

May 7, 1957

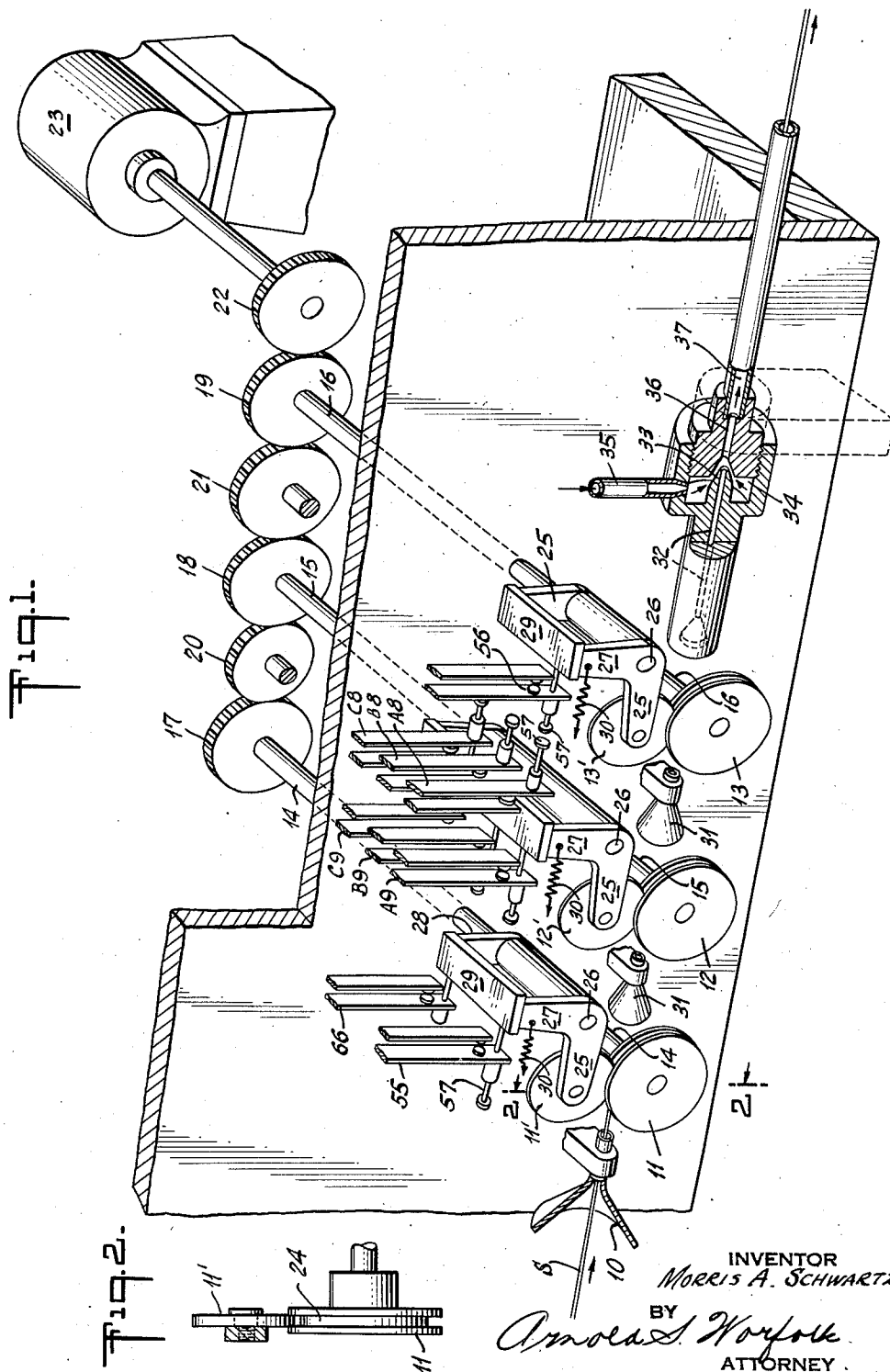
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2,791,329

ARTICLE GAUGING, CLASSIFYING, SORTING AND COUNTING APPARATUS

Filed Feb. 13, 1952

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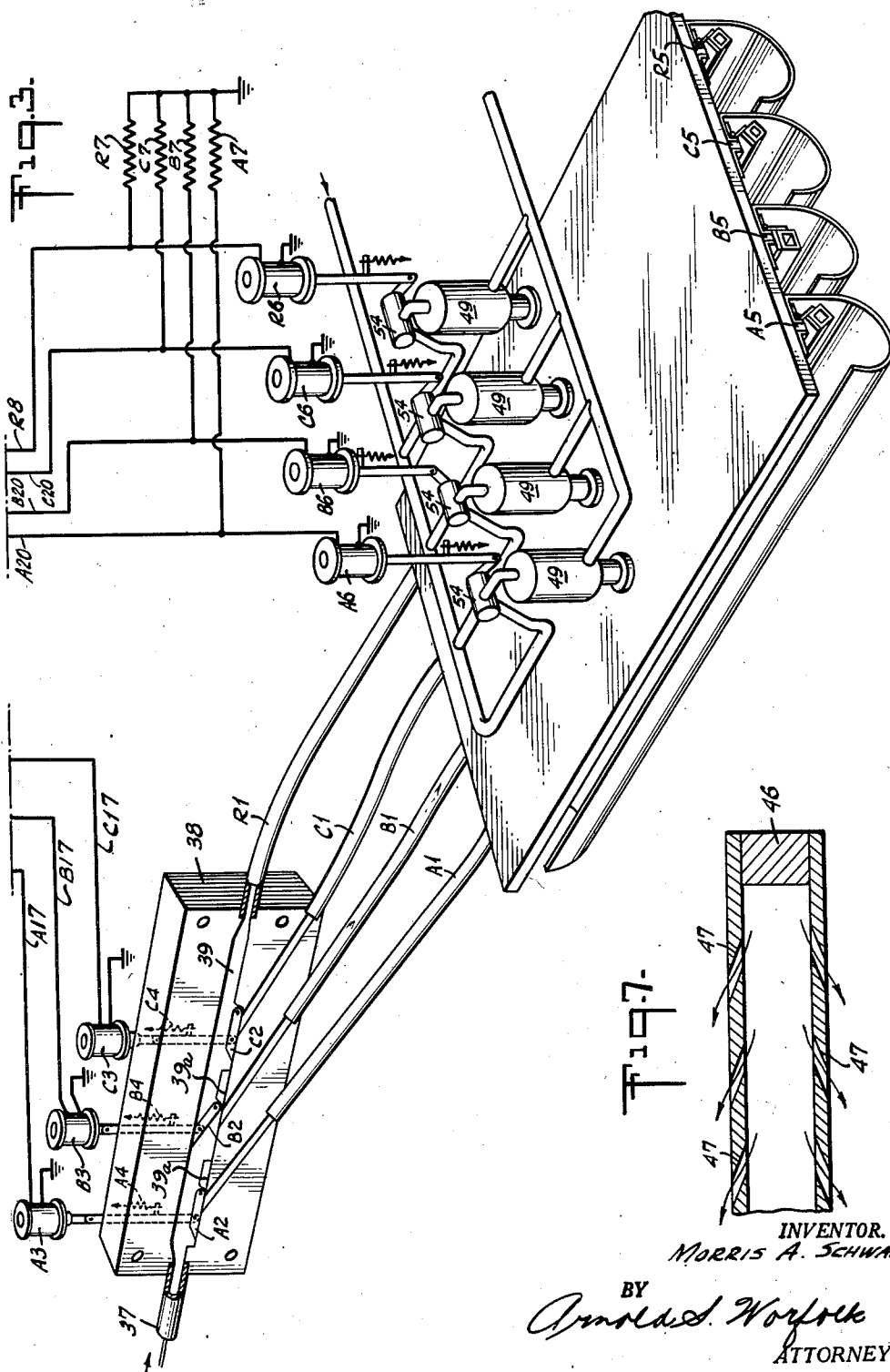
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4 Sheets-Sheet 2



