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2,913,271

LOOP-FORMING AND KNOT-TYING DEVICE

Filed March 13, 1957

2 Sheets-Sheet 1

Fig. 1

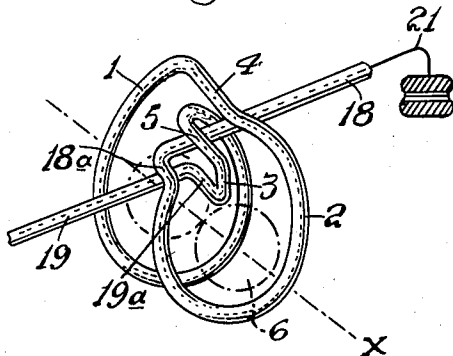


Fig. 2

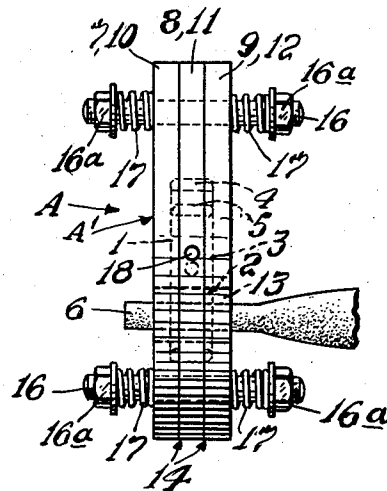


Fig. 3

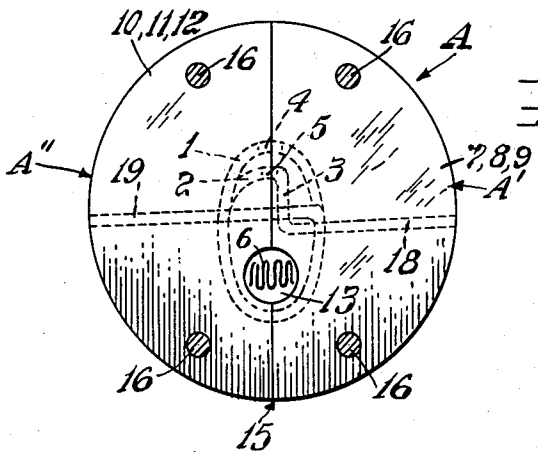


Fig. 4

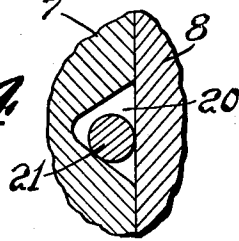


Fig. 5

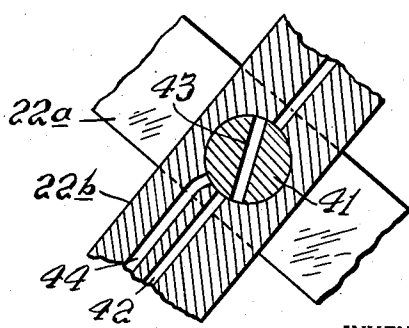
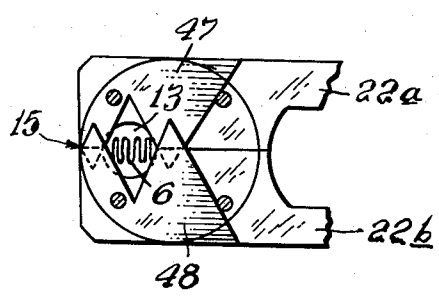


