The Parkwood PaddleKey – An Experiment in Key Design

By Richard A Meiss, WB9LPU

Introduction

Like many CW operators, I like to use either a paddle or straight key (or bug) as the occasion arises. A number of key makers have met this need by mounting a paddle and a straight key side-by-side on the same base. While this works nicely, it does make for a rather large footprint on the operating desk. Besides this, many transceivers with built-in keyers require some kind of adjustment to switch from paddle to straight key input. It occurred to me that if both keying functions could be incorporated into the same instrument, with automatic switchover between modes, these objections could be overcome. This was the motivation to develop a CW instrument that I will call the PaddleKey, and this write-up will cover the process of design, development and testing of such a device. Whether it really fills a general need remains to be seen, but in my own experience in exploring this development has been an enjoyable challenge.

Design Goals

A number of ideas had to be incorporated into the design process from the beginning. As Walt Kelly's Pogo said, "If we don't know where we are going, we are liable to end up somewhere else." So at the outset I had the following points in mind.

- There should be no compromise in either the paddle or key operation – too many multi-purpose devices don't do either jobs very well.
- The paddle portion of the PaddleKey would be non-iambic ("single") – an iambic version could come later. (I must admit that I do not use an iambic paddle as a "squeeze key" anyhow.)
- Paddle operation should be positive, with a definite "dead center" and no "falsing" due to overshoot when using close spacing. Straight key operation should be smooth and have no tendency to bounce or wobble. Neither function should interfere with the other.
- There should be independent adjustment of tension and spacing for both paddle and straight key operation.
- Switchover between the two modes should be automatic and immediate.
- The design should incorporate approaches that have been tried out in previous designs, and it should use parts in common with my other designs.

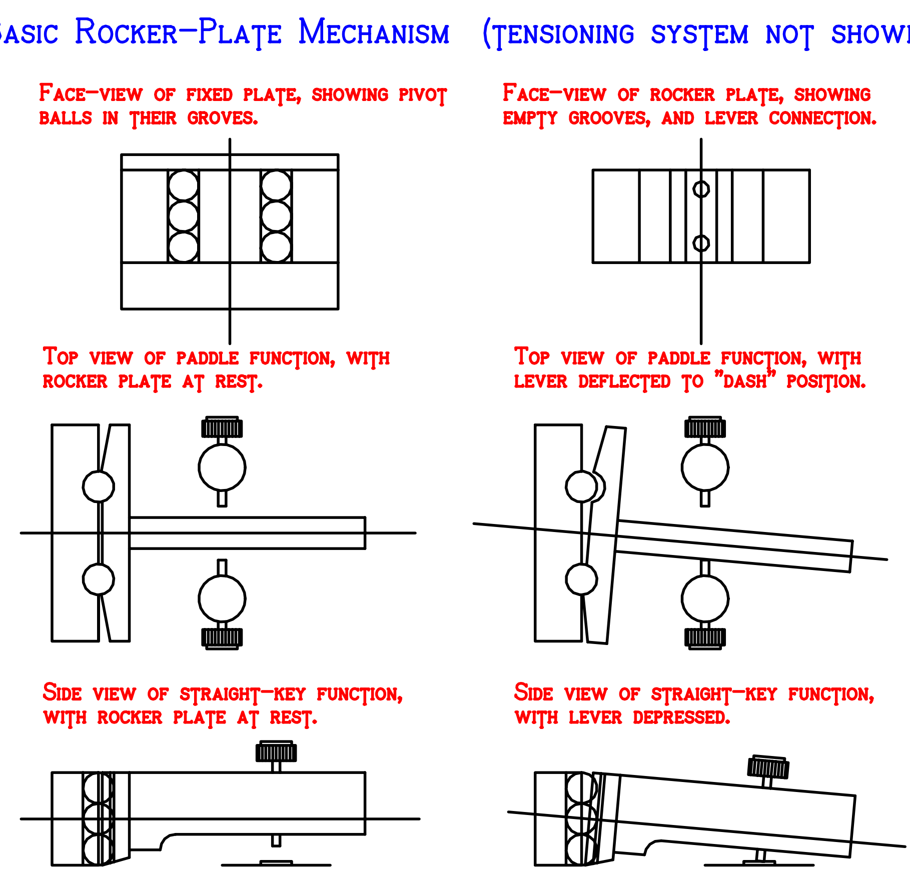
Besides this laundry list, the project would allow a comparison between spring and magnetic tension design, and it would let me experiment with a special high-strength aluminum alloy called Fortal.