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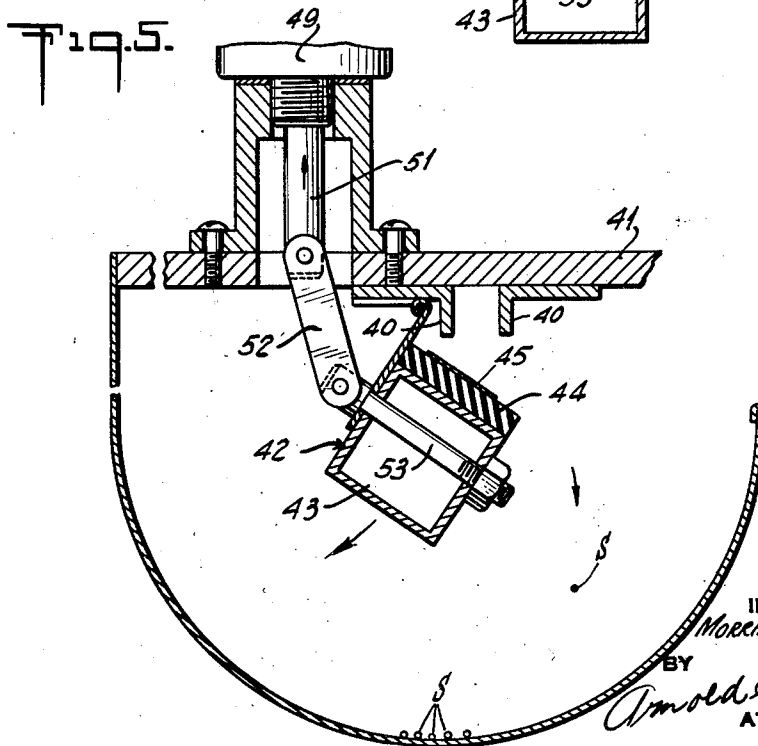
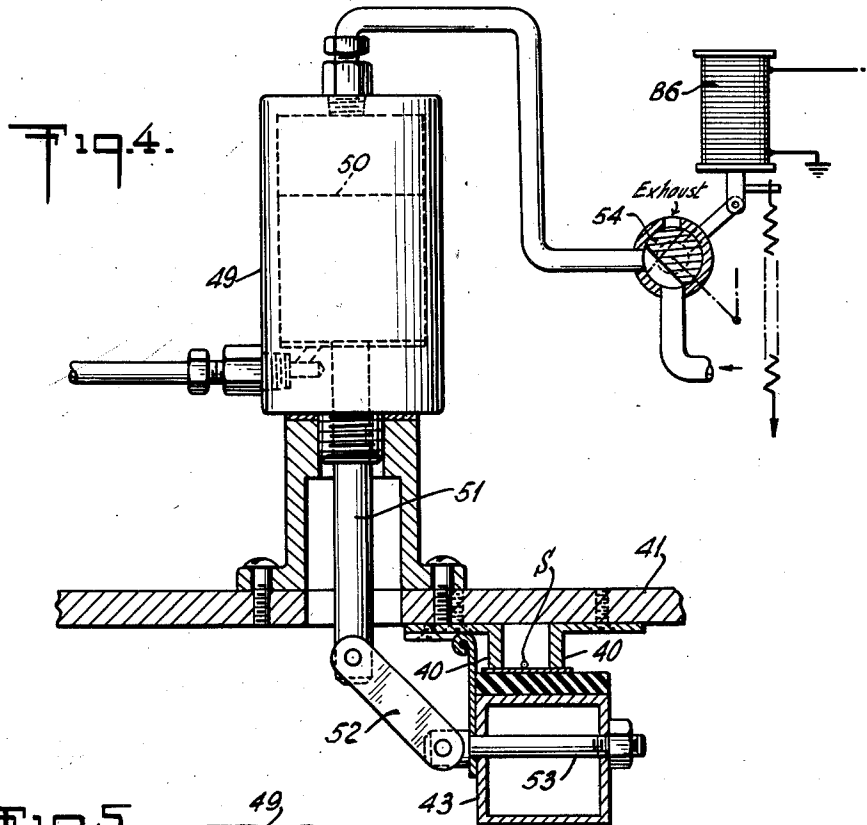
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4 Sheets-Sheet 3



