Jan. 7, 1964 C. J. BATH 3,116,780

PRESTRETCH FIXTURE AND COMBINATION THEREOF WITH DRAWING DIE PRESS

Filed Feb. 14, 1962 5 Sheets-Sheet 1

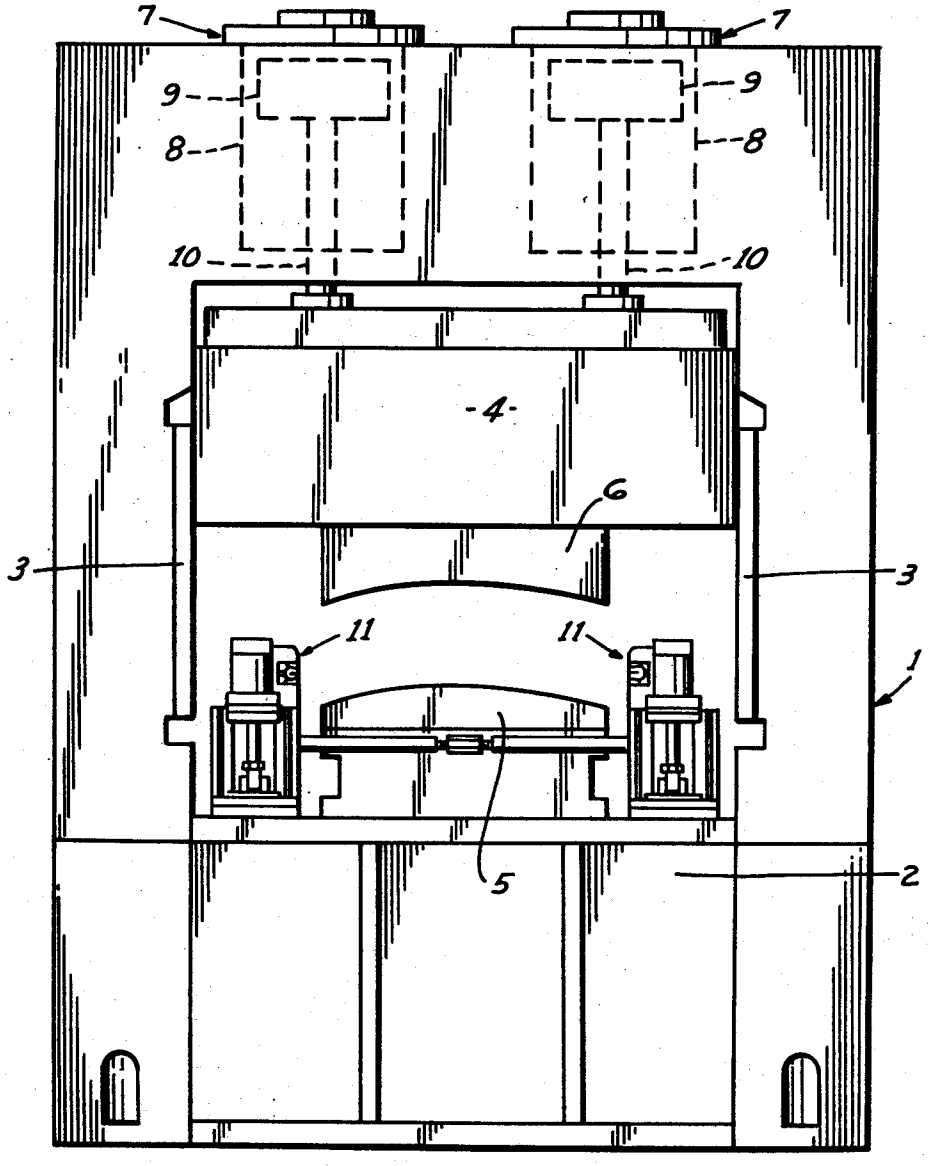


Fig. 1.

INVENTOR.
CYRIL J. BATH
BY
his ATTORNEY.

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PRESTRETCH FIXTURE AND COMBINATION THEREOF WITH DRAWING DIE PRESS

Filed Feb. 14, 1962 5 Sheets-Sheet 2

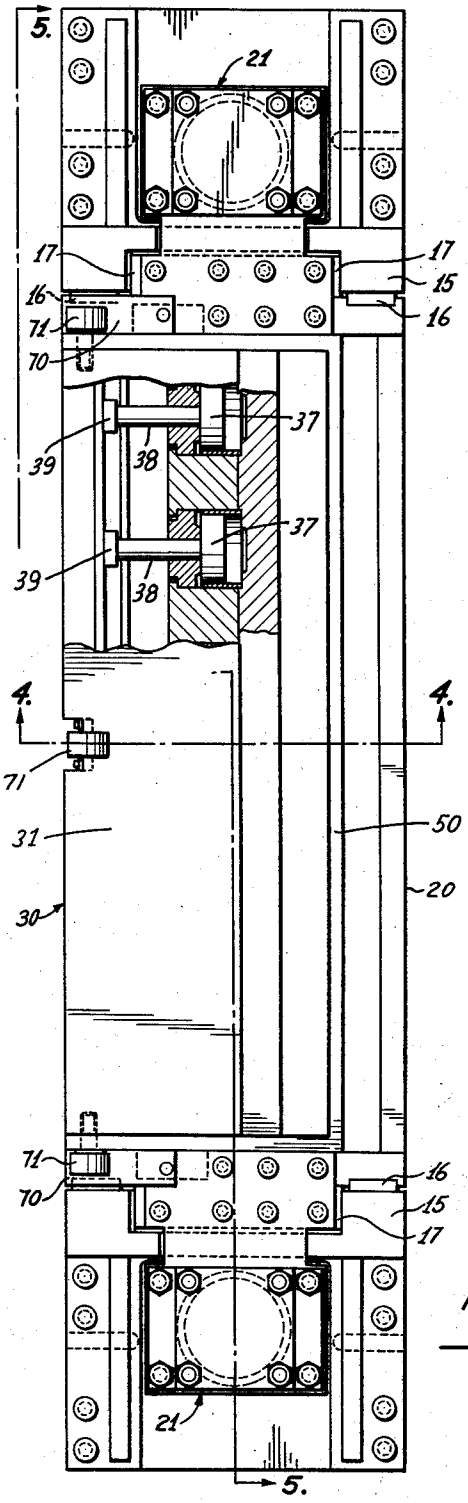


Fig. 2.

