APPARATUS FOR CONTROLLING RELATIVE MOVEMENT
BETWEEN A WORK TOOL AND A WORKPIECE

Filed May 28, 1969 2 Sheets-Sheet 1

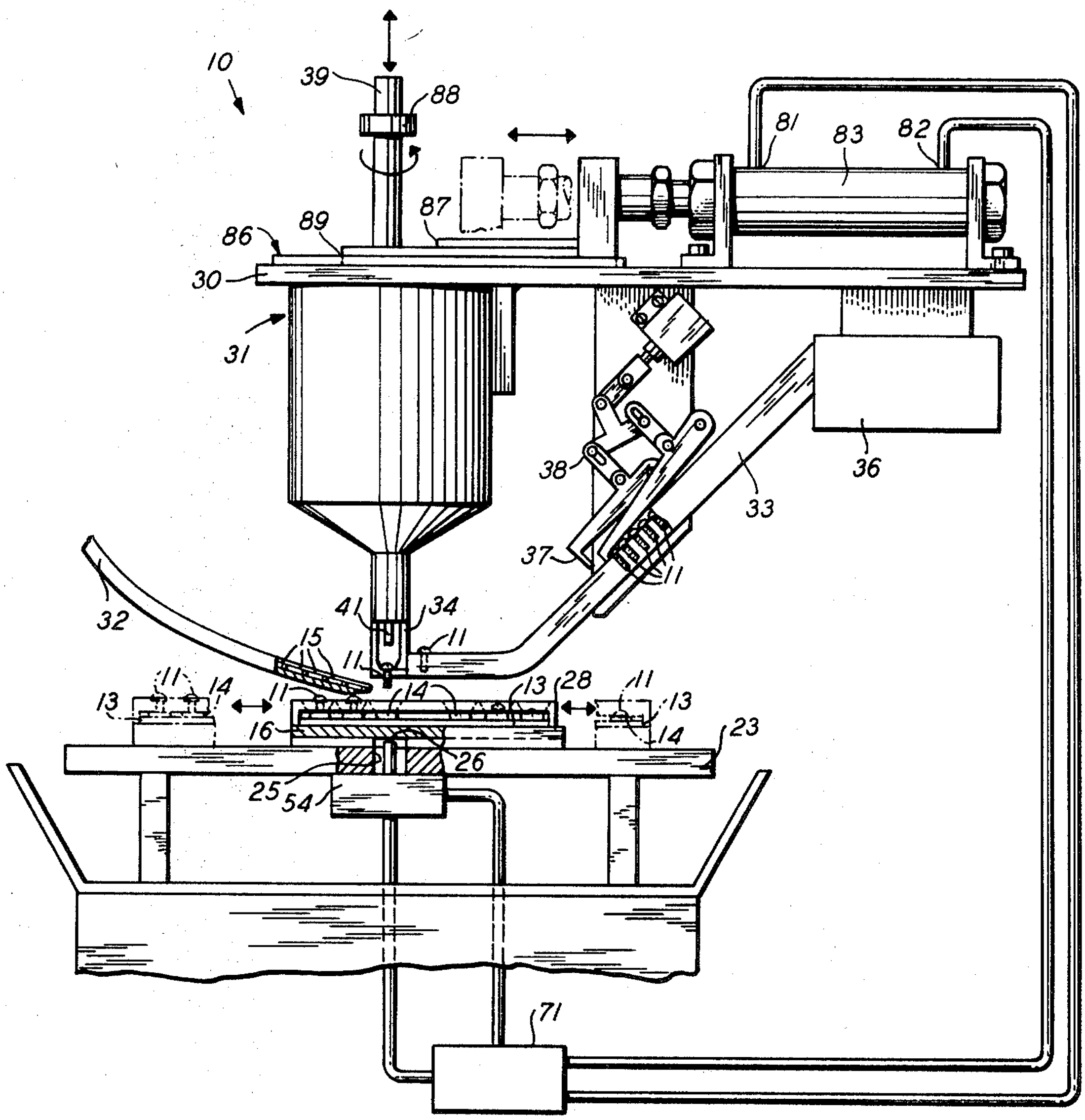

FIG-1

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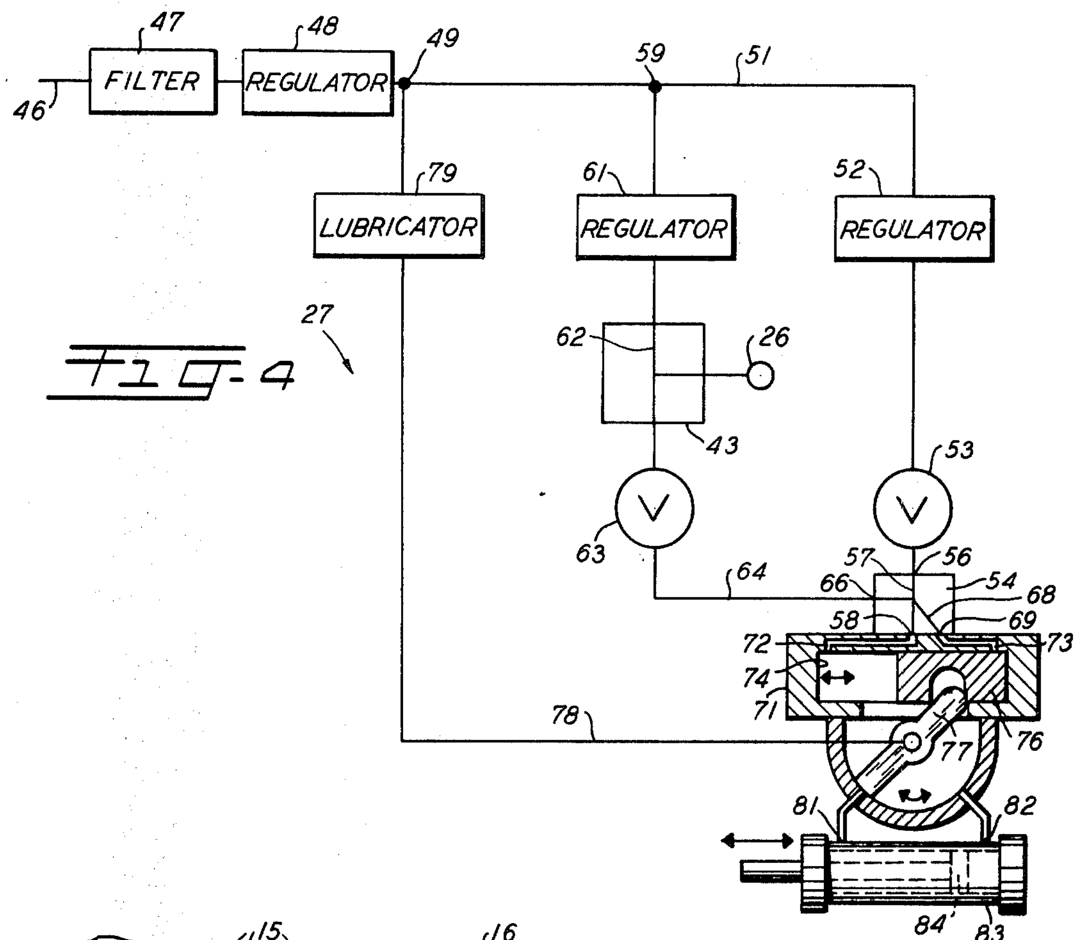

Fig-4

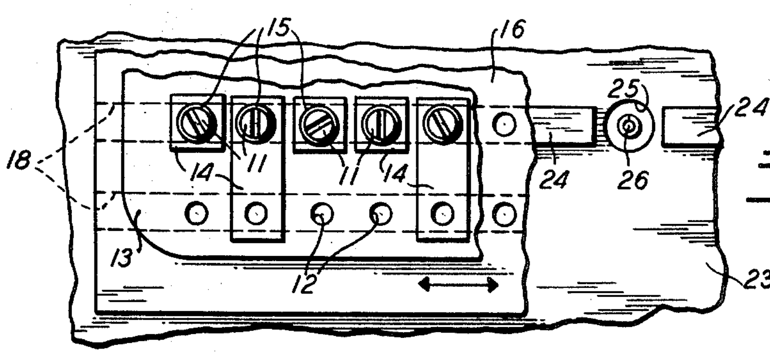

Fig-2

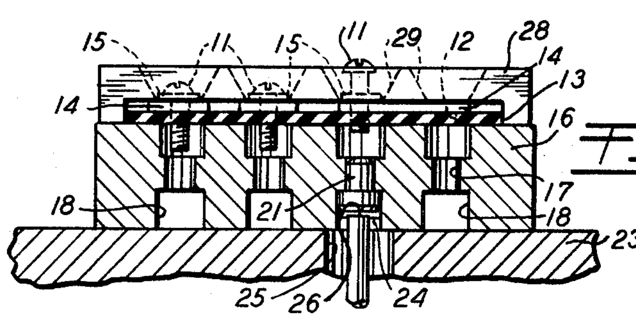

Fig-3

United States Patent Office

3,581,370

Patented June 1, 1971

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3,581,370

APPARATUS FOR CONTROLLING RELATIVE MOVEMENT BETWEEN A WORK TOOL AND A WORKPIECE

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Filed May 28, 1969, Ser. No. 828,603

Int. Cl. H05k 13/04

U.S. Cl. 29—203 13 Claims

ABSTRACT OF THE DISCLOSURE

A workpiece having an array of openings is placed on a workholder to align the openings with a like array of bores in the workholder. The workholder is moved to position successively each of the openings in the workpiece in alignment with a work tool which is actuated to insert a part in each of the openings to a predetermined depth. When selected ones of the openings are aligned with the work tool, pins prepositioned in the corresponding bores block a sensor orifice to energize a fluidic circuit and operate a device to limit the travel of the work tool to insert the part to a depth less than the predetermined depth.

BACKGROUND OF THE INVENTION

(1) Field of the invention

This invention relates to a fluidic apparatus for controlling the relative movement between a work tool and a workpiece, and more particularly, to a fluid logic circuit for controlling a travel impeding device to control the depth to which terminal screws are driven into a terminal board.

