Jan. 27, 1970 J. M. LINDLER 3,491,999

VAULTING POLE WITH HELICAL WINDING HAVING SPACED APART CONVOLUTIONS

Filed March 10, 1967 2 Sheets-Sheet 1

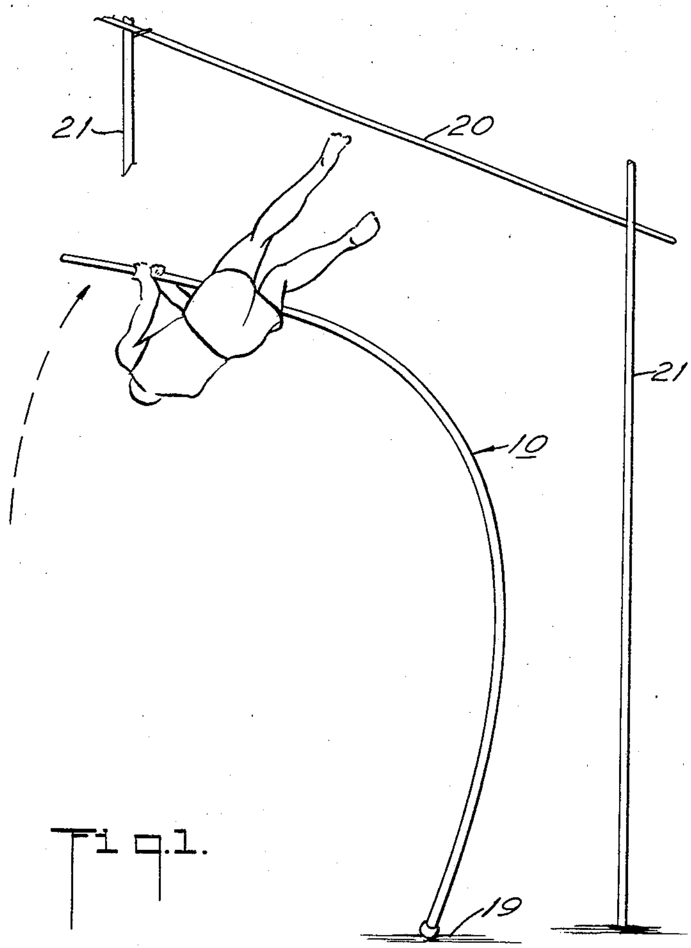

Fig. 1.

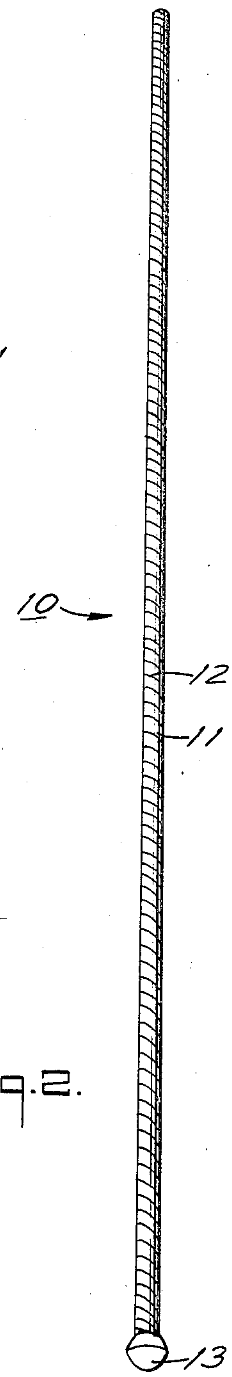

Fig. 2.

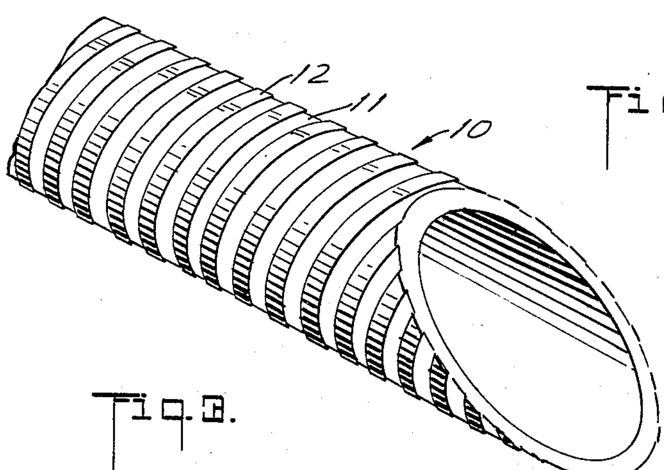

Fig. 3.

