Nov. 7, 1967 E. M. JUNKINS 3,351,032

WORK HOLDING AND TRANSFERRING DEVICE

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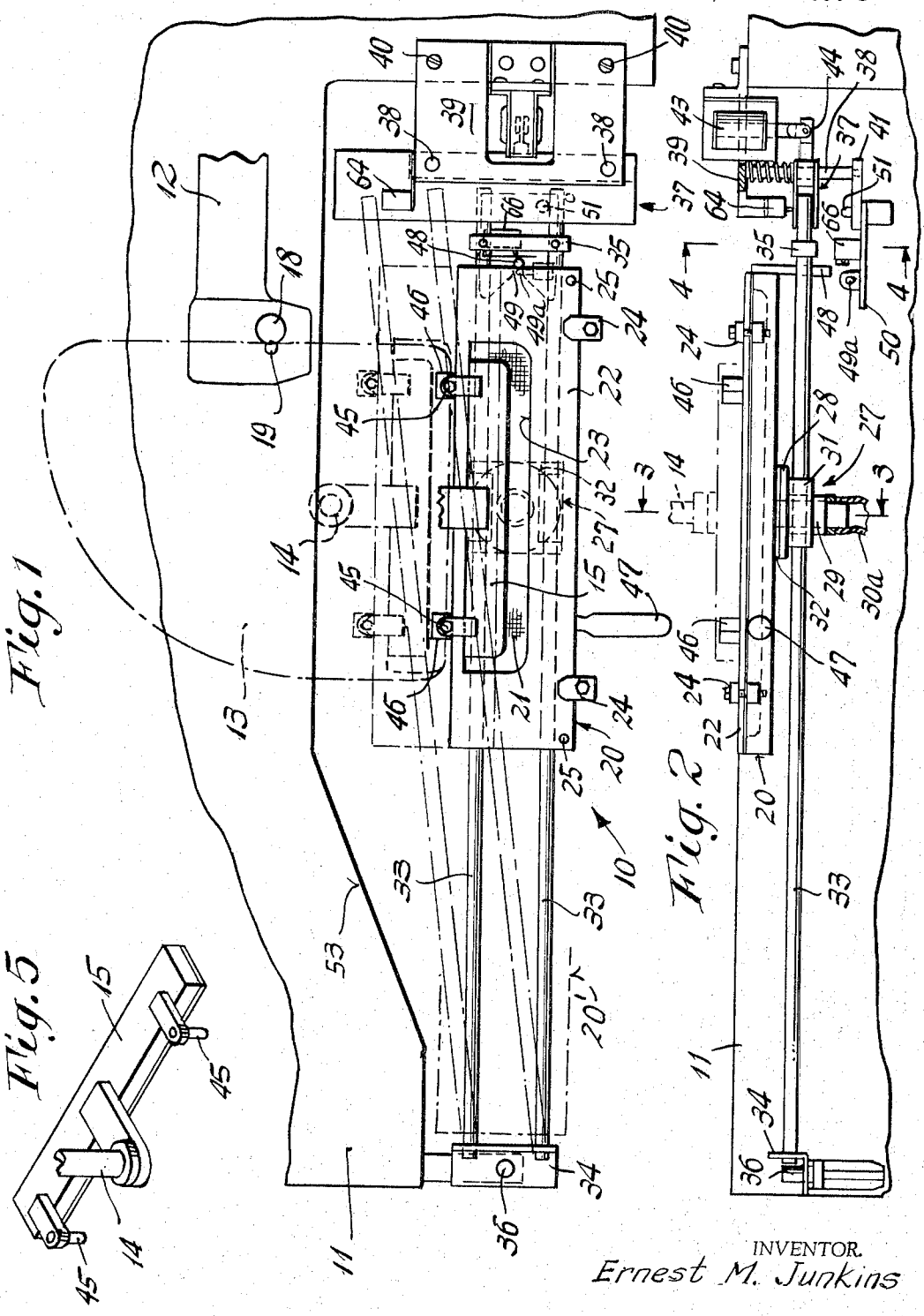


