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PLANETARY DRIVEN LINEAR SUTURE GRINDER

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2 Sheets-Sheet 1

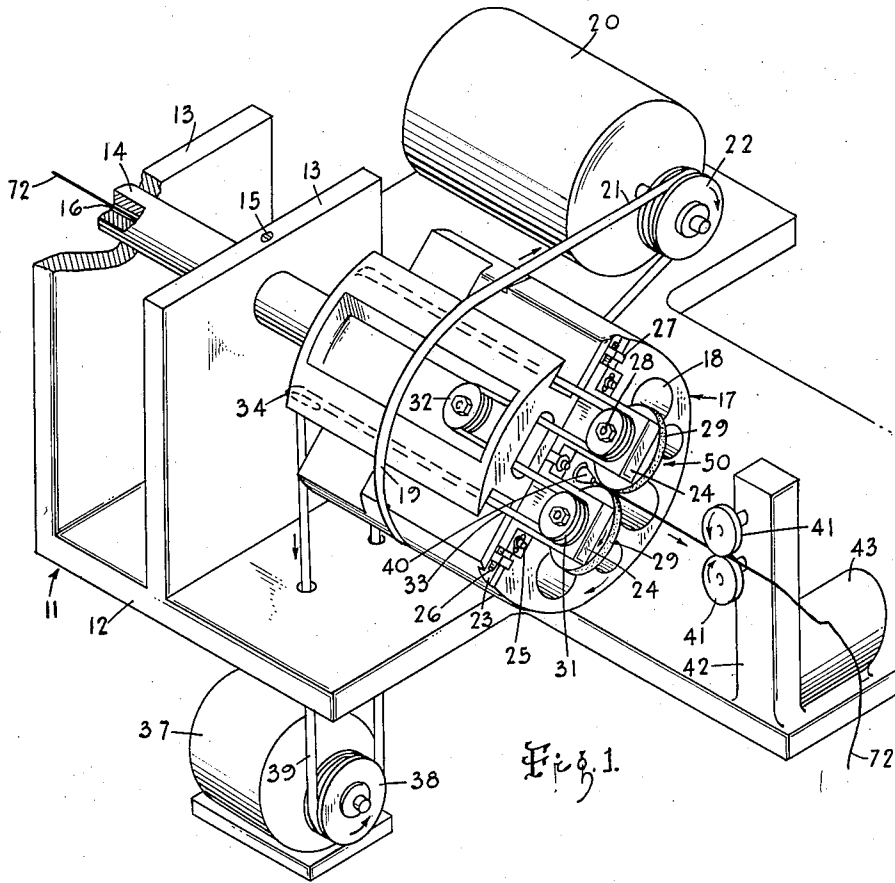


Fig. 1.

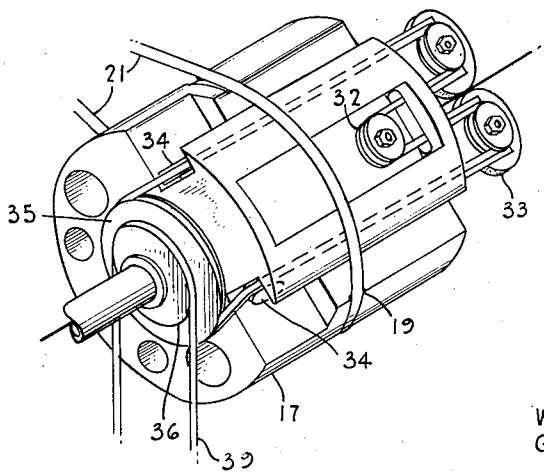


Fig. 2.

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2 Sheets-Sheet 2

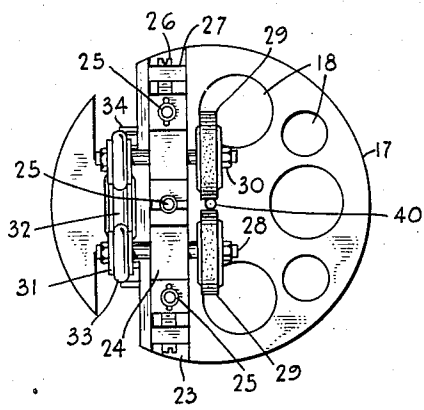


Fig. 3.

