United States Patent [19]

Shwayder et al.

[11] **3,777,517**

[45] **Dec. 11, 1973**

[54] **SAW AND IMPACT RESISTANT LOCK SHACKLE**

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[73] Assignee: **Warren M. Shwayder,** Bloomfield Hills, Mich.

[22] Filed: **June 7, 1972**

[21] Appl. No.: **260,397**

[52] **U.S. Cl.** **70/53,** 70/417

[51] **Int. Cl.** **E05b 67/06,** E05b 63/00

[58] **Field of Search** ..... 70/53, 38 R, 38 A, 70/38 B, 38 C, 54–56, 417, 333, 416; 29/420, 420.5

[56] **References Cited**

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[57] **ABSTRACT**

A lock shackle formed of an elongated metal core having longitudinally extending shallow grooves formed in its surface, and a thin wall tube closely fitted around the core, with the grooves filled with a matrix formed of hard carbide particles and a soft material binder.

4 Claims, 8 Drawing Figures

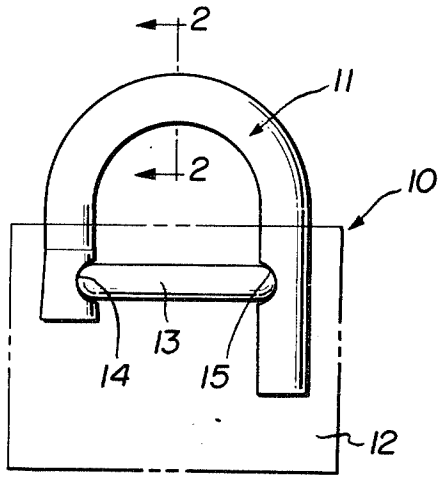


FIG. 1

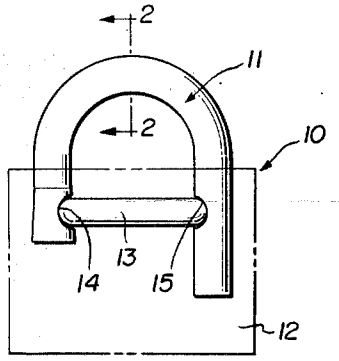
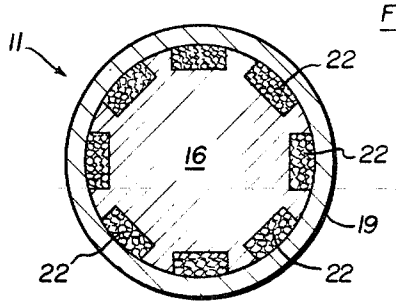


