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(54) A METHOD AND A MACHINE FOR EXPANDING A SLOTTED WORKPIECE

- (71) We COMALCO (J. & S.) PRY. LIMITED an Australian Company incorporated in the State of Victoria, of 95 Collins Street, Melbourn, State of Victoria, 5 Commonwealth of Australia, do hereby declare that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 10 This invention relates to a method and a machine for expanding a slotted work-piece.
- Proposals have been put forward heretofore for the formation of expanded metal 15 wherein a strip of metal is sheared to have a series of rows of slits, the slits of any one row being staggered with respect to those of the next adjacent row, and the metal edges are then drawn apart so as to bend 20 the metal between adjacent slits, tilt them with respect to the plane of the metal before bending, and form a mesh-like panel. Such a panel has certain limited applications, but is not suitable for use as a load bearing 25 member primarily because of the high stress concentrations at the ends of the slits and secondly because of the bending and displacement of the metal between adjacent slits.
- 30 This problem has been recognised and a number of proposals have been made to provide a member which is suitable, for example, for use as a load bearing member. Thus for example in the United States 35 Specification 1510702 a truss-like metal beam was formed from a workpiece by firstly forming slits between beads (thickened parts of the workpiece cross-section) and then stretching the workpiece 40 (and hence the beads) by passing it longitudinally over gradually diverging guides. A subsequent rolling operation may be employed if this is desired. In the United 45 States Specifications numbers 1510697, 1472770, 1472771, and 1472772, there is
- taught various methods of expanding a slit metal member, all of which incorporate either the use of rollers or of heat, and in some instances reference is made to the distortion of beads in a plane at right 50 angles to the vertical plane of the product so as to obtain a preliminary stretching of the beads.
- The United States Specification 2010670 refers to the production of an openwork 55 structure from a member wherein a web has a series of rows of staggered slits, but this also employs the conventional expanding guide. Again, the United States Specification 1927442 teaches the use of a 60 wedge die which closely embraces both the web and flanges causing the flanges to be separated.
- While prior art means and methods have been suitable for very large production of 65 one size of open web structure, they have been quite unsuitable for general purpose work, and the tooling cost is prohibitive when small production runs of different configurations are required from a single 70 machine.
- A main object of this invention is to provide a machine which has a wide application for the expansion of slotted metal members, so that it can be quickly and easily 75 adjusted from one configuration of expansion to another. A second object is to provide a machine not requiring expanding rollers to provide a satisfactory product, and a still further object is to provide a machine 80 which can be quickly and easily loaded with a workpiece, which will then expand the workpiece, and allow ready removal of the expanded workpiece.
- The present invention provides a machine 85 for the expanding of a workpiece having parallel edge portions, a web portion between the edge portions, and a series of rows of slots in the web portion, the slots of each row being staggered with respect 90
- [Price 33p]

to and overlapping the slots of at least one adjacent row, comprising:

(a) a frame having a longitudinal member and bearers extending transversely thereof,

(b) spaced parallel workpiece tool supports supported by the bearers and extending in a longitudinal direction,

(c) workpiece engaging tools carried by respective tool supports and arranged to engage said edge portions of the workpiece,

(d) power actuated means operatively coupling the tool supports and arranged upon actuation to perform an outward movement to increase the transverse distance between the tool supports and thereby expanding the engaged workpiece,

(e) a first abutment member and a first control member operatively coupled to said power actuated means, one of the members being secured to the frame and the other secured to the tool support and respectively positioned so that at the end of the outward movement said power actuated means is reversed to reduce said transverse distance, and

(f) a second abutment member co-operable with a second control member respectively positioned so that on completion of an inward movement of the tool support sufficient to relax tension in said expanded workpiece, said inward movement is terminated.

The present invention also provides a method of expanding a workpiece having parallel edge portions, a web portion between the edge portions, a series of rows of slots in the web portion, the slots of each row being staggered with respect to and overlapping the slots of at least one adjacent row, said method comprising the steps of securing the parallel edge portions to tools carried on respective workpiece tool supports, driving the tool supports outwardly away from one another to separate the edge portions and stretch those portions of the web between said staggered adjacent slots, driving the tool supports inwardly towards one another by an amount sufficient to relax the stretched web portions, and removing the expanded workpiece from the tools.