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2 Sheets-Sheet 2

Fig.6.

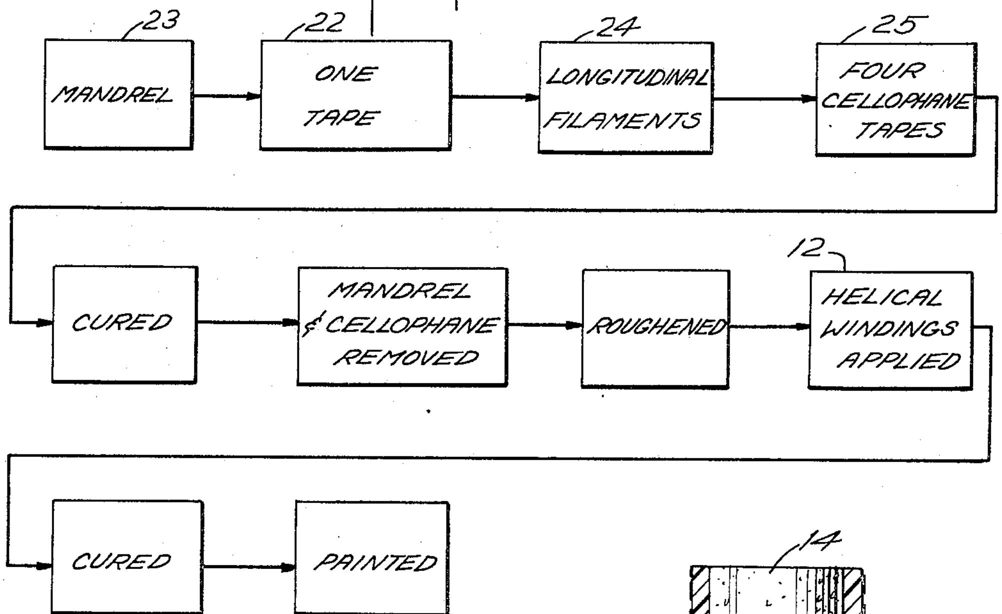


Fig.5.

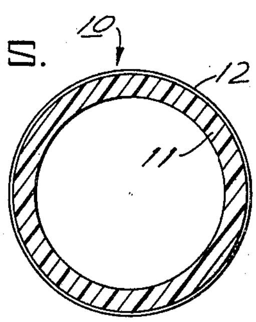


Fig.4.

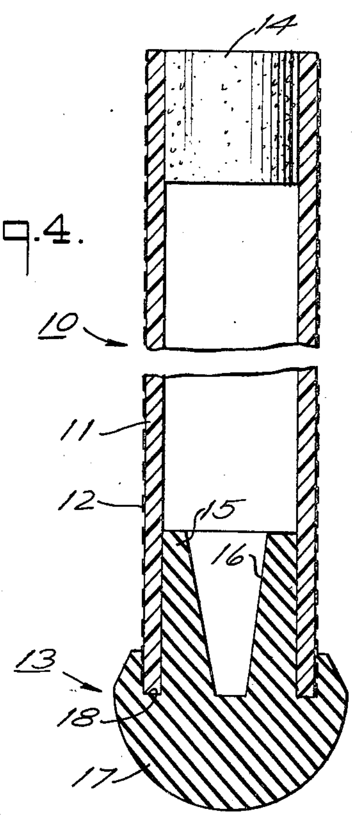
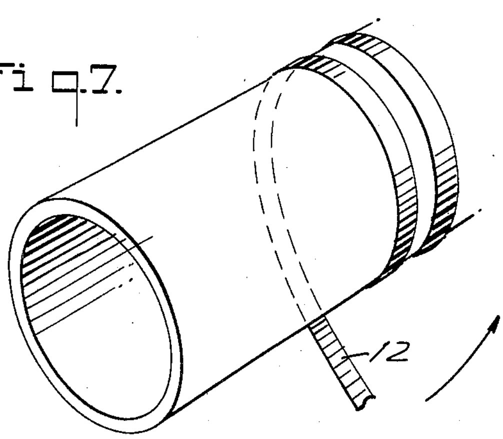


Fig.7.



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3,491,999
VAULTING POLE WITH HELICAL WINDING HAVING SPACED APART CONVOLUTIONS

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U.S. Cl. 272—59 7 Claims

ABSTRACT OF THE DISCLOSURE

A vaulting pole of hollow construction with an integral helical winding along at least a portion of the length of the pole, and a method of making the same. The pole has a glass fiber reinforced tube, and a helical winding having spaced apart convolutions of resin-impregnated glass fibers which is cured and integrally bonded to the tube.

