DROP-FOOT APPLIANCE WITH CONCEALED SPRING

W. H. TUCK, STANMORE, ENGLAND

From the Royal National Orthopaedic Hospital and the Institute of Orthopaedics, London and Stanmore

The problem of an efficient and inconspicuous drop-foot appliance has taxed the ingenuity of surgical appliance makers for many years. In the Royal National Orthopaedic Hospital's workshops this problem has been studied during the past four years, and various types of apparatus have been constructed.

The apparatus that has now been developed has several particular advantages: 1) the toe-raising device is invisible externally; 2) the power unit—which may be produced in quantity—can be fitted by any appliance maker and is concealed within the heel of the boot or shoe; 3) the special side steels and their spur pieces are easily removed from the spring socket; 4) the side steels are of D-section and relatively thin, but can be heavier if the pressure of a T-strap has to be taken.

At present two types of spring are in use—preferably a flat clock spring or alternatively a wire coil spring. The upper ends of the side steels are attached to a calf band and it will be noted that the metal band is in front and the soft part at the back of the leg. The details of construction (Fig. 1) are as follows. Into an ordinary 3/16 inch round socket of extruded aluminium is inserted a loosely fitting steel tube of which the internal section is 3/16 inch square. A central section of 1 inch is cut out of the aluminium socket and this is extended into the plate to a total symmetrical antero-posterior width of 3/4 inch (A, Fig. 1).
Two $\frac{1}{2}$ inch holes are drilled in the tube for the purpose of lubrication. Before the steel tube is inserted into the extruded aluminium socket a slot is cut in the centre of the steel tube $\frac{7}{16}$ inch long and $\frac{1}{4}$ inch wide directly through the tube, and a $\frac{3}{8}$ inch hole is drilled in the centre of the slot on one side only (B, Fig. 1). A 6-inch length of flat 24 gauge clock spring $\frac{3}{8}$ inch wide is prepared. It is necessary to soften the metal for $\frac{1}{2}$ inch at each end of the spring to allow a $\frac{1}{8}$ inch hole to be punched in the centre of the end of the spring $\frac{1}{8}$ inch from the edge, and to fix a $\frac{1}{4}$ inch iron rivet to the spring, to prevent its pulling through the other slot when the spring is wound. The spring is wound by hand with a crank handle with one end squared to fit into the square socket. When the end of the spring is fixed to the aluminium plate and wound tight the mild steel spring cover is fitted to prevent recoil (E, Fig. 1). Spring tension can be increased by using a wider clock spring, up to a maximum of $1\frac{1}{4}$ inches wide. It will be necessary to increase the cut-out section in the aluminium socket and the slot in the steel tube, according to the width of the spring used. Before the unit is fixed to the shoe it is necessary to remove a small part of the leather seat to receive the under portion of the clock spring.

If a coil spring is used it should be made of 14 gauge first quality spring wire. One end is inserted into a hole drilled in the steel tube, and after seven coils have been wound loosely on this tube the free end is carried forward on to the flat surface of the plate, where a groove has been cut to receive it. It is necessary to wind this spring so that the coils do not bunch together when the tightening action of the toe-raising spring is effected (D, Fig. 1).

The power unit thus constructed is self-contained, and can be fixed in the usual manner of sockets—that is, on the seat and waist of the shoe with two copper rivets (Figs. 2 and 3). The heel is then rebuilt (Fig. 4) but it is important to leave an adequate section in it for the spring to work freely. This cut-out area is lightly packed with Marfak grease before the heel is completed.

The lightest side steels are made of $\frac{5}{8}$ inch D-section steel bar, and the lower ends are turned and made $\frac{1}{2}$ inch square to fit into the heel socket. The upper end is splayed out and a $\frac{3}{8}$ inch hole is drilled $\frac{3}{8}$ inch from the end.
Figure 5—The position of the instrument and shoe before the tension is applied.

Figure 6—The position of the instrument in the shoe with the tension applied.

Figure 7
The spur and socket modified for a full-length appliance. The rounded half of the spur is to sustain weight, and the squared half is to engage in the spring mechanism.
The metal calf band is made of 18 gauge steel 1 inch wide to which are attached the side members by a shoulder rivet on each side. The calf band is thus free to swivel on the side members and so avoid edge pressure on the shin.

It is essential that the metal band should be anterior for the apparatus to work properly. The calf band is then padded and covered in the usual way, and completed by a soft posterior part to which is attached a ¼-inch leather strap and buckle.

Method of application—The instrument is applied to the square sockets in the position shown in Figure 5. If the tension is not strong enough the spurs are disengaged from the socket, and the instrument is rotated downwards and the spurs are inserted in the next square position. The instrument is raised to the position shown in Figure 5, and when the instrument is in the position shown in Figure 6 a stronger tension is obtained.

Modifications for a full-length appliance—For a full-length appliance extending to the thigh it is considered that the ¼ inch square spur pieces would not be strong enough. This difficulty can be overcome by using the normal ⅛ inch round spur pieces, leaving half the length of spur nearest to the side piece of the appliance ⅛ inch round and shaping the other half ⅛ inch square (Fig. 7). The spring socket is altered by fitting a piece of steel tubing 1½ inches long in the centre of the socket and fixing the spring by the method explained. This will leave at least ⅛ inch of the socket free at each end to receive the ⅛ inch spurs, and the centre of the socket will remain the toe-raising unit; each end will take the weight of the appliance in the usual way.

With the full-length appliance the patient may encounter difficulty in getting the foot into the shoe, but that can be overcome by using a long ankle strap which can be slipped lower down the side stems of the appliance until it is directly behind the back of the heel of the shoe; this will keep the shoe at right angles to the appliance, and can be raised to the correct position of the ankle strap when the shoe and instrument are on.

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