generally indicated at 25 a metal stamping press constructed in accordance with the instant invention. Press 25 comprises a base plate 26 upon which is mounted a frame, generally indicated at 27, and to be more fully described hereinafter. Plate 26 is supported by leveling screws 28, one of which is positioned at each corner

thereof, the leveling screws extending through the plate, and being held in proper adjusted relation by means of upper and lower adjusting nuts 29 and 30, respectively. Leveling screws 28 have enlarged lower extremities 31 which have secured thereto pads 32 of suitable vibration absorbing material. Leveling screws 28 permit the machine to be mounted in such manner that bed plate 34 can be made level even though a supporting floor F might not be level.

The top 33 of frame 27 has fixedly secured thereto a bed plate 34, which in turn supports a bolster 35. Top 33 and bed plate 34 are provided with aligned openings 36 and 37, respectively, adjacent each corner thereof, each pair of aligned openings containing a guide bushing 38. Each guide bushing 38 has a top flange 39 which rests on the top of bed plate 34, and upon which rests a rod dust seal 40, secured in position by a rod guide retainer 41, all as best shown in FIGURE 4.

Pull rods 42 extend through each guide bushing, and are reciprocable therein in a manner to be more fully described hereinafter.

Each pull rod 42 is provided adjacent its top with a threaded portion 43 upon which is mounted a ram leveling nut 44. A slightly reduced smooth portion 45 of each rod 42 extends through a tightly fitted opening 46 in each corner of a ram 47. Additionally, reduced threaded portions 48 of rods 42 extend above the openings 46 with ram level lock nuts 49 tightly securing the parts in related assembly. Each ram level nut 44 may be individually adjusted to level ram 47 in absolute parallelism with bolster 35. Ram 47 may be of any desired conventional configuration, but in the illustrative embodiment of the instant invention shown, includes longitudinally extending reinforcing ribs 50 on its upper surface as well as transverse strengthening and reinforcing ribs 51, as best shown in FIGURES 4 and 5. Raised annuli 52 may surround each opening 46 to ensure firm and level engagement of lock nuts 49. A die of positive design is normally fastened to the underside of the press ram and a die of negative design is normally fastened to the top side of the bolster plate, both dies aligned with one another and fastened by means of clamps or screws in holes tapped into the ram and bolster especially for that purpose. Such holes are not shown in the drawings because they are usually located to suit the set of dies. Material to be shaped is then placed upon or passed between the dies which are forced to open and close alternately and thus to cut or otherwise change the shape of the material.

The lower ends of rods 42, which extend substantially to the bottom of frame 27 are reduced as indicated at 53, and force fitted through openings 54 in a plate 55, the latter serving as a portion of the connection between the pull rods and the driving mechanism in a manner to be more fully described hereinafter.

Reduced ends 53 below plate 55 are surrounded by piston members 56, which are reciprocable in lower guide bushings 57 which are inserted in openings 58 in base plate 26. The lower portions of bushings 57 are flanged as at 59 and secured to the underside of base plate 26 by means of screws 60.

Each piston member 56 is provided at its lower end with a recess 61 for the reception of a fastening nut 62 mounted on the threaded extremity 63 of each reduced portion 53, and beneath each fastening nut is positioned a locking nut 64 similarly threaded. Appropriate bushing seals 68, piston seals 65, and rod seals 66 are provided, and a suitable rod washer 67 seats in the base of each recess 61.

Counterbalancing of the mechanism associated with the rods 42 is effected by compressed air in counterbalance tanks 70, the tanks being provided with flanges 71 which are secured by means of screws or bolts 72 to ribs 73 depending from the underside of base plate 26. Compressed air is supplied to tanks 70 through inlets 74

which extend to a suitable air compressor (not shown) or other suitable source of compressed air. The size of tanks 70, and the pressure of the compressed air contained therein may vary as conditions warrant. In the apparatus herein shown and described, and based on the assumption that each piston assembly is five inches in diameter giving a total piston area of approximately 78 square inches, it has been found that air pressure of approximately 100 pounds per square inch will support or counterbalance approximately 7,800 pound of mechanism. The pressure may obviously be varied in accordance with the weight of the assembly which it is required to counterbalance.

Plate 55 carries on its upper surface a pair of aligned oppositely disposed lugs 75, which are secured thereto as by means of bolts 76 or the like. Each lug 75 is apertured as at 77 for the reception of a pivot pin 78 which also extends through aligned apertures in depending lugs 79 which in turn depend from ram height adjusting boxes 80. Ram height adjusting boxes 80 serve pivotally to connect through wrist pins 78, plate 55, and hence pull rods 42 and ram 47 with a pair of aligned ram height adjusting links 81. The function and operation of ram height adjusting boxes 80 will be more fully described hereinafter.

At their upper ends each adjusting link 81 extends between a pair of yoke arms 82 and is pivotally connected therebtween by means of a yoke connection pin 83 mounted in a suitable bearing or bushing 84. Each pair of yoke arms 82 extend from the ends of a yoke block 85, the central portion of which is provided with a pair of spaced openings for the reception of heavy guide rods 86. Guide rods or bars 86 are secured to yoke block 85 by means of nuts 87. At their opposite ends rods 86 extend through aligned openings in a lower hinge leaf 90A, beyond which is positioned a yoke screw stabilizer plate 88, having openings therein through which rods 86 extend, the assembly being firmly secured by stabilizer lock nuts 89. Lower hinge leaf 90A is secured through a hinge pin 90 to an upper hinge leaf 90B, through suitable openings in which extend a pair of spaced upper guide bars 91. Upper guide bars 91 also extend through openings in the upper portion of frame 27 and are secured in position by upper guide rod or bar retainers 92 which are secured in turn by screws 93 to the exterior of the face of the frame.

