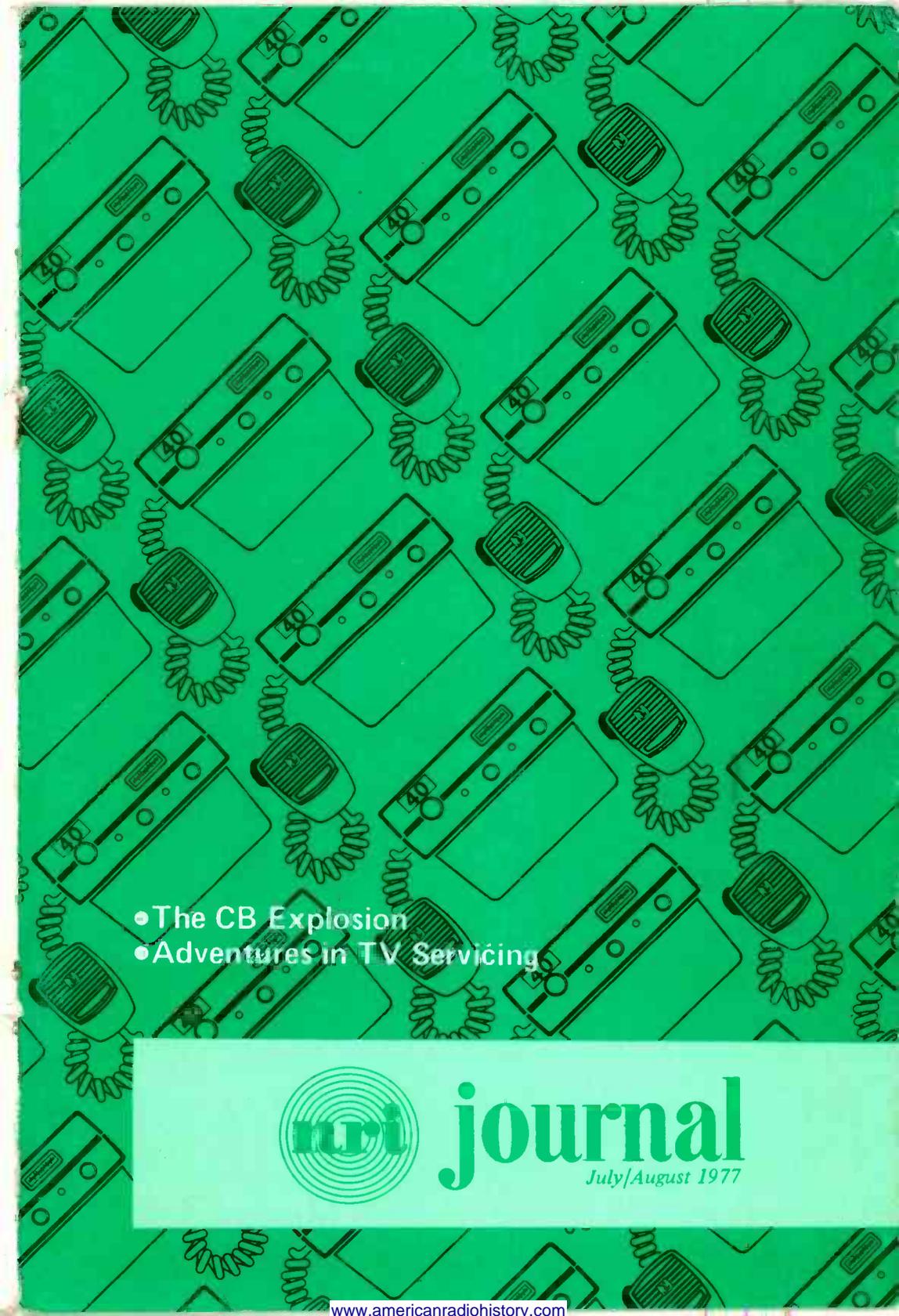


- 
- The CB Explosion
 - Adventures in TV Servicing



journal

July/August 1977

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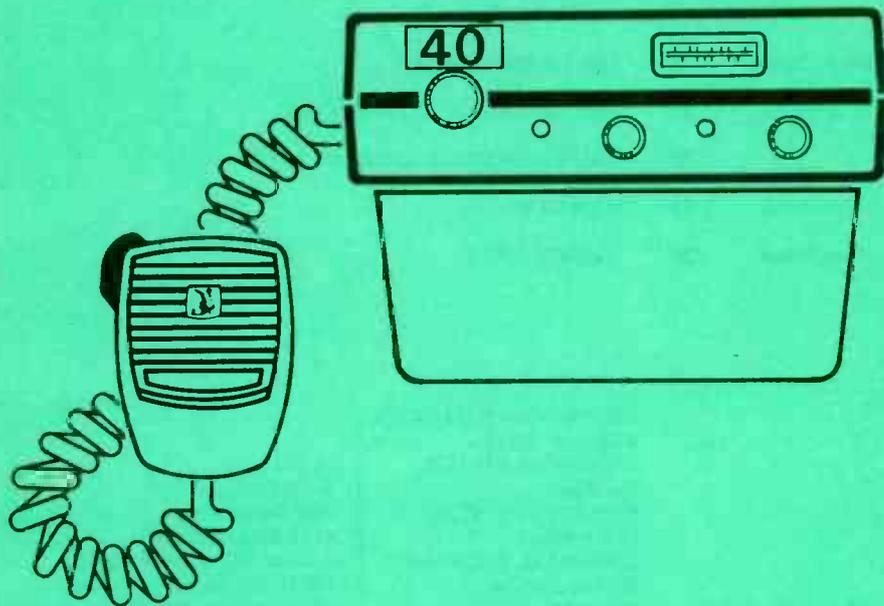
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In this issue, while fourth of July fireworks are exploding everywhere, *Journal* Editor and Publisher Bill Dunn touches off a story about another explosion happening everywhere – the CB radio explosion. In addition, *Journal* mainstay J. B. Straughn sets off a few more of his adventures as a TV service technician.

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THE CB EXPLOSION



by
William F. Dunn

In the late 1950's, the FCC authorized 23 channels in the frequency range of 26.965 MHz to 27.255 MHz for Class D Citizens Band operation. The technical requirements placed on the transmitting equipment were kept to a minimum so that relatively low-cost equipment could be made available to the general public. The frequency tolerance that must be maintained by the transmitter is 0.005 percent. The power input to the final amplifier is limited to 5 watts. The purpose of the band is to provide business people and others with the opportunity of setting up a relatively low-cost communications system.

No technical requirements are placed on applicants for a CB License. All you have to do is apply for the license — no tests or examinations are given.