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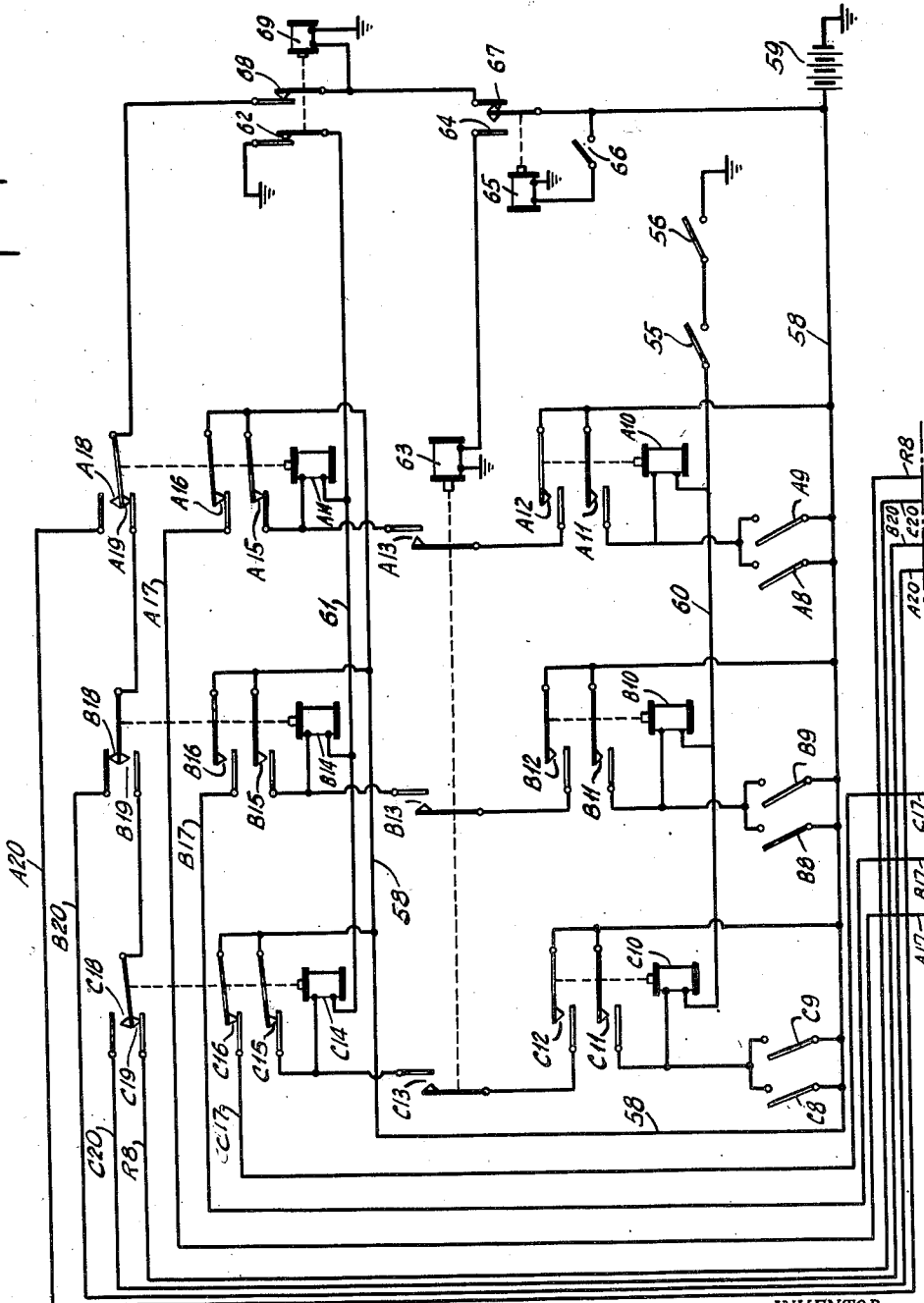
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ARTICLE GAUGING, CLASSIFYING, SORTING AND COUNTING APPARATUS

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Fig. 6.



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ARTICLE GAUGING, CLASSIFYING, SORTING, AND COUNTING APPARATUS

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Application February 13, 1952, Serial No. 271,311

14 Claims. (Cl. 209—88)

This invention relates to apparatus for automatically gauging, classifying, sorting and counting articles having dimensional variations. The principles involved may have application in the processing of articles of many types and particularly, although not limited thereto, flexible articles and where the problem presented is one of sorting into or identifying such articles in classes defined by maximum or minimum or by maximum and minimum thicknesses along their lengths.

Apparatus according to the invention has particular utility in the suture industry to sort sutures of varying diameters according to diameter size into classes having prescribed upper and lower limitations in this dimension.

The apparatus chosen as illustrative of the invention includes a gauging head for continuously measuring diameters along the length of a suture, an electrical station for classifying the suture according to maximum and minimum diameters along its length, a sorting head under the control of the electrical station for routing the suture along one path or another according to its classification, different chambers for receiving the classified sutures after sorting, mechanism for counting the sutures in each of the assorted classes and trays into which the sorted sutures are deposited from the sorting chambers in orderly fashion.

Referring to the drawings:

Fig. 1 is a perspective view of a suture gauging head incorporating the present improvements;

Fig. 2 is a vertical sectional view on line 2—2 of Fig. 1;

Fig. 3 is a perspective view of a suture sorting head and of a plurality of suture receiving chambers, which if arranged at the right of and somewhat lower down from the view shown in Fig. 1 illustrates the manner in which said elements co-operate with the gauging head;

Fig. 4 is an enlarged sectional view through one of the suture receiving chambers shown in Fig. 3 and its operating mechanism, the parts being shown in condition ready to receive a sorted suture;

Fig. 5 is an enlarged sectional view of a portion of the mechanism shown in Fig. 4 but with the parts in their normal positions;

Fig. 6 is a circuit diagram of an electric station which, under the control of the gauging head, effects classification of the sutures, control of the sorting head, operation of the suture receiving chambers and the mechanism for counting the sorted sutures; and

Fig. 7 is a horizontal sectional view through the end of a receiving chamber showing details of its construction.

A suture S to be gauged, classified and sorted is inserted endwise into an enlarged opening of a funnel-like member 10 whose smaller end directs the suture between the first of a series of three pairs of feed wheels 11, 11', 12, 12', 13, 13', arranged one behind the other in tandem relation and with the wheels of each pair one directly above the other. The lower wheels 11, 12 and 13 of each pair are fixed at corresponding ends of individual shafts 14, 15 and 16, all of which are parallel and provided

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at their opposite ends with gears 17, 18 and 19 interconnected by idler gears 20 and 21 and driven through gear 22 from motor 23 in a manner to effect rotation of the lower feed wheels in the same direction and at the same speed (Fig. 1). The lower feed wheels are formed each with a groove 24 extending around its peripheral edge to accommodate edgewise within the groove its associated overlying wheel (Fig. 2).

