

- [54] **APPLICATOR FOR SURGICAL CLIPS**
- [75] Inventor: **David Frederick Weston, Runcorn, England**
- [73] Assignee: **Imperial Chemical Industries Limited, London, England**
- [22] Filed: **June 22, 1973**
- [21] Appl. No.: **372,510**

Related U.S. Application Data

- [63] Continuation of Ser. No. 56,519, July 20, 1970, abandoned.

Foreign Application Priority Data

July 29, 1969 Great Britain..... 37944/69

- [52] U.S. Cl. **72/410, 81/43, 128/326**
- [51] Int. Cl. **B21d 9/08, B25b 9/02, A61b 17/12**
- [58] Field of Search 30/123, 134, 181; 72/409, 72/410; 81/43, 342, 345, 349, 351, 428; 128/321, 322, 330, 346, 354, 326

[56] **References Cited**

UNITED STATES PATENTS

774,142	11/1904	Brick	30/181 X
1,633,237	6/1927	Whitlow.....	81/345 X
1,714,822	5/1929	Segal.....	128/354

FOREIGN PATENTS OR APPLICATIONS

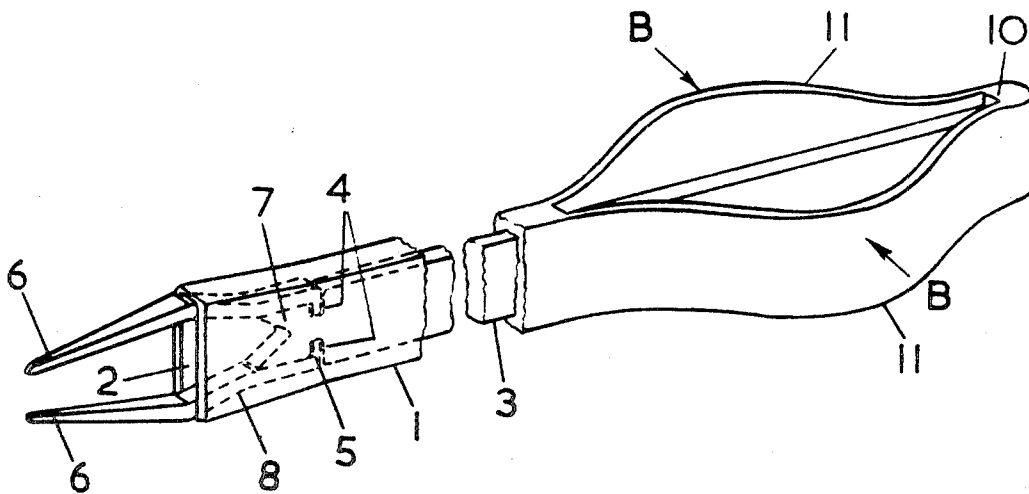
66,539	3/1948	Denmark	81/345
902,641	9/1945	France.....	128/354
962,626	7/1964	Great Britain.....	128/354
937,416	8/1948	France.....	128/354

Primary Examiner—Charles W. Lanham
Assistant Examiner—E. M. Combs
Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

A hand-operated applicator for use with surgical clips, such as wound clips, comprising a pair of elongate members, one of which is capable of axial movement within a longitudinal cavity in the other, and a pair of jaws projecting from the cavity resiliently biased into an open position and connected to the inner elongate member so that the said axial movement causes the jaws to close against the bias. Clips are fitted into the jaws, preferably from a magazine. The applicator can be made entirely from plastic material but it may be preferred to make the small jaw members from steel. The cost could be low enough to allow the applicator to be supplied pre-sterilised and thrown away after one operation.