Growth in the Class D Citizens Band was relatively slow for a number of years. New licenses were granted every year, but it wasn't until the oil embargo and the imposition of the 55 mile speed limit on the highways that the CB service really began to grow. Truckers, who felt they could not observe the 55 mile speed limit and still operate profitably, immediately began installing CB radios in their trucks. Almost overnight, practically every truck on the interstate highways had CB equipment. Truckers used the equipment to warn each other of the location of speed traps. This was far from the original intention of the FCC in authorizing the CB service.

The truckers soon found out that having a CB transceiver in the truck served much more useful purposes than avoiding speed traps. When the truck broke down on an isolated stretch of highway, the driver could almost always contact another trucker who could send help. The truckers were able to assist stranded motorists by summoning help. They could also summon rescue equipment when it was needed.

After the truckers, the general public

became aware of the usefulness of CB's and the advantages of having a CB transceiver in the car. As more and more people began installing CB equipment, they began advising each other of traffic conditions during rush hour in major metropolitan areas. They were able to advise police and emergency vehicles of accidents so that help could be dispatched promptly. CB became useful in obtaining directions for lost motorists. The number of licenses issued by the FCC began increasing at a faster and still faster rate until the FCC office issuing the licenses was deluged with license applications. In January of 1977 alone, over a million CB licenses were issued.

