Oct. 24, 1967 H. E. DAY 3,348,285

PRODUCTION LINE

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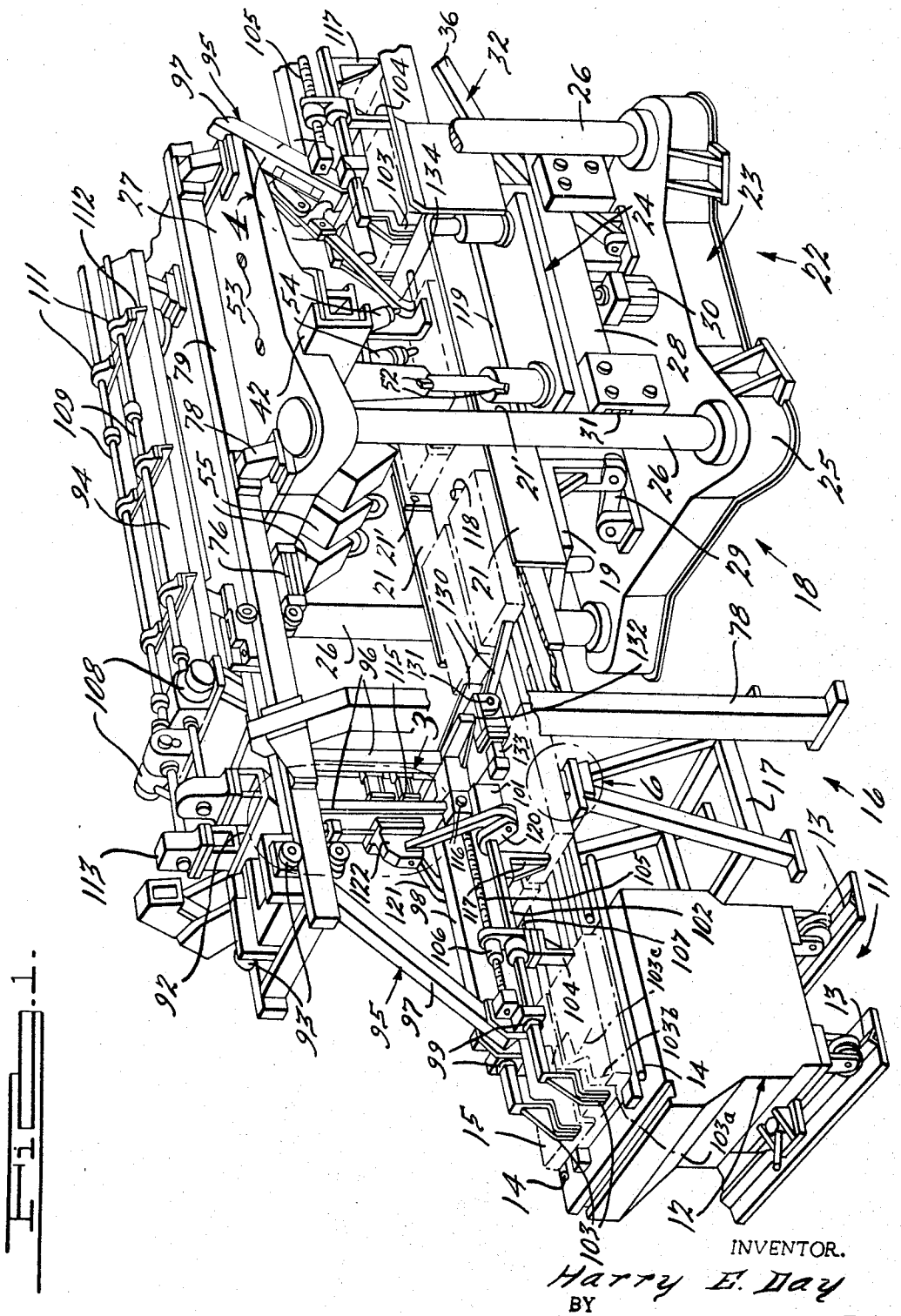


Fig. 1.

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PRODUCTION LINE

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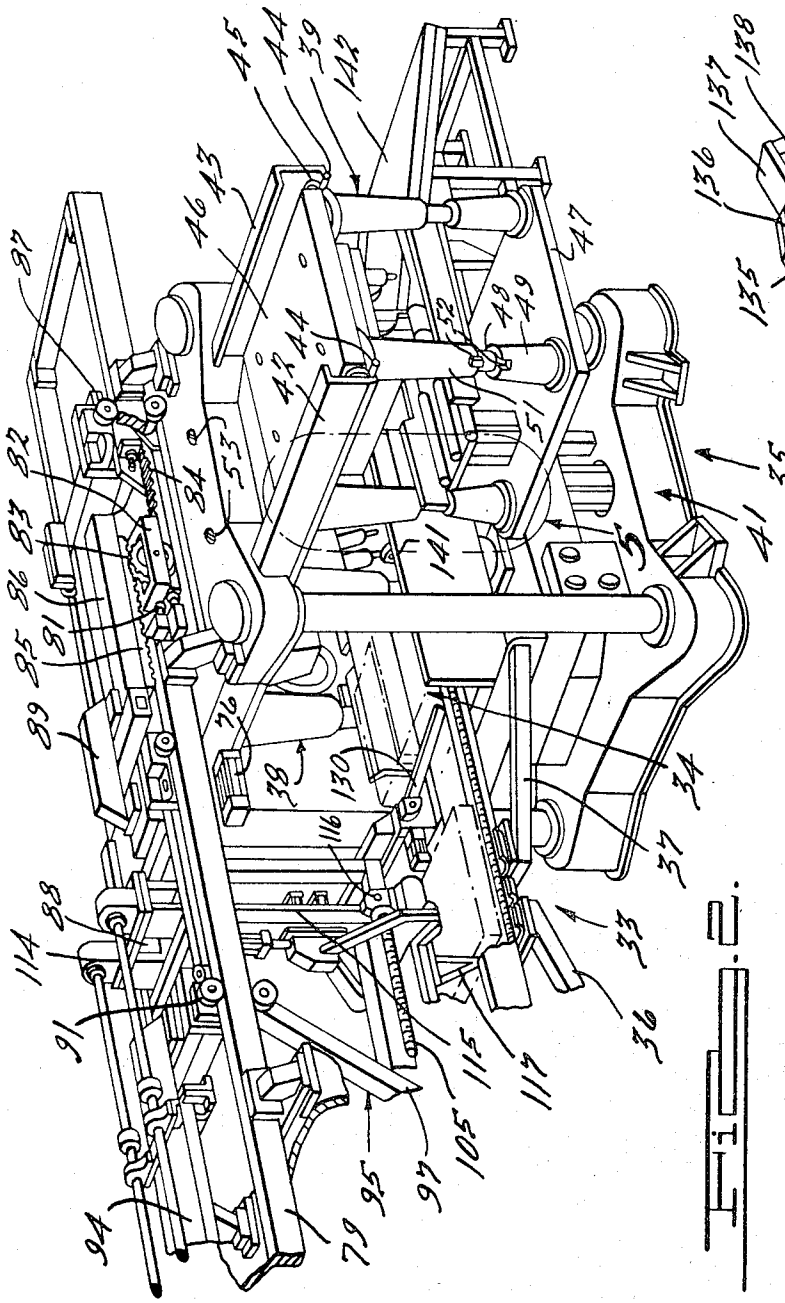


Fig. 2.