Fig. 1

Fig. 2

Fig. 5

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Fig. 3

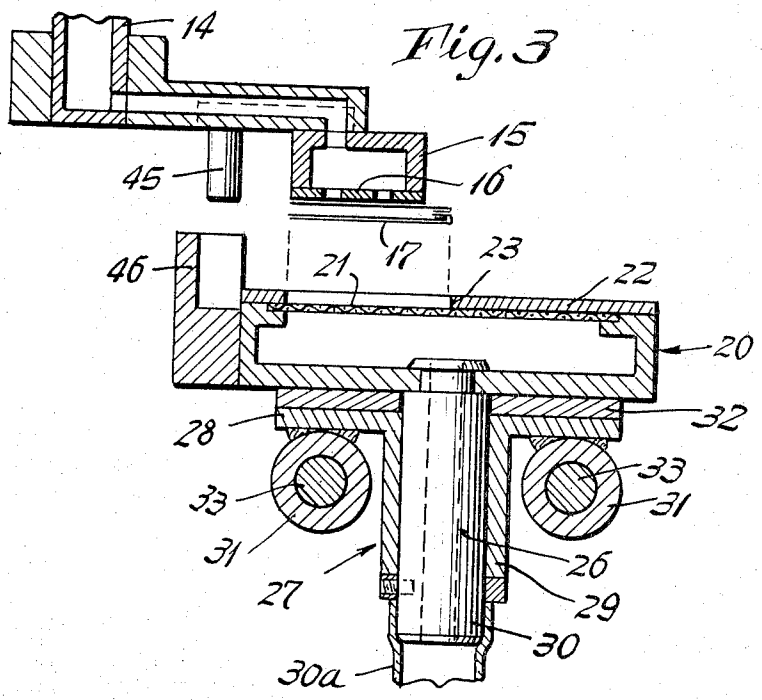
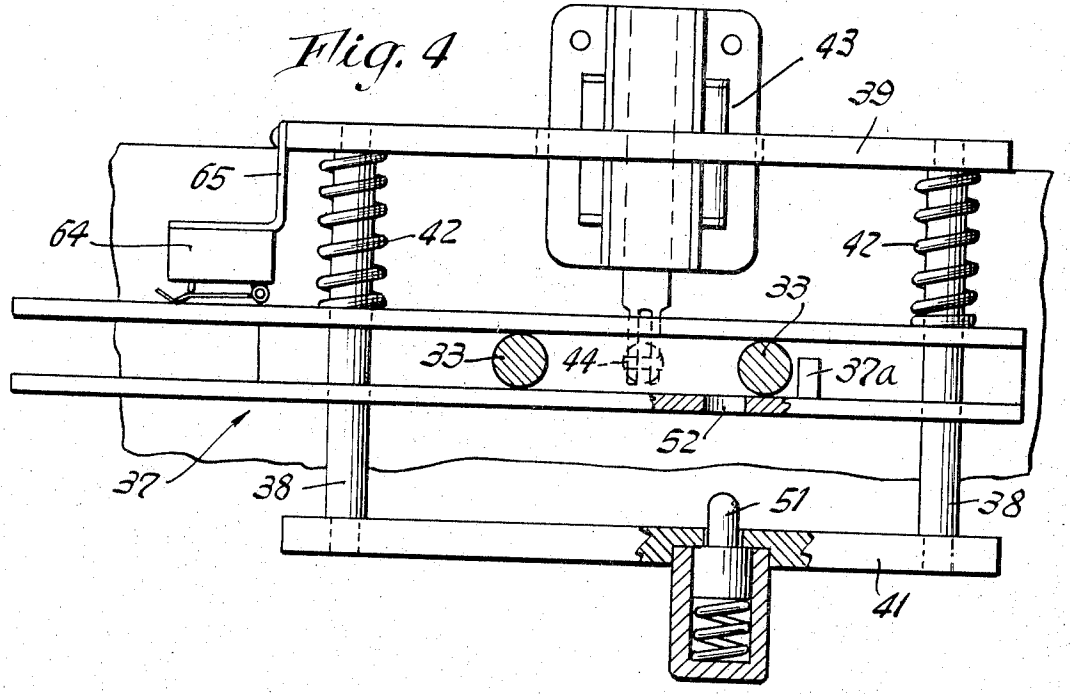


Fig. 4



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Fig. 6

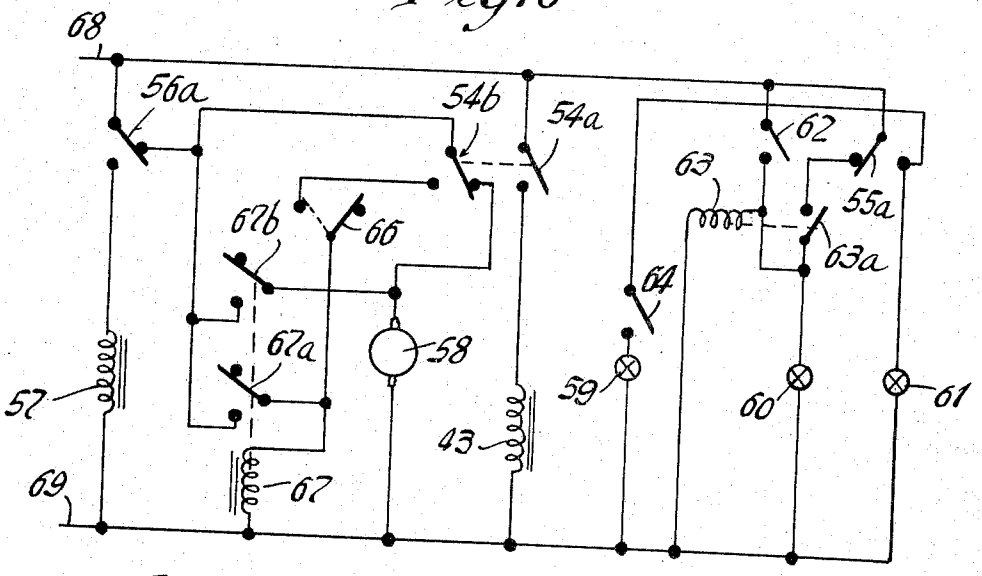


Fig. 7

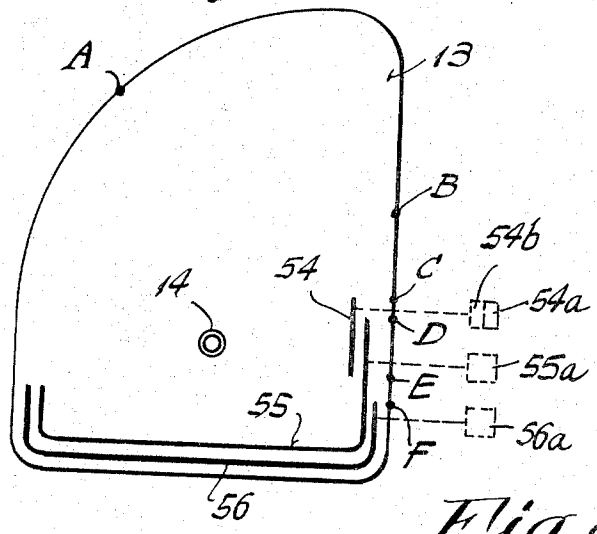
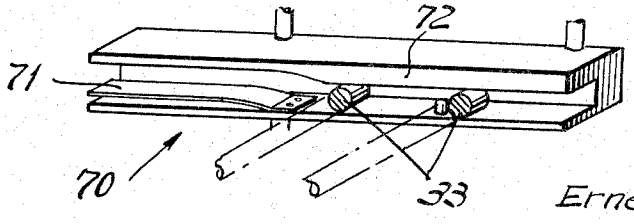


