United States Patent

Maytag

[15] **3,696,657**

[45] **Oct. 10, 1972**

[54] **METAL WORKING CRANK AND SLIDE PRESS MECHANISM**

[72] Inventor: **John Hardy Maytag,** Denver, Colo.

[73] Assignee: **Coors Porcelain Company,** Golden, Colo.

[22] Filed: **Nov. 19, 1970**

[21] Appl. No.: **91,020**

[52] **U.S. Cl.** **72/450,** 72/456

[51] **Int. Cl.** **B21j 9/18**

[58] **Field of Search** 72/450, 456, 449; 113/12; 100/292

[56] **References Cited**

UNITED STATES PATENTS

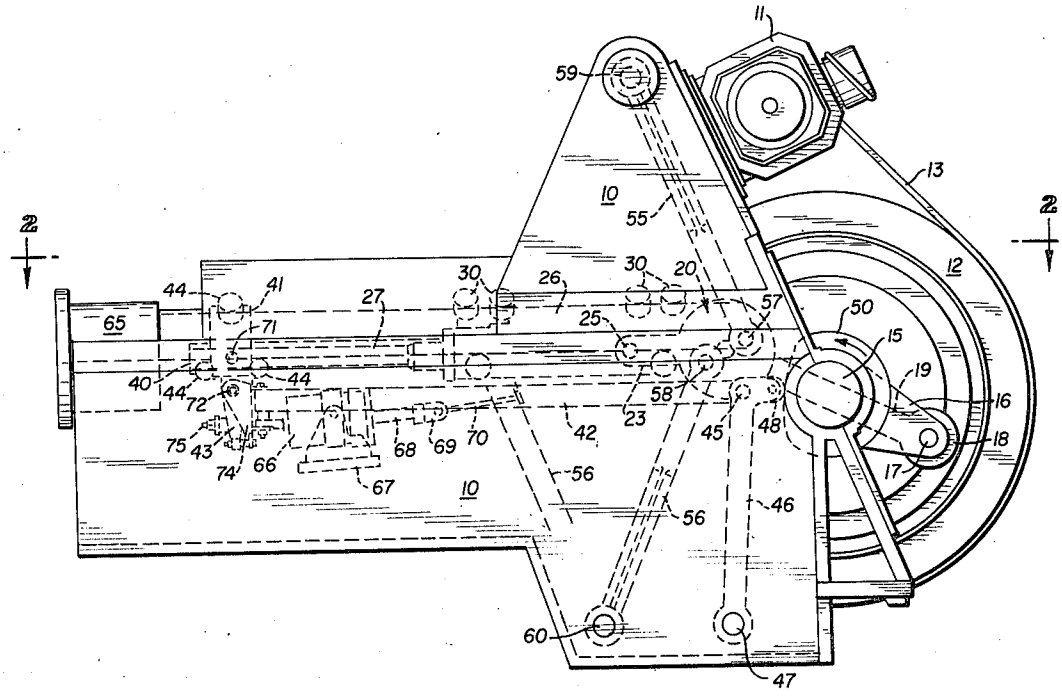
461,917	10/1891	Beaudry	72/450
2,482,678	9/1949	Laxo	113/12
2,652,801	9/1953	Laxo	113/12
3,221,690	12/1965	Laxo	113/12

Primary Examiner—Charles W. Lanham
Assistant Examiner—Gene P. Crosby
Attorney—Bertha L. MacGregor

[57] **ABSTRACT**

A metal working crank and slide press mechanism for reciprocating parallel members, for example, a carriage-mounted ram and a sleeve slidable on the ram. The press mechanism is arranged to resist heavy side pressure exerted upon the connecting rod which assumes extremely angular positions relatively to the carriage. A cross head and side thrust resisting levers produce a straight line motion by translating the thrust of the connecting rod into a direction in line with the travel of the ram-carrying carriage connected to the cross head. The carriage is mounted on wheels running on the top and bottom of hardened way strips, the wheels being adjustably mounted on eccentric axles to grip the ways with a predetermined amount of pre-load to prevent slack in the wheels. The working surfaces of the wheels and way strips extend radially with respect to the center of mass of the carriage assembly to minimize the effect of thermal expansion on the wheel pre-load.

