United States Patent

[11] 3,601,393

[72] Inventor George F. Hawley
Bogota, N.J.

[21] Appl. No. 871,326
[22] Filed Nov. 19, 1969
[23] Division of Ser. No. 601,768, Dec. 4, 1966, abandoned.
[45] Patented Aug. 24, 1971
[73] Assignee Ivanhoe Research Corporation
New York, N.Y.

[54] **APPARATUS FOR TREATING FABRIC WORKPIECES IN SEQUENCE AT A PLURALITY OF WORK STATIONS**
7 Claims, 17 Drawing Figs.

[52] U.S. Cl. 271/54, 198/218
[51] Int. Cl. B65h 5/10
[50] Field of Search 271/54, 14, 84; 198/218

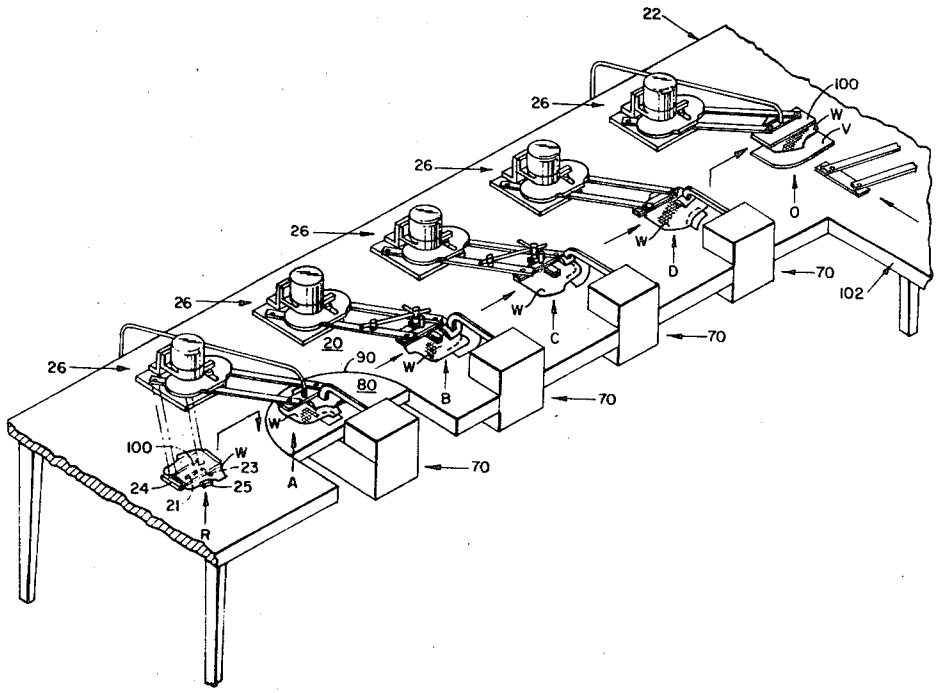
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Primary Examiner—Joseph Wegbreit
Attorney—Bryan, Parmelee, Johnson & Bollinger

ABSTRACT: A transfer module for transferring fabric workpieces from one workstation to another along a low friction surface, including an arm swingable forward and back with friction gripping means carried by the arm and engageable with the workpieces to slide and orient the workpieces relative to a series of workstations. The arm is shown including a parallel linkage.



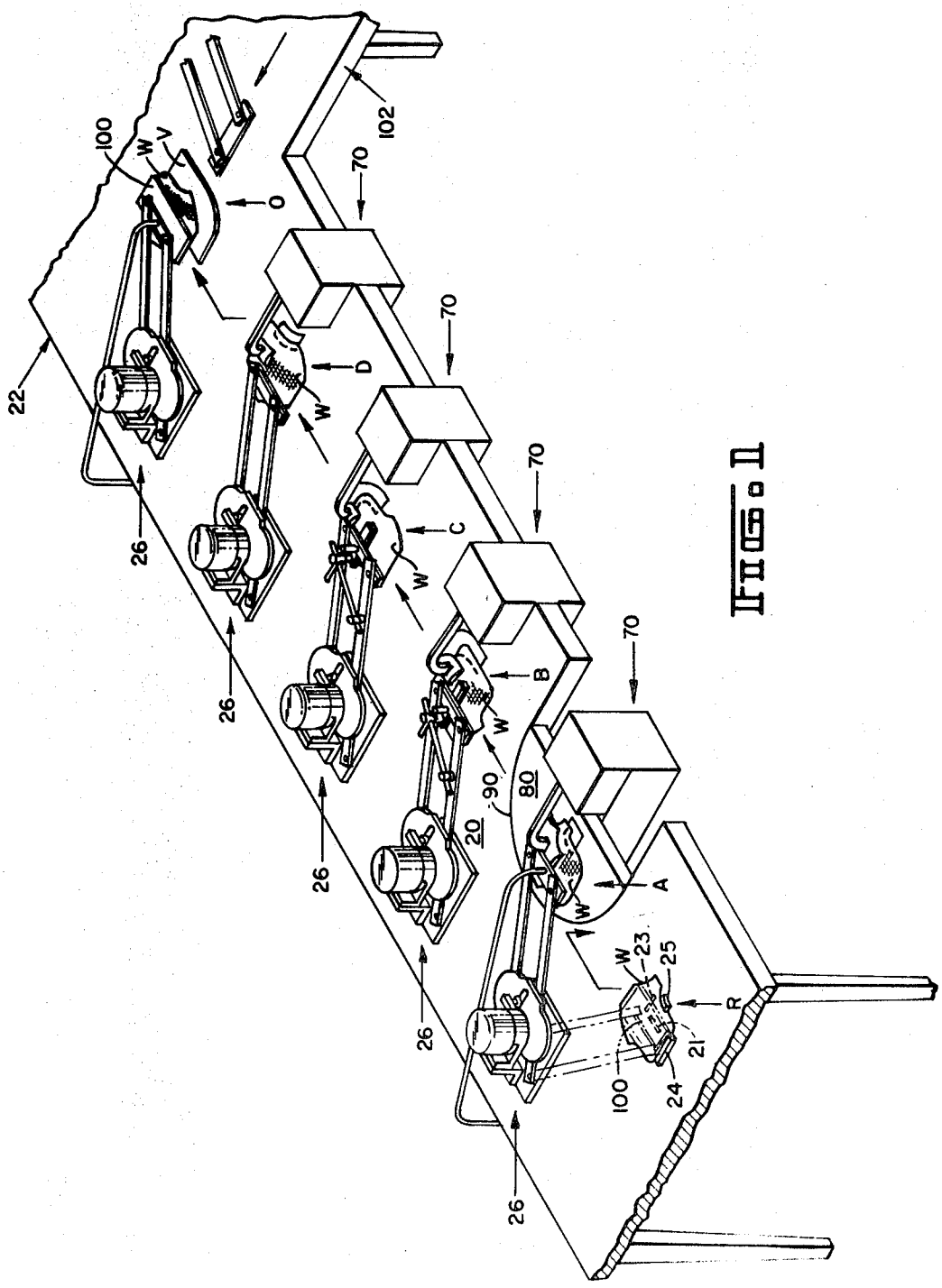


FIG. 1

INVENTOR.
GEORGE F. HAWLEY

BY
BRYAN, PARMELEE, JOHNSON & BOLLINGER
ATTORNEYS.