An embodiment of the invention will now be described with reference to the accompanying drawings in which:

Fig. 1 is a fragmentary plan view of a machine according to the invention,

Fig. 2 is a side elevational section taken on line 2-2 of Fig. 1,

Fig. 3 is an end elevational section taken on line 3-3 of Fig. 1,

Fig. 4 is also an end elevational section but taken on line 4-4 of Fig. 1,

Fig. 5 is a plan view of a workpiece before expanding, showing the parallel edge

portions, beads, the web portion, and a series of rows of slots in the web portion, the slots of each row being staggered with respect to and overlapping the slots of adjacent rows,

Fig. 6 is a section taken on line 6-6 of Fig. 5,

Fig. 7 is a plan view which corresponds to Fig. 5 but showing the workpiece after it has been expanded and involving, stretching of the beads of the workpiece,

Fig. 8 is a section taken on line 8-8 of Fig. 7 but showing in addition to the workpiece, also the tools and tool supports utilised in the expansion thereof,

Fig. 9 is a section taken on line 9-9 of Fig. 1 which illustrates the end clamps utilised for the longitudinal stretching of the workpiece,

Fig. 10 is a fragmentary plan showing a workpiece like that of Fig. 5 but wherein the beads are bent rather than stretched during the expansion of the workpiece,

Fig. 11 is a section on line 11-11 of Fig. 10 but drawn to an enlarged scale,

Fig. 12 is an enlarged plan view illustrating the tool location after expanding of the workpiece illustrated in Fig. 10,

Fig. 13 is a fragmentary perspective illustrating locating means for the locating of the tools shown in Figs. 10, 11, and 12 before expansion of the workpiece, and

Fig. 14 is a diagrammatic representation of the hydraulic and electrical control means for the machine.

In general, the machine 20 of Fig. 1 comprises a frame 21 (shown also in Figs. 2, 3 and 4) which has a single longitudinal member 22 of I section, and bearers 23 which extend transversely of the longitudinal member 22.

A pair of spaced parallel workpiece tool supports 26 are carried by the bearers 23, resting upon them, and coupled to the frame 20 by a plurality of power actuating means in the form of pressure fluid actuated cylinders 27. It will be noted that in the embodiment described both workpiece tool supports 26 are arranged to be moved over the bearers, but in many instances only one need be movable, and one of the workpiece tool supports can be fixed to the frame 20. The means which couple the cylinders 27 to the frame 20 comprise trunnion blocks 28 described hereunder in further detail, and which enable limited relative pivotal movement of the cylinders 27 to take place.

The various valves and connections necessary for operating the machine are not illustrated in Figs. 1, 2, 3 or 4, but are shown diagrammatically in Fig. 14 as a solenoid valve 30 (in practice use may be made of more than one valve) connected by pressure fluid conduits 31 to the cylinders 27 so that operation of the valve 30 will effect actua-

tion of the cylinders 27.

The valve 30 has two solenoids and the valve itself has three positions. On energising one solenoid to cylinders 27 are actuated to move supports 26 outwardly: on energising the other solenoid the cylinders 27 are actuated to move supports 26 inwardly: and on de-energising both solenoids the cylinders 27 become inactive.

- 10 The frame 20 has secured to it first and second valve 30 control means, the first valve control means being a limit switch 33, attached to a transverse bearer 23, (shown in Figs. 1 and 14) which is operated by an adjustable abutment member 34 in the form of a pawl carried on an arm 35 on the workpiece tool support 26 as it moves outwardly, and the second valve 30 control means comprising a second limit switch 37, also attached to transverse bearer 23, which is functional to reverse operation of the valve 30. This second control means is actuated by a second adjustable abutment member 38 in the form of a pawl also carried on the arm 35, the abutment member 38 having on it a swinging arm 39 arranged so that the second limit switch 37 is actuated only upon reversal of movement (that is in an inward direction) of the workpiece tool support 26. The valve 30 is further controlled by hand operated valve control means in the form of the two push button switches designated 41 and 42 in Fig. 14 (but not shown elsewhere), and it will be seen from Fig. 14 that one of these switches is effective in causing continued inward actuation of the cylinders 27, actuation of which had previously been arrested by the limit switch 37. Operation of the second button 42 will be seen to initiate the outward stroke of the respective cylinders 27.

