



# PHASE SHIFT TELETYPE - PART I

## TRANSMISSION

CECIL CRAFTS, W6ZBV

This discussion of methods for the generation of a PSK signal will be confined to the audio frequency sub-carrier system, since to date, no word has been received from the FCC as to the legality of using phase shift keying on the amateur bands where FSK is now authorized. If PSK proves to be authorized, a future article will deal with higher frequency methods. However, the system described here is readily adaptable to high frequency use.

The schematic shows a circuit which has been used for many hours in tests with very satisfactory results. V1 and its associated components form a conventional phase shift oscillator. Any oscillator at the appropriate frequency may be substituted. Oscillators using tuned circuits, crystal controlled divider chains, or a tuning fork oscillator are all excellent possibilities. However, close attention must be given to frequency stability. Since one of the advantages of PSK is the very narrow bandwidth required and, up to the point where the loss of sidebands degrades copy, the ability to work down into the noise improves with decreasing bandwidth, frequency stability is essential. The oscillator circuit shown, with a well regulated power supply has a "cold start" stability within about 10 cps and after warm-up, about 2 cps. Capacitors C1, C2, and C3 should be silvered mica for best results. V2 is a cathod follower which couples to the phase shift network and also prevents loading effects on the oscillator. The values shown for C8 and R11 give approximately 120° phase shift, depending on component tolerances. It is suggested that R11 be tacked in temporarily for the purpose of transmitter adjustment and fixed accurately by tuning to the receiver unit by methods which will be discussed at a later date in the article on the receiver.

Referring now to the keyer circuit, V4 is a D.C. amplifier coupled to a Schmidt

trigger circuit is characterized by the fact that, depending on the D.C. input voltage level either V5 or V6 is in full saturation while the other section is cut off. Thus, if the voltage at the plate of V5 is at +150V, the plate of V6 is at about +80v (MARK), and vice versa. In this (MARK) condition, diodes CR3 and CR4 are biased in the forward direction and form a low impedance path to ground through C10, C12, and C13. This effectively grounds point "D," preventing the signal from point "B" from reaching the grid of V3. However, at the same time, diodes CR1 and CR2 are reverse biased, presenting a high impedance from point "C" to ground, allowing the signal from point "A" to reach the grid of V3 and thence to the line or transmitter. In the (SPACE) condition, the reverse is true, and the signal from point "B" is sent to the line. Since the voltages at points A and B are 120° apart in phase, the desired result is accomplished.

While the writer is inherently distrustful of polar relays, the adherents of same, if desired, can eliminate the entire keyer circuit by inserting the polar relay with the contacts to points A and B and the arm to the grid of V3. However, stray capacity to ground from the relay must be watched carefully since it will affect the amount of phase shift.

