Nov. 22, 1955 S. L. DART ET AL 2,724,264

STRAND HOLDING APPARATUS

Filed Aug. 23, 1952

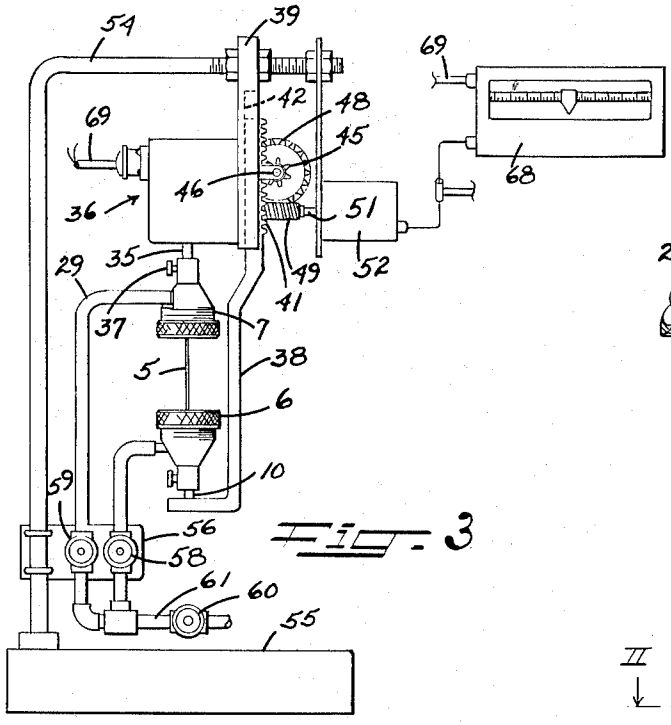


Fig. 3

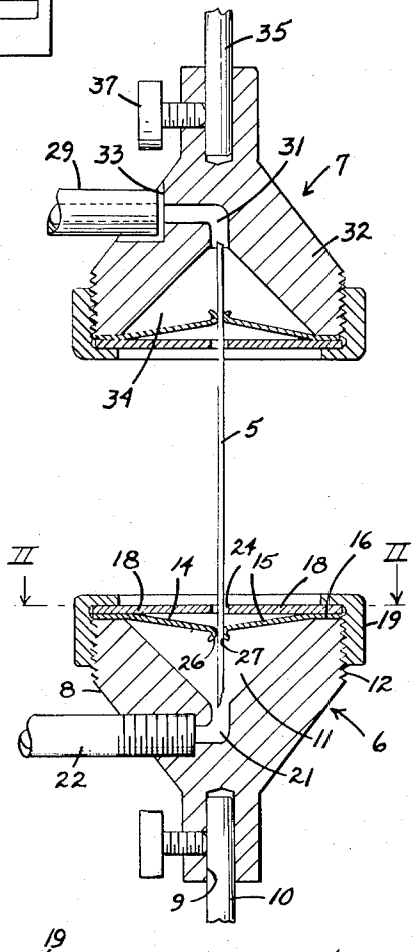


Fig. 1

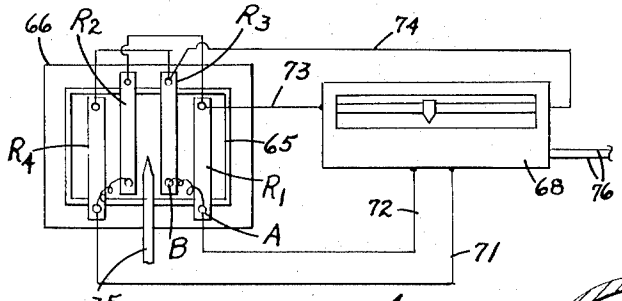


Fig. 4

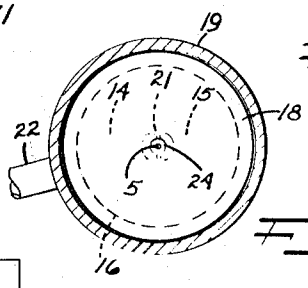


Fig. 2

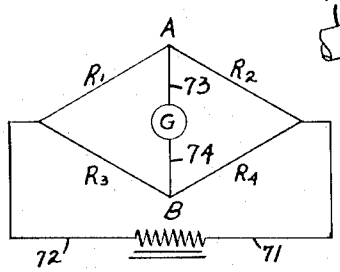


Fig. 5

INVENTORS.
SIDNEY L. DART
LEROY E. PETERSON
JAMES A. RICHARDS, JR.