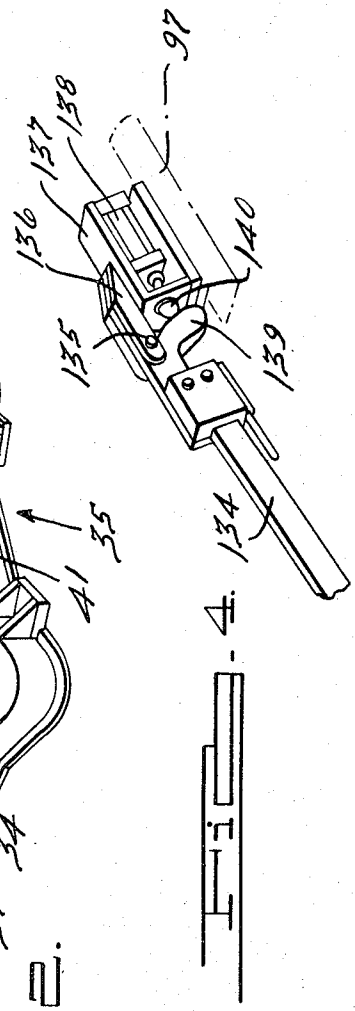


Fig. 4.

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PRODUCTION LINE

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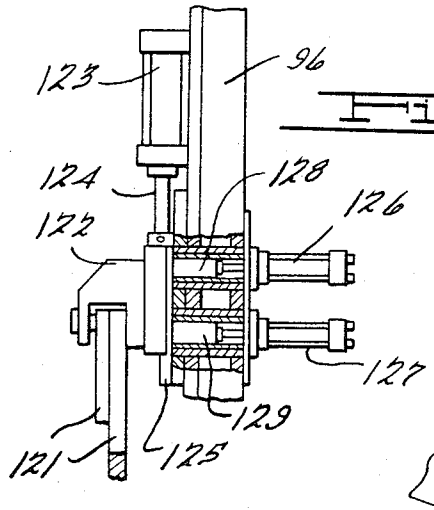


FIG. 3.

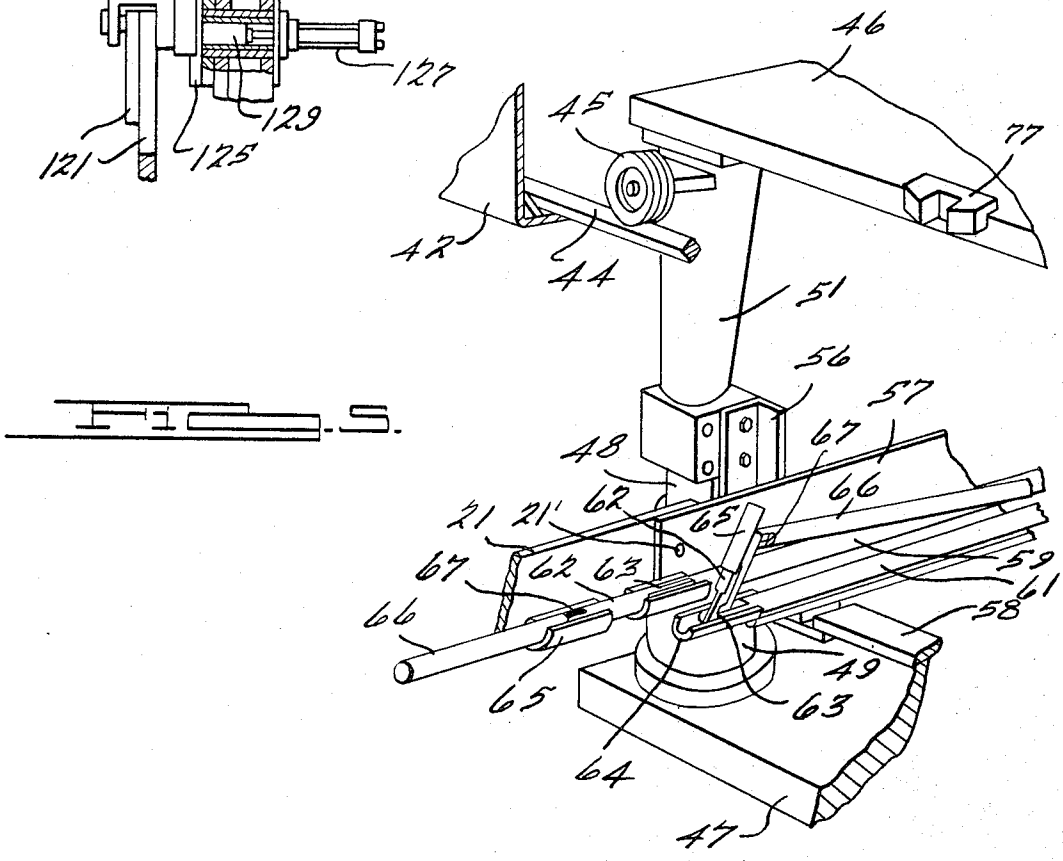


FIG. 5.