The overlying wheel of each pair of feed wheels is rotatably mounted at the front end of an arm 25 extending forwardly from a yoke member arranged to pivot about a fixed shaft 26 and which includes two spaced parallel arms 27, 28 extending upwardly from the shaft and connected together at the top by a flat horizontal yoke bar 29 of non-conducting material whose front and rear edges are parallel with the shaft 26 and with each other. A tension spring 30 associated with each yoke member urges the upper wheel thereon, 11', 12', or 13' as the case may be, down into the groove of its associated lower feed wheel 11, 12 or 13 and into engagement with the base of the groove or with the suture if one is present between the wheels. As the suture passes endwise between the first pair of feed wheels, it is fed thereby through the next pair of feed wheels, and by the latter through the third pair which in turn feeds it along. Funnel-like members 31 arranged one in advance of the second and another in advance of the third pair of feed wheels insure that the sutures are properly guided between them.

The arrangement is such that the yoke bar 29 of each yoke member will assume one position or another depending on whether or not there is a suture between its associated pair of feed wheels and, if a suture is present, depending on the diameter of that portion thereof which momentarily is between such wheels. The center pair of wheels 12, 12' gauges the suture as well as feeds it. Its action in this respect is described later on.

As the suture leaves the last pair of feed wheels 13, 13', it enters endwise into a tubular passageway 32 flared at its front end to insure such entry and which terminates in nozzle 33 located in chamber 34 to which air under pressure is fed through tube 35 from a suitable source not shown. The nozzle 33 in turn projects into the flared end of another tubular passageway 36 in alignment with passageway 32 and which likewise opens into pressure chamber 34. Passageway 36 whose diameter is preferably somewhat larger than the diameter of passageway 32 connects with a tubular member 37 constituting a duct for conveying the previously gauged suture to a sorting head 38 shown in Fig. 3. The flowing air traveling through the tubular member 37 created by pressure in the chamber 34 is the medium which bears the suture along the tube.

The sorting head 38 has a main passageway 39 extending completely through it. It connects at its front end with the tube 37 and at its rear end with a tube R1 which accommodates rejected sutures. Between these ends, the passageway 39 connects with a series of passageways A1, B1 and C1 corresponding in number to the number of classes to be sorted. These passageways are disposed at an obtuse angle with respect to the path of the oncoming suture to facilitate its deflection into the appropriate passageway. In the passageway 39, there are three pivoted gates A2, B2 and C2 which, in one position, seal off their associated passageways A1, B1 and C1 permitting sutures to pass over them and, in another position, block off the main passageway 39 to deflect sutures which strike them into their associated passageways. The gates A2, B2 and C2 for this purpose have flat top and bottom surfaces. Also for this purpose, the gates have bevelled end surfaces adapted, when the

gates are open, to engage flush with the top of the main passageway 39 and locate them in position such that their bottom surfaces are in alignment with their associated passageways. Then too, when the gates seal off their respective passageways A1, B1 and C1, the bevelled surfaces act to deflect the leading ends of the sutures up over the closed gates so as to facilitate their passage through the sorting head. Also to help out in this respect, blocks 39a, the same height as the thickness of the gates, are provided to bridge the gaps between the gates.

The gates A2, B2 and C2 normally are open providing access to the associated passageway A1, B1 and C1 but when any given classification has been violated as when the diametrical dimensions of a suture are such as to exclude it from a given class, the gate appropriated to that particular class is closed. Accordingly, a suture arriving at the sorting head is deflected into the passageway corresponding to the first gate in line that remains open, i. e., the second gate B2 under the conditions depicted in Fig. 3 by way of example. Solenoids A3, B3 and C3 are connected to the gates A2, B2 and C2 and, when energized, close them respectively. When de-energized, springs A4, B4 and C4 restore the gates to their normal positions. If all gates are closed indicating that the suture has been rejected by all classes, it passes on to the reject duct R1.

Ducts A1, B1, C1 and R1 connect at their exit ends with independent receiving chambers A5, B5, C5 and R5 for the sutures of the respective classes and the rejects. As shown in Figs. 3, 4 and 5 these chambers are defined each by a pair of parallel angle members 40 somewhat longer than the sutures to be processed and having each a horizontal leg and a depending vertical leg, the horizontal leg being fastened to the under side of a flat member 41. The flat member 41 is common to all of the chambers and constitutes the top thereof. The chambers are normally open at the bottom, but when a given chamber is signaled to receive a suture, it is closed at the bottom by a pivoted gate 42 extending throughout the length of the chamber and which, in the embodiment shown, consists of a tubular member 43, square in cross-section, with a rubber gasket 44 at the top faced with a thin metal plate 45 which seats against the depending legs of the angle members (Fig. 4). The resilient rubber gasket provides a tight seal while the metal plate grounds the suture to eliminate any static electricity it may have collected and also prevents undue wear upon the parts. The tubular gate members 42 are hinged along one face to the underside of the flat top member 41. A plug 46 located between the depending legs of the angle members seals off the end of each receiving chamber when its gate 42 is closed. A plurality of air escapes ports 47 drilled in the depending angle legs and slanting backwards with reference to the direction of air flow in the receiving chamber permits air to escape without tendency to pull the sutures through the ports (Fig. 7). When a suture has been delivered endwise into a receiving chamber, its gate 42 thereafter is opened permitting the suture to drop gently into an underlying accumulating tray 48. There is an accumulating tray for each suture class. It is fastened to the underside of the flat top member 41. It is suitably curved in cross-section and open along one side and at the end so that ready access may be had to remove classified sutures that are deposited therein.

In the embodiment shown, opening and closing of the gates 42 are effected by independent cylinder and piston devices 49 (Figs. 3, 4 and 5). Each device is vertically disposed above the flat top member 41 adjacent the receiving chamber it operates. A piston 50 within the cylinder has a piston rod 51 connected at its underside and which extends downwardly through the bottom of the cylinder. The piston rod, at its lower end is connected by a link 52 to the head of a bolt 53 which extends transversely through the tubular gate member 43. The

cylinder below the piston is connected to a source of say 10 lbs. air pressure, not shown. A two way valve 54 associated with each cylinder will when turned to one position (the solid line position shown in Fig. 4) connect the top of the cylinder with a source of say 70 lbs. air pressure, not shown, causing the piston to descend by virtue of the differential in pressure above and below the piston. This serves to close the associated chamber gate 42 ready to receive a suture. The chamber gate is opened to deposit the suture in the collecting tray as the valve 54 is turned to its other position (the dotted line position shown in Fig. 4) which vents the top of the cylinder to atmosphere, and allows the piston to ascend under the influence of the 10 lbs. pressure exerted on its under surface.

