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SORTING APPARATUS

Filed Dec. 24, 1957

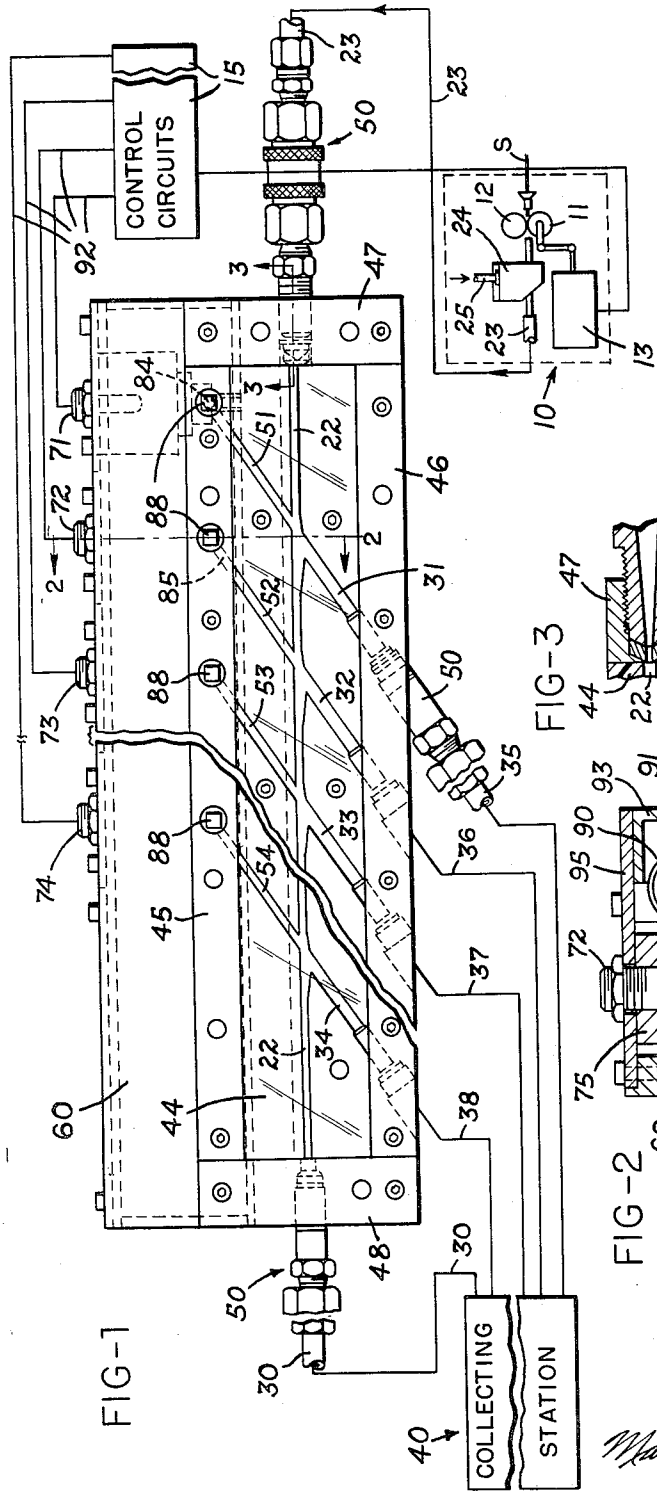


FIG-1

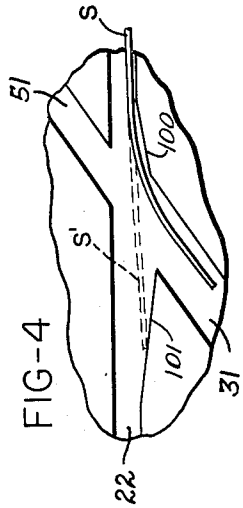


FIG-4

FIG-3

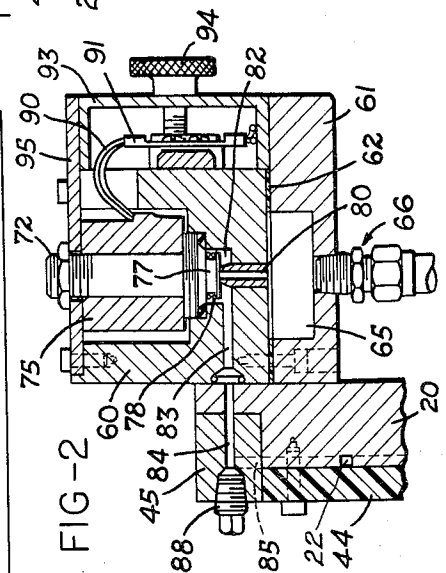


FIG-2

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SORTING APPARATUS

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This invention relates to sorting and classifying apparatus, and more particularly to apparatus for use in the high speed sorting of flexible strands.