1 Claim, 5 Drawing Figures



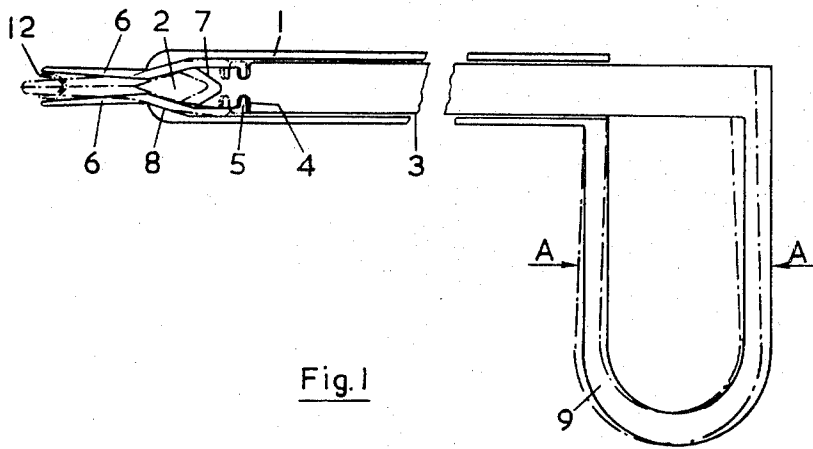


Fig. 1

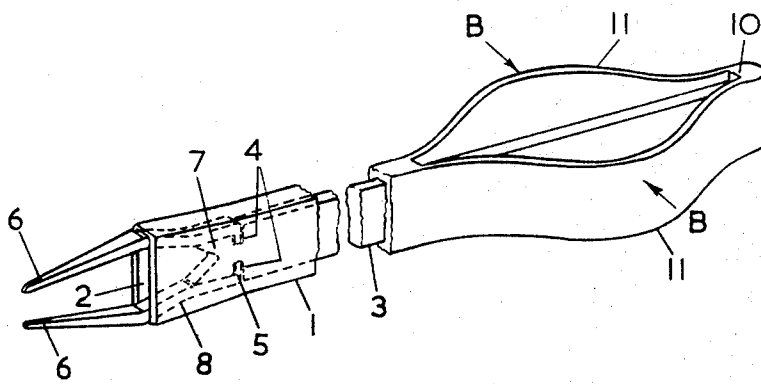


Fig. 2

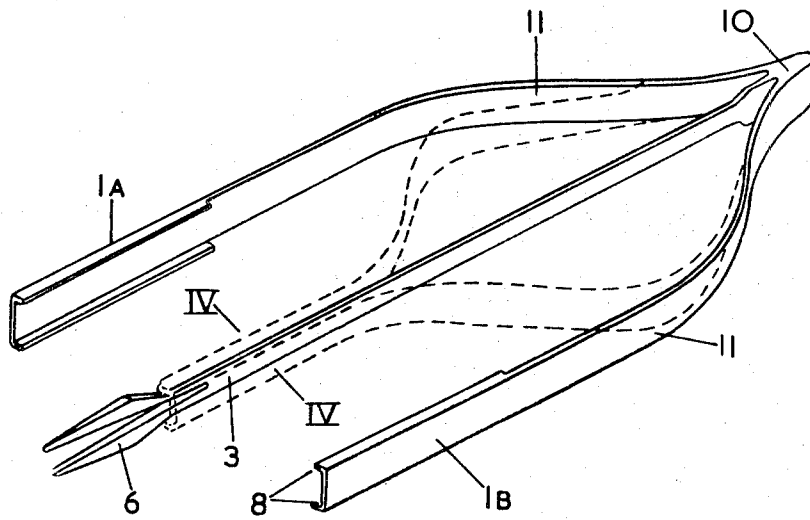


Fig. 3

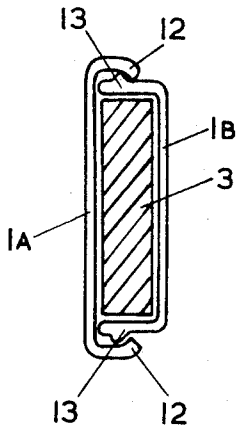


Fig. 4

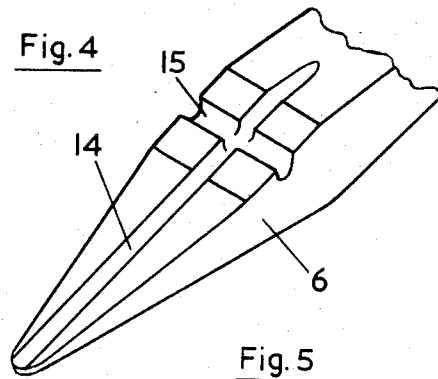


Fig. 5

APPLICATOR FOR SURGICAL CLIPS

This is a continuation of application Ser. No. 56,519 filed July 20, 1970, now U.S. Pat. No. 3,774,438.