Fig. 6



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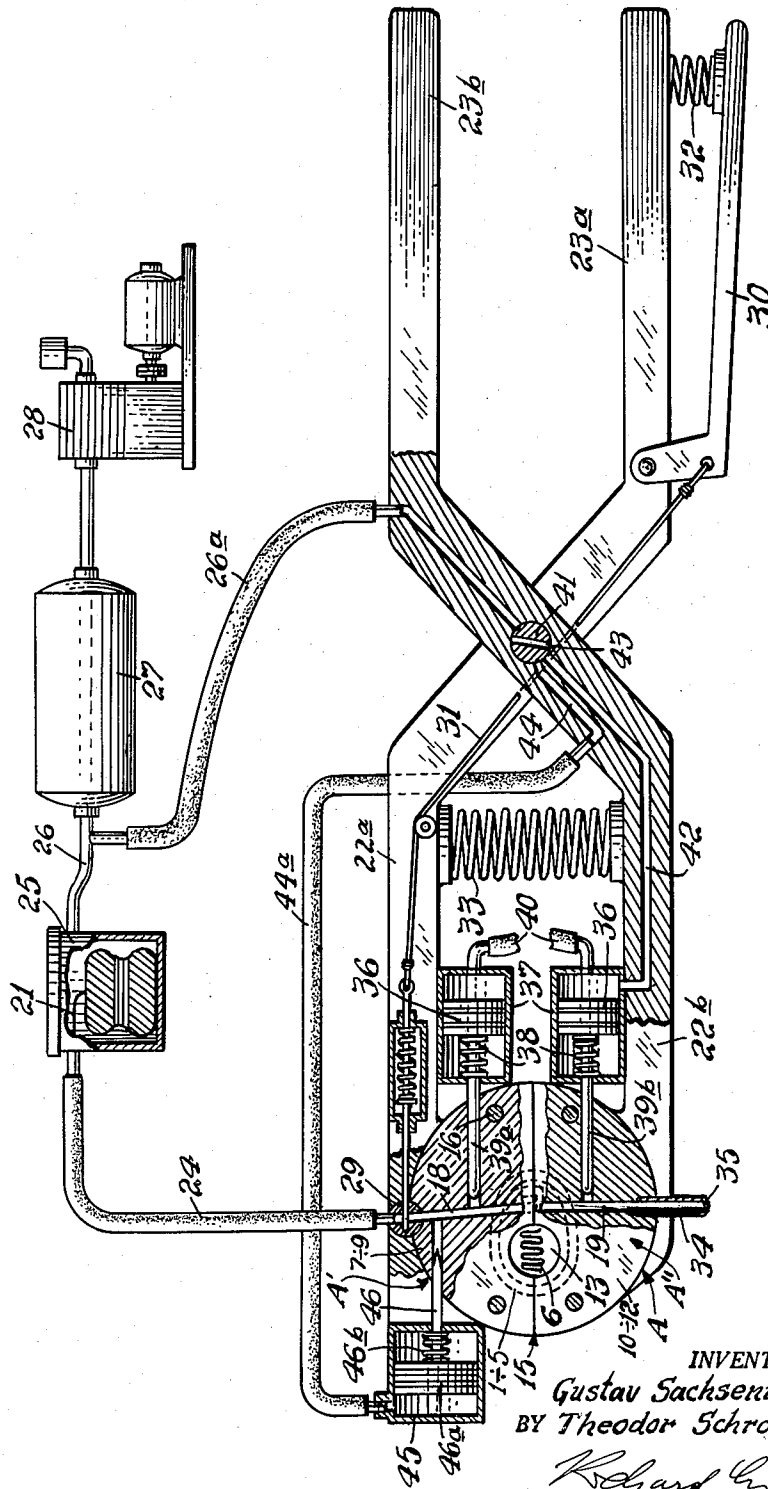
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2 Sheets-Sheet 2

Fig. 5



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LOOP-FORMING AND KNOT-TYING DEVICE

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Claims priority, application Germany March 20, 1956

17 Claims. (Cl. 289—2)

The present invention relates generally to a device for looping and knotting a length of flexible binding material around the goods to be tied, and more particularly is directed to a device of the described character having a passage, in the shape of the knot to be tied, through which the binding material is conveyed by a gaseous stream, and provided with means for metering the length of the binding material conveyed through such passage, for tightening the knot formed in the binding material and for thereafter cutting the knotted binding material to separate the latter from the supply thereof.

Heretofore, it has been proposed to provide a device for knotting a length of binding material around the goods to be tied that has a hollow tube looped in the shape of the knot to be tied and formed with a slot extending therealong at the inside of the looped tube, with the flexible binding material, such as, for example, twine, cord, or synthetic binding thread, being conveyed through the looped tube by a gaseous stream, for example, an air stream. In the proposed arrangement, the looped tube is connected with feed and discharge pipes and is split in an axial plane to form two halves which are adapted to move towards and away from each other, in order to receive the goods to be tied therebetween, and which are interengageable to form an airtight seal. The slot running along the length of the looped tube is covered by a strip of elastic material, for example, rubber and the like, which is secured, along one edge of the slot, to the exterior surface of the tube so that, after the flexible binding material has been conveyed, by an air stream, through the tube, the opposite ends of the length of flexible binding material disposed in the tube can be pulled to draw the looped flexible binding material tight into the desired knot, with the flexible binding material being withdrawn from the tube through the longitudinal slot of the latter during the tightening of the knot. If compressed air is used in the above described arrangement in order to convey the flexible binding material through the looped tube, substantial losses of compressed air occur through the longitudinal slot, since the strip covering the latter must permit easy withdrawal of the binding material during tightening of the knot. On the other hand, if the discharge end of the looped tube is connected to a source of low pressure or vacuum in order to induce the conveying flow of air through the looped tube, the relatively low pressure within the tube causes the sealing strips to seat tightly against the external surface of the tube for effectively sealing the slot, but, in that case, the pressure differential available for conveying the flexible binding material through the tube cannot exceed a theoretical maximum of one atmosphere, whereas, any desired pressure differential may be applied when using compressed air. The use of compressed air to produce the desired conveying airstream is further desirable by reason of the fact that it is cheaper and simpler to compress air than to develop a substantial vacuum.