The interest in CB has now reached such a point that most of the automobile manufacturers will offer a CB transceiver as a built-in option in new cars. As more and more people become aware of the usefulness of CB, it is likely that the number of CB transceivers in use will continue to grow at an almost unbelievable rate. In fact, each license usually means at least two transceivers, but as many as 15 may be operated without any special authorization. Thus, the million licenses issued in January of 1977 could result in as many as 15 million new stations on the air.

EARLY CB TRANSCEIVERS

The first CB transceivers used vacuum tubes. They were designed to operate on only five or six channels. The number of channels was limited because the frequency tolerance is such that a crystal oscillator had to be used to be sure the transmitter would be on frequency. Thus, one crystal was used when transmitting on a given channel and another was used to generate a signal 455 kHz below the frequency of that channel to mix with the incoming signal to produce a 455 kHz i-f.

For example, if the transmitter was to be operated on Channel 1, the crystal that could generate a 26.965 MHz signal was selected in the transmit position and one that could generate a 26.510 MHz signal was used in the receive position. With a frequency tolerance of 0.005 percent, the transmitter operating frequency must be within 1.35 kHz of 26.965 MHz. Many transceivers were sold without crystals. The owner then selected the crystals required to operate on the desired channels. Twenty-three channel transceivers were not available because this would require 46 crystals. Not only would it be expensive to buy 46 crystals, but in addition to the transceiver using vacuum tubes, it was already large enough with the crystal needed to operate on 5 or 6 channels and would have to be made just that much larger to accommodate 46 crystals.

23 CHANNEL TRANSCEIVERS

It was only natural that the transistor should replace the vacuum tube in CB transceivers. Transistors are very small, so the unit could be made more compact. The transistor consumes far less power than the vacuum tube and hence is admirably suited to mobile installations. The transistor is also more rugged, another factor that makes it more suitable than the vacuum tube for a mobile installation.

However, simply substituting transistors for vacuum tubes would not make it practical to build 23 channel transceivers using 23 crystals to transmit and another 23 crystals to receive. Twenty-three channel receivers were made practical by the development of the frequency synthesizer. A frequency synthesizer is a circuit which produces a sizable number of frequencies, each having the stability and accuracy that would normally be obtained only by using indivi-

dual crystal oscillators. The frequency synthesizer used in the 23 channel Johnson Messenger 123A Transceiver is shown in Fig.1.

Figure 1 has been simplified. We do not show the oscillator circuits, the mixer, or the filter, but the important details of the synthesizer are shown. Notice that two oscillators are used — one a high oscillator that can be operated on any one of six frequencies, the other, called the low oscillator, can be operated on any one of eight frequencies. Signals from the high oscillator and low oscillator are fed to the mixer where they are mixed to produce the desired signals. Since the two oscillators are crystal controlled, the resulting output signal from the mixer will have the stability and accuracy of a crystal oscillator.

To see how the crystal frequency synthesizer works, let's see what happens when the transceiver is tuned to Channel 1. The operating frequency of Channel 1 is 26.965 MHz. This is the frequency on which we want the transmitter to transmit. To receive a signal on Channel 1, the oscillator must operate on a frequency 455 kHz below the channel frequency to produce a 455 kHz i-f. Thus, the output from the mixer must be 26.510 MHz in the receive position.

In Fig.1, the switches are shown in the Channel 1 position. Notice that the high oscillator is operating at 32.700 MHz because the crystal Y9 is connected in the circuit. In the transmit position, the low oscillator will operate on 5.735 MHz because Y1 will be connected into the circuit. These two signals are fed to the mixer and the resulting difference frequency will be 26.965 MHz, which is the transmit frequency on Channel 1.

