June 1, 1937. W. H. VOGT ET AL 2,082,190

COMBINED TREATMENT CHAMBER AND CUFF

Filed Feb. 15, 1936

Fig. 1

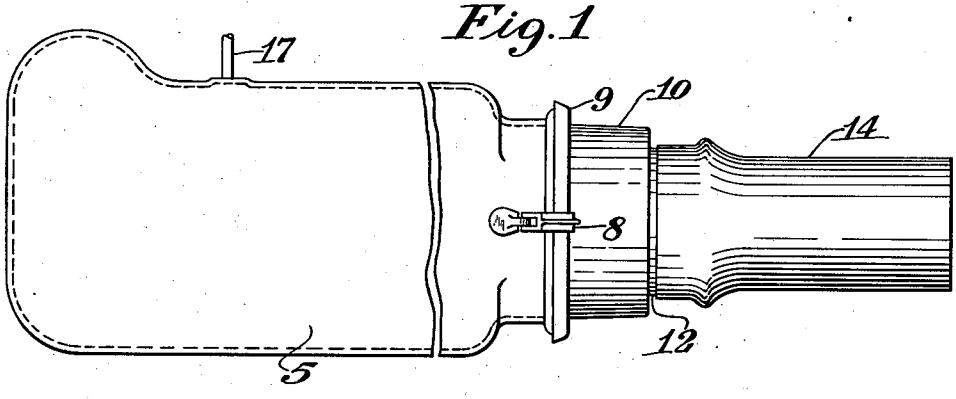


Fig. 2

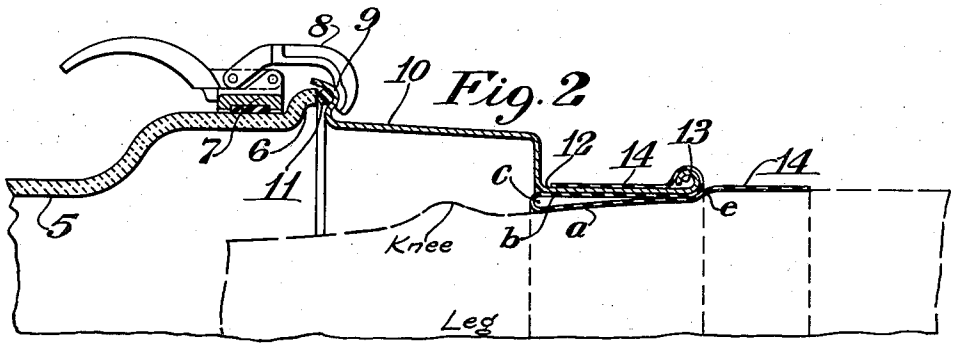
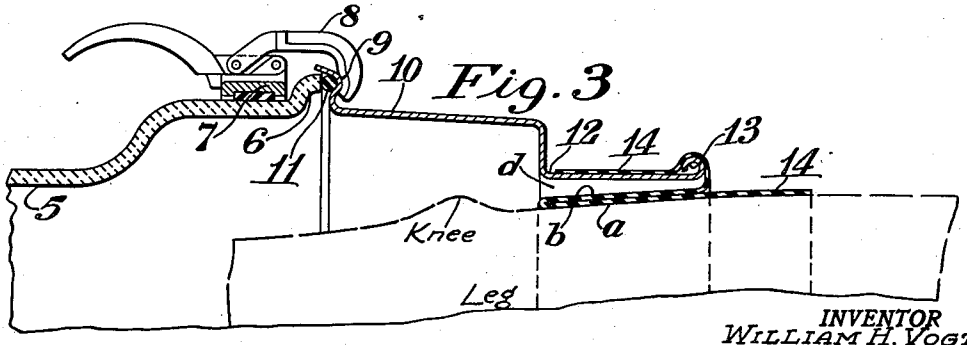


Fig. 3



INVENTOR
WILLIAM H. VOGT
RICHARD F. RODA

BY D. Clyde Jones

ATTORNEY

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COMBINED TREATMENT CHAMBER AND CUFF

William H. Vogt, Rochester, and Richard F. Roda, Pittsford, N. Y., assignors to Taylor Instrument Companies, Rochester, N. Y., a corporation of New York

Application February 15, 1936, Serial No. 64,132

4 Claims. (Cl. 128—297)

This invention relates to treatment chambers or receptacles for use in connection with passive vascular exercisers.

