CRYSTAL CONTROLLED RTTY

continued from page 14

23. CONCLUSION

While crystal controlled RTTY is particularly beneficial - in fact all but mandatory for good autostart operation, it would certainly appeal to those who don't care to use their 25-30 tube transmitter where an inexpensive $50 c.w. transmitter would actually do a better job. Even inexpensive surplus FT-243 type crystals will provide considerable more stability for general use than will some of the best transmitters with VFO's.

Use of the International Crystal Co., "HA" type crystal will provide literally no-drift operation from cold till weeks later.

24. CREDITS

The gang on 3637.500 80M autostart (170 shift) Have all provided interesting experience and comments. Keith Petersen W8SDZ in particular has been most helpful over the years in working with the author on crystal controlled circuits for RTTY. The original 6AK5 oscillator we published in May 1965 QST was largely his basic circuit. As such it was an adaptation of W6NRM's crystal oscillator that he had successfully used while still in Wisconsin as W9TCJ. This all proves perhaps that there is really "nothing new" involved other than the new "HA" crystal itself. W7AHW/4 provided valuable help with his 3-oscillator crystal circuit allowing him to use three different crystals completely independent of each other.

* * *

BARTG

DX CONTEST RESULTS

A letter from Arthur Owens of the BARTG gives us some preliminary figures on the last BARTG Contest from Alan Walmsley G2HI0 the contest manager. Further details are to follow. The winner was WA4LWE with 104, 152 points, followed by W3KDF, I1AHN, W2RUI, I1KG, W1GKJ, W3ISE, VE3AYL, ON4BX and K5OLU. 55 entries were received from all continents and 20 stations achieved WAC during the contest.

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RTTY JOURNAL

December – 1967

EXCLUSIVELY AMATEUR RADIOTELETYPE

Vol. 15 No. 11 30 Cents

VOLTA RTTY DX CONTEST
December 2-3rd 1967

See last month for complete details.

A RTTY Transmitter & Receiver for $100

TRUMAN BOERKOEL, K8JUG
195 Brandywine Dr.
Comstock Park, Mich.

This is enough to raise some eyebrows, but let's be more specific. Would you believe excellent copy on 170 cycles shift and stability so precise that unattended auto start is easily accomplished?

The unit we are taling about is Heath Kit's new HW-16 novice 3 band transceiver. The receiver contains an RF amplifier, hetrodyne mixer, crystal controlled hetrodyne oscillator, bandpass coupler, variable VFO, VFO mixer, crystal filter, IF amplifier, product detector, crystal controlled BFO, and 2 audio amplifiers. Sensitivity, less than 1 microvolt for 10 DB signal-pulse-noise to noise ratio. Selectivity, 500 cycles at 6 DB down.

Sounds like a winner for 170 cycles shift, but there are some problems. First apparent thing is that the BFO crystal comes out on the wrong sideband and not in the center of the passband for 170 cycles shift. This must be changed.

The BFO crystal originally supplied should be removed and replaced with a 3393.090 Kcs crystal. This will put the receiver on the lower sideband and the 170 cycle shift signal is now in the center of the passband of the receiver.

To crystal control the receiver, it is necessary to disconnect the variable receiver condensor at point "X" on the receiver printed circuit board (this eliminates L-7, C-55, C-54 and C-53 from the circuit). Using the vacated hole at point "X" on the P.C. board as one hole for mounting the crystal, drill another hole in the P.C. board so that the crystal can be mounted from point "X" to ground. Solder this crystal in the same manner used to mount the other crystals on the P.C. Board. Desiring to use crystal controlled receive on 3637.5 Kcs, use a 2012.285 Kc crystal. If the frequency needs pulling one way or the other to zero a few cycles, you may adjust the frequency by varying the tuning of L-6 on the P.C. board.

The side tone built into the HW-16 must be disabled. Disconnect one end of the neon lamp associated with the side tone generator to accomplish this. By removing the side tone function, the receiver will be able to be used for monitoring the transmitted signal.

It may be necessary to install, on the back panel, a speaker matching transformer to match the input impedance of your particular terminal unit. Put a pad on the speaker so the speaker may be run at normal room audio levels, yet supplying the terminal unit with enough audio to fully saturate the limiters.

Transmitter modifications would include a small NPO type trimmer capacitor at 1.5-7 mmfd soldered across the crystal socket terminals to zero the crystal to the exact desired transmitting frequency.

Using an FSK keyer circuit, such as shown with the TT/L MAINLINE terminal unit, mounted on a 3 lug terminal strip, fasten the foot of the terminal strip under the VFO tube socket mounting flange. Disconnect the VFO cable center conductor from pin 9 of this tube and connect it to the input of the FSK keyer. Connect the 1.5-7 mmfd trimmer of the FSK keyer circuit to pin 2 of the VFO tube. Position this trimmer condensor so it can be adjusted from the bottom of the transceiver, through one of the holes in the chassis bottom plate. Add a 100 mmfd condensor from pin 8 of the VFO tube to ground. The FSK keyer line from the terminal unit may now be plugged into the VFO socket on the back apron of the transceiver.

Rapid switching may be accomplished

at a remote location such as a switch on the keyboard of the printer. This switch then would short the key jack located on the back apron of the transceiver. When closed, it will automatically actuate the transmitter and simultaneously mute the receiver by means of the automatic switching design of the transceiver.

It was found that there was too much output from the transceiver when used with a linear, even when the RF drive control was completely backed off. If necessary to reduce the drive for your equipment, install a 1500 ohm 1 watt resistor in parallel with the 47K ohn 2 watt resistor going to ground from one end of the RF drive control on the front panel.

Computations for determining crystal frequency for the transceiver thanks to Keith Petersen W8SDZ.

Assuming that the half-lattice filter operates as they normally do, the center frequency will be half-way between the two crystals. (This is 3395.300 Kcs.) When working with RTTY, it is easier if you convert everything to center frequencies. For instance the 3637.500 Kcs channel is a center frequency of 3637.415 kcs.

3637.500 Kcs
\- .085 (.085 cycles is just half of 170 cycles)
3637.415 Kcs channel center frequency

Heath Kit Transceiver
9045.000 High frequency oscillator
-3637.415 Channel center frequency
2012.285 Second hetrodyne oscillator (VFO)

The desired audio center frequency is
2125
plus 85 Cycles
2210 Cycles

Heath Kit
3395.300 Second I.F. center frequency
\- 2.210 Audio center frequency
3393.090 BFO crystal frequency

Using the center frequency approach is possible because you figure that you have plus or minus 150 cycles bandwith (at I.F.) on either side of it. It is therefore possible to state: For the Heath Kit HW-16 CW transceiver and the 80 meter autostart frequency, one would need a 2012.285 Kcs crystal to replace the receiver VFO, and a 3393.090 Kcs crystal to replace the present receiver BFO crystal.

Considerations for continued investigations for improving the operation of the transceiver. The following ideas have been suggested by many before I began working on the HW-16. When I had completed the basic steps to put this on the air, I found it unnecessary to continue beyond this point to achieve my initial goal. However, these certainly would be highly recommended, especially for the really serious stability conscious minded individual.