The respective valves 54 are operated by solenoids A6, B6, C6 and R6, i. e., one for each of the suture classes and the rejects. When the solenoids are energized the piston mechanisms are operated to prepare the respective chambers to receive the sutures and when the solenoids are de-energized, the piston mechanisms are returned to normal position to facilitate disposition of the sorted sutures into their respective trays.

Electrically operated counting devices A7, B7, C7 and R7 of any suitable commercial type and which have been diagrammatically illustrated, are connected in parallel with the solenoids A6, B6, C6 and R6 so that each time one of the latter solenoids is signaled to prepare its receiving chamber to receive a suture, the corresponding counting device is actuated. In this way, an accurate count may be kept of all sutures sorted to the various classes and rejected.

At this point, it might be stated that instead of air pressure applied at the leading end of the duct 37 to promote movement of the suture therethrough, a source of vacuum could be applied at the end of the receiving chambers to draw the sutures through the sorting head to the chambers. However, it is preferred that the system be operated by air pressure applied at the leading end of the duct 37 since a slight back pressure is created through the entrance tube 32 which tends to keep it free of dust. Such back pressure will not interfere with the entrance of the sutures into the tube 32 because it is readily overcome by the action of the feeding wheels 13, 13'.

Let it be assumed now for purposes of illustration that the sutures are to be classified according to diameter sizes as follows:

	Low Limit	High Limit
Class A	.022"	.030"
Class B	.016"	.025"
Class C	.010"	.018"
Class R	Rejects that violate the dimensional characteristics of all classes.	

The electrical circuit and the manner in which it operates to classify sutures into the above classes and to control the various other apparatus will now be described. Referring to both Figs. 1 and 6 it will be observed that there are two contact switches 55 and 56 which are connected in series and operated one by the yoke bar associated with the first sets of feed wheels 11, 11' and the other by the yoke bar associated with the third pair of feed wheels 13, 13'. Each of these switches has a fixed contact and a movable contact. The movable contact is on a resilient arm which is biased to close the switch but which in the absence of a suture between the wheels is held in an open position by an adjustable banking screw 57 threaded through the movable contact arm and into engagement with the yoke bar of its associated yoke member. On the other hand, when there is a suture between the first and third set of feed wheels 11, 11' and 13, 13', the switch contacts 55 and 56 are closed. As previously stated, the actual gauging of the sutures is accomplished by

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the middle set of wheels 12, 12'. On each side of the yoke bar 29 associated with this set of wheels, there is a contact switch for each of the classes into which the sutures are to be sorted. Thus there are switches A8, B8 and C8 at the right which are low limit switches for the respective classes and opposed switches A9, B9 and C9 at the left which are high limit switches for the corresponding classes. These switches are similar in construction to the contact switches 55, 56 and have each a similar adjustable banking screw 57 passing through the outer resilient contact member and banking against the adjacent edge of the yoke cross bar corresponding to the gauge wheels 12, 12'. In operation, however, the low limit switches A8, B8 and C8 respectively are adjusted by their banking screws to close when the diameter of a suture being gauged becomes less than the minimum diameter set for the classes A, B and C whereas the high limit switches A9, B9 and C9 respectively are adjusted by their banking screws to close when the diameter of a suture being gauged exceeds the maximum diameter set for the corresponding classes. Thus, for example, if a suture being gauged has diameters along its length ranging between .016" and .025" it will be eligible for sorting in Class B and during gauging of such a suture, neither the low limit switch B8 nor the high limit switch B9 corresponding to Class B will have been closed. However, during the gauging of such sutures, the low limit switch A8 for Class A will have been violated rendering the suture ineligible for that class and the high limit switch C9 for Class C will have been violated rendering the suture ineligible for that class. Accordingly, the only gate in the sorting head 38 which will remain open is the gate B2 associated with the passageway leading to the receiving chamber corresponding to Class B. Similarly, if the diameters along the length of a suture being gauged range between .022" and .030" rendering it appropriate for sorting in Class A, the high limit switches B9 and C9 for Classes B and C would have been closed, or if the diameters range between .010" and .018" rendering it appropriate for sorting in Class C, the low limit switches A8 and B8 would have been closed and the corresponding gates in the sorting head actuated accordingly so that the suture is directed into the appropriate receiving chamber. If the diameters along a suture being gauged fall within the limits of two classes, say between .015" and .019" or outside the limits of all classes, say below the limit for Class C or above the limit for Class A, all gates in the sorting head will close causing the suture to pass on to reject chamber R5.

It will be observed that there is an overlap of several thousandths inches between Class A and Class B and between Class B and Class C and it is of course possible that the diameters of a given suture might fall entirely within a range common to two classes rendering it eligible for sorting in both. With the circuit arrangement disclosed, such a suture would be sorted in the class of larger diameter since in the sorting head 38 the gates in the order reached by an oncoming suture are arranged with the ones corresponding to the class of largest diameter first followed by those corresponding to other classes in order of decreasing diameter size. However, merely by adjusting the switches A8 and A9 to measure the limits of the smallest class, and the switches C8 and C9 to measure the limits of the largest class, a suture eligible for two classifications would be sorted in the smaller classification.

Referring to the circuit diagram of Fig. 6, it will be observed that the high and low limit switches A8, B8, C8, A9, B9 and C9 are connected at one side to lead 58 from positive side of battery 59, whose negative pole is grounded. Each pair of such high and low limit switches is connected respectively to relays A10, B10 and C10 all of which have connection with common return lead 60 to ground through the two switches 55 and 56 previously referred to and which, as will be recalled, are in series. The purpose of the two switches 55 and 56 which are op-

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erated respectively by the feed wheels 11, 11' and 13, 13' is to insure that the suture to be gauged is between the middle pair of gauge wheels 12, 12' before the high and low limit switches become effective to classify it. For example, were the classifying circuits energized before the suture arrived between the gauging wheels 12, 12' or after the suture had left the gauging wheels, the low limits of all classes would be violated so that no actual suture classification would be possible. By delaying activation of the classification circuits however, until the leading end of the suture is between the third pair of feed wheels 13, 13' and by insuring that the classification circuits are deactivated as the trailing end of the suture leaves the front pair of feed wheels 11, 11' proper classification of the suture is assured.