In the copending application of Louis G. Herrmann, Serial No. 696,190, filed November 1, 1933, there is disclosed a passive vascular exerciser including a treatment chamber or "boot", in which a human extremity can be inserted and substantially sealed from atmospheric pressure, while the environmental pressure in the chamber about the extremity is rhythmically varied between positive and negative pressure limits.

Such treatment chambers are necessarily bulky owing to the fact that they must be of sufficient length and diameter to receive the largest foot and lower leg encountered during use. In order to seal the space between the thigh and the wall of the boot at the open end thereof, it has been the practice to apply one end portion of a tubular rubber cuff around the boot at its open end, the other end of the cuff encircling the thigh and making a substantially air-tight seal therewith. Since the opening in the boot is relatively large, there is considerable space between the wall at the open end of the boot and any leg therein, except an extremely large one. Owing to this large space it has been necessary to make the cuff of relatively heavy rubber in order to prevent the cuff from being sucked into the boot during the vacuum phase of the cycle and from being expanded outwardly or "ballooned" during the compression phase of the cycle. The thickness of prior rubber cuffs has necessarily been such that they have been applied to the boot only by real effort and frequently only by the joint efforts of two persons. As a result of the difficulty of applying the cuff to the boot it has not been customary to remove the cuff therefrom and consequently it was necessary when applying the boot to the patient, to insert the leg through the cuff while it was attached to the boot. The size of the boot and the necessary tightness of the thick cuff usually required the efforts of two persons when applying the cuff and boot to the leg of the patient. Furthermore, as a result of the space between the thigh and the top of the boot the leg of the patient was alternately sucked into and forced out of the boot during each pressure cycle. Since this movement of the leg was relatively large, it was somewhat annoying to the patient.

The present invention has for its purpose the provision of a treatment chamber or boot and a cuff which can be readily applied by one person, to the extremity to be treated and in which the seal between the treatment chamber and the extremity does not materially impede the circulation of the blood therein.

The main feature of the invention relates to a combined treatment chamber or boot and a cuff unit which can be readily attached to the boot and removed therefrom so that a cuff unit of the approximate diameter of the patient's thigh can be used, thereby materially reducing the back and forth movement of the patient's leg with respect to the boot and also insuring a minimum constriction of the leg tissue.

Another feature of the invention relates to a novel type of cuff by which the environmental pressure both during the positive phase and the negative phase of the pressure cycle, tends to maintain the seal against leakage.

A further feature of the invention relates to a cuff unit which can be readily connected to and detached from a treatment chamber or boot and which effects a novel type of seal with the patient's extremity.

These and other features of the invention will appear from the detailed description and claims when taken with the drawing in which Fig. 1 is a fragmentary side elevation of a treatment chamber or boot with a novel cuff unit of this invention attached thereto; Fig. 2 is a fragmentary longitudinal section of the treatment chamber together with the cuff unit attached thereto, showing the position of the cuff with respect to the thigh (indicated in dotted lines), during the negative pressure or vacuum phase of the cycle; Fig. 3 is a similar sectional view showing the position of the cuff during the positive or compression phase of the pressure cycle.

Referring to the drawing, 5 designates a treatment chamber or boot made wholly or partially of any transparent material such as glass or cellulose acetate. This boot is adapted to receive a human extremity and is of sufficient length to encase the foot and the lower part of the patient's leg approximately to the knee. The rim of this boot preferably flares outwardly to provide a shoulder 6 which serves as an anchor for a divided mounting ring 7. This ring, although clamped to the wall of the boot, is preferably separated therefrom by a resilient washer of rubber or like material so that the ring will not contact the boot. At spaced points about this ring there are provided two or more cam-actuated clamping hooks 8 of well-known construction. These hooks engage an annular flange 9 at one open end of a sheet-metal collar 10 of a cuff unit, to clamp the collar in sealed relation with the edge of the boot. In order to ensure an effective