1. The use of high stability crystals in place of the hetrodyne oscillator crystals. (W6FFC ex K8DKC)
2. Dropping and stabilizing the voltage of the crystal oscillator plate circuit, by using a 11K ohms 1 watt series resistor and a VR-150 voltage regulator tube. (W6FFC ex K8KDC)
3. The use of an improved 6EA8 oscillator-keyer circuit to replace the 6CL6 oscillator in the HW-16, such as designed by W6FFC ex K8DKC.
4. Receiver AVC action by the use of a CK1121 Raytheon raysistor, as suggested by W8SDZ.
5. Obtaining AVC controlling voltages directly from the TT/L teminal unit, so that the terminal unit requirements for AVC in limiterless copy could be fully achieved, as suggested and tried by K4TMF ex KG4CG.

CONCLUSIONS

The HW-16 is being used here on the 170 cycle AUTO START NET on 3637.5 Kcs operating from 4 p.m. to 8 a.m. by means of a time clock. The frequency stability has been excellent.

A note should be made about true transceiver type operation. Most transceivers use portions of the receiver and portions of the transmitter for dual function purposes, therefore it is impossible to receive your own signal while transmitting. It is impossible to tell exactly what your transmitted frequency is. The HW-16 is a completely separate receiver and transmitter. If you desire, you may leave the receiver connected to the input of the terminal unit and monitor your transmitted signal on the terminal unit scope.

It is said, "The proof of the pudding is in the eating". The same would hold true, that the proof is in the copy. I have not been able to notice any difference in copy between this HW-16 and my original equipment. Reports received here state that the transmitted signal is clean and stable.

One final and happy thought, about $700.00 difference in cost between the HW-16 and the present equipment.

* * *

CRYSTAL CONTROLLED RTTY

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Los Altos Hills, Cal. 94022

1. WHY CRYSTAL CONTROLLED RTTY?

For stability. Also to find the same frequency any time you want without having to "guess at it". Another advantage not immediately apparent is the ability to use simple and inexpensive c.w. transmitters in lieu of the normal transmitter which in the case of s.s.b. units may employ 25-30 tubes. A suitable c.w. type transmitter can be used with a total of perhaps three tubes including the crystal oscillator section. Certainly one of the advantages of a good crystal oscillator is the ability to keep a given frequency from "cold" to "warm" hours later. No v.f.o. normally used by an amateur can compare in this respect.

2. HOW STABLE ARE VFO'S?

The best answer to this is: "Not Very." The figures given for most VFO's indicate over a 24-hour period of time that the best you can expect is on the order of 1×10^4, which is the equivalent of about 100 Hertz per megahertz. This would be about 360 Hz. on the 80m band for example. Thus you can see the reason some companies have for placing the frequency of their VFO's to 2.5 MHz. (Collins) The use of "PTO's" rather than "VFO's" can greatly improve the picture, as it is the variable capacitor that introduces nearly all the drift in a VFO. In a PTO such as is used by Collins, there is no variable capacitor and thus the drift can be held to a small amount when compared with other units. There will still be substantial "warm-up" drift, however, and due to heat generated after long periods of transmission such as RTTY, some drift will still be evident. The PTO used in the receiver gives an overall stability the transmitter cannot match, as the heat level in the receiver stays at a uniform level, and many operators (if interested in stability) never turn their receivers off.

3. HOW STABLE DO WE NEED?

This question YOU have to answer. It depends on what you want to do. Since it is the other fellow who has to keep his hand on his receiver, you may be satisfied with that clunker of a VFO you have always been using. If you are interested in good, stable operation, then 100-200 cycles during an entire QSO might be your goal. If you are interested in unattended autostart, then you would want long term stability of 15-20 Hz. or less.

4. WHAT ARE THE REQUIREMENTS FOR AUTOSTART?

This depends primarily on the shift being used. Most unattended RTTY autostart nets have found narrow shift (170 Hz) to be much more reliable than 850 Hz. shift. Since the other fellow's receiver will have some drift, the amount by which your transmitter may be off will add to the amount by which his receiver might be off. A guess based on several years of practical experience would be perhaps $\mp$ 50 Hz. for 170 shift autostart. It would be nice to keep the transmitter frequency within say 50% or less of this tolerance to allow for some receiver drift at the other end. A good receiver can stay within 25-35 Hz. per day, although this narrows your selection of "brand names" down to only a few.

5. HOW CLOSE WILL A GOOD CRYSTAL OSCILLATOR STAY?

Until recently, a normal crystal oscillator with decent components would only stay to perhaps $\pm$ 75 Hz. per day. This was (as we now know) due primarily to the crystal and not to the oscillator. Crystal ovens were used where better stabilities than this were required. New crystal cuts now available are so exceptionally stable (without ovens) that even on 20M you can expect stability from "cold" to hours (or days) later of around $\pm$ 5 Hz. and better. This is well within the most stringent tolerances for autostart.

6. HOW MUCH CAN A CRYSTAL BE SHIFTED?

This depends on the frequency and the circuit being used, as well as the type of crystal selected. I was able to pull a normal 80M crystal over 3300 Hz. using every trick I could discover. Using these same methods, I got over 17,000 Hz. shift on a 20M crystal. As soon as you add the RTTY circuit, these figures change. If you follow the "rules", you will have no trouble in pulling the crystal at least 850 Hz. on 80M, and have enough "pull" left over to hit a specific frequency as well. Only on 80M does "maximum shift" become a problem, however, so particular attention must be given if 850 Hz. is needed on 80M. On 80M, you can shift 850 Hz. and perhaps an additional 400-500 Hz. as well.

7. WHAT ARE THE "RULES" FOR MAXIMUM SHIFT?

A few "rules" are important for maximum shift:

1. Keep the screen by-pass capacitor fairly large. (100-150 pf. seems quite good.)
2. Use a 1N270 diode in the shifter - it's low forward voltage drop aids in maximum shift - in any event use a germanium diode here, not a silicon diode.
3. Use a phenolic core RF choke in the shifter such as a National R-50. (Not a ferrite core RF choke for maximum shift.)
4. Use a 6AK5 or 6EA8 tube.
5. Keep the grid capacitance very small (a 1.5-7 pf. trimmer)
6. Keep the grid connections as short as possible.
7. Use only "plated" type crystals - not the "ressure" type usually purchased surplus.