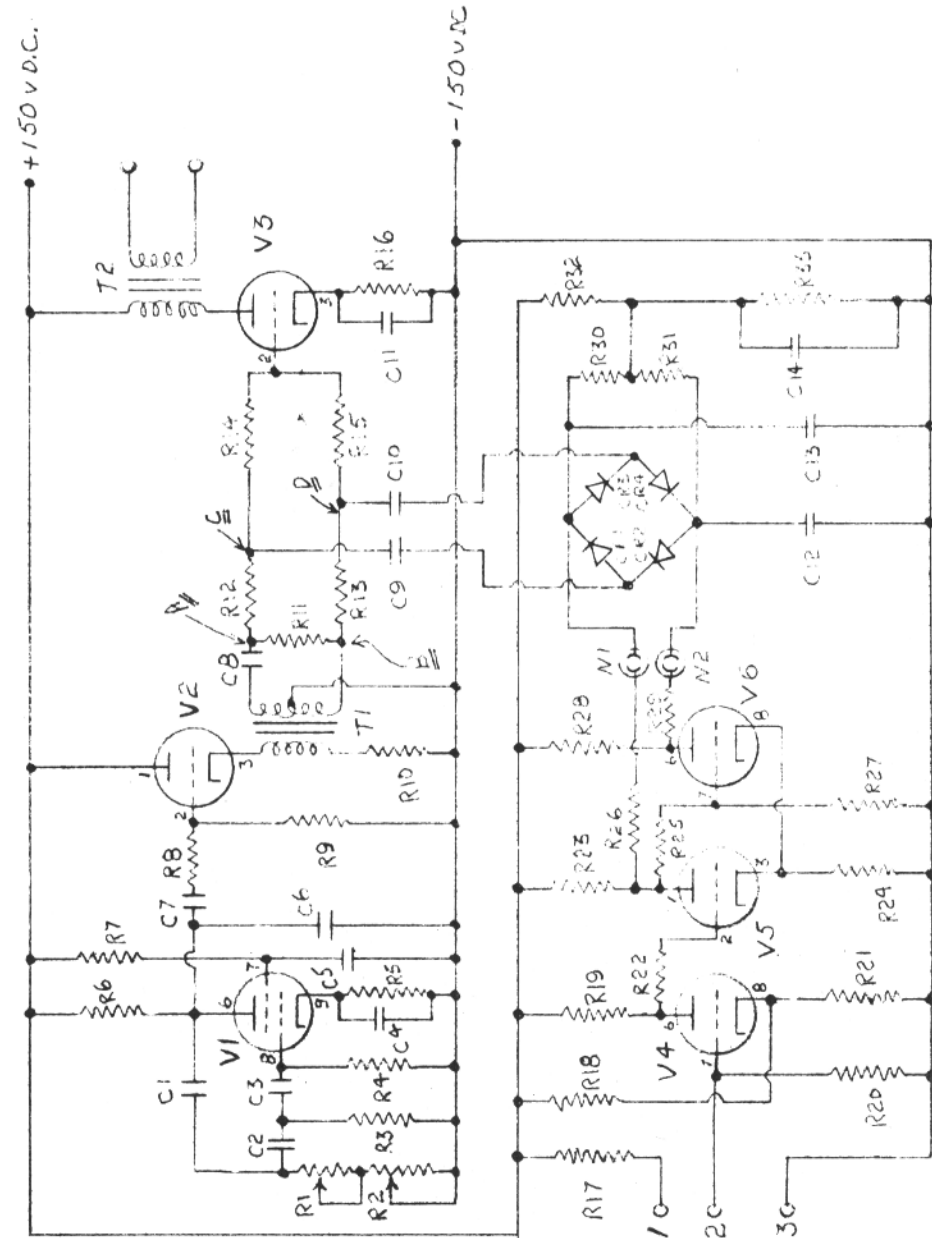
### ADJUSTMENT

The operating frequency tentatively selected is 2125 cps, since filters and filter designs are generally available and a "steady" mark tone will not disturb FSK units on the circuit.

Wiring of the unit is not critical and normal attention to parts placement should provide good results.

Type NE-2-E neons should be used for N1 and N2 since their operating voltage is quite accurately controlled. If other types are used, the values of R30 and R31 should

(Continued on Page 6.)



# NCARTS "Operator of the Week"

ED, WIBDI

Francis E. Handy, "Ed" W-1-BDI, QTH West Hartford, Conn. Birthplace was Augusta Maine, the capitol of the Pine Tree state. XYL Winifred, sons Dick and Herb. The former is W1RZP.

Pre WW 1 activity was with Crowfoot batteries, Sounders, Galena and other dets, all resulting in the Department of Commerce license, soon as licensing was resumed in 1919 after WW QM the Ford Coil gave way to  $\frac{3}{4}$  KW type T Thordarson, Benwood Non-Sync Gap, Mason Jars, 6 Wire Antenna. Then Moorhead Tubes, 2 Filament Audiotron, Home Brewed Gear 03A's, 6 Wire Ant. and 11 Wire Counterpoise. Held district sup't. in early ARRL organization; station description July 24 QST.

Graduated University of Main BS (EE) was followed by Westinghouse posts, instrument section and radio operations at early KDKA (PGH). Ham calls of 115 meter transatlantic RSCB-ARRL across Herring pond traffic days and earlier, 1BDI, 1XAH, 1GIBI, 8 BCM, ARRL traffic mgr from February 1925. Wrote first three editions the Radio Amateurs Handbook; trustee 1-MK and 1AW. Served on ARRL's executive committee then with 1AW, 3ZS, 1ES, 1EH Maxim-Stewart-Hebert-Warner. Presently vice-president and communications manager ARRL.

Lieut. in USN (C) R 1933 to 1941. Then 1942 to 1946 major in directorate of communications USAF, controls div'n. Air Force

## PHASE SHIFT TELETYPE PARTS LIST

R1—100K Potentiometer  
 R2—10K Potentiometer  
 R3, 7,—47K  $\frac{1}{2}$ w Resistor  
 R4—68K  $\frac{1}{2}$ w Resistor  
 R5, 16, 21—2K  $\frac{1}{2}$ w Resistor  
 R6—30K  $\frac{1}{2}$ w Resistor  
 R8, 28—1 Meg  $\frac{1}{2}$ w Resistor  
 R9, 12, 13, 14, 17, 18, 19, 26, 29, 32—100K  $\frac{1}{2}$ w Resistor  
 R10—1K  $\frac{1}{2}$ w Resistor  
 R11—See Text—Approximately 10K— $\frac{1}{2}$  watt  
 R15—See Text—Approximately 100K— $\frac{1}{2}$  watt  
 R20—12K  $\frac{1}{2}$ w Resistor  
 R23, 24, 28 24K  $\frac{1}{2}$ w Resistor  
 R25, 27 300K  $\frac{1}{2}$ w Resistor  
 R30, 31 7.5K  $\frac{1}{2}$ w Resistor

representative on ICB working committee on NRCM, methods and procedures and security. K most of 1943 in North Africa and Libya Q with NW African air force and AFHQ, then back to Pentagon, organization's division. Back to ARRL headquarters first of 1946.