The coupling between control means 33, 34 and cylinders 27 is by way of electrical conductors connected between the limit switches and the solenoids of valve 30.

- After a workpiece has been expanded (Fig. 7), it will be noted that those parts of the web portion 56 not directly connected with edge portions 55 of the expanded workpiece have not been themselves stretched (see dimension indicating arrows at the top of Fig. 7) and to avoid wastage of material it is desirable to separately stretch these. To this end, the machine is provided with workpiece end-engaging clamps 45, these being under the control of further pressure fluid actuated cylinders designated 46 and referred to as end stretch cylinders, the cylinders 46 being trunnion mounted on brackets 47 which extend outwardly from the frame 20 at respective ends. These are controlled by further control valves (not herein illustrated) which may be hand operated or electrically operated but are

continuously under operator control. No automatic termination of actuation of the cylinders 46 is incorporated in this embodiment, although if desired the automatic control of the cylinders 27 may be duplicated for this purpose.

The above description is a description of some of the main elements of the machine, but the embodiment is described hereunder in further detail as follows:

Each of the cylinders 27 is trunnion mounted in a trunnion mount block designated 28 in Figs. 1 and 3, the trunnion block 28 also having trunnion mounted therein a threaded rod 49 which carries on it two pairs of nuts 50, the arrangement being such that the nuts 50 abut the respective trunnion blocks 28 at the inner or outer end of stroke of the respective cylinders 29. This provides a positive termination of stroke, and the adjustable abutment member 34 is so adjusted that reversal of the valve 30 does not take place until the termination of stroke as fixed by the nuts 50. There are occasions when it is desirable for the workpiece to be expanded so that the final product has tapered sides instead of parallel sides, and this can be readily achieved with the arrangement described herein by mere adjustment of the nuts 50 since both the cylinders 27 and the threaded rods 29 are trunnion mounted and are pivotally mounted onto respective brackets 51 on the workpiece tool supports 26.

Figs. 5, 6, 7 and 8 illustrate workpieces before and after expansion. In Figs. 5 and 6 an extrusion 54 of an aluminium alloy (or other ductile material) is provided with edge portions 55, and a web portion 56 extending between them. The web portion is itself formed to have three beads 57, and the web portion is separately pierced to have a series of rows of slots 58 (four rows being shown) the slots of each row being staggered with respect to and overlapping the slots of each adjacent row. (In some cases, the rows are divided into pairs of rows of adjacent slots wherein the slots are staggered, but the adjacent rows of adjacent pairs have the slots in transverse alignment).

Fig. 8 illustrates how the workpiece is clamped by workpiece engaging or clamping tools designated 61 which are carried on respective workpiece tool supports 26. The lower of the tool supports 26 is coupled directly to the piston rods of the cylinders 27 through the brackets 51 as described above, but the upper tool supports 26 are pivoted on pivot pins 62 (see particularly Figs. 3 and 4), and are arranged to be lifted upwardly and outwardly from the lower tool supports 26 by means of tool clamp cylinders 63, pivotally attached to the lower tool support 26 and coupled to the upper

tool supports 26 by means of lever arm 64 and coupling links 65.