BY Thomas R. Malley
ATTORNEY.

United States Patent Office

2,724,264

Patented Nov. 22, 1955

2,724,264

STRAND HOLDING APPARATUS

Sidney L. Dart and Leroy E. Peterson, Swarthmore, and James A. Richards, Jr., Sharon Hill, Pa., assignors to American Viscose Corporation, Philadelphia, Pa., a corporation of Delaware

Application August 23, 1952, Serial No. 306,038

7 Claims. (Cl. 73—95)

The present invention relates to holding strands from lengthwise movement in one direction relative to gripping surfaces that are applicable thereto, and particularly to apparatus for the handling and clamping of very fine strands such as single filaments of small denier.

It is an object of the present invention to provide a strand-holding device which holds the strand positively against slipping without weakening the strand in the gripped portion. Another object is to provide a holding device for a strand of extraordinary utility in the handling of very fine strand, i. e., a device that is self-lacing. Still another object is to provide a strand clamp or holding device that is self-cleaning, for example, a tensile testing apparatus for a strand that purges itself of broken remnants of successively tested strand sections. It is also an object to provide apparatus for supporting a strand with the slackness removed therefrom so as to place it in desirable condition for observation or other types of testing. Other objects, features, and advantages will become apparent from the following description of the invention and the drawing relating thereto in which

Fig. 1 is a sectional view of apparatus constructed in accordance with the present invention for holding a section of strand;

Fig. 2 is a sectional view of a portion of the apparatus illustrated in Fig. 1 taken along line II—II;

Fig. 3 is an elevation of tensile testing apparatus comprising the strand-holding system shown in Fig. 1;

Fig. 4 is a circuit diagram illustrating the principle of operation of one type of strain gauge which the apparatus of Fig. 3 may comprise; and

Fig. 5 is a Wheatstone bridge diagram correlated with portions of Fig. 4.

The above-stated objects and others ancillary thereto are accomplished by a strand-holding device having elements in normally resiliently wedge relationship which may be moved apart to receive a strand therebetween. In a preferred embodiment the elements are separated by a flexible diaphragm, and structure for producing a difference in the air pressure on the opposite sides of the diaphragm whereby the diaphragm is deflected to move apart the strand-holding surfaces of the elements located immediately adjacent an aperture in the diagram. Preferably, the holding surfaces are on the side of the diaphragm subjected to the lower air pressure so that the aperture may be utilized for automatic threading or lacing of the device.

In a specific form of the invention, a testing apparatus comprises a pair of such devices in opposed aligned relationship connected to a suction-producing system, one of the devices and the duct connecting it to the said system being constructed to effect automatic connection thereof when suction is applied and automatic separation when suction is discontinued.

Fig. 1 illustrates a pair of strand-holding devices 6 and 7 which are supported in the generally relative disposition shown by means such as the testing machine

illustrated in Fig. 2. The strand 5 by operation of the automatic threading feature of the devices is necessarily positioned along a fixed path or axis with all slackness removed therefrom since the lacing action of the last-threaded device places the strand 5 under slight tension.

The devices 6 and 7 are similar in construction except for the manner in which they are attached to a suction source. The device 6, by way of example, comprises a body member 8 (not shown), preferably of circular construction symmetrical with respect to an axis aligned along the strand 5. The body portion has a coaxial bore 9 to receive a rod-like supporting element 10, a recess 11, and an exterior threaded surface 12 extending around the portion of the wall defining the larger end of the recess. Other portions of the device 6 are a pair of leaf or cantilever-type springs 14 and 15 secured to the body member 8 within the peripheral edge 16 thereof as by soldering, screws, or clamps. The edge 16 is preferably recessed for each spring so that the exposed surface of the spring will be flush with the surface of the edge whereby a substantially sealed joint may be obtained when a flexible diaphragm 18 is placed over the recess and secured to the edge 16 by an annular cap or coupling 19 having an interiorly threaded portion adapted to fit the threaded surface 12.

