Using a Dual–Lever Paddle

by Chuck Adams, K7QO

Revised September 10, 2013

This article is written for the purpose of showing you some techniques that you can use for **dual–lever paddles** for sending the International Morse Code for communications.

If you are new to using the morse code, may I humbly suggest you learn to receive before attempting to send it. Receiving is a different skill set than that of sending and learning both at the same time is, in my opinion, a bad idea. It causes more confusion than helping.

First let me clear up some terminology that I believe to be used incorrectly. The mechanical device that I am going to use is a **dual–lever** paddle. It has two moving parts, the arms connected to finger pieces that you touch and move to cause contacts to close and then operate a keyer.

The dual–lever paddle is typically connected to an **iambic keyer** for generating morse characters.

The paddle itself does not generate iambic keying. It is the **keyer** that does that. I will go with the flow in calling a dual–lever paddle an iambic paddle as shown in advertisements world wide, but technically it is probably in error, but who cares?

For sending Morse at speeds greater than 20 WPM you will need something other than a straight key or you will become very tired and frustrated. Sending good code should be fun and not a great deal of work.

You may or may not already have experience sending Morse. If you do not, then let me personally recommend that you start with an dual–lever paddle and a keyer. Most modern commercial rigs and a number of QRP kits that I know of have a built-in electronic keyer. You should learn to make good use of it if you haven’t already.

First let me take the “bug” (mechanical paddle) people aside. You know that it takes a certain force to hit the mechanical paddle and get the lever that sends the dits to move and stay moving long enough to get some number of dits. You will have to kill off the tendency that you have to “hit” the paddle with a lot of force. Be gentle, please. The following steps will help guide you. Please bear with me. There are quite a few details and try not to skip anything.

From personal observations over the years at swapmeets, ham conventions, field day events and other ham gatherings I have noted that I cringe when I see a large number of individuals use an iambic paddle. They “slap” the paddle around like it was a bug. Just a light touch is all it takes if you have an iambic paddle adjusted correctly. If the paddle shifts on the table during sending, then you are using too much force. If you are sending with one hand and holding the paddle in place with the other, you are doing it wrong. The base of paddle should not be moving on the desk or table. If it is, then you are not using a gentle force on the paddles. The typical paddle has a mass around 2 kg or so and it takes a large force to move it. Take it easy. It isn’t going anywhere on its own.

So let’s begin. You will need the following items.

- an dual–lever paddle
- an iambic keyer
- connecting cables
- phone book, dictionary, book or a newspaper.

Let’s first have a look at your paddle. Hopefully you can find one used and get it at a good price, if you don’t have one already. I have managed to get Bencher paddles for less than $40 at swap-meets on the last day when everyone is in a dealing mood and doesn’t want to pack up all that stuff left over to take back home. You know the story, they were told not to come back home with anything….. The paddles didn’t look pretty but I spent some elbow grease, paint remover, primer, and paint to get them looking like new again.

Take a good look at the paddle and note how all the parts fit to-gether. The iambic paddle has two separate movements and sets

of contacts which I will call the left side and the right side as seen from the finger pieces side. Note the adjustments for spacing on the contacts. Play with the adjustments and see if they are clean and operate in a smooth manner. If you are mechanically inclined and working with a used paddle that needs some work, then take it apart and clean it up and put it back together. Take notes and photographs with a digital camera before you take it apart. Keep a small box to hold all the parts 'cuz Ace Hardware and others may not have a replacement part if you lose it or damage it in any way. There are many early paddle manufacturers that are no longer in business, and spare parts are almost impossible to obtain. Use common sense on chemicals, etc. Do this in one sitting if possible so you don't forget how to reassemble the device correctly. Keep kids away from the parts unless you are showing them what a wizard you are or teaching them how to do some mechanical work.

Do not use a file, fingernail file, sandpaper, or other abrasive material on the contacts. I use a sheet of typing paper that I slide between the contacts while holding the paddle piece to close the contacts to clean them aperiodically. The sulpher dioxide and other pollutants in the air tarnish the contacts and cause problems while in use. The contacts are usually silver or gold plated. You do not want to remove the thin layer of plated material. Hopefully the contacts have not been abused by previous owners if you working with a used paddle. We do need a paddle police force to prevent or reduce this abuse.

Now that we have a working paddle, hook it up to the keyer. I will assume that you are right-handed. Just reverse things for left-handed operation. You need a small cable that has two wires and a shield. It should be long enough to reach from where you will have the paddle on the operating desk to where you would like the keyer or rig to be. I have used the audio output cable found in CD drives for computers. It is small and flexible. If you are lucky to have the manual for the keyer, find out the connections needed to the paddle. The following connections are what I used for the many keyers and my rigs. Hook the left paddle contact to the tip connection of the stereo plug; the right paddle contact to the ring connection of the stereo plug; and the shield to the ground of

the paddle and to the ground connection of the stereo plug. You need shielded cable so that later, when you connect this setup to a transmitter, you will not have problems with RF getting into the keyer and causing it to malfunction.

