MODEL 15-KSR (gil smith)

I got this machine from Tom Kleinschmidt, who is actively saving machines and finding them new homes. This is my second tty machine. Everything seemed to be in nice shape, except for a little fabric strap that I found in two pieces at the bottom of the box. It turned out to be a "carriage-return strap" that I would need to replace.

This M15 is a "Bell System Teletypewriter Service" machine. A plate on the base reads "15-C Teletypewriter Base," and stamped next to it in 1/2" silvery ink is "7540." It has a "15-D Motor Unit," a synchronous 110V motor. It has a "15-E Keyboard," and a keyboard serial number plate says "84751." It also has a "15-Y Typing Unit." Stamped in orange ink, a couple of places on the machine, it says: "R JUL60 DET." Also stamped in many places on the machine, in the same orange ink, is "MBT." According to Don House, the orange ink was common in the Bell System, and the "R JUL60" is the date the machine was retired, "DET" is some kind of a disposition code, and "MBT" is Michigan Bell Telephone Co.

You can stare at it for hours and still find new things.

Wiring (and lack thereof):

The main terminal block on the right side (behind the power switch) has connections for 115VAC power and line interface. On this M15 unit, there were a lot of wires cut off the back of this terminal block, as well as a 1K resistor connected to only one terminal. There were more wires cut off another terminal block in the unit's base (under the bottom cover), and a power resistor that had only one wire connected. Also, the send/receive/break switch wiring had been cut off.

I traced out the unit's wiring, which is stripped down to only bring out the 115VAC motor power, printer magnet wires, and the keyboard contact wires. There was a 0.1 uF and 1K series filter across the KB contacts, which has been disconnected. This minimal wiring is sufficient to operate the unit, but I would like to eventually restore the original wiring, if possible.

According to John White, the series R and C across the keyboard contacts are not generally connected when using "dry-keying" (full-duplex with keyboard isolated), but are used when running the loop current through the keyboard (half-duplex) to prevent pulse distortion and noise.

This unit has a small coil mounted to a bracket, to the right of the send/receive/break switches -- this

coil/bracket is not shown in the manual. All wiring in this area has been cut off.

This unit does not have a "line-test" button above the keyboard, and there is no "blank" key on the keyboard.


The green keycaps are spring-cushioned for a soft touch.

The M15 connects to a 60-milliamp (or sometimes 20-milliamp) current loop. This loop current energizes the "selector magnet," a solenoid which enables the typing unit to print specific characters, based on the serial on/off pattern of a 5-bit baudot code.

M15 typing units came with two types of selector magnets: the "Pulling" magnet selector has round windings, while the "Holding" magnet selector has a square core, with rectangularly-shaped coil windings. According to George Hutchinson, the holding magnet selector is a bit better than the pulling magnet selector, although a bit trickier to adjust. Holding selectors also have "HM" stamped on the "Range-Finder" plate. The range-finder is an adjusting mechanism for tuning the machine to the serial data stream.

The rangefinder plate in the lower right has a movable lever and lock knob. Selector magnet coils can be seen to the upper left.
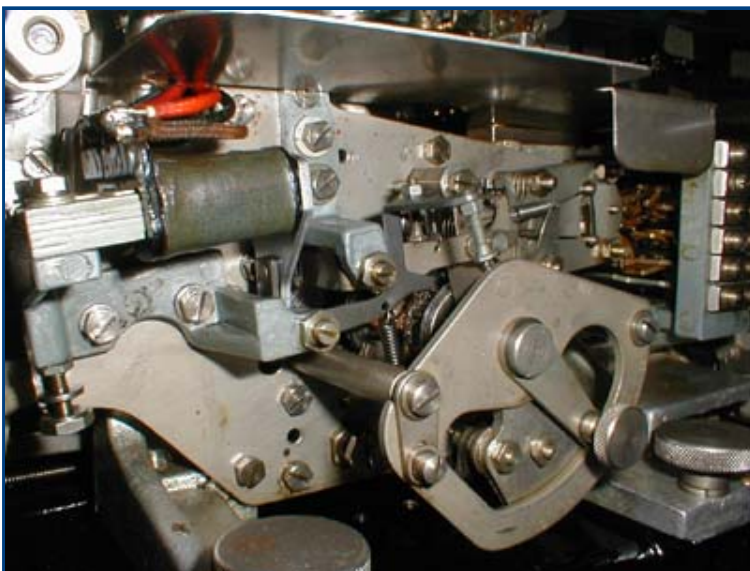
Pulling magnet selectors are for 60-milliamp loops only, while holding magnet selectors can be wired to run either 60- or 20-mils. On some M15 units, there is a switch mounted above the selector, with a locking bracket and the letters "S" and "P", on it, indicating series or parallel operation of the selector. Parallel coils are for 60-mil use (preferred), and series coils are for 20-mil. This M15 does not have an S/P switch, just a 3-position terminal block for strapping the coil wires. The coils were originally wired in series (20-mil), although the specified 5K resistor was not connected across the series coils (one end was lifted). I configured the unit for parallel (60-mil) operation. With power off, it measures approximately 50-ohms across terminals 45 and 46 (on the main terminal block) when the coils are in parallel.