The invention is described hereinafter in connection with a specific embodiment thereof for use in apparatus for the high speed gauging and classifying of successive lengths of string-like articles or strands constituting an intermediate product in the manufacture of surgical sutures and ligatures. More specifically, there is a stage in the manufacture of such sutures at which it is desirable to ascertain the minimum diameter of each individual strand of the material, which commonly are in standard lengths of five feet each, with this measurement being in fine graduations of the order of a few thousandths of an inch, and to sort the measured strands according to categories differing by such fine graduations in preparation for further furnishing operations. An example of apparatus of this character is found in Schwartz Patent No. 2,791,329, issued May 7, 1957 to the same assignee as this application.

In apparatus of the above type to which this invention is applicable, the successive strands are conveyed in a continuous operation through a gauging station and then to a sorting station from which they are redirected to a multiple-category collecting station. The gauging station incorporates equipment for detecting the minimum diameter of each strand and forwarding this information to the sorting station in time to control the sorting station in such manner that each strand is redirected to its proper category in the collecting station as determined by the gauging station. The present invention is especially related to apparatus for use in the sorting station of such a system.

It is a primary object of the present invention to provide sorting apparatus as outlined above which is capable of receiving successive strands of flexible material and of redirecting each strand along a proper selected source in accordance with information provided to the sorting apparatus during the passage of the strand thereto.

An additional object of the invention is to provide such sorting apparatus which is rapid and accurate in its operation while at the same time requiring a minimum of moving parts and offering minimum likelihood of frictional damage to the material being sorted.

Another object is to provide sorting apparatus as outlined above which is simple and economical to construct and maintain, and particularly which offers minimum opportunity for a strand to be caught therein with the resultant possibility of jamming.

It is a particular object of the invention to provide sorting apparatus as outlined above wherein the control over each successive strand is effected entirely by means of air jets which convey the strand to the apparatus and also direct it along the properly selected course from the apparatus.

Further objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing—

FIG. 1 is a view showing in side elevation sorting apparatus constructed in accordance with the invention and including a diagrammatic showing of the other stations which combine therewith to make up a complete gauging and classifying system;

FIG. 2 is an enlarged section on the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary section on the line 3—3 of FIG. 1; and

FIG. 4 is an enlarged fragment of FIG. 1.

Referring to the drawing, which illustrates a preferred embodiment of the invention, the individual strands S are initially introduced in succession to the gauging station, which is indicated generally at **10** as of the character disclosed in the copending application of Valentine et al., Serial No. 705,008, filed of even date herewith and assigned to the same assignee as this application. As each strand passes through the station **10**, its diameter is continuously measured in terms of the extent in which it displaces the sensing member provided by the movable gauging wheel **11** with respect to its complementary gauging wheel **12** which rotates on a fixed axis. The movements of the gauging wheel **11** are detected and temporarily recorded by a differential transformer **13** in combination with the control circuits indicated generally at **15**, and which are described in detail in the above Valentine et al. application. For the purposes of the present invention, the mechanism constituting the gaging station **10** could also be of the structure and mode of the operation disclosed in the above Schwartz patent.

The sorting apparatus of the invention includes a main housing **20** having extending therethrough a main unobstructed passage **22** for receiving the successive strands from the gauging station **10**. The strands are conveyed to the passage **22** by way of a conveyor tube **23** extending from the block **24** at the gauging station which is provided with a continuous supply of pressure air at **25**. The passage **22** continues from end to end of the housing **20** and is connected at its opposite end with a conveyor tube **30**. In addition, a plurality of branch passages **31**—**34** have continuously unobstructed connections with, and lead obliquely downwardly from the main passage **22**, and each is connected at its outer end with a conveyor tube **35**—**38** respectively. As indicated by the break in FIG. 1, the housing **20** may be of any appropriate length in accordance with the number of branch passages desired therein.