Upon violation of either limit of any of the classifications, the appropriate limit switch A8, A9, B8, B9, C8 or C9 as the case may be, is closed to energize the corresponding relay A10, B10 or C10. Each relay, upon activation, respectively closes two sets of contacts, A11 and A12, B11 and B12 and C11 and C12. The closing of contacts A11, B11 or C11 completes holding circuits from positive lead 58 through their respective relays to ground lead 60 to maintain the relays energized once they are signaled since operation of the limit switches may be momentary only. The closing of contacts A12, B12 or C12 will, when a series of three contacts A13, B13 and C13 are closed connects positive battery lead 58 with the corresponding relay of a second battery of relays A14, B14 and C14 which have a return lead 61 to ground through normally closed contact 62. Contacts A13, B13 and C13 normally are open but are closed upon activation of a common relay 63 whose circuit is completed from positive lead 58 to ground when normally open contact 64 is closed. Closing of contact 64 is effected by relay 65 whose circuit is completed from positive lead 58 to ground upon the closing of a switch 66. Switch 66 is associated with the first set of feed wheels 11, 11' and its construction and operation are the same as switch 55 already described (Fig. 1). Switch 66 closes simultaneously with switch 55 but there is a time delay in the operation of relay 65 until approximately three-quarters of the suture being gauged has passed through the middle set of gauging wheels 12, 12'. In other words, if the machine is set to gauge sutures at the rate of one per second which is a convenient rate for an operator feeding sutures into the machine, the relay 65 is designed to close contact 64 about .7 second after switch 66 has closed. When contacts A13, B13 and C13 are closed, such of the relays A14, B14 and C14 in the second relay battery corresponding to those relays A10, B10 and C10 in the first battery which previously had been energized or which subsequently are energized as gauging of the suture is completed, will in turn be energized.

The second battery of relays A14, B14 and C14 controls the gates in the sorting head, the suture receiving chambers and the counting devices. Activation of relays A14, B14 and C14 closes respectively contacts A15, B15 and C15 to establish a holding circuit through the respective relays from positive battery lead 58 to ground lead 61. This permits retention by the second battery of relays of signals received from the first when the second battery is electrically disconnected from the first for a purpose and in a manner subsequently made clear. Activation of relays A14, B14 and C14 also closes respectively contacts A16, B16 and C16 to complete circuits from positive battery lead 58 through leads A17, B17 and C17 and solenoids A3, B3 and C3 respectively to ground. Solenoids A3, B3 and C3, it will be recalled, operate respectively gates A2, B2 and C2 in the sorting head, i. e., to close them and permit the suture to proceed to the first open gate representing the largest diameter class whose limits have not been violated.

There are also associated respectively with each of relays A14, B14 and C14 normally closed contacts A18,

B18 and C18 and normally open contacts A19, B19 and C19. When contact A18 remains closed, which it will if relay A14 has not operated, it completes a circuit from positive battery lead 58 through contacts 67 and 68 when closed, and through a lead A20 to the solenoid which readies the receiving chamber A5 to receive the Class A sutures. If relay A14 has been signaled indicating that Class A has been violated, then contact A18 is broken and contact A19 established. If contact B18 remains closed which it will if relay B14 has not operated, the establishment of contact A19 will complete the circuit from positive lead 58 through lead B20 to the solenoid which readies the receiving chamber B5 to receive the Class B sutures. If both relays A14 and B14 have been signaled indicating that both Class A and B have been violated, both contacts A18 and B18 will have been broken and both contacts A19 and B19 established. Then if contact C18 remains closed which it will if relay C14 has not operated, the circuit from positive lead 58 will be established through lead C20 to the solenoid which readies receiving chamber C5 to receive Class C sutures. If all relays A14, B14, and C14 have operated indicating that all classifications have been violated, then all of contacts A18, B18 and C18 will be broken and all of contacts A19, B19 and C19 established. The circuit from positive lead 58 then will be established through contacts A19, B19 and C19 and through lead R8 to the solenoid which readies the receiving chamber R5 to receive the suture rejects. Each time one or another of the chambers A5, B5, C5 and R5 is readied to receive a suture by the operation of its corresponding solenoid A6, B6, C6 or R6, the counting device A7, B7, C7 or R7 corresponding to such solenoid will be actuated to indicate disposition of the suture.

Operation of contacts 62 and 68 is controlled by relay 69 which is energized when contact 67 controlled by relay 65 is closed. Relay 69 also is a time delay relay whose period after activation but before operation is slightly less than the corresponding period for relay 65. In other words, if relay 65 is set to operate after .7 second, relay 69 may be set to operate after .6 second. Furthermore, it should be noted that contacts 62 and 68 are closed when relay 69 is de-energized and opened upon its operation.

In the drawings, a condition has been illustrated in which a suture has been classified for sorting in the second class, i. e., Class B. By way of example, operation of the apparatus will be described for a condition such as this. The operator inserts the suture endwise into the receiving funnel 10 and between the first pair of feed wheels 11, 11' which thereupon start feeding the suture through the apparatus. As soon as the suture is between feed wheels 11, 11', switches 55 and 66 close. The closing of switch 66 energizes relay 65 which however does not operate until approximately .7 second later as previously stated. The suture passes between the gauging wheels 12, 12' which however do not actually start effectively gauging it until it also has arrived between the last set of feed wheels 13, 13' and has closed switch 56. When switch 56 closes, a circuit which includes the limit switches A8, A9, B8, B9, C8 and C9 is prepared for operation, and as the upper gauge wheel 11' moves about its pivot 26 in accordance with the varying diameters of the suture being measured, such limit switches will or will not close depending upon whether the diameter of the suture is less or greater than the limits set for any particular class. In the supposititious case, the upper limit for the smallest classification C and the lower limit for the largest classification A, are violated but not the limits allocated to the intermediate classification B. The relays A10 and C10 operate as soon as limit switches A8 and C9 signal violation of their respective classes and even though the signals are but momentary, such relays remain energized throughout measurement of the suture by virtue of the holding circuits which are completed through contacts A11

and C11 which the relays close. When approximately three-quarters of the suture has traversed the gauging wheels, the time will have elapsed after the closing of switch 66 for the operation of relay 65. Operation of relay 65 breaks the circuit through relay 69, which permits contacts 62 and 68 to close and prepare the second battery of relays A14, B14 and C14 and the circuits controlled thereby for operation. Operation of relay 65 also closes contact 64 which energizes relay 63, closing all the switches A13, B13 and C13 electrically to connect the second battery of relays with the first battery A10, B10 and C10. Those relays A14, B14 and C14 in the second battery are activated which correspond to those in the first battery that have already been activated or which later may become activated as the suture completes its travel through the gauging wheels. Such relays in the second battery, in the supposititious case, are relays A14 and C14.

