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A Prototype Foot Switch for the Future

Judging from CQ-Contest reflector discussions, many contesters do not seem to appreciate the importance of a foot switch in a contest environment. For those who enjoy a 48 hour SSB contest, the foot switch should feel like a part of the body. Many types of foot switches are available, but only a few are specific to Amateur Radio use. Many hams have used commercially available foot switches in their stations, and I was no exception. But as I gained more experience with several foot switches, I became frustrated with their flexibility. Finally, I decided to design a more comfortable foot switch.

Figure 1 — Pieces of square aluminum stock frame the pedal opening. A “flap” is cut along one side of each, then trimmed to create a slight flare. The flap then is bent over to enclose the end.

Pedal Style

The two most common types of foot switches are the button type and the pedal type. For a situation such as a 48 hour contest, it’s necessary to reduce the fatigue by making foot switch operation as easy as possible. For this reason, a pedal style switch is most suitable. To understand which pedal type is best, let’s analyze how the foot switch operates.

There are several methods for pedaling. Method 1 involves lifting the whole leg. In Method 2 you activate the switch with your toe, while keeping your heel on the floor. Method 3 involves pushing the switch with your heel, while keeping your toe on the floor. In most cases, a button type switch will require method 1, and a pedal switch will require either method 2 or method 3. Method 1 obviously requires more effort than method 2 or method 3, so avoiding method 1 will help to minimize fatigue.

You also need to consider how to rest your foot. You’ll want to keep the foot switch close to your foot to be ready to reply quickly, so it complicates things a bit if you have to rest your foot away from (ie, off) the switch. This is also another reason why a button type is not suitable for contesting, since you can’t rest your foot on it. Experience has shown that the ideal switch style lets your foot remain in place to minimize fatigue. This also offers a clue regarding how you rest your foot. Method 2 is preferable to method 3, because the latter requires you to lift your whole leg by using your toe as a fulcrum, while method 2 requires moving only your foot and toe, or up to the calf at most.

You may ask, “How about the operation of a foot switch with a sloping pedal, where

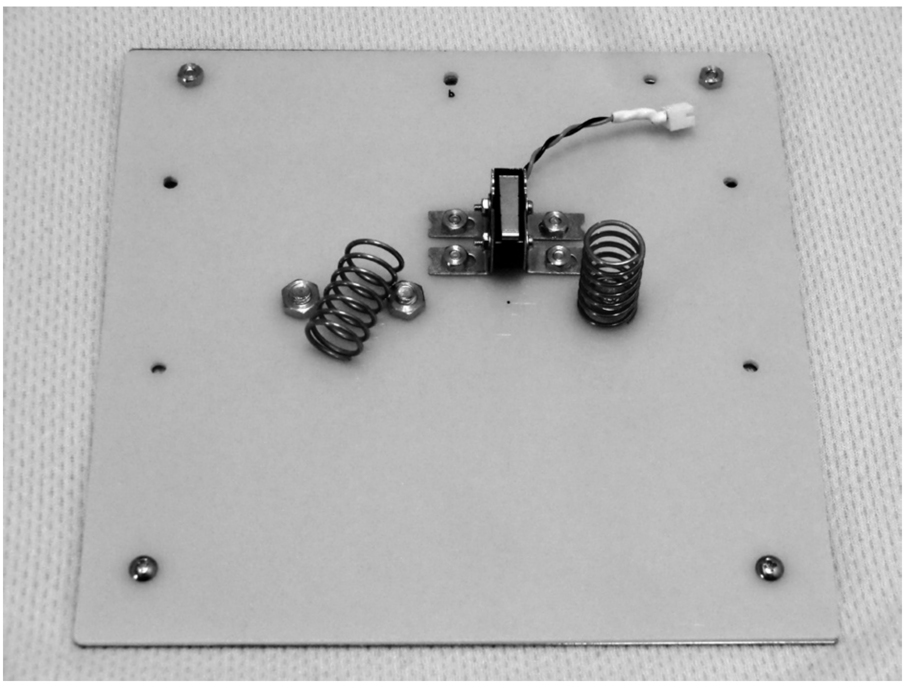

Figure 2 — The microswitch assembly showing the springs

the sole of the foot presses on the pedal?" In this case, it's difficult to operate using only your toe; you have to "pedal" with your entire foot. This requires you to exert more energy than just using your toe would. So, this kind of foot switch is also unsuitable for contesting.