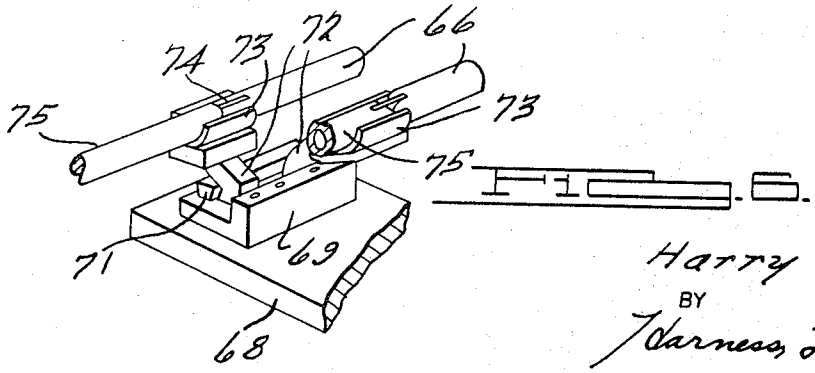


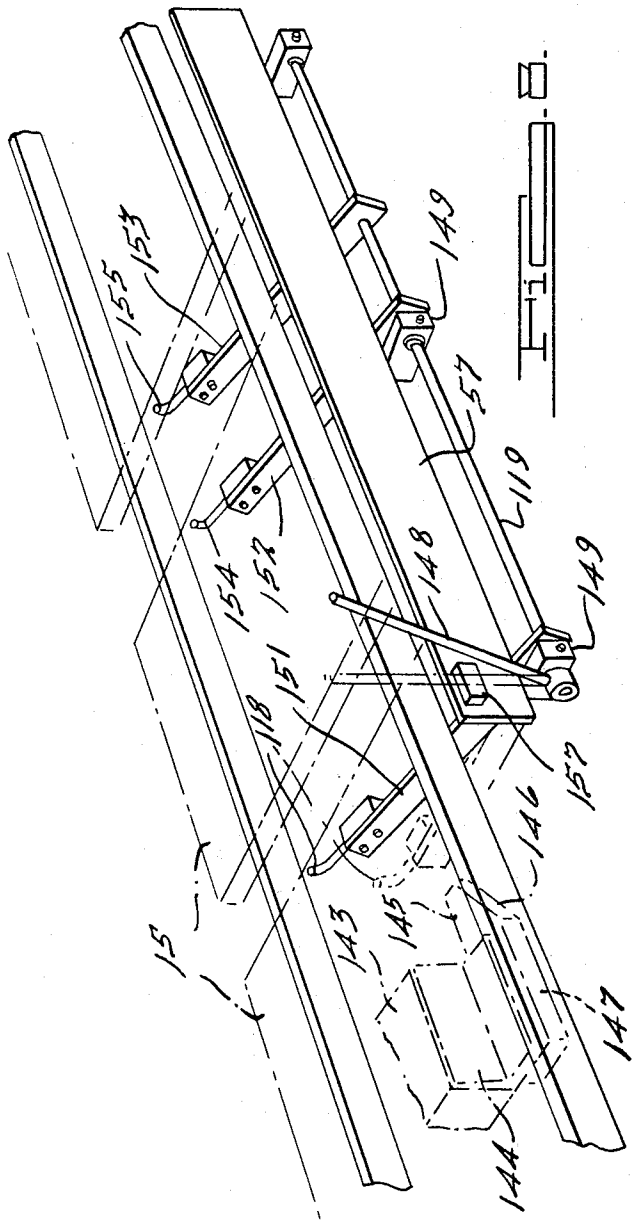
FIG. 6.

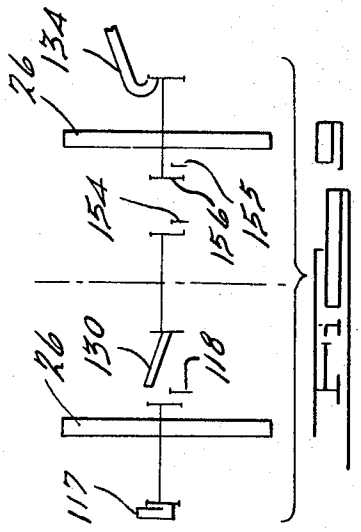
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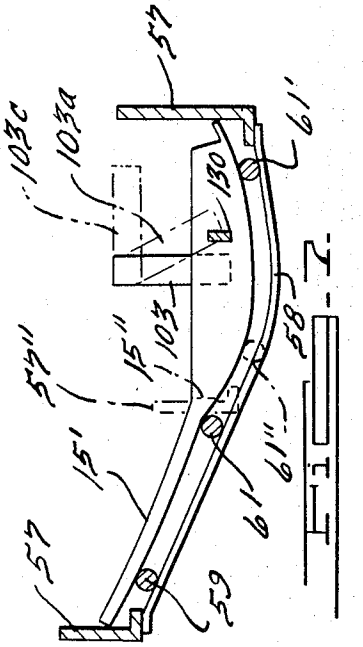
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PRODUCTION LINE

Filed Nov. 6, 1964 4 Sheets-Sheet 4







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3,348,285

PRODUCTION LINE

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Filed Nov. 6, 1964, Ser. No. 409,441
17 Claims. (Cl. 29—33)

This invention relates to production lines, and more particularly to constructions of a multipurpose nature for performing welding, hemming, or similar successive high production operations on various workpiece shapes.

The increasing proliferation of styles and models in certain products such as automobiles, has made it impracticable in many cases to build highly automated equipment for performing successive operations on subassembles for such products, since the lesser number of subassemblies needed for each style or model often makes prohibitive the unit cost of constructing fully automated equipment. Furthermore, if highly automated equipment is constructed, the production rate of such equipment is so high that the needs for any one model would be met in a relatively short time, the equipment thus having long periods of idleness. The time required to change tools on conventional types of equipment for different subassembly styles or models is quite lengthy.

It is an object of the present invention to provide a novel and improved construction for automated production lines which will permit easy and rapid changeover to different shapes or styles of assemblies, subassemblies or workpieces upon which a successive series of operations are to be performed.

It is another object to provide an improved production line of this nature which is especially adapted for operations which use bottom action presses.

It is a further object to provide a construction of this character which may be used with parts of greatly varying length and width.

It is also an object to provide an improved production line having these characteristics, in which each fixture carries with it guide rails especially adapted to support the particular shape of subassembly upon which the fixture is intended to operate, and in which these guide rails may be extended across other stations outside the fixture, such as idle stations or table top machines.

Other objects, features and advantages of the present invention will become apparent from the subsequent description, taken in conjunction with the accompanying drawings.

In the drawings:

FIGURE 1 is a perspective view showing the left hand portion of a production line made according to the invention, parts being omitted for clarity;

FIGURE 2 is a perspective view showing the right hand portion of the production line, parts likewise being omitted;

FIGURE 3 is an enlarged fragmentary elevational view, parts being sectioned, taken in the area marked 3 of FIGURE 1, showing the slide stroke limiting cylinders for controlling the angular positions of the lower fingers;

FIGURE 4 is an enlarged fragmentary perspective view taken in the area marked 4 of FIGURE 1 and showing an extractor lift cylinder;

FIGURE 5 is an enlarged fragmentary perspective view taken in the area marked 5 of FIGURE 2 and showing the guide rails in open and folded positions as well as a roller track and roller for a fixture;

FIGURE 6 is a fragmentary perspective view taken in the area marked 6 of FIGURE 1 and showing the means for supporting the joints between the guide rail extension sections;

FIGURE 7 is a schematic elevational view in cross section showing the manner in which two different types of

automobile doors could be supported by the guide rails and side guides;

FIGURE 8 is a fragmentary and partially schematic perspective view showing the operation of the stop linkage actuated by forward movement of the carriage; and

FIGURE 9 is a schematic elevational view showing the manner in which the stops are disposed within the confines of the press posts.

Briefly, the illustrated embodiment of the invention comprises a series of work stations for a workpiece such as an automobile door subassembly to which parts are to be welded or otherwise attached. Two of these work stations have bottom action presses at which welding operations are performed, several transfer or idle stations being disposed between the two welding stations. The workpieces are transported from a first station which has a table top machine past two idle stations to the first press station, from the first press station past three idle stations to the second press station, and from the second press station to a discharge ramp. Other arrangements, such as a different number of work stations, could be made within the principles of the invention.

The workpieces are spaced apart a distance equal to their length in the direction of movement plus an additional distance, and are moved simultaneously from station to station. The movement is accomplished by an overhead transfer assembly which extends along the entire series of stations and is operated by a reciprocating motor. The assembly comprises a plurality of sets of relatively short forward and rear fingers for engaging forward and trailing portions of the workpieces respectively at some of the idle stations and the table top machine station, additional short rear fingers for pushing the workpieces at other idle stations, relatively long pusher fingers engageable with the trailing portions of the workpieces to push them into the press stations, and relatively long hook-shaped extractors engageable with the leading portions of the workpieces to pull them from the press stations.

The fingers and extractors are provided in pairs, that is, there are two of each of these elements at each location along the line, spaced symmetrically on opposite sides of the centerline of the production line. Either one or the other of these will be used, depending upon the lateral position of the particular workpiece. If the workpiece is very wide, both fingers may be used.

The short fingers are so mounted that they may be laterally adjusted to a variety of positions, so as to engage the particular workpiece involved at its center of resistance, thereby pushing it along the guide rails without any tendency for the workpiece to turn laterally. This arrangement is unnecessary for the pusher fingers and extractors because side guides are provided in their vicinity. Stops automatically actuated by advancing transfer mechanism movement limit the forward workpiece positions when they are advanced by the additional short fingers, pusher fingers and extractors.

