May 15, 1962 A. L. CROSBY ET AL 3,034,663

ARTICLE TRANSFER APPARATUS

Filed Sept. 29, 1959 4 Sheets-Sheet 1

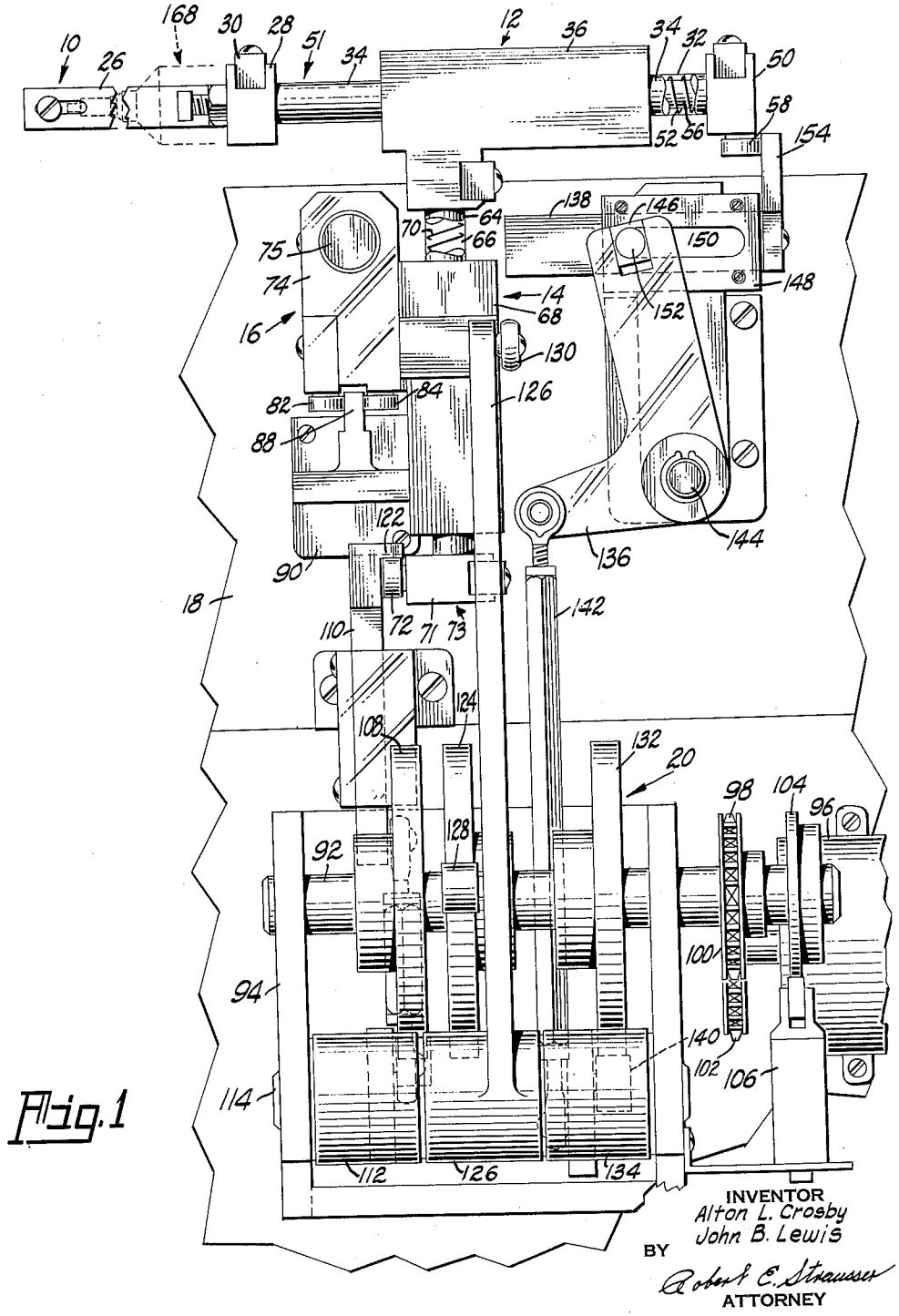



Fig. 1

INVENTOR
Alton L. Crosby
John B. Lewis
BY
Robert E. Strausser
ATTORNEY

May 15, 1962 A. L. CROSBY ET AL 3,034,663

ARTICLE TRANSFER APPARATUS

Filed Sept. 29, 1959 4 Sheets-Sheet 2

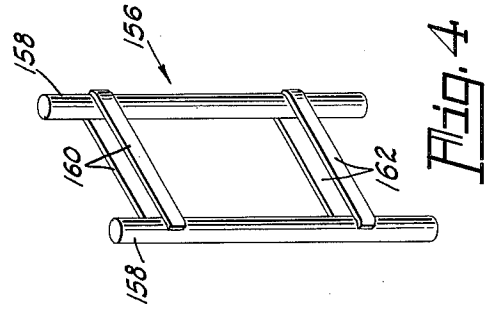



Fig. 4

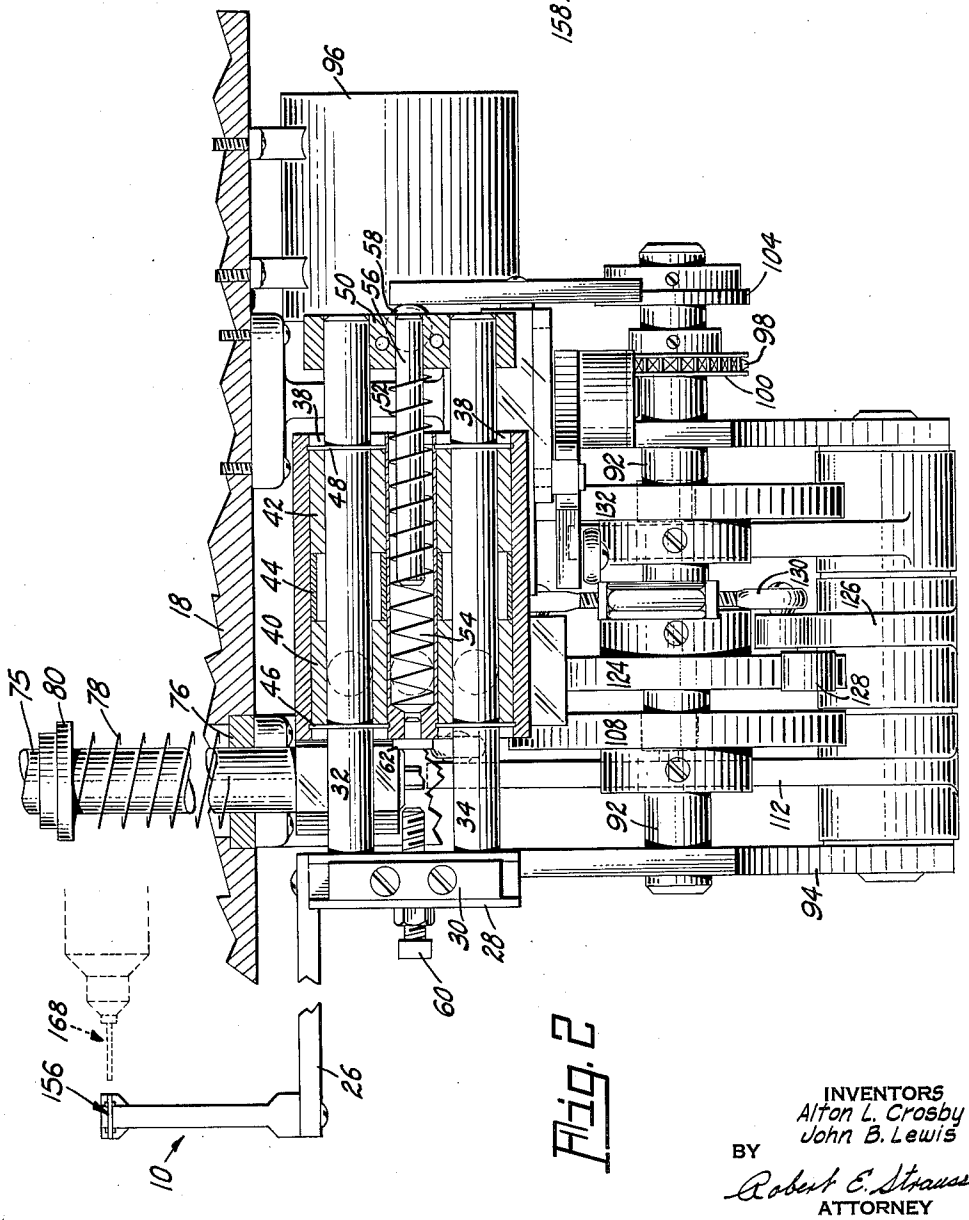



Fig. 2

INVENTORS
Alton L. Crosby
John B. Lewis
BY
Robert E. Strausser
ATTORNEY

May 15, 1962 A. L. CROSBY ET AL 3,034,663

ARTICLE TRANSFER APPARATUS

Filed Sept. 29, 1959 4 Sheets-Sheet 3

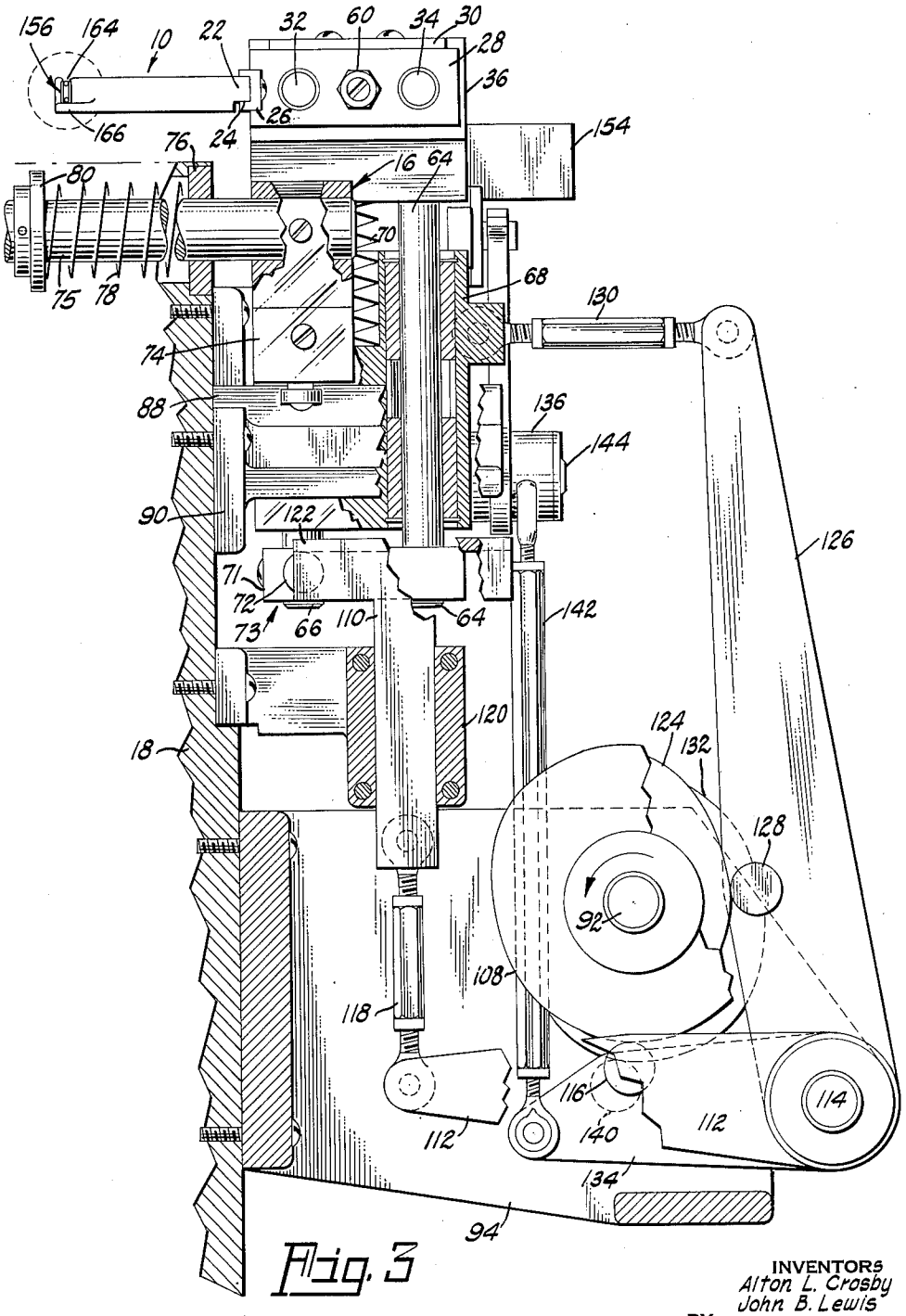



Fig. 3

INVENTORS
Alton L. Crosby
John B. Lewis

BY

Robert C. Strausser
ATTORNEY

May 15, 1962 A. L. CROSBY ET AL 3,034,663

ARTICLE TRANSFER APPARATUS

Filed Sept. 29, 1959 4 Sheets-Sheet 4

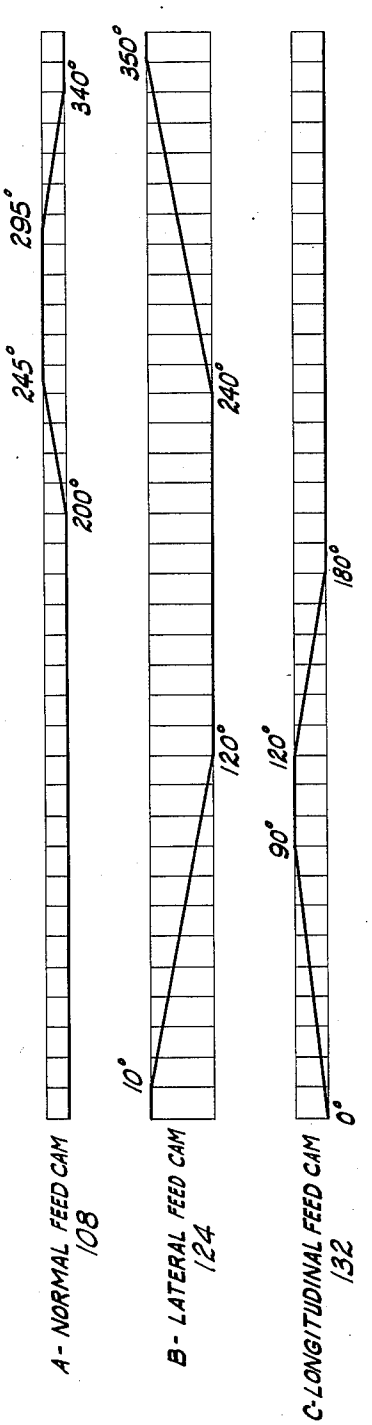



Fig. 7

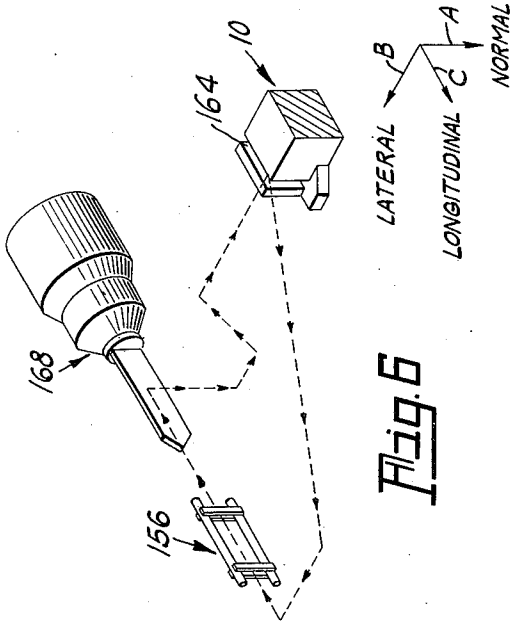



Fig. 6

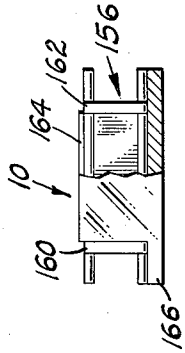



Fig. 5

INVENTORS
Alton L. Crosby
John B. Lewis

BY

Robert E. Strauss
ATTORNEY

United States Patent Office 3,034,663
Patented May 15, 1962



3,034,663

# ARTICLE TRANSFER APPARATUS

Alton L. Crosby, Austin, and John B. Lewis, Emporium, Pa., assignors to Sylvania Electric Products Inc., a corporation of Delaware

Filed Sept. 29, 1959, Ser. No. 843,205
1 Claim. (Cl. 214—1)

This invention relates to article transfer apparatus and more particularly to a device for accurately positioning a grid frame blank on a grid winding mandrel.

Technological advances have created demands for electron discharge devices having special characteristics. One outgrowth of these demands has been the requirement that the electrodes employed in the electron discharge devices or tubes be made smaller and smaller. The reduction in size of the electrodes has greatly increased the handling problems involved due to the increased fragility of such structures. This is particularly true of the grid electrodes and their frames. In some tube types the grid frame is fabricated from two side rods which are spaced apart by strap members attached to the rods adjacent their ends. Mass production of tubes employing these small grids presented a particular problem in feeding the grid frames to an automatic winding machine. Automatic winding in some instances required that the individual grid frames be delivered to, and threaded upon, a winding mandrel. The winding mandrel supports the grid frame during the subsequent operations performed thereon. The smallness of the grid frame and the requirement that the winding mandrel closely conform to the configuration of the grid to support the grid during the winding operation made the threading of the frame upon the mandrel extremely difficult. Heretofore, this critical operation has been painstakingly performed manually. It is an object of this invention to reduce the difficulties involved in accurately locating and positioning small articles with respect to a receptor. It is another object of this invention to eliminate manual manipulation of an article which is to be placed upon a receptor.

Many article transfer devices have heretofore employed grasping means which held a portion of the article tightly while it was being oriented. In the case of the manual operation, tweezers or the like have been employed. The delicateness of the electrode frame utilized in high frequency receiving type tubes resulted in deformed grid frames and rejected tubes unless special care was taken. Specialized handling techniques to prevent such distortion increased costs to a point where production of certain tube types was considered economically unfeasible. Therefore, it is yet another object of this invention to reduce distortion of the article transferred during the orientation and delivery of the article to a receptor.

Briefly, in one aspect of the invention there is provided an article transfer apparatus for placing an article on a receptor including the combination of a first slide, an article holder carried by the first slide, a second slide, a slideway for the first slide affixed to the second slide, a third slide, a slideway for the second slide affixed to the third slide, a support, a slideway for the third slide affixed to the support, and means for moving the slides to produce relative movement of the article holder with respect to the receptor to place an article carried by the holder on the receptor.

For a better understanding of the invention, reference is made to the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a front elevational view of the apparatus;

FIG. 2 is a top view of the apparatus;

FIG. 3 is a side elevation and partial section of the apparatus;



FIG. 4 is a perspective view of a grid frame;

FIG. 5 is an end view and partial section showing a grid frame in the article holder;

FIG. 6 is a schematic representation in perspective of the motions of the article holder; and

FIG. 7 is a cam chart showing the functions of the various cams.

The subject apparatus is particularly useful in conjunction with an automatic grid winding machine. By using a loading device of this nature it is possible to increase the acceptable output of the winding machine by loading undistorted frames on the winding mandrel automatically.

Referring to FIG. 1, an article holder **10** is carried by first support means **12** mounted for movement on the second support means **14**. Second support means **14** is mounted for movement on a third support means **16** which is in turn mounted for movement on a support **18**. Motive means **20** are provided to produce the coordinated movements of the first, second, and third support means **12, 14, 16** respectively.

The article holder **10** has one end formed into a tongue **22** which is adjustably affixed within a groove **24** in an arm **26** which is part of the longitudinal or first support means **12**. Tongue **22** is secured by a screw that passes through a slot in arm **26** as shown in FIG. 1. The arm **26** is attached to the front cross bar **28**. The cross bar **28** is clamped by a plate **30** to the slide rods **32, 34** which pass through the slideway or slide body **36**. The slide rods **32, 34** are journaled for movement in the longitudinal direction in recesses **38** within the body **36**. Within each of the recesses are positioned bearings **40, 42** which are each separated by a spacer **44**. The bearings **40, 42** and spacer **44** are retained in the slide body **36** by snap rings **46, 48**. The opposite ends of the slide rods **32, 34** are clamped by a second or rear cross bar **50** to form the longitudinal slide **51**.

A return spring **52** is positioned in a recess **54** formed in the slide body **36** intermediate the rods **32, 34**. It reacts against the second cross bar **50** and the body **36**. The spring is retained in position by a pin **56** affixed to the cross bar **50** which extends into the recess **54**. A roller **58**, whose function will be explained later, is affixed to the under surface of the rear cross bar **50**.

An adjustable stop **60** is mounted on the front cross bar and cooperates with an insert **62** in the slide body **36** to determine the rest position of the slide **51** with respect to slide body **36**.

The longitudinal slide body **36** is affixed to one end of the slide rods **64, 66** which are journaled in the normal or second support means **14**. The rods **64, 66** are supported within the normal slideway or slide body **68** in a manner similar to that employed in supporting the longitudinal slide rods **32, 34** within the longitudinal slide body **36**. A return spring **70** reacts between the longitudinal slide body **36** and the normal slide body **68**. It cooperates with the lower cross bar **71**, which is clamped to the slide rods **64, 66**, to determine the rest position of the longitudinal support means **12** relative to the normal slide body **18**. A roller **72**, whose function will be explained later, is affixed to the cross bar **71**. The longitudinal slide body **36**, slide rods **64, 66**, and the cross bar **71** comprise the normal slide **73** which is carried by the normal slide body **68**.

The body **74** of the lateral or third support means **16** is secured to a shaft or slide **75** which is moveable in a bearing or slideway **76** affixed to the support **18** (FIG. 3). Spring **78** reacts between the bearing **76** and a collar **80** affixed to the shaft. The normal slide body **68** is secured to the lateral slide body **74**. Rotation of the lateral slide body **74** and the shaft **75** is prevented by a pair of rollers **82, 84** depending from the body

74. The rollers 82, 84 slidably straddle a rail 88 which is formed as part of a bracket 90 secured to the support 18.

The movement of the various support means 12, 14, 16 is produced by cams affixed to a common cam shaft 92. The cam shaft is journaled adjacent its ends in a bracket 94 affixed to the support 18. The cam shaft 92 is driven by a motor 96, mounted on the support 18, through a sprocket 98 on the cam shaft, and motor sprocket 102. Timing cam 104 is secured to the cam shaft 92 in operative relation with a limit switch 106 also carried by the bracket 94.

The normal slide rods 64, 66 are reciprocated by the normal feed cam 108 attached to the cam shaft 92. A slide bar 110 is coupled to the cam 108 through a lever arm 112 which is pivoted about a shaft 114 carried by the bracket. The cam follower 116 is positioned on the arm 112 intermediate the shaft 114 and the point of attachment of the connecting rod 118. Connecting rod 118 is affixed to the slide bar 110 which is carried by a slide box 120 secured to the support 18. The upper end of the slide bar 110 is formed into a rail 122 along which the roller 72, which is secured to the lower cross bar 71, is adapted to move. The return spring 70 urges the slide rods 64, 66 upwardly thus bringing the roller 72 against the rail 122. Sufficient force is applied by the spring 70 to maintain the cam follower 116 against the cam 108. Reciprocation of the slide bar 110 as produced by the cam 108 will cause the slide rods 64, 66 to reciprocate in the normal direction independent of the lateral position of the normal slide body 68.

The body of the lateral or third support means 16 is reciprocated by the lateral feed cam 124 which is attached to the cam shaft 92. The lateral slide body 74 is coupled to the lateral feed cam 124 through a lever arm 126 pivoted about the shaft 114. The cam follower 128 is positioned on the arm 126 intermediate shaft and the point of attachment of connecting rod 130. The connecting rod 130 extends between the lever arm 126 and the body 68 of the normal support means 14 which is affixed to the lateral slide body 74. Return spring 78 exerts sufficient force, through the above-described linkage, to retain the cam follower 128 against the lateral feed cam 124.

The longitudinal slide 51 is reciprocated by the longitudinal feed cam 132 which is also affixed to the cam shaft 92. The slide 51 is moved by the cam 132 through lever arm 134, bell crank 136 and slide bar 138. The lever arm 134 is pivoted on shaft 114 and has its cam follower 140 mounted intermediate the pivot shaft 114 and the attachment point of the connecting rod 142. The connecting rod 142 extends between the end of the lever arm 134 and the bell crank 136. Bell crank 136 is mounted on a pivot member 144 secured to the support 18. One end of the bell crank 136 is bifurcated and slidably straddles a pivot block 146 attached to the slide bar 136. Slide bar 136 is carried by a slideway 148 affixed to the support 18. The slideway 148 is provided with a slot 150 through which the pin 152, on which the pivot block is mounted, extends. A plate-like arm 154 is secured to the slide bar 136 in contact with the roller 58 carried by longitudinal rear cross bar 50. Movement of the longitudinal feed cam 132 is thus translated into longitudinal movement of the slide rods 32, 34 independent of the normal and lateral position of the slide body 36. The spring 52, which is positioned intermediate the slide rods 32, 34 maintains the roller 50 against the plate 154 and also keeps the cam follower 140 against the longitudinal feed cam 132.

In the embodiment of the invention shown and described, the article to be positioned on a receptor is a grid frame blank 156 (FIG. 4). A typical grid frame 156 has side rods 158 .0315 inch in diameter which are 0.497 inch long joined together by transverse pairs of strap members 160, 162. The overall width of the frame is .158 inch. The distance between the strap pairs 160, 162 along the longitudinal axis of the side rods, is .305 inch.

The free end of the article holder 10 has an article receiving pocket 164 formed therein. The length of the pocket 164 is slightly less than the distance between the transverse strap members 160, 162 measured along the side rods 158, while the width of the pocket 164 is slightly greater than the diameter of the side rods 158. The depth of the pocket 164 is such that both side rods are within the pocket when a grid frame is placed therein with the strap members 160, 162 straddling the holder 10. The grid frames are placed in the article holder 10 by automatic loading means, not shown.

The strap members 160, 162 cooperate with the article holder 10 to limit longitudinal movement of the frame. Frame movement in the normal direction is prevented by the bottom of the pocket 164 and a ledge 166 formed on the arm. Lateral movement of the frame is restricted by the vertical walls of the pocket 164. The frame is thus positioned accurately without the utilization of grasping means which might introduce distortion into the fine and delicate grid frame structure.

The typical article receptor 168, as shown in FIG. 6, is a longitudinally extending mandrel which is a portion of a grid winding machine. The normal and lateral dimensions of the mandrel closely approximate the corresponding inner dimensions of the frame so that the frame will be fully supported during the subsequent winding operations. The close match between the dimensions of the frame and the mandrel requires that an extremely precise delivery of the frame to the mandrel be accomplished. Further, the delivery must be readily repeated to secure the desired threading or loading rate of the grid winding machine. Other article and receptor forms which require precise delivery of an article may also be employed in conjunction with this article transfer apparatus, such as the delivery of a formed pin to a pin receiving opening or in a similar type of threading operation.

The operation of the apparatus may be best understood if the description is begun with the article holder 10 in its rest or loading position at a point spaced laterally from the receptor. The movements illustrated in FIG. 6, which are produced by the cams diagrammed in FIG. 7, is exemplary of the article manipulations of which the apparatus is capable.

A grid frame 156 is loaded into the nest 164 of the article holder 10 and the motor 96 is energized by means not shown. Rotation of the motor 96 drives the cam shaft 92 causing the cams 108, 124, 132 to operate their respective slides or movable support means 12, 14, 16. During the first 90 degrees of cam shaft rotation the article holder 10 moves simultaneously in the lateral and longitudinal directions. Roller 58 on the longitudinal slide 51 maintains contact with the moving plate 154 while the first support means 12 is also moved laterally by the lever arm 126. From 90 degrees to 120 degrees of cam shaft rotation only the lateral movement of the holder 10 occurs. The movement continues until the end of the lateral movement path is reached. This point had been previously selected to center the grid frame on the axis of the receptor. The alignment of the centers in the normal direction had been previously adjusted. These adjustments are made by means of the adjustable connecting rods, stops, as well as by the selection of proper cams.

From 120 degrees to 180 degrees of cam shaft rotation the longitudinal feed cam 132 operates to allow the longitudinal slide 51 to return to a position longitudinally the same as the rest or loading position although spaced laterally from the rest position. During this movement the frame 156 is threaded upon the mandrel 168 to the proper longitudinal position thereon. The holder 10 is

inactive from 180 degrees to 200 degrees. At 200 degrees of the cam shaft rotation, the normal feed cam begins to move the holder in the normal direction by means of the slide **110**, and cooperating roller **72** attached to the normal slide rods **64**, **66**. From 240 degrees to 350 degrees the lateral feed cam allows the holder to return to its original lateral position while simultaneously the normal feed cam allows the holder to return to its original normal position. At approximately 360 degrees the timing cam **104** actuates the limit switch **106** to deactivate the motor **96** until the next threading cycle is required.

The above described apparatus is capable of accurately transferring an article to a receptor without distorting the article structure. Once set for a particular article and transfer path the apparatus will repeatedly and rapidly perform the complex threading operation.

Although a preferred embodiment of the invention has been shown and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claim.

What is claimed is:

In an apparatus for transferring a grid frame from a grid receiving position to a spaced position whereat the grid frame is threaded onto a longitudinally extending receptor, the combination of a first slide mounted for movement in the longitudinal direction of said receptor, a grid frame holder having a pocket therein for supporting the grid frame mounted on said first slide, a second slide mounted for movement in a normal direction relative to said receptor, a slideway for said first slide affixed to said second slide, a third slide mounted for movement in a lateral direction relative to said receptor, a slideway for said second slide affixed to said third slide, a support, a slideway for said third slide affixed to said support, a cam shaft, a device for rotating said cam shaft, a first cam on said shaft operatively connected to said first slide to provide longitudinal movement of said holder, a second cam on said shaft operatively connected to said second slide to provide normal movement of said holder, and a third cam on said shaft operatively connected to said third slide to provide lateral movement of said holder, said first, second, and third cams being formed and positioned relative to one another to operate upon said first, second, and third slides respectively during rotation of the cam shaft to move said holder with the grid frame in the pocket thereof from said receiving position in a direction longitudinally away from said receptor, then laterally toward said receptor, then longitudinally toward said receptor to thread the grid frame onto the receptor, then normally away from the receptor to withdraw said frame from said pocket, and then laterally away from said receptor to return said holder to the frame receiving position.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,933,225 | Smith | Oct. 31, 1933 |
| 2,507,709 | Gronros | May 16, 1950 |
| 2,535,961 | Schutt | Dec. 26, 1950 |
| 2,813,380 | Narel et al. | Nov. 19, 1957 |
| 2,853,769 | Stahl | Sept. 30, 1958 |
| 2,911,114 | Gartner | Nov. 3, 1959 |