In order to limit distortion of the flanges 55 of the workpiece 54, it is desirable that these flanges be clamped in place, so that use is made (in addition to the tool clamp cylinder 63) of back clamp cylinders 68 (Fig. 1). One back clamp cylinder is trunnion mounted to each of the tool supports 26, and the back clamping of the flanges is effected by longitudinally movable clamp bars 69 (Fig. 1 and 8) which are coupled to the lower of the tool supports 26 by a plurality of short swinging links designated 70, each link 70 being pivoted at one end to a tool support and at the other to a clamp bar 50 that, on actuation of cylinders 68, the bars 69 perform an outwardly and inwardly movement. This arrangement then provides means for quickly loading and unloading the workpiece, and clamping the workpiece flanges. The control means for the cylinders are their respective valves 73 (for cylinder 63) and 74 (for cylinder 68), these valves being solenoid operated valves. The valve 74 is controlled inter alia by a limit switch designated 75 (shown only in Fig. 14), the limit switch 75 being co-operable to reverse the valve 74 when the workpiece is to be loaded or unloaded. This then is a standard cam operated limit switch but for simplicity of illustration this has not been shown in Fig. 1. The cylinders 63 are either hand operated by a means of the switch designated 76, or alternatively timer operated by means of the timer designated 77. The function of the timer is described hereunder.

Referring further to Fig. 14, an electric motor designated 80 is mechanically coupled to two pumps, the pump designated 81 feeding the cylinders 27 for expanding the workpiece and the pump designated 82 feeding only the clamping cylinders 63 and 68. In both cases there is an overload valve (both being designated 84) to protect the equipment against over pressure. (In practice there are two other tandem pumps, effecting independent control of the cylinders 27, clamp cylinder 68, and end stretch cylinders 46. For the sake of simplicity these are not illustrated.)

A reference to Fig. 7 will illustrate how certain parts 87 of beads 57, some of which are not directly connected to the edge flanges 55, are not fully stretched upon outward movement of the edge flanges 55. To effect the full stretch the workpiece end clamps 45 are utilised. In Fig. 7 there are only two parts 87, not fully stretched, and these are joined with a part of the web portion 56 as shown. In Fig. 1 a more complicated arrangement is shown whereby it is necessary to elongate four pairs of

parts 87 (not shown), and this is achieved by means of the end clamps 45 operated by the end stretch cylinders 46. The end stretch cylinders 46 are trunnion mounted so that normally they do not constitute an obstruction to the loading of workpieces in the machine. However they may be swivelled upwardly so that the wedge clamp member 89 (Fig. 9) lie in the same plane as the parts 87 to be stretched, whereupon the cylinder 46 may be actuated to move the wedge clamps inwardly and over the beads to be stretched. Each pair of wedge clamps 89 is carried in a clamping block 90 (see also Figs. 1 and 2), and the clamping blocks 90 are interconnected by means of toggle links 91, the toggle links being themselves connected to adjustable mounting blocks 92 by means of tension bars 93, and the arrangement is such that as the tension bars 93 are drawn rearwardly, the toggle links 91 become co-linear, and are retained in their co-linear positions by means of abutment extensions designated 94 which interengage one another. This then correctly positions the parts 87 (which otherwise tend to be too close to one another). The gaps between the respective parts 87 are engaged by the pins 96 (Fig. 9) to further effect the accurate location of those parts. The mounting blocks 92 are adjustably positioned in a cross-bar 97, by means of bolts 98 the heads of which lie in a T-slot 99.

The wedge clamp members 89 are urged against ramp faces in a clamping block 90 by springs 102, but these springs may be compressed and the blocks 89 released by operation of a release handle 103. Each release handle is joined at the two sides of the clamping block 90 to respective members 89 by screws 104. Withdrawal of handle 103 retracts members 89 so that the space between them increases. This is best illustrated in Fig. 9.

The Figs. 10, 11, 12 and 13 illustrate the means and method by which the machine is used for expanding material to a mesh shape, wherein the beads 57 are bent rather than stretched. Bending (without appreciable stretching) can take place only if the length of the mesh panel is allowed to contract as the width increases, and this is effected by securing to the lower workpiece tool support 26 a track designated 110 containing a slot 111 which guides and supports rollers 112 on carriage blocks 113, each carriage block 113 having clamped to it a support hook 114 which engages the edge of a mesh panel (that is portion of the bead 57) as shown in Fig. 11. There are a series of carriage blocks 113 arranged in line in each of the tracks, and the centre carriage block is fixed, the others being movable with respect to that carriage block. They are interconnected by a flexible line