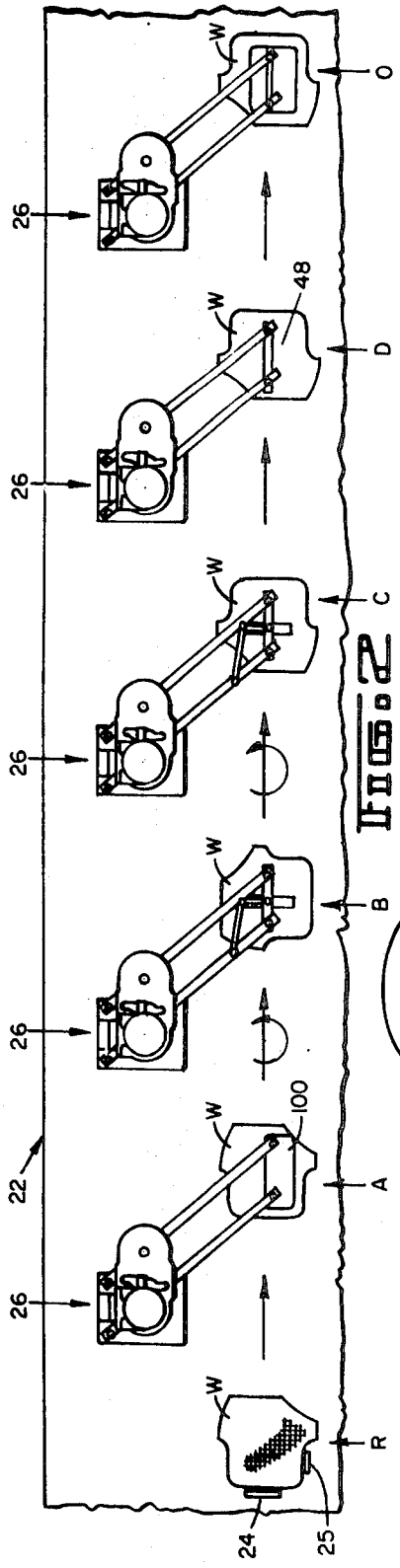


FIG. 2

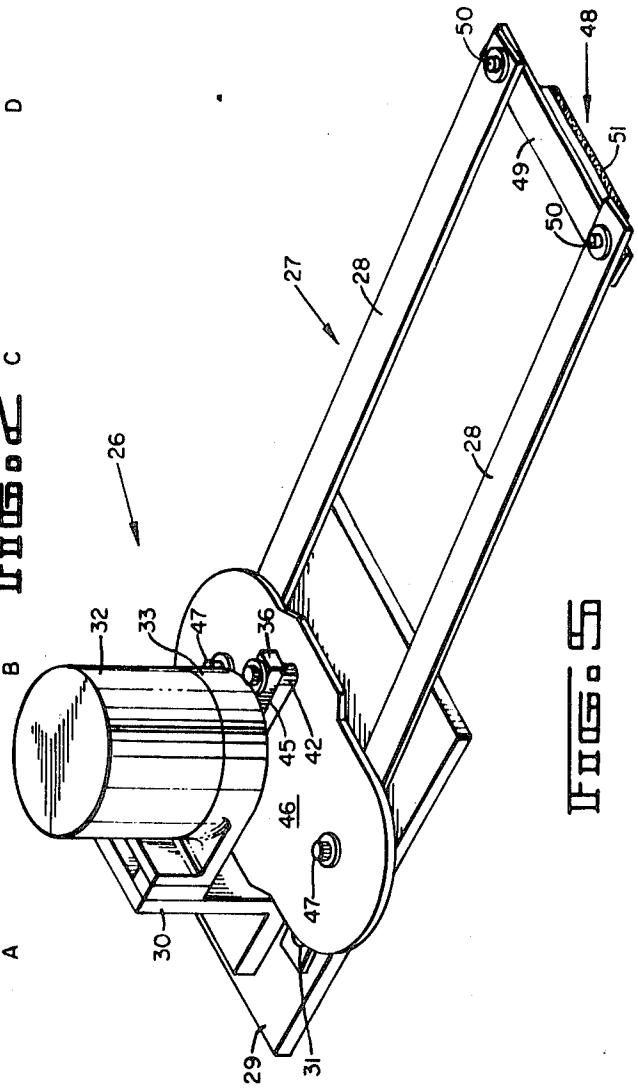


FIG. 5

INVENTOR.
GEORGE F. HAWLEY
BY
BRYAN, PARMELEE, JOHNSON & BOLLINGER
ATTORNEYS.

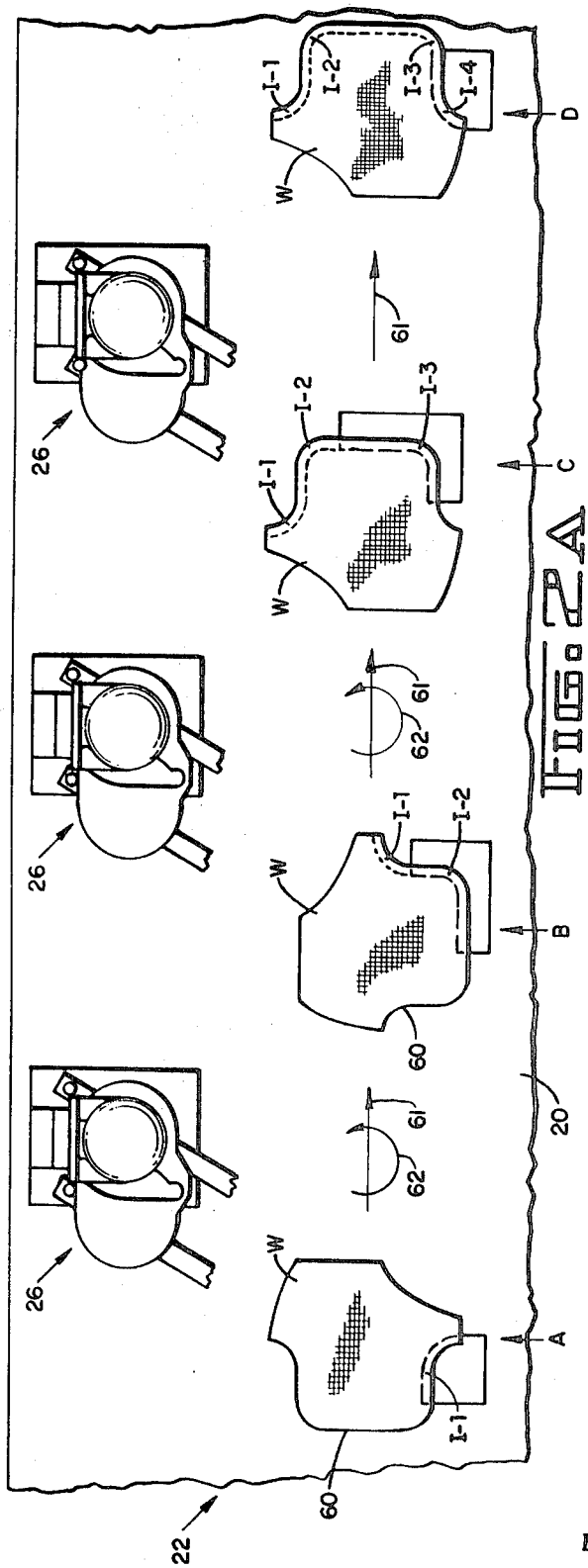


FIG. 2A

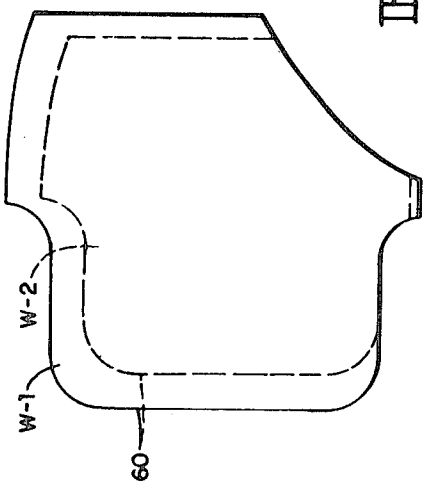


FIG. 2B

INVENTOR.
GEORGE F. HAWLEY

BY

BRYAN, PARMELEE, JOHNSON & BOLLINGER
ATTORNEYS.