15 Claims, 13 Drawing Figures



PATENTED OCT 10 1972

3,696,657

SHEET 1 OF 7

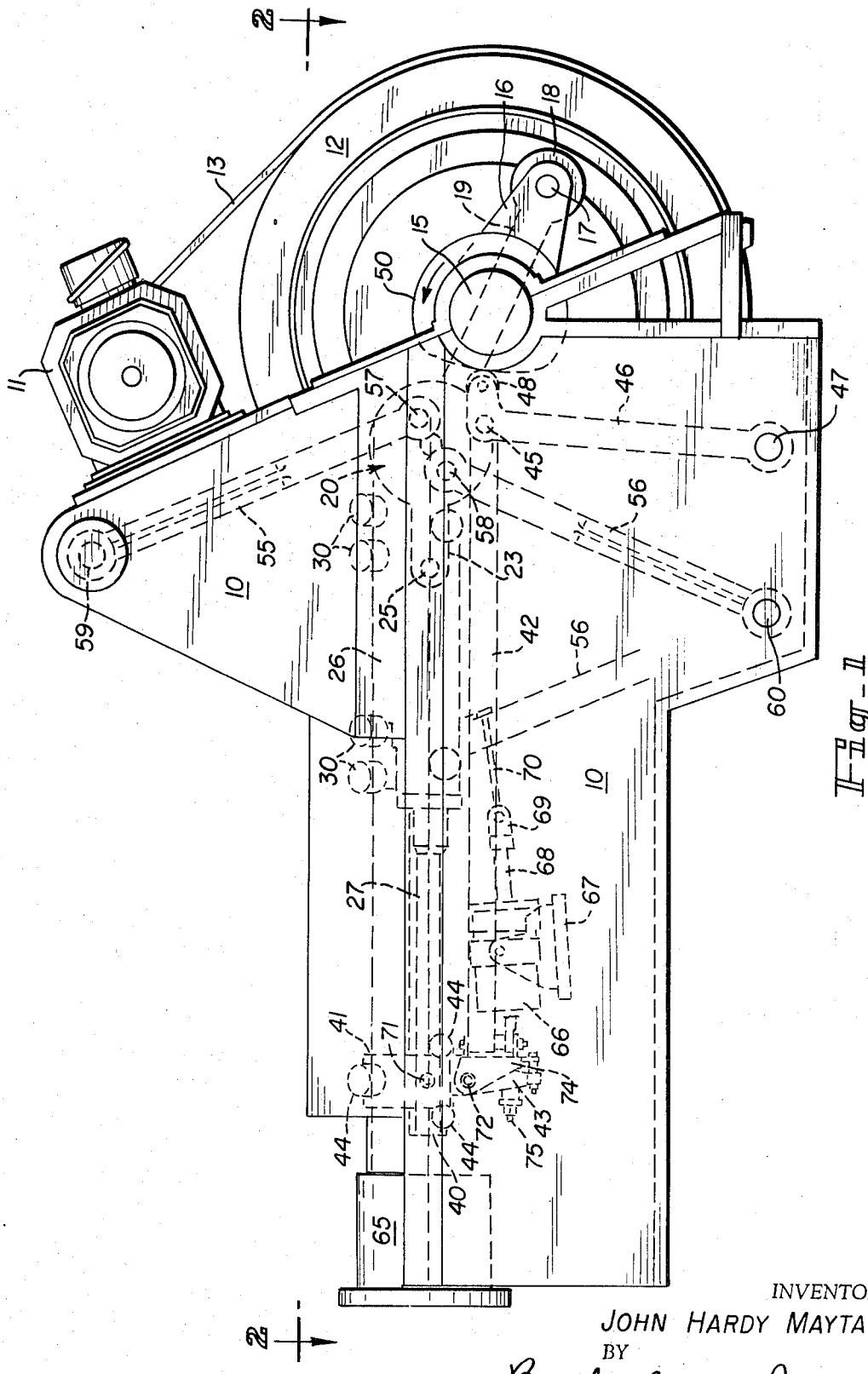


FIG. 1

INVENTOR.
JOHN HARDY MAYTAG
BY
Bertha L. MacGregor
ATTORNEY

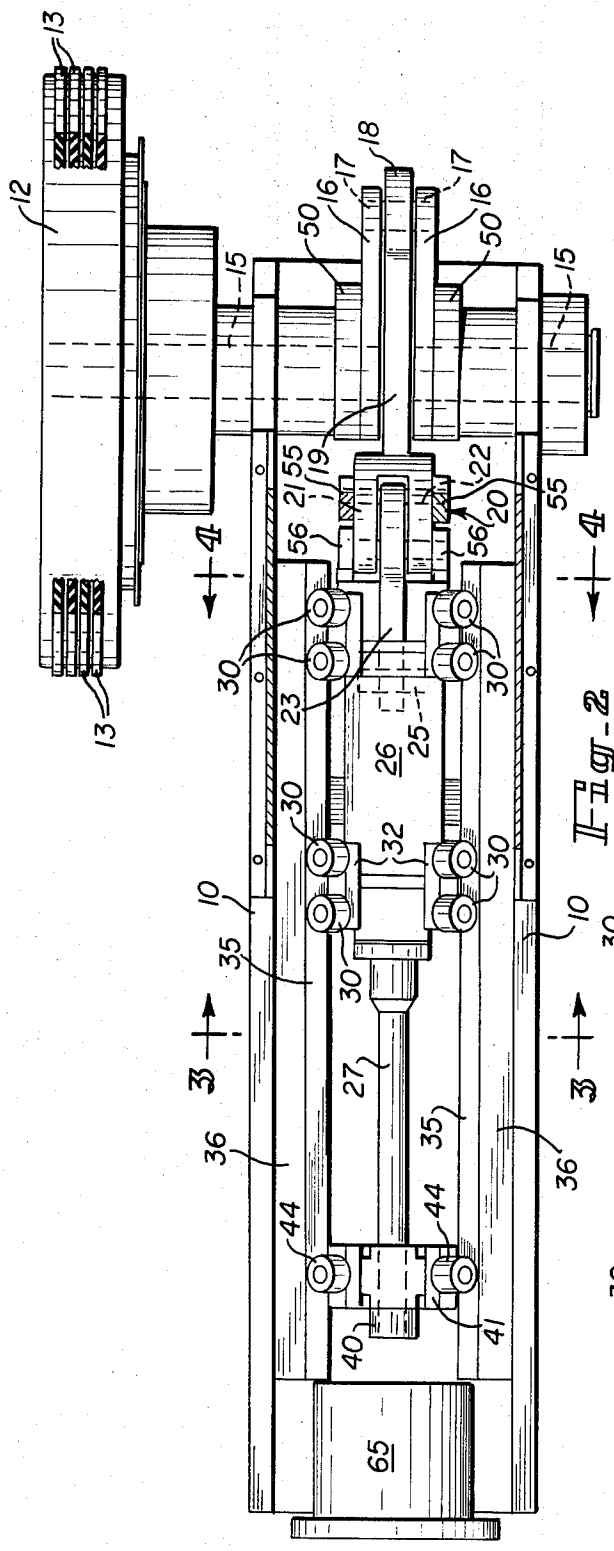


Fig. 2

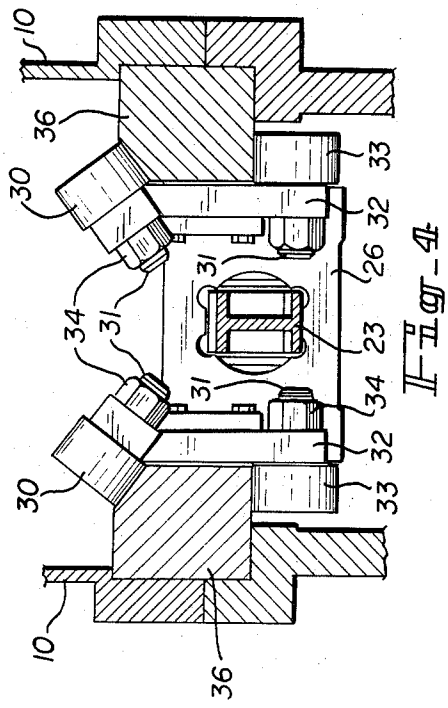


Fig. 4

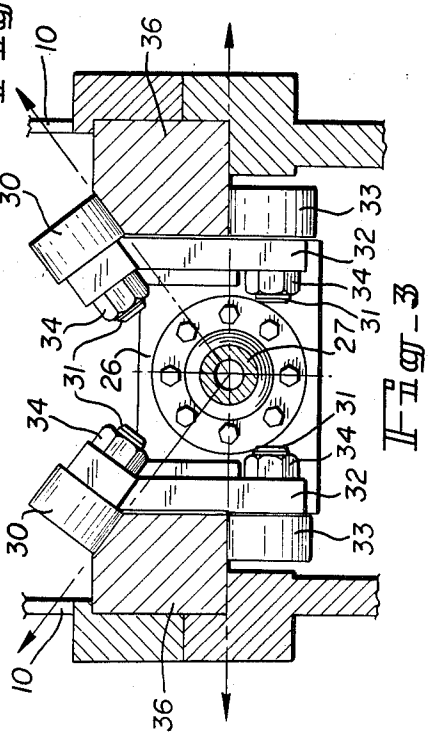


Fig. 3

INVENTOR.
JOHN HARDY MAYTAG
BY
Bertha L. MacGregor
ATTORNEY

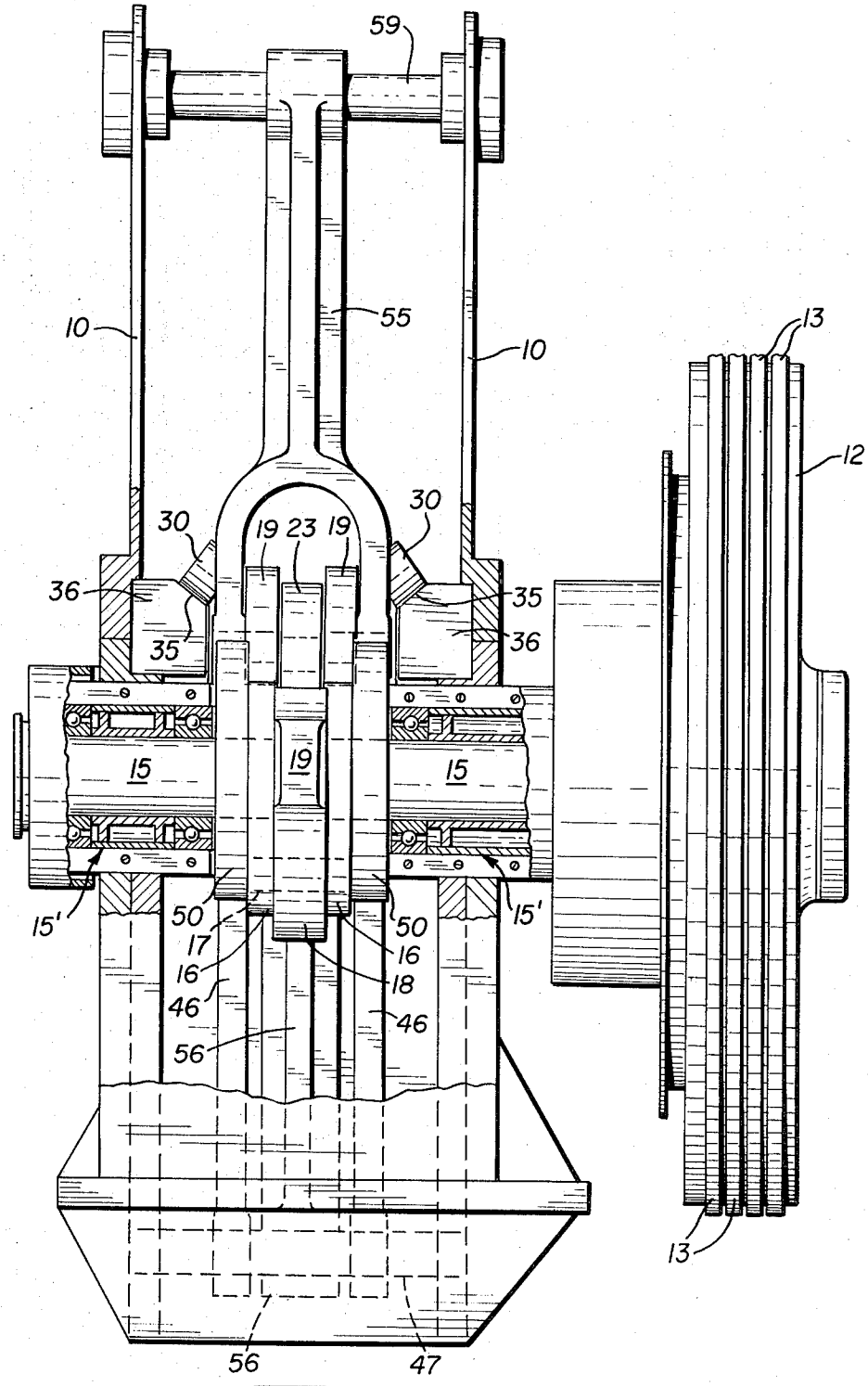


Fig. 5

INVENTOR.
JOHN HARDY MAYTAG
BY
Bertha L. MacGregor
ATTORNEY

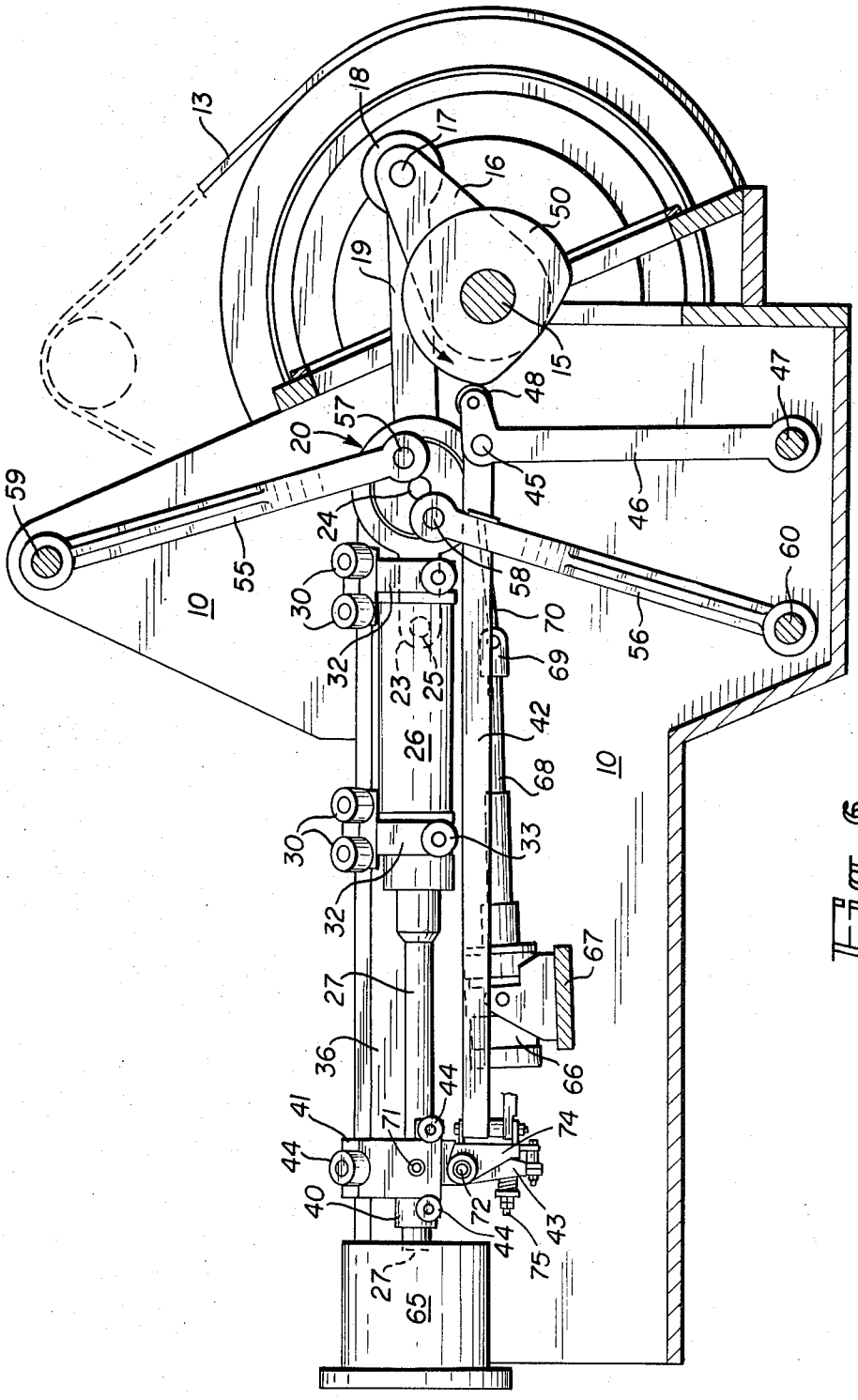


Fig - 6

INVENTOR.
JOHN HARDY MAYTAG
BY
Bertha L. MacGregor
ATTORNEY

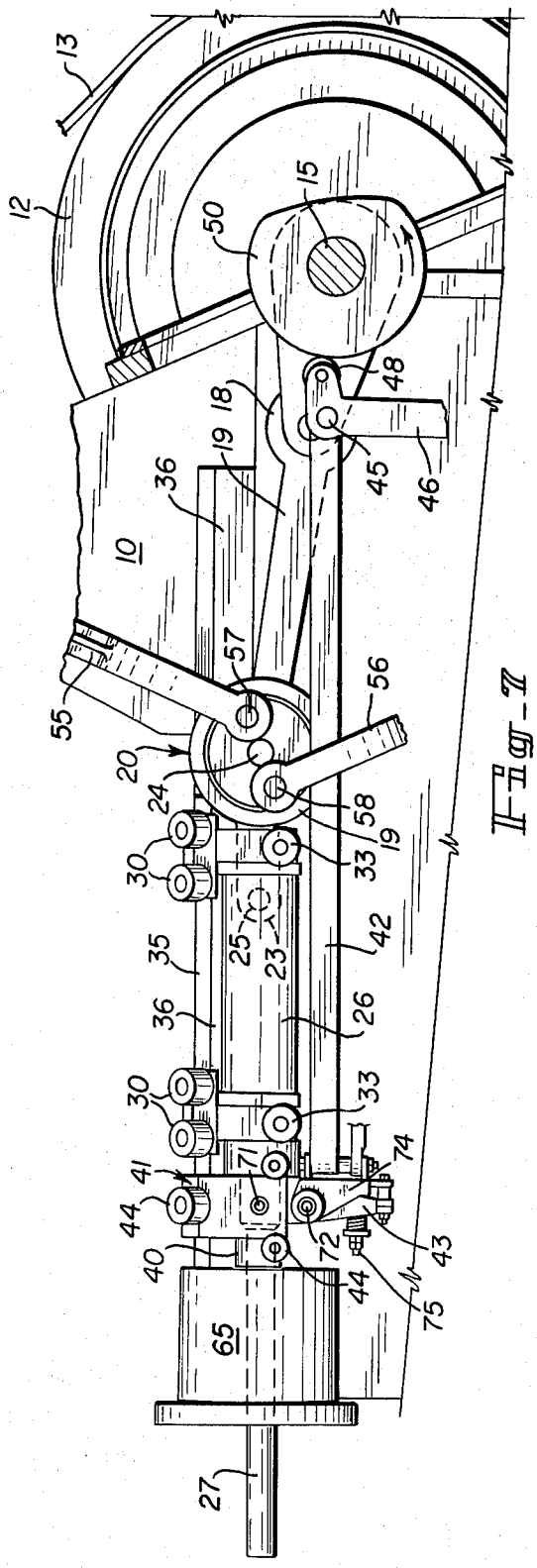


Fig. 7

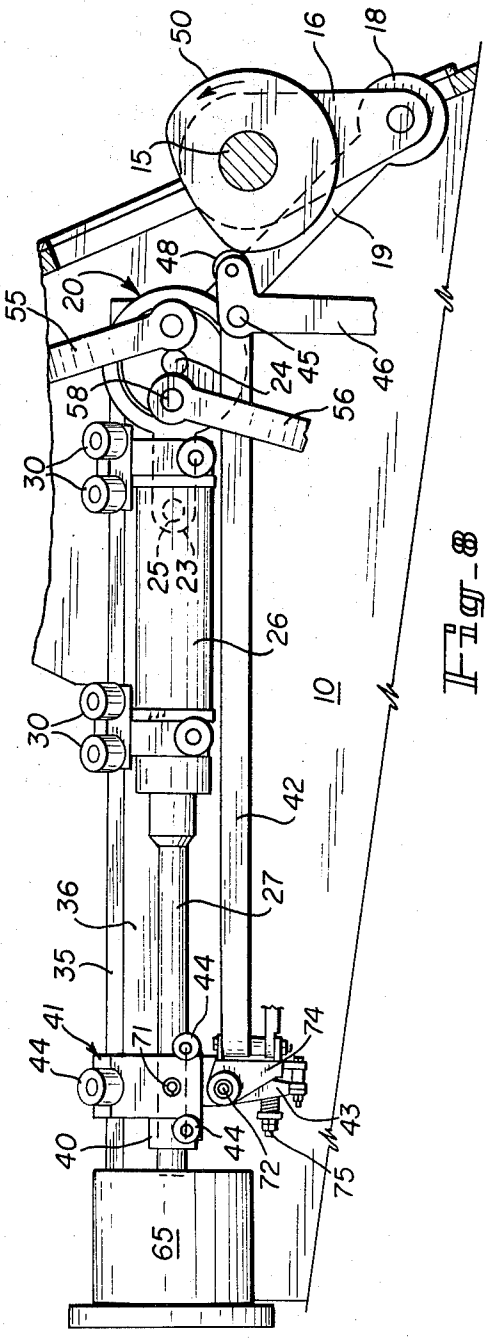


Fig. 8

INVENTOR.
JOHN HARDY MAYTAG
BY
Bertha L. MacGregor
ATTORNEY

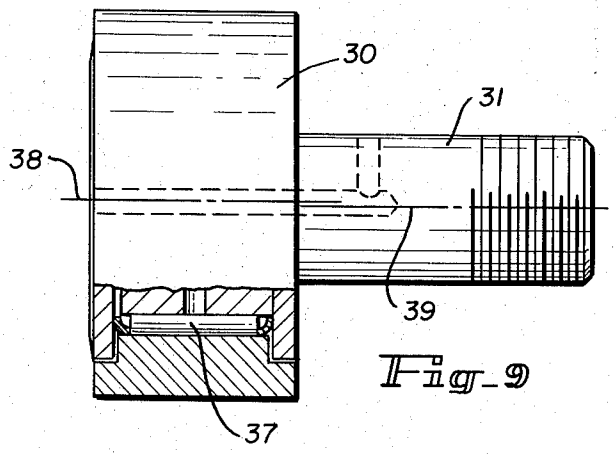


Fig. 9

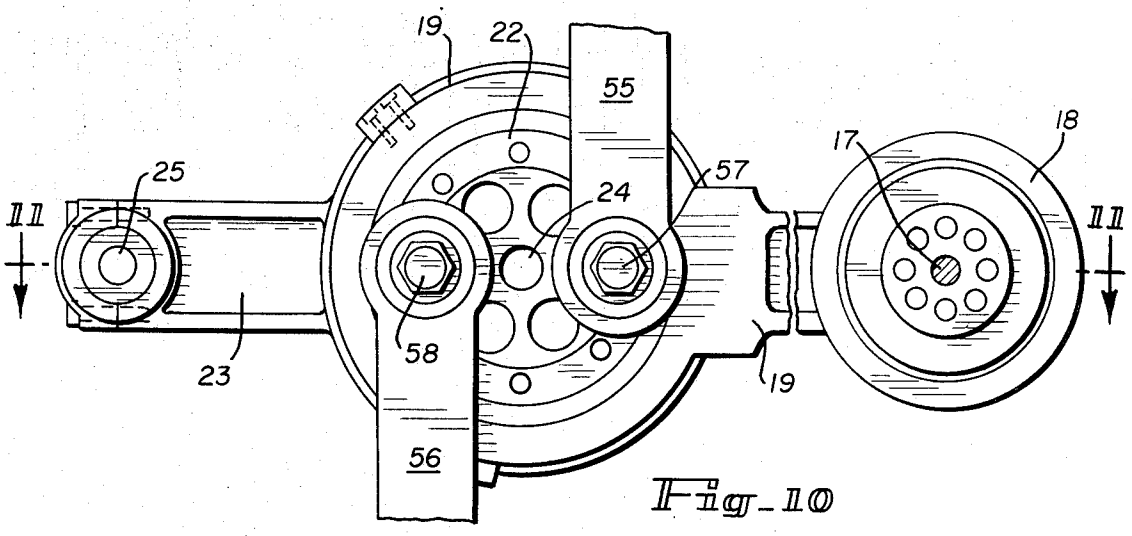


Fig. 10

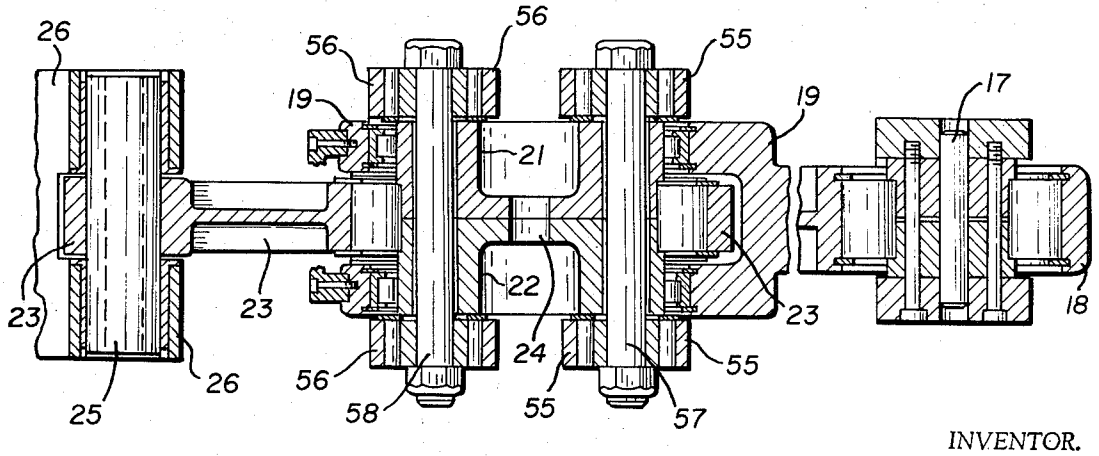


Fig. 11

INVENTOR.
JOHN HARDY MAYTAG
BY
Bertha L. MacGregor
ATTORNEY

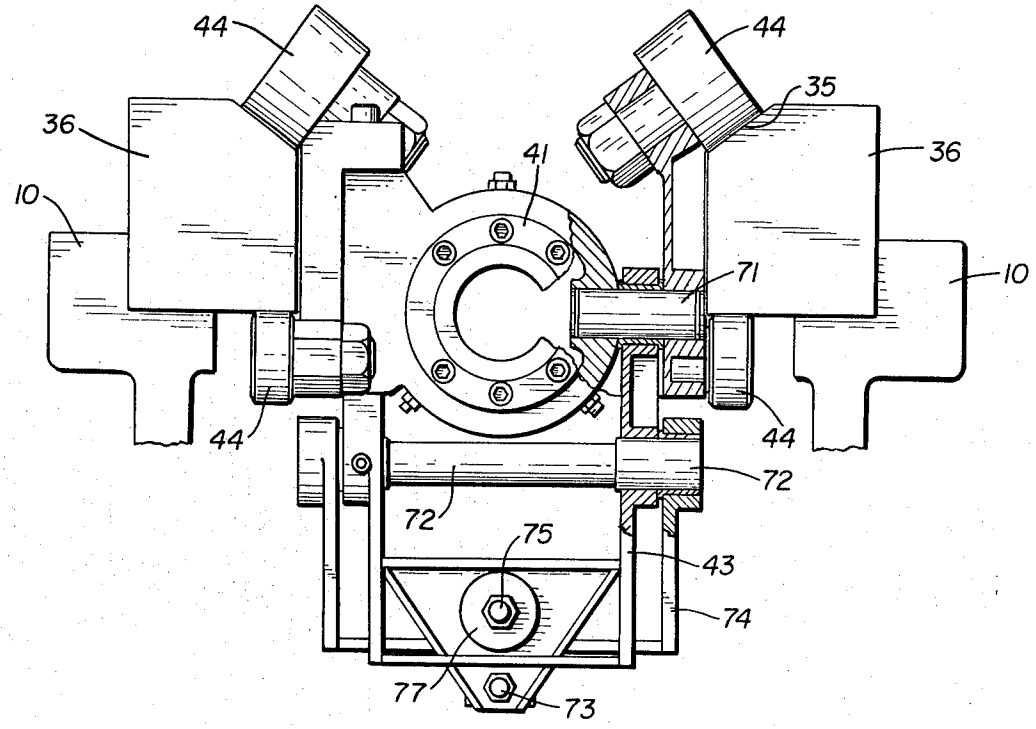


Fig_12

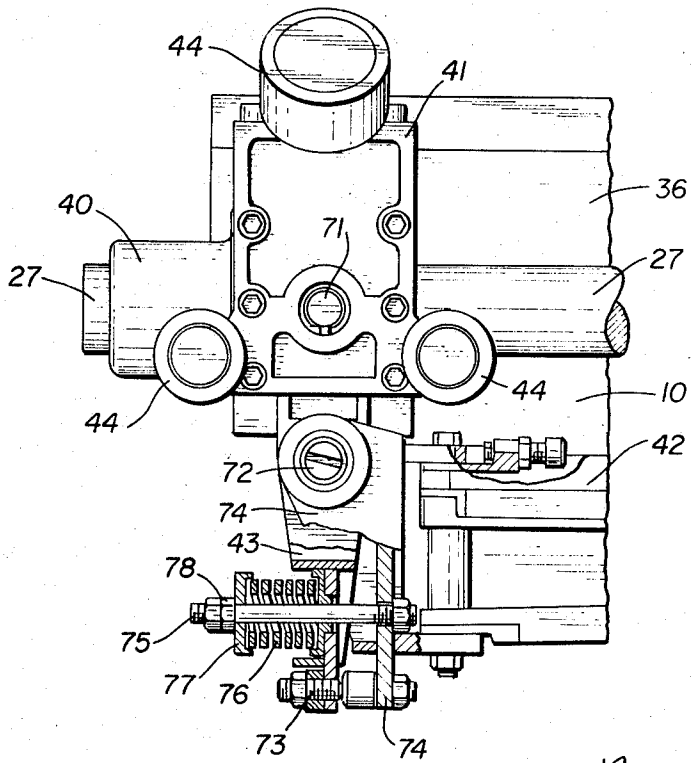


Fig_13

INVENTOR.
JOHN HARDY MAYTAG
BY
Bertha L. MacGregor
ATTORNEY

METAL WORKING CRANK AND SLIDE PRESS MECHANISM

This invention relates to improvements in metal working crank and slide press mechanisms, and is described herein as embodied in a machine for reciprocating parallel members such, for example, as a carriage-mounted ram or punch and