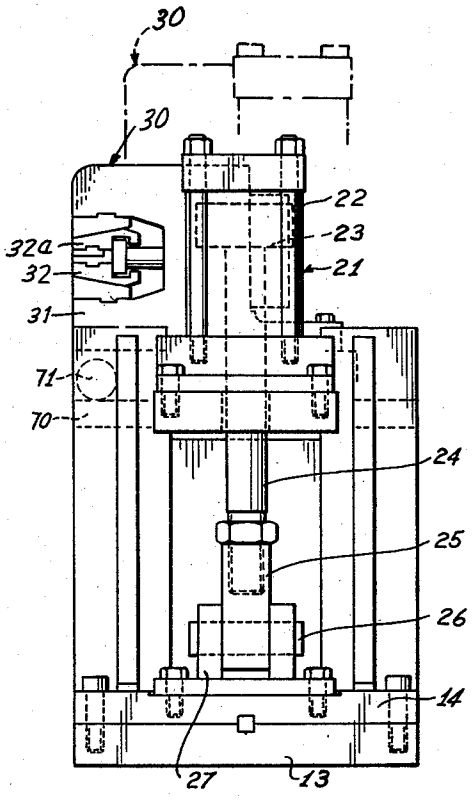


Fig. 3.

INVENTOR.
CYRIL J. BATH
BY Johnston Howard, Jr.
His ATTORNEY.

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PRESTRETCH FIXTURE AND COMBINATION THEREOF WITH DRAWING DIE PRESS

Filed Feb. 14, 1962 5 Sheets-Sheet 3

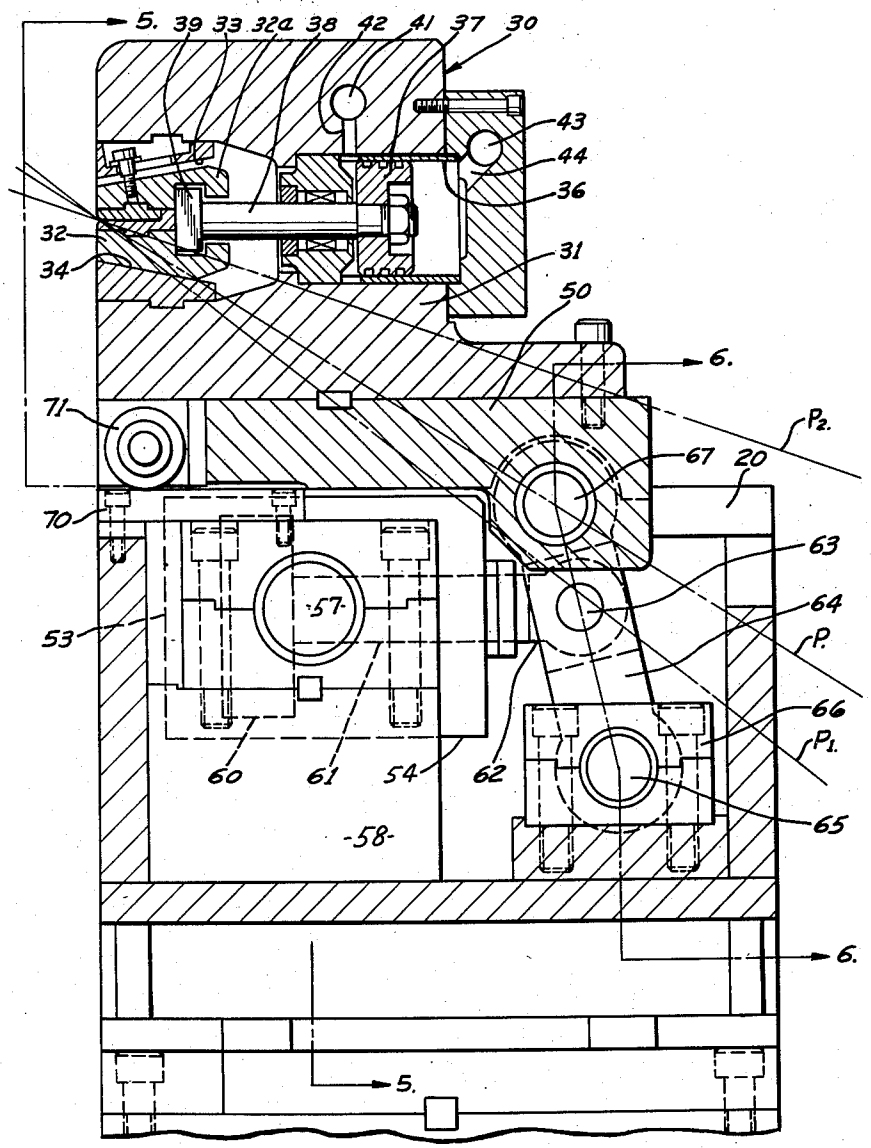


Fig. 4.

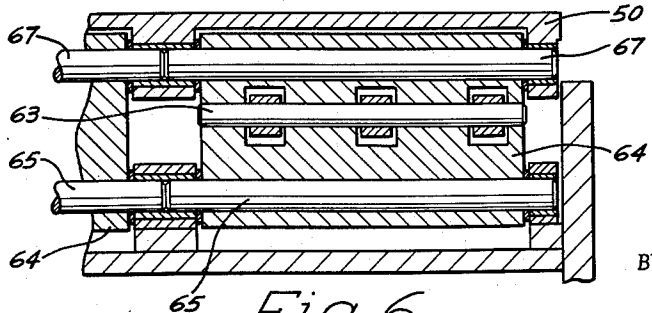


Fig. 6.

INVENTOR.
CYRIL J. BATH
BY John A. Howard
his ATTORNEY.