Yoke block 85 also has a lug or arm 94 projecting at an angle opposite to the yoke arms 82, to the opposite sides of which are secured a pair of second links 95 by means of yoke pins or pivots 96 mounted in bushings 97.

The opposite ends of second links 95 are connected by pins 98 movable in bushings 99 to one end of a lever 100, it being understood that such levers 100 and their associated components are provided in duplicate on opposite sides of the assembly.

Each lover 100 is pivotally mounted on a pivot pin or fulcrum 101 mounted in bearings or bushings 102 which extend between spaced supporting lugs 103 carried by the underside of top 33 of frame 27. The opposite end of each lever 100 is pivotally connected as by a pivot pin 104 mounted in bushings or bearings 105 between the bifurcated ends 106 of crankshaft arms 107.

It should here be pointed out that pins 98, 101, and 104 are all in aligned relation as are pins 83, 96, and hinge pin 90. It will also be seen that crankshaft arm 107 reciprocates, the reciprocation being effected in a manner to be more fully described hereinafter in a vertical direction to oscillate levers 100 about their fulcrum pins 101. Due to the constant lengths of second links 95, pin 96 and pin 83 are similarly moved, in conjunction with yoke block 85 about hinge pin 90 as a fulcrum Thus, variation of the distance between hinge pin 90 and pin 83 will vary the distance of movement of pin 83, and consequently link 81, plate 55, pull rods 42 and ultimately ram 47. The structure for varying the distance between hinge pin 90 and pin 83, and hence the effective stroke of ram 47, will be more fully described hereinafter.

The two crankshaft arms 107 are simultaneously moved by means of a crankshaft 108 which extends transversely across the base of the frame and is mounted in bushings or bearings 109 carried by bearing blocks 110 which are carried by the end walls 112 of frame 27 and intermediate partitions 113, the arrangement being such that there is a bearing block on each side of each crankshaft arm. Bearing blocks 110 are provided with bearing caps 114 secured to the bearing blocks by means of screws 115, the caps being on the outer side of the frame to facilitate the removal or interchange of crankshaft 108 when necessary or desirable. Crankshaft arms 107 are provided at their lower ends with connecting bushings 116 which surround eccentrics 117 on shaft 108. Connection caps 118 are provided for crankshaft arms 107, and held in position by screws 119, so that the crankshaft arms may also be readily removed from the apparatus if desired.

A motor bracket 120 supports an electric motor 121, which through a suitable pulley 122 and drive belts 123, drives a fly wheel 124 which in turn through a conventional clutch 125 and brake 126, drives crankshaft 108.

Referring back now to the ram height adjustment housings 80 and having particular reference to FIGURES 11 to 14, inclusive, and more particularly to FIGURE 13, it will be seen that each housing contains a worm nut 130 which is rotatable by worm 131 mounted on a worm shaft 132 which is rotatably mounted in bushings 133 and 134. One end of shaft 132 is squared at 135 and extends through the face 136 of the adjacent bushing 134. Screws 137 serve to hold the outer bushing in position around the shaft. Thrust bearings 138 are positioned at opposite ends of the worm, to minimize friction between the ends of the worms and bearings.

The lower portion of worm nut 130 is provided with teeth 139 engageable by the worm 131 while the upper portion thereof is provided with vertical slots 140. The interior of nut 130 is threaded and engages the lower threaded end 141 of links 81 (see FIG. 6). When locking means, to be more fully described hereinafter, compressing the nut 130 by means of its slots about threaded portion 141, are not operative, it will be seen that rotation of shaft 132 by means of a suitable crank or the like will, through worm 131 and worm gear teeth 139, rotate nut 130 to move housing 80 vertically with respect to the threaded end 141 of link 81. Such vertical movement will in turn move plate 55 and pull rods 42 vertically to adjust the position of ram 47 relative to the bolster 35. After such adjustment has been achieved, however, it is necessary to lock the nut 130 against inadvertent or accidental turning, it being noted that such turning can be effected only through worm 131. The locking means take the form, as best shown in FIGURE 11, of locking splits or slots 142 in a locking block 143 secured to the cover 144 of housing 80. Cover 144 is secured in position by means of screws 145.

Transversely extending bolts 146 extend through aligned bores in the opposite split portions of member 143, so that when screws 146 are tightened, the slots 142 close effectively to close the slots 140 and clamp the nut 130 about threaded end 141 in such manner that rotation thereof either by means of a crank applied to squared end 135, the shaft 132, or any other means, is positively precluded. A pin 146*a* extends through locking block 143 and cover 144 being press fitted into suitable aligned openings to prevent turning of block 143 when bolts 146 are loosened.

Loosening of bolts 146, however, releases the pressure locking nut 130 to reduce threaded portion 141, and permits linear adjustment of the parts in the manner previously described, thus serving to adjust the position of ram 47.

The two housings 80 and their associated links 81 are

connected by means of a coupling shaft **147** which is connected to the opposite worm shafts **132** by means of interlocking coupling sleeve **148** having oppositely positioned fingers **149** thereon, and keyed as by means of keys **148***a* to the adjacent ends of the worm shafts **132** and coupling shaft **147**. It is to be noted that only one of the housings **80** is provided with a squared end of the shaft, this being the one most accessible to the operator for use.

