March 23, 1948. T. R. SELBY ET AL 2,438,131

MANUFACTURE OF SUTURES

Filed Aug. 24, 1945 5 Sheets-Sheet 1

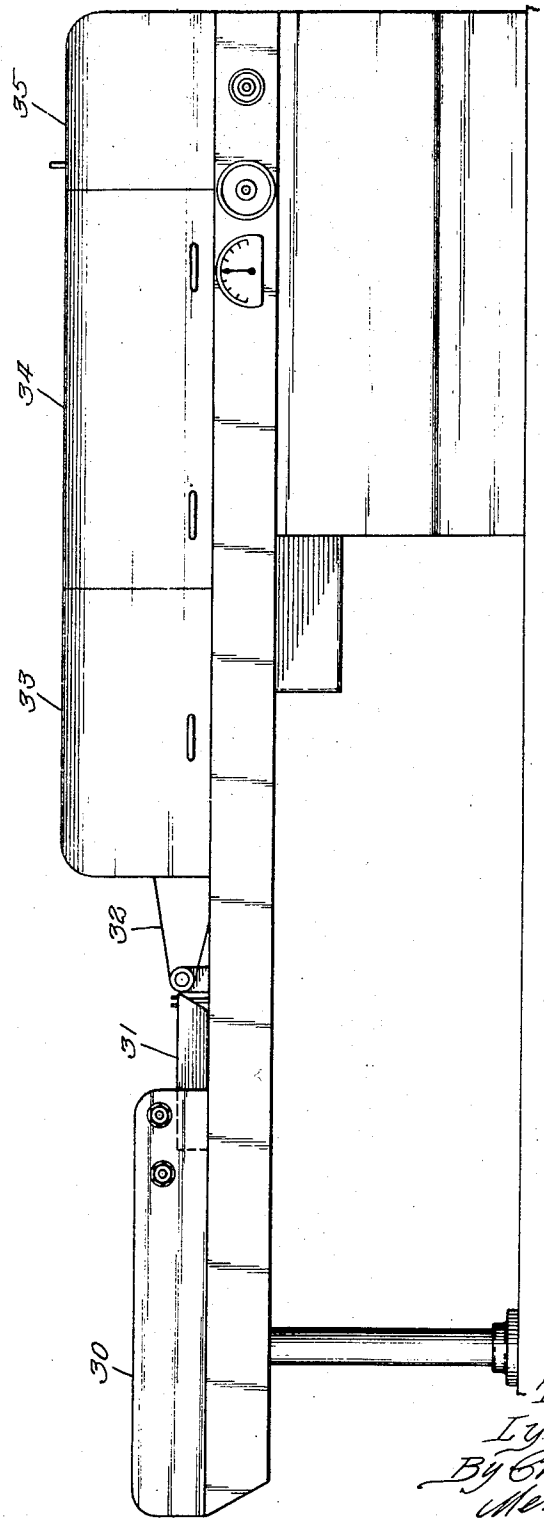


Fig. 1.

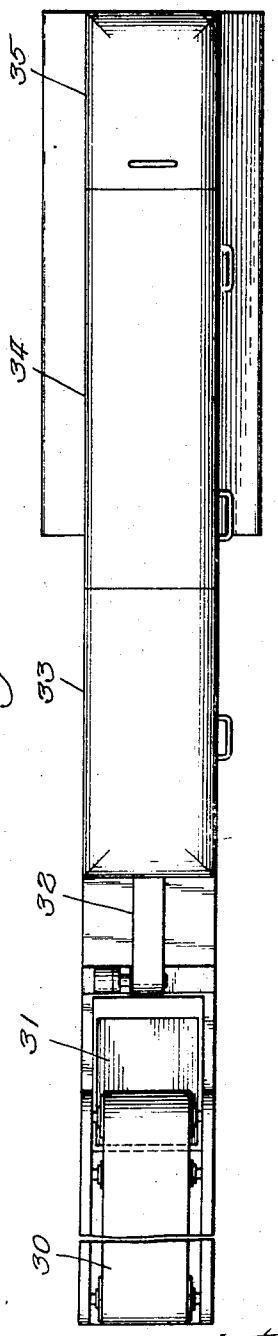


Fig. 2.

Inventors
Theodore R. Selby,
Lyman I. Campbell,
By Chritton, Wiles & Schroeder,
Merriam & Hofgren, Attys.