Each of the tubes **35**—**38** leads to a different receiving chamber or compartment in the collecting station indicated diagrammatically at **40**, and which for the purposes of this disclosure may be of the construction shown in the above Schwartz patent. The operation of the sorting apparatus of the invention is to receive the successive strands at the entry end of the passage **22** and to direct each strand down a selected one of the branch passages **31**—**34** in accordance with the information received from the control circuits **15**. The tube **30** forms a passage to a reject category or compartment in the collecting station, also in accordance with the operation of the gauging station and its associated control circuits.

Referring in more detail to FIGS. 1–3, the housing **20** is essentially a rectangular plate of metal having the passage **22** milled in one surface thereof, and with the passage conveniently of rectangular section as shown in FIG. 2. The passage **22** is enclosed on its front side by a plate **44** which is bolted to the plate **22** and is preferably of glass or a transparent plastic to permit ready observation of the passage of the successive strands through the unit. Additional metal bars **45**, **46**, **47** and **48** are secured to the plate **20** along the top, bottom and both ends thereof as shown in FIGS. 2 and 3.

The several branch passages **31**—**34** are also milled in the same surface of the plate **20** as the passage **22** and diverge from the passage **22** at angles of about 35°. They connect at their lower ends with suitable bores in the bar **46** which may be tapped to receive the connecting members **50** for the tubes **35**—**38**, and the conveyor tubes **23**

and 30 are similarly connected with opposite ends of the passage 22 by connecting members 50 and the bars 47 and 48. There is an additional oblique passage 51—54 which extends upwardly in line with each of the passages 31—34 on the opposite side of the main passage 22.

The passages 51—54 form air supply passages, and means are provided in accordance with the invention for connecting a selected one thereof with a continuous source of air pressure in such timed relation with the entry of each strand to the main passage 22 that the leading end of the strand is directed down the correspondingly selected branch passage. The air supply means is incorporated in a unit mounted at the back of the housing plate 20 and comprising an extended block 60 having a plate 61 bolted to the underside thereof in conjunction with a sealing gasket 62. A relatively wide slot 65 extends over most of the length of the upper surface of the plate 61 and forms a supply header for air pressure having a connection at 66 to an air supply source (not shown), which may be the same as for the line 25 at the gauging station.

A plurality of solenoid air valves are mounted in the block 60, there being one valve assembly 71—74 for each branch passage 31—34, and the valve assembly 72 is shown in detail in FIG. 2. It includes a coil 75 and cooperating plunger 77, and in the deenergized condition of the coil 75, the lower end of the plunger 77 is biased by the spring 78 into seating relation with the upper end of a nozzle 80 which leads upwardly from the header 65 to the valve chamber 82 in the block 60. A bore 83 leads from this chamber 82 to a matching bore 84 in the bar 45, and an oblique bore 85 in the underside of bar 45 connects the bore 84 with the upper end of the passage 52. The bore 84 is shown as a through bore for convenience of manufacture, and its outer end is therefore provided with a plug 88. This structure is duplicated for each of passages 51—54, as indicated by the additional plugs 88 in FIG. 1.

As already noted, there is a solenoid air valve for each of the branch passages 31—34, but there is no valve corresponding to the conveyor tube 30. FIG. 2 shows the operating connections 90 for the coil 75 leading to a multiple conductor unit 91 to which the leads 92 from the control circuits 15 and the other valves are also connected. A removable cover plate 93 provides access to these connections, as indicated by the threaded knob 94, and the block 60 is also provided with a top cover plate 95 enclosing the electrical parts.

In operation, the control circuits 15 cooperate with the gauging mechanism to energize one of the air valves 71—74 just before the leading end of each strand enters the passage 22, with the selection of the particular valve being determined by the minimum and/or maximum diameter noted by the gauging mechanism as the strand passed therethrough. The result of this operation is shown in FIG. 4. If the valve 71 is energized, an air jet will blow down the passage 51 into the branch passage 31, and the leading end of the strand will be directed down the passage 31 as indicated at S. The valve 71 will remain energized for a short interval of sufficient duration to assure continuation of the air jet until the strand has been conveyed completely through the passage 31 to the tube 35, and then the valve will be deenergized in preparation for the next strand, as explained in the above Valentine et al. application. Such prolonged operation of the valve may also be obtained as explained in connection with the solenoids A3, B3 and C3 in the above Schwartz patent.

