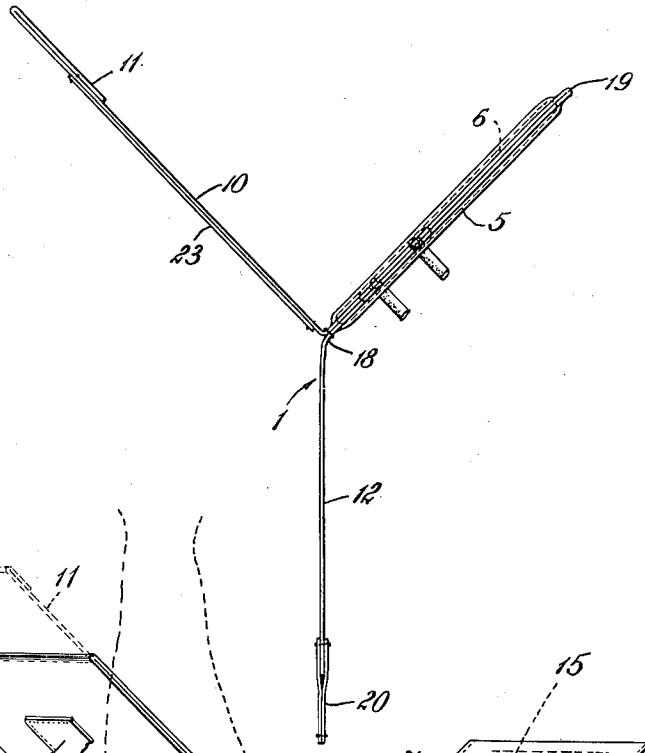
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SPHYGMOMANOMETER CUFF

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Fig. 1.