designated 116, which when stretched taut maintains them in an equally spaced position. To accurately fix those positions, the upper (that is the pivoted) of the two workpiece tool supports 26 is provided with cam plate 117 as illustrated in Fig. 13, and tapered mouth abutment surfaces or recesses 118 in the cam plate 117 engage over respective carriage blocks 113 to accurately position both them, and the hooks 114 thus enabling the workpiece to be engaged on the hooks 114. To ensure that the final product has a consistent pattern throughout its entire area, the blocks 113 are formed of such length that they abut one another at the termination of formation of the panel from the workpiece. The pitch of the expanded pattern of the workpiece then equates with the length of the blocks 113. As the hooks 114 move towards one another, the flexible line 116 flexes as illustrated in Fig. 12.

The following is a summary of the sequence of operations when a workpiece is to be expanded by stretching of beads 57 (Figs. 1 through to 9):

- A. All pumps idling, workpiece engaging tool supports 26 at their innermost position with clamping tools 61 open and back-up clamp bar 69 released outwardly.
- B. Slotted workpiece loaded either from the end or above.
- C. Tools 61 closed and back-up clamp bar 69 moved inwardly by manual switching.
- D. Expansion cycle initiated. Expansion cycle completed. Tools 61 relaxed so that no stress is left on the expanded workpiece. All valves are positioned so that the cylinders 27 are locked at this point. Clamps 89 engaged on workpiece.
- E. End stretch cylinder 46 operated and clamps 89 released.
- F. Strain released from cylinders 27 (by manual switching).
- G. Bar 69 moved outwardly and tools 61 fully released (by manual switching).
- H. Expanded and stretched product unloaded.
- I. Machine reset.

The following summary is a sequence of operations when the workpiece is to be expanded by bending of beads 57 (Figs. 10 through to 13):

Machine changed from an expand-by-stretching to an expand-by-bending cycle by a resetting selector switch (not shown herein).

- A. All pumps idling. Section engaging hooks positioned and retained by location plate 118.
- B. Slotted workpiece placed on hooks.
- C. Expand-by-bending cycle initiated.

Timer delays cylinders 27 until location plate 118 has retracted, then bending cycle carried out to the released position.

- D. Expanded workpiece unloaded.
- E. Hooks reset by manual switching of top jaw and location plate 118.
- F. Machine reset.

WHAT WE CLAIM IS:—

1. A machine for the expanding of a workpiece having parallel edge portions, a web portion between the edge portions, and a series of rows of slots in the web portion, the slots of each row being staggered with respect to and overlapping the slots of at least one adjacent row, comprising:

(a) a frame having a longitudinal member and bearers extending transversely thereof,

(b) spaced parallel workpiece tool supports supported by the bearers and extending in a longitudinal direction,

(c) workpiece engaging tools carried by respective tool supports and arranged to engage said edge portions of the workpiece,

(d) power actuated means operatively coupling the tool supports and arranged upon actuation to perform an outward movement to increase the transverse distance between the tool supports and thereby expanding the engaged workpiece,

(e) a first abutment member and a first control member operatively coupled to said power actuated means, one of the members being secured to the frame and the other secured to the tool support and respectively positioned so that at the end of the outward movement said power actuated means is reversed to reduce said transverse distance, and

(f) a second abutment member co-operable with a second control member respectively positioned so that, on completion of an inward movement of the tool support sufficient to relax tension in said expanded workpiece said inward movement is terminated.

2. A machine according to claim 1 wherein said power actuated means comprise a plurality of pressure fluid actuated cylinders, and a two-solenoid operated valve having three positions, the valve being arranged so that upon energising one of the two solenoids the cylinders are actuated to move the tool support outwardly; upon energising the other solenoid the cylinders are actuated to move the tool support inwardly; and upon de-energising both solenoids the cylinders become inactive, wherein said first and second control members comprise respective limit switches secured to the frame, wherein the couplings between control members and power actuated means comprises electrical conductors connected to the limit switches and respective

designated 116, which when stretched taut maintains them in an equally spaced position. To accurately fix those positions, the upper (that is the pivoted) of the two workpiece tool supports 26 is provided with cam plate 117 as illustrated in Fig. 13, and tapered mouth abutment surfaces or recesses 118 in the cam plate 117 engage over respective carriage blocks 113 to accurately position both them, and the hooks 114 thus enabling the workpiece to be engaged on the hooks 114. To ensure that the final product has a consistent pattern throughout its entire area, the blocks 113 are formed of such length that they abut one another at the termination of formation of the panel from the workpiece. The pitch of the expanded pattern of the workpiece then equates with the length of the blocks 113. As the hooks 114 move towards one another, the flexible line 116 flexes as illustrated in Fig. 12.