Jan. 7, 1964 C. J. BATH 3,116,780

PRESTRETCH FIXTURE AND COMBINATION THEREOF WITH DRAWING DIE PRESS

Filed Feb. 14, 1962 5 Sheets-Sheet 4

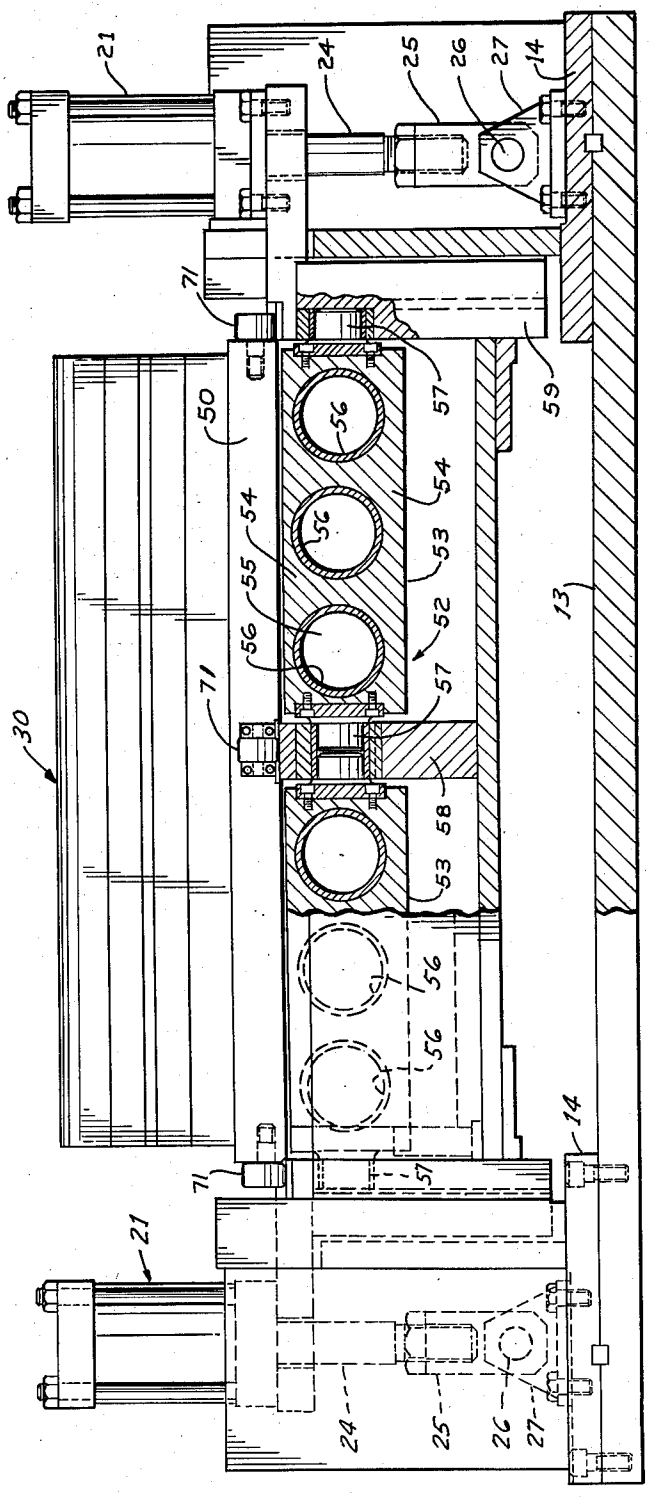


Fig. 5

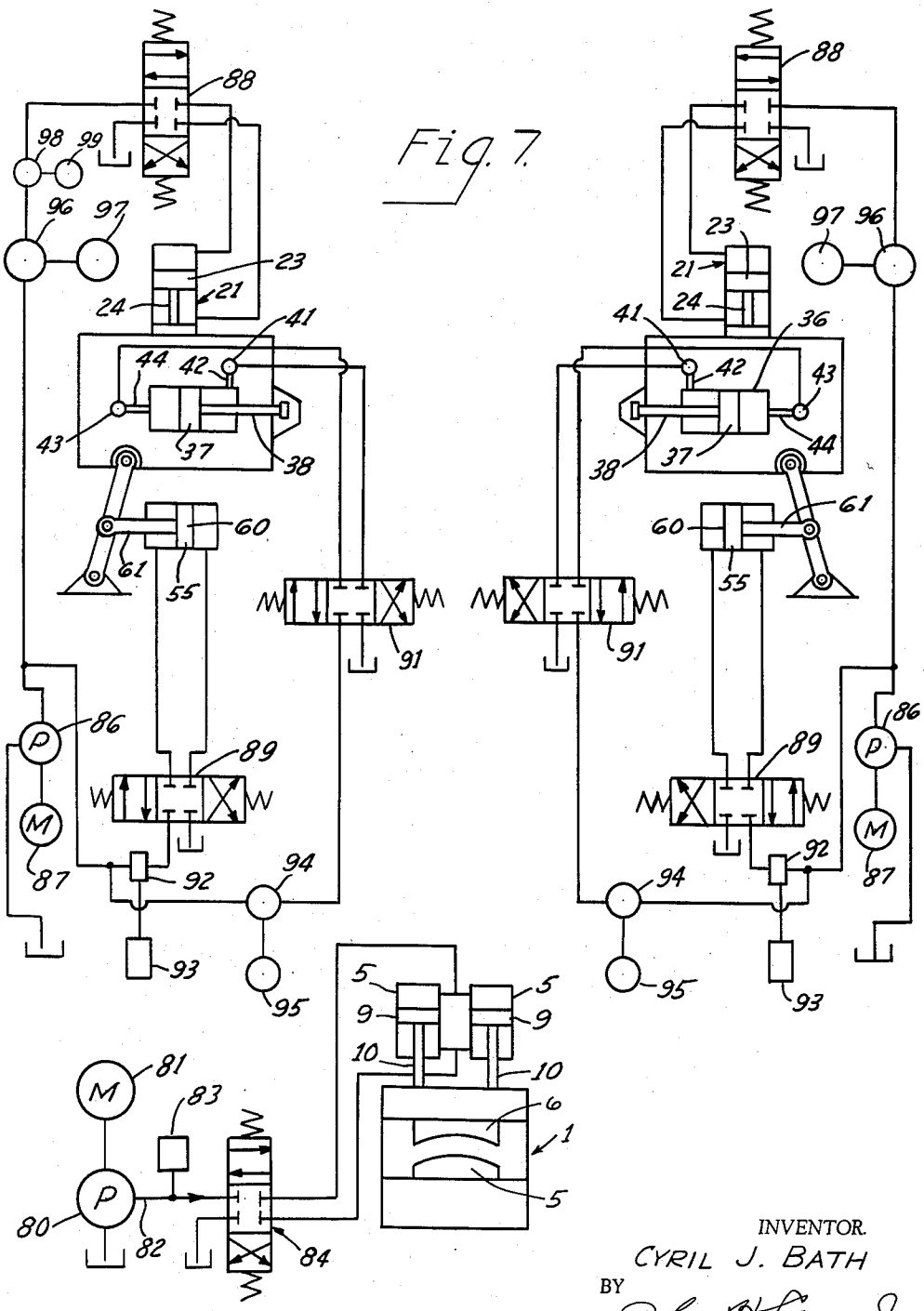
INVENTOR.
CYRIL J. BATH
BY John A. Leonard
his ATTORNEY.