Classification of the suture is completed as its trailing end leaves the first set of feed wheels 11, 11' and permits restoration of switches 55 and 66 to their normal open condition. Opening of switch 55 breaks all electrical connections through the first battery of relays A10, B10 and C10, opening the switches controlled thereby and which previously had been closed. Simultaneously therewith, i. e., immediately upon the opening of switch 66, time delay relay 65 is de-energized opening the circuit through relay 63. Contacts A13, B13 and C13 are thus broken to effect complete electrical dissociation of the second battery of relays A14, B14 and C14 from the first battery of relays A10, B10 and C10. Also as time delay relay 65 is de-energized, contact 67 establishes the circuit through relay 69 whose contacts 62 and 68 are in the circuit of relays A14, B14 and C14 and the circuits controlled by such relays which operate the gates in the sorting head, the suture receiving chambers and counting devices.

It will be recalled that relay 69 is also a time delay relay designed to operate after initial activation at a time interval somewhat less than the delay provided for in time delay relay 65, say about .6 second. During the period of delay after activation of relay 69 and before it operates, the suture is sorted and delivered to its appropriate receiving chambers according to the signals that are transmitted to the battery of relays A14, B14 and C14 from relays A10, B10 and C10. In the meantime, while this operation is progressing, the next suture to be gauged and classified may be started through the apparatus since, as previously stated, the first battery of relays A10, B10 and C10 which store classification signals is electrically divorced from the second battery of relays which receive the corresponding signals for sorting.

In the supposititious example, signals evidencing violation of Classes A and C were transmitted to relays A14 and C14. Contacts A15 and C15 were closed to hold the signal which otherwise would be destroyed when the batteries of relays are electrically disconnected. Contacts A16 and C16 are closed to energize solenoids A3 and C3 which close gates A2 and C2 in the sorting head corresponding to the classifications which have been violated and leaving open gate B2 corresponding to the classification not violated, i. e., the gate controlled by relay B14. Closing of contact A19 upon operation of relay A14 completes a circuit through contact B18 which has remained intact because relay B14 was not signaled. The circuit thus completed, energizes solenoid B6 which prepares for reception of the suture, the receiving chamber B5 devoted to sutures of the intermediate Class B and at the same time, operates the counter B7 appropriate to that class.

The length of the suture conveying tube 37 in advance of the sorting head 38 coupled with the rate at which the suture travels through the tube is such as to permit operation of the parts controlled by the battery of relays A14, B14 and C14 prior to the time that the suture reaches the sorting head 38.

It should be noted in the supposititious example that the classification limits for Class C were violated causing

operation of the relays C10 and C14. Such operation of the relays however, has no effect upon sorting of the suture since, as will be apparent from Fig. 3, it is the sorting gate corresponding to the first classification whose limits are not violated that controls distribution of the suture.

Sorting and distribution of the sutures to the proper receiving chambers and their counting all occur within the interval commencing with activation of the time delay relay 69 and ending with its operation. When relay 69 operates, contacts 62 and 68 are broken. Breaking of contact 62 breaks the circuit through relays A14, B14 and C14 which previously had been activated. Contacts A15, A16, A18, A19 and C15, C16, C18 and C19 controlled respectively thereby are restored to normal condition. The relay holding circuits are broken and solenoids A3 and C3 de-energized to restore the sorting gates. Simultaneously therewith, contact 68 which likewise is controlled by time delay relay 69 is broken to disestablish the electrical circuit to the solenoid controlling operation of the receiving chamber and the counter.

The sorting, suture receiving chamber and counting mechanisms and their controlling circuits are thus ready for the next suture which in the meantime has been fed into the apparatus for classification. The time delay characteristic of relay 69 is made less than the corresponding characteristic of relay 65 to insure that signals which are collected by the first battery of relays pursuant to classification of the sutures can not be transmitted to the second battery of relays prior to the time they are cleared of the signals devoted to the earlier classified suture.

The velocity of the air stream which carries the suture through the apparatus is regulated so as to insure that all operations to be performed on the suture will have been completed by the time that the second battery of relays is de-energized.

It will be understood that provision may be made for any number of classifications desired merely by duplicating the number of parts required for handling such increased number of classifications and that the three classifications and the one reject classification herein shown are merely by way of illustration.

The invention has been illustrated in connection with one embodiment only, but many modifications thereof are within its spirit and particularly such modifications if any as may be necessary to accommodate it for operation on other types of articles, flexible or otherwise. The invention therefore, is to be limited only by the prior art and scope of the appended claims.

What is claimed is:

1. Apparatus for gauging in an article a selected dimension which throughout a second dimension may vary and classifying said article with reference to such selected dimension, said apparatus including a gauging device adjustable automatically in response to such variations in said selected dimension, means for presenting an article throughout at least a part of said second dimension for the gauging of the selected dimension means defining a plurality of different sets of upper and lower limits embracing, as regards each set, a range in the selected dimension having a portion common to a portion of the range in the selected dimension embraced by a different set and which automatically respond to adjustments of the gauging device indicating a violation of any of said sets of predetermined limits, and devices controlled by said means and acting upon said article to classify it in one category or another according as the selected dimension varies within one set of predetermined limits or another.

2. Apparatus for gauging in an article a selected dimension which throughout a second dimension, may vary, and classifying said article with reference to such selected dimension, said apparatus including a gauging device movable automatically in response to such variations in

said selected dimension, means for presenting an article throughout at least a part of said second dimension for the gauging of the selected dimension means comprising a plurality of pairs of electrical switches operable in response to the gauging device upon movement of the latter indicating violation of one or another sets of predetermined maximum and minimum limits in the selected dimension for which each pair of switches is set, each set of predetermined maximum and minimum limits embracing a range in the selected dimension having a portion common to a portion of the range in the selected dimension covered by a different set and devices including an electrical circuit controlled by said switches for acting upon the article to classify it in one category or another according as the selected dimension varies within or without any of said sets of maximum and minimum limits.