The terminal strip allows strapping the selector magnet coils for either 60-mil (wired in parallel) or 20-mil (wired in series) operation.
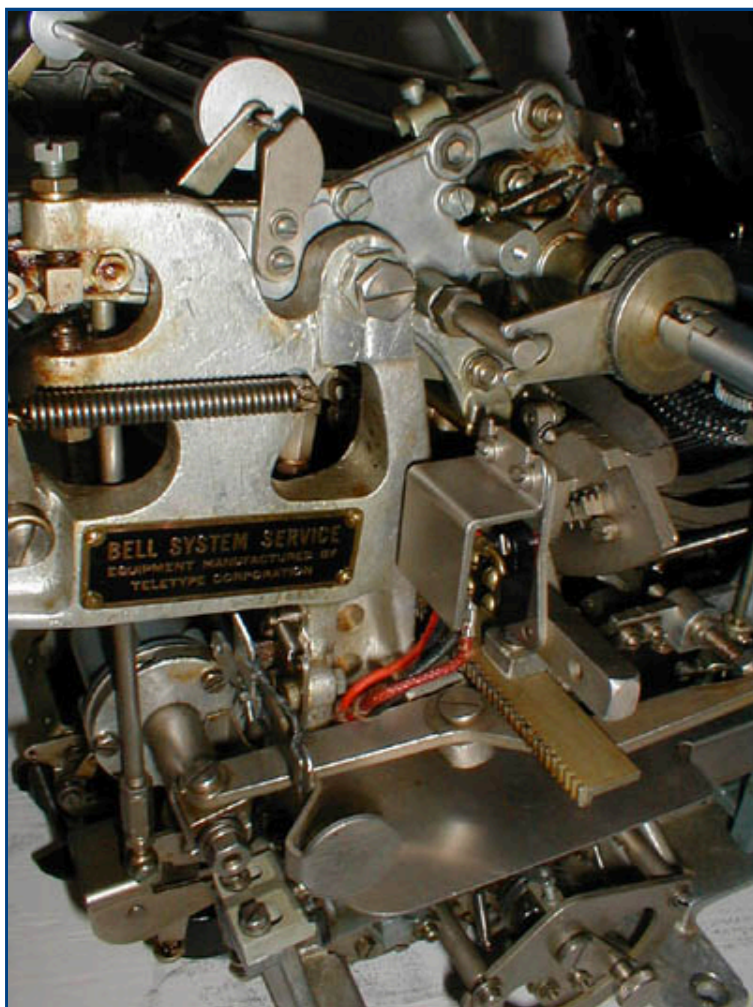
Interfacing:

The main terminal block is labelled, starting at terminal 21 on the left (actually the front of the machine), and goes to 46 on the right (back of the machine). AC power is on 22 and 23. The keyboard contacts are on 32 and 34, and the selector magnet is on 45 and 46. Other M15 units may connect differently (perhaps using a line relay on different terminals).

