

Feb. 4, 1964

J. F. SKOLD

3,120,230

SURGICAL CLAMP

Filed Oct. 24, 1960

Fig. 1

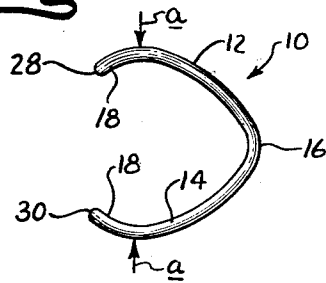


Fig. 2



Fig. 3

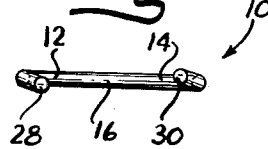


Fig. 5

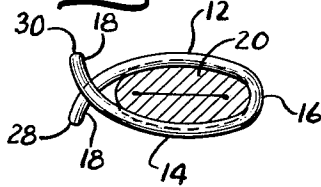


Fig. 4

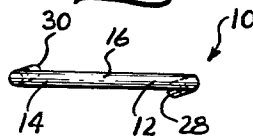


Fig. 6

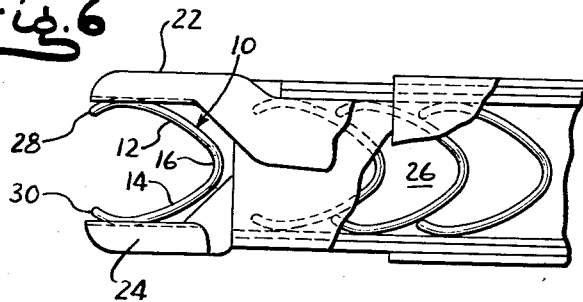
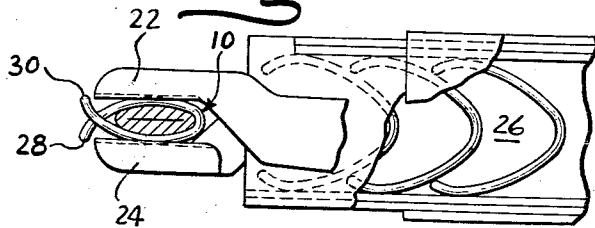


Fig. 7



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SURGICAL CLAMP

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Filed Oct. 24, 1960, Ser. No. 64,551

1 Claim. (Cl. 128—325)

The present invention relates to a surgical clamp of the type which is shown and described in my copending application Serial No. 763,402, filed on September 25, 1958, and entitled "Application for Surgical Clamps," now Patent No. 2,968,041, of which application the present application is a continuation-in-part.

The invention is specifically concerned with a novel form of surgical clamp designed for use during the course of surgery and adapted to be applied to a vein, artery or other blood vessel, either directly or in combination with surrounding anatomical tissue, to constrict the same in a localized region thereof in such a manner that, after the clamp has been effectively applied to the vessel, the latter may be severed in the vicinity of the clamp to prevent issue of blood therefrom.

The constriction of blood vessels during the course of surgery for the purposes briefly outlined above has involved the use of surgical thread, frequently necessitating considerable skill on the part of the surgeon and, in any event, involving prolonged manual operations and the use of both hands, as well as, in many instances, professional assistance by an attending surgeon or nurse. Due to the fact that the severing of a blood vessel usually requires that the severed vessel be twice constricted, one on each side of the region of severance, the performance of each severing operation must be preceded by manual preparatory procedures which greatly lengthen the operating time.

The surgical clamp of the present invention is designed to overcome the above-noted limitations that are invariably attendant upon surgery involving the severing of blood vessels and, toward this end, it contemplates the provision of a novel metallic clamping element capable of being deformed by contracting the same about the blood vessel and which, when so deformed or contracted, and the deforming or contracting force or pressure relieved, will retain its shape and maintain the vessel constricted at the region of application of the clamp with a view toward leaving the clamp in position on the vessel permanently, although in certain instances it may be desired to remove the clamp after it has served its desired purpose.