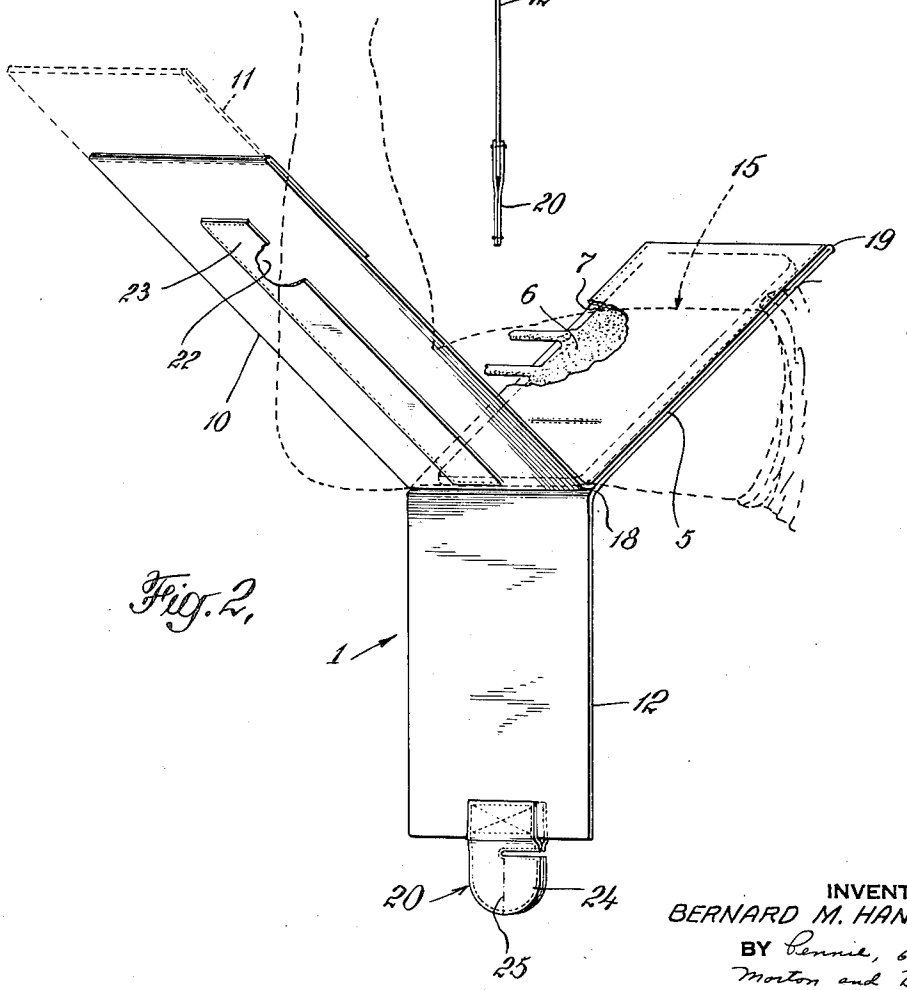




Fig. 2.

INVENTOR
BERNARD M. HANAFIN
BY Pennie, Edmonds, Morton and Barrows
ATTORNEYS

Sept. 13, 1949. B. M. HANAFIN 2,481,924

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Fig. 3.

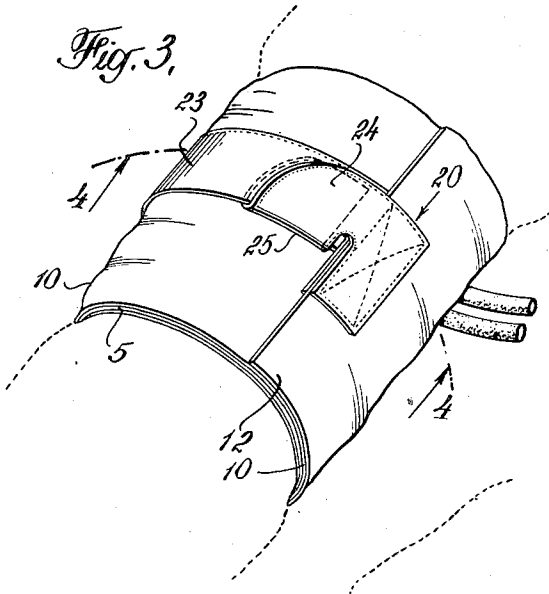



Fig. 4.

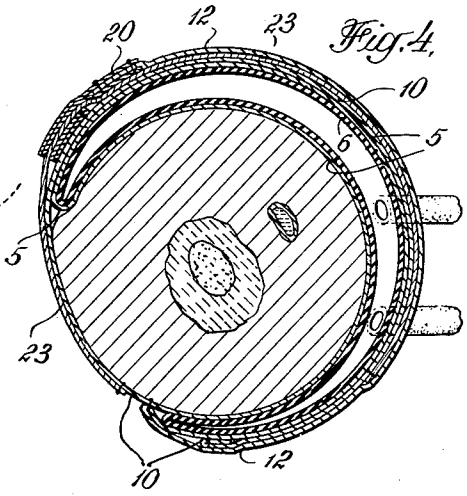



Fig. 5.

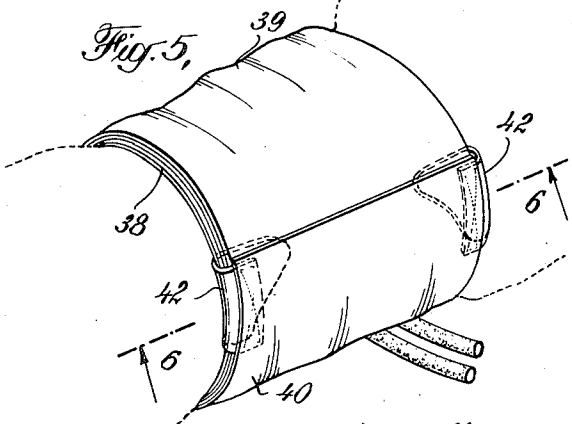



Fig. 6.