a sleeve slidable on the ram to form aluminum cans from a previously manufactured cup. In this operation, the cup is fed into position ahead of the ram, is clamped by the sleeve, between the sleeve and a tool pack housing, and then is forced by the ram through a redraw die and a plurality of ironing dies located in the tool pack housing. In a machine employing a crank and connecting rod for the reciprocatory movement of the ram, the connecting rod must be short in relation to the crank length in order to provide enough time to feed the cup in front of the ram at a reasonable speed, and consequently the connecting rod assumes extremely angular positions relatively to the carriage-mounted ram and exerts heavy side pressure thereon; causing the ram to travel in other than a straight line.

The object of this invention is to provide means for eliminating side thrust exerted by the connecting rod on the ram, to ensure straight line motion of the carriage-mounted ram, and thus consistently produce uniform can walls.

Another object of the invention is to provide means for eliminating conditions which affect adversely the straight line motion of the carriage mounted ram, said means including the mounting of the carriage on wheels which run on the top and bottom surfaces of hardened way strips, and the mounting of the wheels on eccentric axles adjustable to a position so that they grip the way strips with a predetermined amount of pre-load and avoid slack in the wheels.

Another object of the invention is to maintain the straight line motion of the connecting rod by providing means for minimizing deflection in the machine frame and carriage due to temperature differences, and thus to avoid change in the pre-load on the carriage wheels. This object is achieved by arranging the working surfaces of the carriage wheels and way strips on which they travel in a radial pattern relatively to the center of mass of the carriage assembly. By this means, any temperature expansion and contraction will occur radially from the center of mass of the carriage assembly (the axial center of the ram), and by arranging the carriage wheels and faces of the way strips to coincide with this radial pattern, the effect of thermal expansion on the wheel pre-load is minimized.

The aforementioned improvements may be embodied in mechanism for reciprocating various kinds of machine members, as well as the herein described can body forming apparatus including a ram and a redraw sleeve concentric with slidable relatively to the ram, the ram being moved a substantially greater distance in axial directions than the redraw sleeve which surrounds the ram. For example, in a can body making machine, the ram may be moved 28 inches from retracted to extended positions while the redraw sleeve moves only 4 inches from its retracted to extended positions.

IN THE DRAWINGS

