

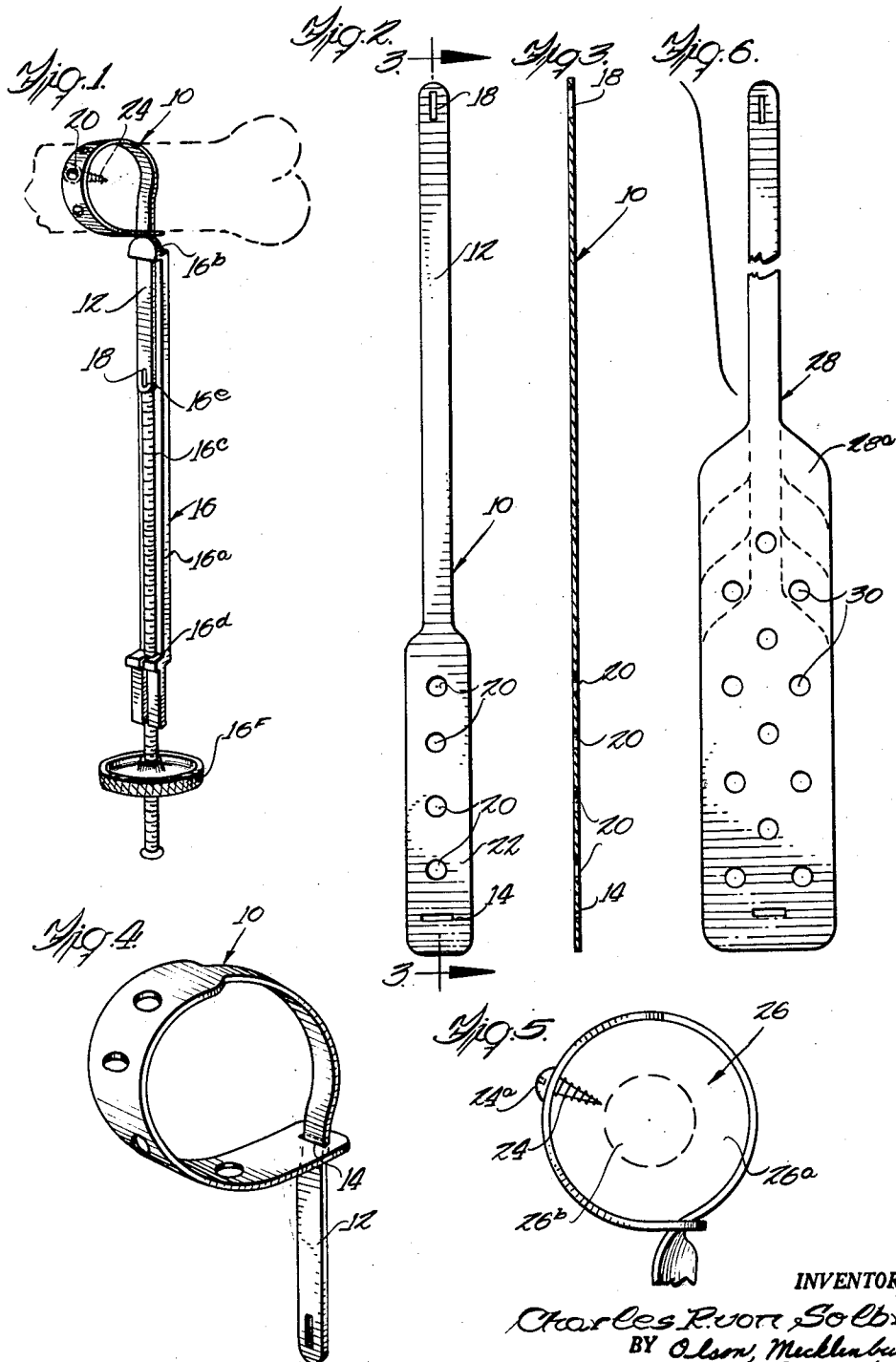
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BONE BAND AND PROCESS OF APPLYING THE SAME

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BONE BAND AND PROCESS OF APPLYING THE SAME

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This invention relates generally to the reduction and fixation of fractured bones, and more particularly to the combination of a flexible band for wrapping around a fractured bone and fastening means for positively securing the band to the bone. The invention also relates to the process of applying the aforementioned combination to a fractured bone.