This invention relates generally to vaulting poles for use in the sport of pole vaulting, and more particularly to vaulting poles comprised of glass fiber reinforced plastics.

In the sport of pole vaulting, the vaulter is required to clear a crossbar releasably mounted between two uprights which are spaced apart by about 12 feet. In approaching the uprights and the crossbar, the vaulter generally carries the vaulting pole with his hands spaced-apart by about 2½ feet and runs about 100 to 140 feet to build up speed. As he nears the uprights, the vaulter generally plants his vaulting pole in a slideway positioned directly below the crossbar which acts as a pivot point, shifts his lower hand up the pole until it is next to his upper hand, and then raises both hands as far as possible over his head before he leaves the ground. He is then in a position to exert the full pulling power of both arms to raise his body and to help him swing up his legs. He then runs off the ground, leaving his body hanging by his hands as long as possible, and lets his legs swing upward and to the side of the crossbar. When his legs are above the crossbar, the vaulter generally shoots his legs higher by means of a strong pull on the pole, and then turns his body face downward to convert his pulling force into a pushing force. At this point the crossbar lies beneath his stomach such that his feet are on one side of the crossbar and his head and shoulders are on the other side. Finally, the vaulter carries his body across the crossbar in a fly-away and releases the vaulting pole.

The foregoing technique requires a high degree of coordination, timing, speed of approach and gymnastic ability on the part of the vaulter. Moreover, one of the essential elements of the technique is a sure and secure grip on the vaulting pole at all times. Further, it has been found desirable that the vaulting pole bend along its length under the vaulter's weight so as to provide a spring-like catapult effect upon the vaulter, and thereby aid the vaulter in clearing the crossbar.

Heretofore, vaulting poles have been made of wood, such as bamboo, and also of metal such as aluminum, and of various lengths and diameters. Vaulting poles have also been heretofore made of glass fiber, such poles having been found preferable over wood and metal poles due to their strength, light weight, resilience, and relative consistency of characteristics under varying environmental conditions.

Briefly, this invention provides a glass fiber reinforced vaulting pole of greater flexural characteristics than heretofore used vaulting poles, including those comprising glass fiber. Further, the invention provides a vaulting pole having an integral helical grip winding which will remain relatively consistent in characteristics during the life of the vaulting pole, and which will enable a vaulter to grip the vaulting pole firmly and securely during all the phases of vaulting described above.

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The glass fiber reinforced vaulting pole described herein is formed of an elongated tube of hollow construction having an internal layer of knitted glass fiber tape or yarn impregnated with a thermosetting resin, an external sheath of longitudinal glass fiber filaments impregnated with a thermosetting resin, and an integral external helical grip winding of glass fibers also impregnated with a thermosetting resin. Adjacent turns of the winding are spaced apart about ¼ inch along the length of the vaulting pole and have a winding pitch of about ¼ inch, and the winding protrudes about $\frac{1}{64}$ inch from the sheath of longitudinal glass fiber filaments.

In forming the vaulting pole, a knitted glass fiber tape pre-impregnated with a thermosetting resin is wrapped about a mandrel, and pre-impregnated longitudinal glass fiber filaments are then laid about the tape substantially parallel to the axis of the mandrel. A plurality of cellophane tapes are then helically wound about the longitudinal glass fiber filaments, and the assembly is formed into an integral unit by curing the resins, as by positioning the assembly within an oven and heating the same through a range of curing temperatures. The cellophane and mandrel are then removed, the surface of the integral unit is roughened as by sanding, and a helical winding of glass fibers pre-impregnated with a thermosetting resin is applied to the surface of the unit. After curing and hardening of the winding, as by standing overnight, the winding becomes integrally bonded to the remainder of the unit. The integral unit is then cut to the desired length and fitted with a pivot cap at one end and a plug at its other end.

It is an object of the invention to provide a vaulting pole having an integral helically-configured gripping area.

It is another object of the invention to provide a glass fiber reinforced vaulting pole which has a helical winding to provide a gripping area for the vaulter.

It is another object of the invention to provide a glass fiber reinforced plastic vaulting pole having improved flexural properties.

It is another object of the invention to provide a method of making a vaulting pole having an integral helically-configured surface.

These and other objects and advantages of the invention will be apparent and be more fully understood from the following description and claims considered in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a perspective view of a glass fiber reinforced plastic vaulting pole of the invention in use during an ascent phase of a vault;

FIG. 2 illustrates a plan view of a vaulting pole of the invention having a helical winding on the outer surface;

FIG. 3 is a fragmentary perspective view, partly in cross section, of a vaulting pole of the invention;

FIG. 4 is a broken cross sectional view of the ends of a vaulting pole of the invention with a pivot cap and plug in place at the ends of the pole;

FIG. 5 illustrates a view taken on line **5—5** of FIG. 2;

FIG. 6 illustrates a flow diagram of a method of making a vaulting pole of the invention; and

FIG. 7 illustrates a perspective view of a manner of applying the helical winding to the vaulting pole.