(2) Technical consideration and the prior art

In the assembly of terminal screws and washers with terminal boards, it is sometimes necessary that selected ones of the terminal screws be driven into the board to a different depth than others. Some of the terminal screws are driven through washers and completely into the terminal board so that the head of the terminal screw engages the washers which are seated against a terminal attached to a top surface of the terminal board. Sometimes it is required that the head of the terminal screw be spaced a predetermined distance from the terminal board so that, for example, installers in the field may wrap a wire around the shank of the terminal screw.

Generally, in the assembly of terminal boards, a plurality of terminal screws are driven into the board by a semiautomatic terminal screw driving apparatus in which an operator moves the mounting board under a driving head, so that an array of openings in the terminal board are positioned in seriatim under the driving head. Then terminal screws are conveyed from a supply to the driving head for insertion into the openings in the mounting board.

However, in the conventional apparatus, all of the terminal screws are driven through the same predetermined distance or are all driven completely into the terminal board until the heads of the terminal screws engage the washers which are seated against the terminals on the top surface of the board. When the heads of the terminal screws are in engagement with the washers which are in engagement with the terminals, the torque applied by the drive head to the screw exceeds a predetermined value and the drive head is disengaged from the drive screw by a slip clutch and returned to an unoperated position in preparation for another cycle. Alternative, a mechanical stop may be used to impede the travel of the drive head after the

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screws have been driven a predetermined distance or completely into the terminal board until the head of the screw engages the washer which engage the terminals.

If all of the screws have been turned completely into the terminal board, it is then necessary for an installer in the field to manually unscrew selected terminal screws from the board until the heads thereof are spaced a predetermined distance from the board so that the bare end of a wire may be wrapped around the screw. Or the terminal boards with the terminal screws turned completely into the openings in the terminal board are processed through another work station. There, each of the selected screws which are to be only partially turned into openings in the board are turned manually to move the head thereof a predetermined distance from the terminal board. This process is time-consuming and is wasteful in that each of the terminal screws must be first turned completely into the openings in the board and then selected ones turned in a reverse direction to move the heads of the selected ones out of engagement with the terminals on the terminal board.

It is therefore an object of this invention to provide a fluid logic circuit for controlling the depth to which the terminal screws are driven into a terminal board.

SUMMARY OF THE INVENTION

With these and other objects in mind, the present invention contemplates an apparatus for selectively controlling the distance traveled by a work tool relative to a workpiece at each of a plurality of work position on the workpiece as the workpiece is advanced indexably to move each of the plurality of work positions on the workpiece into alignment with the work tool.

More particularly, an apparatus for controlling a depth to which terminal screws are driven into a terminal board includes a workholder having a plurality of longitudinal grooves formed on an underside thereof and on which is placed a terminal board having an array of openings formed thereon. The openings in the terminal board are aligned with bores in the workholder so that as the workholder is moved along a guide rail to position each of the openings in the board in alignment with a work tool, each of the bores in the workholder is positioned in seriatim over a fluidic sensor which is connected into a fluidic circuit that operates an air cylinder. The air cylinder is double acting and controls the movement of a travel impeding device into engagement with a collar attached to a drive shaft of the work tool. The workholder is preassembled with programming pins selectively placed in those bores that are aligned with the openings in the terminal board to which terminal screws are to be driven to only a predetermined depth. As the operator moves the workholder along the guide rail, the operator actuates the work tool as each of the openings is aligned with the work tool. Then as such of the pins is positioned over the fluidic sensor, the fluidic circuit is energized to operate the air cylinder and move the travel impeding device into engagement with the collar on the drive shaft to limit the downward travel of the work tool, and hence, insert the terminal screw to only a predetermined depth within the opening in the terminal board.

Additional advantages and features of the invention will be better comprehended by reference to the drawings and detailed description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of an apparatus for inserting terminal screws in a terminal board which is moved between positions shown in phantom and having a control system constructed in accordance with the principles of the apparatus of this invention for regulating the descent of a driving bit;

FIG. 2 is an enlarged detailed view in plan of a portion of a terminal board mounted on a workholder having a plurality of longitudinal grooves formed on the underside thereof, one of which is received on a guide rail on a worktable;

FIG. 3 is an enlarged view section of the workholder taken transverse to the longitudinal grooves to show an opening in the workholder into which a terminal screw is to be driven into seating engagement with a terminal secured to the terminal board, and showing another opening in the workholder into which a pin has been inserted in order to block a sensor orifice connected to a fluidic circuit to cause the fluidic circuit to operate an air cylinder to limit the downward travel of the driving bit; and

FIG. 4 is a schematic view of a fluidic circuit which is used to control the operation of the air cylinder to move a travel impeding device into engagement with a collar mounted on a drive shaft of the driving bit when one of the pins in the workholder is aligned with the driving bit and blocks the sensor orifice.