FIG. 1 is an elevational side view of can body making mechanism embodying my invention, for imparting reciprocatory movements to a ram and a redraw sleeve concentric with and slidable on the ram, showing a die-containing tool pack housing at the forward or left end of the machine in axial alignment with the ram and sleeve, and showing a motor and pulley wheel at the right end of the mechanism. The ram and sleeve are shown in retracted positions.

FIG. 2 is a top plan view of the mechanism shown in FIG. 1.

FIG. 3 is a transverse vertical sectional view in the plane of the line 3—3 of FIG. 2.

FIG. 4 is a transverse vertical sectional view in the plane of the line 4—4 of FIG. 2.

FIG. 5 is an elevational view, partly in section, of the rear end of the machine.

FIG. 6 is an elevational side view of the mechanism of FIG. 1, with the forward side of the machine omitted, showing the ram and sleeve in partially extended positions.

FIG. 7 is an elevational side view, partly broken away, showing the ram and sleeve in fully extended positions.

FIG. 8 is a view similar to FIG. 7, also partly broken away, showing the ram and sleeve partially retracted in their return movements to the retracted positions of FIG. 1.

FIG. 9 is an elevational side view partly in section of one of the carriage wheels and the stud on which it is mounted, detached from the rest of the machine.

FIG. 10 is an elevational side view on an enlarged scale of the straight line motion mechanism between the connecting rod and the carriage.