The stroke length of the transfer mechanism is constant regardless of the workpiece size and is equal to the length of the workpiece plus the distance between workpieces. Therefore, whatever the size of the workpiece in its direction of movement, the point or points at which it is engaged by the advancing elements of the transfer mechanism at the beginning of each stroke will always be in the same position at each work station. The construction of the fixtures is calculated by using this point to determine a reference line. For example, in the case of an automobile door, this reference line could pass through or be included in a surface which supports the lock or the hinge. In any case, the surface including the reference line will be on the trailing portion of the workpiece.

Each press station has a bottom action press with a

bed and an upper platen fixedly supported above the bed by four posts at the corners thereof. Means are provided for alternately positioning two or more fixtures in each bottom action press. This means includes a pair of laterally extending roller tracks immediately below the upper press platen, the tracks extending to one or both sides of the press. The desired fixtures are mounted on these tracks by means of rollers, so that any fixture may be rolled into position within the press, the others being rolled out of position.

Each press further comprises a lower platen above the bed which is vertically movable by appropriate motor means and on which rests the lower plate of the fixture. Each fixture comprises upper and lower plates connected by telescoping vertical guide posts. These plates are secured to the press platens, and the upper plate carries guide rails below it for slidably supporting the workpieces. Means are provided on the die carried by the lower fixture plate for lifting a workpiece resting on the guide rails when the lower press platen is raised.

The guide rails on each fixture comprise tubular members secured to the upper or fixed portions of the telescoping guide posts. Preferably, folding guide rail extension sections are provided, these having an articulated connection with the fixed guide rail sections on the fixture and being movable from a folded position within the confines of the fixture to an extended position in which they serve as guide rails at the adjacent work or idle stations of the production line. Short lengths of semicircular tubing are provided for supporting the foldable guide rail sections in their extended position. When in their folded position, the guide rails will clear the press posts so that the entire fixture may be rolled into or out of position.

When the lower fixture plate is raised by the lower press platen, it will lift the workpiece off the guide rails and support it in position for the welding operation, the welding guns being secured to the upper plate of the fixture. After the welding is completed, the guns will be retracted and the press platen retracted downwardly, the workpiece being again brought to rest on the guide rails so that it may be advanced to the next station.

The pusher fingers are provided with retracting motors for clearing the workpieces when they are raised and when the reciprocating transfer mechanism is retracted for the next stroke. Similarly, the short fingers and the extractors are swingable out of their normal position for the retracting stroke of the transfer mechanism.

Each of the alternately usable fixtures at each press station will of course have its own welding gun or other tool arrangement as well as its own arrangement of guide rails to conform to the contour of the particular workpiece to be operated upon. The transfer mechanism will be the same regardless of the type of workpiece. It is thus possible to quickly change from the production of one workpiece or subassembly to that of another by merely folding the guide rails of the fixture to be removed, detaching the fixture from the press platens, removing the fixture by rolling it along the roller tracks, rolling the new fixture into position, attaching it to the press platens, and unfolding its guide rails.

Referring more particularly to the drawings, FIGURES 1 and 2 show adjacent portions of a complete production line constructed according to the invention, and should be studied by positioning the figures in horizontal alignment with FIGURE 1 to the left of FIGURE 2. The production line shown in FIGURES 1 and 2 has eight stations. The first station, generally indicated at **11**, has a table top machine generally indicated at **12**, this machine being of a type which may support a workpiece for any of a variety of operations. A typical use would be to mount weatherstripping elements by welding them onto an automobile door subassembly. Machine **12** is moutned on laterally extending rails **13** so that it may be moved out of position and another machine, or a guide for an idle station, inserted in its place. Machine **12** is provided with guide rails **14** which are so positioned as to conform to the contour of the workpiece **15** which it is intended to carry.

The next station, generally indicated at **16** in FIGURE 1, is an idle station, and has an A-frame support **17** for guide rails which extend from the fixture at the nearest press station, these guide rails being described in detail below. For a particular workpiece **15**, of course, the guide rails supported by frame **17** will be aligned with the guide rails on whatever machine is placed at station **11**.

The next station is generally indicated at **18** and is also an idle station, resting on a support bracket **19** secured to the press of the adjacent station. Station **18** is provided with side guides **21** for guiding the workpieces and with guide rails for supporting the workpieces. Side guides **21** and the guide rails, described below in greater detail, comprise extended sections which are foldably connected to the fixture at the press station.

The first press station is indicated generally at **22** and comprises a bottom action press generally indicated at **23** and any one of a number of fixtures, one such fixture being indicated generally at **24** in FIGURE 1. Press **23** is of a conventional type, having a bed **25** and four posts **26** extending upwardly from the corners thereof, an upper platen **27** being secured to the upper ends of the posts. A lower platen **28** is provided above bed **25**, this platen being vertically movable by motor means (not shown) to which it is connected by toggle crank linkage means **29**. These crank linkage means are movable from the folded position shown in FIGURE 1 to an extended or over-center position holding lower platen **28** in an upper position so that the welding operations may take place. One or more auxiliary cylinders **30** may be provided under platen **28** for assisting in lifting and holding the platen in position. Guide rollers indicated partially at **31** are carried by lower platen **28** and are engageable with posts **26**.

Following station **22** there are three idle stations designated generally at **32, 33** and **34** in FIGURES 1 and 2. These idle stations are disposed between station **22** and a second press station generally indicated at **35**, and are formed by outwardly extending support brackets **36** and **37** secured to stations **22** and **35** respectively. The guide rails for supporting workpieces **15** along these idle stations are mounted on the fixtures **24** and **38** within welding stations **22** and **35** respectively, and are foldable in a manner hereinafter described to positions confined within their respective fixtures so that the fixtures may be removed from or installed in the press stations.

Station **35** is constructed similarly to station **22** and need not be described in detail. However, FIGURE 2 shows two fixtures **38** and **39** provided for welding station **35**, fixture **38** being mounted in the station and fixture **39** away from the station.

The manner in which the fixtures are removably mounted in their respective press stations will now be described. Referring to FIGURE 5, the upper platen **27** of each press (press **23** at station **22** and the press generally indicated at **41** at station **35**), has on its underside a pair of parallel rail supports **42** and **43**. These are channel-shaped members with their open sides facing each other, and roller tracks **44** are mounted on the insides of the lower flanges thereof. These roller tracks are adapted to support the four rollers **45** which are provided at the corners of the upper plate **46** of each fixture.

Each fixture also has a lower plate **47**, the plates being connected by telescoping posts **48**. These posts are secured to pedestals **49** fixed to plate **47** and slide in downwardly extending guides **51** secured to plate **46**.

Means indicated partially at **52** in FIGURES 1 and 2 is provided for securing the fixture in its collapsed position, that is, with posts **48** telescoped into guides **51**. Lower plate **47** of each fixture when in its operative position is adapted to rest on lower platen **28** of its corresponding press. Means indicated partially at **53** are provided on the upper platen of each press for drawing upper plate **46** of a fixture disposed thereunder upwardly toward plate

27, and securing it in such position. In this secured position, rollers 45 are spaced slightly above tracks 44. With elements 52 in locked position and elements 53 released, a fixture may be rolled along tracks 44 into or out of its corresponding press.