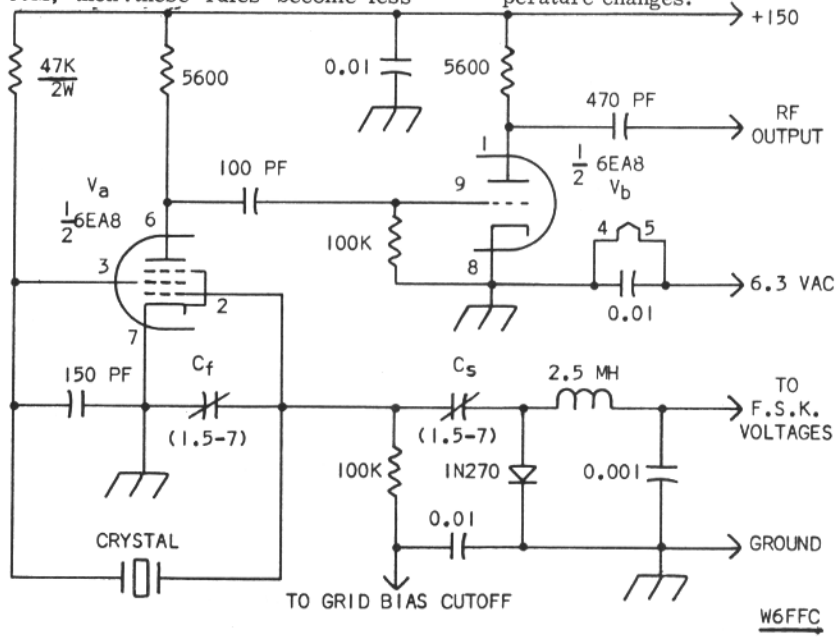
If you are not interested in 850 shift on 80M, then these rules become less important and can be disregarded completely for 20M.

8. MAXIMUM STABILITY WITHIN REASON

If you are not interested in net operation or autostart, but just in good stable RTTY operation on any convenient frequency allowed, then there is little justification in spending $9 for a "HA" crystal and even the military surplus crystals selling for a dollar or two will be excellent for your purpose. Almost any crystal used in this case will compare with the very best VFO's after the VFO has been warmed up for a day or two.

However as long as you are building the crystal oscillator anyway, you will find it won't add but pennies to the total cost to "do it right" and added stability can be achieved. Again some rules are in order.

1. DON'T use "air variable" capacitors. This after all is what causes the VFO to have excessive drift. If you don't believe this, just TRY to find some published curves on the drift of an air variable with temperature changes.



THE MAINLINE XT/4 CRYSTAL RTTY OSCILLATOR

Use dipped silver mica capacitors for the smaller fixed values. Use disc ceramic for the 0.01 mfd. by-pass capacitors. See the text for the "C_f" and "C_s" trimmer capacitors. See the text for the proper method of ordering the crystal for RTTY.

2. DO use "no-drift" (NPO) trimmer capacitors such as the ERIE 557 or ERIE 507 types.
3. Use silver mica capacitors (or NPO temperature compensating capacitors) for the other fixed capacitor values.
4. Use a stable crystal, such as the International "HA" type.
5. Mount all the components except the tube inside the external oscillator box. (Be sure the box is covered on all sides including the bottom).
6. Do not modify the existing crystal oscillator in the transmitter but build an external oscillator as shown in the schematic - this then plugs into the "VFO" input on the c.w. transmitter.

9. THE CIRCUIT

Various circuits will work, and with the ideas shown, you may want to try some other oscillator circuit. However, the circuit shown has been used successfully by many operators and can be offered as a "guaranteed" stable circuit. (Assuming you follow the "rules" for selecting components.) It can be used in conjunction with crystal ovens if you prefer them to the "HA" crystal.

10. HOW ABOUT OVENS?

Any reasonably priced oven would be a thermostat type, cycling on and off. They usually are set for 85 C, and special crystals cut to operate best at this temperature must be obtained. While these crystals are somewhat cheaper than the "HA" crystals, by the time you buy the oven and its associated transformer (they usually pull about one amp at 6 volts), you have probably exceeded the cost of the "HA" crystal, in addition to having an oscillator of bulky size with AC voltages nearby.

11. HOW DOES A COMMERCIAL OVEN AND CRYSTAL COMPARE WITH THE "HA"?

About the same. My experience with a digital counter has been that the "HA" crystal gives as least as stable results as the oven combination, without all the associated parts.

12. HOW ABOUT A "HA" CRYSTAL IN AN OVEN?

Sounds like a real winner, doesn't it? The factory doesn't make crystals for 85 C ovens, and they say the "HA" design should not be used at temperatures "that high". (85 C is around 185 F!) Forget about this combination.

13. SELECTING THE CRYSTAL FREQUENCY

Remember on RTTY you LOWER the frequency of the transmitted signal when you go to space. Thus you must consider the frequency of the space signal when selecting a crystal. As most amateurs refer to the MARK frequency when talking about net operation, etc., you can make an expensive mistake if you don't read this paragraph before ordering the crystal. (In military "MARS" circuits they quote the "center" frequency between mark and space for net operation, so if you are planning "MARS" operation, be a little careful!)

The frequency printed on most crystals represents its use in a normal circuit where it is loaded to a specific capacity. Usually this is 32 pf. It can be less - some crystals are provided for 20 pf. operation. They are normally the same crystal, only in this case it has a slightly different frequency marked on its case, is all.

A 32 pf. crystal does not need to be used in a 32 pf. circuit, but to get the frequency printed on its case, it does. If it is put in a 10 pf. circuit, it oscillates higher in frequency, and if put in a 50 pf. circuit it oscillates lower. It is easier to raise the frequency of a crystal than to lower it before it stops oscillating.

Thus you should purchase the crystal with "space" frequency in mind, as you can then raise it easily to hit the mark frequency. Since most crystals have some error in frequency from that stamped on its case, you must also allow for this to some extent. (The "HA" crystals are ground quite accurately compared with the cheaper $3 - $4 crystals). Since there will be some additional capacitance in the wiring to the grid leads of the oscillator, etc. we recommend that for ordering the crystal you do it this way:

850 shift
mark frequency minus 700 Hz.
170 shift
mark frequency minus 100 Hz.
850 shift (MARS)
net frequency minus 275 Hz.

As an example - let's say you want to get on 3620.000 850 shift:

3620.000
- 0.700
3619.300

So order the crystal for 3619.300. This example should suffice for hitting any frequency you are interested in. Let's say you want to hit 14090.000 where your transmitter doubles up from 40M:

14090.000
−0.700
2) 14089.300
7044.250

And that is the way it's done. 170 shift is identical only substitute "-100" for "-700" in the arithmetic.

You can use a 850 shift crystal for 170 shift also, for that matter, but on 80m you can't very well use a crystal selected for 170 shift on 850 shift and hit the same frequency for mark operation. Selecting the 170 shift crystal by "-100" keeps both mark and space near the 32 pf. load region.

14. SELECTING THE OTHER OSCILLATOR COMPONENTS

Again do not use air variable capacitors or your oscillator will drift considerably with room temperature changes. (Many homes are cooled overnight, etc.) The ERIE type 507 or 557 make excellent choices:

ERIE 557-000-COPO-10R
1.5-7 pf. $0.90
ERIE 507-000-COPO-10R
1.5-7 pf. $1.16

The Centralab 822 and 827 are also acceptable:

CENTRALAB 827A 2.5-7 pf. $0.90
CENTRALAB 822EZ 1.5-7 pf. $1.14

Now if you want to really go deluxe, by all means use a glass piston trimmer of good quality. Such a trimmer can be front-panel mounted. With the fantastic vernier action such a trimmer offers, it is extremely easy to hit a frequency and/or shift exactly. After some investigating for temperature co-efficients, it was found that the:

JFD VC-20-GY 0.8-8.5 pf. $3.40

is outstanding for this purpose. They are very small and yet have a temp. coefficient of only 50 parts per million per degree centrigrade. This is roughly one Hz. on 20M for a room temperature change of 15 F. The same type of trimmer may be used for setting the shift, if desired, but in this case it must be insulated from the chassis. For this purpose the 90¢ types listed above are probably adequate, since once the shift is set, you only need to occasionally touch up the frequency. If you wish to use the piston trimmers, it mounts in a hole a number #10 screw would take. For insulating the shift trimmer from ground (if you do use a piston trimmer for the shift) get some extruded fiber washers for a #10 screw, such as Newark Radio's stock 21B1003-2. These cost 10¢ each and you will need two for each trimmer you want to insulate from the chassis. You can probably also buy them locally.