Jan. 7, 1964 C. J. BATH 3,116,780

PRESTRETCH FIXTURE AND COMBINATION THEREOF WITH DRAWING DIE PRESS

Filed Feb. 14, 1962 5 Sheets-Sheet 5

Fig. 7.



INVENTOR.
CYRIL J. BATH
BY
John A. Lennard,
his ATTORNEY.

United States Patent Office 3,116,780 Patented Jan. 7, 1964

3,116,780

PRESTRETCH FIXTURE AND COMBINATION THEREOF WITH DRAWING DIE PRESS

Cyril J. Bath, Chagrin Falls, Ohio, assignor to The Cyril Bath Company, Cleveland, Ohio, a corporation of Ohio

Filed Feb. 14, 1962, Ser. No. 173,310
19 Claims. (Cl. 153—48)

This invention relates to a new and improved prestretch and draw die combination and particularly to a new and improved prestretch fixture forming a part thereof.

In United States Patent of Cyril J. Bath, No. 2,961,028, issued November 22, 1960, there is disclosed a method of die drawing sheet metal stock wherein the stock is prestretched into a range above its elastic limit prior to any drawing action occasioned by cooperation of drawing dies therewith, and is maintained in this range during die drawing, thus rendering the metal more readily drawable in the dies.

In the pending application of Paul Maize, Serial No. 76,806, filed December 14, 1960, there is disclosed a fixture designed for adapting conventional presses, employing a ram operating between upright guideways at its ends, for practicing the method of the above Bath patent. As disclosed in the application, the fixture comprises two prestretch units mounted on the bed of the press at opposite ends of the die path in a direction lengthwise of the ram. These units are arranged to tension the metal endwise of the ram into a range above its elastic limit preparatory to drawing by the dies by means of grippers or gripping heads connected to the ends of the stock and yieldably urged away from each other by hydraulic piston and cylinder assemblages. During the die closure, the gripping heads can move in against the yieldable hydraulic pressure so as to allow the metal to be pulled into the dies endwise of the ram while maintaining the stock tensioned above the elastic limit. To permit this movement of the heads, they are mounted in slideways extending endwise of the ram. The slideways for the heads are arranged on elevators whereby they and the heads can move upwardly and downwardly in relation to the movement of the ram so that the heads can lay the pretensioned stock on the male die during the descent of the female die.

The space between the upright ram guideways on conventional presses is limited in relation to the rated pressure of the press and the size of the part for which the press normally would be used. Accordingly, the prestretch units must be relatively limited in their dimensions in a direction endwise of the ram in order not to limit unduly the effective die space remaining between them. This limited dimension of each unit limits the length of the slideways of the gripping heads. As a result, at higher tensions, the heads tend to cock and bind in the slideways, thus greatly increasing the resistance to movement of the heads toward the dies by the stock over that which is normally imposed by the hydraulic piston and cylinder assemblages. As a result, accurate control of the tension to which the stock is subjected is very difficult to maintain, and not infrequently the stock is overstretched.

In accordance with the present invention, a fixture is provided which fits within the space between the ram guideways without unduly limiting that remaining for the dies. The stretch heads are so mounted, free from slideways, that they can be moved by the stock against the resistance of the hydraulic stretch forming piston and cylinder assemblages wtihout binding. Accordingly, substantially all of the yieldable resistance to movement of the heads by the stock is that due directly to the piston and cylinder assemblages and is directly related to the pressure of the hydraulic fluid in the cylinders of the assemblages. With the stock thus directly responsive to

the pressure in the cylinders due to reduction of frictional and binding resistance between the stretch forming heads and their mountings to negligible amounts, accurate control of the tension on the stock can be maintained at all times.

Again, depending upon the shape of the die cavity, it is desirable that the tension applied by the stretch heads at one end of the stock be controllable independently of that applied by the stretch heads at the opposite end. Further, the rise and fall of the elevators should be controlled independently of the rise and fall of the die, and the tension applied by the heads, so that the stretch heads at times can be lowered to substantially lay the entire piece of stock onto the male die in stretched condition preparatory to engagement of the stock by the female die, and the drawing of the stock by cooperation of the dies. At other times, it may be desirable that the tensioned stock be lowered so that it is spaced from both dies initially and engaged substantially at the same time by both dies.

Again, after the ram is seated on the forming stroke, it may be desirable to lower the stretch forming heads still farther to impart an overstress adjacent the gripped margins of the stock. At times, advantages are obtained by hydraulically locking one stretch forming assemblage during all or part of the stretching operation, the yieldable tension being applied by one stretch head only.