Member ARRL, IRE, QCWA, NCARTS, CN. CVN, etc. Past president and current treasurer of Connecticut Wireless Ass'n. besides such hobby and interests as amateur radio traffic, DXCC, WAS, FMT, RCC and several nets, dabble in photography, Volkswagen and general do-it-yourself . . . Hold ORS, OES, AREC-registered.

Enjoy doing with 6146 (and another home-brewed of 5514's) work that was greater struggle with 044A's and 861 of earlier years. Slow build up on 4-250A Grounded grid linear, as there is little time. Work a little S.S.B. as well as RTTY on occasion. Main reliance for results is on antennas, 10-15-20, three element with traps, 66 inverted L, loaded for 40 and 80; 6 over 6 yagi on 2 . . . Car mobile uses halo and collapsible beam.

(Ed note): Ed's Ham activity speaks for itself and I can vouch for the photography part with Ed's start in color photography pack in the 30's on one of his visits to Colorado and our adventurers experience of those hair pin turns through the Rocky Mountains over Phantom Canyon road while Ed leaned from the window shooting movies 2000 feet down.

R33—15K  $\frac{1}{2}$ w Resistor  
 C1—300 MMFD Mica Capacitor  
 C2—860 MMFD Mica Capacitor  
 C3—360 MMFD Mica Capacitor  
 C4, 11, 14 10MFD—25v Electrolytic  
 C5, 7, 8, 9, 10—.01 MFD—400v Capacitor  
 C6—20 MMFD Mica Capacitor  
 C12, 13—.02 MMFD 400v Capacitor  
 CR1, 2, 3, 4—1N456 Silicon Diode  
 N1, 2—NE-2-E Neon Lamp  
 T-1—10,000 ohms to 10,000 ohms CT-Triad M-1X or equivalent  
 T-2—Plate to Line—Triad A-53X or equivalent  
 V1, 2-6AN8  
 V3, 4-12AU7  
 V5, 6-12AU7

## MODEL 15 TELETYPE

Recently the Telephone Company released a number of the model 15s to RTTY, INC., to sell to licensed amateurs at a very reasonable price. These machines are purchased in an "as is condition," but so far all have been operative. They are complete with tables and have sync motors. The type faces are the so called "commercial" style which includes fractions in upper case on B, C, F, J, K, L, N, and V. Palletts are available to convert to communications types.

The model 15 is a page printer, self contained, with keyboard and motor. It has a single magnet selector, which can be operated direct from your Terminal Unit or through use of a polar relay. Two types of selectors are to be found on various models of the 15, first the so called "pull type," magnet which requires the current to be on to pull the selector back after each operation. The second type is called a "Holding Type" selector, which mechanically returns the selector to operating condition after each operation. The later machines have the second type of selector, but does in no manner make the earlier version unsatisfactory. Both types can be operated with the two coils either in series or parallel, to provide 30 or 60 mil operation.

The keyboard has the standard type of distribution assembly, which is similar to that in the model 12, 14, 19, 24, 26 machines. As received, they have the coil and condenser across the contacts which has to be removed for operations of your FSK direct. However if a polar relay is used, it can be left in place to reduce RF noise generated by the contacts breaking the keying current.

In the model 15, the paper is held on a roller which does not move back and forth as in the model 24 and 26s. The type basket travel from left to right a copy is received.

The range finder is located on the left hand side of the printer, and can be adjusted when necessary through a small door on the left side of the cover.

An "unshift on space," cut out or in, lever is provided under the front of the printer. See photo for location of this feature. Many DX RTTYers will find this feature to be of advantage in copying weak signals, especially when a static pulse operates the shift to upper case. It can be cut out by shifting the lever to the other position. Optional features which can be added include automatic carriage return which can be purchased and added easily. Tab, for business operations also can be added. This operates from "upper case G," and is not used in amateur operations. A few of the recent lots received have this feature installed in them.

Also the keyboard can be replaced with a 15 perforating keyboard, which makes the 15 similar to a 19 unit. This requires a power supply which will provide 500 mils at 110 volts DC. The base casting is slotted for this modification.

The complete model 15 is made up of the following major parts: Base, with wiring, keyboard which plugs into the base; motor with electrical connections which make, when the motor is bolted to the base; printer, which contains all of the selecting and printing functions; a cover which completes the unit. Additionally some of the 15s have a polar relay socket mounted in the rear, others have an additional relay which controls the motor from line current. Other type motors can be had to operate from generator AC supplies or DC. Other type faces can be purchased to convert to weather operations. To mount the type faces soft solder is used, which permits one change the fractions pallets quite easily. Key tops can be changed by lifting at the top of the keys and pulling up, to replace, reverse the operation. Normal amateur operations are at a speed of 60 WPM, using gears which have numbers 74912 and 74913. However, speeds of 75 WPM can be had for other uses. To operate with a typical set-up amateur circuits, one would connect cords and plugs to terminals 41 and 42 for the printer, if there is no polar relay wired into the circuit.