Fig. 8



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Fig. 9

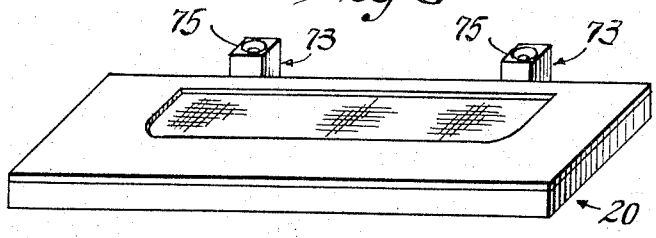


Fig. 10

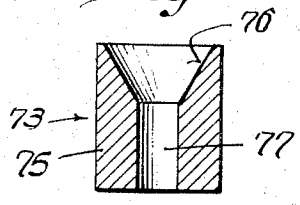


Fig. 11

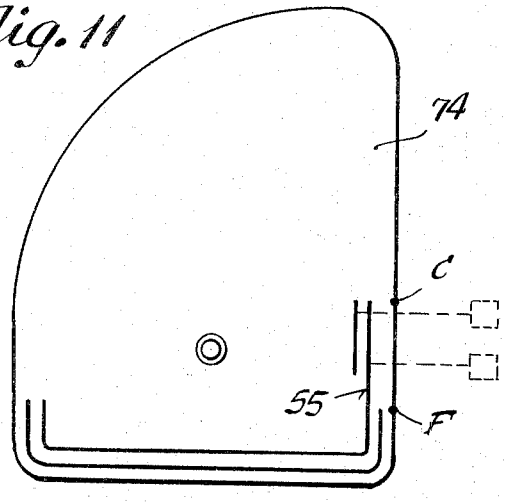
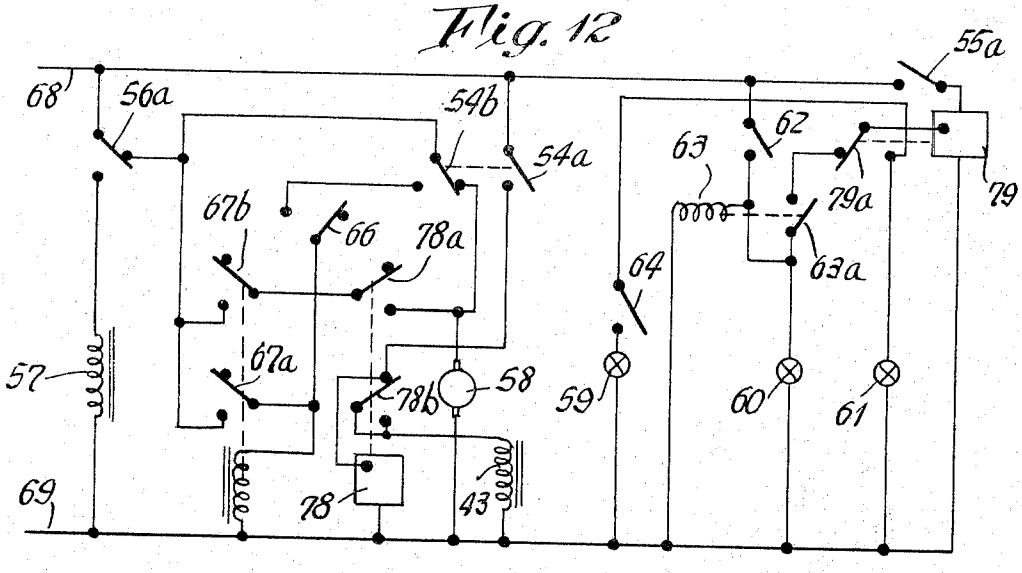


Fig. 12



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3,351,032

WORK HOLDING AND TRANSFERRING DEVICE

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Filed Feb. 8, 1965, Ser. No. 431,121
13 Claims. (Cl. 112—2)

ABSTRACT OF THE DISCLOSURE

A work holding and transferring unit for use with a guiding means that guides work past the needle of a sewing machine to form a predetermined line of stitching in which the work holder and the guiding means each carries aligning means that cooperate for accurately aligning them to effect a precise transfer of the work with the work holder being mounted for free movement to accommodate for a variable position of the guiding means.

In U.S. patent application Serial No. 105,193 filed April 24, 1961 by Thomas F. Henebry and entitled Automatic Guiding Apparatus, now Patent No. 3,170,423, there is disclosed an apparatus that holds work and guides the work with respect to a sewing machine needle in order to form the desired stitch path in the work. The apparatus includes a hollow foot having a perforated bottom and the work is secured to the foot by at least suction. The foot is caused to traverse a path corresponding to the stitch path and in order to assure that the path of stitches will be accurately placed in the work, the work must be precisely positioned on the foot.

The movement of the foot is accurately controlled substantially only adjacent the needle, as disclosed in said application, which causes the position of the foot when remote from the needle to be not sufficiently precisely predictable to enable work to be transferred from a work holding station to the foot with the required assurance of accuracy. While it has been suggested to transfer work from a fixed work holding station to the foot this has not been found completely satisfactory as it presented difficulties in causing the foot to become accurately aligned with the fixed work station and in addition required that the foot be stationary at least while the work is being transferred.

It is accordingly an object of the present invention to provide a work holding and transferring device which enables the work to be transferred from the device to the foot of the automatic guiding apparatus, reliably and with accuracy.

Another object of the present invention is to provide a work holding and transferring device for use with the above disclosed type guiding apparatus which enables the device to have work positioned thereon for subsequent transfer to the foot irrespective of the particular location of the foot during the positioning of the work and in which even an inexperienced operator may quickly and readily accurately position the work on the holding and transferring device.

A further object of the present invention is to provide a work holding and transferring device which is normally in a position where it is incapable of transferring work and is actuated to a position where it may transfer the work when the foot is at a predetermined location in its path of travel and ready to receive the work.