The following is a summary of the sequence of operations when a workpiece is to be expanded by stretching of beads 57 (Figs. 1 through to 9):

- A. All pumps idling, workpiece engaging tool supports 26 at their innermost position with clamping tools 61 open and back-up clamp bar 69 released outwardly.
- B. Slotted workpiece loaded either from the end or above.
- C. Tools 61 closed and back-up clamp bar 69 moved inwardly by manual switching.
- D. Expansion cycle initiated. Expansion cycle completed. Tools 61 relaxed so that no stress is left on the expanded workpiece. All valves are positioned so that the cylinders 27 are locked at this point. Clamps 89 engaged on workpiece.
- E. End stretch cylinder 46 operated and clamps 89 released.
- F. Strain released from cylinders 27 (by manual switching).
- G. Bar 69 moved outwardly and tools 61 fully released (by manual switching).
- H. Expanded and stretched product unloaded.
- I. Machine reset.

The following summary is a sequence of operations when the workpiece is to be expanded by bending of beads 57 (Figs. 10 through to 13):

Machine changed from an expand-by-stretching to an expand-by-bending cycle by a resetting selector switch (not shown herein).

- A. All pumps idling. Section engaging hooks positioned and retained by location plate 118.
- B. Slotted workpiece placed on hooks.
- C. Expand-by-bending cycle initiated.

Timer delays cylinders 27 until location plate 118 has retracted, then bending cycle carried out to the released position.

- D. Expanded workpiece unloaded.
- E. Hooks reset by manual switching of top jaw and location plate 118.
- F. Machine reset.

WHAT WE CLAIM IS:—

1. A machine for the expanding of a workpiece having parallel edge portions, a web portion between the edge portions, and a series of rows of slots in the web portion, the slots of each row being staggered with respect to and overlapping the slots of at least one adjacent row, comprising:

(a) a frame having a longitudinal member and bearers extending transversely thereof,

(b) spaced parallel workpiece tool supports supported by the bearers and extending in a longitudinal direction,

(c) workpiece engaging tools carried by respective tool supports and arranged to engage said edge portions of the workpiece,

(d) power actuated means operatively coupling the tool supports and arranged upon actuation to perform an outward movement to increase the transverse distance between the tool supports and thereby expanding the engaged workpiece,

(e) a first abutment member and a first control member operatively coupled to said power actuated means, one of the members being secured to the frame and the other secured to the tool support and respectively positioned so that at the end of the outward movement said power actuated means is reversed to reduce said transverse distance, and

(f) a second abutment member co-operable with a second control member respectively positioned so that, on completion of an inward movement of the tool support sufficient to relax tension in said expanded workpiece said inward movement is terminated.

2. A machine according to claim 1 wherein said power actuated means comprise a plurality of pressure fluid actuated cylinders, and a two-solenoid operated valve having three positions, the valve being arranged so that upon energising one of the two solenoids the cylinders are actuated to move the tool support outwardly; upon energising the other solenoid the cylinders are actuated to move the tool support inwardly; and upon de-energising both solenoids the cylinders become inactive, wherein said first and second control members comprise respective limit switches secured to the frame, wherein the couplings between control members and power actuated means comprises electrical conductors connected to the limit switches and respective



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valve solenoids, and wherein said abutment members are limit switch operating pawls.

3. A machine according to claim 2, wherein there are two rows of said cylinders, each tool support comprising a horizontally movable portion fixed to the piston rods of a respective row of cylinders and a portion pivoted on the horizontally movable portion, and further comprising a clamping tool and further pressure fluid actuated cylinders operatively coupling the horizontally movable and pivoted portions of each tool support for clamping of the workpiece edge portions between clamping tools.