Referring back now to the means for varying the relative distance between hinge pin **90** and wrist pin **83**, in order to vary the effective stroke of ram **47**, it will be seen that upper guide rods **91** extend through openings in depending portions **150** and **151** of frame **27** which are carried by top wall **33**. Rods **91** are retained in fixed position at one end by the previously mentioned guide bar or rod retainers **92** and at their other ends, after passing through a partition **152** apertured to receive their ends, abut against the inner wall **153** of a generally channel-shaped stroke adjustment gear train bracket, generally indicated at **154**, and having side wall portions **155**. An upper adjusting screw **160** having a smooth portion **161** engages in a threaded bore **162** in upper hinge leaf **90***b*, the smooth portion **161** extending through an upper screw guide **162***a* in partition or depending lug member **150**. A bearing **163** extends through an opening in end wall **152**, as well as inner bracket wall **153** and is provided with a thrust bearing **164** and a lock nut **165**. The smooth portion **161** reduced as at **166** extends through a bearing or bushing **167** in a vertical partition **168** comprising a part of bracket **154**. A thrust bearing **169** and a lock nut **170** hold portion **166** in position. The outer end of reduced portion **166** carries a worm gear **171**. It will thus be seen that rotation of worm gear **171**, in a manner to be fully described hereinafter, serves to move upper hinge leaf **90***b* between partitions **150** and **151**.

A second screw **172** engages in a threaded bore **173** in lower hinge leaf **90***a*. Screw **172** has a smooth portion **174** which extends through a suitable opening in stabilizer **88** and is provided with a thrust bearing **175** and a lock nut **176**.

During an adjustment of the stroke, lower hinge leaf **90***a* and upper hinge leaf **90***b* move simultaneously because of their connection through hinge pin **90**. While at the point of the stroke which is to be duplicated (in this illustrative embodiment of the invention, the bottom) yoke block **85**, and more specifically, pin **96** must always remain in the same position relative to the vertical center line of frame **27** as viewed in side elevation. Screw **172**, being restricted from longitudinal movement in yoke block **85** serves to accomplish this because its thread has the same pitch and lead as screw **160**.

When screws **160** and **172** are rotated at the same rate of speed, in a manner to be more fully described hereinafter, screw **172** travels through lower hinge leaf **90***a* with the same speed at which upper hinge leaf **90***b*, hinge pin **90** and lower hinge leaf **90***a* are traveling, but in the opposite direction. This serves to eliminate, by counter effect, any longitudinal dislocation of screw **172** or any parts attached thereto, especially yoke block **85**. In other words, even though hinge leaf **90***b* may carry hinge leaf **90***a* forward or backward, neither screw **172** nor yoke block **85** will be dislocated in either direction. Screw **172**, therefore, has as its primary function the maintaining of the position of yoke block **85** and pin **96** at all times.

The travel of lower hinge leaf **90***a* is limited at one end by a stabilizer **88** and at its other end by yoke block **85**, the arrangement being such that lower hinge plate **90***a* may travel between the opposite pairs of yoke arms **82** to a position wherein pin **90** is in alignment with pin **83**, at which point the stroke of ram **47** will be zero, as will be more fully explained hereinafter.

The opposite end of screw **172** is smooth as indicated at **177** and extends through a yoke screw bushing **178** in a suitable central bore in yoke block **85**. A yoke thrust bearing **179** engages in an enlarged portion **180** of the bore, and is held by a flange **181** on the end of smooth portion **177**. A universal joint assembly **182** is secured to the head or flange **181**, and extends into a telescopic sleeve **183** to which it is also secured. A telescopic shaft **184** is linearly movable within sleeve **183** and is in turn connected to a second universal assembly **185**, which is provided with a shaft **186** which extends through a suitable bushing **187** in partition **168**. A second worm gear **188** is provided on the extremity of shaft **186**.

It will now be seen that when identical worm gears **171** and **188** are rotated simultaneously, the hinge assembly comprised of hinges **90***a* and **90***b* and hinge pin **90** will move as a unit along the threaded length of screws **160** and **172**. As hinge pin **90** approaches pin **83**, the stroke of ram **47** will be reduced, and as pin **90** is moved away from pin **83**, the stroke of ram **47** will be increased, as will be pointed out hereinafter.

Means are provided for simultaneous rotation of worm gears **171** and **188**, and take the form of identical upper and lower worms **190** and **191**, respectively. Worms **190** and **191** are mounted on shafts **192** and **193** which extend through suitable openings in horizontal partitions **194** and **195**, respectively, suitable conventional thrust bearings and bushings being provided for the support of the shafts.

Shafts **192** and **193** are connected by and keyed to a coupling **196**, the shaft **193** carrying a miter gear **197**. Miter gear **197** is enmeshed with a second miter gear **198**, the hub of which extends through a face plate **200** and carries exteriorly thereof a gear **201** which has a square central opening **202** therein. The square hole **202** is adapted for the reception of the squared end **203** of a crank handle **204**. Rotation of crank handle **204** will thus obviously rotate the screws **160** and **172** to move upper and lower hinge plates **90***b* and **90***a* transversely of the apparatus.

A locking pinion **205** may, if desired, be provided on plate **200** enmeshed with gear **201** and provided with a socket head screw **206**. When screw **206** is tightened, pinion **205** will be precluded from rotation, and consequently gear **201** cannot be turned. When the screw **206** is loosened, however, gear **201** is free to rotate and through the mechanism previously described, to rotate the screws **160** and **172**. Such a locking pinion is, however, optional since the nature of the mechanism renders locking unnecessary and, if desired, a plain disc may be substituted for gear **201** and pinion **205** omitted entirely.