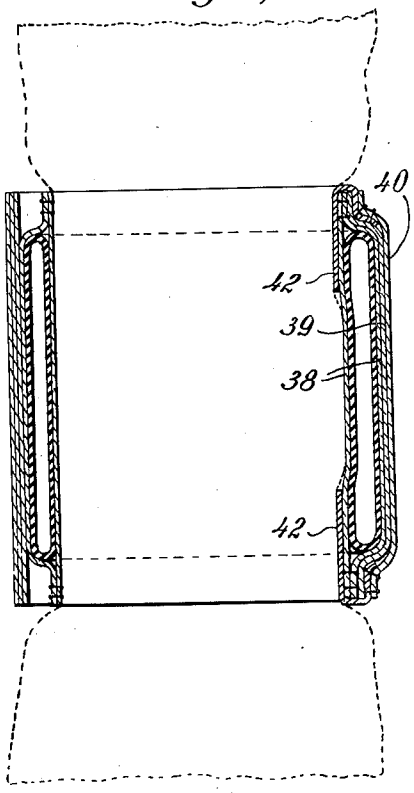
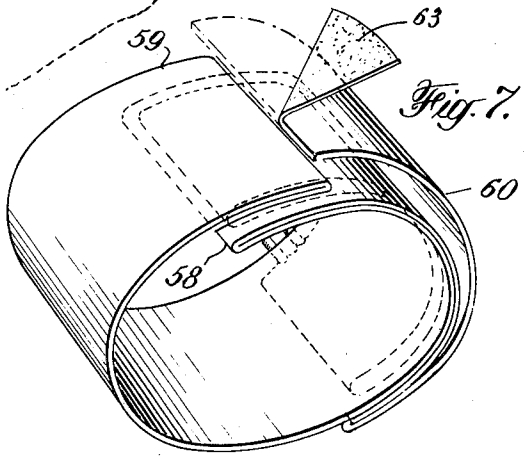



Fig. 7.




INVENTOR
BERNARD M. HANAFIN
BY Pennie, Edmonds, Morton and Barrows
ATTORNEYS

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2,481,924

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## SPHYGMOMANOMETER CUFF

Bernard M. Hanafin, Kew Gardens, N. Y., assignor to W. A. Baum Co., Inc., New York, N. Y., a corporation of New York

Application April 24, 1948, Serial No. 23,076

6 Claims. (Cl. 128—327)

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This invention relates to an inflatable cuff particularly useful in sphygmomanometer apparatus. The invention provides an improved cuff which is short and compact, which is immediately applicable to limbs of a wide variety of sizes without adjustment, and which requires no metallic or other rigid fastening elements to hold it in place upon a patient's limb. The present invention represents an improvement over that disclosed in the joint application of William A. Baum and Bernard M. Hanafin (the latter being the applicant herein), Serial No. 23,108, filed April 24, 1948, and assigned to the assignee hereof.

The inflatable cuff of my invention may be made of one or more strips of flexible material which are folded and sewn, or joined if there are more than one, to form a structure having three portions or branches extending from a common line of junction. When the branches are extended to radiate in planes from their line of junction at approximately equal angles to each other, the structure has the general shape of a Y. An inflatable bag adapted to constrict the flow of blood in the patient's artery is associated with and supported by one of the branches of the Y. The cuff is applied to the patient by wrapping the three branches of the Y about the patient's limb from their line of junction in successively opposite directions, beginning with the bag-supporting branch, so that the ends of the three branches overlap each other and the inflatable bag, and are stressed together in frictional contact when the bag is inflated.

Means are provided which apply to the overlapping branches of the cuff a stress normal to their surfaces, pressing them together in the region of their overlap so that they will not become disconnected or unwrapped, for example if the patient moves about. In particular this normal stress retains the outer end of the outermost branch in contact with the second branch wrapped, independently of inflation of the bag, much as if it were held down with the finger. Inflation of the inflatable bag, which underlies the three branches of the cuff in the region of their overlap, is therefore effective to stress together the second and third branches in the portion of their overlap lying between this outer end of the third branch and the end of the second branch, as well as to stress together the first and second branches throughout their region of overlap. A relatively small perpendicular stress thus applied between the second and third branches at the outer end of the latter, suffices to secure the much greater perpendicular stresses

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between the branches which are provided by inflation of the bag in aid of retention of the branches in overlapping relation upon the patient's limb. For, the overlapping branches so stressed together perpendicularly to their surfaces are held against lengthwise slipping with respect to each other by the large forces of friction thus made available.