FIG. 11 is a horizontal sectional view in the plane of the line 11—11 of FIG. 10.

FIG. 12 is an elevational view, partly in section, of the redraw carriage assembly.

FIG. 13 is an elevational view, partly in section, showing one side of the structure shown in FIG. 12.

In the embodiment of the invention shown in the drawings, a frame 10 has mounted thereon a motor 11 which drives a large pulley wheel 12 by belts 13. The pulley 12 is fixedly mounted on one of a pair of transversely extending axially aligned crank shafts 15 with crank arms 16. The shafts 15 are rotatable in bearing 15' mounted in opposite sides of the frame 10. The crank arms 16 are connected together by a crank pin 17 extending through the bearing 18 of a main connecting rod 19 which terminates at its other end in two parallel transversely spaced apart arms for engaging the circumferential surfaces of cross head members 21, 22, which are parts of the straight line motion assembly designated 20 as a whole in FIGS. 1 and 2 and shown in detail in FIGS. 10 and 11. The pivotal point of the assembly is designated 24. The members 21, 22 are engaged circumferentially by the end of a carriage connecting rod 23 between the arms of the connecting rod 19, as shown in FIG. 11. The carriage connecting rod 23 is pivotally connected at its other end by a pin 25 to a ram carriage 26, in which is mounted a ram or punch 27.