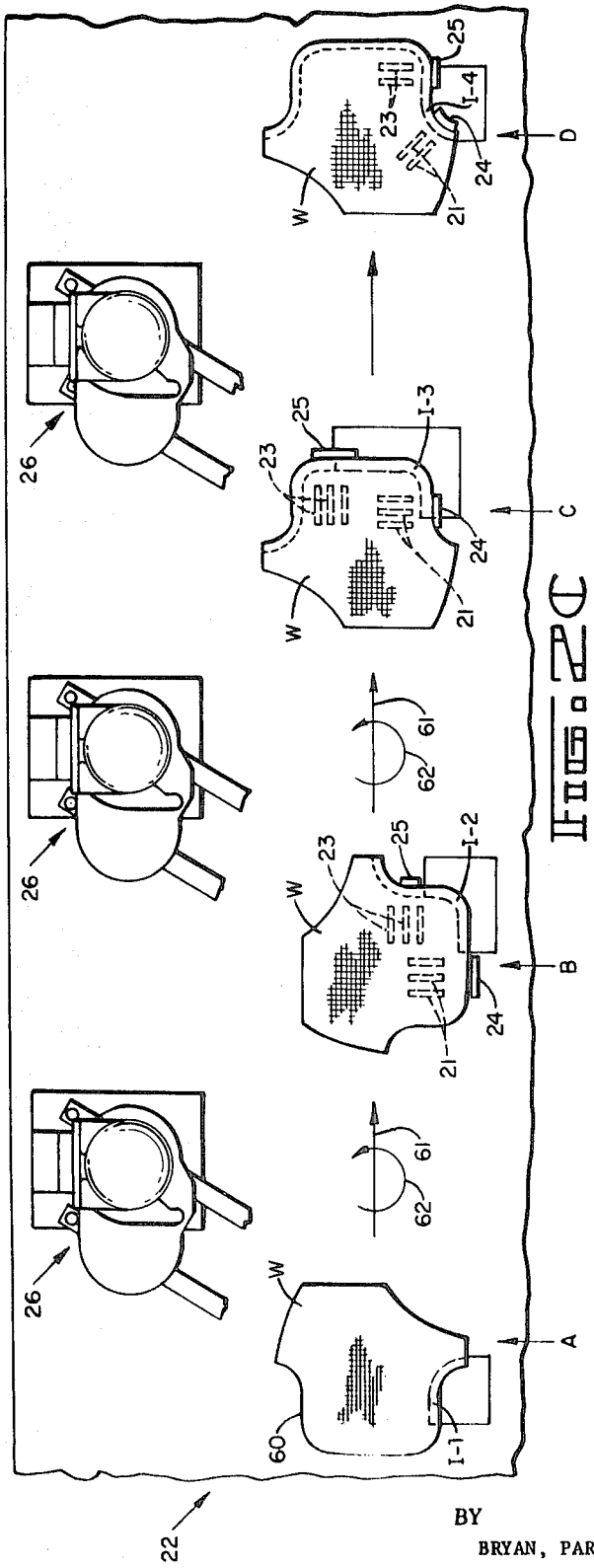


FIG. 2C

INVENTOR.
GEORGE F. HAWLEY

BY
BRYAN, PARMELEE, JOHNSON & BOLLINGER
ATTORNEYS

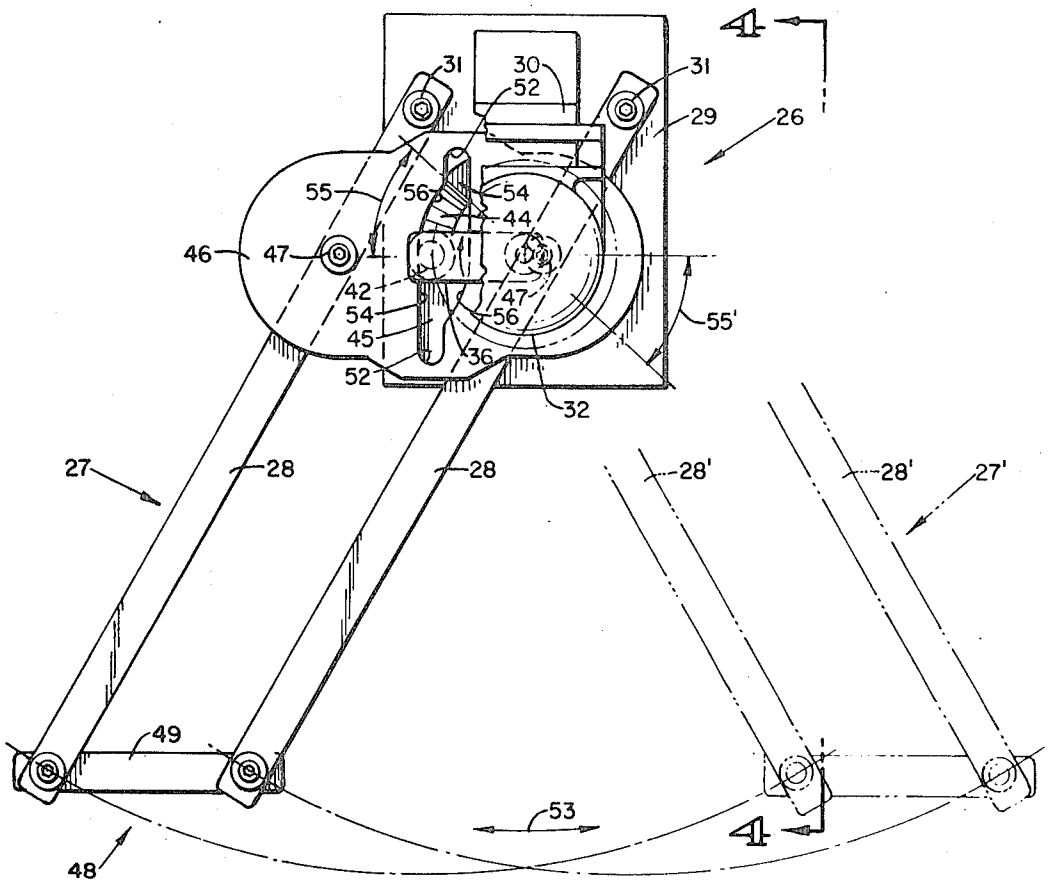


FIG. 3

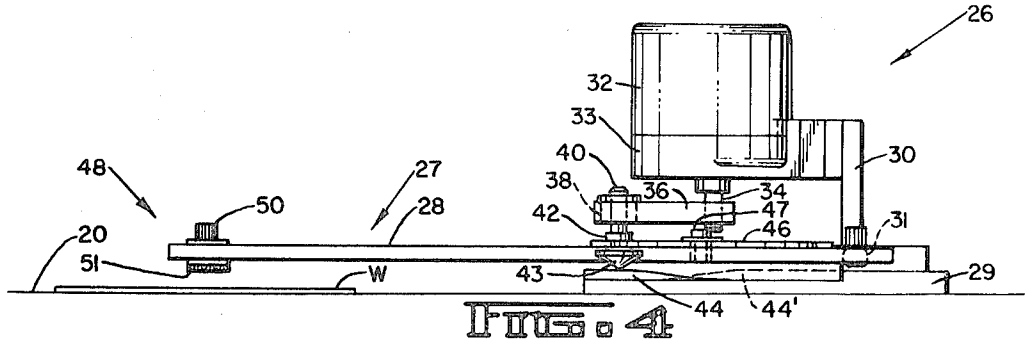


FIG. 4

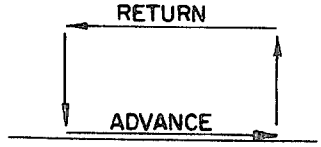


FIG. 9A

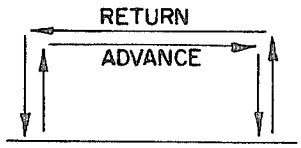


FIG. 9B

INVENTOR.
GEORGE F. HAWLEY

BY
BRYAN, PARMELEE, JOHNSON & BOLLINGER
ATTORNEYS.