If a polar relay has been installed, it is necessary to connect one of the coil lead from the selector magnet which was connected to terminal 65 and move it to terminal 66. This lead goes to terminal 42. Next remove the lead which goes to the polar relay socket from terminal 61, and tape up. Then move the other selector magnet lead which was on terminal 62 and connect it to terminal 61 which goes to terminal 41.

The keyboard connects to terminals 32 and 34. Other wiring can be traced on the circuit shown. Photographs of various features show major items on the model 15.

The model 15s are available from RTTY, INC., for \$90.00 complete, and crating for shipment is \$10.00 additional. Shipment via motor freight or by rail collect. A notarized waiver is required.

\*TELETYPE is the trade mark of the Teletype Corporation.

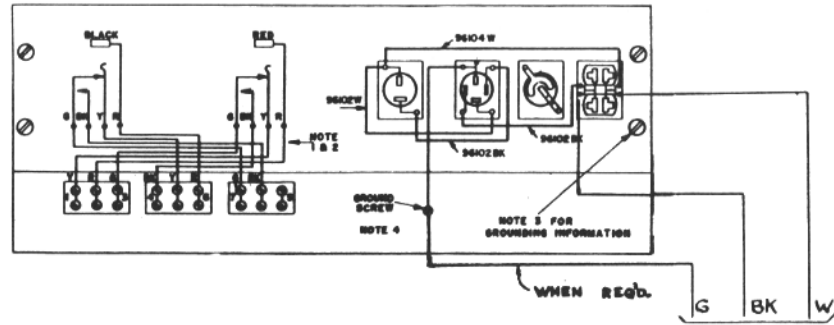
PHASE SHIFT

be adjusted for minimum keying transients. Types other than the NE-2-E show a considerable variation in operating voltage and require compensation.

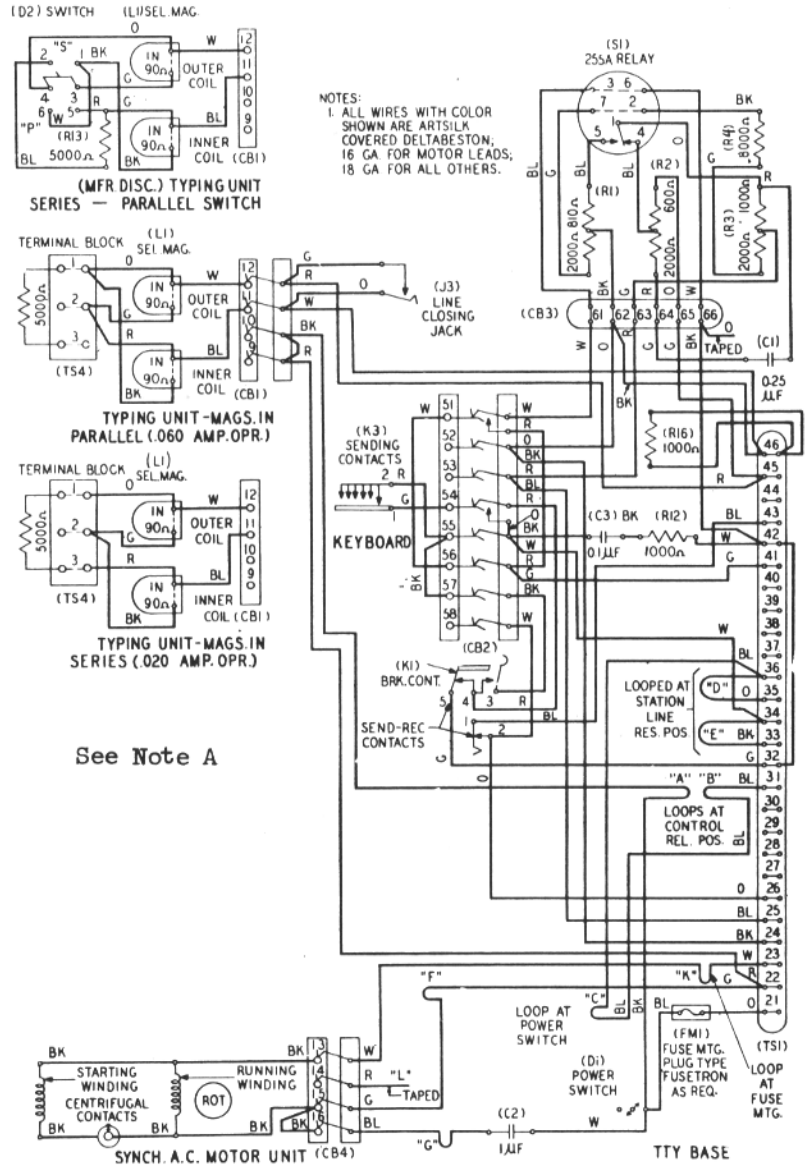
The silicon diodes were used because they were on hand. However, two 6AL5 tubes should give equivalent results. Germanium diodes should be expected to present problems due to their lower back resistance, and are not recommended.