March 23, 1948. T. R. SELBY ET AL 2,438,131

MANUFACTURE OF SUTURES

Filed Aug. 24, 1945 5 Sheets-Sheet 2

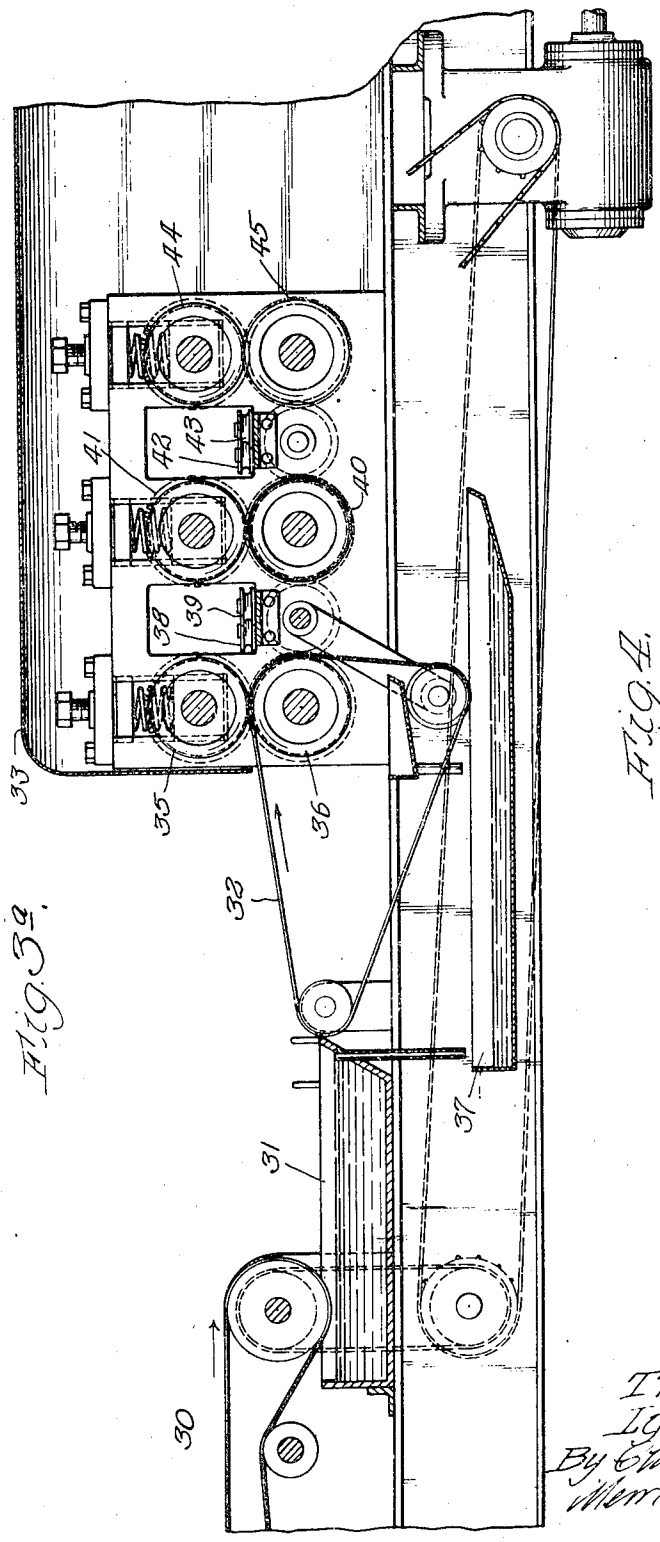


Fig. 3a.

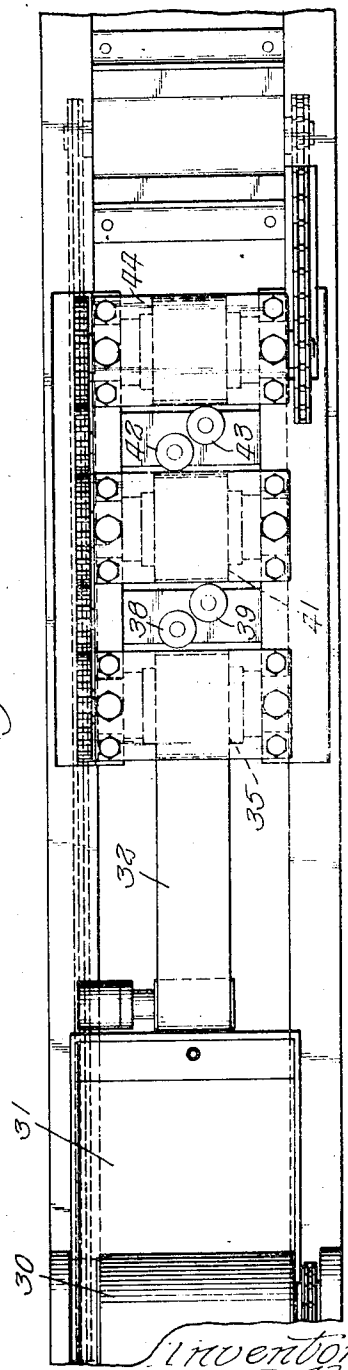


Fig. 4.