The diaphragm 18 comprises a flexible material such as vulcanized rubber film or a film formed from one of the organic synthetic resins such as polyethylene, plasticized polymers or co-polymers of vinyl chloride, vinylidene chloride, acrylonitrile, and vinyl acetate, or films of regenerated cellulose and nylon. The outer and inner surfaces of the diaphragm 18 assume a plane contour when the diaphragm is relaxed and not subjected to transverse forces. Substantial portions of the surfaces of the springs 14 and 15 which face outwardly from the recess extend very closely along, or in contact with the inner surface of the diaphragm when the atmospheric pressure is the same on both sides of the diaphragm. The recess 11 is connected by a passageway 21 extending within the member 8 with a tube 22 which screws into the wall of the member 8. The tube 22 is connected with a valve, as shown in Fig. 3, for controlling the application of suction to the device 8.

The diaphragm 18 has an aperture 24 through which the strand 5 extends into the recess 11 between opposed flat surfaces of the springs 14 and 15. The springs 14 and 15 are of sufficient length to enable the strand-gripping surfaces 26 and 27 to meet at a point spaced away from the plane assumed by the diaphragm 18 when relaxed. Consequently, as the surfaces 26 and 27 are movable along converging paths, a force exerted on the strand 5 toward the device 7 will tend to wedge the surfaces 26 and 27 of the lower unit 6 together, whereby the wedging action increases with the pull on the strand 5.

The surfaces 26 and 27 are separated, however, when suction is applied to the recess 11. A reduction in the air pressure within the recess 11 causes an inward deflection of the diaphragm 18 against the outwardly facing surfaces of the springs 14 and 15. The springs are thus deflected inwardly of the recess and their gripping surfaces are parted. Simultaneously, air is drawn through the aperture 24. Under these conditions, a fragment of strand held just previously between the springs and not otherwise gripped will be sucked away from the springs, into the passageway 21, and through the tube 22. Also any strand of sufficient smallness in diameter to enter the aperture 24 will be drawn therethrough between the gripping surfaces 26 and 27. Such a strand may be held outside the device 6 to prevent the entire passage thereof into and through the device. With the cessation of suction applied to the recess 11, the resilient diaphragm 18 returns to its

normally planular shape, and the springs thereupon swing into engagement with the strand.

Assuming that the device **6** has been threaded in the manner just described, device **7** may then be threaded by applying suction thereto through a tube **29** which is supported very closely to the exterior entrance of a passageway **31**. The exterior surface of a body portion **32** is provided with a flat surface **33** surrounding the entrance of the passageway **31** whereby the tube **29** is drawn toward, and establishes a substantially sealed connection with, the surface **33** when suction is applied therethrough to the device **7**. The tube is supported sufficiently closely to the surface **33**, within perhaps one sixteenth of an inch, so that when a valve is actuated, the resulting suction snaps the end of the tube against the surface **33** to establish a continuous substantially closed duct between a recess **34** of device **7** and a suction-producing source.

Referring now to the tensile testing apparatus illustrated in Fig. 3, device **7** is shown attached to a rod-like force-transmitting element **35** of a strain gauge **36**. The device **7** is provided with a bore complementary to the end portion of the element **35** and is secured thereto by means such as a set screw **37**.

The device **6** is supported by an arm **38** and the connecting element **10** which are movable in a direction parallel to the lengthwise direction of the strand **5** with respect to a frame portion **39** of the apparatus. The frame **39** has a slot **42** in which the frame receives a portion of the arm **38**; the arm is guided by the surfaces defining the slot during reciprocal movement thereof in the direction indicated above. Attached to the arm **38** is a rack gear **41**. The rack gear is engaged and driven by a small spur gear **45**. A shaft **46** supports the gear **45** and also a worm gear **48** in mesh with a worm **49** supported on a shaft **51** of a motor **52**. The motor **52** and frame portion **39** are mounted in fixed relationship on a curved rod-like frame member **54** connected to a base **55**. Attached also to the member **54** is a panel **56** for supporting a pair of valves **58** and **59** which control suction applied to devices **6** and **7**. As hereinbefore discussed with respect to device **7**, the tube **29** is not attached directly to the device **7**. This tube is flexible and is preferably shaped with a curve as shown in Fig. 3 so that it is substantially self-supporting with its upper end portion free and disposed normally quite closely to the entrance of the passageway **31** but not touching any surface of the device **7**. Although separate valves **58** and **59** are provided for lacing the devices **6** and **7**, the normal procedure being to first secure one end and then trap the other end of a test section of yarn by the devices, it is possible to thread both devices simultaneously by operating a valve **60** in the single suction line **61** with the valves **58** and **59** open, or by simultaneous operation of both valves **58** and **59** while holding a strand section at approximately the middle of its length and allowing the end portions of a strand section to be sucked into both devices simultaneously.