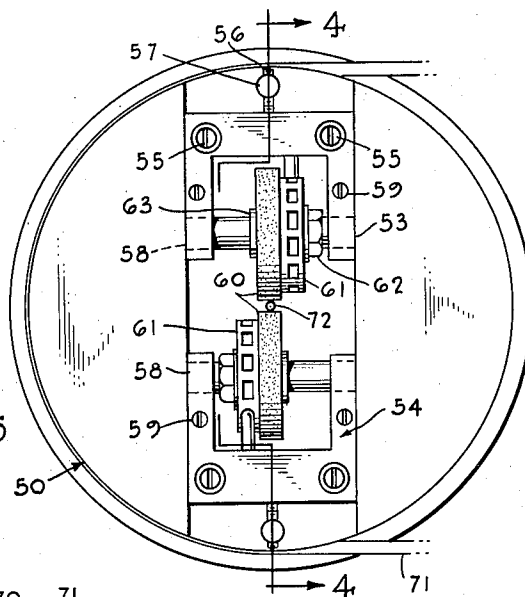


Fig. 5.

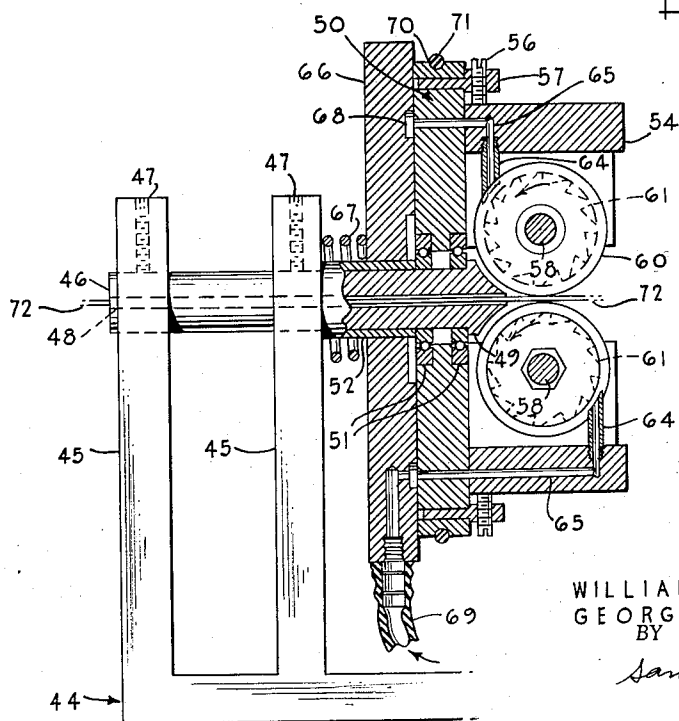


Fig. 4.

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**PLANETARY DRIVEN LINEAR SUTURE GRINDER**

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Application May 23, 1958, Serial No. 737,407

8 Claims. (Cl. 51-87)

This invention relates to an apparatus and method for grinding and polishing of strands, such as surgical sutures, by rotating about the strand a grinding head on which are mounted grinding wheels which rotate to give a longitudinal grinding action.

As used herein the term "sutures" includes ligatures. The technical distinction to the medical profession is that sutures are used to sew, whereas ligatures are used to tie off. The same strand of catgut is used interchangeably for both purposes in many instances. Similarly, the method and apparatus of the present invention may be used to grind flexible materials other than catgut and may be used to grind such materials for uses other than in sutures, as, for example, strings for musical instruments, strings for sport equipment such as tennis rackets, badminton rackets, etc. or for other purposes for which similar strands are desirable, whether such strands are short or are very long.

Such strands of catgut or related materials are frequently comparatively short, 5 foot lengths being conveniently processed, and because derived from natural sources, are of somewhat uneven diameter, and perhaps are not even circular cross-section.

The surgical suture may be made from collagen strands, slit as ribbons from suitable animal tissues, and twisted together; or the suture may be fabricated by spinning and adhesively uniting suitable collagenous fibers or by regenerating solutions or suspensions of collagen.

Such methods of fabrication, particularly those using ribbons of animal tissues, yield a string having thick and thin portions. It is desirable that such strands be sized to uniform diameter for use. Many efforts have been made to grind strands of sutures or suture material both by rotating the strand against sand paper, or by attempting to position the strand adjacent a moving abrasive surface. In general attempts to position a flexible suture against a flat grinding surface have met with the insurmountable problem that the flexibility of the suture permits grinding of not only the high points but also adjacent areas. The problem of grinding with rotating wheels has normally encountered the problem of juxtaposition of tangent circles under such conditions that minor errors in placement introduce errors in sizing, with related problems of positional control.

Also the strands of surgical catgut forming the sutures are frequently comparatively short, as sutures are usually sold in about five foot lengths, and are necessarily manufactured, when of plies, from plies whose maximum length is determined by the raw material which, for example, when of beef gut, have a maximum length of about 100 feet. Usually it is convenient to cut longer strands into 5 foot length sutures and then classify as to size these 5 foot lengths, as adjacent sections may be sized differently. One problem then is to reduce these lengths to a uniform cross-section, preferably just smaller than a maximum diameter of a standard suture specification size.