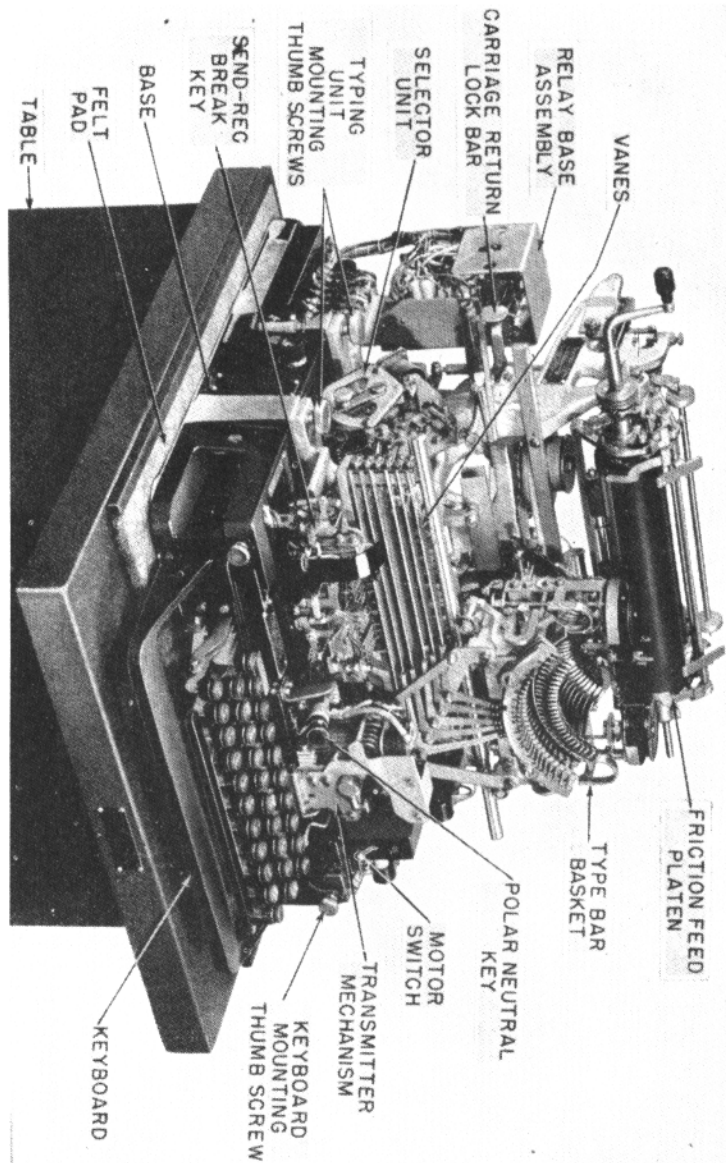
The unit should oscillate readily and may be adjusted to frequency by means of R1 (coarse) and R2 (fine). The keyboard connects to points 1 and 2. If it is desired to use an external voltage to key the unit, it should be connected to points 2 and 3. A positive voltage of about 6v gives the MARK condition and zero volts SPACE. With the unit turned on in the MARK condition, meter and note the output voltage from T2. Press the break button and adjust R15 until the amplitudes for MARK and SPACE are equal. The unit is now ready for use.

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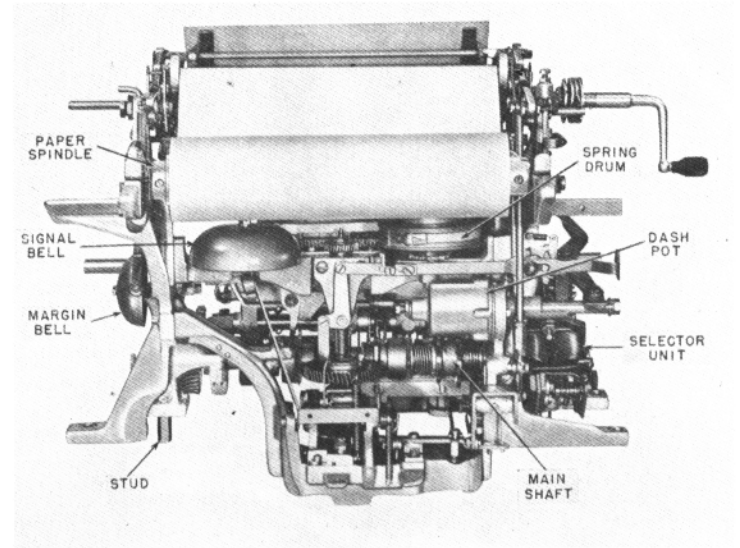