Each fixture also carries a plurality of welding guns 54, transformers 55 and other equipment needed for the welding operation.

The construction of the guide rails carried by the fixtures is perhaps best seen in FIGURES 5, 6 and 7. As indicated previously, the straight guide rails will together form different configurations from fixture to fixture to accommodate various workpiece configurations with which they are intended to be used. Brackets 56 are secured to guides 51 fixed to upper plate 46 and carry angle members 57 extending in the direction of movement of the workpieces. Cross straps 58 extend between the ends of the angle members on opposite sides of the fixture, and the angle members and end straps support a plurality of tubular members 59, 61, etc. in parallel relation, these members being secured to the fixture. The height and spacing among tubular members 59, 61, etc. are such as to form in cross section the proper configuration for supporting the workpiece. Angle members 57 and tubular members 59, 60, etc. all terminate within the confines of posts 26 of the press, so that they will not interfere with the movement of the fixture into or out of its operative position. Cross straps 58 and tubular members 59, 61, etc, are so positioned as not to interfer with the lower fixture die (not shown) resting on plate 47 which lifts workpiece 15 during its upward movement.

FIGURE 7, for example, shows two possibilities. In solid lines we see a schematic showing of an automobile door 15' having a header, that is, a frame for a window. The rails 59, 61 and 61' are so positioned as to support the door in a cradled manner, with members 57 acting as side guides which are of course secured to the fixture. The center of resistance of such a door might be such that finger 103, described below, would be most effectively positioned when it is vertical, as indicated at 103 in FIGURE 7.

If the door does not have a header (for example, if it is intended for a "hard-top" car), it will end at the dotted line indicated at 15'' in FIGURE 7. In such case, the left hand guide rail 57 would be at the location marked 57'', and only two guide rails might be required indicated at 61'' and 61' in FIGURE 7. Also, the center of resistance might be such that finger 103 would be most effectively used if it is in the position marked 103*a*. The area 130 indicates a lateral location of a pusher finger with respect to such a workpiece. The pusher finger is described below.

A short link 62 is connected at one end by a pivotal tongue-and-groove connection 63 to each end of each member 59, 61, etc. for which an extension is to be provided. This short link 62 may swing between the upper or folded position shown in FIGURE 5 and a lower position aligned with its corresponding fixed guide rail, being supported in this lower position by a semi-cylindrical member 64 secured at one end to the fixed guide rail and extending outwardly therefrom.

The other end of link 62 has a semi-cylindrical member 65 secured thereto, and an extension guide rail 66 is pivoted to that end of link 62 by a tongue-and-groove connection 67. In its folded position, extension 66 is folded back upon its corresponding fixed guide rail, and in its extended position is aligned with the fixed guide rail and the link 62, being supported by the outer end of semi-cylindrical member 65.

FIGURE 6 illustrates the manner in which a plurality of contiguous rail extensions may be supported on frame 17 or on a support bracket such as those indicated at 32, 36 and 37. A bed 68 is provided on the frame or bracket, and a nest block 69 is secured thereto for each two adjacent guide rails, this block being of L-shaped cross section and having a spring-loaded locking block 71 thereon, this locking block being slidingly mounted on block 69 and urged by springs (not shown) toward the upstanding portion of block 69. A rail lock finger 72 is provided for each guide rail, this finger having a lower portion releasably disposed between members 69 and 71 and extending upwardly therefrom, the two members 72 in each block 69, 71 extending in opposite directions, as seen in FIGURE 6. The uper portion of each finger 72 has a semi-cylindrical member 73 secured thereto. Fingers 72 may be positioned so that members 73 will support the pivoted tongue-and-groove joints 74 between each extension 66 and its additional extension 75. The arrangement is therefore such that the extensions may all be folded back on each other so as to be within the confines of the fixture, but when in extended position will be aligned and fully supported. As seen in FIGURE 2, the guide rail extensions from adjacent fixtures will be in abutting relation, so as to provide a smooth and uninterrupted guiding surface for the workpieces as they move from the first press station 18 through the idle stations to the second press station 35. In order to assure proper alignment of the guide rails, a fixture locking cylinder 76 is provided on the upper platen of each press, this cylinder operating a bolt (not shown) movable in a direction parallel to the direction of movement of the workpieces, and receivable by a keeper 77 on the upper plate 46 of each fixture, as seen in FIGURE 5.

The side guides 21 for the idle stations are also shown as being pivoted to the fixed side guides 57; this pivotal connection is indicated at 21' in FIGURES 1 and 5. Additional extensions could be pivoted to sections 21. The side guides would thus be foldable to positions within the confines of the fixture at the same time that the rail extensions are so that the fixture may be moved into or out of the press station.

Referring now to the means for moving workpieces 15 along the guide rails, a plurality of posts 78 are provided along the assembly line and outwardly of the path of movement of the workpieces, these posts supporting an elongated framework 79 which forms parallel rails, as seen in FIGURES 1 and 2. A transfer drive cylinder 81 is mounted at the forward end of frame 79 on one side thereof and is connected to a frame 82 which rotatably supports a tooth pinion 83. The lower side of this pinion meshes with an upwardly facing rack 84 fixed to frame 79, and the upper side of the pinion meshes with a downwardly facing rack 85 secured to a transfer carriage 86. This transfer carriage rests on the rails of frame 79 by means of rollers 87, so that, for example, when frame 82 and pinion 83 is pushed to the right in FIGURE 2 by motor 81 at a certain speed, carriage 86 will move to the right at twice the speed of pinion 83. Similarly, when frame 82 and pinion 83 are moved to the left, carriage 86 will move in the same direction at twice the speed of pinion 83.

A second transfer carriage 88 is provided on an intermediate portion of frame 79, this carriage being connected with carriage 86 by a tie rail 89. Carriage 88 has rollers 91 which support it for movement along frame 79.

A third transfer carriage 92 is mounted on the left hand end of frame 79, as seen in FIGURE 1, by means of rollers 93, and is connected with carriage 88 by means of a tie rail 94. Therefore, all three carriages 86, 88 and 92 will move in unison as driven by motor 81.

Carriages 88 and 92 are each provided with a finger supporting frame generally indicated at 95 which carries the various workpiece-engaging elements. Each frame has a pair of downwardly extending columns 96 secured at their upper ends to their respective carriage, and a downwardly and rearwardly inclined member 97, the lower ends of these frame members being connected by a horizontal member 98.

A forward and a rear finger bar supporting block, designated at 99 and 101 respectively, in FIGURE 1, are secured to each side of the lower portion of each frame 95. Each pair of blocks 99 and 101 rotatably sup-

ports a finger bar **102** which extends alongside frame member **98**. This bar is of non-circular cross section, and a rear or trailing finger **103** is secured to the rear end of each bar. Fingers **103** extend downwardly and are adapted to engage the trailing edges of workpieces **15**, the fingers having intermediate horizontal portions for extending the effective rearward position of fingers **103**. Fingers **103** are fixed to their respective bars **102**. A forward finger **104** is slidably but non-rotatably mounted on an intermediate portion of each bar **102**, between blocks **99** and **101** thereof. The position of each finger **104** along bar **102** is determined by the rotation of a lead screw **105** rotatably mounted on frame **95** alongside bar **102**. This lead screw carries a nut **106** with a downward extension **107** rotatably connected to the forward end of finger **104**.