DETAILED DESCRIPTION

Referring now to FIG. 1, there is shown an apparatus, designed generally by the numeral **10**, for driving a terminal screw **11** to a predetermined depth into each of a plurality of openings **12** (see also FIG. 3) formed in an array of rows and columns in a terminal board **13**. The terminal board **13** into which the terminal screws **11** are to be driven is preassembled with a plurality of terminals **14** having prongs which extend through the terminal board so that the terminals **14** are in engagement with a top surface of the board and the prongs protrude below a bottom surface of the board. The terminals **14** are pretapped to permit insertion of terminal screws **11** into the openings **12** in the terminal board **13**. A pair of washers **15** are prepositioned in engagement with the terminals **14** in alignment with each of the openings **12** prior to insertion of one of the terminal screws **11**.

The apparatus **10** includes a work tool **31** (see FIG. 1) which is cylically operated to drive a terminal screw **11** into each of the openings **12** in the terminal board as the openings are successively positioned in alignment with the work tool. Also, as the openings **12** are moved into alignment with the work tool **31**, the openings are aligned with a sensor orifice **26** which is connected through a fluid logic circuit **27** (see FIG. 4), that operates a travel impeding device **86** to limit the downward travel of the work tool. Normally, the terminal screws **11** are turned into the openings **12** until the headed ends thereof are in engagement with the washers **15** which are supported on the terminals **14**. For this condition, the fluid logic circuit **27** functions to convey air from a supply (not shown) and exit freely from the sensor orifice **26**. As other selected ones of the openings **12**, into which the terminal screws **11** are to be turned with the headed ends thereof spaced from the terminals, are moved into alignment with the sensor orifice **26**, the sensor orifice is blocked by sensor elements **21** (see FIG. 3) to create a back pressure and render effective the fluid logic circuit **27** to operate the travel impeding device **86**.

In order to support the terminal board **13** during the screw driving operation, the terminal board is placed on a workholder **16** having a plurality of stepped bores **17** formed therein in an array identical with the array of openings **12** in the terminal board (see FIGS. 1 and 3). The top surface of the workholder **16** is formed with a plurality of apertures for receiving the protruding prongs of the terminals **14** when the terminal board **13** is placed on the workholder **16** to align the openings **12** with the stepped bores **17**. Also, the workholder **16** has a plurality of longitudinal spaced grooves **18** formed parallel to each other in the underside of the workholder with each of the grooves aligned with a column of the array of openings **12** (see FIG. 3). Each of the stepped bores **17** terminates in one of the grooves **18** in the workholder **16**.

Prior to the assembly of the terminal screws **11** with the terminal boards **13**, a sensor element or programming pin **21** is inserted into each of selected ones of the stepped bores **17** in the workholder **16**, as shown in FIG. 3. These selected bores **17** are those into which the terminal screws **11** are to be driven to a depth such that the headed end of the terminal screw does not engage a terminal **14**. Each of the sensor elements **21** is inserted with a shank portion thereof oriented upwardly with a top end of the shank portion spaced from the top end of the shank poriton spaced from the top surface of the terminal **14** on the terminal board **13** to permit insertion of a terminal screw **11** to the predetermined depth.

Referring now to FIG. 1, an operator places the workholder **16** on a worktable **23**. The worktable **23** is formed with a guide rail **24** (see FIGS. 2 and 3) which is received in one of the grooves **18** of the underside of the workholder. The guide rail **24** is formed with two portions which are spaced apart as shown in FIG. 2, one on either side of a hole **25** on the table **23**. A sensor orifice **26**, connected to a fluid logic circuit (see FIG. 4), designated generally by the numerals **27**, protrudes upwardly through the hole **25** in the table **23** so that the top open end of the orifice is approximately in a plane with a top surface of the guide rail **24** (see FIG. 3). When one of the stepped bores **17** having a sensor element **21** inserted therein is moved over the sensor orifice, the open end of the sensor orifice **26** is spaced from the lower surface of the headed end of the sensor element a distance not greater than 0.015 inch.

Then, the operator places a cover plate **28**, having countersunk openings **29** formed therethrough in an array identical to the array of openings **12** in the terminal board **13**, in engagement with the terminal board (see FIG. 3). The cover plate **28** is undercut to fit over the terminal board **13** and align the countersunk openings **29** with the openings **12** in the terminal board. Moreover, the countersunk openings **29** have a diameter sufficiently large to pass the washers **15** and hold the washers aligned and in engagement with the terminals **14** in preparation for the insertion of the terminal screws **11**.

The operator moves manually the workholder **16** slideably along the guide rail **24** on the top surface of the table **23**, to the left as shown in FIG. 1, to position successively each of the openings **12** in each column in the terminal board **13** in alignment with a work tool, for example, a screwdriver, designated generally by the numeral **31**, which is aligned with the hole **25** in the table and the sensor orifice **26**. The work tool **31** is mounted on a frame **30**.

Terminal screws **11** and washers **15** are supplied to the drive tool **31** and the cover plate **28**, respectively for assembly with the terminal board **13**. A supply chute **32** (see FIG. 1) has an exit end spaced above and sufficiently off-center from a vertical axis through an axis of rotation of the work tool **31** and the center of the hole **25** to permit the work tool to be moved downwardly to turn a terminal screw **11** into the opening **12** in the terminal board. The supply chute **32** conveys pairs of the washers **15** from a supply (not shown) into the countersunk opening **29** currently positioned in alignment with the work tool **31**.