Problems in Single Paddle Design

It might sound strange at first, but it has been harder to design a good single paddle than an iambic one. The most difficult problem is getting a positive "dead center" without overshoot or "mushy-ness". A number of commercial paddles have tried a several approaches to this problem. The VibroKeyer ® approach has been to adapt the tried-and-true bug mechanism. This works well, but it is fairly complex to construct. The Kent ® single paddle uses an interesting system that is simpler in design, but it requires a lot of care in machining. The HiMound Manipulator uses a system that is similar in concept, but it uses coil springs instead of leaf springs like the Kent paddle. Some less-expensive single paddles use a simple leaf spring between two contacts; this works passably for portable operation, but I couldn't reach my design goals with this approach. I finally decided to use the "ball-pivot" rocker-plate design that I had experimented with several years ago. This had the advantage that it could be modified to serve as the basic mechanism of both the paddle and the straight-key function. The diagrams below show the basics of this mechanism, as used for both paddle and straight-key function in the same instrument.

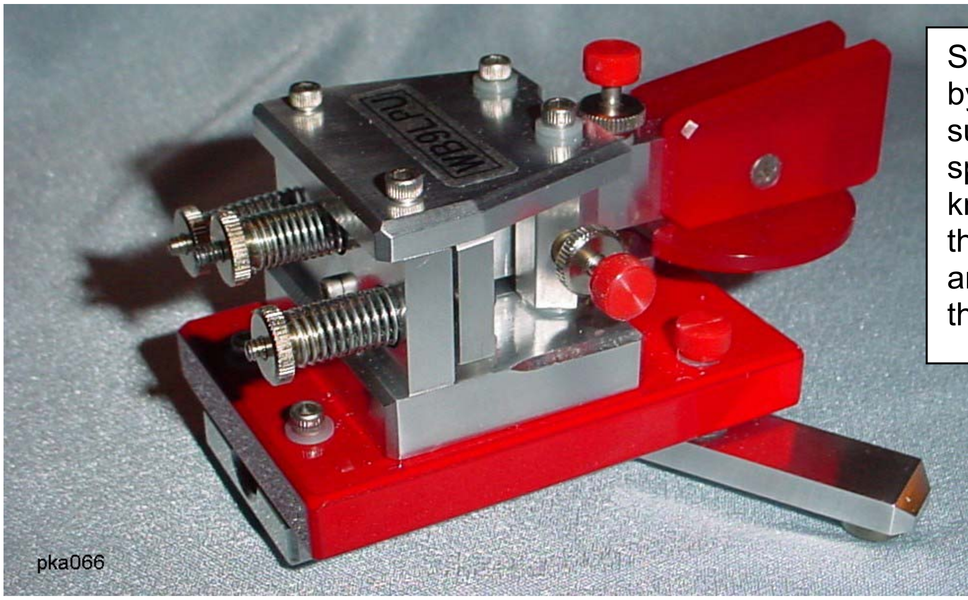
In this mechanism, a moveable plate is held against a fixed plate by spring or by magnetic attraction, depending on the design, and a lever is fastened to the moveable (rocker) plate. On either side of the center, a vertical channel in both plates holds a stack of precision bearing balls. When the lever is pushed to either side, that stack of balls forms a bearing that holds the plates in vertical alignment but allows pivoting. The rocker plate is kept from moving up or down and the balls are kept captive by the base and top plate of the assembled paddle mechanism (not shown in the diagram – see later pictures).