The capacitors other than the trimmers should be good quality dipped silver micas or else regular temperature compensating no-drift (NPO) types. These usually cost around 13-18¢ each.

In selecting the crystal, one with solder leads rather than plug-in leads will in the long run give more satisfactory results, as it can be soldered directly to the bottom of the tube socket where the leads will be kept short, and where the crystal will be neatly kept out of air currents or RF voltages around the shack.

In building the oscillator be sure to use a tightly enclosed "minibox" for RF protection. Also by-pass with 0.01 capacitors (inexpensive disc ceramic are fine here) any wires coming in or leaving the external oscillator with the exception of the RF output connection. This should eliminate any problems from stray RF in the area.

15. FINDING THE PARTS

If you have any trouble finding any of the parts mentioned at your local distributor, Truman Boerkoel K8JUG has indicated he will be able to supply them to you:

Truman Boerkoel, Purchasing Agent
Newark Industrial Electronics Corp.
2114 South Division Avenue
Grand Rapids, Michigan 49507
Phone 616-452-1411

16. PURCHASING THE CRYSTAL

The chances are you already have your favorite crystal manufacturer, but for stable RTTY purposes, the International Crystal Corp. seems to stand out well above the others. We are not in a position to try all brands, but can speak from experience that this firm can supply the type of performance that you probably want. Assuming you might have an interest in the superb qualities of the "HA" crystal, order it this way:

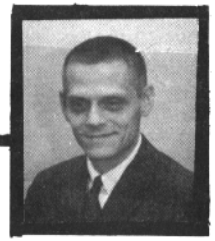
Frequency:
Type of Crystal: HA
Type of holder: F-700 (solder leads)
For Room Temperature 25 C
Crystal load: 32 Pf.
Your name and address
Remittance: $9

Send the order to:

International Crystal Mfg. Co. Inc.
10 North Lee

Continued on page 14

VHF RTTY NEWS



RON GUENTZLER, W8BBB Editor
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Ada, Ohio 45810

TIME CONSTANTS IN TELEGRAPH LOOPS

This month we are going to discuss the effects of L/R time constants in telegraph loops and show how they affect selector operation.

SERIES R,C CIRCUITS

When a series circuit composed of a resistance, R, a capacitance, C, and a DC source, V, are connected, a current I = V/R flows at the instant of circuit closure. As time progresses, the current slowly decreases until it reaches O. The decay of current is governed by the product of R and C, and the current decays to 36.8% of its initial value in a period of time in seconds equal to the product of R in ohms and C in farads. The voltage across the resistor follows this same pattern; it starts at V volts at the time of circuit closure, decreases to 0.368V in RC seconds, and ultimately reaches O volts. The voltage across the capacitor starts at 0 volts, reaches (1-0.368)V = 0.632V in RC seconds, and finally reaches V volts.

If, after the capacitor has charged to V volts, the battery is disconnected, the capacitor will remain charged indefinitely. When the circuit is closed with the battery removed, the capacitor will discharge and will reach 0.368V volts in RC seconds.

SERIES R,L CIRCUITS

In the case of a series R,L circuit there are some similarities and some differences from the R,C situation. For example, consider a simple series circuit composed of an inductor, L, a resistor, R, a battery of V volts and a switch. Assume that the circuit is sitting with the switch open; no current flows and the voltage across the resistor and inductor is zero. When the switch is closed, the voltage across the inductor immediately becomes V volts, but the current is still zero and the voltage across the resistor is also zero. The current slowly increases until it ultimately reaches I = V/R amperes. The increase of current is dependent upon the ratio of L to R. The current reaches 0.6321 in a period of time in seconds equal to L/R where L is in henries and R in ohms. The voltage across R follows the same pattern reaching 0.632V in L/R seconds, and the voltage across the inductor decays to 0.368V in the same L/R seconds.

A similarity between R,L and R,C circuits is they both have time constants; a difference is the R,C circuit time constant is proportional to R while the R,L circuit time constant is inversely proportional to R. Another difference becomes evident when the switch is opened. In In the R,C circuit, as noted above, the capacitor can remain charged indefinitely; after the switch is opened, the voltage across the capacitor will remain at V volts until something is done to the circuit. In the R,L circuit the inductor can remain "charged" only so long as the current remains at I amperes, and this requires that the circuit remain closed. As soon as the circuit remain closed. As soon as the circuit is opened, the inductor will "discharge." The "discharge" of the inductor regardless of the circuit configuration, must obey the rule that the current thru the inductor cannot change instantaneously This leads to two interesting situations:

1) Assume that the circuit is as described previously: A simple series combination of an inductor, a resistor, a switch, and a battery. Assume that the switch has been closed for a while and a steady current is flowing. If the switch is opened, current must cease, but the inductor will not permit it to cease instantaneously. Therefore, as the switch contacts separate, the inductor will react by generating a "back emf" of sufficient magnitude to break down the air gap between the contacts for a sufficient period to allow the discharge of the inductor; the air gap breakdown is evidenced by a spark. This sparking will, of course, eventually damage the contacts. A remedy is to provide some alternate path for the inductor discharge current. A device providing this path is known as a Contact Protection (C.P.) network.

2) Assume the circuit is the same as

described previously, but in addition a C.P. net work composed of a series R,C circuit is placed across the contacts. (The mathematical analysis of this arrangement can become a bit much unless certain assumptions regarding component sizes are made; we will assume the appropriate values.) Because the C.P. network is across the switch contacts, it will have no effect upon circuit operation when the switch is closed; the closed or mark interval time constant will be L/R, where R is the loop resistance. When the switch is open the total resistance of the circuit will be the sum of the loop resistance and the C.P. network resistance; call this total resistance, r. Therefore the open-switch or space interval time constant will be L/r. The spacing or "turn-off' condition resistance, r, is larger than the marking or "turn-on" condition resistance, R; consequently, the current decay at switch opening will be faster than the current build-up at switch closure.

A SELECTOR MAGNET LOOP

Consider the following series circuit: A 260-volt DC power supply, teleprinter selector magnets, a resistor, and a set of metallic contacts with a C.P. network across them.

The selector magnets have some resistance and an inductance. L. The resistor is set to such a value that its resistance plus the resistance of the selector magnets is 4330 ohms. (This value will permit a steady-state current of 60mA to flow in the selector magnets.) Call the total loop resistance, R. (R-4330 ohms.) The metallic contacts can be either the keyboard contacts or the contacts on a polar relay. (We will consider driver tubes and transistors later.)