Referring to the figures and in particular to FIGS. 2 to 5, vaulting pole **10** comprises a cylindrical hollow tube **11** and a helical winding **12** which is coiled around the entire length of the hollow tube **11**.

Tube **11** is formed as a laminated integral unit with an interior layer of knitted glass fiber tape impregnated with an epoxy resin, and an exterior layer or sheath of longitudinal glass fiber filaments also impregnated with an epoxy resin. The glass fiber tape is wrapped on a mandrel in overlapping helical convolutions, while the glass fiber filaments are laid over the convoluted tape substantially parallel to the longitudinal axis of the tube to form a concentric sheath about the tape. The respective resins of the tape and filaments serve to integrally bond the tape and filaments together to form the hollow tube **10**. Alternatively, instead of using a knitted glass fiber tape, a single layer or double layer of right hand and left hand close-wound glass fiber yarn impregnated with an epoxy resin can be used.

A helical winding **12** is integrally formed on the hollow tube **11** by a plurality of closely related epoxy impregnated glass fibers. These glass fibers are wound in a continuous manner about the hollow tube, as show in FIG. 7 for example, for the entire length of the tube **11**, and are integrally bonded to the tube **11** through curing of the resin of the winding **12**. Adjacent convolutions of the helical winding **12** are uniformly spaced apart, by for example about 1/4 inch, along the length of tube **11**, and are wound on the tube with a pitch, for example, of about 1/4 inch. Further, these convolutions are sized to project from the surface of the tube **11** a distance of, for example, about 1/64 inch, and to be a width of, for example, about 1/8 inch.

As shown in FIG. 4, a pivot cap **13** is in engagement with one end of the vaulting pole **10** and a plug **14** is in engagement with the opposite end of the pole to seal the respective ends of the pole. Pivot cap **13** is comprised of a resilient, slip-resistant material such as rubber. It has a tenon portion **15** with a tapered internal recess **16**, and a substantially semi-spherical head portion **17**. The two portions **15**, **17** of the pivot cap are integral with one another, the head portion **17** extending over the tenon portion **15** in a manner to form an annular recess **18** therebetween. This annular recess **18** receives one end of the vaulting pole **10** while the tenon portion **15** is bonded by adhesive, for example an epoxy adhesive within the vaulting pole **10**. Plug **14** is of a material such as cork, and is sealingly secured within the opposite end of the vaulting pole **10** by means of friction or a suitable adhesive.

Pivot cap **13** and plug **14** serve to seal the interior of the vaulting pole **10** against the entrance of dirt, moisture or other foreign matter. In addition, pivot cap **13** serves as a means to frictionally engage a slideway or vaulting starting recess or block (not shown) on the ground **19** so as to permit the vaulting pole **10** to be planted and pivoted during a vaulter's ascent over an elevated crossbar **20** releasably mounted between a pair of uprights **21** (FIG. 1).

Describing a method of making vaulting pole **10** now in further detail and referring to FIG. 6, initially an epoxy-impregnated knitted glass fiber tape **22** having a width of about 1½" is wrapped in a helical manner about a cylindrical mandrel **23** which may be of steel. The tape **22** is wrapped with a pitch or lead of about 0.35 to 0.40 inch per revolution so that successive convolutions of the tape overlap and form essentially four layers of tape on the mandrel. Next, a plurality of epoxy-impregnated glass fiber filaments **24** are applied about the tape-wound mandrel to form a sheath each of the filaments being laid substantially parallel to the longitudinal axis of the mandrel. Then, four layers of tape **25** such as cellophane are helically wound about the sheath of longitudinal filaments in overlapping convolutions to form a packaged assembly, two layers of tape **25** extending clockwise about the sheath of longitudinal filaments, and two layers extending counterclockwise about the sheath. The assembly is then hung in an oven where the epoxy resins are cured under heat to form the tape and filaments into an integral hollow tube. The oven heats the assembly at 150° F. for four hours, then at 175° F. for one hour,

then at 200° F. for one hour, then at 210° F. for one hour and then at 220° for two hours. Finally, the oven is shut off and allowed to cool for two hours before the assembly is removed.