For straight-key operation, the rocker plate is beveled at the bottom to form a knife-edge that will allow it to tip forward. When the lever is pressed down, the rocker plate pivots about the bottom ball in each stack, which also holds it in lateral alignment. The top and base plates of the paddle mechanism hold the rocker plate in alignment and prevent upward travel of the lever. This combination of effects means that the lever has two preferred directions of movement – lateral and vertical. In operation, these are distinct enough to prevent movement in the unwanted direction.



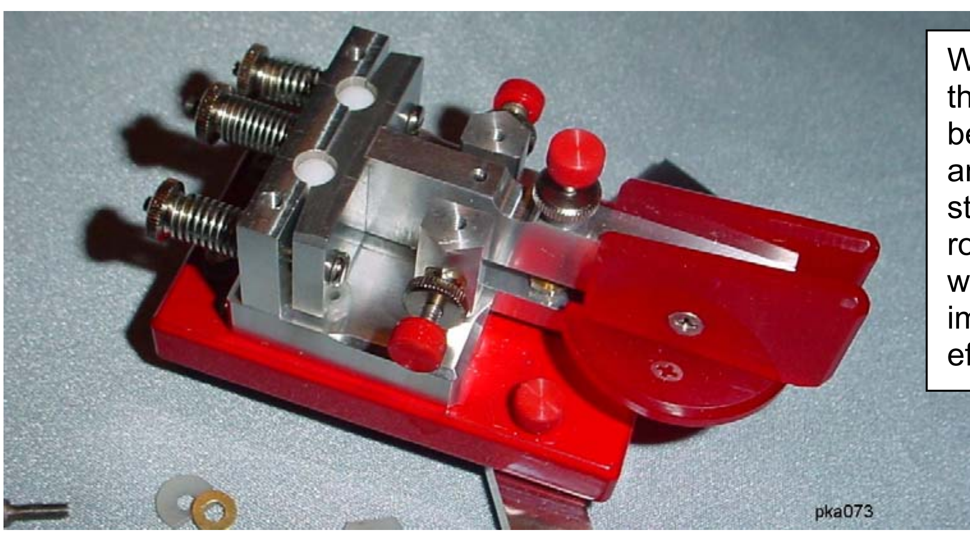
A Spring-Tensioned Version

The first paddle to be constructed used springs for tension. For a single-purpose paddle, only one spring would be needed, although this would not allow for independent adjustment of dots and dashes. In this dual-function paddle, two springs are used for the paddle tension, and a third spring is used for the straight-key function. This spring also prevents "droop" of the lever due to gravity. Although the three springs do interact somewhat, separate adjustments are possible.



Spring tension is set by the knurled nuts supporting the springs. The red knobs are used to set the paddle spacing and the lever travel in the straight-key mode.

This paddle was machined from a very hard aluminum alloy called Fortal. This material takes a high polish that lasts for many months - I am not sure how many. It is easy to work and is relatively inexpensive. The needed weight for stability is provided by a powder-coated steel base. While the paddle construction is all metal, I was able to use Teflon pivot balls because the springs provided electrical continuity. The Teflon gives a good feel to the lever with just a hint of drag.



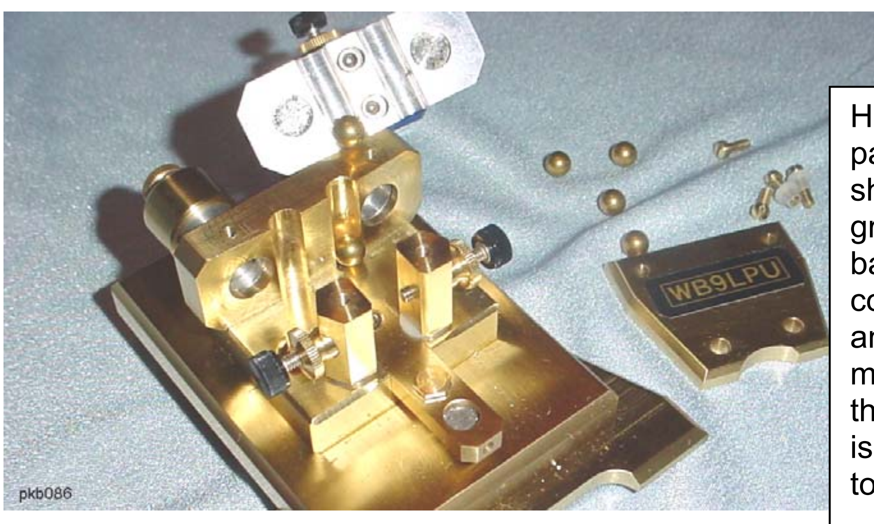
With the top plate removed, the pivot balls may be seen between the rocker plate and the fixed plate. In the straight-key mode, the rocker plate pivots on nylon washers. This design was improved upon in the next effort.