Whereas with sutures manufactured from plies it is

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convenient and customary to have the 5 foot lengths as above stated. In certain instances when using sutures manufactured by a continuous process as, for example, by regeneration of collagen, it is necessary to have a grinding procedure which can operate on continuous strands no matter how long the strand.

Also, it is desirable to have a grinding system which can size the ends of strands only. In the manufacture of needled sutures, that is products which have a needle firmly attached to a suture which needle is used but once, at times the so-called drilled-end needle is used in which a hole is drilled into the back end of the needle. The end of the suture is inserted into this hole and the needle is crimped about the suture. As will be obvious in working with the fine clearances and small sizes used in some sutures, it is necessary that the end of the suture to be inserted in the hole in the end of the needle must be rather accurately sized. Sometimes it is desirable to size only about 3/8-inch or less of the suture so that the end of the suture may be readily inserted into a drilled-end needle, and the remainder of the suture is a larger size so that the greater strength of the larger size suture is obtained and at the same time less tissue damage is caused because the needle is smaller in size than could be used to grip the full size suture.

It has now been found that surgical sutures may be accurately sized for either a short length, as, for example, the 3/8-inch end for insertion in a drilled-end needle, or full length for the standard 5 foot section, or full length for continuous sutures, by a single machine in which the suture is fed into the bite of grinding wheels which grinding wheels are rotating in the same direction at a high speed about axes parallel to each other and at the same time are rotating as a matched pair about the suture being ground. In such an operation the axis of the grinding wheels are parallel to each other and are symmetrical about and perpendicular to the line of advance of the suture.

Because the grinding wheels are parallel to each other the gap between them extends across the entire faces and gives a comparatively wide zone of action in which grinding may be accomplished; and even if the suture being ground deviates from side to side within the gap, it is still accurately sized. By rapidly rotating the grinding gap in a spiral fashion around the suture, in effect, a thread is ground on the suture but because the thread has such a fine pitch as compared with the curvature of the generating surface of the grinding wheel, the thread is so fine that, effectively speaking, the suture has a uniform diameter, and smooth surface.

The grinding wheels themselves are conveniently of a plastic or ceramic bonded grit or other synthetic grinding material, which is somewhat porous. Wheels which are designed for cutting softer materials are usually preferred because the material ground off the suture has less tendency to load such wheels. The wheels themselves may be made of a very fine or a very coarse grit. A grit of from #60 to #120 mesh is conveniently used for a slightly coarser grind or a first grind, and from #100 to #150 mesh for a second grind or final grind. By using a grit within the range of about 80 to 150 mesh, a single grind may be used which satisfactorily sizes the sutures. A coolant, such as kerosene, may be used if desired.

Insofar as the grinding action is concerned, a wheel surface speed of as fast as the wheels can stand is satisfactory. Usually the wheels are rotated at a somewhat slower speed because of the difficulty of maintaining such a high peripheral speed or surface speed with the small size wheels which are convenient for use in the present grinder.

Even though the action of the grinding wheels in the present grinding device is not strictly a planetary type

because the path of the grinding wheels is anything but cycloidal, nonetheless, the term "planetary" is used as the word most descriptive of the type of drive, and because the grinding head is rotating around the path of the suture being ground. The maximum speed for both the grinding wheels themselves and for the grinding head is determined by centrifugal stresses and vibration. Grinding head speeds of much over 3,000 revolutions per minute are apt to be accompanied by undue vibration unless the grinding head is most meticulously balanced.

Because the grinding wheels are very small their actual rotational speed can be extremely high. With air driven wheels surface speeds up to 6,000 feet per minute or more are convenient. With belt driven wheels slightly slower speeds are usually more easily maintained. Uniform speeds are more easily maintained with belt driven wheels.

Because the longitudinal component of motion of the grinding wheels is so much greater than the circular component of motion at the point of suture contact, the suture is dressed with essentially a linear grind mark. Actually, inasmuch as the wheels are both rotating in the same direction, the effective spirals on the suture are in one instance right-hand and in the other instance left-hand, so that the grind marks have a slight criss-cross pattern which tends to polish out the grinding marks so that a smoother surface is obtained. Any grind marks which remain are essentially longitudinal and, accordingly, lines of weakness induced by the grind marks are essentially longitudinal of the suture; and for that reason much less damaging than if the grind marks extended around the suture as is obtained with centerless grinding methods.

On a theoretical basis if the grinding wheels are each two inches in diameter, giving a radius of one inch, it can be calculated that for a variation in diameter of  $\frac{1}{40,000}$ -inch, a pitch of approximately  $\frac{1}{100}$ -inch or 50 turns per inch is sufficient. Actually, with a grinding wheel top and bottom, twice this pitch should be adequate. However, because the grinding wheel surface may vary slightly, it is frequently advantageous to use a slightly finer pitch so that more than one grinding action occurs at any given point along the suture even if measured to less than  $\frac{1}{10,000}$  of an inch. If the grinding head is rotated at 3,000 revolutions per minute, a suture feed speed of 30 inches per minute gives an effective pitch of  $\frac{1}{100}$ -inch for each wheel. The thread ground in such a system cannot be ascertained by ordinary inspection. A feed of up to at least 60 inches per minute gives a suture which is so smooth that conventional measuring devices do not show any scallops or threads in the suture surface.