Power up the keyer and see if touching the left paddle sends dits and the right paddle sends dahs. If you have a keyer built into the rig, then set the power output to the lowest level and use a dummy load. Historically the reason for the dits on the left paddle and the dahs on the right paddle is due to the semi-automatic mechanic paddle, a.k.a. bug, first being built in the configuration that gave dits with the left paddle, etc. A number of people do it the opposite way and that is fine. Just be prepared to be unable to walk up to any operating position and use their setup unless they have a keyer that will electronically switch to the opposite paddles for dits and dahs (reverse mode).

OK, now first adjustments. Make sure that all the adjustment components are aligned correctly and ready to be adjusted. With the keyer powered on I take the adjustment on the dit contact closure and move it to narrow the spacing until contact is made and the keyer starts sending a continuous string of dits. Then I back off the adjustment until the dits stop. This is just a small portion (1/8 is typical) of a turn on the typical paddle. Don't make the spacing too wide as I will explain in a minute. I find that a sheet of 20 pound typing paper just barely fits and there is a slight amount of friction. That's how narrow it is when I make the adjustment. Now some people are going to come along and suggest or demand that you use a wider spacing. I don't think so. If the paddle will hold the adjustment and stop sending when you release pressure on the paddle, then it is fine.

Next do the same thing on the opposite side for the dah paddle, and you are just about done. There may be a tension adjustment for either a spring or springs or magnets. Adjust this for the minimum tension you can get and still have the contacts stay open after you release pressure on either or both paddles.

A note of the historical reason why the dit is on the left–hand paddle. This was the way the semi–automatic paddle, the bug, was set up for the right–handed operators. You can, for extra coin of

the realm, get a paddle for left handed operators in which the sides are reversed. But there is no real reason for a left handed operator not to use a paddle that is set up for right handed operation to even change the settings. It is just a matter of beginning use of a paddle with it set up for the so called right hand operation. I see guys and girls on YouTube that have the paddles set up reversed from the standard. Not a problem unless I try to use the setup, which is very unlikely to ever happen.

So with the light touch and the narrow spacing, let's get down to some real exercises. Sit down at the desk you will be using and place your entire arm from the elbow to the wrist on the table in a comfortable position. Some of you may want your arm parallel to the edge of the desk and some at an small angle. I don't think straight into the desk is a good idea. You want to be able to do this for hours on end later in your CW career.

Now point your index finger straight along the same direction as the rest of the arm. This is the direction I want your paddle to line up with the paddles towards your hand. Extend your thumb straight out and place the paddle with the left paddle just touching it. The thumb should be relaxed, and you may want to bend it just a little. It's up to you. The index finger should just touch the opposite paddle on the right side of the pair. I use the area of the finger opposite the fingernail near the tip while the finger is curved. I find my wrist is turned to the left a little so that the back of the hand is not vertical to the desk surface. The wrist, the arm and elbow are resting on the table surface.

With the thumb and index finger touching both paddles and no dits or dahs being sent and with you in a comfortable position, I want you to hold this position for a few minutes. Don't take your fingers off the paddles, and don't push on them either. Not a word and not a sound for a few minutes. Think about what you are doing and if there is something that doesn't feel right, then adjust your posture, arm position, etc. until you feel comfortable. I don't need 5 minutes from you, but you get the picture. If you can't do this for 5 minutes then how are you going to do it for longer periods of time while talking to someone on the air?

If you are uncomfortable having the thumb and index finger touch-

ing the finger pieces, then by all means move them slightly away, but not too far. Maybe a few millimeters. You don't want to have to take a running start from the resting position to make contact with the paddle.

Get ready to send. I assume that you know all the characters and numbers and if not, pick the ones you do know. If you have the manual on the keyer or rig. Look and make sure you know what mode the keyer is in. There is usually a Mode A and a Mode B. I personally prefer the Mode B and if I set down to send and have a Mode A keyer then I am screwed. I can not send in that mode and I demonstrated that at a QRP gathering at Pacificon one year. Got a laugh out of the audience at the time.

Set the keyer speed to 15 wpm or so and no slower. Apply pressure to the left paddle with your thumb. You should hear a string of dits the entire time you have it depressed. Do this with the right paddle and you hear a string of dahs. Here is the neat part. Hold down both paddles at the same time. This requires a 'squeezing' motion on the part of both fingers, thus the term 'squeeze keying' in some literature and advertising. The sound pattern will alternate continuously between dits and dahs. With both paddles closed lightly, let the pressure off of one of the paddles. Now bring pressure back on with the finger you let off and get the alternating pattern going again. Now let off with the other paddle, again keeping the finger or thumb touching and get a continuous pattern of dits or dahs. Bring the finger or thumb back. Do this until you get the feel of it. The important thing that I want you to learn is how the sending is done with the two paddles. I like to do this with thumb and finger in contact with the paddle most of the time.