It is contemplated that the surgical clamp be formed of a material which is durable in that it will last indefinitely, is not subject to deterioration or to attack by body acids, and that, in its environment within the body, the clamp will not set up any galvanic action or otherwise be subject to electrolysis.

The clamp also is possessed of surface smoothness, offers a low coefficient of friction to the surrounding body tissue, is devoid of sharp protuberances so that it may conveniently be applied with a minimum of resistance to deformation thereof during application and thereafter borne by the patient with a minimum of irritation and with maximum comfort.

The surgical clamp of the present invention per se possesses the above noted advantages of use, and it also is so designed that, by the use of the surgical instrument shown and described in my above-mentioned copending application, or by the use of an instrument which will serve a similar purpose, it may be effectively and accurately applied to the blood vessel or tissue with a minimum of effort and without taxing the skill of the surgeon. The present surgical clamp is additionally designed so that a large number of the clamps may be conveniently

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nested in stacked relationship within the magazine of such a surgical instrument so that the stack will consume a minimum of space, thereby increasing the number of clamps which any given magazine may hold.

The provision of a surgical clamp of the character briefly described above and possessing the stated advantages of construction and use, being among the principal objects of the invention, numerous other objects and advantages will readily suggest themselves as the following description ensues.

In the accompanying single sheet of drawing forming a part of this specification a preferred embodiment of the invention has been shown.

In these drawings:

FIG. 1 is a plan view of a surgical clamp constructed in accordance with the principles of the present invention;

FIG. 2 is a side elevational view of the structure shown in FIG. 1;

FIG. 3 is a front end view of the structure shown in FIG. 1;

FIG. 4 is a rear end view of the structure shown in FIG. 1;

FIG. 5 is a sectional view taken substantially transversely through a blood vessel showing the improved surgical clamp operatively applied thereto;

FIG. 6 is a fragmentary side elevational view of the tip end of a clamp applicator showing a limited portion of the applicator magazine and illustrating the manner in which a series of the surgical clamps may be nested within the magazine with the foremost clamp in position for ready application to a blood vessel; and

FIG. 7 is a fragmentary side elevational view similar to FIG. 6 showing the manner in which the clamp is constricted by the applicator during surgery.

Referring now to the drawings in detail and in particular to FIGS. 1 to 4 inclusive, a surgical clamp constructed in accordance with the principles of the present invention has been designated in its entirety at 10 and it is of generally V-shape configuration. The clamp is in the form of a length of stainless steel or other non-corrosive wire stock bent into such V shape. The material of the clamp is readily deformable and it possesses no appreciable degree of resiliency other than that required to enable it to retain its shape after it has been clamped in position around a blood vessel or body tissue. Stated in other words, after the clamp has been deformed and the deforming pressure relieved, the clamp will retain the shape to which it has been deformed with no appreciable tendency to spring back to its original shape.

The clamp includes generally parallel diverging bowed arms 12 and 14 respectively of slight curvature which are joined together at a relatively sharp apex region 16. The distal end regions of the arms 12 and 14 are turned inwardly as at 18 to provide reentrant portions of small extent. These intumed end regions 18 are afforded by gradually decreasing the radius of curvature of the arms 12 and 14 progressively from the apex region 16 outwardly toward the distal ends of the arms. As shown in FIGS. 2 to 4 inclusive, when viewed edgewise from any angle, all portions of the clamp are substantially but not precisely coplanar, the extreme distal ends 28 and 30 of the arms being slightly laterally offset from each other for a purpose that will be made clear presently. These extreme distal ends are of blunt rounded convex configuration, thus avoiding sharp edges which, otherwise, might effect rupture of a blood vessel during application of the clamp.

The clamp is adapted to be applied to a blood vessel such as the one shown at 20 in FIG. 5, or to a section of body tissue within which there is embedded such a blood vessel, by causing the arms 12 and 14 to straddle

the blood vessel and thereafter applying inward pressure to the arms at approximately the regions designated by the opposed arrows *a-a* in FIG. 1. Such inward pressure may be exerted by the opposed surfaces of a pair of jaws 22 and 24 associated with a magazine-type surgical applicator instrument of the type shown and described in my aforementioned copending application although other types of applicators may be devised for use in connection with the clamps 10, including ordinary surgical pincers-type instruments. Where a magazine-type applicator is employed, the clamps are capable of assuming the closely nested relationship in the applicator magazine 26 illustrated in FIGS. 6 and 7.