Another object of the present invention is to provide a work holding and transferring device in which the foot continuously moves and during a portion of the movement, the work is initially caused to be accurately aligned with the foot and then subsequently transferred.

An additional object of the present invention is to provide in a work holding and transferring device for automatically stopping the movement of the foot if work is not in position to be transferred to the foot.

In carrying out the present invention, a feature thereof resides in a work holding and transferring device having a work holder that is formed with a top, substantially flat surface that is perforated to enable work to be held on the surface by suction applied through the perforations. A recess corresponding substantially exactly to the exterior shape of the work is formed on the top surface and the work is positioned in the recess with suction applied only to the recess. Accordingly, the location of the work on the holder is accurately controlled.

The holder is mounted for free rotational, lateral and longitudinal movement and carries with it aligning means that cooperate with mating aligning means carried by the foot. The foot at a particular length on its path of travel effects engagement between the cooperating aligning means and by reason of the holder having free substantially universal movement, the foot causes the holder to move until they both become aligned. In one embodiment, the aligning means enables the foot to continue in its path of movement without stopping by causing the holder to move with the foot while in another embodiment the foot and holder are stationary during the transfer of the work.

After engagement of the aligning means, and the foot and holder are aligned the work is transferred from the holder to the foot. This is achieved in the specific embodiment herein described by applying suction to the foot and air pressure to the holder to cause the work to move from the holder to the foot. After the transfer, the holder is moved away from engagement with the foot so that each may then traverse its own course.

In addition to being mounted for free rotational, lateral and longitudinal movement, the holder also is mounted to be moved vertically between high and low positions. In the high position, the aligning means of the holder is positioned to engage the aligning means of the foot and to have the foot and holder aligned. After the transfer, the holder is dropped to its low position where its aligning means is incapable of maintaining engagement with that of the foot. Thus the holder is freed from being caused to move within the foot. Additionally, in the low position the holder may be manually or otherwise moved from the general area where the foot is moving to an area that is always clear of the foot and where subsequent work may be positioned on the holder by an operator. Moreover, after being loaded, the holder may, by remaining in its low position, be moved to a location in the holder's path of movement without any possibility of interference with the foot, irrespective of where the foot is located when the movement is made.

Other features and advantages will hereinafter appear.

In the drawing:

FIGURE 1 is a plan of the work holding and transferring device of the present invention with portions of the above-disclosed automatic guiding apparatus being shown.

FIG. 2 is a front view thereof.

FIG. 3 is a section, somewhat enlarged, taken on the line 3—3 of FIG. 2 with the holder in its low position after transferring work to the foot.

FIG. 4 is a detail, somewhat enlarged, taken on the line 4—4 of FIG. 2.

FIG. 5 is a perspective view of the foot showing its aligning means.

FIG. 6 is an electrical schematic diagram showing the interconnection of the electrical components of the present invention.

FIG. 7 is an illustration of the cam showing the relative dispositions of the camming surfaces for initiating operations at predetermined locations of the foot.

FIG. 8 is a detail of another embodiment of a guide which may be utilized in the present invention.

FIG. 9 is a perspective view of the pan showing another embodiment of aligning means.

FIG. 10 is a section taken on the line 10—10 of FIG. 9.

FIG. 11 is an illustration of the cam showing the relative dispositions of the camming surfaces for initiating operations at predetermined locations of the foot when the embodiment of the aligning means shown in FIG. 9 is employed.

FIG. 12 is an electrical schematic diagram showing the interconnections of various electrical components when the embodiment of the aligning means shown in FIG. 9 is employed.

Referring to the drawing, the work holding and transferring device of the present invention is generally indicated by the reference numeral 10 and is mounted on a table 11 that supports a sewing machine 12. As disclosed in the above-noted application, the automatic guiding apparatus includes a cam 13 mounted for rotation on a tubular shaft 14 with the shaft being supported for free longitudinal and lateral movement. Fixed to the lower end of the shaft 14 is a foot 15 that is hollow and has a perforated lower surface 16. Suction and/or pressure may be thus applied to the foot through the shaft 14 to hold work 17, such as pieces of fabric, against the bottom of the foot for movement therewith.

The cam periphery drivingly engages a driving member 18 at a point which is vertically aligned with the needle (not shown) and needle bar 19 of the sewing machine 12. As the driving member 18 is rotated, its engagement with the periphery of the cam causes it to move the cam while sensing means causes rotation of the tubular shaft 14 upon a deviation of the portions of the cam periphery adjacent the driving member 18 deviating from either the path in which stitches are to be placed in the work or the rest of the path of movement of the foot. Thus, at any particular instant and particularly when the foot is remote from the driving member 18, it is not known with sufficient certainty where the foot may be, as the deviation at the driving member may be within a minimum amount of tolerance prior to it being sensed by the sensing means and subsequently corrected. However, the foot must be located within at least a small area whose size is dependent upon this tolerance and the distance of the foot from the engagement of the cam and driving member. Thus even though it is not known with sufficient accuracy where the foot is exactly located at any given location in its path, it is known where it will be approximately located.

The work holding and transferring device 10 includes a hollow pan 20 which may be made out of sheet metal having a perforated top surface 21 on which is placed a work defining member 22 having a recess or cutout 23 that corresponds to the periphery of the work 17. The member 22 is formed from a sheet of imperforate material such as plywood having a thickness which is approximately that of the work and is detachably secured on the top surface 21 to be held in place as by clamping means 24. It will be appreciated that by accurately aligning the member 22 on the surface 21 as by use of aligning pins 25, that the work may be easily, surely and accurately positioned in the recess 23 and as the position of the recess is accurately known with respect to the pan then the position of the work is accurately known with respect to the pan.