I patched the kb/sel in series for half-duplex testing with an external loop supply and current-limit resistor. Pressing keys will activate the transmit-encoding switches for pulsing the line current in the appropriate baudot pattern. When the sel-magnet is wired in series with the keyboard contacts, this keypress will cause the character to be printed on the typing unit as well.

If the motor is turning, and the selector magnet is not pulled in (due to no line current), the machine "chatters" rather noisily. Applying line current will quiet it down to the standby state.
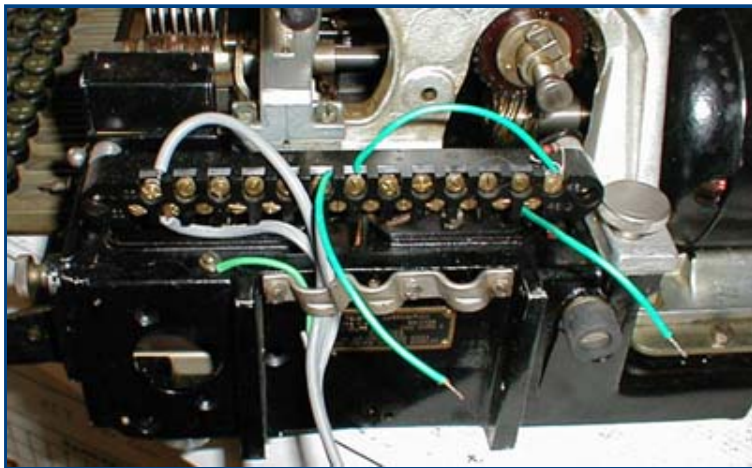
The keyboard contact assembly is below the keyboard shaft, at the front. You can pull the keyboard out and still operate the typing unit (loosen the two front thumbscrews, and pull the keyboard forward) -- a jack switch on the base should short out the keyboard contact terminals and close the loop again. I cleaned the keyboard contacts with Bel-Ray spray Contact Cleaner, which you can get at a motorcycle shop (used for magnetos 'n stuff), or you can find a more traditional source for electronic chemicals, and get something similar. You want something that will degrease and leave no residue -- lacquer thinner would likely work well too.
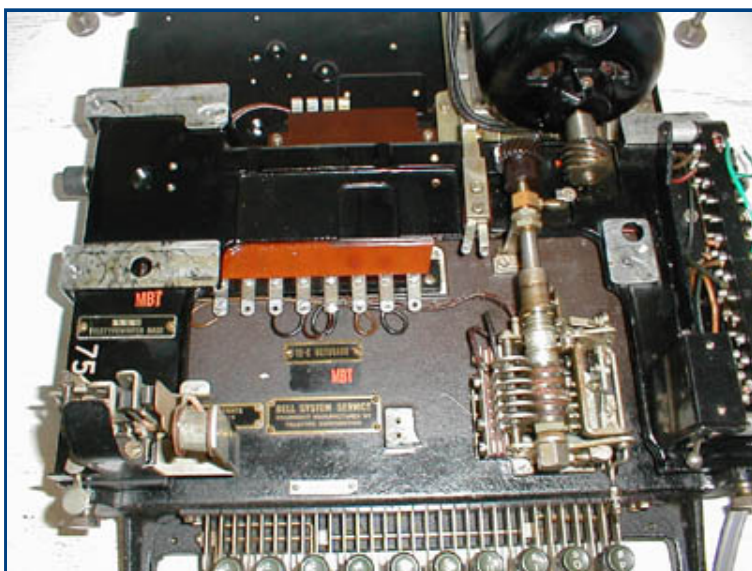
Some unwanted crap:

A previous owner added a couple of non-standard solenoids to the unit (as well as some bits of steel wire to tie them to the appropriate linkage points). One solenoid was mounted on the base plate and activated the "line-feed vertical link." The second solenoid was mounted above the signal bell, and activated the linkage to the "vertical spacing shaft." This is the same linkage that is activated if the "lockbar" is pressed on the side of the unit. There was also a microswitch mounted above the power switch. This was a homebrew version of "automatic carriage-return line-feed." I removed all of the switch/solonoid stuff.

The homebrew linkage bit is sticking up in the middle -- I'd like to replace this with the original. The motor flywheel has fan slots, identifying a 110-VAC sync motor. The space at the lower right is for the line relay and other options.