Whereas the method, characteristic features, and scope of this invention are fairly broad, they are illustrated and more readily understood from the specific embodiments set forth in the following description, taken in connection with the accompanying drawings, wherein:

Figure 1 is a pictorial view of a belt driven planetary grinder.

Figure 2 is a pictorial view taken from the rear of part of the grinder showing details of the sun pulley drive system.

Figure 3 is an axial view of the suture grinding head showing certain details of the grinding wheel drive system.

Figure 4 is a view in partial section of an air driven suture grinder along line 4—4 of Figure 5.

Figure 5 is a front view of the air driven suture grinder of Figure 4.

The size and relationship of the parts is related to the size of suture of strand being ground. For the normal run of surgical suture sizes two-inch diameter grinding wheels are very convenient and the grinding head may be about six inches in diameter. Obviously this size may be markedly varied depending upon the size of the suture being ground and other conditions. With smaller grind-

ing wheels and grinding heads, high rotative speeds may be obtained to achieve the same surface grinding speed, and reduce the moment of inertia of the rotating mass.

As shown in Figure 1, a grinding stand 11 is used as a main frame. The grinding stand includes a mounting plate 12 and vertical supports 13. Mounted in the vertical supports is a spindle 14. Whereas the spindle may be vertical, using the force of gravity to assist in feeding the suture, or may extend in other directions, conveniently the spindle is horizontal and accordingly is so shown in the accompanying figures. The spindle is retained in the vertical supports by a spindle screw 15. The spindle is hollow and has a hole running the center thereof which is the suture feed tube 16. A longer tube may be inserted in the spindle so that a greater length of the suture may be supported in the suture feed tube. Inasmuch as the suture itself is not rotated, a short suture feed tube is conveniently used and the suture is fed from reels if in continuous lengths, or, if in short lengths, from a table on which the sutures are untangled.

On the spindle is mounted a grinding head 17. Preferably the grinding head as well as other rotating parts are mounted on antifriction bearings, such as ball bearings. Inasmuch as the details of such ball bearing construction are well-known to those in the art, further details of such construction will not be mentioned. In the grinding head are a number of balancing apertures 18. Parts of the grinding head are cut away to leave room for pulleys, belts, etc. which lightens one side of the grinding head. Accordingly, the balancing apertures are located so that the completed grinding head assembly is in both static and dynamic balance. If desired, movable weights may be located in one or more of these apertures so that minor balance variations resulting from wear on the grinding wheels and position adjustment can be compensated by moving or adding weights. Inasmuch as the grinding wheels are symmetrically located with respect to the axis of rotation of the grinding head, any wear on them causes negligible variation in static balance, and usually does not deleteriously affect the dynamic balance of the rotating mass.

In the grinding head is a grinding head drive belt groove 19. A grinding head motor 20 is fastened to the mounting plate 12 and drives the grinding head by means of a grinding head driving belt 21 which also runs over the grinding head driving pulley 22 mounted on the grinding head motor shaft.

In the face of the grinding head is a cross way 23. This cross way is located in the plane of rotation of the face of the grinding head. Dovetail construction may be used but a rectangular cross way is more easily machined. In the cross way are two grinding wheel brackets 24. The bases of these brackets fit into the cross way, and are locked in position in the cross way by bracket clamp screws 25. Conveniently, the bases of the brackets have oblong slots for bracket adjustment screws. A common central bracket clamp screw is usually convenient because of the small clearances involved. The position of the grinding wheel brackets is accurately controlled by feed screws 26 which pass through a feed screw block 27 in the cross way and bear on the grinding wheel bracket. A fine pitch is preferred for the feed screw inasmuch as it is desirable at times to be able to control the size of the sutures to within less than half a thousandth and at times within one or two ten-thousandths of an inch. To make such adjustments the feed screw must be moved only a small amount. The bracket clamp screws are loosened to permit adjustment of the bracket position, and retightened after adjustment.