The pan 20 is hollow and includes a downwardly extending tubular opening 26 by which suction or pressure may be applied to the interior of the pan and hence only to the area of the top defined by the recess 23. The work 17 in the recess will be accordingly held against the top surface when suction is applied at the opening 26 and blown from the surface if air pressure is applied to the opening 26.

The pan 20 is mounted, as shown in FIG. 3, on a bracket 27 that includes oppositely extending lateral portions 28 and a downwardly extending tubular portion 29 between the lateral portions 28. The tubular portion 29 encompasses the exterior of a tube 30 for a substantial length to provide a bearing surface therefor with the tube 30 communicating with the opening 26 and a hose 30a, the latter being connectible to either a source of suction or pressure. Bushings 31 are carried by the lateral portions 28 while disposed between the pan and the surface of the lateral portion 28 is a washer 32. As more clearly shown in FIG. 1, the present invention includes a pair of parallel rods 33 fixed at one end to an L-shaped bracket 34 and having a spacer 35 secured adjacent their other ends. The rods 33 pass through the bushings 31 and enable the bracket 27 carrying the pan to be movable axially of the rods. In addition, it will be appreciated that the pan may also pivot or rotate with respect to the bracket 28, the washer 32 minimizing any friction therebetween.

The L-shaped bracket 34 is mounted on a stationary vertical pin 36 secured to the table in any desired manner and the bracket 34 may pivot about the pin 36. The other ends of the rods 33 extend beyond the spacer 35 to be contained within the legs of a horizontally disposed guide 37 that is substantially U-shaped in cross-section. The guide 37 is mounted for vertical movement on a pair of spaced apart posts 38 that are connected to a top plate 39 secured as by screws 40 to the top surface of the table 11 while the lower end of the posts 38 are secured to a lower plate 41. Encircling the posts are springs 42 that urge the guide 37 towards the lower plate 41. For raising the guide against the resistance of the springs 42, there is provided a solenoid 43 connected as at 44 to the guide.

It will thus be appreciated that normally the guide 37 engages the lower plate 41 by reason of the springs but that upon energization of the solenoid 43, the solenoid causes the guide 37 to be raised to an upper position. The movement of the support 37 is transferred to the pan 20 so that it is also shifted between a lower and an upper position.

The foot 15, as shown in FIG. 5, includes aligning means which in the specific embodiment shown consists of a pair of depending cylindrical pins 45 that project downwardly to approximately the lower surface 16 of the foot. The pins 45 are spaced laterally on either side of the center line of the foot 15 and are secured adjacent the edge of the foot nearest the shaft 14. The pan 20 also carries aligning means and in the specific embodiment shown these consist of a pair of V-blocks 46 secured to the rear surface of the pan, with the blocks projecting upwardly above the surface 21 of the pan. The V-blocks 46 are accurately positioned on the pan 20 and as the pins 45 are similarly accurately positioned on the foot, whenever the pins are nested in the apex of the V of the blocks, the pan and the foot are accurately aligned. As before mentioned, the cutout 23 may be positioned accurately with respect to the pan as by the aligning pins 25. The work positioned in the recess 23 is thus accurately positioned on the pan, and hence may be accurately positioned with respect to the foot when the pins are nesting in the apex of the V-blocks.

In the operation of the disclosed device 10, the pan is initially positioned by an operator grasping a handle 47 secured to the pan and drawing the pan to the dotted line position 20' where work may be positioned in the recess 23 by the operator. Unless otherwise noted, the guide 37 is at its low position which is sufficiently low to place the top of the V-blocks in a plane beneath the plane in which the foot moves. The operator then pushes the pan rightwardly, as shown in FIG. 1, until a depending dowel 48 on the pan engages an opening 49 formed in a flat plate 50 with the opening being closed by a spring urged pin 49a. The rods 33 have been positioned in their front solid line position shown in FIG. 1 and maintained thereat by a spring urged pin 51 passing through an aperture 52 in the guide 37 to engage the side of the end portion of the adjacent rod while the other side of the rod engages a stop 37a mounted on the guide.

The opening 49 and the spring urged pin 51 are positioned so that when the dowel 48 is in the opening and the pin engages the side of the rod, the pan is positioned somewhere within the extremes of the path of movement of the foot. With the pan being thus positioned in its lower position and suction being applied through the opening 26, the work is thus held in the pan. As the foot in traversing its path approaches the place where the pan is located, the solenoid 43 is energized, raising the guide 37 together with the pan 20 to the solid line upper position shown in FIG. 2 at which time the dowel 48 frees itself from the recess 49 and the rod frees itself from the spring urged pin 51 so that the pan is now free to move. Moreover, the V-blocks are elevated to a level where their entrance will be horizontally aligned with the pins 45 as the foot continues its movement. After a short movement of the foot, the pins enter the entrance of the V-blocks to engage the sides of the V and the pins cause the pan to move with the foot. If the pins are not exactly aligned with the apex of the V-blocks, they will initially engage a side of the V and exert a resulting force on the V-blocks that causes movement of the pan until the pins do nest in the apex of each V-block. This aligning and mutual movement of the pan is accommodated by the freely pivotable movement of the pan on the bracket 27 and the longitudinal movement of the pan on the rods 33 while lateral movement of the pan towards the sewing machine is accommodated by the rods 33 pivoting on the pin 36 and sliding in the guide 37.

The first portion of movement of the foot and pan will cause alignment therebetween and after this initial short movement, suction is removed from the pan 20 and pressure applied thereto while suction is applied to the foot 15 through the shaft 14 to cause the work to be transferred from the pan to the foot by the difference in air pressure. The time for transferring the work requires a length of movement of the foot and after this movement, the solenoid 43 is deenergized causing the pan to drop to its low position which disengages the pins 45 from the V-blocks 46, thereby freeing the pan from the foot. The foot continues on its movement, as disclosed in the above-noted application, while the pan assumes a dotted line position beneath the plane of the foot where it was dropped from the foot. The operator then grasps the handle 47 and pulls the pan on the rods 33 to the dotted line position 20'. The pan during the movement to the dotted line position 20' engages a camming surface 53 formed on the table which forces the rods 33 from their rearward position to their forward position where they are held by the pin 51.