A second chute **33** for supplying terminal screws **11** has, as shown in FIG. 1, an exit end adjacent an access opening in a split collet **34** of the work tool **31** when the work tool is in an unoperated, or up position. Terminal screws **11** are fed singularly from a supply **36** which is suspended from the frame **30** (see FIG. 1), and are released by an escapement **37** to fall through the opening into the collet **34** with the headed end of the terminal screw oriented upwardly. The escapement **37** is opened by a linkage **38** which is operated as the work tool is moved upwardly following the turning of a terminal screw **11** into an opening **12** in the terminal board **13**. A typical arrangement of a power operated mechanism for assemblying threaded fasteners which shows screws fed from an escapement mechanism and through an access opening in one of a pair of opposed jaws and then driven into a workpiece by a drive tool is shown in U.S. Pat. 2,989,996 issued June 27, 1961 to P. H. Dixon.

Assuming now that an opening **12** into which a terminal screw is to be driven to a first depth until the headed end engages the washers **15** supported on one of the terminals **14** is in position under the work tool **31**, the operator depresses a pedal (not shown) which actuates a control circuit (not shown) to release a pair of washers from the supply chute **32** into the countersunk opening **29** and to operate a drive shaft **39** (see FIG. 1) to turn a driving bit **41**. Simultaneously, the driving bit **41** is moved downwardly to urge the terminal screw **11** in the collet **34**, through the collet **34** and into the countersunk opening **29** in the cover plate **28** which is now in alignment with the work tool **31**. The drive bit **41** turns the screw **11** into the opening **12** in the terminal board **13** until the headed end of the terminal screw is in engagement with the washers **15** supported on one of the terminals **14** on the board **13**. As can best be seen in FIG. 3, there is adequate clearance around the lower end of the terminal screw **11**; since the lower end of the terminal screw enters the large diameter portion of the stepped bore **17**, the screw does not engage the workholder **16**.

After the headed end of terminal screw **11** is in engagement with the washers **15** supported on the terminal **14**, the torque applied to the work tool **31** exceeds a predetermined value and the control circuitry (not shown) disengages rotation of the work tool through a slip clutch (not shown) and moves the work tool upwardly. A typical torque control system for a power screwdriver is shown in the hereinbefore referred-to patent issued to P. H. Dixon.

As the work tool **31** is moved upwardly, the linkage **38** is operated to open the escapement **37** and release the leading one of the screws **11** to descend in the chute **33** and be received in the access opening in the collet **34** with the threaded end oriented downwardly and the headed end upwardly. In this way, the terminal screw **11** is oriented properly so that in the next cycle of operation, upon descent of the work tool **31**, the drive bit **41** will engage the head of the screw and push the screw through the split collet **34** into the countersunk opening **28** then in alignment with the work tool.

The apparatus **10** is also operated to turn terminal screws **11** a second depth into selected ones of the openings **12** in the terminal board **13** so that the headed ends of the terminal screws are spaced a predetermined distance above the washers which are supported on the terminals **14**. When the operator moves one of selected openings **12** aligned with one of the stepped bores **17** in the workholder **16** which contains one of the sensor elements **21**, over the hole **25**, the sensor element is positioned over the sensor orifice **26** from which a fluid such as air from a supply (not shown) is normally emitted. Since the gap between the sensor orifice **26** and the sensor element **21** is no greater than approximately 0.015 inch, the positioning of one of the sensor elements over the sensor orifice **26**, which is connected through a touch sensor **43** (see FIG. 4), creates a back pressure and renders effective the fluid logic circuit **27** to operate the travel impeding device **86**. Alternatively, a proximity sensor device (not shown) could be used in which a plurality of jets of air converge at a point and which is rendered operative if the sensor element **21** is spaced 0.2 inch or less from the convergence point.

The fluid logic circuit **27** as shown in FIG. 4, includes the supply (not shown) of air which is moved over a conduit **46** through a filter **47** and a first regulator **48** to a junction point **49** at a pressure of approximately 90 lbs. per sq. in. From junction point **49**, the air flows through a conduit **51** and a regulator **52** where the air pressure is reduced to approximately 10 lbs. per sq. in. and then continues through a flow control valve **53** to a commercially available fluid logic device **54**, such as, for example, an OR/NOR device or a NOT device.

The fluid logic device **54** is a fluid logic element in which a power supply output is changed in response to a control input. As shown in FIG. 4, the fluid logic device **54** is constructed with a power supply opening **56** connected to the valve **53** and connected by a passageway **57** to a first output port **58**. Control air is supplied off conduit **51** from a junction point **59** through a regulator **61** to reduce the air pressure to approximately 1 lb. per sq. in. and then through a passageway **62** of the touch sensor **43** to a flow control valve **63** and along a conduit **64** into a control input port **66** in the fluid logic device **54**. The input port **66** is connected to the passageway **57** and intersects the passageway **57** at a point common with a passageway **68** that connects to a second output port **69**.