The ram carriage 26 is mounted on a plurality of "cam followers" comprising wheels 30 rotatable on studs 31, at opposite sides of the carriage body 26. The studs 31 are surrounded by the inclined upper ends of supports 32. The lower ends of the supports 32 carry

wheels 33. The wheels 30 and 33 are retained by nuts 34. The wheels 30 travel on the inclined edge surfaces of hardened way strips 36 at opposite longitudinal sides of the machine, and the wheels 33 travel on the bottom surfaces of the strips 36. The working surfaces of the way strips and of the carriage wheels 30 extend radially relatively to the center of mass of the carriage assembly, i.e., the axial center of the ram 27, as indicated by the arrows in FIG. 3.

As shown in detail in FIG. 9, the carriage wheels or cam followers 30 comprise bearings 37, and the center 38 of the bearings is off center relatively to the center 39 of the stud 31 on which the wheels are rotatably mounted. The wheels are adjustable to a position where they grip the inclined surfaces 35 of the way strips 36 with a predetermined amount of pre-load which avoids slack in the wheels.

A redraw sleeve 40 is slidable on the forward portion of the ram 27 and is fastened at its rearward end to a redraw carriage 41. The latter is connected at each of its sides to an elongated redraw sleeve actuating bar 42 parallel to the ram 27 and movable in longitudinal direction independently of the ram. The redraw carriage 41 has pivotally connected thereto a downwardly directed rocker arm 43 provided with rollers 44 which travel on the carriage way strips 36. The rocker arm 43 will be described in detail hereinafter by reference to FIGS. 12 and 13. Each bar 42 is pivotally connected at its rearward end 45 to a cam follower lever 46 which has its lower end mounted on a fixed pivot 47 on the frame 10 and has on its upper end a laterally extending arm shaped to provide a cam follower 48 for contacting a cam 50. Each of the two cams 50 is keyed to one of the crank shafts 15 or may be fastened to or be integral with one of the crank arms 16 to rotate with the shafts 15.

The straight line motion assembly 20 includes a side thrust resisting upper swing lever 55 and lower swing lever 56, both bifurcated at their inner ends so as to straddle the cross head members 21, 22. The upper swing lever 55 is pivotally connected to each of the cross head members 21, 22, as indicated at 57, and the lower swing lever 56 is pivotally connected at 58 to each of the cross head members 21, 22. The upper end of the upper swing lever 55 is pivotally connected to the fixed pivots 59 on frame members 10, and the lower end of the lower swing lever 56 is pivotally connected to the fixed pivots 60 on frame members 10, as shown in FIGS. 1 and 5.

A tool pack housing 65, in a can body making machine, encloses a series of drawing and ironing dies (not shown) through which a work piece such as a cup (not shown) is pushed by the ram 27. In its extended position, the ram 27 passes through the tool pack as shown in FIG. 7.

Referring to FIGS. 12 and 13, the downwardly directed rocker arm 43 is rotatably attached at its upper end to the horizontal center of the redraw carriage 41 by means of rocker pivots 71, and at near its center to a shoe 74 fixedly attached to the actuating bar 42 by means of a rocker shaft 72. An adjustable stop screw 73 engages the shoe end passes the rocker arm 43 and rests against the lower end of the shoe 74. A threaded stud 75 engages the shoe and passes through the rocker arm 43, a suitable spring 76 and a spring retainer 77. The spring 76 is compressed by adjustment of the nut 78 causing the spring through the rocker arm 43 to urge the redraw carriage 41, carrying redraw sleeve 40, to the most forward position permitted by the stop screw resting on the shoe 74. As the actuating bar 42 approaches the forward extreme of its motion, the workpiece or cup (not shown) covering the end of the redraw sleeve 40 strikes the face of the die pack 65, terminating the forward motion of the redraw carriage 41. Further motion of the actuating bar 42 causes the spring to be compressed and the stop screw to withdraw from the stop. By proper adjustment of the stop screw, the motion of the redraw carriage 41 may be arrested as gently as possible, and by means of the spring adjusting nut, the pressure of the redraw sleeve on the cup may be adjusted for proper metal control for the redrawing operation.

The redraw sleeve 40 and actuating bar 42 receive their forward moving power from the rotated cams 50 imparted to the cam followers 48 on levers 46. The return mechanism for imparting rearward movement to the redraw sleeve 40 and actuating bars 42 comprises an air cylinder 66 mounted on a support 67, and a piston rod 68 connected to the bar 42 by the joint 69 and link 70. The air cylinder maintains contact between the cam followers 48 and the cam face. In order that the redraw sleeve 40 will not rebound when striking the bottom of the cup and the redraw die, the redraw sleeve must overtake and pass the ram 27 in its forward motion and must precede the ram sufficiently to have time for proper deceleration before striking the bottom of the cup ahead of the punch. This timed relationship is accomplished by the contour of the cams and the angular relationship of the cams to the crank which operates the ram. The operation of the mechanism for imparting reciprocatory motion to two members, such as the ram 27 and redraw sleeve 40 shown herein, or other parallel members, is as follows: Motor 11 drives the pulley wheel 12 through belts 13; pulley wheel 12 rotates the crank shafts 15 and thereby rotates the two oppositely located crank arms 16 connected by crank pin 17. Rotation of the crank shafts 15 and arms 16 rotates the cams 50.

To move the ram 27 in axial direction toward the tool pack housing 65, the crank arms 16 and connecting pin 17 move bodily in a circular path around the axis of the shafts 15 and move the connecting rod 19, the straight line motion assembly 20, carriage connecting rod 23, ram carriage 26 and ram 27 from the retracted position of FIG. 1 to the partially extended position of FIG. 6, and then to the fully extended position of FIG. 7. After the ram 27 has passed through the tool pack housing 65 as shown in FIG. 7, continued movement of the reciprocating mechanism causes the ram to be retraced to the FIG. 8 position and then returned to the FIG. 1 position.

At the same time, the redraw sleeve 40 is actuated by the cams 50 rotated by cranks 15, 16. The cams 50 are engaged by the cam followers 48 on levers 46 connected pivotally at 45 to actuating bars 42. The sleeve 40 is thereby moved from its retracted position of FIG. 1, to the fully extended position as shown in FIG. 6, where its motion is arrested by contact of the workpiece (carried by the sleeve 40) with the face of the tool pack 65. From the FIG. 6 position, the sleeve 40 is

moved by the cam means above described to the FIG. 7 position while the ram 27 has passed through and beyond the housing 65. The redraw sleeve 40 remains stationary during the travel of the ram through and beyond the tool pack housing 65, as well as during most of the ram's return travel to the FIG. 8 position. From the FIG. 8 position to the FIG. 1 position, the ram and sleeve return to retracted positions.

During the described movement of the connecting rod 19, regardless of its varying extreme angular positions relatively to the carriage-mounted ram, side thrust is eliminated by the three link cross head assembly comprising the members 21, 22 and the levers 55, 56, pivotally connected to the cross head assembly by parallel pivot pins 57, 58, respectively, which extend through the ends of the levers and through the cross head members in positions diametrically equally spaced from the pivotal point 24 of the assembly, whereby straight line motion is imparted to the carriage 26 and ram 27. This straight line motion is maintained uniformly due to the adjustable pre-load on the carriage wheels 30, and the control of temperature changes resulting from the radial pattern in which the bearing surfaces of the wheels and inclined surface of the way strips cooperate.