In September of 2013, I made a YouTube video using an MFJ-564B dual–lever paddle and a K1EL microprocessor based keyer. Because I had not been on the air in a decade or so, I was very rusty and my thumb came off the paddle a small distance. If a CW operator is not on the air at all, is he/she a silent key? In inquiring minds want to know.

Remember when you learned to write? What did your parent(s) your teacher(s) or whoever have you do? They gave you some paper, most likely a Big Chief writing tablet, a number 2 yellow

pencil and a picture of the alphabet. A sample of the alphabet was usually on the inside cover of the Big Chief wiring tablet. You started with the letter A. I don't remember whether it was lower case or a capital A. Probably caps first 'cuz you could do those with straight lines. Then you did one or more complete lines of all A's, then B's, etc. Well welcome back kid, we're gonna do the same thing all over.

First do the letter A. This is done with a di-dah sound combination. I'm going to adopt the following notation for the finger pushes. A lower case 'r' means the right paddle and only long enough for one element, the dah. An upper case 'R' means the right paddle for at least two or more elements. Of course you can figure out what a 'l' and 'L' are for the left paddle and sending dit(s).

So an A looks like the combo of `lr` with almost no time between the first and the second depression. Try it. You have to gently tap the left paddle and immediately tap the right paddle with a gentle pressure. Make sure you are not sending ET as we aren't trying to phone home just yet. It is important to not leave a gap larger than the time unit for a single dit between the dit and the dah. The neat thing about a keyer is that it will always put at least the smallest allowed spacing, and you have to react fast enough on the next element so that it doesn't leave more space. Some keyers will automatically space for a letter if you hesitate or delay just a fraction of a dit too long.

OK, just like pre–school, kindergarten or the first grade. Time to do a series of A's. Send an A every two seconds and do ten of them in sequence. And repeat until you can do this without a SINGLE error. Remember how you used to complain and say to your parents? "Oh, mom, oh, dad, this is so easy and so boring. Can't I do something more interesting?" No. Do your homework and no dessert until you finish...

Now here is the time to tell you something. Did you notice that if you didn't let up on the left paddle very quickly you'd get the letter R? This has to do with an internal memory of the keyer. Here is one of ways the Mode B iambic keyer works. If the left paddle is still depressed past the half-way point of the dah, the keyer will automatically 'lock' this info into memory, and after the dah is

finished the keyer will go ahead and send an additional dit EVEN if you have released pressure on the left paddle!! This is gonna make the letter R and some other letters easier to send as we will see later.

OK, now the letter B. The finger combination will be ’rL’ where we will hold the left paddle down in order to get the string of dits. I don’t know any other way to say this. Don’t you dare count. Counting is bad. Counting kills. Just remember the sound of the letter B and do what it takes to sound the letter. If you start counting dits, you are dead meat. You’ll never get to high speeds. So break the habit now, work on it until you do. Go back to the beginning code CDs or tapes if you must.

Repeat the same exercise we did for the letter A. Send a letter B every two seconds for 15 seconds until you get a perfect sequence. Now go to 30 seconds and alternate A and B until you get it perfect or near perfect.

Now the letter C. The letter C is the first neat one that you get to demo the power of IAMBIC KEYING. Observe someone who was a long time bug user. They will use the ‘rlrl’ combination for the letter C. You try it. This is a waste of time and energy. You just took four strokes to get one letter. Now try this combo to get C — ‘RL’. Hold the right paddle down and then immediately depress the left. Hold the right until after the second dah is half finished or complete and release and immediately release the left paddle at the mid-point or later during the second dah. Work on this until you can send C perfectly. You only need to touch each paddle once and apply pressure briefly.

OK, we did a C with only TWO strokes instead of four. This is the beauty of iambic Keying with a little help from Mode B. There is a Mode A for iambic keying that can do the same thing but requires a longer paddle hold timing and I don’t care for it at all. In fact, with Mode B or A we can send all the letters and numbers with TWO strokes except for the letters X and P.

Practice on the letter C until you can send one every two seconds for 30 or more seconds without a single error. Practice makes perfect. I find that people who are accomplished musicians make the best students. Know why? They learned very early in life

that patience and sticking to something will allow you to do most anything. I don't think it is so much music but the love of doing something well that makes them better at a lot of things.