In operation, if one of the sensor elements **21** is not aligned over the sensor orifice **26** to block the orifice, air flows from junction point **59** through the regulator **61** and touch sensor **63** and exits from the sensor orifice **26**. In this normal unoperated state, air pressure is not present at input **66**, and air flows from the power supply port **56** through passageway **57** to the first output port **58**. However, if one of the sensor elements **21** is positioned over the sensor orifice **26**, air flow therefrom is blocked and the air moves through the touch sensor **43** and the valve **63** over line **64** and to the input port **66**. In response to control air present at the input port **66**, the supply air flow is switched from the first output port **58** to the second output port **69**.

The fluid logic device **54** is used to control the operation of a commercially available FLICR valve **71** with the output port **58** connected to a passageway **72** in the valve and the second output port **69** connected to a passageway **73** in the valve. The passageways **72** and **73** open to opposite ends of a chamber **74** which houses a slideably movable actuator **76**. The actuator **76** is moved in either direction as shown in FIG. 4 by air flowing from one of the passageways **72** or **73**. As the actuator **76** is moved in either direction, the actuator moves a pivotally mounted conduit **77**. The conduit **77** is connected through a conduit **78** and lubricator **79** to the junction point **49** to supply air under a pressure of approximately 60 to 90 lbs. per sq. in. pressure to the FLICR valve **71**. The conduit **77** pivots between two supply connections **81** and **82** to supply air to an air cylinder **83**. Normally the FLICR valve **71** is in an unoperated condition, as shown in FIG. 4, so that air is supplied through the lubricator **79** and line **78** to the FLICR valve, and then out of the valve to the supply connection **81** of the double acting air cylinder **83** to maintain a piston **84** in a retracted position within the cylinder.

The fluid logic circuit **27** is responsive to one of the sensor elements being moved over the sensor orifice **26** to operate the double acting air cylinder **83**. When one of the sensor elements **21** is positioned above and in close proximity of the sensor orifice **26**, the air flow from the orifice is blocked to create a back pressure through the touch sensor **43**. The back pressure in the touch sensor **43** causes the supply of control air at approximately 6 to 10 lbs. per sq. in. to flow along line **64** to the fluid logic device **54** to switch the fluid logic device and change the output from port **58** to port **69**. As the air supply which normally maintains the actuator **76** to the right as shown in FIG. 4 is shifted to output port **69**, air travels through the passageway **73** and urges the actuator **76** to the left. As the actuator **76** is moved to the left, the conduit **77** is moved pivotally in a counterclockwise direction, as viewed in FIG. 4, to align with the cylinder connection **82** and air is moved into the cylinder **83** to urge the piston **84** to the left.

As the piston **84** is moved to the left, as shown in FIG. 4, a travel impeding device **86** (see FIG. 1) is moved to the left to position a yoke **87** about the periphery of the drive shaft **39**. Then, when the operator depresses the pedal (not shown) to actuate the driving bit **41**, the work tool **31** is moved downward until a collar **88** secured to the drive shaft **39** engages the yoke **87**. In this way, the downward travel of the work tool **31** is interrupted or limited so that the terminal screw **11** is moved the second depth into the opening **12** in the terminal board **13** a distance which is less than that which occurs when one of the sensor elements **21** is not in alignment with the sensor orifice **26**.

On the other hand, if one of the pins **21** is not positioned in alignment with the driving bit **41**, the double acting air cylinder **83** is not operated and the travel impeding device **86** is positioned as shown in FIG. 1 so that the collar **88** engages a portion **89** of the travel impeding device and the terminal screw **11** is driven the first depth into the terminal board **13** so that the head engages the terminal **14** on the terminal board. It can be seen that the torque controlled slip clutch (not shown) described hereinbefore is not necessary in that the engagement of the collar **88** with the portion **89** of the travel impeding device **86** performs the same function.

After the operator has actuated the apparatus **10** to drive a terminal screw **11** into one of the selected openings **12** in the terminal board **13**, the operator moves slideably the workholder **16** along the guide rail **24** until the next successive opening **12** is positioned in alignment with the driving bit **41**. As the operator moves the workholder **16** and the sensor element **21** away from the sensor orifice **26**, air again escapes from the orifice so that the pressure in passageway **62** is reduced and bias is removed from the fluid logic device **54** so that air from the power supply (not shown) moves through passageway **72** to urge the actuator **76** to the right, or normal unoperated position. As the actuator **76** is moved to the right, the conduit **77** is moved pivotally in a clockwise direction as viewed in FIG. 4 to move from the supply port **82** to the port **81** of the double acting air cylinder **83** and move retractably the piston **84** within the air cylinder. As the piston **84** is moved to the right, the impeding device **86** is moved to the right as shown in FIG. 1 to position the portion **89** under the collar **88** so that the apparatus **10** is conditioned to drive the next successive terminal screw **11** completely into the next successive opening **12** in the terminal board **13**. Should the next successive opening **12** be aligned with a stepped bore **17** that contains a sensor element **21**, the above-mentioned cycle will be repeated when the sensor orifice **26** is blocked by the sensor element.