It has also been proposed that compressed air could

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be employed in a loop forming and knot tying device of the above described character by substituting a sliding cover for the resilient sealing strip thereof. However, such a sliding cover is relatively costly to produce and uneconomical and, further, requires expert maintenance to avoid frequent breakdown in the apparatus.

Accordingly, it is an object of the present invention to provide an improved loop forming and knot tying device of simple and rugged construction which operates on the general principles indicated above, and which employs a positive pressure differential for the purpose of causing the stream of air intended to convey the binding material along the passage in the shape of the knot to be tied.

In accordance with an aspect of the present invention, an improved loop forming and knot tying device includes a body having a passage extending therethrough in the shape of the knot to be tied and terminating in feed and discharge ports, such body being formed of several sections which are separable along the passage through which the binding material is to be conveyed so that, after the binding material has been conveyed through the passage, the sections of the body are adapted to move apart in a manner permitting the flexible binding material to be pulled tight into a knot around the goods to be tied.

The above arrangement which is characteristic of knot tying devices embodying the invention effects sealing of the passage during the conveying of the flexible binding material through the latter merely by the interengagement of plane mating surfaces on the separable sections of the body, and thereby avoids the necessity for any rubber gaskets or other sealing devices. Further, by reason of the fact that the several sections making up the body are separable along the passage through which the flexible binding material is to be conveyed, the various parts of such passage may be easily produced in the mating faces or surfaces of the body sections by casting, milling or drilling operations, and the necessary sealing engagement of the adjacent faces of the separable sections can be easily ground flat.

The above, and other objects, features and advantages of the invention, will be apparent in the following detailed description of an illustrative embodiment thereof, which is to be read in connection with the accompanying drawings forming a part hereof, and wherein:

Fig. 1 is a diagrammatic perspective view of the configuration of a passage formed in a knot tying device embodying the present invention for guiding the flexible binding material so that the latter may thereafter be pulled tight into a desired knot;

Fig. 2 is a side elevational view of a body formed of several separable sections, in accordance with the present invention, and having an internal passage of the configuration shown in Fig. 1;

Fig. 3 is a front elevational view of the body of Fig. 2;

Fig. 4 is an enlarged, detail sectional view showing a portion of the passage in the body of Figs. 2 and 3 defined between two of the separable sections thereof;

Fig. 5 is a general schematic view of a knot tying device embodying the present invention and including a body of the kind illustrated in Figs. 2 and 3;

Fig. 6 is a fragmentary front elevational view of a portion of the device shown in Fig. 5, and particularly illustrating means for compressing the goods to be tied prior to the knotting of the flexible binding material therearound; and

Fig. 7 is an enlarged, detail sectional view of a control valve included in the device of Fig. 5.

Referring to the drawings in detail, and initially to Fig. 1 thereof, it will be seen that, in a loop forming and knot tying device embodying the present invention, the

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passage for guiding the flexible binding material into the shape or form of the desired knot may include two loop portions 1 and 2 lying in spaced apart parallel planes, so that the goods 6 to be tied may be extended through the loops 1 and 2 in the direction of the axis extending normal to the planes of the loop portions 1 and 2. The loop portions 1 and 2 of the passage are connected, at one end, by a straight portion 4 extending substantially at right angles to the planes of the loop portions 1 and 2, while the other end of the loop portion 1 connects to a straight portion 5 extending parallel to the portion 4 and, in turn, connecting to a straight portion 3 which lies in the plane of the loop portion 2. Further, the passage for guiding the flexible binding material includes a feed portion 18 and a discharge portion 19 extending in generally diametrically opposed directions in a plane substantially midway between the planes of the loop portions 1 and 2 and terminating, at their inner ends, in connecting portions 18a and 19a, respectively, which extend generally parallel to the portion 4, that is, generally parallel to the axis *x*, and connect to the other end of the loop portion 2 and to the portion 3, respectively, so that the feed portion 18 of the passage is enveloped, on three sides, by the portions 5, 3 and 19a of the passage. Thus, the several described portions of the passage illustrated in Fig. 1 define an intertwining or self-tightening knot.

It is apparent that, if a length of flexible binding material 21 is fed through the passage of Fig. 1, or otherwise arranged in the shape of that passage, and the object 6 to be tied is arranged with its longitudinal axis *x* extending through the looped portions 1 and 2 and at right angles to the parallel planes of the latter, and assuming that the structure defining the passage of Fig. 1 permits contraction of the flexible binding material about the object 6, then the knot to be tied around the latter can be tightened merely by pulling, in opposite directions, the portions of the flexible binding material disposed within the feed portion 18 and the discharge portion 19 of the described passage.

Preferably, in accordance with the present invention, the portions 4 and 5 of the described passage for conveying the flexible binding material are disposed in a plane which is perpendicular to the planes of the loop portions 1 and 2 and which extends through the longitudinal axis *x* of the object 6 to be tied.