In accordance with the present invention, the stretch forming pressure applied to the stretch forming assemblage at one end of the stock is controlled independently of that at the other end, each assemblage having its own independent and separate circuit, including a separate motor driven pump and control valve means. Furthermore, at each end of the stock the elevators are raised and lowered by hydraulic means separately controllable independently of the ram and independently of the elevator means at the opposite end. The ram itself is provided with its own hydraulic circuit whereby it can be controlled independently. The controls of all the circuits may be controlled by a common control circuit in preselected coordinated cycles, as desired.

Various specific objects and advantages of the invention will become apparent from the following description wherein reference is made to the drawings illustrating a preferred embodiment of the invention, wherein:

FIG. 1 is a front elevation of a ram with the prestretch fixture of the present invention installed therein;

FIG. 2 is a top plan end of one of the prestretch units on the prestretch fixture;

FIG. 3 is a front elevation of the unit illustrated in FIG. 2;

FIG. 4 is an enlarged vertical cross-sectional view of the unit illustrated in FIG. 1, and is taken on the line 4—4 of FIG. 2;

FIG. 5 is a vertical longitudinal sectional view of the unit illustrated in FIG. 2 taken on lines 5—5 in FIGS. 2 and 4, respectively, part thereof being shown in elevation for clearness in illustration;

FIG. 6 is a fragmentary vertical longitudinal sectional view taken on the line 6—6 in FIG. 4, part thereof being shown in section for clearness in illustration;

FIG. 7 is a diagrammatic illustration of the apparatus of FIGS. 1 through 6, showing the hydraulic circuitry therefor.

Referring to the drawings, the invention is shown as incorporated in a conventional hydraulic press, indicated generally at 1, comprising a bed 2 with upright guide members 3 arranged at the corners and guiding a ram 4 for vertical reciprocation. The bed supports a male die 5 which is convex upwardly, and the ram supports a complementary female drawing die 6 which is concave downwardly. The dies 5 and 6 are conventional drawing dies which define, when closed, a concavo-convex pat-

tern or patterns into which the metal is drawn by the dies. Conventional holddown devices are not employed.

The ram is driven on its forming and return strokes by means of a hydraulic piston and cylinder assemblage indicated generally at 7, comprising cylinders 8 and pistons 9 having piston rods 10 secured to the ram. Mounted on the bed 2 is a prestretch fixture, indicated generally at 11, which comprises two units 12 arranged on the bed 10 between the guideposts 3, one unit at each end of the male die 5. Since the units are the same in form and function, only one unit 12 will be described in detail.

Referring particularly to FIGS. 2 through 6, each unit comprises a base plate 13 on the ends of which are mounted guide supports 14 which support upright guides 15. Each guide 15 has upright slide surfaces 16 facing inwardly of the unit in a direction forwardly and rearwardly of the bed, and upright guide faces 17 at right angles to the surfaces 16. Mounted for vertical reciprocation in the slideways is a stretch head elevator 20 which is guided thereby for movement upwardly and downwardly while the elevator itself remains parallel to its starting position.

For moving the elevator 20 upwardly and downwardly, suitable piston and cylinder assemblages 21 are provided, one at each end of the elevator. Each assemblage comprises a cylinder 22 mounted in fixed position on the carriage. A piston 23, having a piston rod 24, is reciprocable in the cylinder. The cylinder 22 is arranged so that the piston rod extends downwardly and at its lower end carries a tongue 25 by which it is pivotally connected by a horizontal pivot 26 to a suitable yoke 27 which is fixedly secured to the base 14 of the associated guideway. Thus, upon introduction of the hydraulic pressure fluid to the rod ends of the cylinder 22, they move the elevator downwardly, and by introduction of the fluid to the head end of the cylinders, they move the elevator 20 upwardly. These movements are under yieldable hydraulic pressure and controllable independently of the operation and control of the ram, piston and cylinder assemblage 7. Thus the elevators can be raised and lowered in preselected variable relation with respect to the rise and fall of the ram.

In order to stretch the stock into a range above its elastic limit independently of the dies, suitable grippers or heads 30 are provided, one for each unit 11. Each head comprises an elongated body 31 which endwise extends forwardly and rearwardly of the press bed, and thus transversely of the direction in which the stock is to be tensioned. Each head has complementary gripping jaws 32 and 32*a* which are cooperable with cam surfaces 33 and 34 so that when the jaws are moved toward the dies they can approach each other and grip the stock. Each pair of jaws extends substantially the full length of the head. In order to close its jaws, each head is provided with a plurality of cylinders 36 in which are provided pistons 37 having piston rods 38. The rods 38 are connected by enlarged heads 39 to the jaws 32 and 32*a* for causing them to move along the cam surfaces 33 and 34 away from the dies for moving the jaws apart from each other and for moving the jaws toward the dies for forcing them into firm gripping engagement with the stock. A plurality of such piston and cylinder assemblages are provided, three being employed in the form illustrated. A common manifold 41 is provided and is connected by individual ducts 42 to the rod ends of the cylinders 36. A common manifold 43 is connected by individual ducts 44 to the head ends of the cylinders 36. Thus all jaw operating piston and cylinder assemblages can be operated concurrently causing the jaws to grip the stock.

As mentioned hereinbefore, it is desirable that each stretch head 30 be arranged so that it can move toward and away from the dies under the yieldable resistance of the hydraulic stretch forming pressure, without binding and with a minimum or negligible amount of frictional stresses. For this purpose, each head is mounted on a carriage or support 50 which is mounted on the elevator 20 for movement toward and away from the adjacent ends of the die. In order to mount the carriage 50 on the elevator 20 for movement toward and away from the die or the path of the ram in a generally horizontal plane, while under the yieldable restraint of the hydraulic pressure, stretch forming means are provided. These means include, mounted on the elevator 20, a stretch forming assemblage. In the form illustrated, they include six piston and cylinder assemblages. For convenience in making standard units which can be combined into prestretch units for different widths of sheets, the cylinders of the assemblages are preferably provided in banks of three. The assemblage illustrated, indicated generally at 52, comprises duplicate banks 53. Each bank 53 comprises a single rigid body 54 in the form of a block of metal having three radially spaced parallel cylinders 55 bored therein with their axes in a common horizontal plane. The cylinders are provided with liners 56. The body 54 is provided at its ends with trunnions 57 for rocking about a horizontal axis extending lengthwise of the head. The trunnions 57 are rockably supported in suitable uprights 58 and 59 which are rigid with the elevator 20.