Motor and Gears:

This unit has a synchronous 110V motor. The M15 parts manual shows these standard gears for "368-OPM" use:

74912 Pinion - 7T
74913 Gear - 30T

These part numbers are stamped on the gears in this M15 unit. The keyboard gear is also stamped 24. The M15 motor is rated at 1800 rpm, and has the 7-tooth pinion, driving the main-shaft 30-tooth gear, turning the main-shaft at 420 rpm. Another main-shaft gear has 21-teeth, and drives the keyboard-shaft 24-tooth gear, turning the keyboard-shaft at 367.5 rpm.

368 OPM (operations-per-minute) is Teletype's way of saying 60 wpm. A "word" is defined a six characters -- someone either did an exhaustive study of the language, or just pulled this number out of their butt. Either way, six-characters is considered an average word size, for describing communication speed. A Teletype theory manual describes that the transmit shaft is driven slightly higher than the 360 rpm needed for 60-wpm, since the shaft is started and stopped once every revolution, hence the 368-rpm keyboard shaft speed.

Each character is one revolution of the shaft, so 360 revs-per-min corresponds to 360 chars-per-min, which is 60 words-per-min (at the 6-chars-per-word standard). This then results in 22 ms bit times in the 5-level baudot coding.

I understand that 75-wpm gear sets were available for the M15 (though I have been warned that the M15 self-destructs at 75-wpm). I have also heard about 66-wpm, and possibly 100-wpm gear sets.

Supplies:

This M15 has the friction-feed platen, and uses standard Teletype roll paper.

Teletype used the same ribbon for most of their machines, apparently the same one used in old Underwood manual typewriters. They were a heavily-inked ribbon made of rayon or cotton. Newer replacement ribbons are made of nylon and only lightly inked so they do not last as long, but they do work fine.

I found a decent $3 black ribbon at my local Staples office supply store: Dataproducts #R3300 (replacement for Okidata ML80/82/84/90 printers).

Ribbons and paper are easy to find. The Type-Basket can be replaced for different character sets (some of the FIGS chars had options). I'd like to find a "WX" basket with the weather symbols on it.

Lube and First test:

With the typing unit removed from the base, I powered up the motor, which seemed happy. So I decided to clean, oil, and grease the unit a bit. I could not lube the motor bearings, since a special grease gun is apparently needed.

I dropped the typing unit in place, and turned it on -- clickety-clack! Adding loop power (kb and printer in series) stopped the chattering. Then, I pressed keys and it typed perfectly! With one exception: CR did not work. I suspected this was related to the fabric belt that I found lying in two pieces.

I was quite happy until the smoke started to rise from the motor. The gear-end shaft was quite toasty, burning the gear grease. I figured the bearings need a good greasing. The rear of the motor seemed cool, so the rear bearing must be ok. One other possibility -- the gears seemed a bit tight when I put the typing unit in place. Could excessive lateral pressure on the motor shaft cause this? Perhaps aggrevated by a dry bearing? I need to check the manual for adjustments. Or, is there perhaps a problem with the motor windings? Crap-ola.

George Hutchison gave me some good lubrication advice:

"First, remove the typing unit, spin the motor shaft with your fingers, and listen to it, and feel for whatever amount of resistance to turning it with your fingers. It should spin fairly freely, and little or no grinding from the bearing.

Next, energize the motor with the typing unit off, and just listen to it. You can use a screwdriver with one end held to the bone behind your ear and the blade on the bearing bosses, and hear whether or not it is in trouble. Any growling, grating, or harsh sound means you have a problem.

The bearings are standard, even after all these years. you can go to most any bearing supply company and probably get a replacement for around five dollars. Take the bearing with you and let the people behind the counter look at it and measure it.

Lubrication - - use CONOCO SUPER-STA lithium based grease. It is excellent. Good temp stability, and has a tackiness agent added to it that keeps it on the metal long after other greases would have spun off..

Clearance/backlash between the motor pinion and main shaft drive gear: there should be 2 or 3 thousandths between the motor pinion and the fiber gear. This can be adjusted by slightly loosening the two motor mount screws that are on either side of the motor, and then loosening and adjusting the jacking screw that is at the rear of the motor, sorta under the fan.