Should successive ones of the openings **12** in a particular schedule of terminal boards **13** be designed to have the terminal screws **11** only partially turned therein, the workholder **16** could be preassembled with a continuous sensor element or programming strip (not shown) which may be received in the groove **18** between those successive openings. In this way, the fluidic sensor orifice **26** is blocked continuously until the operator has moved the workholder so that the strip (not shown) no longer covers the orifice.

After the operator has successively positioned each of the openings **12** in one column of the array of openings in the terminal board **13**, the operator disengages the workholder from the guide rail **24**. Then the operator shifts the workholder **16** laterally of the worktable **23** until the next adjacent groove **18** in the workholder is aligned with the guide rail **24**. Then the operator repeats the cycle of the operation and moves successively each of the openings **12** aligned with the next adjacent groove **18** in which the rail **24** is now received into alignment with the work tool **31**.

It would be within the scope of this invention to provide a feed device which would advance the workholder **16** indexably to align successively each of the openings **12** in a column with the work tool **31**. Moreover, modifications could be provided which could also shift laterally

the workholder **16** to disengage the workholder from the guide rail **24** and then reengage the next adjacent groove **18** with the guide rail and repeat the cycle of operation to insert terminal screws **11** in the openings **12** in the column of openings aligned with the next adjacent groove **18**.

It would also be within the scope of this invention to provide an apparatus having a work tool **31** which may be selectively moved through any of a plurality of different distances relative to a workpiece at each of a plurality of work positions. In the specific embodiment of this invention discussed hereinbefore, a terminal screw **11** could then be turned into an opening in the terminal board **13** to any selected one of a plurality of different depths. This may be accomplished by using sensor elements **21** having differing dimensions which are inserted into the stepped bores **17** of the workholder **16** in accordance with a predetermined program of the depths to which the terminal screws **11** are to be turned. Each of the sensor elements **21** is dimensioned to cooperate with one of a plurality of sensor orifices **26** which protrude different distances above the worktable **23** to render effective the fluid logic circuit **27** and move one of a plurality of mechanical stops **86** into the path of travel of the collar **88**.

This invention also comprehends the use of fluid logic devices **54** other than an OR/NOR logic element or a NOT element. For example, an AND/NAND logic element could be included so that a first sensor orifice **26** is normally blocked to create a back pressure and apply a control signal to one input of the AND/NAND element. The workholder **16** is programmed to include another sensor element **21′** at each work position where a different distance of travel of the work tool **31** is desired. When the workholder **16** is moved into registration with the work tool **31**, the other sensor element **21′** blocks a second sensor orifice **26′** and supplies a control signal to the second input of the AND/NAND element thereupon switching the power supply to operate the FLICR valve **71**.

Other combinations of sensor elements **21**, mechanical stops **86** and fluid logic elements **54** to control the distance traveled by a work tool **31** with respect to a workpiece are within the scope of this invention.

What we claim is:

1. In a fabricating machine;

a workholder;

a tool;

means mounting said workholder and tool for relative movement with respect to each other;

normally unoperated means for limiting the extent of said relative movement; and

selectively settable means rendered effective upon movement of said workholder for operating said movement limiting means.

2. In a system for controlling the extent of successive movements of a work tool with respect to a workpiece which is advanced to align successively each of a plurality of work positions on the workpiece with the work tool;

means for supporting said workpiece;

normally unoperated means for limiting the travel of said work tool relative to said workpiece;

a sensor element prepositioned in said supporting means indicating a selected one of said work positions; and

means responsive to the alignment of one of said selected work positions with said work tool for detecting said sensor element to operate said travel limiting means.

3. In a system as set forth in claim **2**, wherein:

said normally unoperated means includes;

travel impeding device mounted for engaging said work tool to limit the travel of said work tool relative to said workpiece;

a fluid logic circuit for operating said travel impeding device to engage said work tool; and

said detecting means includes sensor means connected to said fluid logic circuit and which in response to the alignment of one of said sensor elements with sensor means renders effective the fluid logic circuit to operate said travel impeding device.

4. In a system as set forth in claim **3**, wherein:

said travel impeding device includes;

a stop selectively positionable to partially obstruct the movement of said work tool for limiting the extent of advance of said work tool with respect to said workpiece; and

pneumatically controlled means for positioning the stop to obstruct the movement of the work tool; and wherein

said sensor means includes means for projecting a stream of air against said workholder;

said sensor element blocks said air stream when said selected work position is aligned with said work tool and said sensor element is aligned with said detecting means; and

said fluid logic circuit includes a pneumatic switch means actuated by the blocking of the air stream for operating the pneumatically controlled means to control the extent of movement of said work tool toward said workpiece.

5. In a system as set forth in claim **4**, wherein:

said work tool is a drive head for turning terminal screws to a predetermined depth into each of an array of openings in a terminal board;

said supporting means is a workholder having a like array of openings formed therein and aligned with said openings in said terminal board; and

said prepositioned sensor elements are pins prepositioned in selected openings in said workholder corresponding to preselected openings in said terminal board into which said screws are to be driven to a depth less than said predetermined depth.