The position of nut **106** on lead screw **105** is determined by a reversible motor **108** which drives a countershaft **109** rotatably supported by and extending between carriages **92** and **88**. A motor **108** is provided for the lead screws **105** on each side of the unit, and countershafts **109** are rotatably supported by bearings **111** carried by cross beams **112** mounted on tie rail **94**, as well as by gear boxes **113** on carriage **92** and gear boxes **114** on carriage **88**.

Gear boxes **113** and **114** contain bevel gears (not shown) which connect the countershafts with vertical shafts **115**, the lower ends of the vertical shafts leading to gear boxes **116** having bevel gears which connect them with lead screws **105**. Rotation of either motor **108** will therefore simultaneously adjust both forward fingers **104** toward or away from its rear finger **103**. This adjustment will be made so as to nest the workpiece **115** between the forward and rear fingers.

When the fingers **103** and **104** on either side of frames **95** are actually transporting workpieces **15**, they will be in the vertical positions shown in FIGURES 1 and 2, or in an angularly adjusted position. Means are provided for retracting the fingers upwardly at the forward end of each stroke, this means also including means for adjusting the angular position of the fingers when in their transporting position so as to accommodate workpieces of varying widths and push these workpieces at approximately their center of resistance to avoid lateral motion thereof. More particularly, when viewing fingers **103** in FIGURE 1 at the extreme trailing end of the machine, the left hand finger **103**, when in its transporting position, may be in either of two positions which are located clockwise of the vertical position shown, and on the retracting stroke, may be swung to a completely horizontal position so as to be above and clear workpieces **15** (see also FIGURE 7). Similarly, the right hand finger **103** could either be in its vertical position as shown in FIGURE 1, or in either of two positions spaced angularly in a counterclockwise direction from the FIGURE 1 position when it is transporting a workpiece, and will be swung counterclockwise 90° to a horizontal position when it is being retracted. The other two operative positions of the right hand finger **103** at the trailing end of the production line in FIGURE 1, are indicated schematically in dot-dash lines at **103***a* and **103***b*, while the retracted position is indicated at **103***c*. Since forward fingers **104** are nonrotatably connected to bars **102** they likewise will be capable of the three other positions described with respect to fingers **103**.

An additional finger **117** is secured to each bar **102**, this finger serving the same purpose as finger **103** but for the station next ahead on the production line. Finger **117** is not adjustable along bar **102**, nor does it have a corresponding forward finger similar to finger **104**. It too, however, will be adjustable to the various angular positions described with respect to fingers **103** and **104**.

Each fixture is provided with a stop **118** automatically movable from a retracted to an operative position by linkage, described in detail below but indicated partially at **119**, in response to forward movement of the transfer carriages, to limit forward movement of the workpiece by a finger **117**. Stop **118** is retractable by linkage **119** in response to rearward movement of the carriages.

The means for selecting the angular position of fingers **103**, **104** and **117** are seen best in FIGURES 1 and 3. Each bar **102** has a crank arm **102** secured thereto, and a pair of links **121** connects each pair of crank arms with a vertically movable slide **122** mounted on the rearwardly facing surface of the rearward post **96** of each frame **95**. A fluid actuated reciprocable motor **123** is vertically mounted on this post **96** above slide **122**, its piston rod **124** being connected thereto as seen in FIGURE 3. A stop **125** secured to post **96** limits the lowermost position of slide **122**, this position being such that fingers **103**, **104** and **117** will be in their vertical positions as shown in the drawings. A pair of cylinders **126** and **127** are secured to the forward side of post **96** and actuates stops **128** and **129**, respectively, between retracted position as shown in FIGURE 3 and operative positions extending to the left of those shown in FIGURE 3. When piston rod **124** is completely retracted upwardly, slide **122** will be raised to a point at which fingers **103**, **104** and **117** will be horizontal, as indicated schematically at **103***c* for finger **103**, thus clearing the workpieces **15**. If stop **128** is extended to the left in FIGURE 3, stop **129** being retracted, downward movement of piston rod **124** will cause slide **122** to engage stop **128**. At this position, fingers **103** will be in the position indicated schematically at **103***b*, and fingers **104** and **117** will be similarly positioned. Should stop **128** be retracted and stop **129** extended to the left, slide **121** will be permitted to move down to a position in which fingers **103** will be in the **103***a* position, with fingers **104** and **117** similarly positioned. It will be noted that except for very wide workpieces, only the left or the right hand fingers will actually be in use, although the other set of fingers will swing at the same time between retracted and operative positions because the bars **102** on both sides of frame **95** are connected to slide **122**.

Two relatively long pusher fingers **130** on opposite sides of the production line are carried by the forward ends of each frame **95** for alternate or simultaneous use in pushing workpieces from idle station **18** to press station **22**, and from idle station **34** to press station **35**. Each pusher finger is movably connected at **131** to a cross bar **132** mounted on the forward end of frame **95** and extends forwardly and downwardly therefrom when in its operative position. A fluid-operated reciprocable motor **133** is provided for each pusher finger **130**. This motor is connected by cam slot-and-follower means (not shown) to finger **130** in such manner as to move it between the operative position shown and a retracted position which is preferably slightly rearwardly of the operative position and swung upwardly to a horizontal position. The slight rearward movement of the pusher finger may be required to clear a rearwardly projecting lip at the lower portion of the trailing edge of a workpiece such as an automobile door subassembly. The horizontal position of pusher finger **130**, when retracted, will enable the entire transfer assembly to be retracted to the left in the figures in readiness for the next transfer stroke. Each fixture is provided with an automatically actuatable stop (described below) similar to stop **118** for limiting the forward movement of workpieces advanced by pusher **130** into the press station.

Two alternately or simultaneously usable extractors **134** are provided on opposite sides of the production line for removing workpieces **15** from press station **22**. The extractors are mounted on the rearwardly facing portion of member **97** on frame **95** which depends from transfer carriage **88**. As seen in FIGURE 4, each extractor comprises a bar pivotally connected by a pin **135** to a bracket **136** on the upper portion of a frame **137** which encloses an extractor lift cylinder **138**. The lower end of the extractor is hook-shaped so as to be capable of engaging the workpiece when in its operative position and pulling the workpiece out of the work station. The upper end of the extractor has an extension **139** which is en-

gageable by the end of a piston rod **140** actuated by fluid-operated motor **138**. When piston rod **140** is moved to the left in FIGURE 4, extractor **134** will be swung clockwise about pin **135** to a retracted position, whereas retraction of piston rod **140** will permit the extractor to return to its operative position. The fixtures carry stops, described below, similar to stops **118** for limiting the advancing movement of the workpieces by extractors **134**.

It should be noted that neither pusher fingers **129** nor extractors **134** are adjustable laterally so as to be aligned with the center of resistance of the workpieces. This is unnecessary in view of the fact that workpieces **15** when engaged by these transfer members will also be guided by side guides **21**.

A stripper seen partially at **141** in FIGURE 2 is mounted in each fixture to be received by press **41**. This stripper is actuable through a one-way connection by a reciprocable fluid-actuated motor (not shown) to push workpieces **15** from station **35** onto a discharge ramp **142**. Stripper **141** may be pivotally mounted so as to permit workpieces being advanced by pusher **130** to ride over it into station **35**.