seal, a rubber ring 11 is seated in a depression in the flange 9 to bear against the edge of the boot. The diameter of the collar at an intermediate point thereon, is reduced or stepped down as indicated at portion 12 thereof, to the approximate diameter of the thigh to be inserted therethrough and the reduced end of the collar is formed with a bead 13 to provide a rounded edge with which the thigh engages. It has been found that three collars of different selected diameters at the reduced portion 12, will accommodate the usual range of thigh sizes encountered in practice. The cuff unit also includes a cuff 14 made of relatively thin live rubber tubing applied over the reduced portion of the collar, being retained thereon by frictional engagement. However, the length of this cuff is such that it can be doubled back and forth upon itself (Figs. 2 and 3) while in contact with the thigh as well as with the inner surface of the reduced portion 12 of the collar to afford an effective seal with the thigh as will hereinafter be set forth.

When a patient's extremity, for example the leg, is to be treated in the boot, the cuff unit is first applied to the leg. This is effected by inserting the foot through the cuff 14 and thence through the collar 10. The cuff and collar are drawn up on the leg until the cuff is high up on the thigh. Thereafter the reduced portion 12 of the collar is telescoped over a portion of the cuff in contact with the thigh, thereby folding a part of the cuff back upon itself to provide two overlapping cuff portions *a* and *b* underneath the reduced collar portion 12. When the cuff unit is thus properly positioned on the leg, the foot and lower leg are inserted into the boot until the open end of the boot can be locked in sealed relation with the flange 9 on the collar, by means of the cam-actuated hooks 8.

The treatment can now be started by introducing rhythmically alternating positive and negative pressure into the boot through conduit 17. On the negative pressure, or vacuum phase of the cycle, the leg will tend to be sucked into the boot but movement of the leg will be substantially stopped by the engagement of the tapered portion of the thigh with the bead 13 of the collar. It will be noted that as the thigh engages the collar the leg tissue will roll up against the bead 13, as indicated at *e*, thereby "corking" the opening in the collar. Any movement of the leg which does occur, will not be annoying to the patient since the folds *a* and *b* of the cuff will slide on each other instead of the cuff sliding on the skin. As the negative pressure or vacuum develops in the boot, air at atmospheric pressure will enter between the cuff folds into the space *c* so that layer *a* of the cuff will be forced against the thigh and layer *b* thereof will be forced against the reduced part 12 of the collar. Thus an effective seal is made with the thigh during the vacuum phase.

During the positive or compression phase, air enters at *d* between the layer *b* of the cuff and the reduced portion 12 of the collar, thereby forcing cuff layer *b* against cuff layer *a* so that this last-mentioned layer closely engages the thigh. Since there is a wide band area of the cuff in contact with the skin, the amount of leakage between the cuff and the thigh is reduced to a minimum at all times.

We claim:

1. In combination, a treatment boot, a collar having a large end detachably connected to the open end of said boot in sealed relation therewith, and having a reduced portion of approximately the diameter of a part of an extremity to be positioned therein, said reduced portion having an outwardly flaring edge, and a flexible impervious cuff telescopically engaging the reduced end portion of said collar in air-tight relation therewith, said cuff being of sufficient length to permit folding upon itself and yet permit its extension beyond said collar.

2. The method of sealing the space between the open end of a treatment chamber and a part of a human extremity enclosed therein, said treatment chamber having a collar attached to the open end thereof, said collar being provided with a reduced end of approximately the diameter of said part of the extremity, and a flexible impervious cuff attached to the reduced end portion of said collar, which method comprises folding a portion of the cuff back and forth in the space between said reduced portion of the collar and said part of the extremity.

3. The method of sealing the space between the open end of a treatment chamber and a part of a human extremity enclosed therein, said treatment chamber having a collar attached to the open end thereof, said collar being provided with a reduced end of approximately the diameter of said part of the extremity, and a flexible impervious cuff attached to the reduced end portion of said collar, which method comprises folding a portion of the cuff back and forth in the space between said reduced portion of the collar and said part of the extremity, and causing a portion of one of the folds to project beyond said collar in contact with the extremity.

4. The method of sealing the space between the open end portion of a treatment chamber and a part of a human extremity projecting therein, the open end portion of said chamber having an opening therein of the approximate size of said member and having a flexible impervious cuff attached thereto, which method comprises folding said cuff back and forth in the space between said extremity and the open end portion of said chamber.

WILLIAM H. VOGT.
RICHARD F. RODA.