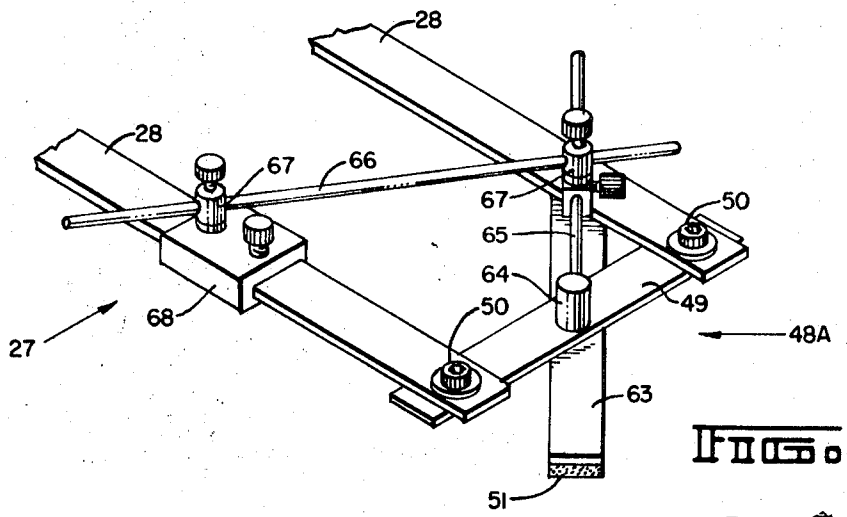


FIG. 6

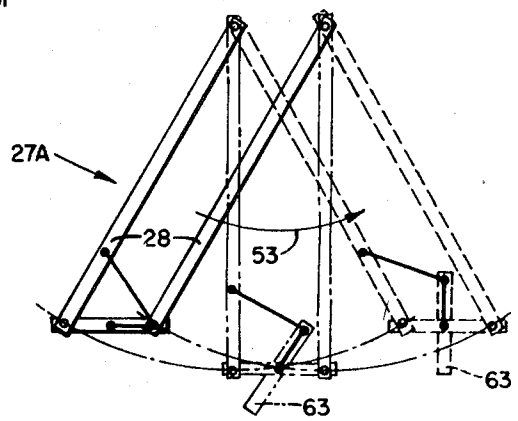


FIG. 6A

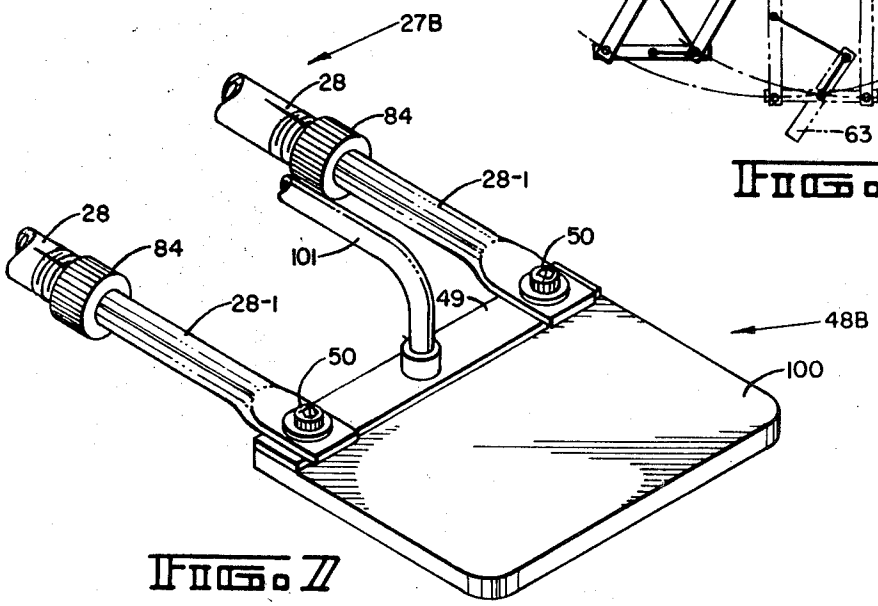


FIG. 7

INVENTOR.
GEORGE F. HAWLEY

BY BRYAN, PARMELEE, JOHNSON & BOLLINGER
ATTORNEYS

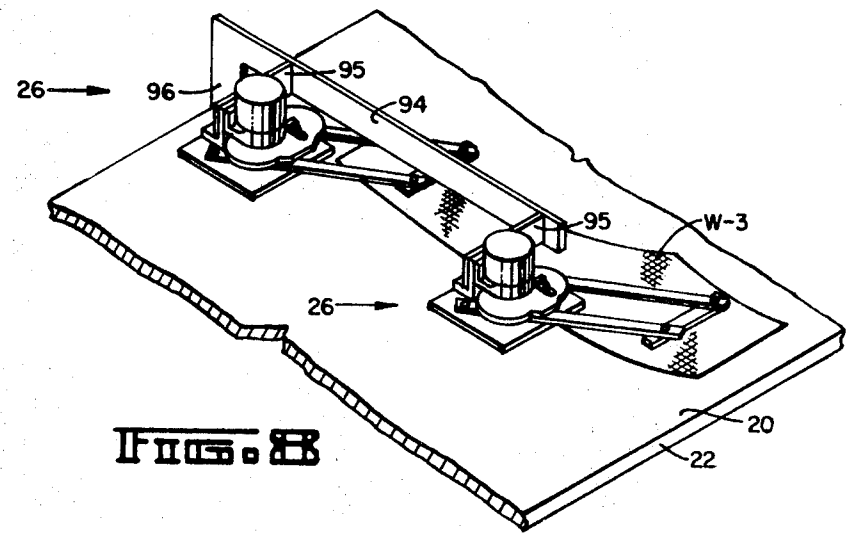


FIG. 11