FIGURES 8 and 9 show the arrangement for automatically raising and retracting the stops which limit advancing movement of the workpieces engaged by fingers **117**, pushers **130** and extractors **134**. This mechanism has been omitted from FIGURES 1 and 2 for purposes of clarity. A laterally extending bar **143** is secured to the lower end of a frame **95**, and carries an angle member **144** to the underside of which is secured a cam **145**. This cam has a sloping portion **146** and a straight portion **147** and is adapted to engage a rod **148** secured to the rear end of a shaft **119**. This shaft is rotatably supported by brackets **149** secured to and extending laterally outwardly from the lower edge of one of the stationary side guides **57** secured within each fixture. Three arms, **151**, **152** and **153** are secured to shaft **119** and extend inwardly therefrom, the ends of these arms carrying stops **118**, **154** and **155** respectively. The positions of these stops along shaft **119** are such that, as shown in FIGURE 9, they will be adapted to stop workpieces **15** moved by members **117**, **130** and **134** respectively, as the carriage mechanism reaches the end of its stroke.

The entire stopping mechanism including elements **148**, **119** and **149** through **155**, are within the confines of the fixture and thus will be removable and insertable therewith with respect to the work station. For this purpose, stop **155** is positioned so as to be engageable by a flange **156** on the trailing portion of the workpiece being removed by extractor **134**.

The movement of stops **118**, **154** and **155** will be between the upper or operative stopping position indicated in solid lines in FIGURE 8, and a lower or retracted position indicated with respect to stop **118** by dot-dash lines. This movement will ensue from the fact that when the carriage mechanism is in its retracted or rearward position, cam **145** will be separated from rod **148** and the weight of arms **151** to **153** will cause counterclockwise rocking of the stop assembly, with rod **148** engaging a limiting member **157** secured to side guide **57**. As the carriage mechanism advances in the direction of arrow **158** in FIGURE 8, surface **146** of cam **145** will first engage rod **148**, rocking the stops upwardly, in which position they will remain as rod **148** rides on surface **147** of the cam. It will thus been seen that cam **146** will coact with rod **148** on any fixture, the positions of the workpiece stops being adjustable in the direction of movement of the workpieces on different fixtures to compensate for varying workpiece lengths and shapes.

In operation, welding stations **22** and **35** will be provided with the desired fixtures, the fixtures rolling along tracks **44** by means of their rollers **45** and being locked in position utilizing the locks operated by cylinders **76** which enter keepers **77**. The upper plates **46** of the fixtures will be secured to upper platens **27** of their respective presses by means of fasteners **53**, lifting rollers **45** slightly off tracks **44**, and locks **52** will be released so that posts **48** of the fixtures may telescope into and out of guides **51**. With the lower plates **47** of the fixtures secured to lower platens **28** of the presses, guide rail extensions **66** and **75** may be unfolded to their aligned positions, being supported by members **64**, **65** and **73**, as described above.

Let us assume that workpieces **15** are in position on the guide rails with their lateral position determined by the cradled nature of the guide rails or by side guides **57** and extensions **21**. Let it be further assumed that the transfer mechanism is initially in the position shown in FIGURES 1 and 2, with fingers **103**, **104** and **117** angularly adjusted, as indicated at **103***a*, **103***b* for fingers **103**, in accordance with the center of resistance of the workpiece, by vertically adjusting slides **121** as controlled by stops **128**, **129** or **125**. Piston rod **81** will be actuated to the right in FIGURE 2, pulling transfer carriages **86**, **88** and **92** to the right along the rails formed by frame **79**. This will push workpieces **15** a distance equal their length plus the distance between them so that they will arrive at the next station. During this transfer movement, the workpiece at station **11** will be held by fingers **103** and **104**, it being kept in mind that unless the workpiece is fairly wide, only the fingers to the left or to the right will be used in any one operation. The workpiece at station **16** will be pushed by a finger **117** and the workpiece at station **18** by a pusher **130**. At station **22**, the workpiece will be pulled toward station **32** by an extractor **134**. A workpiece will be transferred from station **32** to station **33** by a set of fingers **103** and **104**, and from station **33** to station **34** by a finger **117**. The workpiece at station **34** will be moved to station **35** by a pusher **130** and the workpiece at station **35** will be pushed by stripper **141** onto discharge ramp **142**.

After the forward stroke of the transfer mechanism has been completed, slides **121** will be pulled upwardly by motors **122**, retracting fingers **103**, **104** and **117** to their retracted position, as indicated at **103***c* for finger **103**. Pushers **130** will be pulled rearwardly and upwardly by motors **133**, and extractors **134** will be swung upwardly into retracted position by extension of piston rod **140**. Pinion **83** will then be drawn to the left by piston rod **81**, moving the transfer carriages and their attached parts to the left in readiness for the next advancing stroke.

Meanwhile, the operator at each press station **32** and **35** will place parts to be welded to the workpiece in proper position. Each press platen **28** will be moved upwardly by its actuating mechansm which is not fully shown but includes links **29** and cylinders **30**. This will raise lower plate **47** of each fixture, causing the workpiece resting on the guide rails above to be lifted from the guide rails. The workpieces will be lifted off the guide rails with the parts to be welded thereto still resting on them. When links **29** have reached an overcenter position, welding guns **54** will be extended, welding the parts to the workpiece. The welding guns will then be retracted.

Platens **28** of presses **23** and **41** will then be lowered, causing the workpieces to be again lowered onto the guide rails. Fingers **103**, **104** and **117** as well as pushers **130** and extractors **134** will again be moved to their operative position and the transfer mechanism again actuated to move the workpieces to their next stations.

The system of course permits the inclusion of any desired number of work stations in the production line. Should it be desired to change the production line to operate on a workpiece having a different shape or style, or requiring different welding or metal forming operations, the fixtures in one or both of the presses shown may be removed and alternate fixtures placed therein. Removal of a fixture is accomplished by first folding guide rail extensions **66** and **75** and side guides **21** which are connected to the fixed guide rails and side guides respectively on the fixture to collapsed positions within the confines of

the fixture. The corresponding press platen **28** is raised until the upper guides **51** of the fixture may be secured to the lower posts **29** thereof by locks **52**. The lower plate **47** of the fixture is then detached from lower platen **28** of the press and the upper plate **46** detached from upper platen **27** of the press. The latter detachment will permit rollers **45** of the fixture to be lowered onto tracks **44**. Platen **28** of the press is then lowered and the fixture is ready to be removed.

While it will be apparent that the preferred embodiment of the invention disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In a production line having at least one work station with vertically spaced and relatively movable tool and workpiece supports, an overhead transfer mechanism mounted above the line, means for repeatedly advancing and retracting said transfer mechanism along the path of the movement of the workpieces, downwardly extending portions on said transfer mechanism disposed forwardly and rearwardly of said station and having elements engageable with said workpieces to move them along the production line, means for moving said elements between upper retracted positions and lower operative positions in which the elements engage the workpieces, means for advancing said transfer mechanism while said elements are in their operative positions, means for retracting said transfer mechanism while said elements are in their retracted positions, at least one fixture for said station, and a track at the upper portion of said station and extending transversely thereto, said fixture being mounted on said track for movement into and out of said station.

2. The combination according to claim **1**, further provided with workpiece-supporting guide rails having portions fixedly secured to said fixture, and extensions for said guide rails movably secured thereto and adjustable between operative positions aligned with their respective fixed portions and folded positions within the confines of said fixture.