FIG. 2



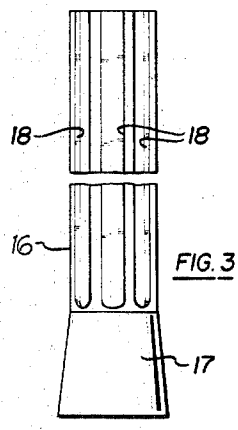


FIG. 3

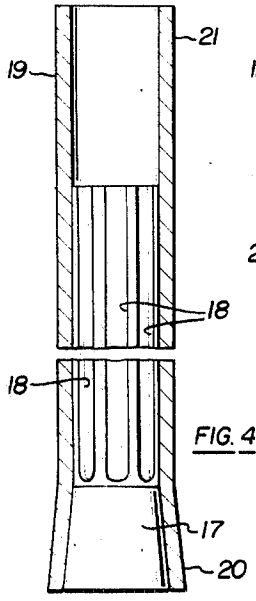


FIG. 4

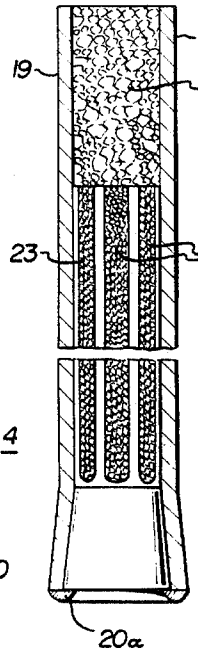


FIG. 5

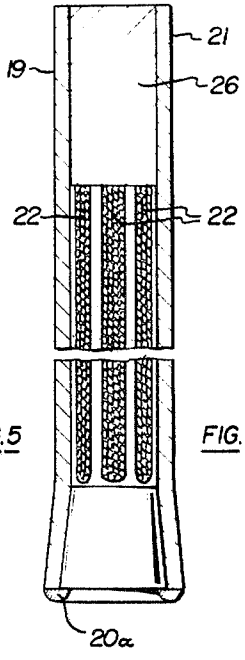


FIG. 6

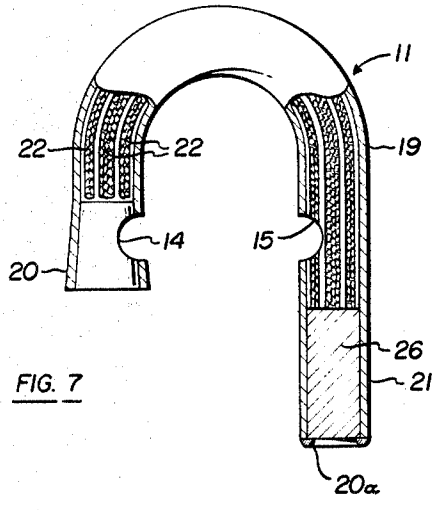


FIG. 7

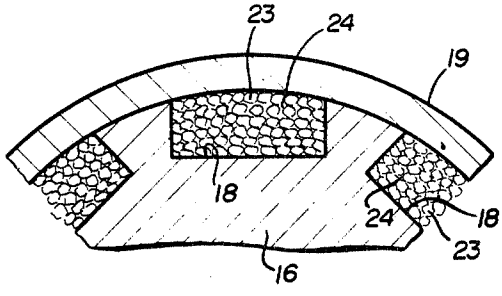


FIG. 8

SAW AND IMPACT RESISTANT LOCK SHACKLE

BACKGROUND OF INVENTION

Padlock shackles are generally made of steel rods bent into the U-shape of a shackle and heat treated for hardness. These conventionally used shackles have only a limited resistance to saw cutting and virtually no resistance to cutting by carbide coated saws such as rod saws. In addition, they are relatively easily broken by the impact of a heavy hammer. Moreover, they can be relatively easily stretched or elongated by insertion of chisels or wedges between a shackle loop and padlock casing, so that they can be pulled out of the locked position. Thus, conventional padlocks, and particularly their shackles, provide no protection against a determined and sustained effort to break them. Thus, the invention herein relates to an improved shackle which is highly resistant to saw cutting, impact application and stretching.

SUMMARY OF INVENTION

The improved shackle herein comprises a conventional appearing, U-shaped, rod-like member, but formed of an elongated, inner core which is generally spline shaped in cross-section to provide longitudinally extending, shallow grooves in its surface, with a tubular sleeve closely fitted around the outside of the core, and with the grooves filled with a matrix of hard particles, such as tungsten carbide or the like, in a soft metal binder. The core and sleeve are made of a work hardenable steel. The assembly of core, matrix and sleeve is swaged to work harden the metal, elongate and form the finished diameter of the part, as well as to seal the elements together.

The finished rod-like shackle cannot be sawed through or broken by impact using any conventional means, including the extremely hard type carbide coated saws. While such a saw might penetrate through the thin sleeve, upon contacting the matrix, it is immediately destroyed so that it cannot penetrate deeply into the shackle. Moreover, the shackle will resist repeated blows or impacts of even a heavy sledge hammer without breaking, and it resists elongation or stretching.

These and other objects and advantages of this invention will become apparent, upon reading the following description, of which the attached drawings form a part.

DESCRIPTION OF DRAWINGS

FIG. 1 is a schematic view of a padlock showing the improved shackle herein.

FIG. 2 is an enlarged cross-sectional view of the shackle taken in the direction of arrows 2—2 of FIG. 1.

FIG. 3 is an elevational view of the core, per se.

FIG. 4 shows the initial assembly of the sleeve upon the core, and

FIG. 5 shows the step of applying the binder material into the grooves which have already been filled with hard particles.

FIG. 6 is a partially cross-sectioned view of the assembled rod-like member.

FIG. 7 is an elevational view, partially in cross-section, of the finished shackle.

FIG. 8 is a fragmentary, enlarged cross-sectional view of a portion of the shackle.

DETAILED DESCRIPTION

FIG. 1 illustrates a conventional padlock **10** having a shackle **11** which fits into and locks within the padlock casing or body **12.** The construction and locking parts of the casing are omitted since these form no part of the invention herein. A locking bar **13,** which is arranged within and forms part of the locking mechanism, is schematically illustrated. This bar engages notches **14** and **15** formed in the shackle to lock the shackle into the padlock casing. It should be understood that the shackle of this invention may be used with any form of padlock casing, regardless of the type of locking mechanism included therein.

The shackle is formed of a central core **16** which preferably is roughly spline-shaped in cross-section and of uniform diameter. The core lower end **17** may be flared or tapered. The core is thus provided with a number of longitudinally extending shallow grooves **18** defined by the tooth-like formation of the spline.

A tubular sheath **19** is closely fitted over the core (see FIG. **4**), including force fitting the lower end **20** of the sheath around the flared end **17** of the core. Additionally, where desired, the lower end **20** may be welded at **20a** to the core lower end. As illustrated in the drawing, the tube is preferably of greater length than the core so that its upper end **21** extends a distance above the upper end of the core.