The magnetic pull exerted upon the armature by the selector magnets varies with the current flowing in the magnets.

When the contacts in the loop are closed the current will slowly build up and the magnetic pull exerted by the selector magnets will also build up. The rate of build up of magnet pull is dependent upon the L/R ratio of the circuit. When the contacts are opened the current will decrease and so will the pull of the selector magnets at a rate dependent upon the L/r ratio of the circuit during the open contact situation. Since the resistance of the circuit is higher during the open interval than during the closed interval, the armature will release faster than it operates; therefore, spacing bias is introduced into the printer mechanism.

The current decay time may be so short compared to the build up time that the decay time can be ignored. If this is true, the amount of spacing bias introduced into the printer is determined solely by the L/R ratio in the selector magnet loop. (It is assumed that the contacts are being operated by an unbiased source.)

Bias can cause troubles when receiving, especially when conditions are less than ideal. The "standard" land-line telegraph loops are 260-volt, 4330-ohm, 60-mA and 130-volt, 2170-ohm, 60-mA. Therefore, the manufacturer/designer of teleprinters designed the machines to give best performance when the selector magnets are inserted into these loops.

LOW-VOLTAGE LOOPS

With the advent of transistors, the 130-volt or higher loop was considered a real pain. This is especially true since 130-volt transistors are (or were) expensive (or non-existant). Because the actual voltage across the selector magnets when energized is typically 12 volts or less, there is a temptation to run the selector magnets from a 12-volt source in series with a transistor using no external resistance. Assuming that enough drive is available to the transistor, the selector magnets will get their required 60 mA current (at least under static conditions) and all seems well until trouble is encountered while receiving under difficult conditions.

An examination of the circuit constants will reveal the following: With a 260-volt, 60-mA loop, the circuit time constant is L/4330; with a 130-volt, 60-mA loop, the circuit time constant is L/2170; and with a 12-volt, 60-mA loop, the circuit time constant is L/200. This means the bias introduced by the loop time constant when using a 12-volt source is 11 times greater than with the 130-volt loop and 22 times greater than with the 260-volt loop! No wonder it is sometimes difficult to receive.

With a vacuum-tube magnet driver the situation is inherently better than with the "typical" transistor circuit because a higher voltage loop source is used. A triode or triode-connected beam power tube will give performance equal to metallic contacts for a given supply voltage. A pentode operated in a "constant-current" mode will outperform all other switching devices especially under the most difficult circumstance of several selectors in the same

Continued on page 12

RTTY-DX

JOHN POSSEHL W3KDF Editor

P.O. Box 73 Blue Bell, Penn. 19422

DX HONOR ROLL

Station	Countries worked	conf.
1. FG7XT	75	61
2. ON4BX	63	58
3. I1KG	66	55
4. W3KDF	60	54
5. W4AIS	62	53
6. K8YEK	55	48
7. W8CQ	53	48
8. W6CG	51	46
9. VE3AYL	48	40
10. WA6WGL	43	38
11. W1GKJ	45	37
12. UA1KBW	36	33
13. W2UGM	36	30
14. W3ISE	41	29
15. WA8BOT	42	28
16. VE4BJ	28	28
17. WB6ADY	30	27
18. K8QLO	38	26
19. K8JTT	30	24
20. W8CAT	29	23
21. KL7BAJ	26	22
22. VP9BY	26	18
23. W6LDA	24	18
24. K9QNV	24	17
25. W8CEM	19	16
26. OA4BR	22	15
27. G3LDI	25	14
28. K4VDM	23	14
29. VK3NR	32	13
30. W4FUI	33	11

WAC RTTY AWARDS

1. VE7KX
2. W6CG
3. K6OWQ
4. W6AEE
5. W7LPM
6. W2RUI
7. W2JAV
8. W6TPJ
9. G3CQE
10. W6LIP
11. W7ESN
12. W8JIN
13. K3GIF
14. W5BGP
15. WØNFA
16. W8UUS
17. TG7AD
18. KR6MF
19. K4JXG
20. W7FEN
21. W6FYM
22. W1BGW
23. ZS6UR
24. VK3KF
25. VE4BJ
26. WØPHM/4
27. I1IRF
28. DL6EQ
29. WØFQW
30. W6UGA
31. W9HJV
32. W5CME
33. K8DKC
34. W3DJZ
35. WB2CVN
36. W6JOX
37. VK4RQ
38. DL1VR
39. DL8IR
40. W5SH
41. W6LVQ
41A. LU1AA
42. W8CAT
43. W6MTJ
44. W7VKO
45. W6NRM
46. W4AIS
47. W7UKH
48. I1AHN
49. K8MYF
50. ZL1WB
51. W4GJY
52. KP4AXM
53. VE3BIJ
54. W2MXN
55. SM6CSC
56. W3KDF
57. KR6BQ
58. W7JWI
59. W1GKJ
60. DL1IN
61. W3ISE
62. SM5KV
63. KH6AX
64. WA6WGL
65. FG7XT
66. W6LDF
67. K5OLU
68. W8CQ
69. KW6DS
70. K8MZS
71. G2HIO
72. PY2CQ
73. PY2SO
74. K7MNZ
75. I1ROL
76. I1ORS
77. OZ8US
78. I1KG
79. K8YEK
80. ON4HW
81. W6DNJ
82. ON4BX
83. WA8BOT
84. W4EGY
85. W8ZYW
86. W7ATV
87. K8JTT
88. WB6ADY
89. F8KI
90. KL7BAJ
91. 3C3GK
92. W6LDA
93. ON4CK
94. W2UGM
95. WA8FYF

Q.C.A.AWARD

Nr. 1 DL1VR
Nr. 2 G3CQE
Nr. 3 G2HIO
Nr. 4 W6CG
Nr. 5 VE4BJ
Nr. 6 W8CQ
Nr. 7 FG7XT
Nr. 8 W6AEE
Nr. 9 W3KDF (50)
Nr. 10 W2RUI
Nr. 11 K8YEK
Nr. 12 I1KG (50)
Nr. 13 not issued
Nr. 14 VE3AYL
Nr. 15 I1ORS
Nr. 16 W1GKJ
Nr. 17 K8MYF
Nr. 18 ON4BX
Nr. 19 WA6WGL
Nr. 20 ON4CK
Nr. 21 WA8BOT

( ) indorsement

Q C A
Sponsored by
B. A. R. T. G.

Hello there. . .

As promised, this month we are listing the W A C, Q C A, and RTTY - DX Honor Roll. Our thanks to Bill Brennan, G3CQE for getting the Q C A listing to us just at the right time.