Each cylinder 55 carries a piston 60 with a piston rod 61. The rods extend generally horizontally and each has a tongue 62 at its outer end by which the rod is pivotally connected by a pivot 63 to an associated rocking link 64, two of which are used with six cylinders 55. The links 64 are arranged in an approximate upright position. At their lower ends they are provided with pivots 65 which are mounted for rocking about their pivotal axis in suitable bearings 66, which are in fixed relation to the elevator 20. As mentioned, in the form illustrated, two links are provided for each unit.

At their upper ends, the links 64 are provided with pivots 67 which, at their ends, are connected to suitable bearing portions on the carriage 50 for rocking relative thereto. The pivots 63, 65 and 67, and also the trunnions 57, are horizontal and parallel to each other.

At that edge of the elevator 20 adjacent the dies, the elevator is provided with upwardly facing trackways 70, one near each end of the elevator and one near the midportion thereof. The trackways extend toward and away from the dies. The carriage 50 is provided with rollers 71 which normally rest on the trackways 70 respectively.

The position of the stretch head illustrated in FIGS. 3 and 4 is the innermost position in which the rollers 71 are closely adjacent that edge of the elevator adjacent the dies. When in this position, the links 64 are in a rotated position slightly past the vertical in a direction toward the dies. When they are in this position, the pistons 60 are in their most nearly retracted position. Upon introduction of pressure fluid the head ends of the cylinders 55, the pistons 60 are thrust to the right in FIG. 4, thereby swinging the links 64 counterclockwise about the pivots 65. During this swinging movement, the axes of the pivots 63 rise slightly above the horizontal until the links 64 are upright, and then lower again to a position at the same level as the pivot had in the starting position. Since the trunnions 57 support the cylinders 55 for rocking about a horizontal axis, this component of vertical movement of the pivots 63 is compensated without causing any binding stresses.

The carriage 50 is free to rock about the axes of the pivots 67. The axes of the pivots 63 are preferably about two thirds of the way from the axes of the pivots 65 toward the axes of the pivots 67 so as to obtain the benefits of a multiplying factor of the force as pressure fluid for stretch forming is admitted to the piston and cylinder assemblages 52.

When pressure fluid is supplied to the head ends of the cylinders 55, it urges the pistons 60 to the right in FIG. 4, thus causing the links 64 to swing clockwise about the axes of the pivots 65, and thereby pull the carriage 50 to the right. As a result of the tension on the stock and

the force applied to the links, turning moments are imposed on the carriage 50.

Assuming the line of reactionary pull of the stock is along the line P through the outer edge of the gripping jaws and the axes of the pivots 67, no turning moment is imposed on the head 30 and carriage 50. If the line of reactionary pull is at a greater angle to the horizontal so that it falls along the line P–1, which is below the axes of the pivots 67, then there is a turning moment on the head 30 and carriage 50 tending to rock them upwardly and clockwise about the axes of the pivots 67. These conditions seldom occur. Generally the line of reactionary pull of the stock through the edge of the gripping jaws falls above the axes of the pivots 67, as indicated by the line P–2. Therefore, it imposes a turning moment on that head about the axes of the pivots 67, which moment is counterclockwise in FIG. 4. This turning moment is resisted and equalized by the reactionary forces of the rollers 71 bearing on the trackways 70. Thus, no appreciable binding stresses are imposed on the carriage 50 resisting its movement along the trackways. There are no elongated slideways supporting it and hence, it cannot cock and produce binding stresses.

It is apparent that with a length of stock gripped at both ends by the gripping heads of the units, then by introduction of pressure fluid to the head ends of the cylinder assemblages 55, tension can be applied to the stock equivalent to the pressure of the fluid, binding, sliding, locking and frictional stresses being negligible. The tension on the stock is in a substantially fixed proportional relation to the fluid pressure applied to the pistons 60.

In the operation of the fixture, both units may be operated concurrently, or one may be hydraulically locked so the stock is stretched from one only while anchored in fixed position relative to the dies in a direction endwise of the ram. Further, they may be operated at different pressures and speeds. Each head can be raised and lowered by means of its elevator independently of the other. Each has its own separate and independent hydraulic circuit and source.

For purposes of illustration, the units and ram are shown as controlled manually by remote control valves and circuitry, as illustrated in FIG. 7. As therein shown, the pressure for fluid for the operation of the ram is supplied by a suitable pump 80 driven by a motor 81 having its pressure side connected to assemblages 7 by a line 82 through a remotely settable pressure control regulator 83 and solenoid operated valve 84. The valve 84 can hydraulically lock the assemblages 7, or supply pressure to the head ends of both concurrently for forcing the ram downwardly while venting the rod ends. The valve 84 may be set to reverse the flow of hydraulic fluid for lifting the ram.

Since the circuitry for operating each stretch forming unit is separate and distinct from that of the other, each having its own complete circuit and fluid pressure source, only one will be described for purposes of illustration. Each unit is supplied with hydraulic pressure fluid from a pump 86 driven by a motor 87. The pressure is supplied to the opposite ends of the elevator assemblages 21 through a suitable solenoid operated control valve 88 which can hydraulically lock the assemblages 21 or admit pressure fluid to one end and vent the other end concurrently to sump.

The pump 86 is also connected through a suitable control valve 89, which supplies the pressure fluid to the cylinders 55 of the hydraulic stretch forming piston and cylinder assemblages described. This valve is arranged so that the flow of hydraulic fluid to the opposite ends of the assemblages can be reversed, the ends opposite the pressure ends being connected to sump. When the valve 89 is in an intermediate position, the cylinders 55 can be hydraulically locked so that the associated unit can function merely as an anchorage and all the stretching can

be performed by the opposite unit. The pump 86 also supplies pressure fluid through the solenoid operated valve 91 to the cylinders 36 of the gripper jaw operating assemblages. The pressure and flow of the fluid delivered to the piston and cylinder assemblages may be regulated by any conventional remotely controlled hydraulic pressure and flow regulators. For example, a settable pressure regulator 92 which may be remotely controlled by a driving motor 93, may be provided between the valve 89 and the pressure side of the pump 86. A similar regulator 94 operated by a remotely controlled motor 95 may be interposed between the pressure side of the pump 86 and the valve 91. A like pressure regulator 96 remotely controlled by a motor 97 and a flow regulator 98 controlled by a motor 99 may be interposed between the pump 86 and the valve 88.