The strain gauge **36** may be any one of several types manufactured for the purpose of registering the magnitude of a tensile or compressive force by transmitting an electrical signal, the intensity of which is measured and varies in accordance with the magnitude of the force applied to the force sensitive mechanism of the unit. A preferred type is that indicated in Fig. 3 and illustrated diagrammatically in Figs. 4 and 5. An example of such gauge is one manufactured by the Statham Laboratories and identified by catalogue No. YE–8–120. The internal circuit of such a gauge is essentially a Wheatstone bridge circuit, such as illustrated in Fig. 5 with sections of the circuit being mechanically arranged as shown in Fig. 4. Essential portions of the unit comprise resistance members R_1, R_2, R_3, and R_4 which are stressed when force is applied to the element **35**. As each of the elements R_1, R_2, R_3, and R_4 are attached by one end to an inner member **65** and at the other end to an outer member **66** extending around the inner member, a tensile force applied through element **35** to member **65** tends to move the member **65** relative to member **66** and place elements R_1 and R_4 in compression with elements R_2 and R_3 in tension. The unit operates in accordance with the well known principle, i. e., the resistance of a conductor changes with elongation or compression, to shift the resistance values of R_1, R_2, R_3, and R_4 within the Wheatstone bridge. The changes in current between A and B through the instrument G provides an electric signal which may be amplified electronically by well known electronic means to operate a conventional recording instrument, such as represented by the instrument **68** of Fig. 3, which may be used also to provide the source of power for energizing the Wheatstone bridge circuit as well as to amplify signals received as a result of a tensile force applied to the strain gauge **36**. A cable **69** connecting the gauge and the instrument comprises, therefore, electrical conductors **71**, **72**, **73**, and **74**. Power for energizing the motor **52** and the instrument **68** may be supplied from a common supply line **76**.

The invention herein described is applicable to all types of textile strands including the larger continuous filamentary bundles such as tow and sliver. A single unit as typified by either device **6** or **7** may be used in the continuous processing of strands in a manner analogous to a check valve in the handling of fluids since it would permit travel of a strand in but one direction. However, the present application of the invention indicates great utility in handling and testing very fine strands, such as single filaments which are extremely difficult to manipulate and thread through portions of existing laboratory testing equipment. Apparatus equipped in the manner taught by the present invention will greatly implement and reduce the cost of testing strands where such tests are performed frequently.

While preferred embodiments of the invention have been shown and described, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

We claim:

1. A device for holding a strand comprising a body member having a recess, duct means extending from the recess to outside the body member, a flexible diaphragm extending over the recess and having an aperture disposed centrally thereover, said recess being substantially sealed by the diaphragm except for the aperture and the duct means, and means having opposed separable surfaces normally urged into resilient engagement and supported generally along an axis of the aperture extending perpendicularly from the plane of the diaphragm, said surfaces being connected with the diaphragm for separation in response to deflection of the diaphragm toward said surfaces, and means connected with the duct means for reducing the pressure within the recess relative to the pressure adjacent the diaphragm outside of the recess.

2. In combination, a device for holding a strand comprising a body member having a recess, a duct extending from the recess to a flat exterior surface of the body member, a flexible diaphragm extending over the recess and having an aperture disposed centrally thereover, said recess being substantially sealed by the diaphragm except for the aperture and the duct, and means having opposed separable surfaces urged into resilient engagement, said opposing surfaces meeting generally along an axis of the aperture extending perpendicularly from the plane of the diaphragm, said surfaces being connected with the diaphragm for separation in response to deflection of the diaphragm toward said surfaces; a flexible conduit having a continuous plane end-surface encircling the end of the passageway thereof, the conduit comprising valve means; means for supporting the conduit with the plane of said end surface closely spaced, and substantially parallel to, the flat surface of the body member, the passageway of

the conduit being aligned with the duct; and suction means connected with the conduit.