In the receive position, Y9 remains in the circuit so that the high oscillator continues to operate on 32.700 MHz. Meanwhile, Y5, which operates on 6.190, is connected into the circuit for the low oscillator. These two signals are fed to the

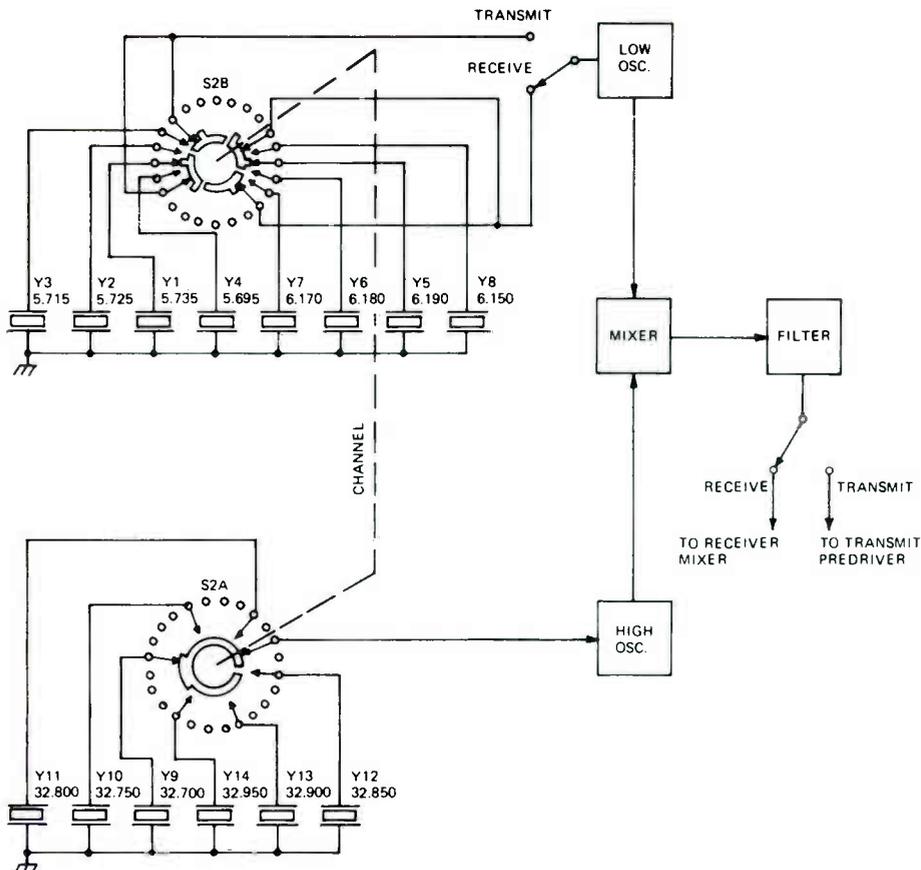


FIGURE 1. A MULTIPLE CRYSTAL FREQUENCY SYNTHESIZER USED IN THE JOHNSON MESSENGER 123A.

mixer where they mix and produce a resulting difference frequency of 26.510 MHz which is the frequency required to mix with the incoming Channel 1 signal to produce a 455 kHz i-f.

Channel 2 is 10 kHz above Channel 1. Let's see how the frequency synthesizer develops the frequencies necessary for Channel 2. To go from Channel 1 to Channel 2, switch S2 is rotated one position in a clockwise direction. When this happens, crystal Y9, which operates at 32.700 MHz, will still be connected into the high oscillator circuit. However, switch S2B will not connect Y2 (which operates on a frequency of 5.725 MHz)

into the circuit in the transmit position, and Y6 (which operates on a frequency of 6.180 MHz) into the circuit in the receiver position.

In the transmit position, with Y9 operating on 32.700 MHz and Y2 on 5.725 MHz, the signals beat in the mixer to produce a frequency of 26.975 MHz, which is the correct frequency for transmitting on Channel 2. In the receive position, with Y9 producing 32.700 MHz signal and Y6 a 6.180 MHz signal, the difference signal produced in the mixer is 26.520 MHz, which is 455 kHz below the channel frequency so the correct i-f signal will be produced in the receiver position.