Well, it seems that most of the predictions we made last month concerning the contest came true. The participation was certainly the best ever and some of the scores I've had the opportunity to see so far are out of this world. As for conditions, they seemed to be contingent upon which area you operated from, but in general were fair to good. Severe QSB seemed to be the biggest factor at times rather than a closed band. This did not, however, prevent a few stations from making contact on five bands and when the distance between them is considerable this becomes quite an accomplishment in any mode. With activity at such a high level the fellows with good band-pass filters, narrow shift, and print on mark or space only capabilities would certainly have a theoretical advantage in getting good copy. However, I was quite surprised to hear so little use of narrow shift. The principle proponent of the narrow was Cas on Ten meters and it really made the difference between getting copy or not in those pile-ups. If the present increased activity continues during contests the trend will no doubt reverse itself and we shall see a predominance of narrow shift in future contests. Now that the smoke has cleared and the dust has settled down let's see what has filtered through as regards countries reported active during the contest. Here we go. Alaska - Antartica - Argentina - Australia - Austria - Belgium - Brazil - Canada - Canal Zone - Colombia - Crete - Curacao - Denmark - England - Estonia - France - Germany - Guadeloupe - Hawaii - Hungary - Ireland - Italy - Japan - Latvia - Liberia - Lithuania - Luxembourg - Mexico - Netherlands - Newfoundland - Northern Ireland - Norway - Okinawa - Peru - Puerto Rico - St. Maarten - Sardinia - Scotland - South Africa - Soviet Union - Sweden - Switzerland - Ukraine - USA - Venezuela -. This all adds up to forty-five countries; quite an impressive multiplier. We may have missed some, but not many, we think. For the above many thanks to FG7XT, XE1YJ, ON4BX, and to Sandy Morton of the BARTG from his listening post in Scotland, and ZL2ALW near Wellington.

A few days after the contest I had a chat with Henry, ZS1FD, on Fifteen meters. Henry was bemoaning the fact he was hearing just about everything but apparently you fellows were not hearing him. He made just three contacts and the lucky ones were PY2CQ, W1GKJ, and WA4LWE. Henry is on Fifteen most week ends at around 18-1900z. Those of you needing South Africa might swing your beams in that direction for a listen.

Although Jose, PY2CQ operated the contest, Sonia, PY2S O, his better half, was warming up the machine a few days before giving many a rare contact from Brazil.

In a contest of this type, with the mode still being quite a rarity in various parts of the world, one often feels sorry for the chaps in those countries represented by only themselves or at the most one or two others who may not be active during the contest. In many cases it not only means the loss of a multiplier but also missing out on WAC which really hurts when it is part of the scoring. Without mentioning calls, as the list is surprisingly long, we all wish to say thanks to you chaps for showing up at these affairs and giving the mob a rare one at some small sacrifice to yourselves.

Leo, EI6D, sent a note recently while on a business trip to Scotland giving some interesting information on activities in Ireland. Although in the past both EI6W and EI7D had machines and had planned to get on they never did quite make it, which makes Leo the only active station at the moment. EI6D is a familiar call in all the contests giving out numbers and a real rare multiplier to all comers. The equipment at EI6D is the SB-300, SB-400 combination, a Creed 7B machine, and while in England recently Leo picked up some tape gear which he is now setting up.

That real loud signal you have been hearing lately coming from the direction of Italy is none other than Lou, I1ORS. Lou is back in business again after a few months lay off setting up some new equipment and also finding it necessary to have the whole house rewired for 220 volt mains that is replacing the 160 volt service formally used in Florence.

A great big thanks is due to Giovanni, I1KG for his fb operation as IS1KG from the island of Sardinia during the contest. That is one that possibly may not be along again for a long time. Giovanni worked 25 countries from that location on the 13-14 October.

As mentioned previously, Norm, W1GKJ, went to Prince Edward Island to operate the W/VE contest. Norm was able to get in some RTTY while he was there and managed to make twentyfive contacts in six countries. P. E. I. is a hard to get and necessary contact for the WAVE Award for those that are interested.

This month it is our pleasure to congratulate the following on making W A C.

Nr. 93 Robert Deseck ON4CK
Nr. 94 Richard Marsino W2UGM
Nr. 95 Stu Fillingham WA8FYF

That makes a total of 16 issued this year and as you see we are fast approaching the century mark.

A new station will be showing up on twenty meters shortly; ZL2ALW. As mentioned above, Barney sent in quite a list of stations copied during the contest so is pretty well set-up in the receiving end. Unfortunately the contest caught him in the midst of building a new transmitter so he was unable to get involved in the riot.

Now that you are all rested up and have fixed up all the things that went wrong

Continued on page 13

Letter from Don, DL5PQ, gives some information on RTTY in Western Germany - Special permission is needed but available for the asking. Frequencies are- 3.575 3.625 and 3.725-3.775; 7.025-7.050; 14075-14110; 21-075-21-125; 28100-28150; Up to 900 cycle shift and 50 baud (everybody uses 45.5) No CW is needed. Most of the frequencies fall in the same general group as commonly used here in the states except for the ten meter band. Every country seems to have different ideas about this band. The ARRL has had a petition with the FCC for RTTY use in the lower CW portion of this band for a long time but the last information we have had was that no action had been taken. In the meantime when calling on ten meters it is a good idea to check all portions of the band for a call. And ten meters has been wide open most of the time. - - - -

* * *

The third annual SAROC Hamfest will be held at the Hotel Sahara, Las Vegas, Nevada, January 4-7. There is even a good program of ham radio planned in case you are interested but the other parties and entertainment sound like a real bargain. Coming right after Santa Claus has raided the exchequer might be a little rough but there is always the chance that you might win it all back. Write John Romero, % Hotel Sahara, Las Vegas, Nev. for details. You even get some free Kentucky Kool Ade.

* * *

Many of you probably remember that Fairbanks, Alaska celebrated the Centennial of Alaska and among other attractions was an old ship housing a ham radio set including RTTY manned by Bill, KL7BLJ, in fact QST carried a pix of Bill at the rig. We don't know if the choosing of a ship was premonition of the floods to come, and whether the ship floated or leaked when they did but it is nice to think that the ARK had some ham equipment rather than an assortment of animals during the rains. Since then, we received a beautiful copy of the Fairbanks Daily, over 100 pages, many in color showing the damage done by the floods but more important the wonderful spirit that the city was showing in getting back to normal. I think the thing that surprised us most was the modern city existing so far North with skyscrapers and beautiful homes where our foggy idea was some igloos and a few miners shacks. Guess 100 years does make a difference. Thanks to whoever sent us the paper.

* * *

K8ZQB sends a note that hams wishing to obtain tuning forks for frequency checking or setting may get them from B. F. Kitchings Co., Inc., 505 Shawmut Ave., LaGrange, Ill. 60525 at a very reasonable price ($3.00) last year, maybe a little more now. These are specially made and aged to a tolerance of .05%cps. Minimum order is $5.00. Since these forks are specially made a wait of 6 to 8 weeks is required for aging and bringing to tolerance.

* * *

"Gerry", WA2YDJ, informs us that a card showing the decoding of the US weather reports sent by the FAA over RTTY channels is available from the U.S. Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 for five cents. Gerry has ordered a hundred copies and will send them to anyone sending a nickel and a SASE envelope to his address. This will probably give faster service than the government office, but either way it is a good deal. WA2YDJ, 35 Amherst Rd. Great Neck, N.Y. 11021.

* * *

In a QSO with Orbra EL2F we learned that an auto start net is operating on fifteen meters with a freq. of 21100 mHz. Orbra is building a Selcal for selective call up and several of the others are also using selective call up. The net meets Tuesdays and Thursdays at 1100 GMT and are planning on joining the RTTY Arms net.