Inventors
Theodore R. Selby,
Lyman L. Campbell,
By Hamilton, Wiles, Johnson & Merriam, Their Attys.

March 23, 1948. T. R. SELBY ET AL 2,438,131

MANUFACTURE OF SUTURES

Filed Aug. 24, 1945 5 Sheets-Sheet 3

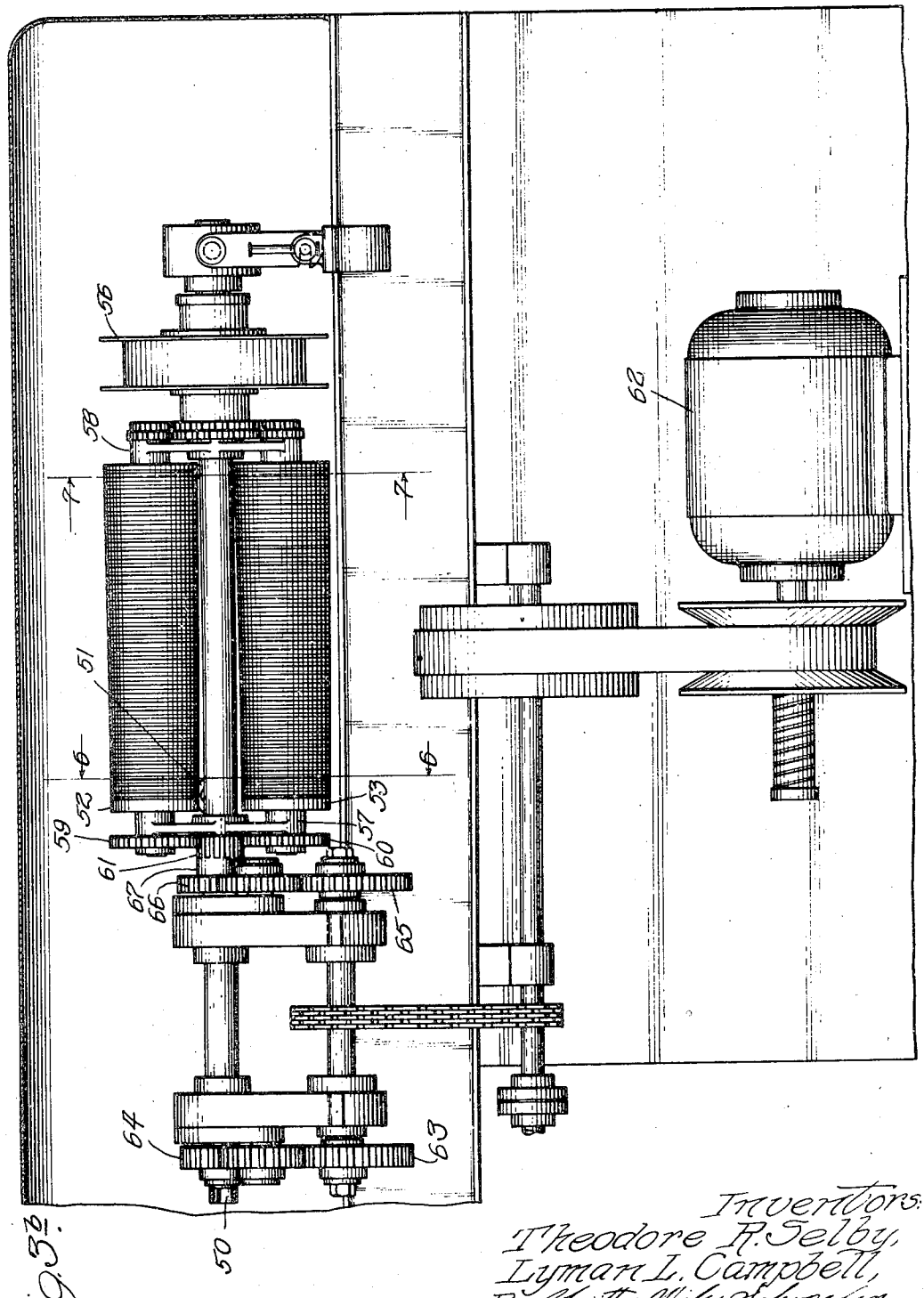


Fig. 5a.