6. In a work fabricating machine having a tool relatively movable through a predetermined distance with respect to a workholder which is movable with respect to the tool, the improvement which comprises:

a plurality of spaced sensor elements on the workholder; and

means responsive to the movement of the workholder for sensing a sensor element and for selectively changing the extent of relative movement of the tool with respect to the workholder.

7. In an apparatus which includes a work tool that is moved a predetermined distance relative to a workpiece supported on a workholder that is advanced to successively align each of a plurality of work positions on the workpiece with the work tool, the improvement which comprises:

means for changing the distance moved by said work tool relative to said workpiece;

means for operating said changing means; and

means prepositioned on said workholder for selectively actuating said operating means.

8. In a work fabricating apparatus having a work tool that is moved a predetermined distance relative to a workpiece supported on a workholder which is movable with respect to the work tool to align each of a plurality of work positions with the work tool, the improvement which comprises:

means for arresting said work tool at selected work positions to limit the travel of said work tool to a distance less than said predetermined distance;

means for projecting a stream of air against said workholder;

means associated with each work position at which said work tool is to be moved relative to the workpiece a distance less than said predetermined distance for blocking the air stream; and

means responsive to the positioning of said blocking means in alignment with said work tool for operating said arresting means.

9. In a system for controlling the extent of successive reciprocating movements of a fabricating tool with respect to a workpiece;

means for reciprocating the tool;

means for interrupting the movement of the tool to reduce the extent of reciprocating movement of the tool;

a carrier for supporting the workpiece;

means rendered effective between successive reciprocating movements of the tool for incrementally advancing the carrier to position successive sections of the workpiece in the path of movement of the tool; and

means on the carrier associated with each of said sections of the workpiece for selectively controlling the interrupting means to control the extent of movement of the tool relative to each of said sections of the workpiece.

10. In a system for inserting parts to different depths in a plurality of openings in a workpiece;

a workholder for supporting said workpiece and having a plurality of bores aligned with the openings in said workpiece;

a work tool selectively moved toward said workpiece to insert one of said parts in each of said openings in said workpiece;

means for guiding said workholder relative to said work tool to successively position each of said openings in alignment with said work tool;

means selectively moved into engagement with said work tool for varying the distance traveled by said work tool toward said workpiece;

fluid circuit means for operating said varying means; and

programming means prepositioned in selected ones of said bores in said workholder for rendering effective said fluid circuit means when one of said selected openings is in alignment with said work tool.

11. In an apparatus for selectively inserting components at two different depths in a series of positions on a workpiece;

a workholder for supporting a workpiece, the workholder having a plurality of sensor elements mounted thereon indicative of predetermined positions on the workpiece at which components are to be inserted at a first depth;

a mechanism having a tool for inserting components into the workpiece;

means for operating said mechanism to advance said tool to insert a component at a second depth;

selectively operable means for blocking the advance of the tool to limit the insertion of a component to the first depth;

means for guiding the workholder to successively align each of said positions with said tool; and

means responsive to sensing a senor element for operating said blocking means to limit the insertion of a component to said first depth.

12. In an automatic screw driving machine having a screw driving means which is cyclically moved a predetermined distance to seat screws in a series of holes in a workpiece;

a workholder for supporting a workpiece;

means for guiding the workholder to successively present each hole of the workpiece in alignment with the screw driving means;

a stop selectively positionable to partially obstruct movement of the screw driving means for limiting the extent of advance of a screw into a hole;

pneumatically controlled means for positioning the stop to obstruct the movement of the screw driving means;

means for projecting a stream of air against the workholder;

means associated with each hole that is to receive a partially seated screw for blocking the air stream; and

pneumatic switch means actuated by the blocking of the air stream for operating the pneumatically controlled means to control the partial seating of a screw in the aligned hole.

13. In an apparatus for moving a drive bit attached to a shaft having a collar mounted thereon to turn terminal screws into each of an array of rows and columns of openings in a terminal board with the heads of the screws normally in engagement with terminal strips attached to a top surface of the board and in which the terminal board is moved in a predetermined manner to position successively each of said openings in alignment with said drive bit;

a workholder for mounting said terminal board, said workholder having a plurality of grooves formed in an underside thereof aligned with the columns of openings in said terminal board and having a like array of stepped bores formed therein which are aligned with said openings when said terminal board is mounted thereon;

a worktable having a guide rail formed on a top surface thereof and aligned with said drive bit for guiding said workpiece under said drive bit when said workholder is placed over said guide rail to receive said guide rail in one of said grooves, said guide rail formed in two linear portions separated by an aperture formed through said worktable and aligned with said drive bit;

a headed pin positioned in each of said stepped bores which correspond to selected openings into which screws are to be turned with said heads spaced above said terminal strips and with the head of the pin spaced above a bottom surface of the workholder a distance slightly greater than the height of said guide rail;

a yoke slideably movable about said shaft to engage said collar to limit the downward travel of said drive bit;

a sensor positioned in said aperture in said workable and extending from a top surface of the worktable a distance substantially equal to the height of said guide rail; and

a fluidic circuit responsive to the movement of one of said pins in juxtaposition with said sensor for moving slideably said yoke around said shaft.

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U.S. Cl. X.R.

144—32; 29—240