In order to provide a structure defining the passage described with reference to Fig. 1 which permits the portions of the flexible binding material conveyed there-through and disposed in the looped portions 1 and 2 in the other portions 3, 4 and 5 to be contracted about the object 6 while insuring an adequate seal along the passage so that compressed air supplied to the feed port 18 can be employed for producing the conveying air stream through the passage, the loop-forming and knot-tying device embodying the present invention preferably includes a body A constructed and arranged in the manner illustrated in Figs. 2 and 3 of the drawing.

Referring in detail to Figs. 2 and 3, it will be seen that the body A is in the form of a cylinder of relatively small axial length, and includes six half-disc elements 7, 8, 9, 10, 11 and 12. Such half-disc elements are arranged in two groups or assemblies A', made up of the elements 7, 8 and 9, and A'', made up of the elements 10, 11 and 12, so that the body A is divided or separable at a diametrical, axially extending plane 15 (Fig. 3) by movement of the assemblies A' and A'' laterally away from each other, while the assemblies A' and A'' are divided or separable at radially extending planes 14 (Fig. 2) by movement of the two end half-disc elements 7 and 9 or 10 and 12 axially away from the central half-disc element 8 or 11 in each of the assemblies.

The half-disc elements in each of the assemblies A' and A'' are held together for movement, as a unit, relative to the other of the assemblies by guide pins 16 which are fixed in the central element 8 or 11 and extend axially

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through suitable openings in the related end elements 7 and 9 or 10 and 12. Further, in order to hold the half-disc elements axially together in each of the assemblies A' and A'', the opposite ends of the guide pins 16 are screw threaded and receive nuts 16a, and helical compression springs 17 are provided on the guide pins 16 between the nut 16a and the outer faces of the related end elements 7 and 9 or 10 and 12, thereby to yieldably urge the latter into facial contact with the opposite radially extending faces of the central element 8 or 11.

The radial faces of the half-disc elements corresponding to the radial planes of separation 14, and the edges of the half-disc elements in the assemblies A' and A'' which are intended to come together at the axial plane of separation 15 are suitably ground to form tight seals at the planes 14 and at the plane 15 when the half-disc elements in each of the assemblies A' and A'' are firmly pressed together in the axial direction, and when the assemblies A' and A'' are firmly pressed together in the lateral direction, that is, in the direction normal to the longitudinal or axial plane of separation 15.

As seen in Fig. 3, the inner or mating edges of the half disc elements making up the assemblies A' and A'' are formed with complementary semi-circular cutouts which register when the assemblies are brought together to define an opening 13 extending through the body A and adapted to receive the object 6 to be tied. Further, in the body A, the looped portion 2 and the portion 3 of the passage for guiding or conveying the flexible binding material are defined by suitably shaped grooves formed in the radial faces of the half disc elements 7 and 10 which confront or contact the half-disc elements 8 and 11, respectively, while the looped portion 1 of the passage is defined by suitably shaped grooves formed in the radial faces of the half-disc elements 9 and 12 confronting or contacting the central elements 8 and 11, respectively. It will also be noted that the portions 4 and 5 of the passage are defined by registering grooves in the edges of the half-disc elements 8 and 11 which are engageable with each other at the axial or longitudinal plane 15, while the feed and discharge ports 18 and 19 for the passage are defined by generally radially extending bores in the half-disc elements 8 and 11, and the portions 18a and 19a of the passage are defined by axially extending bores communicating with the bores defining the ports 18 and 19 and opening at the radial face of the central half-disc element 8 or 11 confronting the element 7 or 10, respectively, to communicate with the groove defining the looped portion 2 and with the groove defining the portion 3, respectively. Thus, all of the portions of the passage described with reference to Fig. 1 are defined within the body A either by grooves in the faces or edges of the half-disc elements making up such body or by drilled bores in such elements. Further, it will be apparent that the portions 1, 2, 3, 4 and 5 of the desired passage are defined by grooves at the planes of separation 14 and 15 of the body A so that, after flexible binding material has been conveyed through the passage, the parts of the flexible binding material disposed within the portions 1, 2, 3, 4 and 5 of the passage can be contracted about the object 6 within the opening 13 of the body merely by moving out of the related grooves and between the half-disc elements which contact at the related planes of separation.

As seen in Fig. 4, each of the grooves defining the portions 1, 2 and 3 of the passage, there indicated by the reference number 20, preferably has a rounded bottom and outwardly flared side walls which, at the face of the related half-disc element, has rounded edges so as to avoid interference with the sealing contact between the end elements 7 and 10 or 9 and 12 with the central elements 8 and 11. The outwardly flared side walls of the grooves 20 facilitate the movement of the flexible binding material 21 out of the groove and between the

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contacting surfaces of the half-disc elements when the flexible binding material is contracted around the object to be tied. The grooves in the edges of the central half-disc elements 8 and 11 defining the portions 4 and 5 of the passage may be of approximately semi-circular cross section.