This invention relates to applicators for use with surgical clips such as artery clips or the like.

Clips with which this invention is concerned comprise small, substantially V-shaped pieces of metal or the like which may be deformed by moderate force so as to cause the arms of the V to come together and to remain in this deformed position, thus clamping an artery or the like located between the arms of the V. Clips of this type will hereinafter be referred to as "deformable clips" or, simply "clips."

It is current surgical practice to use small, inert (e.g., of tantalum, stainless steel or silver) deformable metal clips, to hold together wound-edges or to clamp arteries before they are severed in surgical operations. The clamping of arteries, for example, is commonly performed by manually inserting a deformable clip in a pair of sterile forceps, and then deforming the clip into its clamping position by means of the forceps.

The forceps commonly used are precision made in surgical quality stainless steel and have to be re-sterilised between surgical operations. Thus they have a high initial cost plus the recurrent cost incurred in successive sterilisations. Attempts to use disposable plastics forceps for this purpose have not proved entirely satisfactory, as it is difficult to make them sufficiently robust while remaining aesthetically acceptable to the surgical profession. The main limitation in streamlining the design of the aforementioned plastics forceps resides in accommodating the large bending moments which have to be withstood by the arms of the forceps.

We have now devised an applicator suitable for use with clips of the type referred to in which only compressive and tensile stresses are generated in the activating members, thus enabling a slimmer design to be used, especially when constructed from plastics materials.

According to the present invention, an applicator for use with a surgical clip of the type referred to comprises a pair of elongate members, one of which fits within an elongate cavity in the other and is capable of axial movement therein, means for causing relative axial movement between the two members, and means by which a pair of movable jaws are retainable within said cavity with one end of each jaw protruding from the cavity, its other end being engagable with the inner member so that the jaws execute a similar axial movement therewith, the walls of the cavity being provided with bearing surfaces adapted to co-operate with corresponding surfaces on the jaws whereby the said relative axial movement causes the jaws to come together in a gripping motion.

The jaws may be permanently retained within the cavity in permanent engagement with the inner member and, in some embodiments, may be formed integrally with it. Preferably the jaws are resiliently biased into an open position so that applied relative axial movement is only required in the "gripping" direction, the return movement being caused by the said bias. This bias is conveniently achieved by the provision of a resilient member between the jaw members but remote from their gripping surfaces.

The co-operating surfaces of jaws and cavity may comprise inclined planes, or tapers, having similar inclination to minimise frictional forces between the two. For example, if the cavity is provided with an outwardly facing taper, the jaws may be closed by drawing them into the cavity, whereas in the case of a cavity having an inwardly facing taper the jaws may be closed by expelling them slightly from the cavity. It will be appreciated that either the jaws or the cavity alone may be provided with a taper.

Any suitable means may be used for causing relative axial movement between the two elongate members, the choice being largely dependent upon whether the device is intended to be hand or power operated. It will also depend on whether the design requires the inner member to be pulled or pushed to effect closing of the jaws.

The applicator may be constructed mainly or totally from plastics materials, two or three mouldings generally sufficing. These may be adapted to interlock or may be secured together by some simple assembly technique, such as welding or riveting which is readily adapted to mass-production. However, it is possible to form our applicators as one piece plastics mouldings.

Suitable plastics materials include polypropylene, polystyrene, polyethylene, and poly(4-methyl pentene-1) and their copolymers, A.B.S. copolymers, and polyamides with or without reinforcement, such as glass or other fibres or filaments. The final choice of material will depend upon the stresses liable to be generated in the particular part of the device for which it is used; for example, polypropylene is very suitable for any part which is required to withstand repeated flexure, whereas a reinforced material, e.g., glass fibre filled nylon is desirable if plastics materials are used for the jaws. When this is done, it is possible to form the inner member and two jaw members from a single piece of plastics material.

When separate jaw members are used, they may be formed, for example, with inwardly pointing hook-like ends adapted to be located within the cavity in the outer member so as to engage with recesses in the inner member which enable them to pivot and thus accommodate the gripping movement generated by relative axial movement between the two members.