Foot Switch Physics

Let's look at the position of the pedal axis. Operation by toe is least fatiguing, so the axis can't be positioned at the front of the pedal. Considering the structure of the pedal for manufacturing, the rear needs to be better positioned. It's not sufficient only to consider pedaling style to reduce the fatigue. You also have to consider the tension of the spring inside the foot switch. It needs to be of moderate strength. If it's too stiff, you'll need to exert more energy, and if it's too weak, you may trip your PTT inadvertently. An ideal strength of spring is the one in which PTT doesn't activate when you rest your toe gently on the pedal and works perfectly through a slight pedaling movement. With a switch having a moderate spring strength, you shouldn't have to hold your instep up to keep from tripping the PTT; you can rest your foot where you pedal.

Another consideration is the length of the pedal stroke. It should be minimal for both the PTT-activated and pedal stop positions. If the stroke length is longer, you need to move your toe too much. The ideal length is about 0.05 inch (0.025 for each).

The method I've described above implies *not* wearing a shoe on your "operating foot." Most find it difficult to clearly feel the pedal while wearing shoes, but if the tip of your shoe sits a bit off the floor, you can still wear your shoe by placing your foot in a position for the pedal to be gently touched.

Prototype

I designed and built six prototype foot switches to satisfy these conditions. The prototypes have two capabilities not available on the most popular foot switch models. The prototype includes both a variable spring strength and a variable pedal stroke length. You can adjust these parameters to suit your individual preference.

The original design of this foot switch was derived from the switches I'd been using for contesting, which seemed okay until I got frustrated. When I decided to design and build this prototype, less than a month remained before I was scheduled to leave Japan for the 2012 CQ World Wide SSB. Although I had to rush, I was always groping for the next step of the build. In fact, I didn't have a complete design until I finished the first build. Only the theory explained above helped me in coming up with the final design (see Table 1 for a list of parts and materials). All materials can be obtained via the Internet, but I bought some of them here in Japan because of time constraints.

It would have been easier to use plastic materials, but I went with metal instead; a foot switch should be durable and heavy enough to stay in place. As opposed to my final version, the first prototype had longer square aluminum stock extending along each side of the pedal proper. It was quite uncomfortable, because the edges of the square stock touched my foot very easily and stressed me out. So, I used shorter pieces of square aluminum stock on either side of the pedal, using a bandsaw to cut a "flap" along one side and further trimming the stock below each flap to create a slight flare. The flaps then are bent to cover the front of the square stock pieces. L brackets secure the shape. (see Figure 1).