Inventors:
Theodore R. Selby,
Lyman L. Campbell,
By Christy, Wiles, Schroeder,
Merriam & Hofgren, Attys.

March 23, 1948. T. R. SELBY ET AL 2,438,131

MANUFACTURE OF SUTURES

Filed Aug. 24, 1945 5 Sheets-Sheet 4

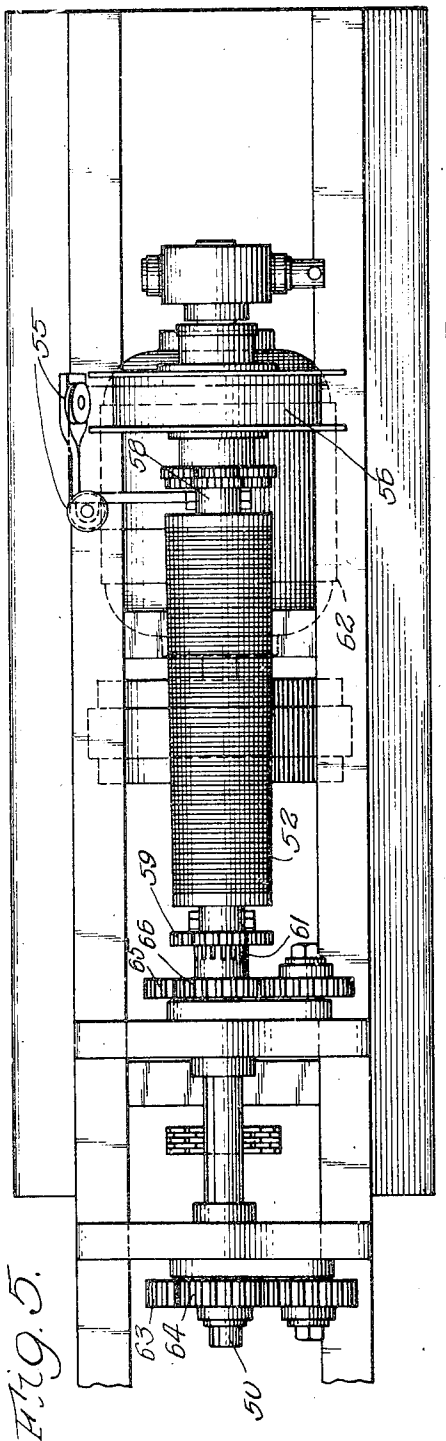


Fig. 5.

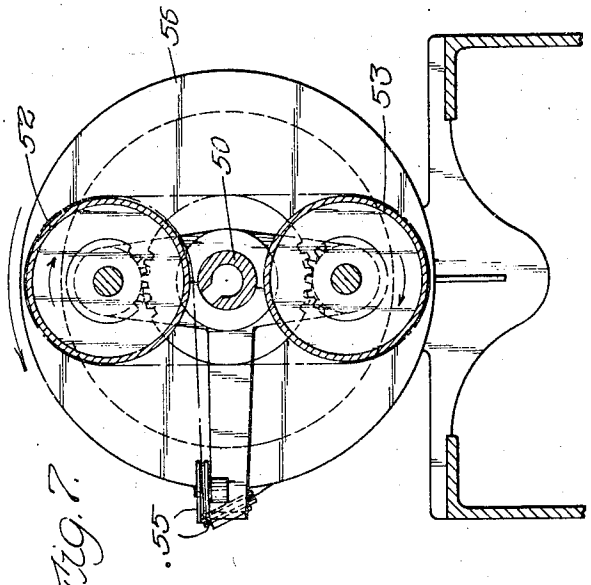


Fig. 7.

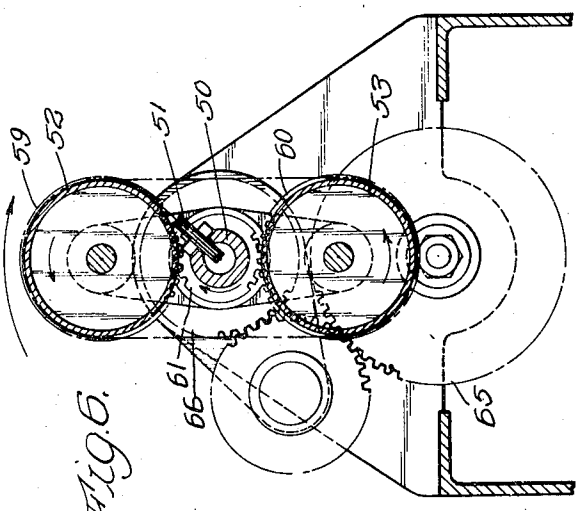


Fig. 6.