If in FIG. 4 a valve other than valve 71 is energized, the strand will follow the course indicated at S' and pass further along the passage 22. In this connection, FIG. 4 shows that the bottom wall of passage 22 includes a short portion 100 immediately upstream of the branch passage 31 which is inclined downwardly in the same direction as the passage 31 but at a smaller angle to the horizontal, shown as about 10°. On the opposite or downstream side of the branch passage, however, the lower wall of passage 22 includes a portion 101 which is inclined downwardly in the opposite direction from the passage 31, at an angle shown as about 6°, and it intersects with the passage 31 at a lower level than the wall portion 100.

This arrangement of inclined lower wall portions is duplicated at each of the branch passages 31—34, and it provides additional guiding action on the individual strands. Thus the wall portion 100 guides the leading end of a strand towards the branch passage 31 for entry thereto if the valve 71 is energized. If, however, the valve 71 is not energized, the wall portion 101 will catch the leading end of the strand if it has sagged towards the passage 31 and will deflect it back to the main passage 22 to prevent it from entering a non-selected branch passage.

This invention accordingly provides sorting apparatus for flexible strands which is of outstanding simplicity of construction while at the same time being capable of accurate operation under high speed conditions, such for example as the sorting of 4000 individual 5-foot strands per hour. Furthermore, since the only moving parts are the plungers of the solenoid valves, maintenance and wear of the apparatus is reduced to a minimum. Another advantage of this minimum of moving parts is that it enables the several passages through the apparatus to be designed for maximum ease of movement of the successive strands, with minimum likelihood of jamming or otherwise causing frictional damage to the strands.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Apparatus for sorting flexible strands according to a specific property thereof, comprising means defining an extended unobstructed main passage for receiving successive said strands, means forming a plurality of branch passages having continuously unobstructed connections with and projecting obliquely from said main passage, means for causing successive said strands to enter said main passage longitudinally, and means for effecting discharge of a jet of air across said main passage and into a selected one of said branch passages in timed relation with the entry of each said strand to said main passage to deflect the leading end of said strand into said selected branch passage.

2. Apparatus for sorting flexible strands according to a specific property thereof, comprising means defining an enclosed extended unobstructed main passage for receiving successive said strands, means forming a plurality of branch passages having continuously unobstructed connections with and projecting obliquely from said main passage, means for establishing a main flow of air to said main passage for conveying successive said strands therethrough, and means for effecting discharge of a jet of air across said main passage and into a selected one of said branch passages in timed relation with the entry of each said strand to said main passage to deflect the leading end of said strand into said selected branch passage and to assist said main air flow to convey said strand through said branch passage.

3. Apparatus for sorting flexible strands according to a specific property thereof, comprising means defining an extended unobstructed main passage for receiving successive said strands, means forming a plurality of branch passages having continuously unobstructed connections with and projecting obliquely at a small angle of divergence from said main passage, means for causing successive said strands to enter said main passage longitudinally, means defining a plurality of air supply passages each extending in line with one of said branch passages on the opposite side therefrom of said main passage, and means operable in timed relation with the entry of each said

strand to said main passage for connecting a selected said supply passage with a source of pressure air to cause a jet of air to be discharged from said selected supply passage across said main passage into the opposite said branch passage for deflecting the leading end of said strand into said branch passage.

4. Apparatus for sorting flexible strands according to a specific property thereof, comprising a housing having therein an enclosed substantially horizontal unobstructed main passage for receiving successive said strands, means for establishing a main flow of air to said main passage for conveying successive said strands therethrough, means forming a plurality of branch passages projecting obliquely downwardly from said main passage at acute angles with the direction of air flow through said main passage and forming continuously unobstructed connections at said main passage, means forming a plurality of air supply passages above said main passage and each aligned with one of said branch passages, and means operable in timed relation with the entry of each said strand to said main passage for connecting a selected said supply passage with a source of pressure air to cause a jet of air to be discharged from said selected supply passage across said main passage into the opposite said branch passage for deflecting the leading end of said strand into said branch passage and of a duration corresponding to the length of one such strand for augmenting the air from said main passage to assure continued movement of said strand through said selected branch passage.