A microswitch does the actual switching. The microswitch assembly consists of a

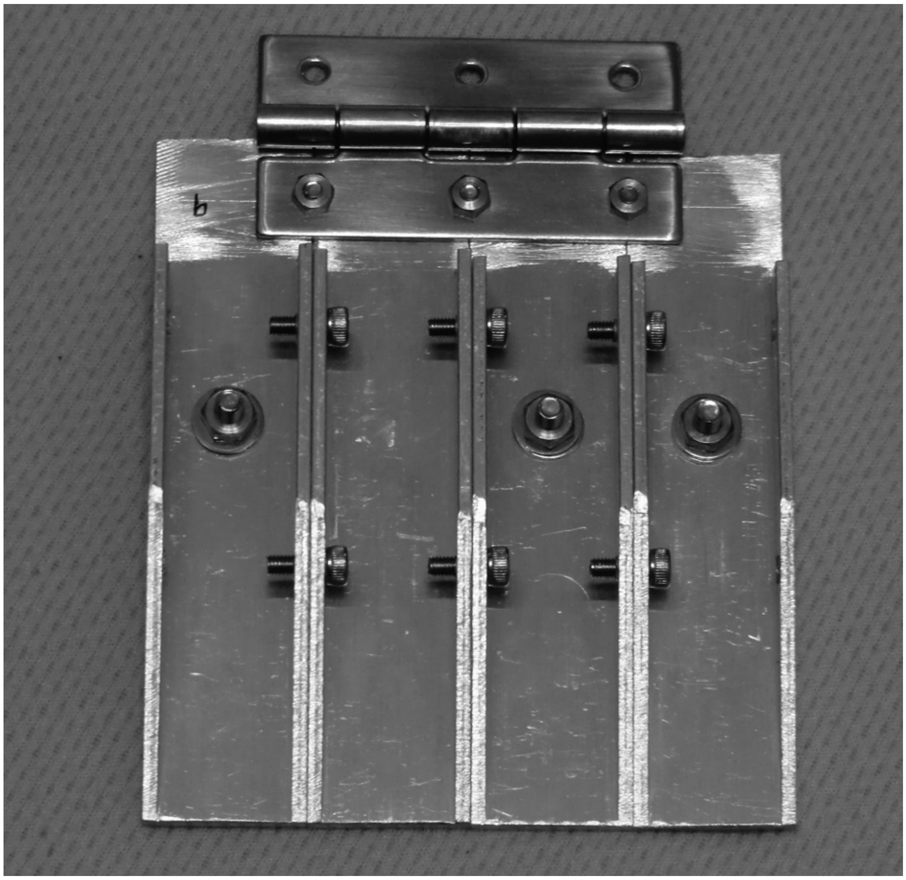

Figure 3 — The underside of the pedal, which is made from four pieces of aluminum channel

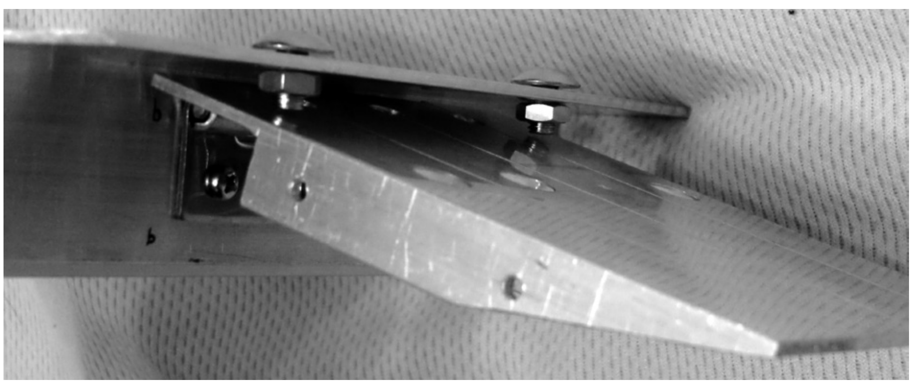

Figure 4 — The pedal attaches to the L angle with a hinge.

vinyl chloride board laid on the top of a piece of stainless. All holes are co-located on each piece, and the microswitch is fitted with a connector, so that the footswitch can be easily taken apart (see Figure 2). There are two springs inside of the footswitch assembly. You can vary the tension by changing the number, length or type of spring. Aside from the microswitch, the only movable part of the foot switch is the pedal, which needs to be physically stiff for proper activation. To satisfy this, I decided to make a pedal by piecing together four pieces of aluminum channel, which I trimmed on the bottom side using a bandsaw. The inner surfaces of the channel pieces are beveled on the lower end after they're secured together (see Figure 3). Three large screws hold the springs in place, and the pedal hinge attaches to the upper part of pedal. A rubber pad on the top of the pedal not only minimizes the possibility that your foot will slip but doesn't feel chilly in colder temperatures.

I combined a longer piece of square aluminum stock plus an L angle at the rear of the footswitch. The pedal attaches to the center of the L angle (see Figure 4). Two screws serve as "pedal stoppers" to control the pedal stroke, and a nut on each keeps the screws from coming loose. I managed to complete the prototype a day before I had to leave Japan. The footswitch actually used at V26B (see Figure 5) weighed 1.2 pounds, excluding the connecting cable.

Practical Application

I took along three of the six prototypes to use in the 2012 CQ WW SSB at V26B. I operated on 10 and 40 meters and made more than 2500 contacts in 25 hours by activating the PTT using this foot switch. Unlike my experience in past contests, I no longer felt fatigued by pedaling, even when the band was getting slow. After the contest, Bob, I2WIJ, commented, "It worked very, very well…better than those supposed to be professional." Vitor, PY2NY, asked for a picture of the foot switch. He told me some of Araucaria DX members were interested. Before the contest, Sam, WT3Q, remarked, "This is nice. The length of the stroke is minimal, and the strength of the spring is moderate." Sam and Dale, N3BNA, asked me if they could *purchase* one, but it was not my plan to sell the foot switch, just to demonstrate the concept and design. But I agreed to let them take one home for their stations.