The above steps are repeated with the operator positioning work in the recess 23 and then moving the pan until there is engagement between the dowel 48 and recess 49. Normally, the time for the operator to move the pan, position work thereon and then move the pan to be in alignment with the path of travel of the foot requires less time than the foot requires to complete its path and arrive above the pan. If the pan is not in position however, the foot may be automatically stopped as more fully hereinafter set forth.

Shown in FIG. 7 is a diagrammatic representation of the cam 13 with the upper surface of the cam having switch actuating surfaces 54, 55 and 56. The surface 56 is disclosed in the above-noted application and is utilized to operate a switch 56*a* that controls the length of the movement of the foot when the sewing machine is operated as by a clutch controlled solenoid 57 which also drives the driving member 18 in timed relation therewith while for the other length of movement of the foot, the driving member is driven by an auxiliary motor 58. The surface 55 operates a single pole double throw switch 55*a* which basically controls suction to the foot and pan. The surface 54 operates a double pole double throw switch 54*a* and 54*b* that controls energization of the solenoid 43 and deenergization of the auxiliary motor 58. It

will be appreciated that the switches 54*a* and 54*b*, 55*a* and 56*a* are actuated only when their respective cam surfaces are positioned on the line substantially perpendicular to a line that is tangent to the driving member 18 at its point of engagement with the cam 13.

Shown in FIG. 6 is an electrical schematic diagram containing the switches 54*a* and 54*b*, 55*a* and 56*a*, the solenoid 43, the sewing machine clutch control solenoid 57 and the auxiliary motor 58. There is also shown a normally closed solenoid valve 59 that is connected between the pan 20 and a source of air pressure (not shown), a normally closed solenoid valve 60 connected between the pan 20 and a source of suction (not shown) and a normally closed solenoid valve 61 connected between the foot 15 and the source of suction. Energization of these valves enables either pressure or suction to be applied to the pan and suction to be applied to the foot. In addition, there is also disclosed a manually actuatable normally open switch 62 that is actuated by the operator when the pan is in the loading position 20' after work has been placed thereon together with a relay 63 having a switch 63*a*, that constitutes holding circuit for maintaining energization of the valve 60 after operation of the switch 62. For eliminating pressure after the pan has been dropped to the low position there is a switch 64 mounted on the top plate as by a bracket 65 to be closed when the guide 37 is in its elevated position. The circuit further includes a switch 66 connected on the plate 49 to be actuated by the dowel 48 when it is contained in the recess together with a double pole double throw relay 67 having switches 67*a* and 67*b*. A source of electrical energy is connected to a pair of leads 68 and 69 such as 110 volts A.C.

In the above-described circuit, the switches are in their normal solid line position shown when the point A of the cam engages the driving member 18. When the point B of the cam is in engagement with the driving member 18, the operator should have work positioned in the recess 33, the switch 62 momentarily activated, the pan moved until it is under the path of travel of the foot where the dowel 48 closes the switch 66. Momentary actuation of the switch 62 is sufficient to energize the relay 63 to close switch 63*a* that energizes the suction valve 60 to supply suction to the pan to hold the work with the valve 60 being maintained energized by current through the switches 55*a* and 63*a*.

As the foot continues its movement to the point C of the cam, the surface 54 closes switches 54*a* and 54*b* and the solenoid 43 is energized, raising the pan to its elevated position. The foot then moves a short distance to the point D on the cam, which is a distance sufficient to enable the pins 45 to engage the V-blocks, initially move the pan and cause alignment between the pan and the foot, whereat the switch 55*a* is actuated by the beginning of the camming surface 55. The actuation of the switch 55*a* to its dotted line position opens relay switch 63*a* and deenergizes the suction valve 60 with consequent removal of suction from the pan 20. In addition, switch 55*a* energizes valve 61 causing suction to be applied to the foot and energizes valve 59 causing pressure to be applied to the pan. The switch 64 is now closed by reason of the guide 37 being elevated. The valves, by being in this condition of energization, cause transfer of the work from the pan to the foot.

During the transfer of the work, the foot has moved from the point D to the point E that corresponds to the end of the camming surface 54 which then enables the switches 54*a* and 54*b* to move to their open position. Opening of switch 54*a* deenergizes the solenoid 43 so that the guide 37 and pan are forced, by the springs 42 to their low position to cause disengagement between the foot and the pan and also opens switch 64 to deenergize pressure valve 59. Thus from this time the foot continues on its movement with only suction being applied to the foot while there is neither suction nor pres-

sure applied to the pan. At the point F on the cam, the switch 56*a* is actuated, causing the sewing machine to begin sewing and drive the driving member while the auxiliary motor 58 becomes deenergized. The operator then returns the pan to the loading position 20' where the above cycle is repeated on the next piece of work.

In the event that the pan is not in position to acuate switch 66 when the switches 54*a* and 54*b* are actuated, the energy to the auxiliary motor 58 is ceased, causing the foot to discontinue its movement. Thus, assuming that the switch 54*b* has been actuated and the switch 66 is in its non-actuated, solid line position, no current flows to the motor 58. When the switch 66 is finally closed, by the pan being properly positioned, a circuit is established through the dotted line position of switch 66 to energize the relay 67. Current is then conducted to the motor through switch 67*b* while switch 67*a* establishes a holding circuit for the relay. When the guide 37 rises, it enables switch 66 to assume its solid line position, which has no effect on the motor, as the relay 67 is maintained energized by its holding circuit. Similarly, a change in condition of the switch 54*b*, once the holding circuit is established, does not effect the energization of the motor 58. As the foot moves, the switch 56*a* is subsequently actuated to deenergize the relay 67 and also the motor 58 when the sewing machine clutch solenoid 57 is energized. It will be appreciated that the switch 66 may be actuated at any time that the motor 58 is energized but only is effective to deenergize the motor 58 when the pan is to engage the foot.