Inventors.
Theodore R. Selby,
Lyman L. Campbell,
By Clinton, Wiles & Schroeder,
Merriam & Kilgren, Attys.

March 23, 1948. T. R. SELBY ET AL 2,438,131

MANUFACTURE OF SUTURES

Filed Aug. 24, 1945 5 Sheets-Sheet 5

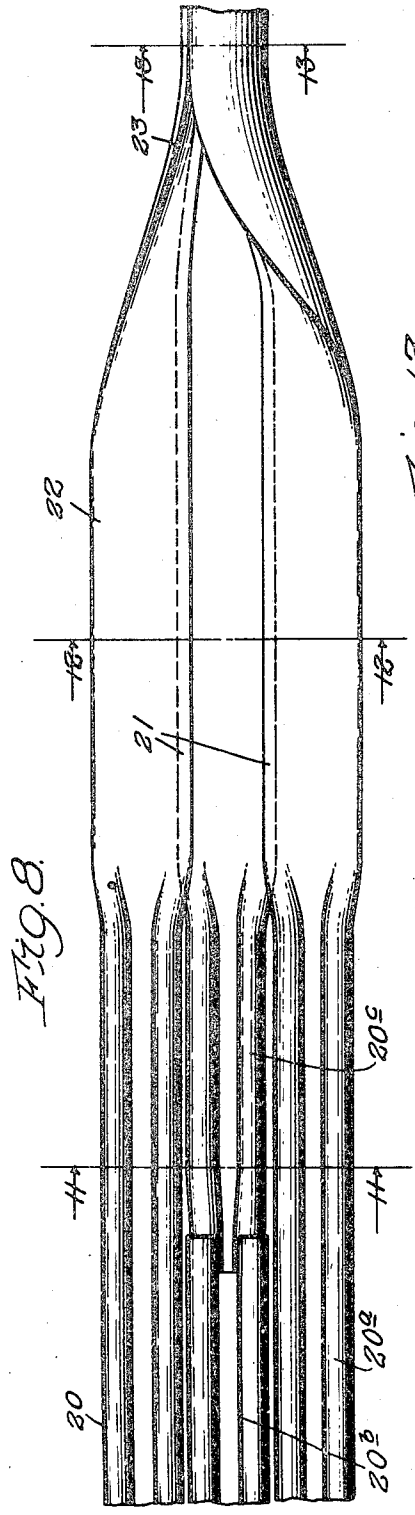


Fig. 8.

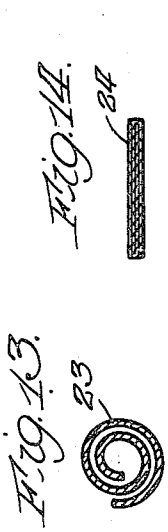


Fig. 13.

Fig. 14.

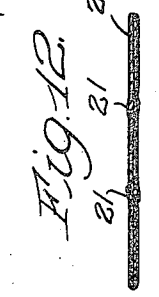


Fig. 12.

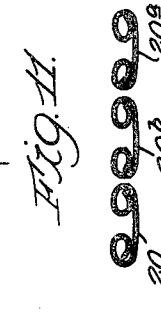


Fig. 11.

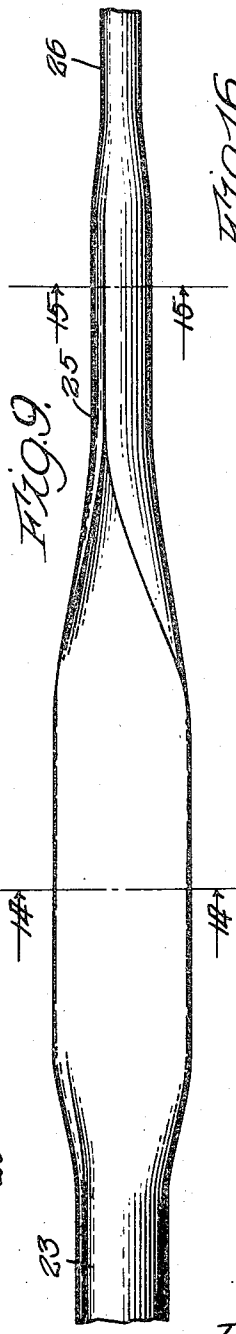


Fig. 9.