The Magnetic Version

After some experience with the spring version, I decided to try a magnetic approach. Although I favor magnets acting in repulsion, because that results in a less "clicky" feel, this approach proved unsatisfactory for the rocker-plate mechanism. Because the rocker plate is not "captive" when it is moved, it had a tendency to try to escape from the magnetic field and to "slip around" as the lever was returned to rest position. So this approach is best suited to paddles and keys in which a positive bearing is used. On the other hand, magnets working in attraction are inherently self-aligning. The problem of "clickiness" can be controlled by using very strong magnets spaced relatively far apart, where the slope of the magnetic gradient is rather flat.

The second PaddleKey was made primarily of brass. Fortal was used for the rocker plate and the lever to keep its weight down. Note that the “business end” of the lever has both paddle fingerpieces and a round straight-key knob. The fixed magnets are contained in the cylinders at the front of the unit. Tension is varied by rotating the cylinders to move the magnets in or out.

Only two main magnet pairs are used, and auxiliary return force for the lever is provided by a bias magnet located below it at the fingerpiece end. This is also adjustable, but less conveniently so than the paddle magnets. Because (in my experience, anyway) good sending with a straight key is less affected by minor variations in return force, I opted to save the fine adjustment for the paddle function. This version used brass pivot balls, which provide electrical continuity from the lever to the base. See the photos for various features of the construction.



Here the device is shown partially disassembled, to show the semi-circular grooves that contain the pivot balls. There is no mechanical connection between the lever and the rest of the key; the magnetic force is sufficient for this function. Vertical register is maintained by the base and top plates.

A Keyer for the PaddleKey

In order to make best use of the new design, a keyer circuit would be needed that would not require any re-setting to go between modes. I was unable to find any available keyer chip that allowed changeover "on the fly", so I opted to use the TenTec 1553 keyer kit. This is a very simple non-iambic circuit that uses 555 timers, but it does have some limitations. One of these is that the "common" input must be isolated from ground, meaning that the paddle would have to be insulated from (accidental) ground. The other problem is that the circuit has no provision for a steady output for straight-key function, and because of its design, biasing a transistor to provide this mode proved to be very difficult. Both of these problems were solved by using optoisolators, and now the inputs are referenced to physical and electrical ground. The system requires a four-wire connection to the PaddleKey, so surplus 5-pin DIN connectors were used. These plug into the rear of the unit, and conventional 1/4-inch phone jacks are provided at the front for other instruments.

The keyer module, with its new optoisolator interface, was mounted in a surplus computer A/B switch box. A new front panel was made of sheet aluminum to cover the original panel markings. A speaker on-off switch was provided so that the transceiver side-tone could be used to monitor the sending.

Results and comments

The question of what kind of fingerpieces to use is not yet settled. I opted to use conventional shapes - trapezoidal for the paddle function, and round for the straight-key function. Other shapes for the straight-key knob were considered, including one that was trapezoidal, similar to the vertical fingerpieces. The jury is still out.

Working out this concept was a lot of fun and was a good design challenge. Whether the design will prove especially useful or not is another matter, but it will be fun to work with for a while. As experience proved, the design is very intolerant of machining errors, with only a small bit of latitude permissible in the "up and down" dimension before the feel of the paddle is spoiled or the straight-key function becomes "wobbly". If there are future versions, they will incorporate fine-tuning adjustments for the critical areas.