Shown in FIG. 8 is another embodiment of the guide 37 and indicated by the reference numeral 70 which enables the guide to resiliently force the pan against the foot which may at times be found desirable if for example the foot and/or pan additionally hold work by means of impaling pins. The guide 70 is substantially U-shaped in cross-section but has a flat spring 71 secured on its lower leg while the forward end portion of the upper leg is thickened as at 72 to maintain the vertical distance between the legs of the guide. It will be appreciated that the ends of the rods 33 are initially at the portion 72, are moved leftwardly in this figure while the pan and foot become aligned and are then resiliently urged upwardly by the spring 71 with subsequent movement of the pan. When one or both ends of the rods are on the spring 71, the spring will urge the rods upwardly until the surface 16 of the foot engages the work in the recess 23 of the pan and the spring 71 will, by flattening, absorb the excess movement of the ends of the rods.

In the above disclosed embodiment of the invention, the pan and foot after alignment are mutually moved during the transferring of the work from the pan to the foot. Additionally, the movement of the foot provides in effect a timing sequence for the various operations. At times however it may be found desirable to transfer the work while the pan and foot are stationary without any substantial movement during or after the transfer. To achieve such a transfer, the pan has secured thereto aligning means 73, as shown in FIG. 9, which is employed together with the cam 74 shown in FIG. 11 and the circuit shown in FIG. 12. Similar parts have been given the same reference numerals.

Referring to FIGS. 9 and 10, the aligning means 73 consists of a pair of blocks 75 with each formed to provide a funnel shaped surface 76 that terminates in a cylindrical bore 77 having substantially the same diameter as the pins 45. In use, the foot 15 is stopped at the point C, the pan 20 is raised to its upper position wherein each pin 45 enters its mating bore 77 to align the pan and foot, the valves 59, 60 and 61 are actuated to transfer the work, the pan is forced to its lower position and the foot is caused to begin to move along its predetermined path.

The cam 74 is the same as the cam 13 with the exception that the camming surface 55 begins at the point C

instead of at the point D. The electrical circuit is also similar. However in order to provide the proper timing sequences, there is added two time delay relays 78 and 79 having normally open switches 78*a* and 78*b* and 79*a* respectively. The switch 78*a* is interconnected between the switch 67*b* and the motor 58 while the switch 78*b* is interconnected between the switch 54*a* and the motor 58. The switch 79*a* is connected in series with the switch 55*a*.

In the operation of the above circuit at the point C, the switches 54*a*, 54*b* and 55*a* are actuated, energizing the solenoid 43 through switch 78*b* and deenergizing the motor 58 by the switch 78*a* being open. Also the switch 55*a* is closed and serves to energize the time delay relay 79 which after one or two seconds changes the position of the switch 79*a* causing the valves 59, 60 and 61 to be operated to effect transfer of the work from the pan to the foot. The time delay introduced by the relay 79 is to enable the pan to be moved upward and become aligned with the foot before the work is transferred.

A few seconds after the switch 79*a* changes its position, the relay 78 becomes operative to change the positions of the switches 78*a* and 78*b*. This change energizes the motor 58 and deenergizes the solenoid 43 which causes the pan to be dropped to its low position and the foot to begin its movement from the point C. Subsequent movement of the foot causes the previously described operations to be effected at the various points of the cam with of course the point D being omitted.

It will accordingly be understood that there has been disclosed a work holding and transferring device for use with an automatic guiding apparatus having a foot that holds the work. The foot is caused to move along a predetermined but not completely predictable path and at a preselected location, work is accurately transferred to the foot. This is achieved by having the work held in a recess formed in a pan, and by having the pan mounted for rotational, lateral and longitudinal movement. Cooperating aligning means carried by the pan and foot are engaged with the foot causing the pan to move until any misalignment between the foot and pan is overcome and they are aligned. The work is then transferred from the pan to the foot and the pan is lowered below the foot, causing them to become disengaged and each is thus able to traverse its own course. The course of the foot is to have the desired line of stitching formed in the work while the pan is moved to a location remote from the foot where the next piece or pieces of work may be precisely positioned on the pan for subsequent transferal to the foot. In one embodiment, the pan and foot are mutually moving in aligned relation during the transfer of the work while in another embodiment the pan and foot are stationary during the transfer of the work. In both embodiments however, the pan is mounted for free movement to enable the aligning means of the foot to engage the aligning means of the pan to cause the latter to move until alignment is achieved before transferring the work.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. In combination with a sewing machine having a needle and an automatic guiding apparatus for guiding work in a predetermined path past the needle of said sewing machine, said apparatus including a foot for carrying the work and means for moving the foot along a predetermined path and for pivoting the foot about a point in alignment with said needle upon a deviation of the movement of the foot from its predetermined path; a work holding and transfering device comprising a work holder adapted to hold work, means mounting the work holder for free movement, aligning means mounted on said holder, cooperating aligning means mounted on said foot, means for relatively moving the work holder and

foot to effect engagement between the aligning means and the cooperating aligning means to cause said foot and holder to become aligned and means for transferring the work from the holder to the foot.

2. In combination with a sewing machine having a needle and an automatic guiding apparatus for guiding work in a predetermined path past the needle of said sewing machine, said apparatus including a foot for carrying the work and means for moving the foot along a predetermined path and for pivoting the foot about a point in alignment with said needle upon a deviation of the movement of the foot from its predetermined path; a work holding and transferring device comprising a work holder adapted to hold work, means mounting the work holder for free movement, aligning means mounted on said holder, cooperating aligning means mounted on said foot, means for shifting the aligning means of the work holder into and out of position to engage the aligning means of the foot, means for relatively moving the work holder and foot during engagement between the aligning means and the cooperating aligning means to cause said foot and holder to become aligned and means for transferring the work from the holder to the foot.