In each grinding wheel bracket is journaled a grinding wheel shaft 28. The grinding wheel shaft is perpendicular to the axis of the spindle, the axis of rotation of the grinding head, and the feed axis of the suture, which are all three the same. The two grinding wheel shafts are parallel to each other. A grinding wheel 29 is mounted

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on each grinding wheel shaft and held in position by a grinding wheel nut 30. The grinding wheels are mounted so that they are lined up with each other and so that the grinding faces of the grinding wheel are each adjacent to the axis of rotation of the grinding head. The suture is fed along the axis of rotation of the grinding head and the gap between the grinding wheel faces is adjusted so that this gap is equal to the diameter of the finished suture. If desired, the grinding wheel can be fastened on the grinding wheel shaft between a pair of nuts, so that by loosening one and tightening the other the grinding wheel can be shifted axially along the grinding wheel shaft, so that sutures may be ground on different points on the periphery of the grinding wheel. The grinding wheel loads up rather slowly and may be re-dressed when worn. For large production runs it is sometimes desirable that the grinding wheels be axially shifted so that new grinding areas are used without re-dressing the wheels. Obviously, the entire grinding wheel shafts can be shifted but it is usually more convenient to shift the grinding wheels on the grinding wheel shafts.

On the other end of the grinding wheel shaft is located a grinding wheel drive pulley 31.

Between the grinding wheel drive pulleys and in the plane of the grinding wheel drive pulleys is an idler pulley 32. The position of the idler pulley conveniently can be adjustable, to adjust for belt length. An idler pulley is not absolutely essential, but an idler pulley gives 180° of belt bearing instead of 90° of belt bearing to the grinding wheel belt 33 at each grinding wheel drive pulley and accordingly there is much less slippage and the belt need not be as tight or driven as hard.

On the side of the grinding head away from the grinding wheels are located two training pulleys 34. The training pulleys are mounted so that the grinding wheel belt feeds smoothly to and away from the grinding wheel pulleys, after passing over the training wheel pulleys, and in the other direction so that the grinding wheel belt leads directly onto a sun pulley 35. If the diameter of the sun pulley is the same as the spacing between the grinding wheel drive pulleys, then the two training pulleys can be coaxial. However, to increase the diameter of the sun pulley and thereby give greater speed to the grinding wheels, it is usually convenient to use a sun pulley which has a somewhat larger diameter and to have the training pulleys at somewhat of an angle with each other but so that the plane of each training pulley includes the line of tangency from the training pulley to the grinding wheel drive pulley and the line of tangency between the training pulley and the sun pulley.

The sun pulley 35 is mounted for independent rotation on the spindle 14. Functionally attached to the sun pulley is sun pulley drive pulley 36. Below the mounting plate 12 is located a sun pulley drive motor 37 on the end of which is a driving pulley 38. A sun pulley drive belt 39 passes over the driving pulley 38 and the sun pulley drive pulley 36.

In operation the grinding wheel belt 33 passes around the sun pulley, over the training pulleys and then around the two grinding wheel drive pulleys and the idler pulley. As the grinding head rotates, if the sun pulley is stationary, a planetary type of driving action occurs and the grinding wheel drive belt rotates the grinding wheel drive pulleys and turns the grinding wheels. As the sun pulley has the greater diameter, a speed step up of 2 or 3 to 1 is easily attained. As the grinding head is turned at speeds up to that at which vibration becomes a limiting factor, the grinding wheels are rotated by this action. For many purposes the sun pulley may be held stationary and the speed of the grinding wheels from this planetary drive is sufficient to achieve the desired grinding action. For more rapid grinding action, the sun pulley is rotated in a direction reverse to the direction of rotation of the grinding head by the action of the sun pulley drive motor and the sun

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pulley drive pulley. As the sun pulley is rotated in a reverse direction, it increases the speed of grinding wheel belt travel and increases the speed of the grinding wheels. The sun pulley is conveniently rotated at a speed such that the grinding wheels have the maximum allowable peripheral speed. A surface speed of around 6,000 feet per minute is satisfactory with most of the grinding pulleys presently available. Special types of grinding wheels can be obtained which permit a somewhat higher surface speed without undue risk of grinding wheel failure.

In operation, also, the grinding head may be held stationary and the grinding wheels themselves dressed by rotating them by the use of the sun pulley drive system. If the sun pulley itself is rotated without rotating the grinding head, the grinding wheels turn at a sufficient speed so that dressing of the wheels is easily accomplished. After the wheels are dressed to size, and the gap between them adjusted to that desired for the final diameter of a suture, the grinding head is rotated by the grinding head driving motor, the sun pulley is rotated in the reverse direction by means of the sun pulley drive motor, and the sutures are inserted through the suture feed tube.

Conveniently the suture feed tube leads up to adjacent the bite between the grinding wheels and ends in a suture feed tube point 40, the shape of which is controlled by the envelope of motion formed by the rotating grinding wheels themselves. Thus, as the suture 72 is fed through the suture feed tube, it feeds into the bite of the pulleys, is ground by them, and emerges from between the grinding wheels in cylindrical ground condition. The end of the ground suture may be grasped with the fingers and the suture pulled on through. If only the end of the suture is to be sized, only the end portion of the suture need be fed between the grinding wheels and then the suture may be retracted. If a short length of suture is to be ground, it is convenient to pull the suture from between the grinding wheels by hand. For longer lengths or continuous sutures, it is convenient to have a suture take-up system.