Be sure the mainshaft is clear. The mainshaft of a model 15 is hollow. As designed, there is a long felt wick which runs the full length of the shaft. In addition, at each point where there is a rotating element on the shaft, there will be a hole through the shaft and short cross-wicks in each of the holes. The gear end of the main shaft should have a little plug in it, with a small leather washer as a seal. Take a good pump oiler, pull the plug, and using a wiping rag as a seal/gasket, try pumping oil (#10 non detergent) into the shaft.

If the shaft is clear, you will soon have oil coming out of the hole in the selector cam sleeve retaining screw, which is marked "Left-Hand Thread", which is located just behind the range finder. If the mainshaft has been fried or left too long, then you will have trouble getting any oil through or into it -- that will require moderate surgery and a main-shaft drill to fix.

A carriage return strap can be made out of a heavy duty boot-string. Just carefully remove the endpieces from the old strap, and crimp them over the replacement piece of boot string."

Thanks George -- it's great to have the inside scoop. By the way, never use WD-40 on these machines. While it is great for a quick clean/lube, it is shellac-based I am told, and will gum up over time. I used 3-in-1 oil as a good light oil for small linkages, 30W motor oil (or 10W or 20W, if you can find it) for shaft oil cups, and a decent lithium grease for cams.

So I tweaked the motor backlash adjustment, and it was indeed too tight. The lateral pressure of the unadjusted gears on the motor shaft caused excessive noise and heated up the motor shaft as well. I had only run it for a short time, so I don't think there was any harm done. I managed to get a few drops of oil in the motor bearings, which quieted things nicely. I have since found that Don House sells greases guns for the motors -- I'll get some proper grease in there soon.

Lots of spots need lubrication in these machines.
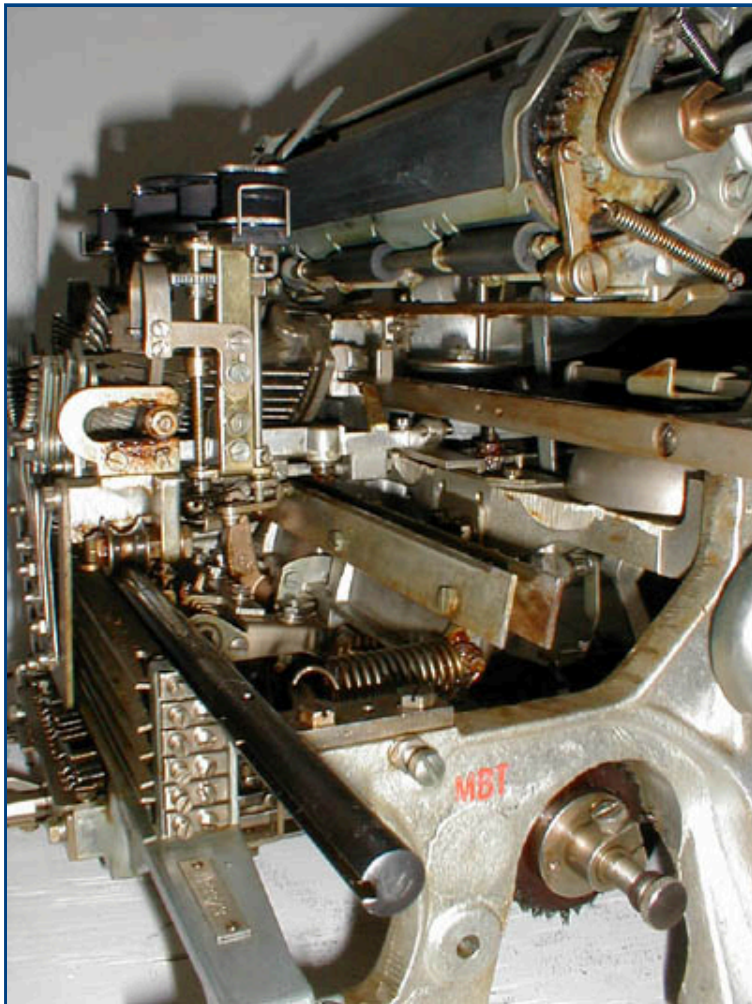
One step forward, two steps back, then a few forward:

Unfortunately, I had a bit of a self-inflicted setback with the machine. As I had the M15 typing unit tipped on its side for pictures, I jarred the table and the carriage zoomed to the end stop, and slightly past. I had intended on moving the carriage to one end before tipping the unit, but forgot. After picking my jaw up off of the floor, and calling myself an asshole a few times, I found where the end-stop had been jumped, and eased the carriage back into proper position -- but then I found a little broken bit of metal! It turns out that the vane-end of the lower bell-crank had broken off. I could turn the mainshaft by hand and see the mechanism cycling properly. And, the other four bell-crank ends were positioned properly in their vanes. Also, the pull-

bar roller was properly in position. I seemed that this might be the only thing broken.

John White came to my rescue with a replacement bell crank, and carriage-return straps. The bell crank swapped out quite easily, though the eccentric adjust at the pivot point is in some arbitrary position (I have not yet checked the manual for adjustment procedure). All characters seem to print fine, so the adjustment must be reasonably close.

When I went to install the carriage-return strap, I could not find instructions in the manual for tensioning the carriage-return drum spring. Then I noticed that there was no spring action at all (the drum just turned). I pulled it off, and found that the spring was not quite catching on the shaft protrusion -- a small tweak to the spring moved it to a position where it hooked up fine. It all seemed pretty dry in there, so I oiled the spring as well.

I put the drum back into the unit, and wondered why the drum seemed to wobble more than I thought it should (there was wobble before I took it off as well) -- it apparently has wear on the shaft bushing (which is pressed into the typing frame); I'm sure it would be considered excessive play, but it seems to work fine, and it looks like a major job to press a new bushing into the frame.

As for tensioning the spring when installing the strap, I moved the carriage to home, gave the drum/spring two full turns, and connected the strap. I don't believe that the spring is overwound at the extreme end of travel. The unit seems to return nicely from extreme position or single char position. It seems pretty snappy during return, and the dashpot slows it nicely.

Under the typing unit you can see the main-shaft. At the upper center there is a hook-like lever which can be positioned to enable "unshift-on-space," which is the position it is currently in.
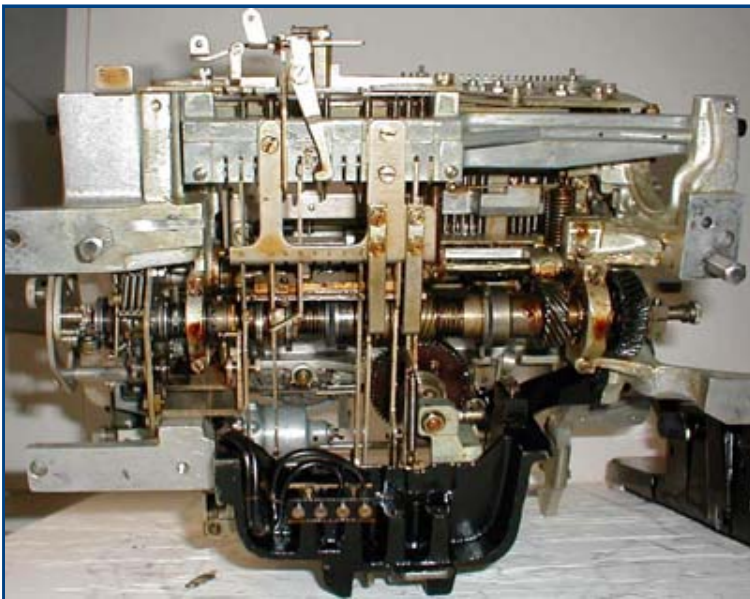
And finally:

Ahh, the M15 is purring nicely. I used Bill Bytheway's RTTYArt program to print some of the art files from the rtty.com archives. Watching the M15 print is most satisfying. Now I want to set up Bill Buzbee's HeavyMetal program to automatically pring selected email to the M15. Fun stuff.