I claim:

1. Metal working crank and slide press mechanism for reciprocating a member in axial directions in a straight line motion comprising

a. a power driven crank actuated connecting rod,

b. a straight line motion assembly pivotally connected to the connecting rod consisting of a pivotally and bodily movable cross head and side thrust resisting levers extending in opposite directions from the cross head and each pivotally connected at one end to a fixed part of the machine,

c. means pivotally connecting the other end of each of the levers to the assembly at points diametrically equally spaced from the pivotal point of the assembly, and

d. means pivotally connected to the assembly and to the reciprocated member, whereby angular thrust of the connecting rod is translated into a direction in line with the travel of the reciprocated member.

2. The mechanism defined by claim 1, in which the means pivotally connected to the assembly and to the reciprocated member is a second connecting rod which has an end circumferentially engaging the assembly and an opposite end pivotally connected to the reciprocated member.

3. Metal working crank and slide press mechanism for reciprocating a ram in axial directions in a straight line motion comprising

a. a ram,

b. a reciprocable carriage in which the ram is mounted,

c. a power driven crank actuated connecting rod,

d. a straight line motion assembly pivotally connected to the connecting rod consisting of a pivotally and bodily movable cross head and side thrust resisting levers extending in opposite directions from the cross head and each being pivotally connected at one end to a fixed part of the machine,

e. means pivotally connecting the other end of each of the levers to the assembly at points diametrically equally spaced from the pivotal point of the assembly, and

f. a carriage connecting rod connected to the assembly and to the carriage, whereby angular thrust of the connecting rod is translated into a direction in line with the travel of the carriage.

4. The mechanism defined by claim 3, in which the carriage connecting rod has an end circumferentially engaging the assembly and an opposite end pivotally connected to the carriage.

5. The mechanism defined by claim 3, which includes parallel carriage ways at opposite sides of the carriage provided with bearing surfaces inclined downwardly toward each other in planes radially aligned with the center of mass of the carriage and ram, and in which the ram carriage is provided with rotatable wheels which travel on said inclined surfaces.

6. The mechanism defined by claim 3, in which the ram carriage is provided with rotatable wheels mounted adjustably eccentrically on studs fastened to the carriage, and which includes parallel carriage ways at opposite sides of the carriage on which the wheels travel with a predetermined amount of pre-load due to their adjustable eccentricity.

7. The mechanism defined by claim 5, in which the carriage wheels are mounted adjustably eccentrically on studs fastened to the carriage to provide a predetermined amount of pre-load on the wheels as they travel on the carriage ways.

8. The mechanism defined by claim 3, in which the ram carriage is provided with rotatable wheels, and which includes parallel carriage ways at opposite sides of the carriage, some of the wheels traveling on top of the carriage ways and others on the bottom surfaces of the ways.

9. The mechanism defined by claim 8, in which the carriage ways have upper wheel bearing surfaces inclined downwardly toward each other in planes radially aligned with the center of mass of the carriage and ram.

10. Metal working crank and slide press mechanism for reciprocating a ram and a sleeve on the ram in axial directions comprising

a. frame members spaced apart transversely of the machine,

b. parallel carriage ways between the frame members,

c. a ram and a sleeve slidable on the ram,

d. a carriage in which the ram is mounted, the carriage being provided with rotatable wheels for travel on the carriage ways,

e. a power driven crank actuated connecting rod which assumes extreme angular positions relatively to the ram,

f. a straight line motion assembly pivotally connected to the connecting rod consisting of a pivotally and bodily movable cross head and side thrust resisting levers extending in opposite directions from the cross head, each pivotally connected at one end to the machine frame members and pivotally connected at the other end to the assembly at points equally diametrically spaced from the pivotal point of the cross head,

g. a carriage connecting rod pivotally connected at one end to the assembly and at the other end to the carriage,

h. a pair of transversely spaced apart actuator bars each connected to the slidable sleeve,

i. a pair of cams each rotatable with the crank actuated connecting rod,

j. a pair of actuator bar levers each pivotally connected to one of said actuator bars and to a frame member, and

k. cam followers on the actuator bar levers in contact with the cams for slidably moving said sleeve on the ram in predetermined time and speed relatively to the ram, said straight line motion assembly translating the angular thrust of the connecting rod into a direction in line with the travel of the ram and sleeve.

11. The mechanism defined by claim **10**, in which the carriage ways are provided with bearing surfaces inclined downwardly toward each other in planes radially aligned with the center of the mass of the carriage and ram, and in which the ram carriage is provided with rotatable wheels which travel on said inclined surfaces.

12. The mechanism defined by claim **10**, in which the ram carriage is provided with rotatable wheels mounted adjustably eccentrically on studs fastened to the carriage to provide a predetermined amount of preload on the wheels, and in which the ram carriage is provided with bearing surfaces inclined downwardly toward each other in planes radially aligned with the center of mass of the carriage and ram on which said wheels travel.

13. The mechanism defined by claim **10**, in which the sleeve actuator bars are moved in one direction by the cams and cam followers, and which includes compressed air means for moving the actuator bars in the opposite direction and for controlling the contact between the cams and cam followers.

14. Metal working crank and slide press mechanism for reciprocating a ram a ram and a redraw sleeve on the ram in axial directions at different speeds, comprising

a. frame members spaced apart transversely of the machine,

b. parallel carriage ways between the frame members,

c. a ram and a redraw sleeve slidable on the ram,

d. a ram carriage traveling on the carriage ways,

e. a power driven crank actuated connecting rod,

f. a cross head assembly pivotally connected to the connecting rod and including slide thrust resisting levers pivotally connected to the cross head assembly and to the frame members,

g. a carriage connecting rod pivotally connected at one end to the assembly and at the other end to the carriage,

h. a pair of actuator bars,

i. a redraw sleeve carriage connected to the redraw sleeve,

j. a rocker arm pivotally connected to the redraw carriage and to said actuator bars,

k. a pair of cams each rotatable with the crank actuated connecting rod,

l. a pair of actuator bar levers each pivotally connected to one of said actuator bars and to a frame member, and

m. cam followers on the actuator bar levers in contact with the cams for slidably moving said sleeve on the ram in predetermined time and speed relatively to the ram.

15. The mechanism defined by claim **14**, in which the rocker arm is attached to the redraw carriage by rocker pivots, and at near its center to a shoe fixedly attached to the actuating bars by means of a rocker shaft, and said rocker arm is engaged by an adjustable stop screw which rests against the shoe, said shoe being engaged by a threaded stud extending through the rocker arm, a compression spring and spring retainer.

* * * * *