After the assembly is taken from the oven, the mandrel is removed from the hollow tube as by pulling with a hydraulic puller, and the cellophane tapes are removed as by the impingement of hydraulic or pneumatic fluid jets. Next, the outside surface of the hollow tube is roughened as by being sanded, and a helical winding **12** of epoxy-impregnated glass fibers is then applied around the hollow tube on a pitch of about 1/4" (FIG. 7). The winding spreads to about 1/8" width while taking on a thickness of about 1/64". After standing at room temperature overnight, winding **12** becomes cured and hardened integrally to the hollow tube so as to form a length of vaulting pole.

The formed vaulting pole length can then be lightly sanded longitudinally to remove small projections and subsequently painted as with a white finish. When the finish has dried, the vaulting pole is cut to the desired length and tested. For example, the vaulting pole may be of any suitable overall diameter, such as from 1¼ to 1¾ inches, and any suitable wall thickness, such as from 1/32 to 1/8 inch, and may be cut to any desired length, such as from 12 to 16 feet. Subsequently, the pivot cap **13** and plug **14** are fitted to the vaulting pole **10** and marketing decals (not shown) are applied.

The invention provides a vaulting pole with a grip winding with uniformly spaced convolutions which enable a vaulter to grip the vaulting pole more securely and surely than heretofore, especially during the sequence of pulling and pushing vaulting phases near the top of the vaulter's ascent. Since the grip winding is an integral part of the vaulting pole there can be no slippage of the winding relative to the vaulting pole nor is there any possibility of the winding becoming unraveled or displaced on the pole during the course of use.

In addition, the invention provides a glass fiber reinforced vaulting pole which possesses greater flexural properties than possessed by prior glass fiber vaulting poles. In this regard, it has been found by comparative tests with heretofore used glass fiber vaulting poles that the vaulting pole of this invention has about 10% greater bending strength than equivalent diameter poles, as well as a greater degree of flexure and resilience. The glass fiber reinforced vaulting poles of this invention have been bent such that the ends of the pole each define an angle of 80° with respect to the plane between the ends of the pole without the pole cracking or becoming permanently deformed.

It is believed that the greater bending strength and flexure of the poles of this invention are developed through the coaction between the cylindrical hollow tube **11** and the helical winding **12**. That is, as the hollow tube flexes under the forces imposed by the vaulter (see FIG. 1), the helical winding acts as reinforcement in tension against the hollow tube and, where other poles might fail under certain bending stresses and strains, the helical winding of the pole of the invention serves to prevent failure at these stresses and strains. Further, it is also believed that the greater resilience of the poles of this invention are at least in part obtained because the hollow tube and helical winding have different spring characteristics due to the structural shape and formation of each, and the spring characteristics augment and complement each other to provide a greater degree of resiliency and reaction during the fly-away phase than heretofore achieved. This adds an additional catapult-like effect to the vaulter's own capabilities and the bending strength qualities of the pole to enable the vaulter to vault greater heights than might be otherwise obtained.

Having described particular embodiments of invention, it is not intended that it be so limited, as changes may be readily made therein without departing from the scope of the invention. Accordingly, it is intended that the foregoing Abstract of the Disclosure and description, and the accompanying drawings be interpreted as illustrative and not in a limiting sense. For example, while epoxy resins have been referred to above, other resins can also be used, such as for example, a polyester resin.

What is claimed is:

1. A vaulting pole characterized by a tube comprised of resin-impregnated glass fibers; and a helical winding comprised of resin-impregnated glass fibers which is integral with said tube and extends along at least a portion of the length of the tube on the outside surface thereof, wherein adjacent convolutions of said helical winding are spaced-apart from one another and wherein the convolutions of said helical winding extend outwardly from the outside surface of said tube.

2. A vaulting pole as set forth in claim **1** further comprising a pivot cap engaged with one end thereof and a plug engaged with the opposite end thereof.

3. A vaulting pole as set forth in claim **2** wherein said pivot cap and said plug are each engaged with said tube in a fluid-tight relationship therewith.

4. A vaulting pole as set forth in claim **1** further comprising a pivot cap sealingly engaged with one end of said pole and a plug sealingly engaged with the opposite end thereof, and wherein adjacent convolutions of said helical winding are spaced apart by about ¼ inch and

each convolution of said helical winding extends about $\frac{1}{64}$ inch from the outside surface of said tube.

5. A vaulting pole as set forth in claim **4** wherein said pivot cap is comprised of rubber and said plug is comprised of cork.

6. A vaulting pole comprising a tube and an integral helical winding of resin impregnated glass fibers extending along at least a portion of the length of said tube, said helical winding having a plurality of convolutions disposed in spaced apart relationship from one another and projecting from the surface of said tube.

7. A vaulting pole as set forth in claim **6** wherein said tube is comprised of resin impregnated glass fibers.

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