Referring now to Fig. 5 of the drawings, it will be seen that, in a device embodying the present invention and employing the previously described body A, the assemblies A' and A'' of the body are mounted on the free ends of two arms 22a and 22b, respectively. The arms 22a and 22b are pivotally connected, as by the pivot pin 41, at their ends remote from the assemblies A' and A'', and are provided with crossed handles 23a and 23b at the opposite side of the pivoting axis so that, when the handles 23a and 23b are pressed together, the assemblies A' and A'' have their mating surfaces firmly sealed against each other at the longitudinal or axial plane of separation 15. A flexible conduit 24 connects the feed port 18 of the passage within body A to a supply container 25 having a ball, spool, reel or the like of the flexible binding material 21 stored therein. A pipe 26 extends from the container 25 to a compressed air storage tank 27 which is fed from a suitably driven compressor 28. A shut-off valve 29 is interposed between the feed port 18 and the tank 27 and, for example, as shown in Fig. 5, the valve 29 may be conveniently interposed in the outer end of the feed port 18. The valve 29 is intended to control the supplying of compressed air to the passage in body A through the flexible conduit 24 and is controlled by means of a lever 30 which is pivotally mounted on the handle 23a. A suitable actuating connection 31, for example, a Bowden wire or cable 31, is provided between the valve 29 and the control lever 30, and a spring 32 is interposed between handle 23a and lever 30 to yieldably urge the latter in the direction away from the related handle. The valve 29 and its control assembly are arranged so that the valve is moved to its closed condition by the action of the spring 32 on control lever 30, and is opened to permit the flow of compressed air for conveying the binding material 21 to the passage in body A only when the control lever 30 is rocked toward the handle 23a by overcoming the force of the spring 32.

As seen in Fig. 5, a spring 33 is interposed between the arms 22a and 22b and yieldably urges the latter apart, thereby to tend to separate the assemblies A' and A'' at the plane of separation 15. Preferably, the resistance of the spring 32 in opposition to rocking of the control lever 30 toward the handle 23a is substantially greater than the resistance of the spring 33 to rocking of the arms 22a and 22b towards each other, so that, when the control lever 30 is grasped along with the adjacent handle 23a and the handles 23a and 23b are manually pressed towards each other, initially the spring 32 prevents actuation of the valve 29 to its open condition until the assemblies A' and A'' have been tightly sealed against each other at the plane of separation 15. Following sealing between the assemblies A' and A'' at the plane 15, continued force applied to the control lever 30 will overcome the spring 32 and the consequent rocking of the lever 30 will open the valve 29.

When the valve 29 is opened, compressed air entering through the feed port 18 will travel along the passage in body A and be exhausted through the discharge port 19 thereby to convey the flexible binding material 21 from the container 25 through the passage in the body A.

It is apparent that the flexible binding material 21 could be conveyed through the passage in body A by an air stream resulting from the connection of a source of vacuum to the discharge port 19, rather than by the connection of a source of compressed air to the feed port, as in the illustrated embodiment.

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In order to limit the length of the binding material that may be conveyed through the passage in the body A during each operating cycle of the device, the orifice or outer end of a discharge port 19 of the passage may be simply reduced to a diameter smaller than that of the flexible binding material 21, so that such opening or orifice of the discharge port is immediately closed by the flexible binding material 21 as soon as the free or leading end of the latter reaches the discharge end of the passage in body A. When the opening or orifice of discharge port 19 is closed by the leading or free end of the flexible binding material, the air flow through the passage in body A is immediately interrupted by the equalization of the pressures acting at the opposite ends of such passage. If it is desired to provide different lengths of flexible binding material within the passage of body A during each operating cycle, replaceable extension tubes, such as the tube 34, may be attached to the outer end of the discharge port 19 and provided with a restricted outer end 35 so that the pressures within the passage of body A will only be equalized when the free or leading end of the flexible binding material reaches the restricted orifice 35 at the outer end of the extension 34. It is apparent that other means may be adopted for metering the length of the flexible binding material 21 conveyed through the passage in body A during each operating cycle. Thus, the flexible binding material may be made to pass between two parallel rollers which revolve in response to conveying of the binding material and which are permitted to rotate through a predetermined number of revolutions during each operating cycle, or the metering of the length of flexible binding material conveyed during each cycle may be achieved simply by controlling the amount of air permitted to flow through the passage of body A during each cycle.