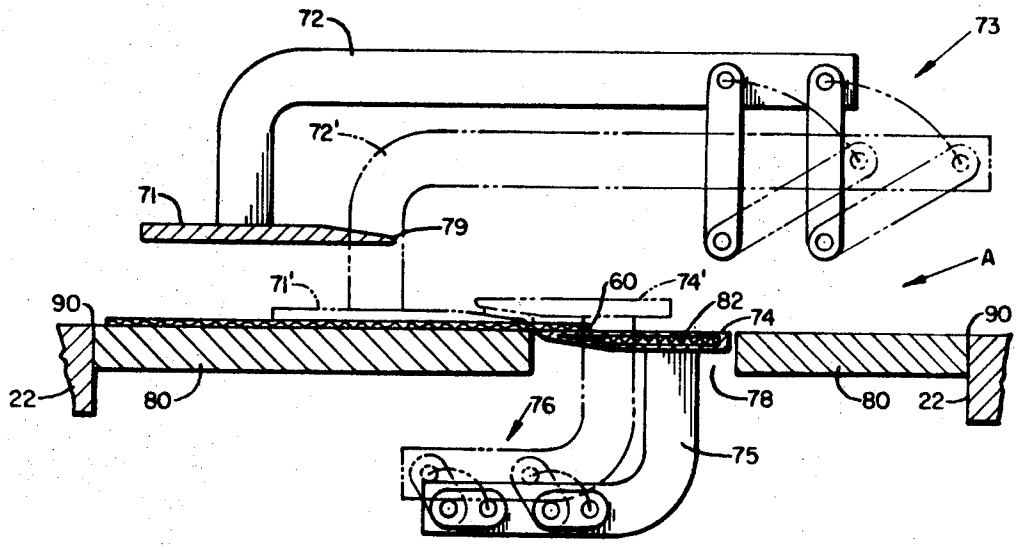


FIG. 12

INVENTOR
GEORGE F. HAWLEY
BY
BRYAN, PARMELEE, JOHNSON & BOLLINGER
ATTORNEYS.

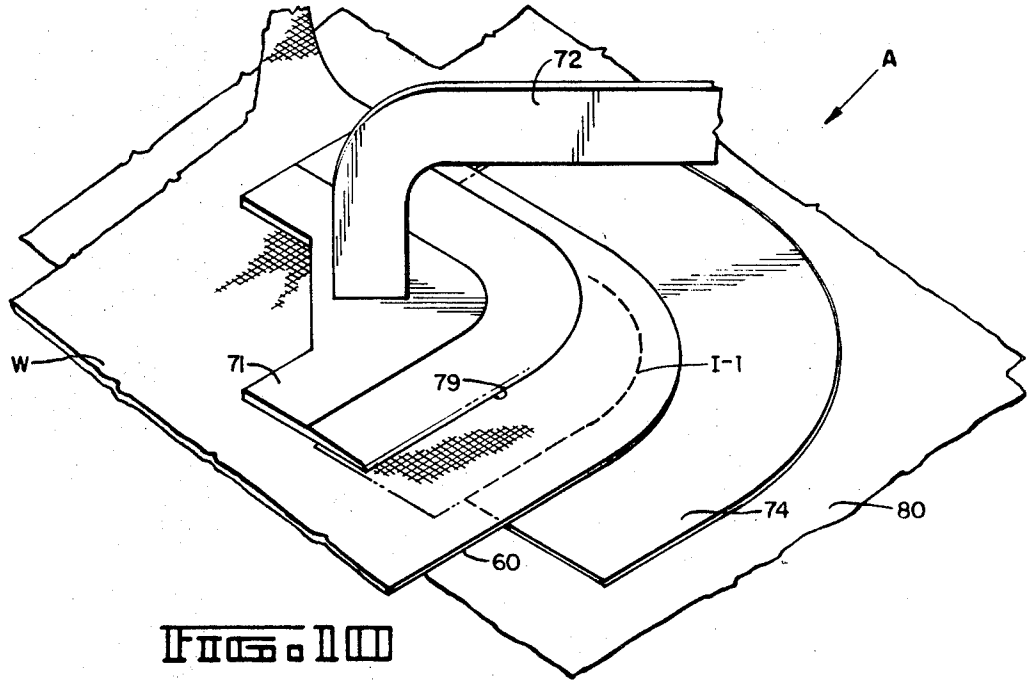


FIG. 10

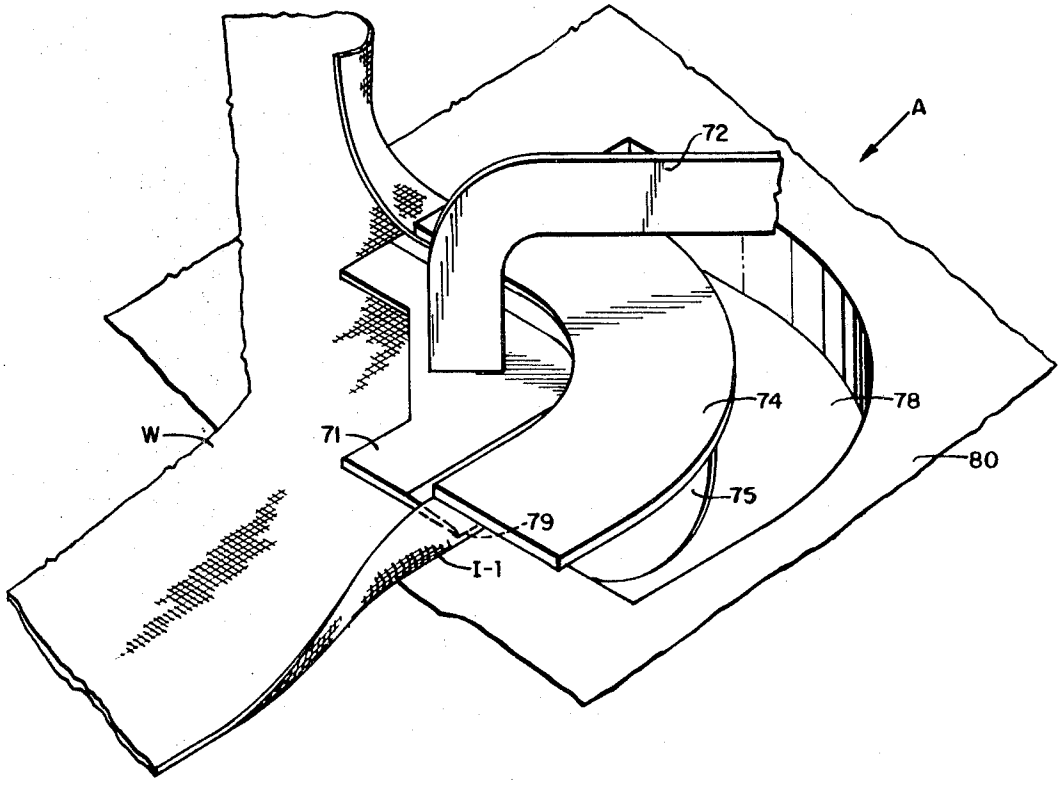


FIG. 11

INVENTOR.
BY GEORGE F. HAWLEY
BRYAN, PARMELEE, JOHNSON & BOLLINGER
ATTORNEYS.