A cuff so constructed is adapted to accommodate limbs of a wide range of sizes. None of the branches of the Y need be as much as a single turn about the limb in length, so that no rolling or gathering of the free ends to be wrapped is necessary, as is required by prior art cuffs consisting of a simple two-ended strip or bandage to be wrapped around and around the limb. The combined length of the branches which make up my novel cuff may be substantially less than the length of the single two-ended strip of old-style bandage cuffs so that my improved cuff is both simpler to apply and less bulky.

Removal of my improved cuff after completion of the blood pressure measurement is correspondingly simplified since no one of the branches of which it is composed need be unwrapped more than one complete turn in order to be entirely freed of the patient's limb.

Thus the rows of hooks and eyes, interengaging bars and eyelets, and similar interengaging positive fastening devices which have been hitherto required to be provided on the two ends of short fastener-type cuffs in order to make them applicable to limbs of various sizes may be dispensed with in cuffs constructed according to my present invention. A short cuff, speedy of application, may therefore be constructed which will retain the pliability and conformability which characterized the early, long, bandage-style cuff with which the presently accepted clinical standards of blood pressure were established. My improved cuff thus conduces to the relative comfort of the early sphygmomanometer cuffs in which a long single strip of fabric was wrapped around and around the limb with attendant difficulty and inconvenience both in its application and removal. My improved cuff also possesses the advantages of the relatively shorter length cuffs subsequently developed, without the need for fastening devices.

All that my improved cuff requires for application is three wrapping motions, none extending for more than a single revolution around the patient's limb, a tucking motion, and inflation of the inflatable bag.

The advantages of my invention and the con-

struction of cuffs according thereto will now be further explained by reference to the accompanying drawings in which:

Fig. 1 is a view of an inflatable cuff according to my invention made of a single strip of material formed into a structure having three branches extending generally in the form of a Y from a line of junction;

Fig. 2 is a view in perspective of the cuff of Fig. 1 in which is shown the relation of the elements of the cuff preparatory to its application to a patient;

Fig. 3 is a perspective view of the cuff of Fig. 1 as applied about the upper arm of a patient;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a perspective view similar to that of Fig. 3 but showing a modified form of cuff in which a pair of tuck-in flaps are employed to assist in holding the cuff in place preparatory to the inflation of the bag;

Fig. 6 is a sectional view on the line 6—6 of Fig. 5 showing the overlapped relation of the branches of the cuff of Fig. 5 as they are stressed together by the inflatable bag; and

Fig. 7 is an exploded view of a cuff according to a further modification of my invention in which a pressure-sensitive adhesive is employed on the branches of the cuff to aid in frictionally retaining the overlapped branches of the cuff in place.

Referring to Fig. 1, a cuff according to my invention is shown with the separate branches thereof extended in the form of a Y as the cuff will appear when held preliminary to its application to the limb of the patient. The cuff of Fig. 1 includes for support of the inflatable bag and its retention against the limb a single strip-like piece 1 of pliable material essentially rectangular in shape. The material employed may be a woven fabric or a plastic or other pliable material. The strip 1 is folded and sewn to provide a pocket-forming branch 5 and two additional branches 10 and 12 all extending from a line of junction 18. Alternately the cuff may be assembled from two strip-like pieces, one forming any two of the branches 5, 10 and 12 and the other the third. The two strips are joined by sewing or otherwise joining the strip which forms a single branch at one of its ends to the other strip transversely of the latter at a position intermediate the ends thereof. Or the cuff may be assembled from three strip-like pieces of flexible material, one for each of the branches. One end of each strip will then be sewn or otherwise joined to one end of each of the others along a common seam or line of junction transverse of the strips.