The controls for the valves and regulators of both units are operable from a common panel, not shown, for convenience of the operator.

Merely by manipulation of the valves and regulators, the operator can select the following: the time during which the metal is stretched sufficiently within the elastic range; the amount of elongation imparted to the metal preparatory to closure of the dies thereon; the amount, if any, to which the metal may be laid on the male die by lowering one or the other, or both, of the elevators preparatory to drawing of the stock by and between the dies; the rates of lowering the elevators individually as the metal is pulled into the dies and downwardly around the male die, not only by the stretch forming assemblages but also by the action of the remale die in the drawing operation; and the operation of the male and female dies for drawing the stock by movement of both heads 3 or, by locking one and causing the other to move inwardly and outwardly, as required by the change of the overall length of the stock, while yieldably resisted by the hydraulic pressure in the cylinders 55.

The stretch forming pressure applied to the stock and its direction and manner of application thus can be predetermined or varied under accurate control, both prior to and during the forming operation of the stock by the dies.

Having thus described my invention, I claim:

1. In a drawing press and prestretch unit combination, a ram movable along an upright path, ram power means for driving the ram, a frame at one side of the ram path, an elevator thereon movable along a predetermined path to raised and lowered positions, elevator power means for moving the elevator to said positions, selectively, a stock gripper, supporting means supporting the stock gripper on the elevator for movement therewith to raised and lowered positions and for movement relative thereto in opposite directions transversely of said ram path, said gripper, ram, and elevator being movable independently of each other, yieldable gripper power means on the elevator and connected to the supporting means for yieldably urging the gripper in one of its said directions of movement transversely of said path, said ram power means, elevator power means, and gripper power means each being operable independently of the others for effecting said movements of the gripper, ram, and elevator independently of each other, and elevator control means operable for controlling the operation of the elevator power means so as to vary the speed of lowering of the elevator independently of the speed of lowering of the ram.

2. The structure according to claim 1 wherein the elevator power means comprises a fluid pressure operated piston and cylinder assemblage, and the control means includes settable valve means for varying the rate of flow of pressure fluid from a source to the assemblage.

3. A prestretch unit comprising a frame, an elevator thereon movable along a predetermined path to raised and lowered positions, elevator power means for moving the elevator to said positions, selectively, a power operated

stock gripper, a support supporting the stock gripper, connection means connecting the support on the elevator for movement therewith to its said raised and lowered positions, for movement relative thereto in opposite directions transversely of said predetermined path normally in a substantially horizontal transverse path, and for swinging movement relative thereto upwardly from said transverse path and downwardly toward said transverse path about a horizontal pivotal axis extending transversely of said paths, said movements being independent of each other, and yieldable power means on the elevator and connected to the support for yieldably urging the gripper in one of said directions.

4. The unit according to claim 3 wherein interengageable means on the support and elevator constrain the support from swinging downwardly relative to the elevator below said transverse path about said horizontal axis.

5. A prestretch unit comprising a frame, an elevator thereon movable along a predetermined path to raised and lowered positions, elevator power means for moving the elevator to said positions, selectively, a power operated stock gripper, a supporting means supporting the stock gripper and carried on the elevator for movement therewith to its said raised and lowered positions and for movement relative thereto in opposite directions transversely of said path, said movements being independent of each other, link means, pivot means pivotally connecting the link means to the elevator for swinging of the link means relative to the elevator about a horizontal axis extending transversely of said predetermined path and of said directions, and additional pivot means connecting the support and link means for swinging of the support relative to the link means about a horizontal axis, spaced from, and parallel to, the first mentioned axis, in the different swung positions of the link means relative to the elevator, yieldable power means on the elevator and operatively connected to the support for yieldably urging the support, and thereby the gripper, in one of said directions transversely of the path.

6. The structure according to claim 5 wherein said gripper is elongated parallel to the axes of said pivot means, and said link means comprise a plurality of rigid links each of which is elongated endwise of its pivotal axis, and said cylinders are arranged in groups, said groups have their pistons connected to different links, respectively.

7. The unit according to claim 5 wherein the yieldable power means are arranged to apply their yieldable force to the link means and thereby yieldably urge the support in said one direction.

8. The unit according to claim 7 wherein the yieldable power means are positioned to apply their yieldable force to the link means generally horizontally in said one direction at a location between said axes.

9. The structure according to claim 8 wherein the yieldable power means comprises a plurality of cylinders, means supporting the cylinders on the elevator for rocking relative thereto about a common horizontal axis, pistons in the cylinders, respectively, rods on the pistons connected to the link means at said location, which location is such that the axes of the individual cylinders remain approximately horizontal and coplanar in all operating positions of their pistons.

10. The unit according to claim 8 wherein the said location is nearer to the second mentioned pivotal axis than to the first mentioned pivotal axis.

11. The structure according to claim 5 wherein said horizontal axes are positioned so that the swinging axis of the link means and the support is above the swinging axis of the link means and the elevator and moves approximately horizontally as the link means swings relative to the elevator between the operating limits of the link means.