4. A machine according to any preceding claim further comprising clamp bars, a series of swinging links coupling each clamp bar to a respective workpiece tool support, for effecting movement of the clamp bars inwardly and outwardly, and back clamp pressure fluid actuated cylinders operatively coupling the clamp bars to the respective workpiece for effecting movement of the clamp bars from outer positions inwardly towards the clamping tools.

5. A machine according to any preceding claim comprising a pair of workpiece end-engaging clamps positioned one at each end of the frame, and yet further pressure fluid actuated cylinders operatively coupling said clamps to respective ends of the frame, so that an end stretch can be applied to the workpiece.

6. A machine according to claim 5 wherein each cylinder for applying end stretch has a trunnion mounting to the respective frame end.

7. A machine according to claim 5 or claim 6 wherein each workpiece end-engaging clamp comprises a pair of wedge clamp members slidable in a clamping block, and arranged to engage inwardly converging surfaces in the mounting block to thereby cause the wedge clamp members to firmly grip a workpiece with which they are engaged upon workpiece stretching movement of the mounting block.

8. A machine according to claim 7 further comprising a series of toggle links, interconnecting the workpiece end-engaging clamps, at each end of the frame, a cross bar secured to the piston rod of each cylinder for applying end stretch, and tension bars joining respective mounting blocks at each end of the frame to a said cross bar.

9. A machine according to claim 3 further comprising a pair of tracks, means securing the tracks to respective movable portions of the tool support, a series of carriage blocks, rollers on each carriage block engaging surfaces in said track, a flexible line interconnecting the carriage blocks carried by each respective track, and an inwardly directed workpiece engaging hook on each carriage block.

10. A machine according to claim 9 having a workpiece engaged therein wherein the lengths of the carriage blocks are equal and also equal the pitch of the expanded pattern the workpiece and the carriage blocks are positionable in end to end abutment.

11. A machine according to claim 9 of claim 10 further comprising a cam plate on the pivoted portion of each respective tool support, each cam plate having a series of tapered mouth abutment surfaces each being arranged to position a respective hook and being so positioned that pivotal movement of the cam plate when effected by operation of the tool clamp cylinders positions said carriage blocks in an equally spaced relationship from one another.

12. A machine according to claim 11, comprising a further solenoid operated valve, pressure fluid conduits coupling said further valve to the tool clamp cylinders, a hand control switch and a timer control switch both interconnected with said further solenoid operated valve and arranged to independently complete an energising circuit therefor.

13. A method of expanding a workpiece having parallel edge portions, a web portion between the edge portions, a series of rows of slots in the web portion, the slots of each row being staggered with respect to and overlapping the slots of at least one adjacent row, said method comprising the steps of securing the parallel edge portions to tools carried on respective workpiece tool supports, driving the tool supports outwardly away from one another to separate the edge portions and stretch those portions of the web between said staggered adjacent slots, driving the tool supports inwardly towards one another by an amount sufficient to relax the stretched web portions, and removing the expanded workpiece from the tools.

14. A method according to claim 13 comprising, after the relaxing of the workpiece, engaging the ends of the workpiece and stretching it to elongate said web portions.

15. A method according to claim 13 or claim 14 wherein the securing of the edge portions of the workpiece to the tools comprises clamping said edge portions at the tools, and the web portions are both stretched and bent.

16. A method according to claim 13 or claim 14 wherein the securing of the edge portions of the workpiece the tools comprises positioning edges of the workpiece over hooks on carriage blocks which are movable along a track moving the tools away from one another to thereby bend the edge portions and simultaneously move the carriage blocks towards one another.

17. A method according to claim 16 in which the carriage blocks move toward one



(17)

another until they abut.

18. A machine for the expanding of a slotted workpiece, the machine being as hereinbefore described with reference to the accompanying drawings.

19. A method of expanding a slotted workpiece substantially as hereinbefore described with reference to the accompanying drawings.

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