To effect proper healing of fractured bones of human beings and other animals, it is necessary to restore the bone segments to their normal position—that is to say, to “reduce” the misplaced bone parts—and to provide some means to retain the segments in such a position until they have had an opportunity to knit. The retaining means will generally remain in the body throughout the process of healing and will not be removed once healing is completed. Such means are usually only removed in the event there is irritation or infection resulting from their presence in the body. Consequently, such retaining devices should be constructed only as large as necessary, should be easy to apply, and should not be composed of materials that may induce infection or cause other harm to the body.

Various means have been used heretofore to retain reduced parts of fractured bones in their proper position. One such means is the intramedullary pin, an elongate, round or diamond-shaped, stainless steel pin of varying lengths, which is applied longitudinally with the bone and is invariably introduced into the highly vascular, soft tissue (marrow or medulla) filling the cavities of most bones. This invasion of the bone marrow cavity causes the circulation of blood therein to be impeded and results in at least partial destruction of tissue. Reduced fractured bones are also retained in place by the Parham Band, a thin, flat elongate flexible element, which is wrapped around the fractured bone segments and tensioned thereto by means of a clamp or similar tightening instrument. This band tends to slip and frequently fails to prevent the bone parts from migrating after reduction.

Moreover, because the band is quite narrow, several are often required in a particular application, multiplying the chances that they will slip and complicating and lengthening the surgery. Suture wire represents still another device for retaining in place reduced fractured bones, but this wire is only used where Parham Bands or the like cannot be used. The wire is more difficult to apply than the aforementioned band and, to even a greater extent than the latter, tends to slip from the bone. Accordingly, it is one important object of this invention to provide a device for use in the reduction and fixation of fractured bones which, after it has been applied to the bone, will not slip and will hold the bone segments in place.

It is another object of this invention to provide a device for use in the reduction and fixation of fractured bones which will not impede blood circulation in the marrow cavity and will not destroy bone marrow.

Another object is to provide a device which may be used to retain in their reduced position the small bone fragments resulting from comminuted fractures—that is, fractures in which the bone is shattered into several pieces.

It is a further object of this invention to provide for use in the reduction and fixation of fractured bones a device which may be simply and economically constructed.

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It is a still further object of this invention to provide a process for retaining fractured bones in their reduced condition, which will not result in the destruction of bone marrow and can be carried out in a quick, efficient and safe fashion.

Further and additional objects will be apparent from the drawings, description and claims.

In one form of this invention a band is provided which comprises a flexible member having a slender tip adjacent one end thereof and a slot adjacent the other end thereof for receiving the tip when the band is formed into a looped position. The band is perforated with a plurality of apertures; and, when the band is wrapped about a bone, fastening means are inserted into the bone through at least one such aperture. In this way the band is securely fastened to the bone and will not slip therefrom, and the bone parts are prevented from shifting.

This invention may be applied to a reduced fractured bone by looping the band around the bone, interconnecting the opposed ends of the band by inserting the slender tip of the band into the slot therein, tensioning the band with a tightening instrument or any other suitable means, securing the opposed ends together, and applying fastening means, such as a screw or a nail, through at least one of the apertures of the band and into the bone. Preferably, the fastening means should penetrate only the outer portion or cortex of the bone; it should not enter the marrow.

The product of this invention is especially useful in comminuted, transverse, and oblique fractures. It may be used alone in most applications, but may be used in conjunction with other devices where desirable. For example, in certain types of severe comminuted fractures the present invention may be used with intramedullary pins to retain the bone fragments in place.

To further illustrate this invention, drawings have been provided as follows:

FIGURE 1 is a perspective view showing the band of the present invention as applied to the bone with a clamp and with a fastening means inserted into the bone through one aperture of the band.

FIG. 2 is a plan view of one embodiment of the band of the present invention before it has been applied to a bone.

FIG. 3 is a cross section taken along line 3—3 of FIG. 2.

FIG. 4 is a perspective view showing the embodiment of FIG. 2 with its opposed ends interconnected.