A suture take-up system is shown in Figure 1 and consists of two suture take-up wheels 41 mounted adjacent to the point at which the suture emerges from between the grinding wheels. These wheels are conveniently mounted on a suture take-up stand 42 and are driven by a suture take-up motor 43. The suture take-up motor conveniently has built-in speed control so that the speed of suture take-up can be controlled. The suture take-up wheels are conveniently of a resilient material, such as rubber, natural or synthetic, such as polyurethane, to grasp the suture as it emerges and draw it forward through the grinding wheels at the desired rate. A rate of from 15 to 200 inches per minute usually is preferred. At the higher speeds the grinding wheels must be driven at a suitable speed in order to give a sufficiently smooth suture, and similarly the grinding head must rotate sufficiently rapidly that the grinding wheels dress the entire surface of the suture.

#### *Air driven grinding wheels*

In Figures 4 and 5 is shown a modification in which instead of a belt drive for the grinding wheels there is used a jet turbine drive. An air jet acting on buckets in turbine wheels attached to each of the grinding wheels drives the grinding wheels. In this modification, a grinding stand 44 has thereon support plates 45 in which a spindle 46 is retained by spindle screws 47. The spindle is hollow forming a suture feed tube 48. This suture feed tube has a slightly enlarged end. On the shoulder 49 thus formed is mounted the grinding head 50. The grinding head is mounted on antifriction bearings 51 which are held in position by a spindle sleeve 52 which bears against the support plate 45. As shown in Figure 5 the grinding head has a symmetrical cross way 53 in.

which two grinding wheel brackets 54 slide. The grinding wheel brackets are held in position by the grinding wheel bracket screws 55. The grinding wheel brackets can be accurately positioned by feed screws 56 threaded through feed screw pins 57. For convenience in manufacture, the cross way is cut entirely across the face of the grinding wheel and the feed screw pin is pressed into position after which it is drilled and tapped.

Mounted in the grinding wheel bracket are two grinding wheel axles 58. The grinding wheel axles are held in position by the end of the bracket being slotted and clamped on the axles by the clamp screws 59. Journalled on the grinding wheel axles are grinding wheels 60. Each grinding wheel is fastened to a turbine wheel 61. The grinding wheel and turbine wheel are held together by a turbine wheel nut 62 which holds the grinding wheel and the turbine wheel together on the grinding wheel sleeve 63. A nozzle 64 mounted in the grinding wheel bracket 54 extends out into juxtaposition to the turbine wheel in such position that air flowing therethrough drives the turbine wheel. Air to the nozzle is supplied through an air passage 65 that extends to the reverse face of the grinding head. Resting against this face of the grinding head is a valve plate 66. The valve plate is held against the grinding head by a spring 67. In the valve plate is a valve chest 68 to which air is supplied by an air line 69. The grinding head has in its peripheral surface a pulley groove 70; and a drive belt 71, driven by a suitable motor and pulleys, rotates the grinding head. Other than the method of driving the grinding wheels, this head assembly is very similar to that previously described.

In operation the grinding head is rotated at a speed as fast as is consistent with vibration, say 3,000 revolutions per minute, and the grinding wheels are driven by air being supplied through the air line 69, the valve chest 68, the air passages 65 and the nozzle 64, operating against the turbine wheel 61; which drives the grinding wheel 60 at high speed. The suture 72 is fed axially through the suture feed tube 48 and taken off either by hand or by take-off rolls as previously described.

As will be obvious, various modifications both in the drive system and the methods of driving the grinding wheels can be made by those skilled in the art without departing from the spirit of the present invention. Such modifications are within the spirit of the present invention which is described in the following claims.

We claim:

1. Apparatus for grinding sutures comprising: a grinding stand, a spindle mounted in said grinding stand having a suture feed tube centrally thereof, a rotating grinding head mounted on said spindle having a grinding head drive belt groove in its periphery, a grinding head motor, a grinding head driving pulley thereon, a grinding head driving belt around said grinding head driving pulley and said grinding head, a cross way in the plane of rotation in the face of the grinding head; two grinding wheel brackets symmetrically slideably mounted in said cross way, a feed screw contacting each grinding wheel bracket to slowly advance the brackets towards each other, fastening means to clamp said brackets in adjusted position, a grinding wheel shaft journalled in each grinding wheel bracket so that the shafts are parallel to each other and perpendicular to the axis of the spindle, a grinding wheel mounted on each grinding wheel shaft, both grinding wheels being in the same plane, and having grinding faces spaced from each other by the final diameter of the ground suture, a grinding wheel pulley on each grinding wheel shaft, an idler pulley on the grinding head in the plane of the grinding wheel pulleys; a sun pulley mounted on the spindle, two training pulleys mounted on the rotating grinding head in position to direct a belt around the sun pulley and around the grinding wheel pulleys; a grinding wheel belt around said sun pulley, the two training pulleys, the grinding wheel drive pulleys, and the