FIGURES 20, 21, and 22 illustrate schematically the operation of the device. In FIGURE 20 the parts are shown at substantially maximum position, in accordance with the disclosure of the apparatus in the previously described form thereof. As here shown, hinge pin **90** is closely adjacent stabilizer **88**, and is linked by the yoke assembly **85** and guide bars **86** with pin **83**. The distance between pin **83** and **96** is fixed by the yoke assembly while links **95** retain the position of pins **96** and **98** in constant relation. Fulcrum pin **101** is also fixed, as is the distance between pin **101** and wrist pin **104**, which is connected to crank arm **107** which is in turn connected to eccentric member **117**. The pivotal mounting of link **81** at **83** and its secondary pivotal mounting at **78** permit reciprocal movement of plate **55** and hence pull rods **42** through the distance indicated by dotted lines in the operation of the apparatus, so that a substantially maximum length of stroke of ram **47** is permitted. In FIGURE 21 hinge pin **90** has been moved, by the previously described rotation of screws **172** and **160**, to any one of an infinite number of intermediate positions, and the stroke has been reduced. FIGURE 22 shows a position of hinge pin **90** closely adjacent its limit of travel which is defined by the position of the edge of yoke block **85**, the corresponding

travel on screw **160** being limited by the face of lug **150**, which, when the parts are in horizontal relation as shown, are in alignment. The positions of FIGURES 21 and 22 are illustrative of the multiplicity of stroke adjustments which may be accomplished by the mechanism hereinbefore described, it being readily apparent that when the hinge pin **90** is in aligned relation between the pins **83**, the effective stroke of plate **55**, and hence ram **47**, will be zero. It is to be noted that with this arrangement pin **83** and hence plate **55** and consequently ram **47** are always in precisely the same location at the bottom of the stroke despite the distance of hinge pin **90** from pin **83**. It is to be noted that crankshaft **108** should be located so that eccentric **117** assumes its top position when lever **100** is substantially perpendicular to the center line of crank arm **107** in order to produce a resultant force which is substantially perpendicular to lever **100** at pin **96**.

However, by changing the length of the crank arm, in a manner to be more fully described hereinafter, a different type of stroke may be achieved as shown in FIGURES 23, 24, and 25. In this arrangement hinge pin **90**, when extended to substantially its maximum position adjacent stabilizer or stop **88**, serves as a fulcrum for a downward movement of pins **83** and **96** and hence link **81** and its associated plate **55**. With the parts so arranged, the ram may be made to duplicate its position at the top of a substantially infinite number of different strokes. It may here be pointed out that in the position to be duplicated the line between points **96**, **83**, and **90** must be parallel to the screw **160**. It is to be noted that by changing the length of crank arm which can be made adjustable either the top, bottom, or midstroke position of the ram may be duplicated.

FIGURES 15 to 19, inclusive, disclose a modified form of crank arm generally indicated at **107***a*, which is adjustable and which may be substituted for the crank arms **107** in order to effectuate the abovementioned top, bottom, or midstroke position duplication. Crank arm **107***a* is comprised of an upper section **207**, the top of which is bifurcated as at **208**, to provide upstanding portions **209** having apertures **210** in aligned relation therein. The portions **209** extend upwardly on opposite sides of levers **100** and are secured thereto by means of pins **104** as in the case of the previously described crank arm **107**. A threaded bore **211** in the bottom of upper section **207** is threaded with a left hand thread to accommodate a corresponding left-hand thread **212** on an adjusting screw generally indicated at **213**. The central portion of adjusting screw **213** is enlarged as at **214**, to form a flange having openings **215** therein which may be engaged by a tool for turning the screw. The opposite end of the screw is right-hand threaded as is the bore **217** in the top **218** of a lower section **219**. The bottom of lower section **219** is apertured as at **220**, the aperture containing a connection bushing **221** which also fits within a corresponding semi-circular aperture in a connection cap **222** which is secured as by means of screws **223** to the lower end of lower section **219**. Bushing **221**, connection caps **222**, and screws **223** are substantially identical to the previously described bushings **116**, connection caps **118**, and screws **119** and serve to secure the crank arm **107***a* to the crank shaft **108** in a manner identical to that previously described.

The left-hand threaded portion **212** of adjusting screw **213** is provided with a left-hand threaded lock nut **224** provided with openings **225** for the reception of a tool for turning the same, while the lower or right-hand threaded portion **216** of adjusting screw **213** is provided with a right-handed hand threaded lock nut **226** provided with turning openings **227**. The arrangement is thus such that by release of the lock nuts **224** and **226** and turning of screw **213** by means of enlarged portion or flange **214**, the effective length of the composite crank arm **107***a* comprised of upper and lower sections **207** and **219**, may be suitably adjusted to vary the effective length of the crank arm, and hence effect the desired duplication of the top, bottom, or midstroke position of the ram.

Adjustment of a stroke by means of this mechanism can be made while the mechanism is in any position. However, in order to calculate the correct length of crank arm **107** or to adjust crank arm **107***a* to the correct center distance between pin **104** and eccentric **117**, then the center line of pin **96**, pin **83**, and hinge pin **90** should be moved to a position parallel to screw **160**, and the crank shaft rotated until the center of the eccentric **117** falls on a center line common to pin **104** and shaft **108**. When using a driving mechanism such as the one herein illustrated, if eccentric **117** is placed above shaft **108** for the aforementioned calculations, then the position of the ram at the bottom of the stroke will be duplicated precisely. If eccentric **117** is placed on the extended center line below shaft **108**, then the top of the stroke position will be precisely duplicated. If crank arm **107** is made, or crank arm **107***a* is adjusted so that the center distance between pin **104** and eccentric **117** duplicates the center distance between pin **104** and shaft **108**, then the mid stroke position of the ram will be duplicated exactly.