One of the branches of the Y, numbered 5 in Fig. 1, provides support to an inflatable bag 6 (see Fig. 2) by means of a pocket 7. In the case of a cuff formed of a single strip of material the branch 5 is formed by folding the strip 1 back on itself along a line 19 which locates the free end of the branch 5. The edges of the two portions of the strip extending from the line 19 are then joined together for a suitable distance, as by sewing, to form a pocket 7 into which an inflatable bag may be inserted. Apertures are provided in the pocket to permit insertion and removal of the bag and for the admission of the tubes which communicate with an inflating bulb and a measuring instrument such as a manometer.

The two layers of material forming the branch 5 are connected together transversely of the strip by a seam, suitably reinforced if necessary, which produces the line of junction 18 from which radiate the three branches of the cuff.



The second and third branches 10 and 12 of the Y are formed one from each of the two ends of the strip 1 as they extend beyond the seam or line of junction 18. The branch 10 forms the first overlapping contact with the bag-supporting branch 5 when wrapped around the patient's limb in the direction opposite to the branch 5. Similarly the third or outside branch 12 provides the second overlapping contact which holds the cuff in place when it is wrapped about the limb from the line 18 down over the branch 5 and the outer end of the branch 10.

The second and third branches 10 and 12 are provided with cooperative means which secure the third branch in contact with the second by holding the terminal end of the former down in contact with the latter. These means may take various forms.

In the cuff of Fig. 1 this auxiliary holding means consists of a folding tab 20 affixed to and extending beyond the free end of the branch 12 and of an open tab pocket 22 extended longitudinally of the branch 10 on the side thereof facing the branch 12. The tab pocket 22 is formed by means of a narrow strip 23 of pliable material sewn or otherwise affixed along three sides to the branch 10 as aforesaid and with the fourth side free to form a pocket open towards one lateral edge of the branch 10.

The folding tab 20 is provided with a projection 24 facing the lateral edge of the branch 12 which is contiguous with the lateral edge of the branch 10 faced by the open side of the pocket 22. The tab may be folded along a fold line 25 parallel to the lengthwise dimension of the branch 12 so as to permit its insertion into the tab pocket 22 when the cuff is applied to the patient's limb. In order to permit application of the cuff to limbs of a wide variety of sizes the pocket 22 is preferably made to extend along a large fraction of the length of the branch 10. The pocket will then be much longer than the tab 20, and the tab may be inserted into the pocket regardless of the extent of the overlap between the branches 10 and 12.

To apply the cuff to the patient it may be held by the branches 5 and 10 with the patient's limb 15 in the angle between the two as shown in Fig. 2. The branch 5 should preferably face the side of the limb on which the artery is located so that when the cuff is applied the inflatable bag will overlie the artery. The branches 5, 10 and 12 of the cuff are then successively wrapped closely around the limb. The branch 5 is wrapped about the limb in one direction beginning at the line of junction 18 and the branch 10 is next wrapped about the limb in the opposite direction so as to overlie the end of the branch 5 and the inflatable bag. Thirdly, the outside branch 12 is wrapped about the limb from the line of junction 18 in the same direction as the branch 5 so as to overlie the other two, with the tab 20 over the tab pocket 22. The tab may then be folded into the pocket to hold the branch 12 in contact with the branch 10. The cuff of Fig. 1 so applied to the upper arm of a patient is shown in Fig. 3. By virtue of the curved section of the arm the tab pocket forming strip 23 is drawn down tightly over the branch 10 and the tab 20 folded into the tab pocket 22 is tightly held therein.

As a result of the close wrapping of the branches and the insertion of the tab into the

tab pocket, the branches 5 and 10 are stressed together perpendicularly to their surfaces upon inflation of the bag, and in turn the branches 10 and 12 are similarly stressed together. Friction between the branches so interleaved and overlapping retains the cuff in place against the bursting stress of the inflated bag so that the bag constricts the artery of the limb. The frictional inter-relation of the branches of the cuff is further shown in Fig. 4, where the tab is shown tucked into the tab pocket over the end of the inflatable bag. As appears from Fig. 4 the area of the surfaces of the branches which are frictionally engaged and which together must be brought to slip before the cuff will loosen under the expansive stress of the inflated bag is nearly twice the circumference of the arm multiplied by the width of the cuff.