Upon constriction of the clamp 10 about a blood vessel or body tissue, the distal end regions of the arms 12 and 14 will cross each other as shown in FIG. 5 although where large diameter blood vessels such as arteries are concerned the distal ends of the arms need not necessarily cross each other during such application of the clamp. The extreme ends 28 and 30 of the arms 12 and 14 respectively may or may not penetrate and puncture the adjacent body tissue, depending of course upon the physical character of the region being operated upon, as well as upon the degree of pressure applied by the surgeon.

It has been stated above that upon application of the clamp 10 to a blood vessel or body tissue the distal end regions 18 may cross each other and, in order to insure such crossing of the arms and to preclude the dangerous possibility of the ends of the arms blocking each other during constriction of the clamp with a consequent possible jamming of the applicator instrument, or misapplication of the clamp to the body of a patient, the clamps may be made with precision accuracy to effect a relative lateral offset between the extreme ends 28 and 30 thereof of a few thousandths of an inch, an offset of even one-thousandths of an inch being sufficient to prevent mutual blocking by these arm ends.

After the clamp has been applied to the body of the patient as described above and the applied pressure relieved, the clamp will retain substantially its constricted condition due to the fact that the material from which it is formed lacks any appreciable degree of springiness or resiliency. It is within the scope of the present invention however to form the clamp 10 from material which does possess a limited degree of resiliency, in which case the surgeon being apprised of this fact will make allowances during application of the clamp and effect an over-application of pressure when applying the same so that upon release of the clamp, its tendency to return toward its original shape will not effect a spring-back operation in excess of that required to maintain the blood vessel closed at the point of application of the clamp.

The specific angle of divergence between the arms 12 and 14 of the clamp 10 may vary within fairly wide limits. It has been found that a satisfactory clamp will result when the angle of divergence, as measured between respective lines of tangency at the apex of the clamp, is not greater than 90° and not less than 75°, and wherein the radius of curvature of each arm is such that the angle between respective lines of tangency at the extreme

distal ends of the arms is less than 10° when the clamp is in its undeformed free-state as manufactured.

The invention is not to be limited to the exact arrangement shown in the accompanying drawing or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit of the invention. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claim is the same to be limited.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

A surgical clamp adapted to be constricted about anatomical tissue and, in its free and undeformed state, comprising a length of non-corrosive wire stock possessing an appreciable degree of resistance to tortional and bending stresses yet lacking resiliency to the extent that its restorative power after deformation is negligible, said length of wire stock being bent into generally V-shape configuration so as to present two outwardly diverging generally arcuate equal length arms of inward concavity, the radius of curvature of said arms decreasing progressively from the apex region of the clamp outwardly toward the distal ends of the arms, each arm lying substantially wholly within a plane, and the planes of the two arms being inclined to each other at a small angle, the angle involved being such that at a distance from the apex which is equal to the length of one arm it subtends a chord substantially equal to twice the diameter of the wire stock, the distal ends of said arms being spaced apart and presenting an open mouth at least as wide as the diameter of a blood vessel or other anatomical tissue to which the clamp is to be applied whereby the clamp may be directed radially toward the vessel or tissue and the latter caused to enter said mouth so as to move within the confines of the clamp, said distal ends presenting generally rounded blunt convex surfaces which merge smoothly with the adjacent cylindrical contour of the wire stock, the resistance of the material of the clamp at the apex region thereof being such that when inward pressure is applied to the distal end regions of the arms substantially normal to the bisecting axis of the angle subtended by the arms, the clamp is collapsed upon the tissue and the latter is confined between the arms and constricted thereby while the distal end regions of the arms are caused to meet and, by a camming displacement action, move past each other into overlapping engagement.

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