An object of this invention has been described as the provision of a mechanism of this character which is so designed that the locking of the adjustable parts in position through positive locking means is not mandatory. The self-locking means for moving the fulcrum **90** consist of the worms **190** and **191** and the mating worm gears **171** and **188**. They are self-locking, especially if the worms are of the common single-threaded type and have a small lead, because while the worms are able to rotate the worm gears in order to accomplish the adjustment, the worm gears are not able to rotate the worms in order to disturb the adjusted setting. Also, rotating the screw **160** will move the fulcrum **90**, but no conceivable movement of **90** could rotate **160**.

The lever assembly referred to in the claims is the group of parts numbered **82** through **94**, **96**, **97** and **172** through **181**. These parts, as assembled, form an adjustable lever, the basic elements of which are the yoke pins **96**, the yoke connecting pins **83**, and the hinge pins **90**. This lever assembly is shown in FIGURES 20 through 25 simply as the lever **96**, **83**, **90**.

In the claims, the means which pivotally connect one end **96**, of the lever assembly to the other end **104**, of the crank arm, consists of the second links **95**, pins **98**, and the levers **100**. The pivots are the connecting pins **83**, which are at an intermediate point on the lever assembly, and the movable fulcrum is the hinge pin **90**, which is adjustably positioned between pivots **83** and the other end **88**, of the lever assembly. The links are the adjustable links **81**, and the reciprocating member is the plate **55**.

The stroke of the reciprocating member is the distance between the two extreme positions assumed by that member when it is forced to travel from one position to the other by a cycling of the driving mechanism. Such a cycle in the machine illustrated herewith would be embraced by a 360° rotation of the crankshaft. The distance between the two extreme positions, assumed by the reciprocating member, can be adjusted, i.e., shortened or lengthened, by means of the stroke adjusting mechanism presented herewith.

The adjustment of the length of the stroke should not be confused with the positioning of the reciprocating member and, consequently, the ram. The positioning adjustment in the subject machine is presented as the ram height adjusting mechanism, which allows the correct spacing between the ram and the bolster plate. In effect, the ram height adjustment permits the movable upper die to be located at the correct distance from the stationary lower die, and the stroke adjustment permits the movable

die to travel various prescribed distances toward and away from the stationary die.

From the foregoing it will now be seen that there is herein provided an improved adjustable stroke mechanism which may be advantageously employed with a wide variety of apparatus, and which through herein shown in conjunction with a particular type of press, is adaptable to many other similar applications, which accomplishes all the objects of this invention, and others, including many advantages of great practical utility and commercial importance.

As many embodiments may be made of this inventive concept, and as many modifications may be made in the embodiment hereinbefore shown and described, it is to be understood that all matter herein is to be interpreted merely as illustrative, and not in a limiting sense.

I claim:

1. Mechanism for varying the length of the stroke of a reciprocating member driven by a rotary eccentric from zero through an infinite number of different stroke lengths to a predetermined maximum length, comprising an eccentric, means for rotating said eccentric, a crank arm, means connecting one end of said crank arm to said eccentric for reciprocation thereby, a lever assembly, means pivotally connecting one end of said lever assembly to the other end of said crank arm, a pivot at an intermediate point on said lever assembly, a movable fulcrum for said lever assembly normally positioned between said pivot and the other end of said lever assembly, a link connected at one end to said pivot, a reciprocating member pivotally connected to the other end of said link, and means for moving said fulcrum from said other end of said lever assembly towards and away from said pivot to vary the stroke of said reciprocating member from zero when said fulcrum is concentric with said pivot through an infinite number of stroke lengths to maximum length when said fulcrum is adjacent said other end of said lever assembly.

2. Mechanism for varying the length of the stroke of a reciprocating member driven by a rotary eccentric from zero through an infinite number of different stroke lengths to a predetermined maximum length, comprising an eccentric, means for rotating said eccentric, a crank arm, means connecting one end of said crank arm to said eccentric for reciprocation thereby, a lever assembly, means pivotally connecting one end of said lever assembly to the other end of said crank arm, a pivot at an intermediate point on said lever assembly, a movable fulcrum for said lever assembly normally positioned between said pivot and the other end of said lever assembly, a link connected at one end to said pivot, a reciprocating member pivotally connected to the other end of said link, means for moving said fulcrum from said other end of said lever assembly towards and away from said pivot to vary the stroke of said reciprocating member from zero when said fulcrum is concentric with said pivot through an infinite number of stroke lengths to maximum length when said fulcrum is adjacent said other end of said lever assembly, said means connecting said one end of said lever assembly to said other end of said crank arm comprising a second link pivoted at one end to said one end of said lever assembly, a lever, means pivotally connecting the other end of said second link to one end of said lever, a pivotal connection between the other end of said lever and said other end of said crank arm, and a fulcrum for said lever fixed on said lever at a dsitance from the center of said pivotal connection at said one end of said lever which is equal to half of or less than half of the total distance between said center of said pivotal connection at said one end of said lever and said pivotal connection at said other end of said lever.

3. Mechanism for varying the length of the stroke of a reciprocating member driven by a rotary eccentric from zero through an infinite number of different stroke lengths to a predetermined maximum length, comprising an eccentric, means for rotating said eccentric, a crank arm, means connecting one end of said crank arm to said eccentric for reciprocation thereby, a lever assembly, means pivotally connecting one end of said lever assembly to the other end of said crank arm, a pivot at an intermediate point on said lever assembly, a movable fulcrum for said lever assembly normally positioned between said pivot and the other end of said lever assembly, a link connected at one end to said pivot, a reciprocating member pivotally connected to the other end of said link, means for moving said fulcrum from said other end of said lever assembly towards and away from said pivot to vary the stroke of said reciprocating member from zero when said fulcrum is concentric with said pivot through an infinite number of stroke lengths to maximum length when said fulcrum is adjacent said other end of said lever assembly, said means connecting said one end of said lever assembly to said other end of said crank arm comprising a second link pivoted at one end to said one end of said first-mentioned lever assembly, a lever, means pivotally connecting the other end of said second link to one end of said lever, a pivotal connection between the other end of said lever and said other end of said crank arm, and a fulcrum for said lever fixed on said lever at a distance from the center of said pivotal connection at said one end of said lever which is equal to half of or less than half of the total distance between said center of said pivotal connection at said one end of said lever and said pivotal connection at said other end of said lever, and means for varying effective length of said first-mentioned link to vary the terminal position of said reciprocating member.