idler pulley, whereby the grinding wheels are rotated in the same direction by the rotation of the grinding head; means to rotate the sun pulley in a direction opposite to the rotation of the grinding head, to give additional rotative effect through the sun pulley to the grinding wheels; suture take-off pulleys adjacent the grinding wheels, and drive means therefor, whereby a suture fed through the suture feed hole and between the grinding wheels is picked up and advanced.

2. Apparatus for grinding sutures comprising: a grinding stand, a spindle mounted in said grinding stand having a suture feed tube centrally thereof, a rotating grinding head mounted on said spindle having a grinding head drive belt groove in its periphery, a grinding head motor, a grinding head driving pulley thereon, a grinding head driving belt around said grinding head driving pulley and said grinding head, a cross way in the plane of rotation in the face of the grinding head, two grinding wheel brackets symmetrically slideably mounted in said cross way, a feed screw contacting each grinding wheel bracket to slowly advance the brackets towards each other, fastening means to clamp said brackets in adjusted position, a grinding wheel shaft journalled in each grinding wheel bracket so that the shafts are parallel to each other and perpendicular to the axis of the spindle, a grinding wheel mounted on each grinding wheel shaft, both grinding wheels being in the same plane, and having grinding faces spaced from each other by the final diameter of the ground suture, a grinding wheel pulley on each grinding wheel shaft, an idler pulley on the grinding head in the plane of the grinding wheel pulleys; a sun pulley mounted on the spindle, two training pulleys mounted on the rotating grinding head in position to direct a belt around the sun pulley and around the grinding wheel pulleys; a grinding wheel belt around said sun pulley, the two training pulleys, the grinding wheel drive pulleys, and the idler pulley, whereby the grinding wheels are rotated in the same direction by the rotation of the grinding head; and means to rotate the sun pulley in a direction opposite to the rotation of the grinding head, to give additional rotative effect through the sun pulley to the grinding wheels.

3. Apparatus for grinding sutures comprising: a grinding stand, a spindle mounted in said grinding stand having a suture feed tube centrally thereof, a rotating grinding head mounted on said spindle having a grinding head drive belt groove in its periphery, a grinding head motor, a grinding head driving pulley thereon, a grinding head driving belt around said grinding head driving pulley and said grinding head, a cross way in the plane of rotation in the face of the grinding head, two grinding wheel brackets symmetrically slideably mounted in said cross way, fastening means to clamp said brackets in position, a grinding wheel shaft journalled in each grinding wheel bracket so that the shafts are parallel to each other and perpendicular to the axis of the spindle, a grinding wheel mounted on each grinding wheel shaft, both grinding wheels being in the same plane, and having grinding faces spaced from each other by the final diameter of the ground suture, a grinding wheel pulley on each grinding wheel shaft, a sun pulley mounted on the spindle, two training pulleys mounted on the rotating grinding head in position to direct a belt around the sun pulley and around the grinding wheel pulleys; a grinding wheel belt around said sun pulley, the two training pulleys, and the grinding wheel drive pulleys, whereby the grinding wheels are rotated in the same direction by the rotation of the grinding head; and means to rotate the sun pulley in a direction opposite to the rotation of the grinding head, to give additional rotative effect through the sun pulley to the grinding wheels.

4. Apparatus for grinding sutures comprising: a grinding stand, a spindle mounted in said grinding stand having a suture feed tube centrally thereof, a rotating grinding head mounted on said spindle having a grinding head drive belt groove in its periphery, a grinding head motor,

a grinding head driving pulley thereon, a grinding head driving belt around said grinding head driving pulley and said grinding head, a cross way in the plane of rotation in the face of the grinding head, two grinding wheel brackets symmetrically slideably mounted in said cross way, fastening means to clamp said brackets in position, a grinding wheel shaft journaled in each grinding wheel bracket so that the shafts are parallel to each other and perpendicular to the axis of the spindle, a grinding wheel mounted on each grinding wheel shaft, both grinding wheels being in the same plane, and having grinding faces spaced from each other by the final diameter of the ground suture, a grinding wheel pulley on each grinding wheel shaft, a sun pulley mounted on the spindle, two training pulleys mounted on the rotating grinding head in position to direct a belt around the sun pulley and around the grinding wheel pulleys; and a grinding wheel belt around said sun pulley, the two training pulleys, and the grinding wheel drive pulleys, whereby the grinding wheels are rotated in the same direction by the rotation of the grinding head.