OK, here is the combo for each of the letters using the K7QO notation for Mode B Iambic Keying. Hopefully I don't have any typos here. Take each letter and learn the combo for doing it. Send the letter for twenty seconds with correct spacing without error and go on to the next one. Afterwards, forget the chart. Just concentrate on the sounds and the feel of sending each character.

```
A - lr
B - rL
C - RL
D - rL
E - l
F - Lr  hold L and tap r
        during the second dit
G - Rl
H - L   don't count
I - L   don't count
J - lR  don't count
K - Rl
L - Lr
M - R
N - rl
O - R   don't count  :-)
P - lRl takes three strokes
Q - Rl
R - Lr
S - L
T - r
U - Lr
V - Lr
W - lR
X - rLr  three strokes
Y - Rl
Z - RL
```

Now note that this notation isn't perfect. It relies on you knowing

the letters and working out the physical timing. With practice you won't need to think about it and it will become second nature to you.

For the numbers

```
1 - lR   Don't count
2 - LR   Don't count
3 - LR   Don't count
4 - LR   Don't count
5 - L    Don't count
6 - rL   Don't count
7 - RL   Don't count
8 - RL   Don't count
9 - Rl   Don't count
0 - R    Don't count
```

Those puppies, the numerals, take a long time to send at 15 to 20 words per minute. Makes them easy if you memorize them by sound and don't count the elements. This is the biggest killer of CW operators, the worst habit to obtain and the most difficult to undo. So get to work if you have the bad habit of counting for any letter or number. Think sound sound sound....

I'll leave it as an exercise for the student to figure out the punctuation symbols , . ? and the / (slant symbol). HINT: 3, 2, 3 and 3 strokes.

Here is something that I found to be interesting, and I had never seen done anywhere else. Here are the number of strokes it takes to send each letter using a straight key.

```
One Stroke    ---  E and T
Two Strokes   ---  A, I, N, and M
Three Strokes ---  K, O, S, U, W,
                   R, D, and G
Four Strokes  ---  B, C, F, H, J,
                   L, P, Q, V, X,
                   Y, and Z
Five Strokes  ---  1, 2, 3, 4, 5,
```

```
                    6, 7, 8, 9,
                    and 0 (zero)
```

So if I asked you to send the entire alphabet and all the numerals, you would have to work the key a total of 2 + 8 + 24 + 48 + 50 which is 132 key closures. No wonder you get tired after sending a long session with a straight key. And the muscles used are in the arm and wrist and more effort is being used in the motions.

September 2013. Please note. I did this analysis over 15 years ago. The purpose was to demonstrate how the graduation from the straight key to the bug and then to the dual lever paddle was the use of technology to reduce the work effort. Marshall Emm and others have taken the work out of context. I did not care what the statistcal distribution of the characters in plain text or even in the use of ham radio QSOs was or will be. You can not do a real analysis due to the lack of a standard to do so. I am just showing you how, with a dual–lever paddle you can simplify your physical motion to send morse code. End of rant.

Now let's graduate to the old 'bug'. Historically the bug was invented before we had a lot of digital designers around who weren't making the big bucks in computers.

```
One Stroke    ---  E, I, S, H, 5,
                   T
Two Strokes   ---  A, B, D, M, N,
                   U, V, 4, 6
Three Strokes ---  F, G, K, L, O,
                   R, W, X, Z, 3,
                   7
Four Strokes  ---  C, J, P, Q, Y,
                   2, 8
Five Strokes  ---  1, 9, 0 (zero)
```

Again, totaling up the number of strokes we get 6 + 18 + 33 + 28 + 15 giving us the winning number of 90 motions. This is quite a savings over 132 strokes required for the straight key. Timing–wise it gave the operator considerable ease and more accurate

timing on the dits. There is still the limit of human capabilities to send by hand each long element rapidly using the other side of the paddle.

Later came along the first electronic keyer. Now let's again go through our counting exercise but this time using only a single lever paddle with an electronic keyer. Some of the better CW ops that I know still only use a single lever paddle. I can see that it closely approximates a bug in operation, and it would be a much simpler transition to the new technology with a rapid learning curve. Here is the count that I get.

```
One Stroke    --- E, H, I, M, O,
                  S, T, 0 (zero),
                  and 5
Two Strokes   --- A, B, D, G, J,
                  N, U, V, W, Z,
                  1, 2, 3, 4, 6,
                  7, 8 and 9
Three Strokes --- F, K, L, P, Q,
                  R, X, and Y
Four Strokes  --- C
```

Wow!! That saved a lot. Totaling up the damages we get 9 + 36 + 24 + 4 for a total of 73 which again is a reduction from the previous two methods that involved 132 and 90 strokes for their respective totals.

And then came the dual–lever paddles with iambic keyers.

```
One Stroke    --- E, H, I, M, O,
                  S, T, 0 (zero),
                  and 5
Two Strokes   --- A, B, C, D, F,
                  G, J, K, L, N,
                  Q, R, U, V, W,
                  Y, Z, 1, 2, 3,
                  4, 6, 7, 8 and 9
Three Strokes --- P and X
```

Now we have 9 + 50 + 6 for a total of 65 strokes with again a savings in strokes.