3. A device for holding a strand comprising a flexible diaphragm having an aperture, means for supporting the diaphragm, recessed enclosing means in engagement with a continuous surface of the diaphragm surrounding, but spaced from, the aperture for enclosing a region adjacent the area of the diaphragm surrounded by said engaged surface, duct means extending through the wall of said enclosing means from said region adapted exteriorly of the enclosing means for connection with gaseous pumping means, strand-holding means supported adjacent the aperture on the side of the diaphragm at which the atmospheric pressure is lower than that at the other side thereof during operation of said pumping means, said strand-holding means comprising a pair of elements having opposed separable surfaces and means for resiliently acting on said elements to urge the surfaces together, said holding surfaces being disposed along an axis extending generally centrally from the aperture and perpendicularly to the plane of the diaphragm, said elements being operably connected with the diaphragm for separating said surfaces in response to deflection of the diaphragm toward said elements.

4. A device for holding a strand comprising a body member having a recess, duct means extending from the recess through a wall of the member and adapted exteriorly of the member for connection with suction means, a flexible diaphragm extending over the recess and having an aperture disposed centrally thereover, said recess being substantially sealed by the diaphragm except for the aperture of the duct means, and a pair of cantilever-type springs supported by the body member at opposite sides of the recess comprising portions extending closely along the surface of the diaphragm facing within the recess from said sides toward an axis of the aperture which extends perpendicularly from the general plane of the diaphragm, said spring portions as they extend inwardly being also inclined away from the diaphragm and joining with other portions of the springs comprising flat surfaces in opposing relationship, said springs being normally under tension to urge the flat surfaces together approximately along the axis.

5. A device for holding a strand comprising a body member having a recess, duct means extending from the recess through a wall of the member and adapted exteriorly of the member for connection with suction means, a flexible diaphragm extending over the recess and having an aperture disposed centrally thereover, said recess being substantially sealed by the diaphragm except for the aperture of the duct means, and a pair of cantilever-type springs supported by the body member at opposite sides of the recess comprising portions extending within the recess from said sides toward an axis of the aperture which extends perpendicularly from the general plane of the diaphragm, each of said spring portions extending from its respective side of the recess into proximity to the diaphragm and then at an inclination away from the diaphragm and joining with another portion of the spring comprising a flat surface, the diaphragm and said spring portions in proximity therewith being relatively disposed for engagement when the diaphragm is deflected inwardly

of the recess for movement of the springs in response to such engagement, said springs being normally under tension to urge the flat surfaces thereof together approximately along the axis.

6. A device for holding a strand comprising a body member having a recess, a passageway extending from the recess to outside the body member and adapted exteriorly of the member for connection with suction means, a flexible diaphragm extending over the recess and having an aperture disposed centrally thereof, a pair of leaf springs supported by diametrically opposing wall portions of the member defining the recess and comprising portions extending within the recess from said wall portions toward an axis of the aperture which extends perpendicularly from the general plane of the diaphragm, each of said spring portions extending from its respective side of the recess into proximity to the diaphragm and then at an inclination away from the diaphragm and joining with another portion of the spring comprising a flat surface, said springs being normally under tension to urge the flat surfaces thereof together approximately along the axis, said wall of the member having an outer circular threaded surface, and an annular cap in threaded relationship with the threaded surface and having a radially inwardly extending flange portion overlapping an outer margin of the diaphragm whereby the diaphragm is secured along a continuous end surface of the member.

7. Apparatus comprising two strand-holding devices supported in opposed relationship and disposed for holding a strand along a desired axis; force-measuring means connected to one of the devices; means connected with the other device for moving it along said axis away from the first-named device; each device comprising a body member having a recess, a duct extending through the wall of the member from the recess to the exterior of the member, a flexible diaphragm secured over the recess to the end surface of the wall defining the recess, the diaphragm having an aperture disposed centrally thereof and along said axis, said recess being substantially sealed by the diaphragm except for the aperture and the duct, and means having opposed separable surfaces normally urged into resilient engagement and supported generally along the axis, said surfaces being connected with the diaphragm for separation in response to deflection of the diaphragm toward said opposing surfaces; suction means; and duct means comprising valve means for connecting the suction means and the duct of each device, said valve means comprising a valve for controlling the suction of both devices simultaneously.

References Cited in the file of this patent

UNITED STATES PATENTS

1,219,594	Scott	Mar. 20, 1917
1,520,716	Judd	Dec. 30, 1924
1,872,047	Templin	Aug. 16, 1932
2,172,086	Marszalski	Sept. 5, 1939
2,203,572	Johnson	June 4, 1940

FOREIGN PATENTS

691	Great Britain	1891
601,326	Great Britain	May 4, 1948