5. Apparatus for grinding sutures comprising: a grinding stand, a spindle mounted in said grinding stand having a suture feed tube centrally thereof, a rotating grinding head mounted on said spindle having a grinding head drive belt groove in its periphery, a grinding head motor, a grinding head driving pulley thereon, a grinding head driving belt around said grinding head driving pulley and said grinding head, a cross way in the plane of rotation in the face of the grinding head, two grinding wheel brackets symmetrically slideably mounted in said cross way, a feed screw contacting each grinding wheel bracket to slowly advance the brackets towards each other, fastening means to clamp said brackets in adjusted position, a grinding wheel shaft journaled in each grinding wheel bracket so that the shafts are parallel to each other and perpendicular to the axis of the spindle, a grinding wheel mounted on each grinding wheel shaft, both grinding wheels being in the same plane, and having grinding faces spaced from each other by the final diameter of the ground suture, a grinding wheel pulley on each grinding wheel shaft, an idler pulley on the grinding head in the plane of the grinding wheel pulleys; a sun pulley mounted on the spindle, two training pulleys mounted on the rotating grinding head in position to direct a belt around the sun pulley and around the grinding wheel pulleys; and a grinding wheel belt around said sun pulley, the two training pulleys, the grinding wheel drive pulleys, and the idler pulley, whereby the grinding wheels are rotated in the same direction by the rotation of the grinding head.

6. Apparatus for grinding sutures comprising: a grinding stand, a spindle mounted in said grinding stand having a suture feed tube centrally thereof, a rotating grinding head mounted on said spindle having a grinding head drive belt groove in its periphery, a grinding head motor, a grinding head driving pulley thereon, a grinding head driving belt around said grinding head driving pulley and said grinding head, a cross way in the plane of rotation in the face of the grinding head, two grinding wheel brackets symmetrically slideably mounted in said cross way, a feed screw contacting each grinding wheel bracket to slowly advance the brackets towards each other, fastening means to clamp said brackets in adjusted position, a grinding wheel shaft journaled in each grinding wheel bracket so that the shafts are parallel to each other and perpendicular to the axis of the spindle, a grinding wheel mounted on each grinding wheel shaft, both grinding

wheels being in the same plane, and having grinding faces spaced from each other by the final diameter of the ground suture, a grinding wheel pulley on each grinding wheel shaft, a sun pulley mounted on the spindle, two training pulleys mounted on the rotating grinding head in position to direct a belt around the sun pulley and around the grinding wheel pulleys; and a grinding wheel belt around said sun pulley, the two training pulleys, and the grinding wheel drive pulleys, whereby the grinding wheels are rotated in the same direction by the rotation of the grinding head.

7. Apparatus for grinding sutures comprising: a grinding stand, a spindle mounted in said grinding stand having a suture feed tube centrally thereof, a rotating grinding head mounted on said spindle having a grinding head drive belt groove in its periphery, a grinding head motor, a grinding head driving pulley thereon, a grinding head driving belt around said grinding head driving pulley and said grinding head, a cross way in the plane of rotation in the face of the grinding head, two grinding wheel brackets symmetrically slideably mounted in said cross way, a feed screw contacting each grinding wheel bracket to slowly advance the brackets towards each other, fastening means to clamp said brackets in adjusted position, a grinding wheel shaft journaled in each grinding wheel bracket so that the shafts are parallel to each other and perpendicular to the axis of the spindle, a grinding wheel mounted on each grinding wheel shaft, both grinding wheels being in the same plane, and having cylindrical grinding faces spaced from each other by the final diameter of the ground suture, and means to rotate the grinding wheels in the same direction, so that the grinding direction of one wheel is primarily in the direction of suture travel, and the grinding direction of the second wheel is primarily opposed to the direction of suture travel.

8. Apparatus for grinding sutures comprising: a grinding stand, a spindle mounted in said grinding stand having a suture feed tube centrally thereof, a rotating grinding head mounted on said spindle having a grinding head drive belt groove in its periphery, a grinding head motor, a grinding head driving pulley thereon, and a grinding head driving belt around said grinding head driving pulley and said grinding head, a cross way in the plane of rotation in the face of the grinding head, two grinding wheel brackets symmetrically slideably mounted in said cross way, fastening means to clamp said brackets in position, a grinding wheel shaft journaled in each grinding wheel bracket so that the shafts are parallel to each other and perpendicular to the axis of the spindle, a grinding wheel mounted on each grinding wheel shaft, both grinding wheels being in the same plane, and having cylindrical grinding faces spaced from each other by the final diameter of the ground suture, and means to rotate the grinding wheels in the same direction, so that the grinding direction of one wheel is primarily in the direction of suture travel, and the grinding direction of the second wheel is primarily opposed to the direction of suture travel.

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