4. Mechanism for varying the length of the stroke of a reciprocating member driven by a rotary eccentric from zero through an infinite number of different stroke lengths to a predetermined maximum length, comprising an eccentric, means for rotating said eccentric, a crank arm, means connecting one end of said crank arm to said eccentric for reciprocation thereby, a lever assembly, means pivotally connecting one end of said lever assembly to the other end of said crank arm, a pivot at an intermediate point on said lever assembly, a movable fulcrum for said lever assembly normally positioned between said pivot and the other end of said lever assembly, a link connected at one end to said pivot, a reciprocating member pivotally connected to the other end of said link, means for moving said fulcrum from said other end of said lever assembly towards and away from said pivot to vary the stroke of said reciprocating member from zero when said fulcrum is concentric with said pivot through an infinite number of stroke lengths to maximum length when said fulcrum is adjacent said other end of said lever assembly, said means connecting said one end of said lever assembly to said other end of said crank arm comprising a second link pivoted at one end to said one end of said lever assembly, a lever, means pivotally connecting the other end of said second link to one end of said lever, a pivotal connection between the other end of said lever and said other end of said crank arm, and a fulcrum for said lever fixed on said lever at a distance from the center of said pivotal connection at said one end of said lever which is equal to half of or less than half of the total distance between said center of said pivotal connection at said one end of said lever and said pivotal connection at said other end of said lever, and means whereby the position of said reciprocating member can be precisely duplicated at either top, bottom or mid-point of said stroke, upon repetition of said stroke, regardless of adjusted variations of said stroke.

5. In a press, the combination of a frame, a fixed platen having openings therethrough carried by the top of said frame, a reciprocating ram positioned above said platen, pull rods extending through said openings and connected at one of their ends to said ram and linearly movable in said frame, a plate connected to the other ends of said pull rods, means for reciprocating said plate, and means

for varying the length of the reciprocating stroke of said plate from zero through an infinite number of stroke lengths to a predetermined maximum stroke length, whereby the position of said plate can be precisely duplicated at either the top, bottom or midpoint of said stroke, upon repetition of said stroke, regardless of adjusted variations of said stroke, said last mentioned means including an eccentric, means for rotating said eccentric, a crank arm, means connecting one end of said crank arm to said eccentric for reciprocation thereby, a lever assembly, means pivotally connecting one end of said lever assembly to the other end of said crank arm, a pivot at an intermediate point on said lever assembly, a movable fulcrum for said lever assembly normally positioned between said pivot and the other end of said lever assembly, a link connected at one end to said pivot, a reciprocating member pivotally connected to the other end of said link, said reciprocating member fastened to said plate for reciprocation thereof, and means for moving said fulcrum from said other end of said lever assembly towards and away from said pivot to vary the stroke of said reciprocating member from zero when said fulcrum is concentric with said pivot through an infinite number of stroke lengths to maximum length when said fulcrum is adjacent said other end of said lever assembly.

6. In a press, the combination of a frame, a fixed platen having openings, therethrough carried by the top of said frame, a reciprocating ram positioned above said platen, pull rods extending through said openings and connected at one of their ends to said ram and linearly movable in said frame, a plate connected to the other ends of said pull rods, means for reciprocating said plate, means for varying the length of the reciprocating stroke of said plate from zero through an infinite number of stroke lengths to a predetermined maximum stroke length, whereby the position of said plate can be precisely duplicated at either the top, bottom or midpoint of said stroke, upon repetition of said stroke, regardless of adjusted variations of said stroke, said last mentioned means including an eccentric, means for rotating said eccentric, a crank arm, means connecting one end of said crank arm to said eccentric for reciprocation thereby, a lever assembly, means pivotally connecting one end of said lever assembly to the other end of said crank arm, a pivot at an intermediate point on said lever assembly, a movable fulcrum for said lever assembly normally positioned between said pivot and the other end of said lever assembly, a link connected at one end to said pivot, a reciprocating member pivotally connected to the other end of said link, said reciprocating member fastened to said plate for reciprocation thereof, and means for moving said fulcrum from said other end of said lever assembly towards and away from said pivot to vary the stroke of said reciprocating member from zero when said fulcrum is concentric with said pivot through an infinite number of stroke lengths to maximum length when said fulcrum is adjacent said other end of said lever assembly, said means connecting said one end of said lever assembly to said other end of said crank arm comprising a second link pivoted at one end to said one end of said lever assembly, a lever, means pivotally connecting the other end of said second link to one end of said lever, a pivotal connection between the other end of said lever and said other end of said crank arm, and a fulcrum for said lever fixed on said lever at a distance from the center of said pivotal connection at said one end of said lever which is equal to half of or less than half of the total distance between said center of said pivotal connection at said one end of said lever and said pivotal connection at said other end of said lever.