After a metered or controlled length of the flexible binding material 21 has been conveyed through the passage in body A, thereby to take the form or shape of the passage illustrated in Fig. 1, it is necessary that such length of the binding material be contracted about the object to be tied which extends through the opening 13 of the body. Contraction of the length of binding material within the passage of body A is effected by locking the binding material within the feed port 18 and the discharge port 19 and then moving the assemblies A' and A'' away from each other by suitable relative rocking of the arms 22a and 22b under the influence of the spring 33. In order to lock or clamp the flexible binding material in the ports 18 and 19 of body A, rods or pins 39a and 39b (Fig. 5) are axially slideable in bores formed in the half-disc elements 8 and 11 which open, substantially at right angles, into the ports 18 and 19, respectively. Each of the pins 39a and 39b has a piston 36 thereon which is axially reciprocable within a related cylinder 37 carried by the related one of the arms 22a and 22b. Return springs 38 are mounted within the cylinders 37 and act against the related pistons 36 to urge the latter in the axial direction for withdrawing the ends of the pins 39a and 39b from the ports 18 and 19. In order to supply compressed air to the ends of the cylinders 37 appearing at the right in Fig. 5, thereby to urge the ends of pins 39a and 39b into the ports 18 and 19, respectively, for clamping the flexible binding material 21 in such ports, a flexible conduit 40 connects the right hand ends of the cylinders 37, in parallel, and a compressed air supply line 42 is connected to the right hand end of the cylinder 37 associated with the pin 39b so that, when compressed air is supplied through the line 42, the pins 39a and 39b will be moved toward their operative or clamping positions.

The supplying of compressed air through the line 42 to the cylinders 37 is controlled in response to rocking of the arms 22a and 22b relative to each other. The line

42 for supplying compressed air may, as shown in the drawing, be defined by a duct extending along the arm 22b and intersected by the pivot pin or bolt 41 which connects the arms 22a and 22b. Further, the pivot pin 41 is fixed with respect to the arm 22a and is provided with a diametrically extending bore 43 so that the pivot pin or bolt 41 acts as a rotary cock or valve. The diametrical bore 43 in pin 41 is arranged so that the bore 43 is out of alignment with the duct 42 when the assemblies A' and A'' are in sealing engagement with each other as shown in Fig. 5. The bore 43 is aligned with the duct 42, thereby to permit the supplying of compressed air through the duct 42 from the tank 27 by way of a connecting pipe 26a when the arms 22a and 22b are pivoted away from each other, to a predetermined extent, by the action of the spring 33.

Thus, when the arms 22a and 22b are moved apart by the return spring 33, the flexible binding material is clamped within the passage of body A at the ports 18 and 19, so that the movement apart of the assemblies A' and A'' causes tightening or contraction of the looped binding material about the object 6 to be tied.

At the end of the tightening step, the arms 22a and 22b are pivoted away from each other to an extent sufficient to again interrupt the supplying of the compressed air to the cylinders 37, and, by way of the bore 43 of pivot pin 41, to place an additional duct 44 in the arm 22b in communication with the source of compressed air. The duct 44 is connected by a flexible pipe 44a to a cylinder 45 having a piston 46a reciprocable therein. A cutting blade 46 extends from the piston 46a and is slideable in an additional bore in the half-disc element 11 which opens into the feed port 18 at right angles to the latter. Thus, when compressed air is supplied to cylinder 45 in response to the completion of the tightening step by spreading apart of the arms 22a and 22b, the cutting blade 46 moves into the feed port 18 and thereby cuts the binding material to separate the length of the latter within the body A from the remainder of the binding material. A return spring 46b is provided within cylinder 45 and acts against piston 46a to move the latter in the direction withdrawing cutting blade 46 from feed port 18 when the supply of compressed air to cylinder 45 is again interrupted.

In order to achieve substantially leak proof tying of an object 6, such as, for example, a bag, tubular container or sausage casing or the like, within the axial opening 13 of body A, it is necessary that the object to be tied be initially folded or compressed before tightening of the knot in the flexible binding material. Such folding or compression of the object 6 to be tied can be effected by a conventional pleating device which is preferably provided or combined with the illustrated loop-forming and knot-tying device.

As seen in Fig. 6, such a compressing or pleating device may include two double-pronged forks 47 and 48, respectively, mounted on the arms 22a and 22b with the resulting V-shaped cutouts facing towards each other and aligned across the plane of separation 15 of the body A so that the object 6 to be tied is compressed in response to movement of the arms 22a and 22b toward each other and can easily enter the opening 13 without being jammed between the sealing surfaces of the half-disc elements of the body A.

Although a particular embodiment of the present invention, and several modifications thereof, have been described in detail herein with reference to the accompanying drawings, it is to be understood that such embodiment has been described merely by way of example, and that the invention is not limited thereto, various other modifications and changes being possible therein, by one skilled in the art without departing from the scope or spirit of the invention, except as defined in the appended claims.