So look at the totals again 132, 90, 73, and 65 for each of the methods of sending Morse. With the Iambic Keying you can save about 50 per cent of the work of using a straight key for sending the entire alphabet and numerals one time. Something to think about and wow your friends and neighbors with.

In using an iambic paddle with a keyer, the only motion required from the human operator is the movement of the thumb and the index finger. With a light touch and small movements, not much energy or effort is required of the operator, so long periods of operation are possible. For on the air operations there is a duty cycle of about 50 per cent. You should allow equal time for the other operator to relay information to you. This allows you to move the arm about and if you are like me, you write down things said by the other operator. I have an OCD condition whereby I write down everything the other operator transmits. Been doing it for 50 years and plan on doing it another 50 years.

I have been criticized on the Internet as making a serious error at this point. The above figures are for the alphabet and numbers being used for the analysis. The criticism that I am getting relates to the distribution of the letters as used in plain English text. Well, I'm sorry to have to tell you that that distribution does not apply to every day QSOs on the air. Radio amateurs tend to abbreviate as much as possible and use Q–signals also, plus the technical terms with their abbreviations tend to bias the distribution of characters and numbers. And the experience of one or both operators greatly affects the length and content of each QSO. All bets are off if the operator(s) are using a keyboard which is the typical case at speeds above 40WPM. So the actual savings may vary from QSO to QSO, but my point in this writing is to show how and why the key and paddles evolved as they have. All for the sake of efficiency and reduction of effort on the part of the operator. I'd like to see less retention and more operating, else the art of Morse will die, and if we can't work together then what is the goal? IMHO.

OK, now it's time to start practicing. Here I'm leaving you on your very own to do the work. Now I asked you to get a phone

directory, dictionary or newpaper or book. The reason? I want you to randomly open it to a page and start sending line by line. If you make a mistake, you have to start over with that line. Do this for about 15 minutes at a time and take a break. Do this for at least 30 minutes a day for a week. I know it's hard work, but when you get to the point that you can do this in your sleep then you will forever be able to get on the air and sent flawless CW day in and day out without breaking into a sweat. Get a copy of QST and send all the calls you see for more practice.

I recommend you start at least 17WPM and work your way up to 20WPM to 25WPM. It shouldn't be too difficult. Just be patient with yourself. If it was easy, every one would be doing it. The things that you probably enjoy the most are the things that took effort and lots of training to accomplish.

OK, graduation time. If you have followed the above instructions and practiced dutifully, you are ready to get on the air daily. Of course, read the ARRL Operators Manual and review all on air procedures that you need. And hopefully I will work you on one of the FISTS calling frequencies and I know I will be impressed with your paddle skills.

September 2013. Look up on the web HST competition for High Speed Telegraphy constests, held in Europe each year. The US needs more young people to participate. Look up the home page for RufzXP. Then look at the videos for the sending competition where operators send five letter code groups as fast as they can without error. You should work on your sending skills and enter this competition, especially if you are a teenager in the USofA. Your chance to get to see Europe and compete against individuals in your age group. Maybe the ARRL can come up with some funding to get you there and back.

dit dit

Appendix

Here are some **YouTube.com** video URLs that you may find interesting and some photographs of keys and paddles. For the first time dual–lever paddle users, may I recommend the new and improved MFJ Enterprises model MFJ-546B paddle. This paddle sells for $69.95 US in September of 2013. I just bought one. I find that it is a much improved quality paddle that ones that may have been done earlier in the century. The paddle has gotten unfavorable reviews, but I'm not sure that is due to quality control issues or lack of patience and experience on the part of the reviewer. Paddles and keys are a personal kind of thing and we all have our favorites. I even own a couple of high dollar paddles (expensive to buy) and I find that I don't get much improvement on my sending skills using one. But, as I mentioned earlier, I am a silent key until I get an antenna up and running. Hope to meet you on the air soon.

Here are some URLs for sending with a straight key. These were done a very long time ago, but are just as applicable today as they were back then.

<http://tinyurl.com/okep6s3>
<http://tinyurl.com/o56gbpy>
<http://tinyurl.com/pb96c5k>

Here are some good vidoes for the sending with the bug that sounds correctly spaced and nice to listen to code. IMHO. If you can't do this, then move on to the dual–lever paddle. Please. :-)

<http://tinyurl.com/q6o2xvv>

The following pages show photographs of some paddles and keys in the K7QO estate.