5. Apparatus for sorting flexible strands according to a specific property thereof, comprising a housing having therein an enclosed substantially horizontal main passage for receiving successive said strands, means for establishing a main flow of air to said main passage for conveying successive said strands therethrough, means forming a plurality of branch passages projecting obliquely downwardly from said main passage, means forming a plurality of air supply passages above said main passage and each aligned with one of said branch passages, a supply header in said housing adapted for connection to a supply source of pressure air, means including a separately adjustable valve having open and closed positions for connecting each said supply passage with said header, and means operable in timed relation with the entry of each said strand to said main passage for opening a selected said valve and holding said valve open for a time corresponding to the passage of a strand to cause a jet of air to be discharged from the associate said supply passage across said main passage into the opposite said branch passage for deflecting the leading end of said strand into said branch passage for urging the length of said strand through said branch passage.

6. Apparatus for sorting flexible strands according to a specific property thereof, comprising a housing having therein an enclosed substantially horizontal main passage for receiving successive said strands, means for establishing a main flow of air to said main passage for conveying successive said strands therethrough, means forming a plurality of branch passages projecting obliquely downwardly from said main passage at acute angles with the direction of air flow through said main passage, means forming a plurality of air supply passages above said main passage and each aligned with one of said branch passages, means operable in timed relation with the entry of each said strand to said main passage for connecting a selected said supply passage with a source of pressure air to cause a jet of air to be discharged from said selected supply passage across said main passage into the opposite said branch passage for deflecting the leading end of said suture into said branch passage, and the lower wall of said main passage including a portion on the downstream side of each of said branch passages which is inclined downwardly in the opposite direction from said branch passages and intersects the adjacent branch passage at a lower level than the portion of said lower wall adjacent said branch passage on the upstream side thereof to prevent the leading end of each of said strands from entering a non-selected branch passage.

7. Apparatus for sorting flexible strands according to a specific property thereof, comprising a housing having therein an enclosed substantially horizontal main passage for receiving successive said strands, means for establishing a main flow of air to said main passage for conveying successive said strands therethrough, means forming a plurality of branch passages projecting obliquely downwardly from said main passage at acute angles with the direction of air flow through said main passage, means forming a plurality of air supply passages above said main passage and each aligned with one of said branch passages, means operable in timed relation with the entry of each said strand to said main passage for connecting a selected said supply passage with a source of pressure air to cause a jet of air to be discharged from said selected supply passage across said main passage into the opposite said branch passage for guiding the leading end of said suture into said branch passage, the lower wall of said main passage including a short portion immediately upstream from each said branch passage which is inclined downwardly in the same direction as said branch passage but at a smaller angle to the horizontal to guide the leading end of each of said strands toward each said branch passage, and the lower wall of said main passage including a portion on the downstream side of each said branch passage whch is inclined downwardly in the opposite direction from said branch and intersects with the adjacent said branch passage at a lower level than said downwardly inclined wall portion on the upstream side of said branch passage to prevent the leading end of each of said strands from entering a non-selected branch passage.

8. A sorting mechanism for elongated flexible strands comprising a block having a planar face, a longitudinal unobstructed groove forming a main passageway cut into said face for the acceptance of said strands, a plurality of diagonal grooves forming branch passageways cut into said face and forming continuously unobstructed connections at said main passageway at an acute angle to the line of movement of said strands in said main passageway, air discharge means including air discharge passageways formed in said face at the junction of said main and branch passageways for selectively deflecting the leading end of said flexible strands into particular ones of said branch passageways according to a preselected program, and a cover plate fitted over said face in sealing relation thereto providing for the closure of said passageways.

9. A sorting mechanism for elongated flexible strands comprising an elongated block having a planar face, a longitudinal unobstructed groove forming a main passageway cut into said face for the acceptance of said strands, a plurality of diagonal grooves forming branch passageways cut into said face and forming continuously unobstructed connections at said main passageway at an acute angle to the line of movement of said strands in said main passageway, air discharge means including air discharge passageways formed in said face at the junction of said main and branch passageways for selectively deflecting the leading end of said flexible strands into particular ones of said branch passageways according to a preselected program, and a transparent cover plate fitted over said face in sealing relation thereto providing a closure for the open side of said passageways.

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