7. In a press, the combination of a frame, a fixed platen carried having openings therethrough by the top of said frame, a reciprocating ram positioned above said platen, pull rods extending through said openings and connected at one of their ends to said ram and linearly movable in said frame, a plate connected to the other ends of said pull rods, means for reciprocating said plate, means for varying the length of reciprocating stroke of said plate from zero through an infinite number of stroke lengths to a predetermined maximum stroke length, whereby the position of said plate can be precisely duplicated at either the top, bottom or midpoint of said stroke, upon repetition of said stroke, regardless of adjusted variations of said stroke, said last-mentioned means including an eccentric, means for rotating said eccentric, a crank arm, means connecting one end of said crank arm to said eccentric for reciprocation thereby, a lever assembly, means pivotally connecting one end of said lever assembly to the other end of said crank arm, a pivot at an intermediate point on said lever assembly, a movable fulcrum for said lever assembly normally positioned between said pivot and the other end of said lever assembly, a link connected at one end to said pivot, a reciprocating member pivotally connected to the other end of said link, said reciprocating member fastened to said plate for reciprocation thereof, and means for moving said fulcrum from said other end of said lever assembly towards and away from said pivot to vary the stroke of said reciprocating member from zero when said fulcrum is concentric with said pivot through an infinite number of stroke lengths to maximum length when said fulcrum is adjacent said other end of said lever assembly, said means connecting said one end of said lever assembly to said other end of said crank arm comprising a second link pivoted at one end to said one end of said lever assembly, a lever, means pivotally connecting the other end of said second link to one end of said lever, a pivotal connection between the other end of said lever and said other end of said crank arm, and a fulcrum for said lever fixed on said lever at a distance from the center of said pivotal connection at said one end of said lever which is equal to half of or less than half of the total distance between said center of said pivotal connection at said one end of said lever and said pivotal connection at said other end of said lever, and means whereby the position of said reciprocating member can be precisely duplicated at either top, bottom or mid-point of said stroke, upon repetition of said stroke, regardless of adjusted variations of said stroke.

8. In a press, the combination of a frame, a fixed platen having openings therethrough carried by the top of said frame, a reciprocating ram positioned above said platen, pull rods extending through said openings and connected at one of their ends to said ram and linearly movable in said frame, a plate connected to the other ends of said pull rods, means for reciprocating said plate, means for varying the length of the reciprocating stroke of said plate from zero through an infinite number of stroke lengths to a predetermined maximum stroke length, whereby the position of said plate can be precisely duplicated at either the top, bottom or midpoint of said stroke, upon repetition of said stroke, regardless of adjusted variations of said stroke, said last-mentioned means including an eccentric, means for rotating said eccentric, a crank arm, means connecting one end of said crank arm to said eccentric for reciprocation thereby, a lever assembly, means pivotally connecting one end of said lever assembly to the other end of said crank arm, a pivot at an intermediate point on said lever assembly, a movable fulcrum for said lever assembly normally positioned between said pivot and the other end of said lever assembly, a link connected at one end to said pivot, a reciprocating member pivotally connected to the other end of said link, said reciprocating member fastened to said plate for reciprocation thereof, means for moving said fulcrum from said other end of said lever assembly towards and away from said pivot to vary the stroke of said reciprocating member from zero when said fulcrum is concentric with said pivot through an infinite number of stroke lengths to maximum length when said fulcrum is adjacent said other end of said lever assembly, said means connecting said one end of said lever assem-

bly to said other end of said crank arm comprising a second link pivoted at one end to said one end of said lever assembly, a lever, means pivotally connecting the other end of said second link to one end of said lever, a pivotal connection between the other end of said lever and said other end of said crank arm, and a fulcrum for said lever fixed on said lever at a distance from the center of said pivotal connection at said one end of said lever which is equal to half of or less than half of the total distance between said center of said pivotal connection at said one end of said lever and said pivotal connection at said other end of said lever, means for varying the effective length of said first-mentioned link to vary the terminal position of said reciprocating member, and means for varying the effective length of said crank arm whereby said terminal position may be either at the top, bottom, or mid-point of the said stroke.

9. In a press, the combination of a frame, a fixed platen having openings therethrough carried by the top of said frame, a reciprocating ram positioned above said platen, pull rods extending through said openings and connected at one of their ends to said ram and linearly movable in said frame, a plate connected to the other ends of said pull rods, a ram height adjusting box pivotally secured to said plate, a driving link having one end adjustably mounted in said box, a yoke block, yoke arms extending from said block, a pivotal connection between said yoke arms and the other end of said driving link, a hinge assembly comprising a hinge pin and upper and lower hinge leaves, a stabilizer plate, lower guide rods fixed in said yoke block and said stabilizer plate, said lower hinge leaf having apertures therein slidably mounting said lower hinge leaf on said lower guide bars, upper guide bars fixed to the underside of the top of said frame, said upper hinge leaf having apertures therein slidably mounting said upper hinge leaf on said upper guide bars, an additional arm carried by said yoke block extending in a direction angularly disposed relative to said yoke arms, a connecting link pivotally connected at one end to said additional arm, a lever pivotally connected at one end to the other end of said link, a fulcrum for said lever secured to the underside of the top of said frame, a crank arm, a pivotal connection between the other end of said lever and said crank arm, a crankshaft mounted in said frame for reciprocating said crank arm to oscillate said lever and swing said lower hinge leaf about said hinge pin to reciprocate said ram through said pull rods, means for driving said crankshaft, and means for moving said hinge pin and said upper and lower hinge leaves linearly along their respective guide rods to vary the position of said hinge pin relative to said pivotal connection between said yoke arms and said other end of said driving link to vary the distance of reciprocating movement of said plate and hence the stroke length of said ram.

10. The invention as set forth in claim 9 wherein said last-mentioned means comprises a pair of threaded members, one extending through a threaded opening provided in said upper hinge leaf, and the other extending through a threaded opening in said lower hinge, and means for simultaneously rotating both of said threaded members.