15 TYPE TELETYPEWRITER WITH HOLDING MAGNET SELECTOR

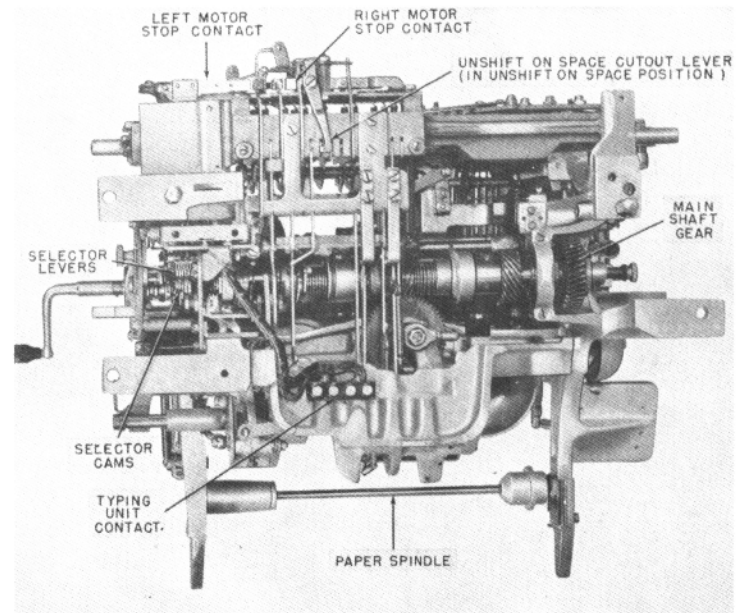




Typing unit assembled with base and keyboard.

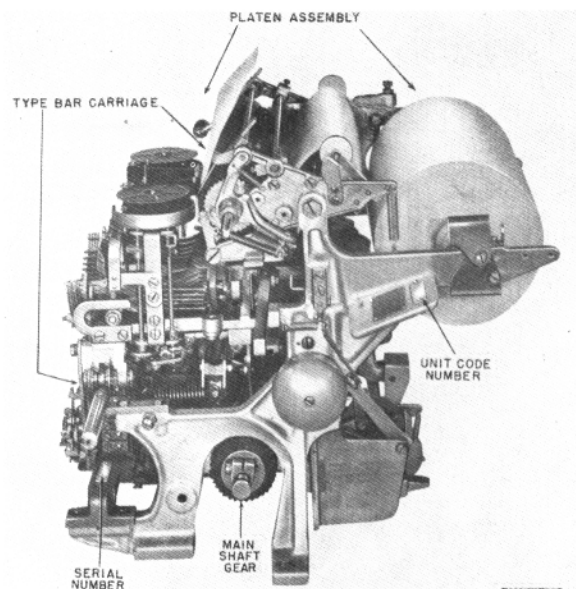


Back of typing unit.

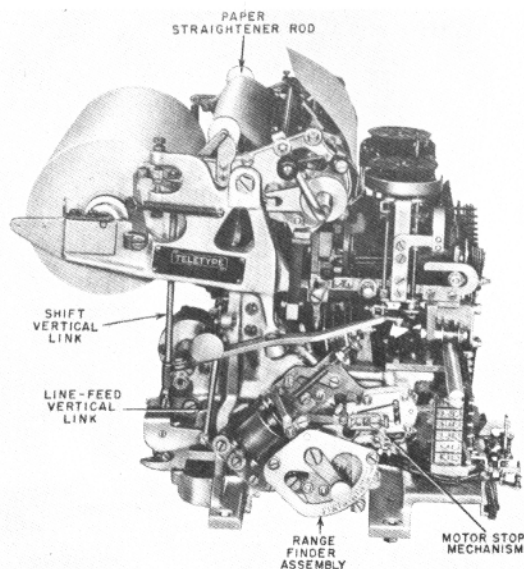


Bottom of typing unit.





Right side of typing unit.



Left side of typing unit.



Well first about the beam, another typhoon came up the nite before the contest and broke the transmission line up at the beam . . . So Bud and I lowered the beam and during the lowering process broke two mast sections !!! Then by the time the beam was back up again the gang had moved to twenty . . . Then last nite discovered that I had a flat 4-65A tube and if anything else shows up will chuck it all and go on fone !!! Hi . . . (You know better that . . . also been calling you ever since. —KR6AK

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Might as well get on your frequency!! W6CG W6CG DE KR6AK KR6AK Fine and dandyi thre Bud . . . Yep be glad to stick around for a few minutes . . .

Dang printer . . . Yep fine about those guys coming down theres . . . I did hear W6AEE and W1BDI on the frequency and WOFMK was the only one that I could work. I stuck around for about an hour and finally left . . . There was no but no definitely no activity on forty meters last night . . . (Your morning) Heard one W6V? Gave a half hearted CQ SS but could not raise him . . . So forty went also . . . Worked you and WOFMK on twenty meters and so far if I am lucky I just might break ten on QSO's hi . . . Yep if Tom will give me a number will get ten !!!