Judging from these positive reactions, I think I have found what we have been looking for without knowing it. Contact me if you are interested in this foot switch or want to know more details.

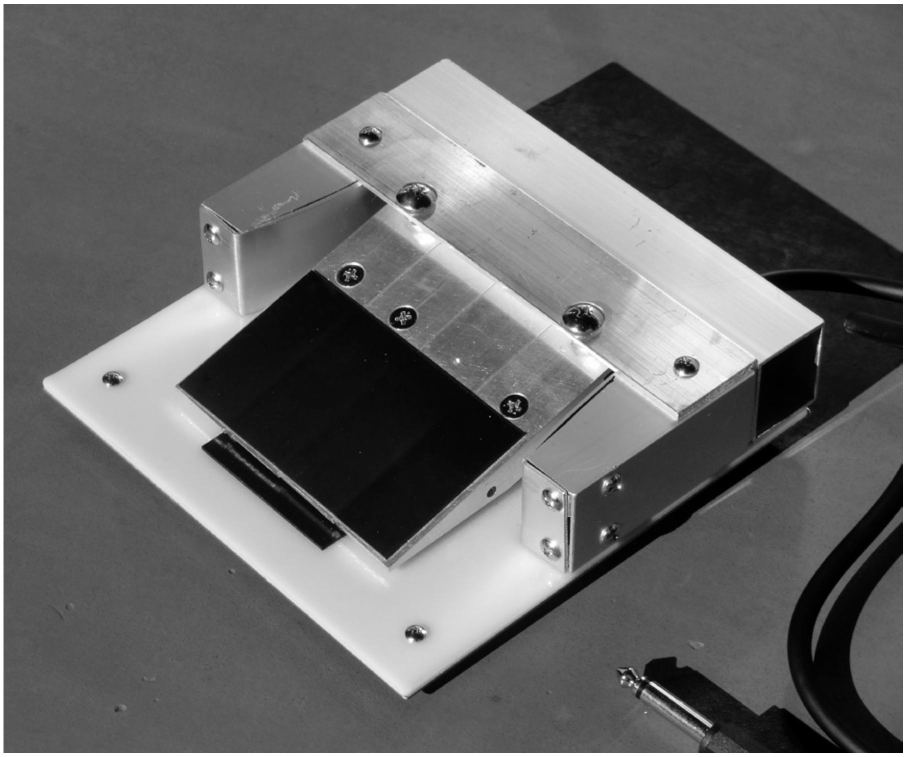

Figure 5 — Final prototype of the foot switch used at V26B

Parts List

One 150 mm (≅ 6 in) piece, square 1.3 mm aluminum stock, 30 × 25 mm
Two 80 mm (≅ 3.2 in) pieces, square 1.3 mm aluminum stock, 30 × 25 mm
One 150 mm (≅ 6 in) piece, 2 mm aluminum L angle stock, 30 × 30 mm
Four 100 mm (≅ 4 in) pieces 2 mm aluminum channel, 12 × 22 mm
One piece of 1 mm stainless sheet, 150 × 150 mm (≅ 6 × 6 in)
One piece of 2 mm vinyl chloride sheet, 150 × 150 mm (≅ 6 × 6 in)
One SPDT microswitch (Omron #SS-5GL13D or similar)
Eight pieces of 7.2 mm metal L bracket, 16 × 14.4 mm
One hinge, 60 × 32 × 1.5 thick
Two small rubber feet
Two medium rubber feet
Two medium rubber grommets
One stainless compression spring, 13 mm (OD) × 1.2 mm (wire diameter) × 14 turns
One rubber sheet, 85 × 50 × 1 mm thick
One rubber sheet, 15 × 50 × 1 mm thick
Three screws, truss head M2.6〜5, flat head M4, pan head M2, 3
Nut, M2〜5
Washer, M2.6, M4
Cable tie (to secure cable)