* * *

CW ID to follow- sent after every transmission is redundant, unnecessary, time consuming and apparently very popular.

* * *

VHF NEWS

continued from page 9

loop.

CONCLUSION

Selectors were made to be operated in loops having at least a 130-volt source. So long as the selector magnets are driven from a source of at least 130-V, loop time constants should not be a problem.

We have omitted from the discussion certain details such as selector operate and release currents and protection diodes used with transistor drivers. Next month we will discuss the topic again in a more thorough and detailed manner and will include items not covered this time.

73, ES CUL, RG.

* * *

The FATT (Florida Amateur Teletype Net) meets every night on 3704 KC, 2300 GMT.

* * *

-RENEWALS-

From the response this past month, we know we are going to be swamped with renewals due the end of the year. You can save us a lot of time if you will give us the exact name and address as it appears on your Journal stencil. The Royal Oak postoffice has been named as one of the experimental offices to first use the Zip code distribution system. In most cases we have the zip code but you might check your zip number and if not correct or missing let us know.

Back issues are pretty sorry- we still have June through December of 1966 but only March and November of 1967. We have had a lot of new subscribers in the past three months and as most of them wanted all the back issues we have exhausted most of the recent issues. Xerox copies of the TT/L-2 demodulator article from the September issue are available for 25¢ but that is about the best we can do.

* * *

RTTY JOURNAL
P.O. Box 837 — Royal Oak, Michigan 48068
"Dusty" Dunn — W8CQ
Editor & Publisher
SUBSCRIPTION - 1 Year (11 Issues)
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DX NEWS

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in the CARTG contest I'll see you all in the Volta Contest starting at 1400z December 2nd. Have fun.

In closing this last issue of the year I would like to say a word of thanks to all you fellows out there that have really made this column possible. It could never be done without your support and I will continue to look forward to your notes, letters, and on the air comments in the coming year.

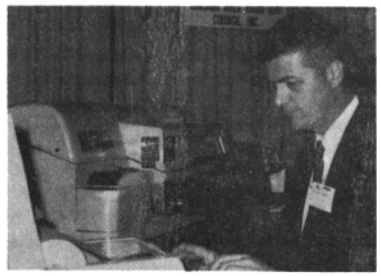
MERRY CHRISTMAS TO ALL.

de John

(FLASH - A last minute note from John stated that "Ven" VU2KV was on the air and his first contact was ON4BX, the day before we had a letter from Ven stating that he finally had permission for RTTY operation and had printed a number of stations but so far none from the states but to watch for him. Last night November 7th at 0150 we turned the beam north and there he was calling a CQ with a fairly good signal. After a short contact the band faded and we failed to find what stations he had worked but there had been several in the states before us. We have written Ven asking the best times for stateside contacts and his frequencies etc. If they arrive in time John will have the dope in next months column. We also offered to distribute his QSL cards so further information may be available on that. This is a new one and a rare one so watch for him. "Dusty.")

* * *

CATS Booth at Electronics Show



Dick Cox, K9PGN, at 32ASR keyboard in the Ham RTTY booth during National Electronics Conference Show, International Amphitheater, Chicago, October 24-26th. Exhibit was co-op shared by C.A.R.C.C., Cats and Hallicrafters with representative operating personnel and equipment. Brag tape reads model 28 ASR and 32ASR with a SR 2000 transceiver.

* * *

CRYSTAL CONTROLLED RTTY

continued from page 7

Oklahoma City, Oklahoma 73102

17. USING MORE THAN JUST ONE FREQUENCY

It is easily possible to use the same oscillator for several different crystals. My own 6EA8 oscillator has 6 different crystals on it for various frequencies and shifts. However, each crystal needs its own trimmer for setting the shift and its own trimmer for setting the frequency. I used a 6 position 4 pole switch, with the 4th pole automatically switching in a fixed resistor to give pleasing narrow shift c.w. identification automatically.

W7AHW/4 and others have made three separate oscillators. This latter system is probably the best overall approach if you need 850 shift.

18. ADDING THE OSCILLATOR TO THE TRANSMITTER

Most c.w. transmitters have an accessory input for an external VFO. This is where the RTTY crystal oscillator plugs in. These transmitters also usually offer 6.3 volts for the filament, cut-off grid bias for keying the oscillator on and off, and B-plds that is switched on and off when you go to the external VFO position. This latter voltage is sometimes as high as 300 volts, which is way too much for best operation of the crystal. In this case, you should either include a VR-150 and its resistor on the external oscillator chassis, or better yet, install it on the transmitter itself where that voltage-dropping resistor can dissipate its heat without affecting the crystal oscillator.

19. WHY NOT MODIFY THE TRANSMITTER'S OWN CRYSTAL OSCILLATOR?

These were usually designed for use of FT-243 military (pressure type) crystals. They put too much current through the crystal circuit for the "plated" type crystals to operate at their best stability. Also, this type oscillator usually has a powerful tube whose capacitance does not adapt at all well for RTTY purposes. Then too, there is quite a bit of heat generated in the chassis when the transmitter is in operation, and finally it becomes quite inconvenient to use more than one crystal on such an arrangement, if desired. If this hasn't convinced you to just build the external oscillator and plug it in, then think of the resale value after you are done cutting holes. You may never want to sell it anyway, but that would about clinch its chances! When all is said and done, the external oscillator usually does a better job anyway.

20. SETTING THE FREQUENCY AND THE SHIFT

In the schematic, a 1.5-7 trimmer is shown for setting the shift and a similar 1.5-7 trimmer is shown for setting the frequency.

On 80M, 850 shift, you may actually need around 60-70 pf. for the shift and perhaps almost nothing for the frequency setting. On 20M, it will about be reversed--you might need 5-10 pf. to set the shift and 20-30 pf. to set the frequency. Thus the values of those two capacitors change rather radically as you go from 850 to 170 shift or from a lower band to a higher one. Consequently, just the 1.5-7 pf. values are shown. To get the right shift/frequency combination, you will no boubt need to pad the trimmers with parallel capacitors (no-drift types mentioned previously). By keeping the trimmers in the 1.5-7 pf. range they will act as a nice "vernier" for finalizing the proper capacitance easily. After all, only a tiny fraction of one pf. is ample to pull the frequency over 100 Hz. on 20M, for example. So just plan on getting a few extra capacitors in the 10-22-47 pf. size (examples) to use for padding to the final shift and or frequency. This is much better than buying a larger trimmer capacitor.

21. YOU'LL LIKE CRYSTAL CONTROL

Nearly any old c.w. type transmitter will give exceptional results on RTTY when crystal controlled. The DX-60A seems to be the most popular such transmitter at present, probably because it is modest cost and ideally suited to drive most linear amplifiers to higher power. Several Viking II are being used, and other c.w. transmitters could be equally successful. At any rate, crystal controlled RTTY is an ideal means to get on the air quickly, easily and for relatively low cost.

22. USING TRANSISTORS

We were going to include a transistor circuit, but perhaps that is better left for another time. It is easier on the c.w. transmitters to use the tube version, due to the ready availability of filament and plate voltages. In any case you have to key the oscillator on and off from transmit to receive and in this case, the tube job is just too simple not to use it.