The auxiliary holding down means provided by the tab 20 and tab pocket 22 are applicable between the overlapped branches continuously around the circumference of the cuff along the length of the tab pocket 22. No discrete steps thus occur in the range of available circumferential lengths for the cuff and no adjustment to or choice between such steps is necessary for application of the cuff to limbs of various sizes as is the case where the cuff is held in place by positive fastening means having complementary interlocking elements on the two ends of a bandage sought to be secured together. By relying upon the frictional effect between the three overlapped branches to prevent loosening of the cuff under the expansive stress of the inflatable bag, the effect required of the auxiliary holding down means which the tab provides is so reduced that positive interlocking members are not necessary.

The branches 5 and 10 should have a combined length greater than the girth of the largest limb about which the cuff is to be applied in order to provide an area of overlap between the two. Subject to this condition the branch 5 may be of any length, although a preferred length therefor is greater than one-half the girth of such large limb and less than one times the girth thereof. The branch 10 should have a length no greater than the girth of the smallest limb to which the cuff is to be applied and no less than that length which with the branch 5 will encircle the largest limb with a substantial area of overlap. A preferred length for the branch 10 is again a length somewhat greater than one-half the girth of the largest limb normally encountered in practice.

It is apparent from Fig. 4 that the outside branch 12 may be of unlimited length. I have found however that making the branches 5 and 12 longer than the girth of the limbs to which the cuff is to be applied is unnecessary and sacrifices the advantages of convenience and rapidity in application which my cuff provides.

To accommodate unusually large limbs the branch 10 may be provided at its outer end with an extension 11 as shown in Fig. 1. When the cuff is used on limbs of normal sizes, the extension is retained folded against the branch, for example by means of a pressure-sensitive adhesive, so that the length of the branch so folded does not exceed the girth of normal limbs. For large limbs the extension 11 is available to provide the branch 10 with length sufficient to overlap the end of the branch 5 when the two are wrapped in opposite directions around the limb from their line of junction 18.

The cuff is made preferably of a rough-surfaced fabric so that the coefficient of friction between overlapped portions thereof may be high. By applying the three branches closely to the limb the elasticity of the tissues in the limb is made to stretch the cuff sufficiently to provide a substantial normal stress between the overlapping portions of the branches. For increased frictional effect the fabric may be rubber-impregnated.



In place of the tab and tab pocket of the cuff of Figs. 1 to 4 a pair of flaps, disposed one at either side of the free end of the outside branch, may be employed to hold the branches of the cuff in frictional contact so that they may be further stressed together upon inflation of the bag. A cuff employing such tuck-in flaps is shown in perspective in Fig. 5. The third or outside branch 40 of this cuff is shown wrapped down over the overlapped ends of the first and second branches 38 and 39. A tuck-in flap 42 is shown affixed to either side of the end of the branch 40, tucked under both of the branches 38 and 39 into contact with the patient's limb. Thus between the flaps 42 and the free end of the outside branch 40 the surfaces of the branches 38, 39 and 40 lie in close contact with each other and the end of the branch 40 is prevented, as a result of friction between the flaps 42 and the underside of the branch 39, from losing contact with the outer surface of the second branch 39. Like the tab and pocket of the cuff of Figs. 1–4, the tuck-in flaps 42 provide an auxiliary holding down means applicable to limbs of a continuous range of sizes without preliminary adjustment of any kind.

Fig. 6 shows in section the cuff of Fig. 5 and further illustrates the large area of frictional contact provided by the Y-type of cuff. The tuck-in flaps 42 are shown interposed between the branches of the cuff and the patient's arm where they are held in place by inflation of the inflatable bag.

A further means for providing the auxiliary holding down stress is shown in Fig. 7. Fig. 7 shows in partially interleaved and overlapping relation the branches of a cuff according to my invention in which a tacky adhesive material is applied to the side of the third or outside branch 60 which faces the first or bag-supporting branch 58 so that when the cuff is applied the tacky area may be pressed down over the end of the second or intermediate branch 59.