3. The combination according to claim **1**, further provided with stops on said fixture movable between retracted and operative positions, and coacting means on said downwardly extending transfer mechanism portions and on said fixture responsive to advancing movement of said transfer mechanism to move said stops to their operative positions and responsive to retracting movement of said transfer mechanism to permit movement of said stops to their retracted positions, the stops and the portion of said coacting means on said fixture being disposed within the confines of said fixture, whereby they will be in non-interfering relation with the compounds of said station when the fixture is moved into and out of the station.

4. The combination according to claim **3**, said coacting means comprising a shaft rockably mounted on said fixture, arms secured to said shaft and carrying said stops at the outer ends thereof, and a cam on said downwardly extending transfer mechanism portion engageable with another arm secured to said shaft.

5. In a production line having at least one bottom action press at a first station with a fixed bed and upper platen and a movable lower platen, a second station rearwardly of said press, and a third station forwardly of said press, the press having corner posts connecting the bed and upper platen thereof, roller tracks secured beneath the upper press platen and extending transversely thereto, at least one fixture for said press having upper and lower plates securable to the upper and lower platens respectively of said press, rollers secured to said upper plate and rollable on said roller tracks, and workpiece transfer carriage means mounted above said stations.

6. The combination according to claim **5**, further provided with telescoping vertically disposed connections between said upper and lower plates having upper portions fixed to said upper plate, workpiece guide rails having portions fixed to said last-mentioned portions, and extensions for said guide rails pivotally secured to said fixed guide rail portions and movable between operative positions aligned with the fixed guide rail portions and folded positions within the confines of said fixture, whereby the fixture may clear the press posts when moved into and out of the press.

7. The combination according to claim **6**, further provided with workpiece side guides having portions fixed to the upper portions of said telescoping connections, and extensions for said side guides movably secured to said fixed side guide portions and movable between operative positions aligned with the fixed side guide portions and folded positions within the confines of said fixture.

8. The combination according to claim **5**, further provided with an overhead frame extending along said production line above said stations, said transfer carriage means being movably mounted on said overhead frame, means for reciprocating said transfer carriage means a distance greater than the length of the longest workpiece to be carried by said production line, portions extending downwardly from said transfer carriage means forwardly and rearwardly of said press, a pusher finger on the portion which is disposed rearwardly of the press, said pusher finger extending forwardly toward said press, means for moving said pusher finger between an operative position in which it is inclined forwardly and downwardly, and a retracted position above said operative position, an extractor carried by the downwardly extending portion of said transfer mechanism which is disposed forwardly of said press, said extractor comprising a rearwardly extending member, and means for moving said extractor between an operative position inclined rearwardly and downwardly and a retracted position above said operative position.

9. The combination according to claim **8**, said fixture being further provided with stops for workpieces engaged by said pusher finger and extractor to limit the advancing movement thereof, and coacting means on said transfer carriage means and said fixture for moving said stops to operative positions in response to advancing movement of said transfer carriage means and to retracted positions in response to retracting movement of said transfer carriage means.

10. The combination according to claim **5**, said production line being further provided with a fourth station rearwardly of said second station, the downwardly extending portion of said transfer mechanism disposed rearwardly of said press further carrying a finger for engaging a workpiece at said last-mentioned station and moving it to said second station, and means fo adjustably positioning said finger in a variety of laterally spaced positions for engagement with workpieces having centers of resistance at various locations.

11. The combination according to claim **10**, said last-mentioned means comprising a bar extending in the direction of movement of said workpieces and rotatably carried by said downwardly extending transfer mechanism portion, said finger being attached to said bar, and means for rotating said bar about its axis including a crank fixed to said bar, a slide carried by said downwardly extending transfer mechanism portion, alternately actuatable stops for limiting the movement of said slide, and a link connecting said slide with said crank.

12. The combination according to claim **11**, said production line being further provided with a fifth station rearwardly of said fourth station, forward and rear fingers mounted on said bar for moving a workpiece from said fifth station to said fourth station, said rear finger being secured to said bar, and means for adjustably positioning said forward finger along the length of said bar to accommodate workpieces having various lengths in their direction of movement.

13. The combination according to claim 12, said last-mentioned means comprising a lead screw mounted on said downwardly extending transfer mechanism portion parallel to said bar, means carried by said transfer mechanism for rotating said lead screw, and a connection between said lead screw and said forward finger.

14. The combination according to claim 12, said bar being on one side of said downwardly extending transfer mechanism portion, another bar on the other side of said downwardly extending transfer mechanism portion, another finger fixed to said last-mentioned bar, a crank on said last-mentioned bar, and a link connecting said last-mentioned crank with said slide, whereby movement of said slide will simultaneously adjust the lateral positions of both of said fingers.

15. The combination according to claim 14, said slide being further adjustable to a position in which said fingers are retracted upwardly a sufficient distance to clear said workpieces.

16. In a production line, a plurality of work stations in spaced relation, a transfer mechanism extending above said work stations, said transfer mechanism comprising a frame having a rail, transfer carriage means movably mounted on said rail, means for reciprocating said carriage means in unison, a first structure depending from said carriage means on one side of one of said work stations, a second structure depending from said carriage means on the other side of said work station, a pusher finger carried by the first depending structure and adapted to push a workpiece into said work station when the carriage means moves in one direction, an extractor carried by the other depending structure and adapted to pull a workpiece from the work station when the carriage means moves in the same direction, said depending structures each being provided with a horizontally extending finger-supporting bar, means for rotating said bars to a variety of angular positions about their own axes, at least one conveyor finger slidably but nonrotatably mounted on each bar, stop means for limiting the forward movement of a workpiece pushed by each of said fingers, and linkage means responsive to forward movement of said carriage means for moving said stop means from a retracted position to an operative position.

17. A work station for a production line comprising a bottom action press having a bed, a fixed upper platen, and a vertically reciprocable lower platen, roller tracks mounted below said upper press platen and extending transversely thereof, a fixture comprising a lower plate and an upper plate, rollers carried by said upper plate and mounted on said roller tracks, whereby the fixtures may be rolled into and out of position with respect to said press, telescoping members at the corners of said fixture plates whereby the plates may be moved together or apart, means for locking the telescoping members in a collapsed position, means for attaching the upper fixture plate to the upper press platen, said last-mentioned means including means for drawing the upper fixture plate upwardly so that its rollers will be lifted from the roller tracks, coacting means on the press and upper fixture plate for locking the fixture in its operative position whereby it may not be moved laterally, reciprocating means mounted above said production line and having portions depending therefrom rearwardly and forwardly of said press, workpiece moving means carried by said depending portions, workpiece stops carried by said fixture, and coacting means on said reciprocating means and said fixture responsive to forward movement of said reciprocating means to move said stops to operative positions with respect to said workpieces.

No references cited.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,348,285 October 24, 1967

Harry E. Day

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, lines 15 and 16, for "subassembles" read -- subassemblies --; column 3, line 71, for "moutned" read -- mounted --; column 5, line 25, for "60" read -- 61 --; column 6, line 7, for "uper" read -- upper --; column 8, line 6, for "crank arm 102" read -- crank arm 120 --; column 12, line 53, for "fo" read -- for --; column 14, line 12, for "fixtures" read -- fixture --.

Signed and sealed this 19th day of November 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents