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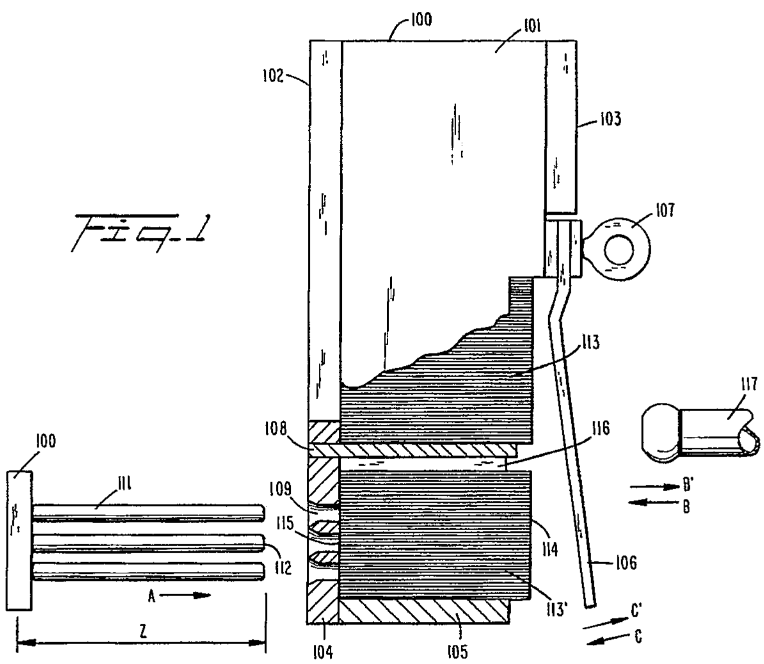
(54) Brush making apparatus for assembling tufts and method therefor.

(57) Picker elements (111) are advanced a first distance (X) into contact with the ends (115) of parallel filaments (113) in a stock box (100) and then stopped (movement from FIG. 1 to FIG. 2). A flap (106) is vibrated by a vibrator (117) and this positions some of the filaments (118) ready to slide into the mouths (112) of the picker elements (111), which are then advanced a second distance (Y) in order to scoop up the aligned filaments in order to form tufts of filaments (movement from FIG. 2 to FIG. 3). The vibrator (117) is then turned off and the picker elements (111) retracted a third distance (Z) in order to remove the tufts from the stock box (100) (movement from FIG. 3 to FIG. 4). The stopping and vibrating during the forward stroke ensures that the filaments do not become misaligned or forced out of the stock box (100) by the picker elements (111).



EP 0 432 868 A2

BRUSH MAKING APPARATUS FOR ASSEMBLING TUFTS AND METHOD THEREFOR

The present invention relates to brush making apparatus for assembling tufts for mounting in a brush and a method therefor.

Conventional staple-set brush picking machinery (forming filament tufts) employs a picker means which removes only a single filament tuft at a time from a stock box or feed mechanism by first entering the stock box approximately at its mid-section (lateral to the parallel filaments) and assembling or picking a given amount of filament at the filaments' mid-section. Such filament stock boxes are disclosed in brush machinery patents, for example, U.S. Patents Nos. 2,433,191 and 3,059,972.

The picker then proceeds to transport the predetermined volume of the parallel filaments to a suitable means for doubling or folding over the filaments at their mid-section, just prior to stapling, thus resulting in a tuft having a U-shaped configuration, wherein both ends of an individual filament are located at the working end of the resultant tuft. A staple or anchor is then inserted through the U-shaped loop and the tuft is forced into a pre-drilled or molded hole in a brush block.

The conventional fusing brush machinery (forming all the filament tufts in a given brush simultaneously) employs a picking device made up of one or more picking elements which move in one direction into a mass of pre-cut synthetic filaments parallel to the filaments' length and removes all the necessary tufts required for a given brush. Such picking devices and machinery are disclosed in brush patents, for example, U.S. Patents Nos. 3,471,202, Re. 27,455, 4,255,224 and 4,693,519. Also, there have been various improvements in picking devices and stock boxes, but a major problem is the ability to insert a picking device containing at least one picking element into a filament stock box to select the proper predetermined amount of cut-to-length filaments. Filling the picking element in one instant of time without causing stray individual filament strands, which first come into contact with the front-end of the picking element, to become pushed through the mass of parallel filaments by the picker element as it works its way into the mass of said filaments towards the back of the stock box is a major problem. This causes the stray filaments to bend over and/or (1) fall out of the rear of said stock box; (2) move out of parallel attitude, causing the mass of parallel filaments to mix in all directions; and (3) bend so that when the picking device is retracted from the stock box the filaments contained within the picking element or elements are held by the stray bent individual filaments, thus causing the filaments within the picking element to remain in the stock box.

Individual filaments that become bent, misaligned or disoriented within the stock box cause voids and pockets of unaligned filaments. This then causes picking misses or unfilled picker elements. In order to keep the unpicked filaments parallel and flowing through the stock box, it becomes necessary to constantly clean the bent and disoriented filaments from the mass by pulling out the bent pieces, and realigning into the parallel relationship the remaining mass, without disrupting the density of the unpicked filament during each subsequent picking cycle.

Improvements in filament flow through stock boxes have been disclosed in U.S. Patents Nos. 4,693,519 and 4,696,519 and are hereby incorporated by reference.

To date, all longitudinal picking of cut-to-length brush filaments has been a single, one-motion index of a picking element into and through the filament stock box while simultaneously causing the filaments, within the said box, to oscillate back and forth from front to back of the box.

According to a first aspect of the present invention, there is provided brush making apparatus for assembling tufts of synthetic filaments for use in manufacturing a brush, comprising: a stock box having a front aperture plate with at least one aperture of predetermined cross section therethrough, side and bottom walls, said box being for containing cut-to-length synthetic filaments parallel to one another and extending perpendicularly to the aperture plate, each filament having a cross section smaller than that of the aperture(s), said box having an open back; a member positioned adjacent to the open back of said box and energizing means for causing said member to oscillate towards and away from said aperture plate against the adjacent ends of said filaments; at least one elongate, hollow picker element having an open end for receiving filaments to form a tuft of filaments, each picker element having the cross-sectional configuration of a respective one of said aperture(s) and being dimensioned to be received therethrough; said picker element being coupled to indexing means for moving said picker element through said aperture, into said stock box and back out of said stock box; and control means coupled to said indexing means and said energizing means for indexing said picker element(s) a first distance forward through said aperture(s) until the open end(s) of said picker element(s) abut the ends of said filaments adjacent to said aperture(s) and further stopping said forward movement of said picker element(s); subsequently for activating said energizing means to oscillate said member and indexing said picker element(s) a second distance into said box to form a tuft of filaments inside each picker element; and subsequently for deactivating said energizing means and retracting said picker element(s) a third distance back through the aperture(s) to remove the picked tuft(s) from said box.

According to a second aspect of the present invention, there is provided a method for picking at least one tuft of cut-to-length synthetic filaments for use in manufacturing a brush, comprising the steps of: providing a stock box having a front aperture plate with at least one aperture of predetermined cross section therethrough, side and bottom walls, said box containing cut-to-length synthetic filaments parallel to one another and extending perpendicularly to the aperture plate, each filament having a cross section smaller than that of the aperture(s), said box having an open back; a member positioned adjacent to the open back of said box and energizing means for causing said member to oscillate towards and away from said aperture plate against the adjacent ends of the filaments; at least one elongate, hollow picker element having an open end for receiving filaments to form a tuft of filaments, each picker element having the cross-sectional configuration of a respective one of the aperture(s) and being dimensioned to be received therethrough; and indexing means coupled to said picker element(s) for moving said picker element(s) through said aperture(s), into said stock box and back out of said stock box; indexing said picker element(s) a first distance forward through said aperture(s) until the open end(s) of said picker elements abut the ends of said filaments adjacent to said aperture(s); stopping said forward movement of said picker element(s); activating said energizing means to oscillate said member and indexing said picker element(s) a second distance into said box to form a tuft of filaments inside each picker element; deactivating said energizing means; and retracting said picker element(s) a third distance back through said stock box and said aperture(s) to remove the picked tuft(s) from said box.

The instant invention achieves improved picking of tufts by timing the movement of the picker element(s) with the energizing of the filaments, as well as maintaining a specific density level within the filaments during picking.

When the filaments are energized, they either move towards the outer edges and away from the individual picker elements or align themselves with the openings in the picker elements in order to be engaged by said elements and received therein. No individual filaments then remain stationary or remain at or in alignment with the forward edge of the picker elements during this step. Filaments are not pushed forward and out the rear of the stock box or bent or twisted within the box by the picker elements.

The completely filled picker elements with all the necessary filament tufts for the brush are indexed out of the stock box and may then be moved onto a filament-end melting device, while a brush element block is melted simultaneously. Then the picker device may be further indexed onto the pre-melted brush element block, allowing the fused ends to be aligned with the melted portion of the brush element substrate. Upon cooling, the filament tufts will he welded onto the substrate to form a tufted fused brush.

The invention may be used in situations where (1) single filament tufts are formed, (2) multiple filament tufts are formed, (3) complete tufted brush-type constructions are simultaneously formed, and (4) continuous modular tufted strip-type brush constructions are formed.

The present invention uses double acting indexing means which, during picking, ensure the complete filling of the picker elements. Also, the filaments in the stockbox do not become disoriented or bent during the indexing of the picker elements into the stock box.

A non-limiting embodiment of the invention will now be described with reference to the accompanying drawings, in which:-

FIG. 1 is a side view of the picking device and filament stock box having a portion of the side wall removed, prior to indexing;

FIG. 2 is a side view similar to FIG. 1 but showing the position of the picking device at the time of the first index;

FIG. 3 is 3 side view similar to FIG. 1 but showing the position of the picking device after energizing during the second index prior to withdrawal from the stock box;

FIG. 4 is a side view similar to FIG. 1 but showing the position of the picking device removing filaments from the stock box; and

FIG. 5 is a schematic of a typical control system for this invention.

The term "synthetic" filaments as used hereinafter includes synthetic monofilaments which are formed from linear thermoplastic polymers from the group consisting of polystyrene and polystyrene co-polymers, polyvinyl chloride and polyvinylchloride-acetate co-polymers, polyethylene, polypropylene, polyethylene-polypropylene co-polymers, polyamides, polyesters and polyurethane. Both oriented and unoriented monofilaments may be employed. Also, various filament cross-sections may be imparted to the monofilaments, such as circular, lobular, trifoil, X, Y, triangular, polygonal, star, etc. Mixtures of synthetic filaments may be employed in cases where the compositions of the filaments are compatible during any fusing operations, i.e. heat-sealing. Such filaments may also have suitable crimp imparted to their length or a portion therof. Filaments may contain organic or inorganic modifications in order to make them biodegradable, or self-decomposing during or after use for a given period of time.

The term "picking" as used in the specification refers to the formation of a filament tuft wherein the tuft is formed by longitudinally engaging more than one cut-to-length filament at its end and removing the engaged filaments from a bundle of parallel filaments. The picking devices employed are those types which are disclosed in the aforementioned U.S. Patent No. 3,471,202, as well as picking elements disclosed in U.S. Patents Nos. 3,910,637, 4,009,910 and 4,109,965. Accordingly, the disclosures of these patents are hereby incorporated by reference.

The term "aperture" as used in the specification refers to an opening in the face or front of the stock box. The opening allows insertion of the picker element into the filaments contained in the stock box. The aperture corresponds in cross-section to the cross-section of the picker element.

The term "choke means" as used in the specification refers to any means located within the filament stock box which allows the control of the flow of the filaments from a filling reservoir to the picking zone where the apertures are located. The choke means may be stationary or adjustable, depending upon the versatility and use of the stock box for more than one kind of filament simultaneously. Such choke means are disclosed in U.S. Patents Nos. 4,693,519 and 4,772,073. These patent disclosures are hereby incorporated by reference.

The term "filament void" refers to an area directly under the choke means where the filament level fluctuates during the picking operation. It is contemplated that filaments which pass through the choke means will rise to occupy the void during the energizing (vibration) phase of the picking operation.

The term "energizing" or "vibration" refers to the process of imparting energy to the non-working ends of the filaments during the indexing of the picker device into the filament stock box in order to fill the picker elements.

The term "index" refers to motion of the picking device towards or away from the stock box during the picking phase of tufting. To date, all disclosure of any forward motion of a picking means, device or other tufting apparatus has stated or inferred that the picking element is advanced forward into a filament mass, in one instant of time, either with or without the need of any vibration or energizing of the filaments. Thus the picking element was described as passing through the face of the stock box in a continuous forward motion to the back of the stock box, stopping and then backing out with the retained filaments contained within the picking element.

Referring to FIG. 1, a stock box 100 has two sides 101, a bottom 105, front upper section 102, rear upper section 103 and a front aperture plate 104 with aperture openings 109. A choke means 108 is located internally and prevents the filaments 113 from cascading into the open area 116 just below the choke means 108. A movable plate 106 is attached to the two sides 101 by means of fixture screws 107. Filaments are located just under the choke means 108 and have a non-working end 114 (at the rear of the stock box) and a working end 115. The filaments are parallel to each other but not as densely packed as the filaments 113 above the choke means 108.

There is a vibration means 117 located opposite the movable plate 106 and which, when energized, moves in the forward and backward directions [B,B'] causing the movable plate 106 to vibrate or oscillate in the forward and backward directions [C,C'], so as to cause the plate 106 to engage (come up to) the non-working ends 114 of the filaments and impart energy into the mass of filaments.

A picking device 110 has picker elements 111 located thereon, with open ends 112 for engaging and filling with filaments during indexing in the direction [A]. The total index length or travel of the picking device 110 during picking is (Z). (Z) is made up of (X) + (Y) and constitutes the total distance needed for the double action picking sequence of the instant invention.

In order to fully illustrate the preferred embodiment of the instant invention, it is necessary to describe the different stages of operation, namely the picking sequence related to tuft formation. Referring now to FIGS. 1-5, by reference characters, the first stage of picking can be accomplished with the picking device 110 in a neutral attitude and at a given distance (Z) away from but in front of and in alignment with the front face aperture plate 104 and apertures 109 therein.

As picking begins, the picking device 110 moves forward in direction [A] by indexing (X) amount which just allow the picker element 111 with open front ends 112 to enter, through the front face 104, the apertures 109 and come to a stop, touching (or contacting) the working ends 115 of certain filaments 118 contained in the stock box 100. At the end of the index stroke (X), the indexing actually ceases for a measurable amount of time, e.g., 0.20 seconds. The delay time depends upon many factors ranging from type of filament employed, its diameter, cross-sectional shape, choking, and the like.

The picking process continues by causing simultaneously the continued forward indexing in direction [D] of the picking device 110 over the distance (travel) (Y) while the energizing means 117 moves to and fro in directions [B,B'], to cause the movable plate 106 to vibrate back and forth in directions [C,C']. The filaments 118 are energized by the plate 106 and allowed to orient themselves at or near the openings 112 of the picker elements 111. The filaments 118 enter the picker elements 111 during the forward movement over the distance (Y). No individual filaments are bent, pushed forward and out of the rear of the stock box 100, or misaligned in directions other than their original parallel relationship by using this procedure.

It is noted that the space 116 is not present in FIG. 3 during the second stage of picking due to the fact that the picker elements 111 take up and occupy space between individual filaments. It is the ability of the filaments to become energized, move freely around in parallel relationship and not be packed tightly that is responsible for no discharge of filaments out of the back of the stock box during picking.

FIG. 4 illustrates the positions of the filaments contained within the stock box 100, which is momentarily without the void 116 (space above the filaments), but has voids 119 left by the removal of the picker elements 111. The vibrating means is stopped prior to the withdrawal of the picker elements 111, and the filaments 118 are retained within the individual elements 111.

FIG. 5 illustrates the overall method shown in FIGS. 1 to 4 and a control system which may include a conventional controller operably coupled to the picking device 110 and plate 106.

After arriving at the positioning shown in FIG. 4, either another empty picking device located on a multi-picking machine can be brought up to and positiond as in FIG. 1 in front of the filament stock box 100, in order for the whole process to start again, or the original picking device 110 can continue to a melting means and further fuse the filaments 118 onto a pre-melted brush or broom block, thereby causing the fused filament tufts to be removed from the picker elements, and the empty picking device 110 brought back into alignment with the stock box 100 for another picking sequence.

The aforementioned illustration is only one of the many embodiments of this invention, and many varied index sequences may be employed. However, the two stage index, whereby the first stage actually stops the forward motion of the picking device when the picking element are immediately in front of the filaments' working ends and the filaments are then energized during picking, has been found to be a very effective method. It allows the filaments to orient and move about prior to entering the picker element openings, and does not cause individual filaments to be further engaged by the leading edge of the picker elements and pushed out the rear of the stock box.

The stationary time between the first index and the continued second index can be in the range from 0.1 to 10.0 seconds, during which time the picker elements project through the apertures in the front face of the stock box and rest against the working ends of the filaments with the ends of filaments and picker elements touching. The speed and vibration of the second index can vary. For example, the speed of the second index can be from 0.5 inch/second (12.7mm/s) up to 10 inches/second (254mm/s), while the vibration or energizing means can oscillate forward and backward with an amplitude of from 0.100 inches up to 1.5 inches (2.54mm up to 38.1mm). Also, the frequency of the oscillations can vary from 1/6 Hz up to 40 Hz. Electrical and/or pneumatic energizing devices may be employed.

From the foregoing, it will be apparent to those skilled in the art that the instant invention provides a very simple and controlled means and method for picking and assembling filament tufts for subsequent fusing into brushes, brooms and the like.

The present embodiment is to be considered in all respects as illustrative and not restrictive.

Claims

1. Brush making apparatus for assembling tufts of synthetic filaments for use in manufacturing a brush, comprising:
   a stock box (100) having a front aperture plate (104) with at least one aperture (109) of predetermined cross section therethrough, side and bottom walls (101,105), said box (100) being for containing cut-to-length synthetic filaments (113) parallel to one another and extending perpendicularly to the aperture plate (104), each filament (113) having a cross section smaller than that of the aperture(s) (109), said box (100) having an open back;
   a member (106) positioned adjacent to the open back of said box (100) and energizing means (117) for causing said member (106) to oscillate towards and away from said aperture plate (104) against the adjacent ends (114) of said filaments;
   at least one elongate, hollow picker element (111) having an open end (112) for receiving filaments to form a tuft of filaments,

each picker element (111) having the cross-sectional configuration of a respective one of said aperture(s) (109) and being dimensioned to be received therethrough; said picker element being coupled to indexing means for moving said picker element through said aperture, into said stock box and back out of said stock box; and

control means coupled to said indexing means and said energizing means (117) for indexing said picker element(s) (111) a first distance (X) forward through said aperture(s) (109) until the open end(s) (112) of said picker element(s) abut the ends (115) of said filaments (113) adjacent to said aperture(s) and further stopping said forward movement of said picker element(s); subsequently for activating said energizing means (117) to oscillate said member (106) and indexing said picker element(s) a second distance (Y) into said box (100) to form a tuft of filaments inside each picker element (111); and subsequently for deactivating said energizing means (117) and retracting said picker element(s) (111) a third distance (Z) back through the aperture(s) (109) to remove the picked tuft(s) from said box (100).

2. The apparatus of claim 1, wherein said energizing means (117) are arranged to oscillate said member (106) with an amplitude in the range from 2.54mm to 38.1mm.

3. The apparatus of claim 1 or 2, wherein said energizing means (117) are arranged to oscillate said member (106) at a frequency in the range from 1/6 Hz to 40 Hz.

4. The apparatus of any one of claims 1 to 3, wherein said control means are arranged to index said picker element(s) over said second distance (Y) at a speed in the range from 12.7mm/s to 254mm/s.

5. A method for picking at least one tuft of cut-to-length synthetic filaments for use in manufacturing a brush, comprising the steps of:

providing a stock box (100) having a front aperture plate (104) with at least one aperture (109) of predetermined cross section therethrough, side and bottom walls (101,105), said box (100) containing cut-to-length synthetic filaments (113) parallel to one another and extending perpendicularly to the aperture plate (104), each filament (113) having a cross section smaller than that of the aperture(s) (109), said box having an open back: a member (106) positioned adjacent to the open back of said box (100) and energizing means (117) for causing said member (106) to oscillate towards and away from said aperture plate (104) against the adjacent ends (114) of the filaments; at least one elongate, hollow picker element (111) having an open end (112) for receiving filaments to form a tuft of filaments, each picker element (111) having the cross-sectional configuration of a respective one of the aperture(s) (109) and being dimensioned to be received therethrough; and indexing means coupled to said picker element(s) (111) for moving said picker element(s) through said aperture(s), into said stock box and back out of said stock box;

indexing said picker element(s) (111) a first distance (X) forward through said aperture(s) (109) until the open end(s) (112) of said picker elements (111) abut the ends (115) of said filaments (113) adjacent to said aperture(s);

stopping said forward movement of said picker element(s);

activating said energizing means (117) to oscillate said member (106) and indexing said picker element(s) a second distance (Y) into said box (100) to form a tuft of filaments inside each picker element (111);

deactivating said energizing means (117); and

retracting said picker element(s) (111) a third distance (Z) back through said stock box (100) and said aperture(s) (109) to remove the picked tuft(s) from said box (100).

6. The method of claim 5, wherein said member (106) oscillates with an amplitude in the range from 2.54mm to 38.1mm.

7. The method of claim 5 of 6, wherein said member (106) oscillates at a frequency in the range from 1/6 Hz to 40 Hz.

8. The method of any one of claims 5 to 7, wherein said picker element(s) (111) are indexed over said second distance (Y) at a speed in the range from 12.7mm/s to 254mm/s.

9. The method of any one of claims 5 to 8, further comprising providing a control means coupled to said indexing means and said energizing means (117) for effecting said steps of indexing said picker element(s) (111) said first distance (X) forward; stopping said forward

movement; activating said energizing means (117) and indexing said picker element(s) said second distance (Y); deactivating said energizing means (117); and retracting said picker element(s) (111) said third distance (Z) to remove the picked tuft(s) from said box (100).

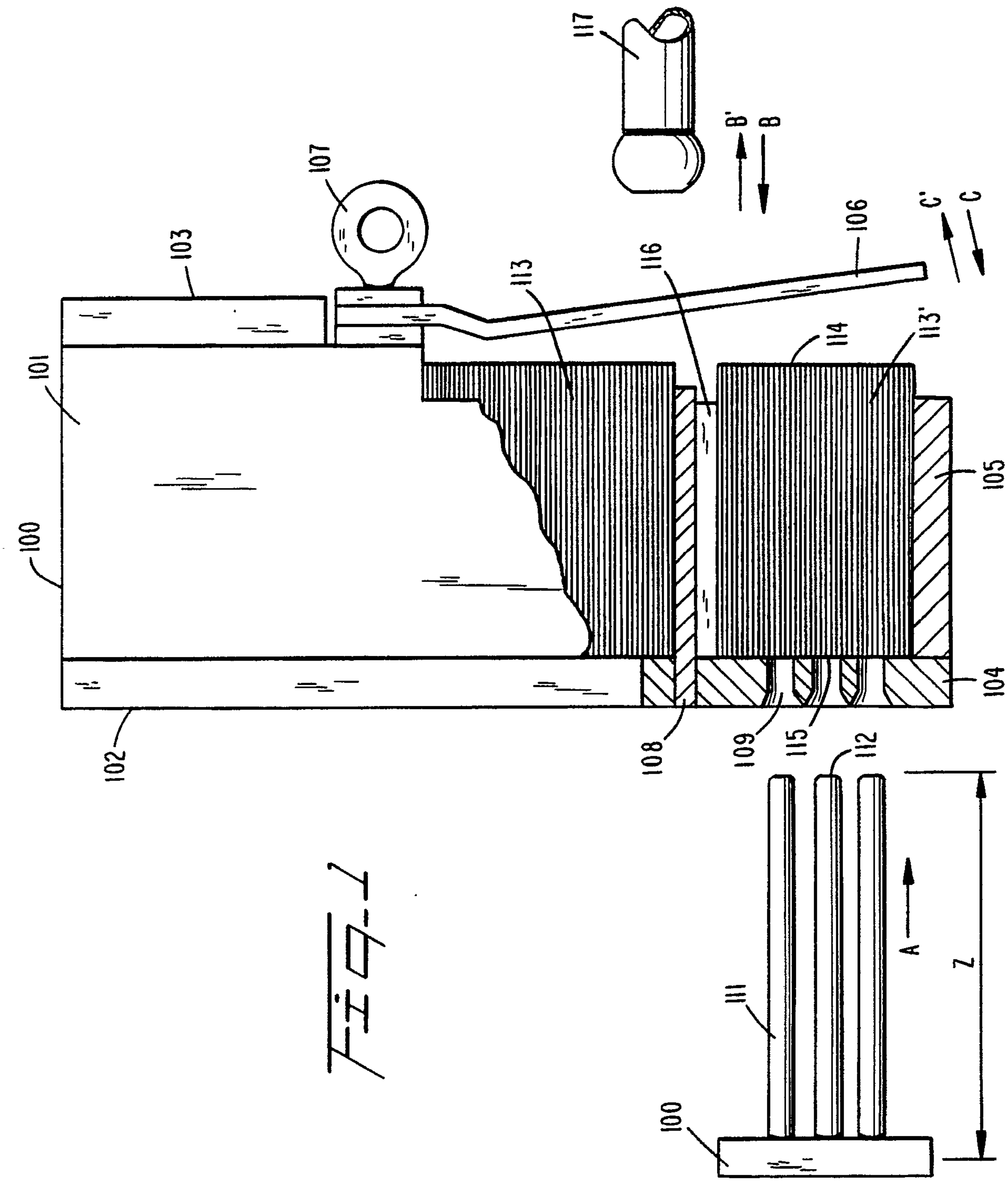

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Fig-1

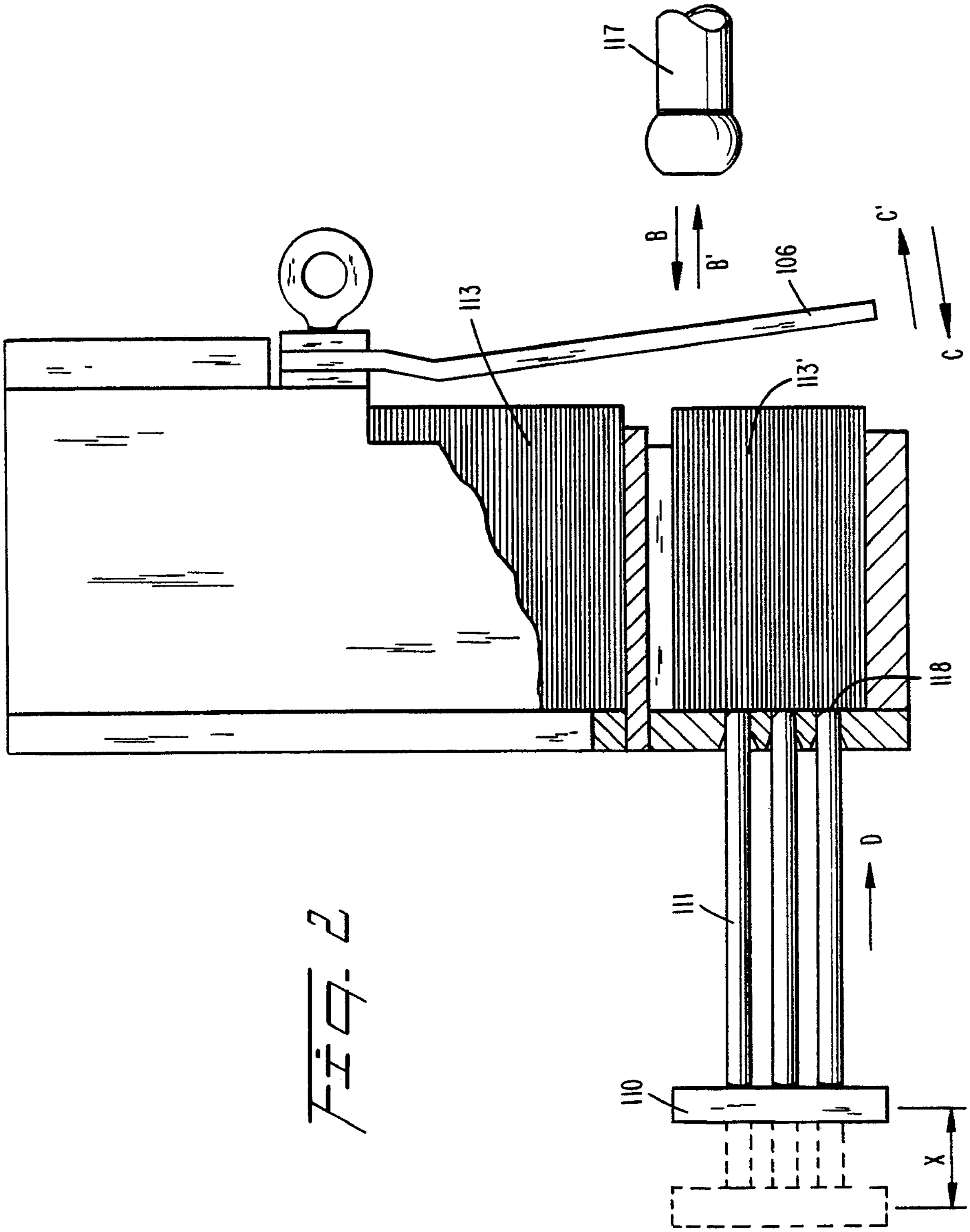


FIG. 2

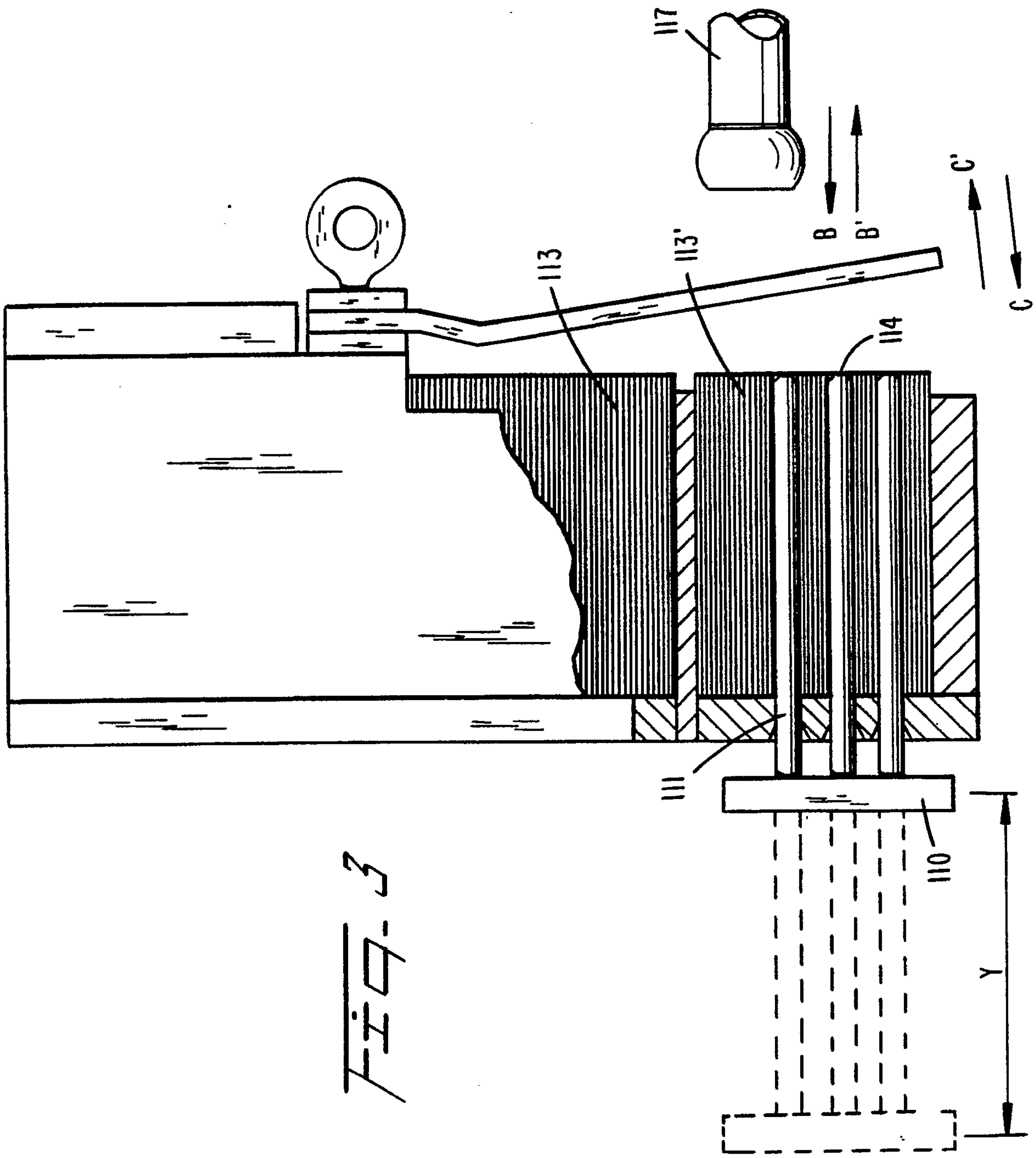
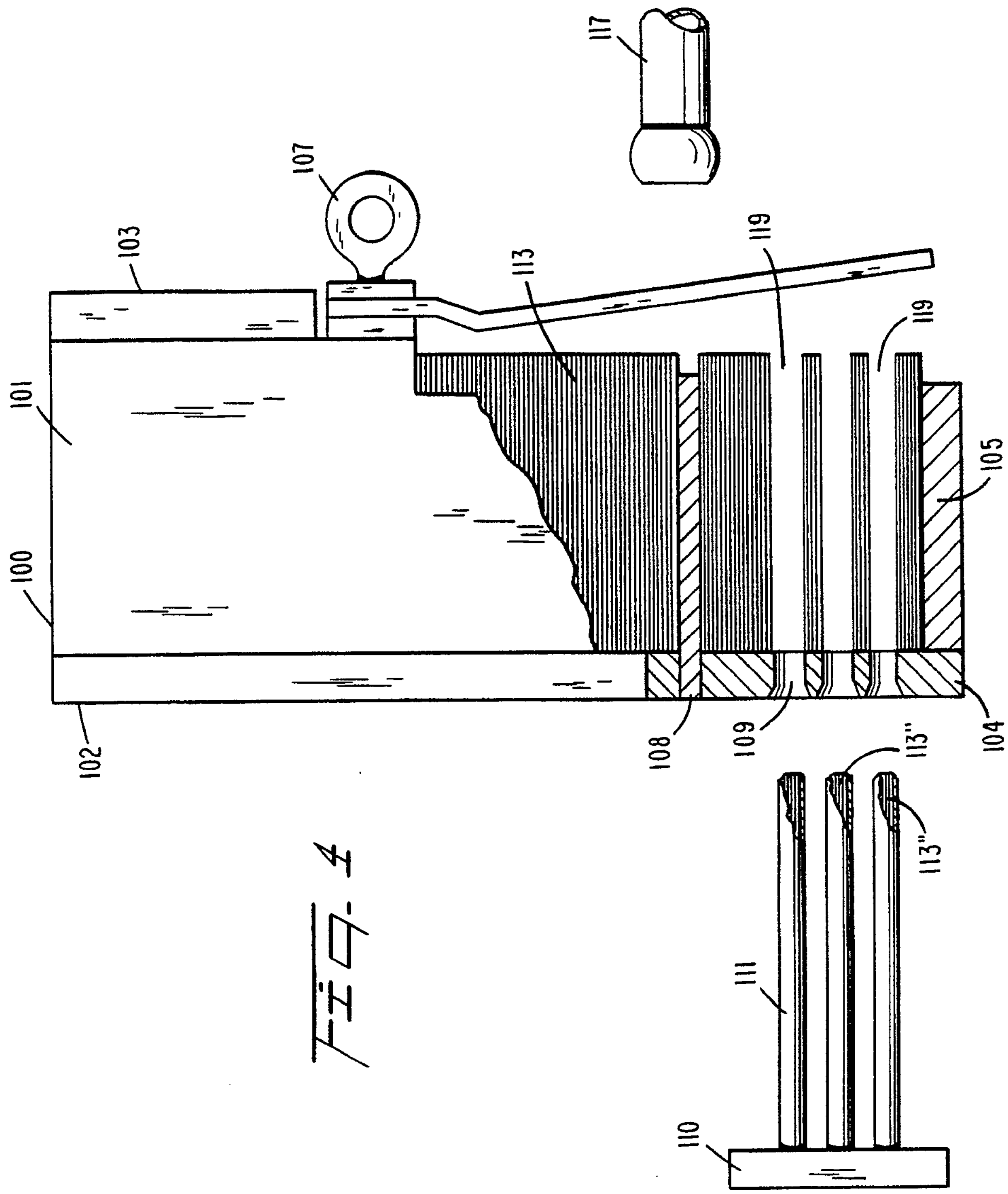


FIG. 3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101
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108
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110
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113"
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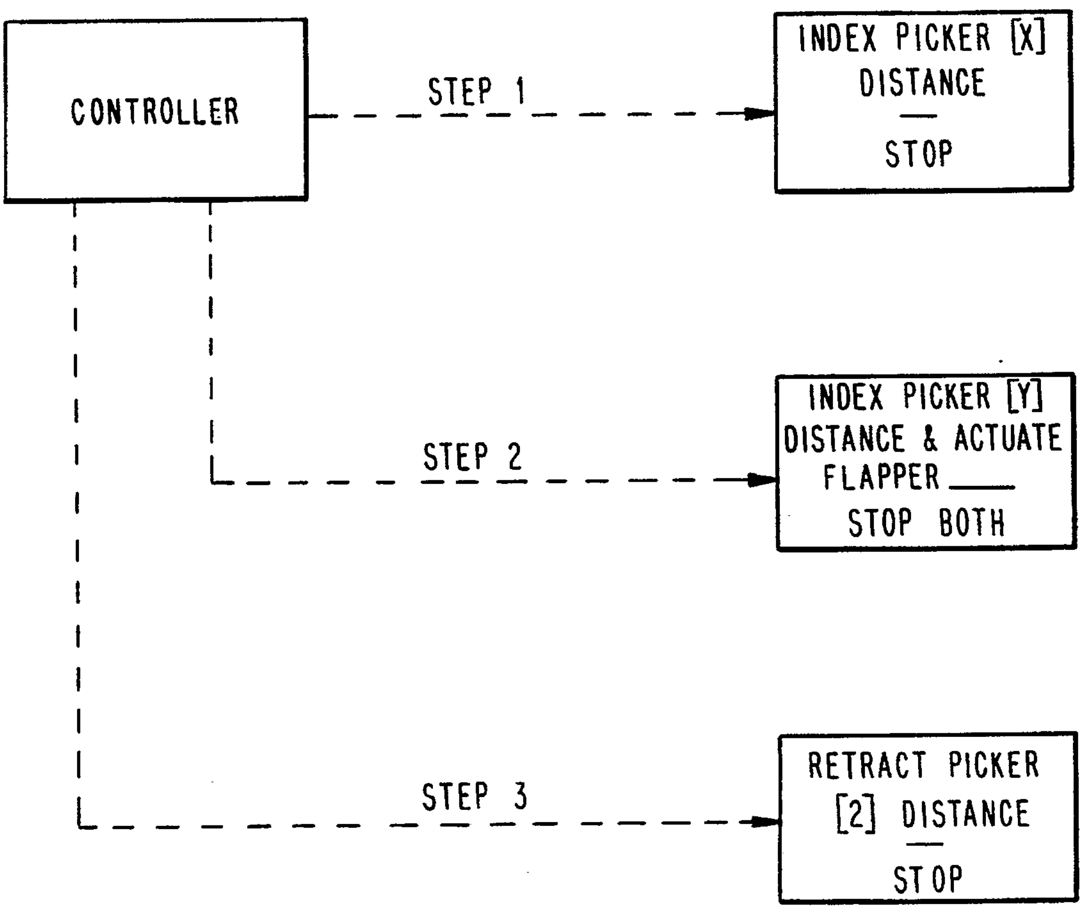
119
119

FIG. 4

Fig. 5


CONTROLLER
STEP 1
INDEX PICKER [X] DISTANCE
STOP
STEP 2
INDEX PICKER [Y] DISTANCE & ACTUATE FLAPPER
STOP BOTH
STEP 3
RETRACT PICKER [2] DISTANCE
STOP