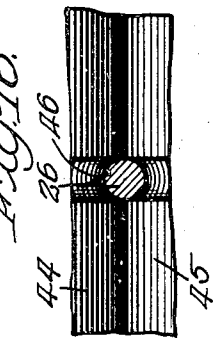


Fig. 16.



Fig. 15.

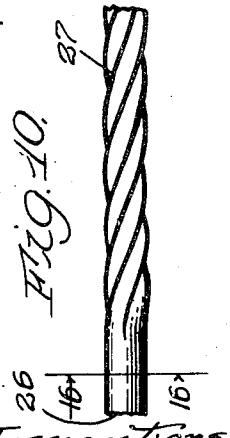


Fig. 10.

Inventors:
Theodore R. Selby,
Lyman L. Campbell,
By Thruston, Wiles, Schroeder,
Merriam & Hofgren, Attys.

Patented Mar. 23, 1948

2,438,131

UNITED STATES PATENT OFFICE

2,438,131

MANUFACTURE OF SUTURES

Theodore R. Selby and Lyman L. Campbell, Chicago, Ill., assignors to Wilson & Company, Inc., a corporation of Delaware

Application August 24, 1945, Serial No. 612,464

7 Claims. (Cl. 57—164)

1

This invention relates to the manufacture of sutures and particularly to the formation of continuous sutures in a small number of individual strands of split casings.

The present practice in the manufacture of sutures having a small number of individual strands is to make up individual lengths of material, which lengths of course are limited by the length of the casings employed. In the manufacture of a continuous suture of this type, for example by the process described in Selby application Serial No. 536,055, filed May 17, 1944, now Patent No. 2,391,483, dated December 25, 1945, the difficulty encountered is that the feeding of a make-up strand to the string materially increases the diameter at the point of overlap and this increase is sufficient to eliminate the string for the finest type of suture work. Likewise loose ends of material are likely to project from the string when following the Selby method, which ends are of no importance for most work but are undesirable for certain types of operations.

The present product, method, and apparatus eliminate these difficulties. This is particularly true with strings or sutures in which normally only three strands of casing are employed.

In accordance with this invention the casings are split longitudinally, the smooth side splits of the casings are selected which curl inwardly at the edges, the casings are provided with an evenly distributed amount of water, the casings are subjected to pressure such that the water therein is squeezed laterally outward to force the casing into a flat surface, the amount of residual water being such as to leave the casing in its natural adhesive state, make-up strands are very slightly overlapped at the termination of each strand, the flattened casings are rolled into a spiral, the spiral is flattened, the flattened spiral is again curled and is then passed through a sizing die and twisted to final condition, all of this occurring while the casings retain plasticity.

The invention is illustrated in the drawings, in which Fig. 1 is a side elevation of a preferred form of apparatus; Fig. 2 is a plan view thereof; Fig. 3*a* is a side elevation partly in section of the central portion of the structure shown in Fig. 1; Fig. 3*b* is a side elevation of the spinner; Fig. 4 is a plan view, partly broken away, of the structure shown in Fig. 3*a*; Fig. 5 is a plan view of the spinner; Fig. 6 is a sectional view taken along the line 6—6 in Fig. 3*b*; Fig. 7 is a sectional view taken along the line 7—7 in Fig. 3*b*; (and Figs. 8 to 16 inclusive are diagrammatic views in the nature of a flow sheet illustrating the progress of

2

the formation of the finished suture); Fig. 8 is a plan view illustrating from left to right the arrangement of the original casings, the flattening of the casings, and the spiraling thereof; Fig. 9 is a continuation of Fig. 8 showing from left to right the spiral casing, the flattened spiral, a curled spiral, and the final cord or string; Fig. 10 continues from Fig. 9 and shows the final cord first in an untwisted and then in a twisted form; Fig. 11 is a sectional view on the line 11—11 in Fig. 8; Fig. 12 is a similar view along the line 12—12 in Fig. 8; Fig. 13 is a similar view along the line 13—13 in Fig. 8; Fig. 14 is a similar view along the line 14—14 in Fig. 9; Fig. 15 is a similar view along the line 15—15 in Fig. 9; and Fig. 16 is a similar view along the line 16—16 in Fig. 10, but in this case the forming rolls have also been added in the illustration.