APPARATUS FOR TREATING FABRIC WORKPIECES IN SEQUENCE AT A PLURALITY OF WORK STATIONS

This case is a division of Ser No. 601,768, filed Dec. 4, 1966, now abandoned.

The present invention relates to method and apparatus for treating fabric workpieces in sequence at a plurality of work stations. More particularly the invention relates to process and apparatus for automatically performing a sequence of work operations upon predetermined portions of a plurality of workpieces at a sequence of work stations.

The present invention enables automobile or semiautomatic production systems to be set up quickly and easily for manufacturing various types and sizes of fabric goods such as clothing, headgear, footgear, home furnishings, and a the like, including subassemblies of such goods. This invention enables such production systems to have flexibility in operation so as to accommodate various sizes, styles and types of fabric workpieces with a minimal amount of changes in tooling or dies in the system.

The invention can be embodied in production systems for performing various sequences of work operations upon a plurality of workpieces as will be explained further below, and the illustrative embodiments of the invention relate to fabric creasing and transferring for creasing an edge portion of a fabric workpiece so that the raw cut edge of the fabric is turned back against the body of the workpiece in preparation for suitable covering. One illustrative embodiment of this invention relates to a creasing and transferring process for turning back and creasing different predetermined increments of the edge of the workpiece in various work stations and adapted for handling different sizes and shapes of workpieces. In one of its aspects this invention relates to transfer module apparatus having wide utility in the automatic processing of fabric workpieces for transferring workpieces from one work station to the next in a sequence of work stations.

In the process of automatically performing a sequence of work operations upon a plurality of fabric workpieces, in the broad aspects thereof, each successive workpiece is registered in a known position, a predetermined work operation is performed on each successive registered workpiece at a first work station, and each workpiece in succession is transferred from the first work station to a second work station and is turned into a different angular orientation, while being controlled so as to position the workpiece in a predetermined registered relationship relative to the second work station. A further operation is performed on each of the workpieces at the second station, and the treated workpieces are delivered in succession from the second work station.

In accordance with the fabric creasing embodiment of the process, the fabric workpieces are moved over a supporting surface having low friction upon which they can be slid, and predetermined increments of the edge of each workpiece are turned back against its main body and are creased so that after the process has been completed the edge remains turned back in preparation for lining or covering of the piece to form a finished part of a garment, apparel, or the like. In this process an increment of the edge is turned back and creased in a first work station, then the workpiece is transferred along the supporting surface to a subsequent work station and another increment of the edge is turned back and creased, and so forth, until the desired total portion of the edge is turned back and remains creased in readiness for further processing.

In accordance with one aspect of this invention transfer apparatus for moving the workpiece along a supporting surface from one work station to another is provided in the form of transfer modules which are conveniently adapted to be used singly or in sets for transferring the workpieces with various desired sequential movements.

Among the many advantages of the illustrative creasing process embodying the present invention are those resulting from the fact that a facility and convenience are provided for creasing the edges of various sizes and shapes of fabric workpieces and for handling a variety of shapes and sizes of such pieces.

A further advantage of the invention results from the fact that a transfer module is provided which is flexible in application and readily adapted to be embodied in various arrangements for transferring fabric workpieces in sequence from one work station to another and for changing the orientation or relationship of the workpieces by predetermined known amounts.

As used herein the term "fabric" is intended to include woven goods and also nonwoven, felted, or perforate goods having a flexibility suitable for use in clothing, headgear, footgear, and similar use, regardless of whether the material of the goods is in one layer or multiple layers and regardless of whether the goods are formed of natural material, synthetic material or blended materials. As used herein the term "workpiece" is intended to include individual pieces as well as subassemblies or semifinished goods including two or more pieces or components secured together.

The term "transfer" or "transferring" is intended to means the movement of a fabric workpiece from one region to a second region, while maintaining known positional relationships for the workpiece during this movement.

In this specification and in the accompanying drawings are described and shown method and apparatus for treating a plurality of fabric workpieces in sequence at a plurality of work stations illustratively embodying the present invention, and it is to be understood that these examples are not intended to be exhaustive nor limiting of the invention. These examples are given so as to disclose the invention fully and clearly to those skilled in the art so that the reader will appreciate how this invention can be adapted in various forms, each as may be best suited for the conditions of a particular type of fabric workpiece in a particular production system.

The various objects, aspects and advantages of the present invention will be more fully understood from a consideration of the following description in conjunction with the accompanying drawings, in which:

FIG. **1** is a perspective view illustrating the process and apparatus for performing a sequence of work operations upon predetermined portions of a plurality of workpieces at a sequence of work stations.

FIG. **2** is a partial plan view of the process and apparatus of FIG. **1**, the workpiece being turned into different orientations at the various work stations;

FIG. **2A** is an enlargement of a portion of FIG. **2** and showing steps in a process of creasing various predetermined increments of the edges of the workpieces in sequence;

FIG. **2B** illustrates the flexibility of the process for creasing various sizes of similarly shaped workpieces;

FIG. **2C** is a further embodiment of the invention wherein the workpieces are registered at each of a plurality of work stations providing great flexibility in accommodating size changes;

FIG. **3** is a plan view of one of the transfer modules of the system of FIGS. **1** and **2**, and shown on enlarged scale with a part broken away to illustrate the structure;

FIG. **4** is a side elevational view of the transfer module of FIG. **3**, as seen from the direction **4—4**;

FIG. **5** is a perspective view of the module of FIGS. **3** and **4**;

FIG. **6** is a partial perspective view illustrating a modified embodiment of the module of FIG. **5**;

FIG. **6A** illustrates successive operating positions of the apparatus of FIG. **6**;

FIG. **7** is a view similar to FIG. **6** and illustrating a further modified embodiment;

FIG. **8** shows a plurality of modules in simultaneous use for transferring a large fabric workpiece;

FIGS. **9A** and **9B** are motion diagrams for purposes of explaining two sequences of operation;

FIGS. **10** and **11** are perspective views illustrating two steps in the creasing of a curved portion of periphery of a workpiece; and

FIG. 12 is a cross-sectional view of the apparatus shown in FIGS. 10 and 11.

In the process shown in FIGS. 1, 2, 2A, and 2C a sequence of work operations are performed upon predetermined portions of a plurality of fabric workpiece W at a sequence of work stations A, B, C and D. At each of the work stations the workpieces are oriented and registered so that the operation to be done is carried out on a different respective predetermined portion of the workpiece. In this manner a manufacturing sequence is accomplished by moving the workpiece through these stations.

In this illustrative example the work operations are shown as being a sequence of creasing steps, and it is to be understood by those skilled in the art that other fabric treating steps such as sewing, cementing or heat fusing can similarly be accomplished. The various fabric workpieces W are transferred to the successive stations A, B, C, and D by sliding them along a low-friction work supporting surface **20** provided by the smooth top surface of a long table **22**. At each station A, B, C, and D a different predetermined increment of the edge of the workpiece is turned back and creased. Thus, after the workpiece has been successively treated in each of the work stations, the desired total portion of the edge has become turned back and remains creased in readiness for further processing, and the creased workpieces are then combined with another workpiece V at an output station O.