11. The invention as set forth in claim 10 wherein said other threaded member includes a pair of telescoping sleeves and a universal joint on each side of said sleeves to accommodate the oscillatory movement of said lower hingle leaf when said crank arm is operated.

12. The invention as set forth in claim 10 wherein said means for simultaneously rotating said threaded members comprise a worm gear on the end of each threaded member, a worm engaging each worm gear, a single shaft carrying both of said worms, a miter gear carried by said shaft, a second miter gear engaging said first-mentioned miter gear, and a removable crank for manually rotating said second miter gear.

13. The invention as set forth in claim 12 wherein lock means are provided for said second miter gear.

14. The invention as set forth in claim 13 wherein said lock means include a flat gear concentric with and secured to said second miter gear, a locking pinion gear in mesh with said flat gear, and means clamping said pinion gear against rotation.

15. The invention as set forth in claim 9 wherein said ram height adjusting box includes upper and lower openings through which said one end of said driving link extends, said one end being reduced and threaded, a split clamping nut in said box engaging said reduced threaded end of said driving link, worm gear teeth cut peripherally on said clamping nut, a worm in said box engaging said worm gear teeth, external removable crank means for rotating said worm, and means for locking said clamping nut against rotation.

16. The invention as set forth in claim 15 wherein said last-mentioned means include slots in said box, said box being comprised of two separable pieces with said slots therebetween, and bolts engaging threaded bores in one of said separable pieces and extending through aligned bores in the other of said separable pieces for compressing said slots to compress said split clamping nut to preclude rotation thereof on said threaded end of said driving link.

17. In a press, the combination of a frame, a fixed platen having openings therethrough carried by the top of said frame, a reciprocating ram positioned above said platen, pull rods extending through said openings and connected at one of their ends to said ram and linearly movable in said frame, a plate connected to the other ends of said pull rods, a ram height adjusting box pivotally secured to said plate, a driving link having one end adjustably mounted in said box, a yoke block, yoke arms extending from said block, a pivotal connection between said yoke arms and the other end of said driving link, a hinge assembly comprising a hinge pin and upper and lower hinge leaves, a stabilizer plate, lower guide rods fixed in said yoke block and said stabilizer plate, said lower hinge leaf having apertures therein slidably mounting said lower hinge leaf on said lower guide bars, upper guide bars fixed to the underside of the top of said frame, said upper hinge leaf having apertures therein slidably mounting said upper hinge leaf on said upper guide bars, an additional arm carried by said yoke block extending in a direction angularly disposed relative to said yoke arms, a connecting link pivotally connected at one end to said additional arm, a lever pivotally connected at one end to the other end of said link, a fulcrum for said lever secured to the underside of the top of said frame, a crank arm, a pivotal connection between the other end of said lever and said crank arm, a crankshaft mounted in said frame for reciprocating said crank arm to oscillate said lever and swing said lower hinge leaf about said hinge pin to reciprocate said ram through said pull rods, means for driving said crankshaft, means for moving said hinge pin and said upper and lower hinge leaves linearly along their respective guide rods to vary the position of said hinge pin relative to said pivotal connection between said yoke arms and said other end of said driving link to vary the distance of reciprocating movement of said plate and hence the stroke length of said ram, said last-mentioned means comprising a pair of threaded members, one extending through a threaded opening provided in said upper hinge leaf, and the other extending through a threaded opening in said lower hinge leaf, means for simultaneously rotating both of said threaded members, said other threaded member including a pair of telescoping sleeves and a universal joint on each side of said sleeves to accommodate the oscillatory movement of said lower hinge leaf when said crank arm is operated, said means for simultaneously rotating said threaded members comprising a worm gear on the end of each threaded member,

a worm engaging each worm gear, a single shaft carrying both of said worms, a miter gear carried by said shaft, a second miter gear engaging said first-mentioned miter gear, and a removable crank for manually rotating said second miter gear, lock means for said second miter gear, said lock means including a flat gear concentric with and secured to said second miter gear, a locking pinion gear in mesh with said flat gear, means clamping said pinion gear against rotation, said ram height adjusting box including upper and lower openings through which said end of said driving link extends, said one end being reduced and threaded, a split clamping nut in said box engaging said reduced threaded end of said driving link, worm gear teeth cut peripherally on said clamping nut, a worm in said box engaging said worm gear teeth, external removable crank means for rotating said worm, means for locking said clamping nut against rotation, said last-mentioned means including slots in said box, said box being comprised of two separable pieces with said slots therebetween, and bolts engaging threaded bores in one of said separable pieces and extending through aligned bores in the other of said separable pieces for compressing said slots to compress said split clamping nut to preclude rotation thereof in said threaded end of said driving link.

18. The invention as set forth in claim 17 wherein a piston is provided on the lower end of each pull rod, said frame having bored apertures through which said pistons extend, compressed air counterbalance tanks beneath said base, and means for supplying compressed air to said tanks to counterbalance said pull rods, said ram and said means for varying said length of said reciprocating stroke of said plate and said ram.

19. The structure of claim 1 wherein said mechanism is provided with a stationary frame, and wherein the means for moving said fulcrum are supported by said frame independently of the operative parts of said mechanism, whereby said fulcrum may be adjusted during the operation of the mechanism.

20. The structure of claim 19 wherein said means for moving said fulcrum include self-locking means whereby the necessity for positive locking of said means for moving said fulcrum is eliminated, the force vectors of the operating components of said mechanism being exerted in directions such that none tend to exert force on said means for moving said fulcrum in a direction tending to change the setting of said self-locking means.

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