FIG. 5 illustrates a cross section of a bone with the band shown in FIG. 2 applied thereto and with a threaded member inserted into the bone through one of the apertures of the band.

FIG. 6 is a plan view of a modification of the embodiment of FIG. 2.

Referring now to the drawings, and particularly to FIGS. 2 and 3, a thin, flexible, substantially non-elastic band 10 is provided, which is generally constructed of high-quality stainless steel. The band 10 has a slender tip 12 and a slot 14 at the opposite end. The slot 14 must be constructed sufficiently long and wide to receive the tip 12, which is inserted through the slot 14 when the band is looped about a bone (see, for example, FIG. 4). Thus, the portion of the band containing the slot 14 must be wider than the slender tip 12. One particular form of band 10 has an overall length of approximately seven inches, of which about 4¾ inches comprises the slender tip 12 and about 2½ inches consists of a somewhat wider portion 22. The tip 12 is about ⅜ inch wide and the wider portion 22 about ½ inch wide. The aforesaid form of band 10 is less than ⅛ of an inch thick.

The band 10 is perforated with a plurality of apertures

20 which are located on the wider portion 22 of the band. In FIG. 2 the band 10 is shown having four apertures, each of which may be approximately $\frac{3}{16}$ of an inch in diameter, arranged along a straight line substantially parallel to and equidistant from the longitudinal edges of the band. It will be understood, however, that more or fewer apertures of varying sizes may be used where desirable and, moreover, that the apertures need not be positioned as shown in FIG. 2. For example, FIG. 6 illustrates a modification 28 of band 10, which contains a considerably wider portion 28a than the corresponding portion 22 of band 10, the modified portion being about one inch in width. Located on portion 28a are twelve apertures 30 arranged in three rows, rather than four apertures arranged in one row, as on band 10. The dotted lines on the band, shown in FIG. 6, illustrate that the portion 28a of modification 28 may be shortened and the number of apertures therein decreased. The same, of course, is true of the corresponding parts of the embodiment of this invention illustrated in FIG. 2.

The band is applied by wrapping it around the bone and inserting the slender tip 12 into the slot 14, as shown, for example, in FIGS. 1 and 5. FIG. 4 illustrates most clearly the manner in which the tip 12 is inserted into the slot 14. The band is then tightened to the desired tension by clamp means 16, shown in FIG. 1, which operates on a principle similar to that employed by a turn-buckle. Clamp means 16, comprises a frame 16a, which is provided with an aperture 16b in the upper portion thereof, and a threaded member 16c rotatably connected to the frame 16a through a threaded aperture 16d, the threaded member having a protuberance 16e on the upper end and a knob 16f on the lower end. After the band 10 has been looped about the bone and the tip 12 has been inserted through the slot 14, the clamp means 16 is connected to the band by inserting the tip 12 through the aperture 16b and securing the tip to the threaded member 16c by inserting protuberance 16e into the slit 18 provided in tip 12. As the knob 16f is turned, the threaded member is actuated in either a downward or upward direction and the band 10 is thereby tightened or loosened. Tightening to the bone is effected by actuating the threaded member with the slender tip 12 attached thereto downward until the upper portion of clamp means 16 abuts the band 10 and then continuing the downward movement of the threaded member until the desired degree of tension is attained. Once the band has been properly tightened, the tip 12 is twisted or secured in some other way to prevent it from slipping back through slot 14, the clamp means 16 is removed, and the surplus band, if any, is severed by suitable cutting means.

After the band is looped about the bone and tightened thereon, a screw 24, nail, or other fastening means, generally constructed of high quality stainless steel, is applied transversely to the bone through one of the apertures 20, as illustrated in FIGS. 1 and 5. More than one fastening means may be used where necessary. By using fastening means, such as screw 24, the band is thus prevented from slipping off the bone segments and the bone portions are prevented from shifting from their reduced positions, two problems quite prevalent when the prior art devices are employed.

FIG. 5 shows the band of the present invention after it has been applied to a bone 26. As can be seen from this drawing, the screw 24 penetrates the cortex 26a of the bone, but is not long enough to enter the marrow 26b. For most applications the fastening means will be only a fraction of an inch in length. Its head should have a maximum diameter greater than the minimum diameter of the aperture through which the fastening means is to be inserted, so as to prevent the band from slipping over the head of the screw; and the head may have any suitable shape and may be any suitable type. The head 24a of the screw 24 is a round, Phillips-type head.