Here number nine KR6AK CK 599 Sukiran Okinawa. Time is 0037 GMT 0037 GMT and date here is November two November two. . .

You go ahead there Bud as I am eating breakfast and trying to get into the contest also hi . . . By the way that time that I called was when the receiver went out on me.

And while I was fixing it Sherry caught her arm in the wringer on the washing machine and by the time I got her back from the hospital the band had folded. Only gashed her hand and burnt her arm a bit where the rollers rubbed on her arm . . . It did not break anything even though it required five stitches in her hand!!!

#### ATTENTION Model 26 Owners!

Are you tired of trying to interpret the intelligence packed into that little eighth inch black square when your machine misses a carriage return? Got a stiff arm from reaching around back to trip the darn thing? Ben, W9US has the real answer . . . He has designed the "Automate 26" an automatic line feed and carriage return, gotten a large quantity of the parts made up commercially and assembles and adjusts them. The unit attaches to the two studs sticking out the rear of the 26 frame. Two wires hook to the line terminals. It is then ready to work! Average installation time is 5 minutes . . . A 115 volt solenoid does the work and is tripped by a micro-switch operated from the carriage. A picture was shown in August "RTTY" and in September "CQ." Ben is furnishing the gadget for \$15 post-paid and when you see it you will figure he is losing money! Actually Ben tells me that he will be satisfied to break even and needs to sell about 200 to make it!

There are all sorts of fascinating possibilities with RTTY. One scheme which has been tried is duplex, using cross band operation . . . Such combinations as 2 meters and 40 meters, 40 meters and 80 meters, etc., depending on distances, can be used. The transmitting station on one band is received by the other station who re-transmits the incoming signal on the other band. The transmitting station thus receives his own copy back on the other band to get local copy with both paths "in the loop." If the other station wants to break, he simply hits his keyboard which causes the converter output to be disconnected from the other station's transmitter and of course, local copy stops so the first station will know that a break is desired. Thus, the result is much like the full breakin on CW or duplex on fone.

W6KUY/MM is still in the shack with me and we have been copying W1 W2 K4 W5 W6 W7 W9 and W0 all morning and screaming off head at em but you are the second one I have been able to arouse this morning! Still copying the same old

gang without them hearing!! Like W1BDI W2JAV W3PYW WOBP W7LPM W7IE W7RQQ K4RRG W5BIW and various and sundry others than just can't hear us at all. . . Beam broke yesterday but that is another subject and we had a typhoon blowing down the back of our necks also anybody have more troubles than that?? Hi W6CG with conductor DE KR6AK K

- 0 -

Was sorry that on the two contacts we tried to close up in the contest did not work out it appeared we were both ORM-ed in the loaded band conditions. I am sorry I didn't get to give you an Iowa multiplier. Hi.

I surely enjoyed the contest. Had lots of fun in fact all I could physically stand. I think there were more stations and sections active than any previous contests.—

73 Lyle

Was doing fine on 40 — although I missed first 6 hours because I had to work.

This RTTY gang is sure *not* a bunch of night-owls when it comes to SS . . . Between 0100 and 0130 (AST-0300 PST) I thought we had had a real fadeout and condy had gone to pot! Was I disgusted. Then kept hearing K6NAR and W6JCK calling CQ like mad—they get no answers. Same with me—hours of CQing and no answers. They were coming in like ton of bricks, so band was open. So, I guess the RTTY gang just went to bed! I was P-O'd, but good. Finally gave up at 0400 myself, real disgusted with SS.—73

KL7BK, Jack

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Another RTTY Sweepstakes has just finished a few hours ago as we write this. Having stuck through practically the full thirty hours we are in fine practice to punch tape except for two finger blisters, saddle sores, and a tired keyboard (not to mention T.O.M.)!! It was a fine turnout. Disregarding our previous admonitions to spread out, we piled up several layers deep. Our excuse is that we were hemmed in between two walls of slightly displaced CW activity. The high power boys jammed each other but the morale and co-operation seemed far superior to contests by other modes, for after all, we are more experimenters than traffic hounds. Sev-

