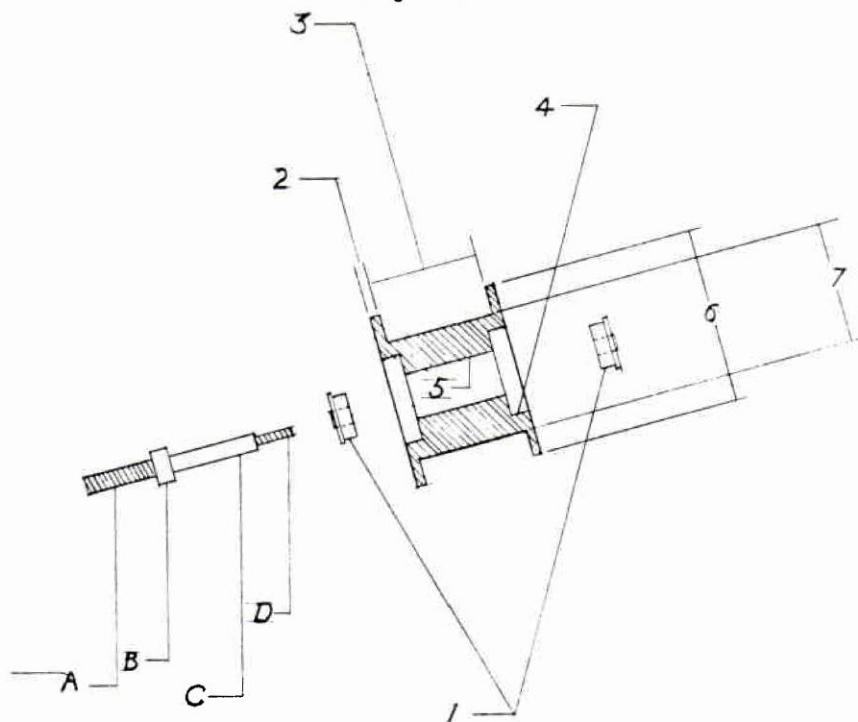


# Technical Notes on Manufacture of Long Leg Braces to Assist the Quadriceps Femoris

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Figure 1—Pulley and bearing for 5.3 lb. Hunter Negator spring (No. 12H3K). The pulley is made from 1.250 aluminum round stock, the flange outside diameter is 1.250, the flange width is .040. The outside drum diameter of pulley is .950. The width between flanges is .775.



## Key No.

1. Two S5518FCHH bearings from Miniature Precision Bearing, Keene, New Hampshire.
  2. Bearing housing—ream .3125 for outside diameter of bearing.
  3. Outside diameter of flange determined by outside diameter of Hunter spring plus .125.
  4. Flanges .040 width.
  5. Width of pulley between flanges, width should be .025 plus the width of Hunter Spring used.
  6. Inside diameter of Pulley determined by inside diameter of Hunter spring plus .062.
  7. Ends of pully counter bored .125 deep x .625 diameter.
- Axel construction—carbon steel drill rod  $\frac{1}{4}$  in. diameter x  $1\frac{1}{2}$  in.

## Key Letter

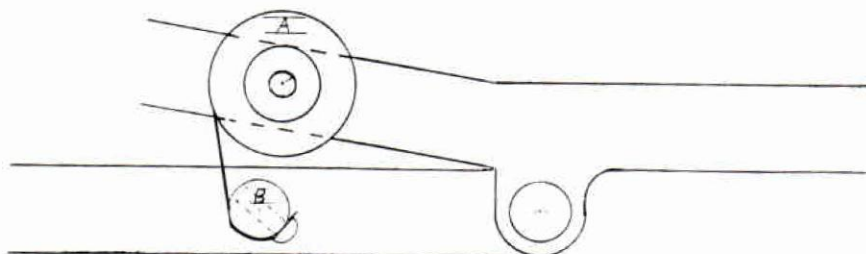
- A. Machine to .125 diameter,  $\frac{1}{2}$  in. length, thread 5-40.
- B. Shoulder  $\frac{1}{4}$  in. diameter, .125 width.
- C. Bearing shaft. .125 to .1245 diameter. Length determined by size of pulley with bearings in place measured with micrometer.
- D. Machine to 0.89 diameter,  $\frac{1}{4}$  length, thread 2-56.

The knee joints of the brace are set posterior to the upper side bars to allow hyperextension to approximately  $183^{\circ}$ . The upper side bars are extended three to four inches beyond the center of the knee joint. This extended arm will have to be longer for large patients than for smaller patients in order to provide adequate torque. The extension has been limited to four inches for adults and can be reduced to two and one-half inches for small children. To each of these extensions is fastened a spindle mounting a ball bearing pulley (Figure 1). Attached to the lower side bars an equal distance from the center of the knee joint are two spindles to which the Hunter Negator spring is attached. Care should be taken when aligning the brace to be sure that the spindles on the upper and lower bars are parallel on the horizontal and perpendicular planes to diminish twist and stress on the springs. It has been found that a five-eighths inch diameter aluminum spindle on the lower side bars reduces the stress and the rate of breakage of the spring at the point of attachment. Nevertheless, since these springs have a life of approximately 10,000 cycles, the rate of fatigue and fracture is relatively rapid and springs will have to be replaced every week or two.

The spring is punched with a sheet metal punch and attached with a screw to the spindle on the lower side bar. Since the spring usually cracks adjacent to the spindle on the lower side bar, it can be cut off, repunched and re-used several times before replacement with a new spring.

The torque provided by the springs should not exceed the torque due to the weight of the lower leg and foot with the brace on. Otherwise the patient cannot bend his knee when sitting. At this Rehabilitation Center an attempt has been made to achieve the torque of the lower leg through the combined use of the spring plus the residual strength of the quadriceps. However, it has been found in several cases that considerably less torque than this was needed to provide a stable knee which allowed nearly normal knee motion during walking. Springs larger than the 5.3 lb. spring (#12H3K) have not been used because of the bulk. However, these springs can be laminated by interwinding to double or treble the tension required.

This brace works most effectively when there is slight hyperextendability of the knee and will not work successfully if knee extension is limited to  $175^{\circ}$  or less. The patient, when walking, can bend his knee as he swings his lower extremity forward but must lock his knee on heel strike rather than allowing knee action for shock absorption. He can sit and rise without inconvenience. The greatest asset of the brace is that it requires additional muscular participation in the normal manner for locking the knee and consequently assists in building muscular strength where possible.



Pulley Attachment

- A. Install proper Hunter spring and pulley approximately  $2\frac{1}{2}$  inches from knee joint on bar attached to upper leg brace.
- B. Mount piece of  $\frac{5}{8}$  diameter aluminum round on lower leg brace same distance from center as spring pulley. Springs are available from: Hunter Spring Co., 17 Spring Ave., Lansdale, Pa.