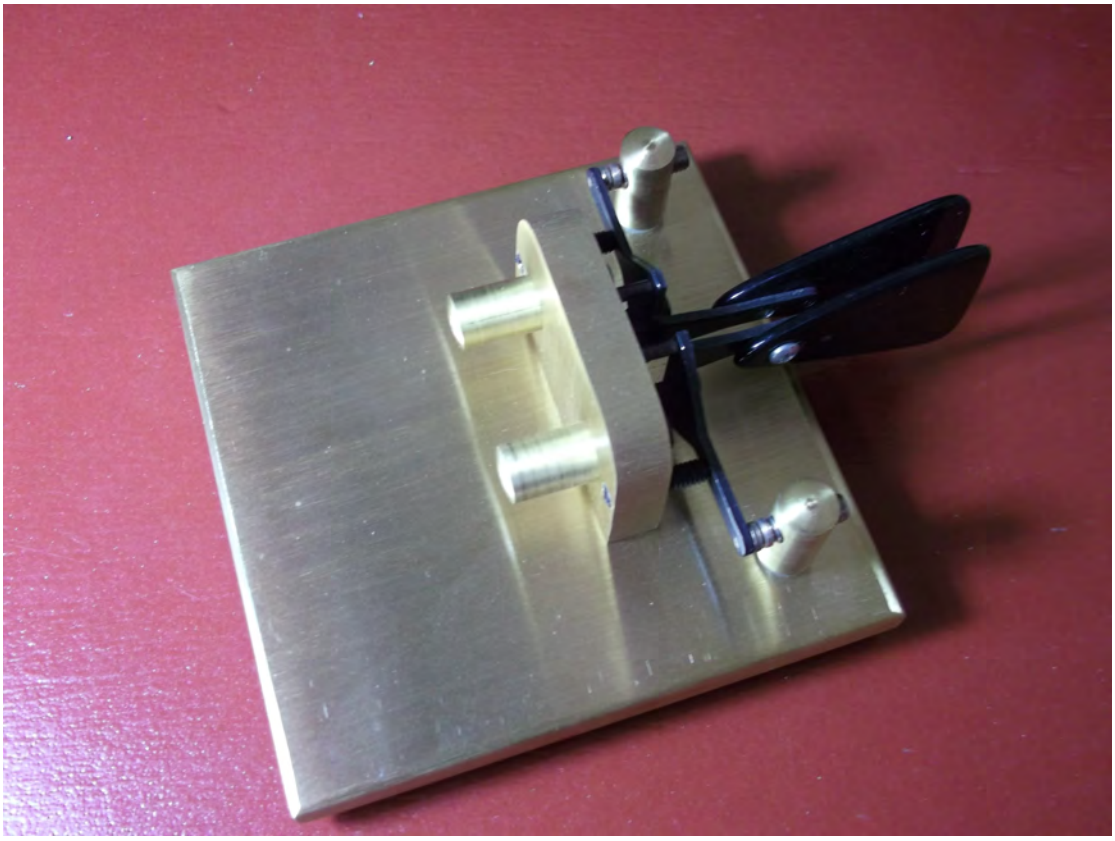

Figure 1: The prototype for the Vibroplex Brass Racer.

This is the prototype for the square base Brass Racer. I talked the former owner of Vibroplex (Mitch Mitchell, W4OA) into to doing it. The original Brass Racer dual–lever paddle had a triangular base with a wooden holder and built–in keyer. I also was in possession of serial number 001 (actually a special number) for a while, but I returned it to Mitch for the museum.