Broadly, the process of this invention comprises loop-

ing a band about the reduced bone segments and applying a fastening means into the bone through the band to positively secure the band to the bone. More specifically, the process of this invention may comprise, for example, looping the band 10 about a fractured bone after the segments thereof have been restored to their proper position, interconnecting the opposed ends of the band 10 as shown in FIG. 4, tensioning the band on the bone as illustrated in FIG. 1, twisting or otherwise securing the free end 12 of the band to prevent such free end 12 from slipping back through slot 14 and loosening the band, severing the excess portion of the free end 12, and applying suitable fastening means, such as the screw 24 shown in FIGS. 1 and 5, into the bone through one of the apertures 20 in the band 10.

Although specific embodiments of this invention are described above, certain modifications may be made within the bounds of this invention. For example, the dimensions of the band are not limited to those specifically shown, but may be varied as required by the particular application; and, if desired, more or fewer apertures may be provided in the band than are shown in the embodiments set forth herein. Also, the apertures need not be arranged as in disclosed embodiments, but may be distributed in any pattern according to the needs of the user. Although a specific screw is set forth in illustration of a fastening means, where proper and desirable, other types of screws, nails or the like may be used in lieu thereof. Finally, it should be noted that any suitable material other than stainless steel may be utilized to construct both the band and the fastening means.

While particular embodiments of this invention are shown above, it will be understood, of course, that the invention is not limited thereto, since many modifications may be made, and it is contemplated, therefore, by the appended claims, to cover any such modifications as fall within the true spirit and scope of this invention.

I claim:

1. An article for retaining reduced fractured bone in place, which article is generally inert with respect to the body fluids, comprising flat flexible means adapted to surround said bone in a single loop under tension, and fastening means adapted to be inserted into the bone through said flexible means, said flexible means having apertures for receiving said fastening means and having at least one other aperture.

2. An article for retaining reduced fracture bone in place, which article is generally inert with respect to the body fluids, comprising flat flexible means adapted to surround said bone in a single loop under tension, said flexible means having a plurality of apertures therein, and fastening means adapted to be inserted into the bone through one of said apertures.

3. An article for retaining reduced fractured bone in place, which article is generally inert with respect to the body fluids, comprising flat flexible means adapted to surround said bone in a single loop under tension, said flexible means having a plurality of apertures therein, and fastening means adapted to be inserted into the bone through one of said apertures, said fastening means being so constructed that it is prevented from entering the bone marrow.

4. An article for retaining a reduced fractured bone in place comprising a flat flexible band having a plurality of apertures therein and having its free ends interconnected to form a closed single loop under tension about the bone, and fastening means adapted to be inserted into the bone through one of said apertures to positively secure said band to the bone, said fastening means being so constructed that it is prevented from entering the bone marrow.

5. An article for retaining a reduced fractured bone in place comprising a flat flexible band having its free ends interconnected to form a closed single loop under tension about the bone, and having a plurality of aper-

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tures; and threaded means adapted to be inserted into the bone through one of said apertures, said threaded means having thereon a head which has a maximum diameter greater than the minimum diameter of said aperture, and being so constructed that it is prevented from entering the bone marrow.

6. An article for retaining a reduced fractured bone in place without invading the bone marrow comprising a flat flexible band having means at the free ends thereof for securing said ends together to form a closed single loop under tension on said bone, said band also having a plurality of apertures therein; and a threaded means adapted to be inserted into the bone through one of said apertures, said threaded means having a head thereon which has a maximum diameter greater than the minimum diameter of said aperture and said threaded means also being so constructed that it is prevented from entering the bone marrow.

7. An article for retaining reduced fractured bone in place without invading the bone marrow comprising a flexible band adapted to be looped about the bone under tension, said band having a slender tip adjacent one end thereof and a slot adjacent the other end thereof for

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receiving said slender tip when said band is in a looped position, said slotted end of said flexible band having a plurality of apertures; and fastening means adapted to be inserted into the bone through one of said apertures, said fastening means being so constructed that it is prevented from entering the bone marrow.

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