3. The invention as defined in claim 2 in which the means for transferring includes means connected to the foot and work holder for applying a difference in air pressure thereto.

4. The invention as defined in claim 2 in which the means for transferring includes means for resiliently forcing the work carried by the holder against the foot.

5. In combination with a sewing machine having a needle and an automatic guiding apparatus for guiding work in a predetermined path past the needle of said sewing machine, said apparatus including a foot for carrying the work and means for moving the foot along a predetermined path and for pivoting the foot about a point in alignment with said needle upon a deviation of the movement of the foot from its predetermined path, said foot moving in a plane; a work holding and transferring device comprising a work holder, means mounting the work holder for free movement, aligning means mounted on said holder, cooperating aligning means mounted on said foot and movable in the plane of the foot, means normally positioning the work holder aligning means out of the plane of the cooperating aligning means and for moving the work holder aligning means into the plane of the cooperating aligning means to effect engagement between the aligning means and the cooperating aligning means to cause said foot and holder to become aligned and means for transferring the work from the holder to the foot.

6. In combination with a sewing machine having a needle and an automatic guiding apparatus for guiding work in a predetermined path past the needle of said sewing machine, said apparatus including a foot for carrying the work and means for moving the foot along a predetermined path and for pivoting the foot about a point in alignment with said needle upon a deviation of the movement of the foot from its predetermined path, said foot moving in a plane; a work holding and transferring device comprising a work holder, means mounting the work holder for free movement, aligning means mounted on said holder, cooperating aligning means mounted on said foot and movable in the plane of the foot, means normally positioning the work holder aligning means and out of the plane of the cooperating aligning means for moving the work holder aligning means into the plane of the cooperating aligning means to effect engagement between the aligning means and the cooperating aligning means to cause said foot and holder to become aligned, means for transferring the work from the holder to the foot and means for enabling the holder to be moved into and away from the predetermined path when it is in its normal position.

7. In combination with a sewing machine having a needle and an automatic guiding apparatus for guiding work in a predetermined path past the needle of said sewing machine, said apparatus including a foot for carrying the work and means for moving the foot along a predetermined path and for pivoting the foot about a point in alignment with said needle upon a deviation of the movement of the foot from its predetermined path, said foot moving in a plane; a work holding and transferring device comprising a work holder, means mounting the work holder for free movement, aligning means mounted on said holder, cooperating aligning means mounted on said foot and movable in the plane of the foot, means normally positioning the work holder aligning means out of the plane of the cooperating aligning means and for moving the work holder aligning means into the plane of the cooperating aligning means to effect engagement between the aligning means and the cooperating aligning means to cause said foot and holder to become aligned, means for transferring the work from the holder to the foot and means for moving the work holder to its normal position after the transfer of the work.

8. The invention as defined in claim 7 in which the foot is maintained moving along its predetermined path during the transfer of the work, the aligning means and cooperating aligning means are engaged to have the holder mutually move with the foot and the means for moving the work holder to its normal position includes means actuated at a predetermined location of the foot in its path of travel.

9. The invention as defined in claim 7 in which there are means for stopping the movement of the foot in its predetermined path during the transfer and the means for moving the work holder to its normal position includes a time delay circuit means.

10. In combination with a sewing machine having a needle and an automatic guiding apparatus for guiding work in a predetermined path past the needle of said sewing machine, said apparatus including a foot for carrying the work and means for moving the foot along a predetermined path and for pivoting the foot about a point in alignment with said needle upon a deviation of the movement of the foot from its predetermined path; a work holding and transferring device comprising a work holder adapted to hold work, means mounting the work holder for free movement and for movement into a selected location that is substantially at a position in the path of travel of the foot, aligning means mounted on said holder, cooperating aligning means mounted on said foot, means for relatively moving the work holder and foot to effect engagement between the aligning means and the cooperating aligning means to cause said foot and holder to become aligned, means connected to the means for relatively moving the work holder and foot and operative to actuate the relative moving means when the foot is at its position and means for transferring the work from the holder to the foot.

11. The invention as defined in claim 10 in which means for actuating the relatively moving means includes means for sensing the absence of the work holder at its position and means for preventing movement of the foot past its position when the absence of the work holder is sensed.

12. In combination with a sewing machine having a needle and an automatic guiding apparatus for guiding work in a predetermined path past the needle of said sewing machine, said apparatus including a foot for carrying the work and means for moving the foot along a predetermined path and for pivoting the foot about a point in alignment with said needle upon a deviation of the movement of the foot from its predetermined path; a work holding and transferring device comprising a work holder adapted to hold work, means mounting the work holder for free movement and including a pair of elongate, parallel rods, means mounting the rods for vertical

and horizontal pivotal movement, a bracket slidably mounted on the rods, means mounting the work holder for rotational movement on the bracket, aligning means mounted on said holder, cooperating aligning means mounted on said foot, means for relatively moving the work holder and foot by moving the rods vertically to effect engagement between the aligning means and the cooperating aligning means to cause said foot and holder to become aligned and means for transferring the work from the holder to the foot.

13. In combination with a sewing machine having a needle and an automatic guiding apparatus for guiding work in a predetermined path past the needle of said sewing machine, said apparatus including a foot for carrying the work and means for moving the foot along a predetermined path and for pivoting the foot about a point in alignment with said needle upon a deviation of the movement of the foot from its predetermined path; a work holding and transferring device comprising a work holder adapted to hold work, means mounting the work holder for free movement, alignment means mounted on

said holder, cooperating aligning means mounted on said foot, means for relatively moving the work holder and foot to effect engagement between the aligning means and the cooperating aligning means, means for causing said foot and holder to become aligned and mutually moved for a length of the path of travel of the foot and means for transferring the work from the holder to the foot only when the foot and holder are being mutually moved.

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