The invention is perhaps best described by briefly referring to Figs. 8 to 16 before describing the apparatus. As there shown, the individual casings 20, 20*a* and 20*b* which have been split and are uniformly supplied with moisture, have the form shown in Fig. 11 with the edges curled inwardly. These strands are arranged side by side in parallel relationship. When one strand ends, a new strand overlaps it, as shown where 20*b* overlaps strand 20*c*. These strands need not be supplied immediately on top of the previous strand but may be supplied side by side. For example, strand 20*b* could be placed above strand 20. It will be secured to the other strands when it is rolled and pressed, as shown in the succeeding operations. Generally, however, one strand will be placed over the end of another, as shown in Fig. 8. The amount of overlap is very small, normally about ¼ inch.

The strands are then pressed, during which pressing the water is forced outwardly and strains the strands into the form shown in Fig. 12. The strands are placed so that the edges overlap longitudinally as indicated, for example, at 21. The composite sheet 22 thus formed is rolled into the spiral 23 shown in Fig. 13, and this spiral is then pressed into a ribbon 24 shown in Fig. 14, and in Fig. 9. This ribbon is then again curled, as shown in Figs. 9 and 15, into a coil 25 and this coil is then passed through a sizing die to form a cylindrical string or cord 26, as shown in Figs. 9, 10 and 16; and this cord is then twisted as shown in Fig. 10 to form the final suture 27.

The apparatus for carrying out these steps is preferably of the form shown in Figs. 1 to 7, inclusive. This includes a primary conveyor belt 30 which brings the individually split casings to

the equalizing water bath 31 from which the casings are drawn onto the secondary conveyor belt 32. It will be noted that the lip of the equalizing bath 31 immediately abuts the conveyor belt 32. This is designed so that the water level at which the casings are placed will not be materially below the pickup edge of the belt. This reduces almost to zero the strain on the casing which otherwise would be different at different stages of withdrawal from the bath. The water content of the casing, is, therefore, substantially equalized throughout its length. Referring further to Figs. 1 and 2, the casings are then passed to the forming section 33 and then to the spinning section 34 and the spooling section 35.

Referring to Figs. 3*a* and 4, the split casings are brought to the equalizing bath along the conveyor belt 30 which is suitably of canvas. The casings are drawn onto this belt from a soaking bath in which they have been immersed so as to have substantially maximum moisture content, and at a suitable pH for maximum adhesiveness. The withdrawal of casings from such a bath in the normal manner may provide an unequal amount of moisture in some parts of the casing and it is, therefore, preferred to pass the casings to the equalizing bath. Such a bath is shown at 31, the casings passing into that bath from the conveyor 30. In this bath any portions of the casing which are deficient in water recover the deficiency and are then passed to the secondary conveyor belt 32 which is so positioned as to put substantially no stress or strain on the casings. It will be observed that belts 30 and 32 are relatively close together so that the individual casing will, except for a short interval at the beginning and at the end thereof, be carried by both belts 30 and 32 while a loop thereof is submerged in the bath 31.

The casings are arranged on the belt 32 substantially as shown at the left side of Fig. 8. As before stated, when a casing reaches the end, the operator places a new casing in parallel relationship to the others (and to the first if desired), and slightly overlapping the end of the first casing.

The casings are then passed to the rolls 35 and 36. One of the rolls 35 is cloth coated, the cloth being thick enough to absorb a substantial quantity of water. Preferably this is the bottom roll. The other roll is a metal roll, preferably steel. The rolls are pressed together in any suitable fashion. Under the pressure, the water content in the casing is squeezed laterally and forces the edges of the casing outwardly into overlapping position, as indicated in Fig. 8.

In this position the overlapping casings stick together to form a ribbon. Water dripping from the rolls may be caught in the pan 37. It is probably not necessary to explain that the water does not pass through the casing but is forced out at the edges thereof. The cloth absorbs water and the upcoming side thereof actually supplies moisture to the casings, thus having a slight tendency to overcome any inequality in moisture distribution. This tendency is more pronounced if the cloth is above rather than below the casings, in which case the moisture supplying edge is the downcoming edge.

The ribbon 22 so formed is then passed between the vertical axis rollers 38 and 39 which roll it into a spiral 23 shown in Fig. 8. This spiral then passes to the horizontal rolls 40 and 41 which flatten it into the ribbon or tape 24, shown in Fig. 14. This multi-ply tape is then

passed between vertical rollers 42 and 43 and rolled into the coil 25.

This coil then passes through the rollers 44 and 45 which are grooved to form a circular central opening 46, as indicated in Fig. 16, which acts as a sizing die to form the circular cylindrical cord 26. At this stage the casing still retains plasticity by reason of its moisture content.