The workpieces W are each initially supplied to an input registration station R and are automatically brought into a known position at this input station by registration means **21** and **23** located beneath the table **22**. The known position of the workpieces is obtained by applying force impulses to the workpiece alternately directed toward edge stops **24** and **25** so as to bring the respective edge portions of the workpiece up against the stops **24** and **25** located at the input station. This registration may be accomplished by automatically placing each workpiece on the supporting surface **20** in the vicinity of the stops **24** and **25**. Then registration apparatus located beneath the table **22**, for example such as shown in my joint copending application Ser. No. 475,986 , **filed July** 30, 1965, serves to impel the edge of the workpiece against the stops **24** and **25**.

In order to transfer the workpieces W along the supporting surface **20**, there are a plurality of transfer modules **26** located intermediate each of the stations. These transfer modules are shown more clearly in FIGS. **3**, **4**, and **5**, to which attention is invited. These transfer modules **26** are all identical except for certain modifications in their transfer arm means **27**, as will be explained further below, for providing various transfer motions. The arm means **27** include a pair of parallel arm members **28** each pivoted by a universal bearing **31** to a base plate **29** adapted be secured to the table **22**. A bracket **30** (FIG. **4**) extends up from the base **29** and holds drive means **32** in the form of an electric motor connected to a speed-reducing gear unit **33** having a vertically extending drive shaft **34** with a crank arm **36** secured thereto so that this crank **36** revolves in a horizontal plane generally parallel with the workpiece supporting surface **20**.

At the outer end of his crank **36** there is a sleeve bearing **38** (FIG. **4**) in which is mounted a vertically slidable stud shaft **40**, said stud shaft carrying both a cam driver element **42** and a cam follower button **43**. This cam driver **42** is cylindrical and engages in a contoured slot **45** (FIG. **3**) in a cam plate **46** which extends across between the pair of arm members **28** and is pivotally connected to each of these arm members by a pair of pivot bolts **47**. Thus, the arm members **28** are swung back and forth by the revolving driver **42**. The cam follower element **43** is a rounded conical button on the lower end of the driver which rides against an elevator cam **44**, so that a shoulder surface above the button **43** lifts or lowers the plate **46** to raise or lower the arm members **28**.

The cam plate **44** is detachably secured to the base plate **29**, and when it alone is used the cycle of motion produced is as shown in FIG. **9A** wherein the arm means **27** is in its elevated position during the return stroke and is in its lowered position during the advancing transfer stroke, there being purely vertical travel during a dwell period at each end of the stroke.

By attaching another cam as indicated by dotted lines at **44'** (FIG. **4**), then the cycle of motion produced is as shown in FIG. **9B**. It is to be understood that the return and advance strokes in FIG. **9B** exactly retrace each other, the respective arrows being offset merely for clarity of illustration. This cycle of motion as shown in FIG. **9B** is used when the fabric workpiece is being lifted during the advance stroke by a suction and friction gripper as shown in FIG. **7**, as will be explained further below.

To engage and move the fabric workpiece W, friction gripping means **48** can be secured to the outer ends of the arm means **27**, as shown in FIG. **4**. The friction gripping means **48** include a link member **49** extending across between the arms **28** and detachably held by pivot bolts **50** with a resilient pad **51** beneath the member **49** adapted to provide a high coefficient of friction against the fabric, for example, this pad **51** is shown as sponge rubber.

Thus, the workpieces W (FIG. **4**) are moved and controlled in position during movement by the differential in friction as between the low-friction supporting surface **20** engaging the lower face of the workpieces W and the high friction gripping means **48** engaging the upper face of the workpieces. In this example the low-friction surface **20** is a hard smooth polished table top for example of hardwood, metal, or the like, it being shown here as aluminum. It is noted that the two arm members **28**, base **29**, and link **49** comprise a four-bar parallelogram linkage of which the base **29** is held stationary. Thus, as the arm members **28** are swung about their respective pivots **31**, the link **49** always remains parallel with its initial position. In this manner the fabric workpiece W engaged by the friction-gripping means **48** can be transferred from one station to the next while retaining its known relative orientation.

The vertical travel as shown in FIGS. **9A** and **9B** at each end of the stroke assures that the workpiece is not accidentally displaced laterally at the moment of engagement or disengagement of the workpiece by the transfer module.

For swinging the arm means **27** as indicated by the arrow **53** and for providing a substantial dwell time period at the end of each stroke, the contoured slot **45** (FIG. **3**) has a pair of end recesses **52** with opposed sidewalls adapted to straddle the revolving driver **42**, and arm means **27** are swung in the advance or return stroke when the driver **42** is in a recess **52**. This stroke continues as the driver **42** travels along the wall surface **54** forming a continuation of one side of the recess **52**.

In the position of the driver **42** as shown in FIG. **3**, the arm means **27** have reached the limit of their stroke, and the dwell period occurs as the driver **42** moves through the angle **55** while travelling along a curved length **56** of the wall, this curve **56** being concentric about the axis of drive shaft **34**. During this dwell period **55**, the cam follower button **43** rides down a slope of the cam **44** to lower the friction gripper means **48** perpendicularly onto a fabric workpiece W. It is noted that the shoulder of the button **43** remains beneath the cam plate **46** in spite of the fact that the central portion of the slot **45** is enlarged.

In order to provide substantially vertical travel of the friction gripper pad **51**, the pivots **31** are positioned close to the plane of the support surface **20**, thereby assuring that the pad **51** is moving in a direction substantially perpendicular to the surface **20** at the instant when the pad **51** engages or disengages the workpiece.

In this illustrative embodiment the slot **45** is symmetrical and it includes a second curved surface **56** for providing a dwell period during elevation of the friction gripper means **48** at the limit **27'**, **28'** of the advance stroke, as the driver **42** moves through the angle **55'**.

As discussed during the introduction, the contoured cut edge **60** of the workpiece is turned back against the body of the workpiece and is creased in preparation for subsequent operations, such as uniting with a suitable covering or lining,

as the case may be. This creasing process is carried out in incremental steps as illustrated most clearly in FIG. 2A. Predetermined increments I–1, I–2, I–3 and I–4 of the contoured edge 60 of the workpiece W are creased at the respective work stations A, B, C and D. The edge 60 as shown here includes concave and convex curved segments with straight line segments extending between these curves and faired into the contiguous curves as by being tangent or asymptotic to the contiguous curves. The respective increments I–1, I–2, I–3 and I–4 are arranged so that they each begin and end at points along the edge 60 which lie on these straight line segments.

Among the advantages of this incremental creasing process are those resulting from the fact that the production line as shown can readily be set up to crease a different size but similarly shaped workpiece. This flexibility in set up and ability to handle different sizes of similarly shaped workpieces is illustrated further in FIG. 2B and is advantageous in garment production lines, because the components of different sizes of the same type of garment have similar shapes. In this process the respective curved edge portions of different size workpieces are made the same, it is the straight line segments which have different length. FIG. 2B shows larger and smaller workpieces W–1 and W–2 wherein the respective curved segments of the edges 60 have the same curvature but the straight line segments of the respective edges 60 are of different length. The smaller workpiece W–2 is shown dotted merely for clarity of distinction.

By virtue of the fact that each creasing increment I–1, I–2, I–3, I–4 begins and ends on a straight line segment of the curved edge 60, these creasing increments fit the respective curves and will crease the edges 60 of either workpiece W–1 or W–2.