What is claimed is:

1. In a device for knotting flexible binding material around an object to be tied; the combination of a body having a passage therein in the shape of a loosely tied knot and including at least one loop portion lying in a flat plane, intertwined portions lying partly in said flat plane and partly in a plane perpendicular thereto, and feed and discharge ports communicating with the ends of said passage at opposite sides of said perpendicular plane, said body including two assemblies movable in directions generally normal to said perpendicular plane into and out of facial sealing contact at said perpendicular plane, each of said assemblies including a plurality of flat elements urged into facial sealing engagement with each other at said flat plane of each loop portion, the faces of said elements engaging in said plane of each loop portion having grooves therein defining the related loop portion and the parts of said intertwined portion lying in said plane of the loop portion, and the edges of said flat elements of said assemblies engageable at said perpendicular plane having grooves therein cooperating to define the parts of said intertwined portions lying in said perpendicular plane and to define an opening extending through said body with its axis lying in said perpendicular plane and enveloped by said loop portion to receive an object to be tied, means communicating with one of said ports and operative, when said assemblies are in sealing engagement with each other at said perpendicular plane, to induce an air flow through said passage for conveying flexible binding material through the passage from said feed port to said discharge port, and means for securing the flexible binding material in said feed and discharge ports so that, when said assemblies are moved apart from said perpendicular plane, the flexible binding material moves out of said grooves and travels between said faces and edges of the elements in said assemblies and thus contracts around the object to be tied.

2. In a device for knotting flexible binding material around an object to be tied; the combination of a body having an opening extending therethrough to receive the object to be tied and including two assemblies separable from each other at a longitudinal plane of separation extending through the axis of said opening, each of said assemblies including a plurality of flat elements facially engageable with each other at planes of separation extending radially with respect to said axis of the opening and means holding said elements together in each assembly for movement as a unit relative to the other assembly and yieldably resisting spreading apart of said elements at said radially extending planes of separation, said elements of each assembly having grooves in the edges thereof engageable with the grooves in the edges of the other assembly, and in the faces thereof engageable with grooves in the faces of elements in the same assembly to define said opening extending through the body and to define a passage in the body in the shape of a loosely tied knot around said opening and lying wholly in said radial and longitudinal planes of separation, said body further having feed and discharge ports communicating with the opposite ends of said passage and opening at the opposite sides of said longitudinal plane of separation, means for supplying flexible binding material to said passage at said feed port, means communicating with one of said ports to induce an airflow through said passage for conveying the flexible binding material through said passage from said feed port to said discharge port while said assemblies and said elements of the latter are in sealing engagement with each other at said longitudinal and radial planes of separation, whereby the flexible binding material assumes the shape of the loosely tied knot of said passage around the object to be tied in said opening, and means for pulling in opposite directions the parts of the flexible binding material in said feed and discharge ports so that the loosely tied knot in the binding ma-

ferial is tightened around the object by contracting movement of the binding material out of said grooves and between the engageable faces and edges of said elements.

3. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 2, means supporting said assemblies for movement toward and away from sealing engagement with each other at said longitudinal plane of separation, and wherein said means for pulling the binding material includes clamping members moveable into and out of said feed and discharge ports to respectively clamp and release the binding material in said ports, and control means for said clamping members operative in response to movement of said means supporting the assemblies to withdraw said clamping members from said ports when said assemblies move together into sealing engagement at said longitudinal plane of separation, thereby to avoid interference with conveying of the binding material through said passage, and to move said clamping members into said ports for clamping the binding material therein when said assemblies move apart from said longitudinal plane of separation so that the pulling of the binding material results from the movement apart of said assemblies.

4. In a device for knotting flexible binding material around an object to be tied, the combination as in claim 2, wherein said means to induce an airflow through said passage includes a source of compressed air, conduit means connecting said source to said feed port, valve means interposed in said conduit means, and control means for said valve means effective to open the latter only when said assemblies are in sealing engagement with each other at said longitudinal plane of separation.

5. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 4, further comprising means for controlling the length of the flexible binding material that can be conveyed through said passage during each opening of said valve means.

6. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 5, wherein said means for controlling the length of the flexible binding material that can be conveyed through said passage includes a restriction at the outer end of said discharge port having a diameter less than that of the flexible binding material so that, when the leading end of the binding material conveyed through said passage reaches said restriction and closes the latter, the pressure at said feed and discharge ports becomes equalized to interrupt the airflow through said passage.

7. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 2, further comprising cutting means operative when said assemblies are moved apart a predetermined extent to move across said feed port and thereby sever the flexible binding material tightly knotted around the object from the remainder of the supply of flexible binding material.

8. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 2, further comprising means moveable with said assemblies and operative to compress the object to be tied for easy insertion in said opening of the body in response to movement of said assemblies toward engagement with each other at said longitudinal plane of separation.

9. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 2, further comprising two support arms having said assemblies mounted thereon, means pivotally connecting said support arms so that relative angular displacements of the latter result in the movement of said assemblies toward and away from engagement with each other at said longitudinal plane of separation, means for urging said arms angularly apart, and handles extending from said arms to permit manual movement of said arms toward each other, and wherein said means for pulling the flexible binding material includes clamping means

operative to clamp the flexible binding material in said feed and discharge ports, and control means for said clamping means effective to operate the latter only during the relative movement of said arms away from each other.

10. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 9, wherein said handles are crossed with respect to the related arms so that the latter are moved toward each other in response to movement toward each other of said handles and said means for urging the arms angularly apart includes a first compression spring interposed between said arms, and wherein said means to induce an airflow through said passage includes a source of compressed air, conduit means connecting said source to said feed port and having normally closed valve means therein, and control means for opening said valve means including a control lever rockably mounted on the outside of one of said handles, means operatively connecting said lever to said valve means so that the latter is opened and closed by movement of said lever away from and toward, respectively, said one handle, and a second compression spring interposed between said one handle and said lever to resist movement of the latter toward said one handle, said second spring presenting a greater resistance to said movement of the lever toward said one handle than the resistance of said first spring to movement of said arms toward each other so that said lever can be moved toward said one handle to open said valve means only after said assemblies have engaged each other at said longitudinal plane of separation.

11. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 9, wherein said control means for said clamping means includes pressure fluid operated means for actuating said clamping means, a source of pressure fluid and a duct in one of said arms for conveying pressure fluid from said source to said pressure fluid operated means, and wherein said means pivotally connecting said support arms includes a pivot pin fixed to the other of said arms and having a diametrically extending bore therein, said one arm having an opening interposed in said duct and rotatably receiving said pivot pin so that the latter acts as a rotary valve to permit the flow of pressure fluid through said duct only when said diametrical bore registers with said duct.

12. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 11, further comprising cutting means moveable into and out of said feed port to cut the flexible binding material in the latter, means normally withdrawing said cutting means from said feed port, pressure fluid operated means for moving said cutting means into said feed port, and means for supplying pressure fluid to said pressure fluid operated means associated with said cutting means including another duct in said one arm branching off from the first mentioned duct at said opening receiving said pin so that pressure fluid is supplied through said diametrical bore to said other duct when said arms are moved angularly apart to a predetermined extent.

13. In a device for knotting flexible binding material around an object to be tied; the combination of a body including two assemblies, each of said assemblies including a central plate element having two opposite faces, two end plate elements facially engageable against said opposite faces, and means securing together said central and end plate elements and yieldably urging the latter against the former, the central plate and the two end plate elements of said assemblies being engageable with each other across inner edges in a longitudinal plane of separation of said body, means supporting said assemblies for movement toward and away from engagement with each other with respect to said longitudinal plane of separation, said inner edges of the end and central plate elements of both of said assemblies having registering grooves therein defining an

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opening through said body for receiving an object to be tied, said body further having a passage and feed and discharge ports, the passage having two opposite ends, the feed and discharge ports communicating with said opposite ends of the passage and opening in generally diametrically opposed directions in said central plate elements of the two assemblies, said passage including two loop portions embracing said opening through the body in parallel, spaced apart planes and defined by grooves in the faces of said end plate elements engageable with the opposite faces of the respective central plate elements, and intertwined portions lying partly in said longitudinal plane of separation, and there defined by registering grooves in said inner edges of the central plate elements, and partly extending parallel to the median plane of one of said loop portions, and there defined by a groove in one of said end plate elements having said grooves defining said one loop portion, means communicating with one of said ports and being adapted to induce, when said assemblies are in sealing engagement with each other at said longitudinal plane of separation, an airflow through said passage conveying flexible binding material through the latter from said feed port to said discharge port and means for securing the flexible binding material in each of said ports so that, when said assemblies are moved away from each other, the portion of the flexible binding material in said passage moves out of said grooves defining said passage and moves inwardly between said inner edges and the engageable faces of said plate elements to tightly contract around the object to be tied.

14. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 13, wherein said means for securing together said central and end plate elements in each of said assemblies includes guide pins secured in said central plate element and projecting perpendicularly from the opposite faces of the latter, said end plate elements having openings therein through which said guide pins extend, the opposite ends of said pins being screw threaded, nuts on the opposite threaded ends of said guide pins, and compres-

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sion springs on said guide pins located between said nuts and the outer faces of the adjacent end plate elements to yieldably urge the latter against the related central plate element.

15. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 13, wherein each of said grooves defining said loop portions of the passage has side walls which diverge in the direction toward the face of the end plate element in which the groove is formed thereby to facilitate the movement of the flexible binding material out of the groove during its contraction around an object to be tied.

16. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 13, wherein said means operative to induce an airflow through said passage includes a source of compressed air and conduit means extending from said source to said feed port, and further comprising means for limiting the length of flexible binding material conveyed through said passage by an airflow in the latter including means defining a restriction at the outer end of said discharge port having a diameter less than that of the flexible binding material so that, when the leading end of the latter reaches said restriction, the restriction is closed by the binding material to equalize the pressures in said feed and discharge ports and thereby interrupt the airflow through said passage.

17. In a device for knotting flexible binding material around an object to be tied; the combination as in claim 16, wherein said means defining a restriction includes a tubular extension of variable length projecting from said discharge port and having a reduced diameter opening at its outer end so that, by changing the length of said extension, the length of the flexible binding material conveyed through said passage may be varied.

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