Continued on page 16

CLASSIFIED ADS

Rates - $1.00 30 words - Additional words 2¢ ea. Closing date 1st of month.

MODEL 15AA FOR SALE, table TD power supply $100.00 CV89A-RTTY converter $150. Boehme repeater new-$30.00. Joe Szabat, W3LST, 228 Plummer, Oil City, Pa. 16301.

FOR SALE - Two Tone Transistor Demodulator as described in cover article June RTTY JOURNAL 1967-glass-epoxy PC board, drilled, $8.00 postpaid with all instructions for building and adjusting. Cashion Electronics, P.O. Box 7307, Phoenix, Ariz. 85011.

TYPEWRITER RIBBON REINKER, Hand operated model now only $3.00. K575 or K764 ink available at all National Cash Register Co. stores at 75¢ per tube. Walter Nettles W7ARS-8355 Tanque Verde Rd. Tucson, Ariz. 85715.

Wanted RTTY Inc. Bulletins back issues to 1960. Please state price. E. Epp VE4SX 261 Hawthrone Ave. Winnipeg 16, Man. Canada.

TT63A REGENERATIVE REPEATER complete with tubes, cable, instructions and schematic - like new $20. each. RTTY Dual frequencyshift tone converter, Northern Radio type 152, each tone converter is self contained with power supply, conversion details and schematic included, used good condition $20.00 each. Model 14 TD with synchronous motor - used - good - $25.00 each. Squelch Adaptor Mofification kit used on Hammarlund radio receivers, SP600 kit includes adaptor unit, name plate, knob, skirt assembly, tubes and cable clamps, new $7.00 each. We buy and sell parts. Write us. . .Atlantic Surplus, 250 Columbia St., Brooklyn, N.Y. 11231

FOR SALE - Model 15, excellent condition. Synch motor, copyholder, inker, friction feed, manual, 60 WPM. Prefer pickup. Tom Lamb K8ERV 1066 Larchwood Rd. Mansfield Ohio.

SELL: NORTHERN RADIO Company type 105 model 4A frequency shift exciter. Operates between 1.75 and 4.5 Mc. on three switchable crystal controlled frequencies. Front panel controls calibrated for 0-1000 cps shift and frequency trimming of 600 cps. Uses thermostat controlled oven for all frequency sensitive circuits and has a 2E26 output tube. TRADE; Have a Markll 28 keyboard and want Mark III keyboard. Also have a Collins ART13 and some audio equipment to sell or trade. WA2YJD, Gerry Block, 35 Amherst Rd, Great Neck, New York, 11021 Phone: 516-487-2435.

WANTED; CAST IRON BASE and motor mount with or without keyboard for model 15 printer. Will buy a complete junk 15 if necessary. WA8MJL, 405 Huffman St. St. Marys, Ohio. 45885.

SELL- PAGE PRINTER PAPER, 3 ply, $7.50. case. Model 14 TD, sync motor, excellent condition $25.00. DXD test set, $160.00. WB2PLY, Box 207, Princeton Jct. N.J. o8550

WANTED: TELETYPE EQUIPMENT & parts; R388, R-390A, SP600, 51J-4, Cash or trade for new radio equipment. Alltronics-Howard Co. Box 19, Boston, Mass. 02101. Tel - (617-742-0048)

RTTY GEAR FOR SALE. List issued monthly. 88 or 44 mhy toroids-5 for $1.50 postpaid. Elliott Buchanan and Associates, Inc. 1067 Mandan Blvd. Oakland, Cal. 94610.

WANTED - Teletype Parts for all machines. Models 14, 15, 19, and 28 etc. Must be new in Teletype Corp. pack or military with 5815FSC ....Phil, K2HJC, Box 96, Morrisonville, New York 12962.

BUY - 28 TYPING units, etc., and all parts. Sell 14s 15s 28KSR. (28ASR) parts. W4NYF, 405 NW 30th Ter., Ft. Lauderdale, Fla. 33311. phone 305-583-1340 after 9.

TOROIDS, 88mhy. center-tapped, unused, unpotted, 5/$1.50 POSTPAID. New lot of paper; ONLY. . .$3.50/case, buy two for $6. and save. . Ameco CN-144W with power supply, $35. Gears for all speeds and machines. . .WRITE. Hallicrafters HA-8 Splatter guard, modulation indicator, $8.50 Globe chief 90A, $38. MAINLINER TT/L TU, complete, operating $75. Heath TC-2, tube checker $15. Viking tape deck #75 with preamp $45. Typewriter: Royal, 20" carriage, with touch control and table, perfect $35. Northern 104: $25. Polar relay $3. Socket $1. Handles for 15 etc: $1.50 Tee Dee for parts, no head $5. Dumont 324 scope $30. Stamp for list. WANTED: NC-300, rotator, audio oscillator, mono AM tuner, lo-pass filter; Gonset two meter communicator. Van W2DLT 302R Passaic, Stirling, N.J. 07980

FOR SALE - TYPING REPERFORATOR model LPR 10ARC for 28ASR. Teletype Service manual for typing reperf and tape printer sets. $175.00 K8MZS, Charles Rex, 2225 Mt. Vernon Blvd. N.W., Canton, Ohio. 44709. Phone 216-492-6230.

TRADE; NEW WHEATSTONE PERFORATOR; Davco DR30 Receiver; RCA SSB-30M commercial mobile transceiver; Mite TT-299 Midget Teleprinter; National 200 Transceiver with power. Roy Brougher, W4RRU, 3743 Wesley Dr. Montgomery, Ala. 36111.

PRINTED CIRCUIT BOARD, TT/L2 with schematic, pictorial, voltage chart and construction tips: $6.00; Precision Tuning Fork 400 hz. with electronics less 2-6AU6, small pwr. supply, modify to 425hz: $5.00; standard 44 or 88 mhy. toroids, unpotted: 5/$2.00 pp. USA; special larger, low resistance 88mhy. toroids, 1.5": 50¢ each; all items above postpaid in USA. K5BQA, 11040 Creekmere, Dallas, Texas, 75218.

LARGE TT/L-2 Drawings - 15 x 30, $1.00 postpaid W8SDZ,1418 Genesee, Royal Oak, Mich. 48073. Phone 313-585-4431

SPECIAL SALE - Teletype Model 14TD. New; $25.00, Good Used $14.00, Specify 65 or 75 wpm. FOB Detroit. Keith Petersen, W8SDZ, 1418 Genesee Ave., Royal Oak, Mich., 48073

END POLAR RELAY TROUBLES; Western Electric #314 sealed, mercury wetted-contact units are direct plug in replacements for #255A. Noise suppression model available. $4.75 postpaid with diagram. Also will swap 28KSR or 35 ASR cabinet for #35 KSR cabinet or major parts. G. White, 5716 N. Kings Highway, Alexandria, Virginia, 22303.

28 ASR COVERS (LPBC) excellent with cradle, glass, copyholders, lites, transformer, complete $27.00. 15 platen cranks $1.30. Wanted Gas Chain Saw. J. Thomsen W9YVP, 8280 S. Tennessee Ave. Clarendon Hills, Ill. 60514.