As shown in FIG. 2A, when the workpiece is being transferred from station A to station B, and from B to C, it is rotated 90° in orientation, this combined translation and rotation being indicated by the composite arrows 61 and 62. A suitable modified transfer arm means 27A (FIG. 6) for providing the combined translation and rotation includes a bar 63 carrying the resilient friction pad 51 and being rotatably mounted on the member 49 by a central pivot 64 having a crank rod 65. A connecting rod 66 is attached at one end to the crank 65 by adjustable clamps 67 having a pivot between them, and the other end of the rod 66 is secured by another pivot clamp 67 to an adjustable slide clamp 68 on one of the arms 28.

As shown in FIG. 6A, by properly positioning the respective clamps 67 and the slide clamp 68, the gripper bar 63 is caused to turn through a change in orientation of 90° in this case, as the swing arm means 27A move through their advance stroke 53. Other amounts of angular orientation either greater or less than 90° can readily be set by adjusting the friction-gripping means 48A.

In order to provide further flexibility in handling fabric workpieces of various sizes, the registration thereof may be carried out at each of a plurality of work stations. Thus, the system automatically takes care of size change and adjustment of transfer stroke may be eliminated, by the process as shown in FIG. 2C. In stations B, C and D there are registration apparatus 21 and 23 located beneath the table 22 to apply force impulses to the fabric directed alternately toward the respective edge stops 24 and 25 so as to impell the edge of the workpiece against the stops. These steps are positioned to locate a predetermined portion of the workpiece in registration for an operation to be performed thereon at the respective station. Thus, the edge portions of the workpiece are properly registered at each of the stations B, C and D for the increments I–2, I–3 and I–4 to be creased in sequence.

The creasing operation at each station is carried out by an incremental creasing module 70 (FIG. 1) including an upper blade or anvil 71 (FIGS. 10, 11 and 12) on an arm 72 having actuating mechanism 73 for moving the anvil blade 71. Also, there is a lower crimp blade 74 on an arm 75 having actuating mechaniam 76 for moving this blade 74. Normally the blade 74 rests within a clearance opening 78 in an adjustable table section 80.

During an incremental creasing operation the anvil blade 71 is initially pressed down firmly in the position 71′ upon the workpiece with its creasing edge 79 aligned with the desired curved line of the crease I–1. Next, the lower blade 74 is raised up from the clearance opening 78 and crimps the edge of the workpiece W over and down onto the anvil blade 71. The anvil blade is withdrawn, and the crimp blade 74 presses down to complete the crease. To give a set to the crease, the blade 74 includes heating means 82. After the crease is set, the blade 74 returns to its initial position and the workpiece is then transferred to the next station.

In order to change the production line set up, the transfer modules 26, can readily be moved into different positions by adjusting the location of the base plate 29. The length of the transfer stroke can readily be changed by changing the length of the drive arm 36 or by extending or shortening the swing arm members 28. For example, FIG. 7 illustrates how these swing arms may readily be made of telescoping sections 28 and 28–1 with a screw clamp ferrule 84.

The creasing modules 70 fit into cut out portions of the table 22 with a circular joint line or seat 90 between the table 22 and the table section 80, the section 80 being included as a part of the creaser module 70. Thus, the creasing module 70 can readily be swung to different angular orientations with respect to the table 22 by turning the table section 80 along the joint line 90 and then securing the creaser module in its new location.

For handling relatively large workpieces W–3 (FIG. 8), for example such as a cloth leg panel of a pair of men's pants, a plurality of the transfer modules 26 may conveniently be ganged together by attaching them to an overhead mounting. The modules 26 are attached to the mounting 94 by brackets 95 secured to the respective brackets 30 of the modules, and a leg 96 of the mounting 94 is adjustably secured to the table 22.

In order to advance the workpiece from the registration station R to the first work station A, the lifting advance cycle (FIG. 9B) is used, and the friction gripping means 48B (FIG. 7) include a hollow shoe 100 attached to the member 49. A controlled suction line 101 communicates with the interior of this shoe 100. There are apertures in the bottom surface of the shoe 100 which engages the workpiece. The suction is applied during the pick up, advance, and lowering of the shoe 100.

The lifting advance cycle (FIG. 9B) or the sliding advance cycle (FIG. 9A) may be used in connection with any of the stations whichever may be more convenient in transferring workpieces.

Also, a pickup cycle (FIG. 9B) and suction shoe 100 are used to transfer the workpiece from station D over onto the other workpiece V which has been transferred into the output station 0 from another table 102 as shown in FIG. 1, this table 102 converges with the main table 22 at the output station.

From the foregoing it will be understood that the illustrative embodiments of the process and apparatus of the present invention are well suited to provide the advantages set forth, and since many possible embodiments may be made of the various features of this invention and as the method and apparatus herein described may be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense and that in certain instances, some of the features of the invention may be used without a corresponding use of other features, all without departing from the scope of the invention as defined by the following claims.

1. A transfer module for transferring fabric workpieces from one station to another station in a production line by sliding the workpieces along a low-friction surface, said transfer module comprising a base, arm means mounted on said base, friction-gripping means carried by said arm means adapted to provide a high friction engagement with workpieces on said surface, said arm means being mounted in movable relation-

ship with respect to said base for motion down toward said surface and up away therefrom, said arm means also being swingable forward and back generally parallel with said surface, and drive means mounted on said base and moving said arm means from an initial position down toward said surface for engaging said friction-gripping means with a fabric workpiece at said one station, said drive means swinging said arm means in a forward stroke for transferring said workpiece to the other station and moving said arm means up away from said surface for disengaging said friction-gripping means from the workpiece at said other station, and said drive means swinging said arm means back in a return stroke to the initial position in readiness to engage another workpiece at said one station.

2. A transfer module as claimed in claim 1, and wherein said friction-gripping means are mounted on said arm means for turning movement relative to said arm means, and mechanism for turning said friction-gripping means relative to said arm means as said arm means are being swung in their forward stroke for providing a predetermined orientation of the workpiece as it is being transferred from one station to another.

3. A transfer module as claimed in claim 2, and wherein said friction-gripping means produce combined translation and rotation of the workpiece as it is being transferred from one station to another.

4. A transfer module as claimed in claim 1, and wherein said arm means include a parallelogram linkage, said friction-gripping means being controlled by said parallelogram linkage to remain parallel to its initial orientation in spite of the swinging motion of said arm means, thereby to maintain the workpiece in the same orientation as it is transferred from one station to another.

5. A transfer module as claimed in claim 1, in which said arm means are connected by pivot means to said base for swinging movement toward and away from said surface, said pivot means being located closely adjacent to said surface to provide travel of said friction-gripping means in a direction substantially perpendicular to said surface during engagement and disengagement between said friction-gripping means and the workpiece, thereby to prevent accidental lateral displacement of the workpiece during said engagement and disengagement at the respective stations.

6. A transfer module as claimed in claim 1, wherein said drive means includes a cam plate connected to said arm means, said cam plate having a contoured slot, a revolving driver element engaging in said contoured slot for swinging said arm means forward and back in the advance and return stroke, and elevator cam means detachably mounted on said base for raising and lowering said driver element to provide the motion of said arm means toward and away from said base.

7. A transfer module as claimed in claim 1, in which said arm means are adjustable in length for adjusting the transfer stroke.