The grooves **18** are filled with a matrix **22** formed of hard particles **23** (see FIG. **8**) and a binder **24.** The particles are preferably of a hard metal carbide such as tungsten carbide, either cast or cemented, or other similar carbide particles which have high degrees of hardness. The binder may be of a soft metal material, such as copper braze or other suitable brazing materials. The particles are closely packed within the grooves and the spaces between them are filled with the binder to form a solid matrix.

METHOD OF MAKING SHACKLE

A method of forming the improved shackle herein is as follows: First, the core **16** is formed with the longitudinally extending shallow grooves and the flared end **17** (see FIG. **3**). Next, the thin walled tubular sheath is forced into position around the core, as illustrated in FIG. **4.** Then, the hard particles are poured into the grooves, with the rod arranged upright as shown in FIG. **5,** to form a packing of particles within the grooves. The space at the upper end **21** of the tube **19** may then be filled with pellets or beads or powder of the brazing compound, such as copper brazing pellets **25,** and while the rod is held upright, it is heated to melt the braze which flows downwardly, filling the spaces between the particles. Preferably enough braze is placed into the tube, so that the upper end **21** of the tube is filled with braze material above the upper end of the core. When the rod is permitted to cool and the braze to solidify, a slug **26** of braze fills the upper end of the sheath (see FIG. **6**).

Next, the composite rod is swaged to reduce its diameter to required size, while simultaneously elongating it and more importantly, work hardening the metal forming the sleeve and the core. Both of these metals are selected from the work hardenable steels, with the tube preferably being of a stainless steel material to provide a greater toughness, corrosion resistance, improved appearance, etc.

After the swaging, the rod is of uniform cross-section, the flared portion being reduced to the common diameter of the rod.

Thereafter, the rod may be bent into the U-shaped shackle form illustrated in FIG. 7 and the notches **14** and **15** formed therein. The notch **14** may be easily cut into the shackle since it is arranged in the area of the end of the core where there is no matrix material. On the other hand, the notch **15,** located in an area where there is matrix material, may be formed either by a suitable deformation process or electrical or heat cutting method.

Alternatively, the area into which the notch **15** is formed may be made without the groove and matrix so as to permit easy notching.

The portion of the shackle below the notch **15,** that is, where the slug **26** of braze fills the tube, is concealed within the padlock casing and does not carry any unexpected loads. Thus, the slug **26** simply functions as a filler, as a place where openings may be easily drilled through for various types of locking mechanisms, and also as a heat conductor to remove heat which may be applied to the shackle.

EXAMPLE OF CONSTRUCTION

While the materials and the sizes and shape of the shackle may vary, an example of its construction is as follows: A one-half inch diameter spline formed of work hardenable 304 stainless steel rod was provided with six grooves, equally spaced apart around its surface, the grooves being approximately 0.12 wide by 0.08 deep. The grooves were filled with cemented tungsten carbide grit of approximately 12/20 mesh size. The tube or sheath was made of approximately nine-sixteenths outside diameter, with a wall thickness of approximately 0.028 inches and formed of 304 stainless steel tubing. Conventional copper braze was used as the binder.

After the assembly, the rod was swaged down to a little less than one-half inch in diameter. The swaging also work hardened the material to roughly Rockwell c-10.

The bent shackle resisted penetration by and destroyed all available saws, including carbide coated ones of the rod-saw type, sustained in excess of 16,000 pounds tensile test and resisted breakage by repeated pounding with a conventional four pound hammer. All of the foregoing results were far in excess of any possible results achieveable in conventional shackles.

While the rod-like construction and method are described in connection with shackles for padlocks, it may likewise be used in other applications where similar types of penetration resistance, impact resistance and stretching resistance is desired, such as for example, protective bars, jail bars, locking bars, etc. Likewise, the cross-sectional shape may be varied as may the shape of the grooves or passageways or spaces which are arranged between the core and the sheath.

Having fully described an operative embodiment of this invention, we now claim.

1. In a lock shackle formed of an elongated, rod-like member bent into a shackle shape, the improvement comprising:

said member being formed of an elongated metal core surrounded by a closely fitting, thin metal sheath, with longitudinally extending shallow passageways formed between the core and the sheath;

said passageways being filled with a matrix formed of closely packed particles of a hard material, such as a metal carbide, and a binder material.

2. A construction as defined in claim **1,** and said core being approximately spline shaped in cross-section, that is, with longitudinally extending tooth-shaped formations arranged around its periphery to define said passageways therebetween, and said sheath being in the form of a metal tube closely fitted upon the core for contact with the outer peripheral surfaces of said tooth formations.

3. A construction as defined in claim **2,** and the sheath having an end portion extending a distance beyond one end of the core and filled with binder material, with the opposite end of the core having a short end portion which is ungrooved and in full surface to surface contact with the adjacent interior surface of the sheath.

4. A construction as defined in claim **1,** and said metal being characterized by being work hardenable, and said member being work hardened.

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