My invention is not restricted to the precise details of construction illustrated in the drawings and as set forth in the accompanying description. Changes and modifications may be made therein without departing from the scope of my invention as set forth in the appended claims.

I claim:

1. An inflatable cuff comprising a structure of flexible material having three strip-like branches radiating from a line of junction in Y-like fashion, and an inflatable bag disposed adjacent the free end of one of the branches, the said cuff being adapted to be applied to a limb by wrapping a second one of the branches thereof about the limb and over the inflatable bag in one direction and by wrapping the remaining branch about the limb in the opposite direction over the inflatable bag and the extremity of the said second branch, whereby said cuff and inflatable bag are retained in a desired relation upon the limb by the combined action of the friction developed between the overlapping branches

thereof under the pressure exerted between the opposed wrapped branches upon inflation of the bag.

2. An inflatable sphygmomanometer cuff comprising a Y-like structure of pliable material having three branches each substantially rectangular in shape extending from a common line of junction, an inflatable bag supported adjacent the free end of one of the branches, a tab-receiving pocket formed on a second one of the branches on the surface thereof remote from the bag-supporting branch, and a flexible tab extending from the free end of the third branch, the said tab being adapted to be folded upon itself along a line substantially perpendicular to the free end of the said third branch, the said tab-receiving pocket having a length along the extension of the second branch from the line of junction substantially greater than the parallel dimension of the said tab, whereby upon application of the cuff to a human limb by the successive wrapping of the three branches thereabout in successively opposite directions, the free end of the third branch may be wrapped down into overlapping frictional contact with the second branch and the tab may be folded into the tab-receiving pocket.

3. An inflatable cuff comprising a Y-like structure of flexible material having three branches radiating from a common line of junction, an inflatable bag supported adjacent the free end of one of the said branches, a tab-receiving pocket arranged on the second one of the three branches on the surface thereof remote from the bag-supporting branch, the said tab-receiving pocket being open towards one lateral edge of the said second branch, and a tab affixed to and extending from the free end of the third branch, the said tab having a projection beyond the free end of the third branch extending transversely thereof toward the lateral edge thereof contiguous with the lateral edge of the second branch faced by the tab-receiving pocket.

4. An inflatable sphygmomanometer cuff comprising a Y-like structure of pliable material having three branches extending from a common line of junction, an inflatable bag supported adjacent



the free end of one of said branches, the said cuff being adapted to support the said bag against a limb over the artery thereof by the wrapping of the bag-supporting branch in one direction about the limb beginning at the line of junction, the wrapping of another branch from the said line of junction about the limb in the opposite direction to overlap the inflatable bag, and the wrapping of the third branch from the said line of junction about the limb in the first direction to overlap the inflatable bag and the free end of the second branch, and a pair of flexible flaps affixed one at either side of the free end of said third branch and adapted to be tucked under the second of the said branches, whereby the free end of said third branch may be retained against the said second branch and the cuff may be retained upon the limb by the force of friction between adjacent overlapping branches thereof as pressed together by inflaction of the bag.

5. A pneumatic sphygmomanometer cuff comprising a first strip of rough-surfaced flexible fabric adapted to support an inflatable bag, an inflatable bag supported on said first strip, a second strip of rough-surfaced flexible fabric secured at one end thereof to an end of said first strip along a line of junction transverse to both strips, a third strip of rough-surfaced flexible fabric secured transversely thereof at one end thereof to said first and second strips along the said line of junction, and a pair of tuck-in flaps secured one at each side of the free end of said third strip.

6. A pneumatic sphygmomanometer cuff comprising three strips of flexible fabric having one end of each sewn to one end of each of the others along a common seam, a pocket formed on one of the said strips and adapted to contain an inflatable bag, an inflatable bag in the said pocket, and a pressure-sensitive adhesive material applied to the free end of one of the strips other than that containing the bag.

BERNARD M. HANAFIN.

No references cited.