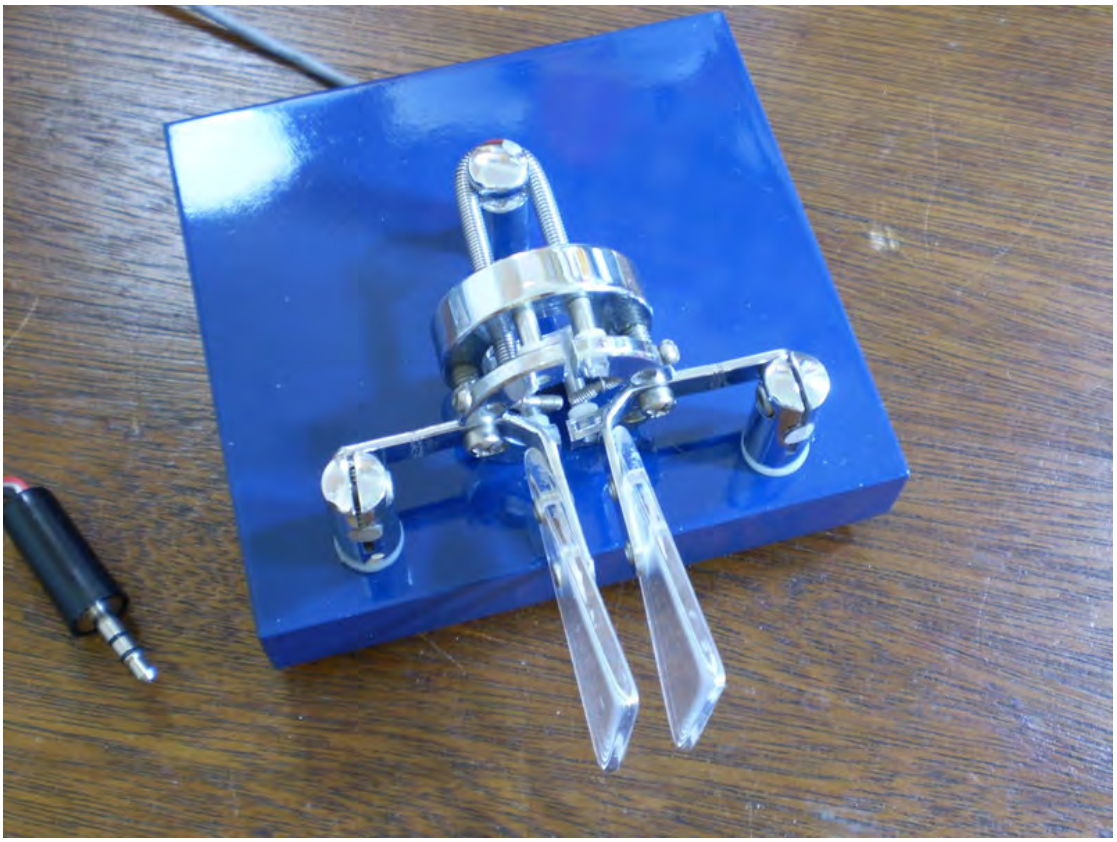

Figure 2: K7QO modifications to a Bencher BY-1.

Figure 3: Photo from Wall Street Journal Oct 2007.

Here is a photo of me using the Begali Sculpture during a 30m QSO while being interviewed by the WSJ for a front page article they did. Note how I hold the pen during sending. This is a trick taught to me by an old friend Ed Campbell, K5SBR, while we were both at Texas A&M University during our graduate student days and both active members of W5AC.