eral pairs of stations worked each other on two, three or four different bands until it became a common joke to say across the country "See you on two meters next—hi!" But Nosey KH6IJ made good his dare and from Hawaii on eighty meters he made fine contacts with W6FYM, W7LPM and WOBP. Quite a haul for 80. The reports during the contest indicate dissatisfaction with the condition of the 15 and 10 meter bands, altho it is believed KL7MZ and W6CG got thru to KR6AK. . . The general RTTY man has one favorite band he best enjoys and on which he rag chews and becomes personally known to those about him, and it is like a visit to a strange church to invade another band. Such types seldom make large scores, nor do they intend to. As Marv W2PAT said, "I got into the contest for the same reason that you did—just to fool around a little, Hi." . . . However some of us with fair power and versatility of several bands like to make the leaders work for top honors with competition. Toward this end, the final hours found WOBP down really digging out the obscure low power chaps, and the log shows on the final day from 1830-2150 a continuous series of those with messages numbered as follows: 4-1-1-8-5-2-1-9-2-1, while WOBP sent them MSGS numbered 28-95! Then in the closing minutes WOBP went "hundred happy" to make a new high in MSG contacts but not we informed as to MSG numbers of past contest winners such as W2RUI, VE7KX & W3PYW. As a final dying gasp, WOBP put out a CQ and raised both W8GIG and W2RUI!! Remaining time did not seem to permit a leisure round table as seconds must be conserved. WOBP answered both stations and sent MSGS to both stations in the same transmission. Because of the similarity of reports, their MSGS were on two separate lines but with ditto marks to denote the novel similarity in the MSGS, perhaps the first time in history that MSG traffic was handled with ditto marks! Here is the copy (quote): "W8GIG: NR 99 99 WOBP CK 589 589 MINN 2251 2251 Nov 1 forty meters W2RUI: NR 100 100 WOBP CK 589 589 MINN 2252 2252 Nov 1 forty meters (unquote). Carl W8GIG receipted for his MSG and gave his NR 8 to WOBP and signed out. WOBP rogered the receipt and over to W2RUI.

Then to the consternation of WOBP, W2RUI gave his MSG NR 100 to WOBP and NR 101 to W8GIG! This would make skipper leader in MSGS!! WOBP rogered for NR 100 and turned it over to W8GIG as skipper directed, but no Carl! We both tried to raise him in the final moments but he seemed not among the living. So on the face of it, Skipper and Beep seemed tied at each making exactly a hundred contacts!! What a rat race!

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Sure did have a barrel of fun working the 1958 RTTY Sweepstakes contest. Lots of noise, QRM and QSO's.

Was surprised to find that the little Viking Ranger working barefoot into a forty meter flat top would work out as well as it did on 15. I tuned up on 15 as an experiment and found that I could work out like nobodys business! Worked KR6AK and East Coast!

Next year will have the three band beam up and think will do better. Have already made plans regarding changes that have to be made before the next contest, for ease of operation, etc.

Hope you will excuse the hastily drawn up log but I think it will be legible enough for your purposes. You will note a few discrepancies which have been detailed at the end of the log. You will note that I gave you a bogus number! Hi hi.

The rig here is Ranger driving pair of 814's to a flat top antenna eighty feet long twenty five feet high and with fifty foot tuned feeders. The receiver is an NC-300 with homemade W2PAT converter which has been modified to the point of losing its identity. Using Model 15 and Model 26, with TD and typing reperf, Model 14's.

Sure hope that I will be able to participate in the 1959 RTTY SS and that it is as much fun as this one was. Incidentally I worked W2RUI on 80, 40, 20, and 15! ! Some were rough but that guy really working all the time. Also I noted furious activity from W6FYM and of course VE7KX and WOBP. Also was slightly provoked at the no listen first tactic of. I suppose there were many operators at that station and some were OK but one or two sure must not know how to tune a receiver! ! Oh well, that's the way it goes.

Hope you know that the English used in this little paper has no similarity to the real thing because of the time. It's after 1 a.m. on Nov. 2. Hi. So here is my log for your inspection and will BCNU on the air. Was surprised to be your first contact but I guess someone had to be. Hi.—73

Jay O'Brien W6GDO

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The following is an article taken from a local newspaper. . .

## FASTER THAN SOUND

Teletypewriter can write 500,000 words a minute

NEW YORK—(UPI)—The army displayed yesterday a teletypewriter that can operate, in theory, at the rate of a half million words per minute.

Actually, the electronic device was shown running at a speed of 3000 words a minute—20 times as fast as most people can talk. The army intends to use it at 750 words a minute.

The 500,000 words per minute speed would be the equivalent of typing the King James version of the Bible (774,746 words) in a minute and a half.

The mechanism will go that fast or faster, but what baffles the experts is how to pass the roll of paper past the printing anvil fast enough. The specification for the machine was prepared by the Signal Corps and it was built by the Burroughs Corporation.

The army is assembling a series of devices to coordinate at the 750 words a minute speed. One is the typing reperforator Kleinschmidt introduced last summer. Other devices geared for this transmission rate—as compared to general news-service transmission speed of 60 words a minute—are said to be near the announcement stage.

The teletypewriter operates with no moving parts except those which pass the paper before an electronic gun that shoots the letters onto the special paper.

After the volley of letters, each line of text passes rapidly over powdered ink and a heated roller, and appears a split second later as clear text. Impulses to activate the device can be transmitted over voice-quality telephone circuits or short-wave frequencies.

The device is about the size of a spinet piano. —K6QLT