12. A prestretch forming unit for stretching sheets of metal stock comprising a frame, an elevator thereon movable along a predetermined generally upright path to raised and lowered positions, elevator power means for moving the elevator to said positions, selectively, a power operated stock gripper, a support supporting the stock gripper on the elevator for movement therewith to its said raised and lowered positions for movement relative thereto in opposite directions transversely of said path, and for swinging movement upwardly and downwardly relative thereto, said movements being independent of each other, yieldable power means on the elevator and connected to the gripper for yieldably urging the gripper in one of said directions transversely of said path for tensioning the metal, a pivotal connection means connecting the support to the elevator for said swinging movement of the support relative to the elevator about a horizontal axis extending transversely of said directions and positioned at a level below the gripper, whereby a turning moment is imposed on the support by the stock gripper when the gripper is operative to tension a length of stock which moment urges the gripper to swing downwardly, and roller means, having axes parallel to said horizontal axis, interposed between the support and elevator in spaced relation to the horizontal axis in rolling engagement with the elevator, and constraining the support from being swung by said moment in a downward direction beyond a predetermined starting position.

13. A drawing press and stretch forming fixture combination, including a press bed, upright guide frame members on the bed, a power driven ram mounted on, and guided by, the guide members for reciprocation in a generally upright path toward and away from the bed, complementary male and female drawing dies defining, when closed, a concavo-convex pattern, one of the dies being mounted on the ram for movement in opposite directions therewith parallel to the closed position of the one die, the other die being mounted on the bed, stretch forming units arranged at opposite sides of the path of the dies, each unit including a stock gripper adapted to engage a margin of a length of stock for applying tension to the stock along one dimension of the stock when the grippers are urged relatively away from each other, preparatory to and during the drawing of the stock by the cooperation of the dies, each unit including an elevator, power means for raising and lowering the elevator relative to the bed, a support supporting the associated gripper on the elevator for movement relatively toward and away from the path of the dies, a link, a first pivot means pivotally connecting the support to the link at one location along the length of the link for swinging of the support relative to the link about a first horizontal axis extending transversely of said dimension, a second pivot means connecting the link at a second location spaced from said one location, to the elevator for swinging of the link relative to the elevator about a second horizontal axis parallel to the first horizontal axis, and yieldable power means operatively interconnecting the link and elevator for yieldably urging the link to swing about the second axis in a direction for moving the support and gripper away from the path of the dies, first control means for controlling the yieldable power means of each unit, and additional control means for varying the operation of the elevator power means of each unit independently of the elevator power means of the other unit and each independently of operation of the ram to cause descent of each elevator at preselected rates independently of the rate of descent of the other elevator and of the ram.

14. A drawing press and stretch forming fixture combination, including a press bed, upright guide frame members on the bed, a power driven ram mounted on, and guided by, the guide members for reciprocation in a generally upright path toward and away from the bed, power means for driving the ram complementary male and female drawing dies defining, when closed, a concavo-convex pattern, one of the dies being mounted on the ram for movement in opposite directions therewith parallel to the closed position of the one die, the other die being mounted on the bed, a pair of stock gripping

units arranged at opposite ends of the bed, each unit including a support, a gripper mounted thereon, said grippers being arranged to engage opposite margins of a piece of stock for applying tension thereto along one dimension of the stock when the grippers are urged relatively away from the path of the dies, each unit including an elevator, means supporting the support of the unit on the elevator for movement upwardly and downwardly therewith and for movement relative thereto toward and away from the dies, elevator power means for the elevators, respectively, for raising and lowering the elevators, stretch forming piston and cylinder assemblages connected to the supports, respectively, for yieldably urging the grippers away from the path of the dies and means for controlling the operation of the elevator power means to cause the elevators to operate in different preselected speed relations to the speed of movement of the ram.

15. The combination according to claim 14 wherein each elevator power means comprises an elevating piston and cylinder assemblage, hydraulic circuit means for supplying pressure fluid thereto and to the stretch forming piston and cylinder assemblage of the gripper supported on its associated elevator, and control valve means are provided for controlling the elevating piston and cylinder assemblage of each elevator independently of the stretch forming piston and cylinder assemblage of the same elevator.

16. The structure according to claim 14 wherein the means for controlling the operations of the elevator power means are operable to cause operation of the elevator power means of one gripper unit independently of the operation of the elevator power means of the other gripper unit.

17. The structure according to claim 14 wherein hydraulic circuits are provided for the stretch forming piston and cylinder assemblages, respectively, each circuit includes a pump and is separate from, and independent of, the circuit of the other stretch forming assemblage and operable independently thereof, and each circuit includes control means for controlling the operation of the stretch forming piston and cylinder assemblage of the associated circuit independently of the operation of the stretch forming piston and cylinder assemblage of the other circuit.

18. The structure according to claim 14 wherein the elevator power means are hydraulically operated, hydraulic circuits are provided for the elevator power means, respectively, and each hydraulic circuit includes a power driven pump and is separate from, and independent of, the hydraulic circuit of the other elevator power means, and the control means for controlling the operation of the elevator power means include independently operable controls for their circuits, respectively, and wherein the power means for driving the ram are controllable independently of the control of the elevator power means.

19. A drawing press and stretch forming fixture combination, including a press bed, upright guide frame members on the bed, a power driven ram mounted on, and guided by, the guide members for reciprocation in a generally upright path toward and away from the bed, complementary male and female drawing dies defining, when closed, a concavo-convex pattern, one of the dies being mounted on the ram for movement in opposite directions therewith parallel to the closed position of the one die, the other die being mounted on the bed, a pair of stock gripping units arranged at opposite ends of the bed, each unit including a gripper, said grippers being arranged to engage opposite margins of a piece of stock for applying tension thereto along one dimension of the stock when the grippers are urged relatively away from the path of the dies, each unit including an elevator, means supporting the gripper of the unit on the elevator for movement upwardly and downwardly therewith and for movement relative thereto toward and away from the dies, elevator power means for the elevators, respectively, for raising and lowering the elevators, stretch forming piston and cylinder assemblages for the grippers, respectively, for yieldably urging the grippers away from the path of the dies, means for controlling the initiation of operation of the elevator power means independently of each other and the speed of operation of the elevator power means independently of each other, hydraulic circuit means for supplying pressure fluid to the stretch forming piston and cylinder assemblages, additional means for controlling the hydraulic circuit means for operating the stretch forming piston and cylinder assemblages independently of each other and independently of the operation of their associated elevator power means, and ram driving means separate from, and operable independently of, the elevator power means and said hydraulic circuit means.

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