If it is desired that the applicator should be pre-sterilised and disposable, it is desirable that plastics materials are used throughout in order to minimise costs, but it is also possible to use small metal jaws in an otherwise plastics applicator. In such a case, the jaws may be adapted to have a "snap-in" action so that they may be sterilised between operations, the remainder being disposable. This may represent a worthwhile saving in sterilisation time, as the jaws are small and may be readily designed to be free of narrow crevices in which bacteria and the like might lodge. However, since the clips used may be as small as 4 mm in length, the jaws need be only some 60 mm long and 6 sq. mm. in cross-section and are readily mass-produced. Thus, even when constructed from, for example, surgical quality stainless steel their cost may be small compared with the cost of repeated re-sterilisation, so that plastic applicators with metal jaws constructed according to our invention may be cheap enough to be disposable.

It is, of course, within the scope of our invention that the whole applicator may be constructed of surgical

quality stainless steel or the like to enable it to be re-sterilised many times.

Applicators according to our invention may be made in a very slim form, even in plastics materials, and may be designed to be used without hand movement across the line of sight, unlike forceps and other applicators of the scissors type. Thus it is possible for our applicators to allow access to very narrow cavities such as are frequently encountered in, for example, brain surgery and to cause a minimum of obstruction of the surgeon's vision.

It will be appreciated that when our applicators are produced as a single plastics article, e.g., a one-shot moulding, the article preferably comprises two elongate portions which are adapted to co-operate to define a cavity in which an inner member may move axially. Such an article may comprise a central elongate inner member, flanked by a pair of elongate cavity-forming members which are capable of co-operating to form an outer member which encloses the said inner member, the three members lying substantially parallel over most of their lengths, one end of each member issuing from a common, integral junction, so that the article has a generally tri-furcated appearance.

The cavity-forming members are preferably designed so as to snap together by means of co-operating grooves, ridges, studs or like expedients which make use of the natural resilience of the plastics material, to facilitate assembly of the applicator. If the jaws of the applicator are also to be of plastics material, these may be formed integrally with the rest of the device. When this is done, the plastics material must be chosen so that it possesses sufficient rigidity for the jaws to deform the clip. It has been found, for example, that nylon filled with 40 percent by volume of glass fibre is a suitable material for such applicators.

In order that the invention may be more clearly understood, three embodiments of our invention will be described, by way of example only with reference to the accompanying drawings of which

FIG. 1 is a sectional elevation of one form of applicator;

FIG. 2 is a partly cut-away isometric view of a second form of applicator;

FIG. 3 is an isometric view of a third form of applicator of one piece construction;

FIG. 4 is a section through the assembled applicator of FIG. 3 on the line IV—IV; and

FIG. 5 is an enlarged view of the end of a jaw of one of our applicators.

Like reference numerals are used throughout to designate like parts.

Referring to FIGS. 1 and 2, outer elongate member 1 is formed from polypropylene and provided with internal cavity 2 within which inner elongate member 3, also formed of polypropylene, is a sliding fit. Inner member 3 is provided near one end with recesses 4, which accommodate hook-like extremities 5 of metal jaws 6. Beyond recesses 4 but at the same end of inner member 3, integral V-shaped protruberance 7 serves to bias jaws 6 resiliently towards the inner surfaces of cavity 2. Co-operating surfaces 8 of jaws 6 and cavity 2 are provided with matching inclined planes which, in the embodiment shown in FIG. 1, serve to force jaws 6 together when inner member 3 is moved towards the left of the drawing, and in the embodiment shown in FIG.

2, movement of member 3 towards the right has a similar effect.

The end of inner member 3 remote from jaws 6 protrudes past the cavity-defining part of outer member 1. In the case of the embodiment shown in FIG. 1, a U-shaped band of polypropylene 9 links inner member 3 to outer member 1. Hand pressure applied across the limbs of the U, as indicated by arrows A, causes the tips of jaws 6 to come together in a gripping action as indicated in broken lines. In the case of the embodiment shown in FIG. 2, the outer extremity of inner member 3 is secured, e.g., by bonding or riveting, to the end 10 of polypropylene loop 11 which is formed integrally with outer member 1. Hand or finger pressure applied across loop 11, as indicated by arrows B, has the effect of closing the tips of jaws 6 in this embodiment.