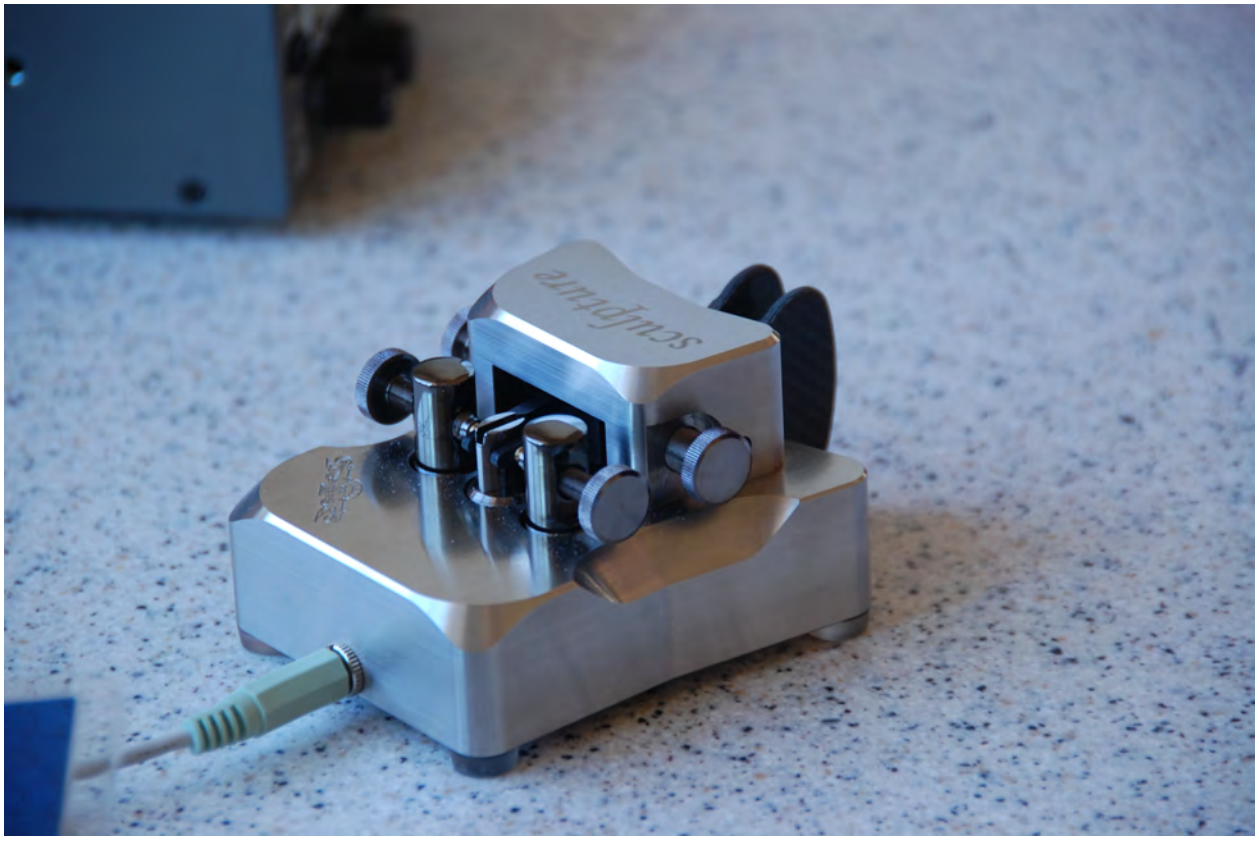

Figure 4: Begali Sculpture.

Here is closeup of the Begali paddle. Because this paddle did appear in the article, I returned it to Begali along with a certificate of authenticity and laminated copy of the WSJ article for Mr Begali to use for hamventions as part of their display.

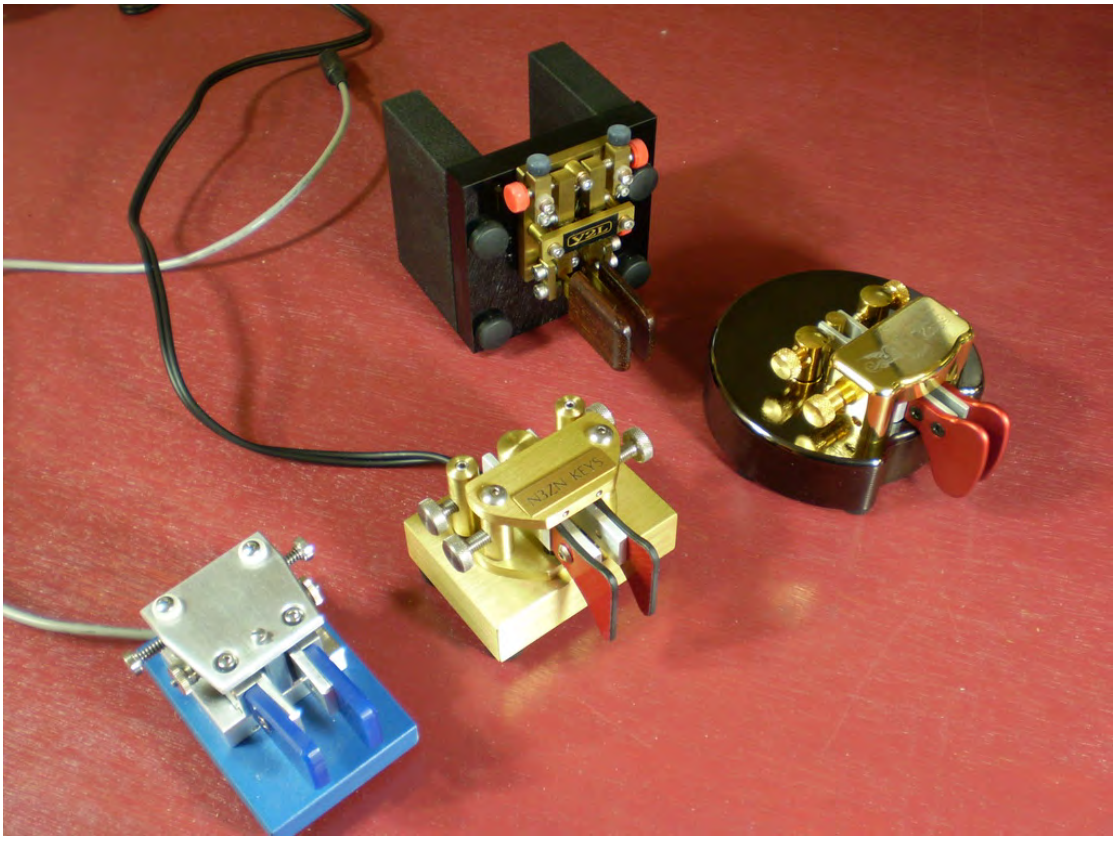

Figure 5: Four dual–lever paddles.

Here are four paddles that I own and use. From left to right. WB9PLU paddle. N3ZN paddle. Begali Pearl. And a W9WBL V2L paddle. The N3ZN and the Begali you can still get, but not the other two.

Figure 6: MFJ-564B dual–lever paddle.

I just bought this paddle for use in the K7QO code course that I will teach live for the TBARC club in PHX in Sept 2013. The quality of this paddle, for 70 bucks US, is very very good. The alignment and quality is excellent for the price and one that I would recommend for starting CW operators. Just treat it nicely and do not abuse it and it should last a long long time. You heard it hear first.