3. Apparatus according to claim 2 wherein means are provided operable automatically to delay activation of the circuit controlled by the gauging device until the gauging device is effectively under the influence of the selected dimension being gauged and automatically to deactivate said circuit just prior to the time that the gauging device ceases to be influenced by the selected dimension being gauged.

4. Apparatus for gauging in an article a selected dimension which throughout a second dimension, may vary, and classifying said article with reference to such selected dimension, said apparatus including a gauging device movable automatically in response to such variations in said selected dimension, means for presenting an article throughout at least a part of the second dimension for the gauging of the selected dimension means comprising a plurality of pairs of electrical switches selectively operable in response to movement of the gauging device when the selected dimension of the article being gauged varies beyond maximum and minimum limits for which each pair of switches are set, each set of predetermined maximum and minimum limits embracing a range in the selected dimension having a portion common to a portion of the range in the selected dimension covered by a different set an electrical circuit including relays controlled one by each such pairs of switches and second relays controlled one by each of the first relays, devices controlled by the second relays for acting upon the article to classify it in one class or another as determined by said maximum and minimum dimensional limitations depending on which of the electrical switches have operated and means for disconnecting the second relays electrically from the first relays after a given time interval to enable gauging of a second article simultaneously with classification of the first.

5. Apparatus for conveying a flexible strand from one position to another including a closed duct between said two positions, an air inlet port at the first position, a block in the duct at the second position disposed in the path of movement of the strand, an outlet port in the wall of the duct in advance of the block, means for establishing a flow of air between the inlet port and the outlet port sufficient to convey a flexible strand endwise along the duct until it is arrested in the second position and means facilitating removal of the strand at said second position.

6. Apparatus according to claim 5 wherein the air outlet port is disposed at an angle with respect to the path of travel of the strand such as to prevent its discharge from the duct through the outlet port.

7. Apparatus according to claim 5 wherein the air outlet port is disposed at an angle sloping backwardly with respect to the path of travel of the strand whereby to prevent the discharge of the strand from the duct through the outlet port.

8. Apparatus according to claim 5 wherein the duct near the second position is closed at the bottom for a distance substantially equal to the length of the strand by means operable upon opening to permit sidewise discharge of the strand by gravity.

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9. Apparatus according to claim 8 wherein there is provided an underlying tray to catch the strands upon their gravity discharge.

10. Apparatus for gauging thickness along the length of a flexible strand, classifying the strand with reference to its thickness and sorting it according to classification, said apparatus including a gauging device movable automatically in accordance with variations in such thickness, means defining a plurality of independent sets of predetermined upper and lower limits for strand thickness and which automatically respond to movement of the gauging device indicating a violation of any of said sets of predetermined limits, a chamber for each classification of strand as determined by each of such sets of predetermined limits and for strands outside such classifications, individual passageways leading to the classification chambers, a gate associated with each said passageway and operable by its position to admit or deny entrance of a strand thereto, means for conveying a strand from the gauging device to the chambers, and instrumentalities controlled by the means defining such predetermined sets of limits for determining the position of the gates to admit or deny entrance of said strand to the chambers according as the thickness of the strand as determined by the gauging device is within one set of predetermined limits or another.

11. Apparatus for gauging thickness along the length of a flexible strand, classifying the strand with reference to its thickness and sorting it according to classification, said apparatus including a gauging device movable automatically in accordance with variations in such thickness, means comprising an electrical switch operable in response to movement of the gauging device when the strand thickness varies beyond a given predetermined limit, an electrical circuit including one relay controlled by the switch and a second relay controlled by the first relay, a chamber for receiving strands within the predetermined limit, another chamber for receiving strands outside the predetermined limit, individual passageways leading to the chambers, a gate controlling entrance of the strands to said passageways, instrumentalities controlled by the second relay for determining the position of the gate to direct the strand to one chamber or another according as the gauging device is within or outside the predetermined limit, means for conveying the strand from the gauging device to the chamber, and means for electrically disengaging the second relay from the first relay to enable the strand to be so conveyed while a second strand is being gauged.

12. Apparatus according to claim 11 wherein the chambers are normally open at the bottom and wherein means connected in circuit as controlled by the second relays act selectively to close the chamber to which the strand is to be conveyed.

13. Apparatus for gauging thickness along the length of a flexible strand, classifying the strand with reference to its thickness and sorting it according to classification, said apparatus including a gauging device movable automatically in accordance with variations in such thickness, means comprising a plurality of pairs of electrical switches selectively operable in response to movement of the gauging device when the strand thickness varies beyond maximum and minimum limits for which each pair of

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switches are set, an electrical circuit including relays controlled one by each of such pairs of switches and second relays controlled one by each of the first relays, a separate chamber for receiving strands whose thickness classification is between the maximum and minimum limits for which each pair of electrical switches is set and another chamber for receiving strands whose thickness is outside said limits, individual passageways leading to the classification chambers, a gate associated with each of said passageways and operable by its position to admit or deny entrance of a strand to such passageway, instrumentalities controlled by the second relays for determining the position of the gates to admit or deny entrance of such strand to the chambers according as their thickness is within or without the limits for which the switches are set, means for conveying the strand from the gauging device to the chambers, and means for electrically disengaging the second relays from the first relays to enable a strand to be so conveyed while a second strand is being gauged.

14. Apparatus for gauging thickness along the length of a flexible strand, classifying the strand with reference to its thickness and sorting it according to classification, said apparatus including a gauging device movable automatically in accordance with variations in such thickness, means comprising a pair of electrical switches operable one in response to movement of the gauging device when the strand thickness exceeds a given maximum limit and the other when said strand thickness becomes less than a given minimum limit, an electrical circuit including one relay controlled by said switches and a second relay controlled by the first relay, a chamber for receiving strands whose thickness is between said maximum and minimum limits and another chamber for receiving strands whose thickness is outside said limits, individual passageways leading to the chambers, a gate controlling entrance of the strands to said passageways, instrumentalities controlled by the second relay for determining the position of the gate to direct the strand to one chamber or another according as the thickness of the strand is within or without said maximum and minimum limits, means for conveying the strand from the gauging device to the chamber, and means for electrically disengaging the second relay from the first relay to enable the strand to be so conveyed while a second strand is being gauged.

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