Referring to FIG. 3, the applicator illustrated is of the same general form as that of FIG. 2 with the exception that it comprises a single piece of nylon reinforced by 40 percent by volume of glass fibre to impart the necessary rigidity to the jaws 6. However, outer member 1 comprises two U-sectioned members 1A and 1B which may be snapped together as shown isometrically in broken lines in FIG. 3 and in section in FIG. 4, to form cavity 2 in which inner elongate member 3 may slide. Cavity forming members 1A, 1B are retained in position by the "snap" action provided by the co-operation of ridges 12, 13 on their inner surfaces. Members 1A and 1B are located near the extremities of elongate members 11 which serve the same purpose as loop 11 in the embodiment illustrated in FIG. 2.

In the embodiment shown in FIG. 3 elongate members 11 and inner member 3, being part of a single piece of nylon, are joined integrally through bridging member 10. Jaws 6 are formed integrally with inner member 3 being biased into an "open" position by the natural resilience of the material. When fully assembled, this embodiment operates in a similar fashion to that shown in FIG. 2, with the exception that the bearing surfaces 8 of cavity 2 are not provided with tapers. It will be appreciated however, that it is possible for form applicators of this general type, but having detachable metal jaws by omitting the jaw members from the end of member 3 and substituting them by recesses 4 and V-shaped protruberance 7, as shown in FIG. 2.

The inner, or gripping, surfaces of the jaws are preferably provided with longitudinal grooves to facilitate alignment of the clip during application. Because of the scale of the drawings, these grooves are not shown in FIGS. 1 to 3; but they are illustrated in FIG. 5 which is a scrap view of one jaw on a much enlarged scale. Referring to FIG. 5, jaw 6 is provided on its inner surface with longitudinal groove 14 into which one leg of an undeformed V or U-shaped clip may be fitted. The jaw illustrated in FIG. 5 is further provided with a transverse groove 15 designed to accommodate a protrusion or like discontinuity in the leg of the clip so as to locate it in a longitudinal direction with respect to the jaws. Instead of groove 15 it is possible to provide a local constriction in the width of groove 14 which will co-operate with a suitably positioned constriction in the leg of the clip. Clips having such protruberances or constrictions are described and claimed in our co-pending patent applications.

In use a V or U-shaped clip 12 (see FIG. 1) of stainless steel or other surgically acceptable material is fit-

5

6

ted into grooves 14 (see FIG. 5) in the inner surface of jaws 6. Clip 12 is then arranged to straddle an artery or the like and deformed into a gripping or clamping position by operation of the jaws of the applicator as described above. On release of pressure from the appropriate part of the applicator, jaws 6 open under the bias of resilient member 7 or under the influence of the natural resilience of the material to enable them to receive another clip.

Although the invention has been illustrated by reference to metal artery clips, it may be used equally well with clips of other surgically acceptable materials.

As previously mentioned, applicators according to our invention may be supplied pre-sterilised and discarded after use. Sterilisation may be conveniently performed after packing the applicators in an air-tight plastics bag, by means of irradiation or ethylene oxide treatment.

What we claim is:

1. An applicator for use with a surgical clip which comprises inner and outer elongate members, one of said elongate members fitting within an elongate cavity

in the other and being capable of axial movement therein, a pair of jaws located within said cavity with one end of each jaw protruding therefrom, the other end of each jaw being connected to or engageable with the inner member so that the jaws execute a similar axial movement therewith, the jaws being resiliently biased into an open position in which the outer surfaces of the jaws extend in their plane of movement, beyond the lateral dimensions of the cavity and present backward sloping bearing surfaces to the leading edges of the walls of the cavity, the said elongate outer member being provided with a loop-like extension disposed remote from the jaws, said extension comprising a pair of outwardly bowed, resilient limbs which straddle the inner elongate member, the outer ends of said limbs and the outer end of the inner member being coupled rigidly together, so that inward pressure on the said bowed limbs causes the jaws to be drawn into the cavity and hence to be forced together in a gripping motion by virtue of the interaction between said backward sloping bearing surfaces and walls of the cavity.
* * * * *

25

30

35

40

45

50

55

60

65