The cord 26 is then twisted while still plastic to equalize the tension and avoid separation of the strands under subsequent operations. While spun, it is stretched progressively about 5% to 7%, after which it is spooled.

The spinning device is illustrated somewhat diagrammatically in Figs. 3*b*, 5, 6 and 7. The cord enters the device through the hollow shaft 50, and is drawn therefrom over the pulley 51 onto the drums 52. These drums are slightly tapered outwardly from left to right to provide the stretch hereinbefore described. The direction of movement of the shaft is indicated in Fig. 6, being clockwise as viewed therein. Both of the drums rotate counterclockwise but the spider 57 upon which the drums are mounted rotates clockwise. From the drums the twisted cord is fed over the pulley 55 to the spool 56.

The drums 52 and 53 are carried on spiders 57 and 58. These are driven by the gears 59 and 60 which in turn are driven by the sleeve gear 61. By changing the gear ratios of 59, 60 and 61 the amount of forward feed of the suture relative to the number of twists may be adjusted. Normally from two to eight twists per inch are provided.

The length of the drums 52 and 53 is such as to permit a suture to dry from a plastic to a non-plastic state in passage thereover, and, as already pointed out, during this period the cord is stretched from 5% to 7%.

The shaft 50, the drums 52 and 53, the spiders 57 and 58, and the spool 56 may all be driven by the motor 62 which has a driving connection with the gear 63 and which in turn drives gear 64 mounted directly on the shaft. It is also in driving connection with gear 65 which drives gear 66 through an idler. Gear 66 is mounted on a sleeve 67 carrying the gear 61.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom.

What we claim as new and desire to secure by Letters Patent is:

1. The method of forming a continuous gut string which comprises moistening a split casing, pressing the casing to extrude water laterally therefrom and thereby spread the normally curling edges of the casing, overlapping make-up gut a small distance at the end of the first mentioned casing while both are in a flat ribbon form, curling the composite ribbon into a longitudinal spiral, pressing the spiral into a narrower tape than the original ribbon, curling the tape, forming it into a substantially cylindrical body, and twisting the cylindrical body while still plastic from moisture.

2. The method of forming a continuous gut string which comprises moistening a split casing, pressing the casing to extrude water laterally therefrom and thereby spread the normally curling edges of the casing, overlapping make-up gut a small distance at the end of the first mentioned casing while both are in flat ribbon form, curling the composite ribbon into a longitudinal spiral, pressing the spiral into a nar-

rower tape than the original ribbon, curling the tape, forming it into a substantially cylindrical body, twisting the cylindrical body while still plastic from moisture, and drying the twisted gut under tension.

3. The method as set forth in claim 1, in which a plurality of casings is positioned side by side in parallel relation prior to the water expressing step, the edges of the casings being in position to overlap after the water expressing step.

4. The method of treating gut which comprises splitting a gut longitudinally while moist whereby the edges of the gut curl inwardly, supplying moisture thereto substantially equally throughout the casing, then expressing water therefrom laterally to produce a flat gut ribbon, and during such expressing step bringing a plurality of split casings into overlapping position whereby the casings are secured together by the natural adhesiveness thereof.

5. The method of treating gut which comprises splitting a gut longitudinally while moist whereby the edges of the gut curl inwardly, supplying moisture thereto substantially equally throughout the casing, then expressing water therefrom laterally to produce a flat gut ribbon, and during such expressing step laying a plurality of gut casings in parallel side by side relationship, said plurality of casings being so spaced that at the conclusion of the moisture expressing step the adjacent edges of the split casings will overlap to form a ribbon.

6. The method as set forth in claim 5 in which the ribbon is then folded and pressed into a narrower and thicker tape and the tape is rounded into a cylinder, all while the gut retains sufficient moisture to render it plastic.

7. The method as set forth in claim 5 in which the ribbon is then folded and pressed into a narrower and thicker tape, the tape is rounded into a cylinder, all while the gut retains sufficient moisture to render it plastic, and the cylindrical body so formed is twisted under tension and dried under such tension to a non-plastic state.

THEODORE R. SELBY.
LYMAN L. CAMPBELL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,039,263	Schulte	Apr. 28, 1936
2,391,483	Selby	Dec. 25, 1945
1,777,568	La Seur	Oct. 7, 1930

FOREIGN PATENTS

Number	Country	Date
272,218	Germany	Mar. 27, 1914
316,004	Germany	Nov. 18, 1919