CHANNEL	FREQUENCY (MHz)
1	26.965
2	26.975
3	26.985
4	27.005
5	27.015
6	27.025
7	27.035
8	27.055
9	27.065
10	27.075
11	27.085
12	27.105
13	27.115
14	27.125
15	27.135
16	27.155
17	27.165
18	27.175
19	27.185
20	27.205
21	27.215
22	27.205
23	27.255

FIGURE 2. FREQUENCIES ASSIGNED THE ORIGINAL 23 CHANNELS.

Figure 2 shows the frequencies assigned to channels 1 through 23. Notice that Channel 3 is 26.985 MHz. To transmit on this channel, Y9 is still in the circuit in the high oscillator and Y3 is in the circuit in the low oscillator. The frequency difference between these two crystals is 26.985 MHz, which is the required frequency. Notice that Channel 4, however, is not 10 kHz above Channel 3 but rather 20 kHz. On this channel, Y9, operating on a frequency of 32.700 MHz is still in the circuit. However, now Y4 is switched into the circuit on the transmit position and this crystal operates on a frequency of 5.695 MHz giving the required difference frequency of 27.005 MHz.

When you switch to Channel 5, Y9 is switched out of the circuit and Y10, operating on a frequency of 32.750 MHz, is switched into the high oscillator circuit. At the same time, Y1, which was used on Channel 1, is switched into the circuit in the low oscillator. This crystal operates on a frequency of 5.735 MHz and the difference between the high oscillator and the low oscillator is now 27.015 MHz which is the transmit frequency on Channel 5. In the receive position, Y10 is used in the high oscillator once again and Y5, which operates on a frequency of 6.190 MHz, is switched into the low oscillator to produce a frequency of 26.560 MHz at the output of the mixer, which is 455 kHz below the transmit frequency.

Notice that Y9 is used in the high oscillator to cover the first four channels. It is used in conjunction with crystals Y1, Y2, Y3, and Y4 in the low oscillator to transmit, and with crystals Y5, Y6, Y7, and Y8 to receive. Also look at Fig.2, and you will see that the transmit frequency for Channel 1 is 26.965 MHz. Channel 2 is 10 kHz higher (26.975 MHz), Channel 3 is 10 kHz higher (26.985 MHz), and Channel 4 is 20 kHz higher (27.005 MHz). Thus, Channel 5 is 50 kHz above Channel 1 which is the reason why the crystal Y10 operates at 32.750 MHz in the high oscillator. It is then used again with crystals Y1, Y2, Y3, and Y4 in the low oscillator to produce the required transmit frequencies and with crystals Y5, Y6, Y7, and Y8 to produce the receive frequencies for the receiver mixer.

Since there are six crystals in the high oscillator, you might think that each would be capable of producing four transmit frequencies. In fact, this is true. However if you look down on the last three channels, you see that the transmit frequency on Channel 21 is 21.275 MHz and Channel 22 is 10 kHz higher, (27.225 MHz). However, Channel 23 is 30 kHz higher (27.255 MHz). Thus, to transmit

on the last three channels. Y14 (which operates on 32.950 MHz), is used in the high oscillator and Y1 is used in the low oscillator on Channel 21. Y2 is used on Channel 22 and Y4 is used on Channel 23. The switch is arranged so that Y3 is not used in the last three channels.

40 CHANNEL TRANSCEIVERS

Effective January 1, 1977, the FCC expanded the Class D Citizens Band from 23 channels to 40 channels. Channels 24 and 25 filled the gap between Channels 22 and 23 as shown in the assignments listed in Fig.3. The remaining channels are spaced 10 kHz apart starting with Channel 26 which is 10 kHz above the old Channel 23. Thus, we have the operating frequencies of Channels 24 and 25 below the frequency of Channel 23.

A crystal synthesizer, such as shown in Fig.1, could be used to cover the 40

channels. Notice that the original 23 channels were arranged so that the last channel in a group of 3 (in the case of channels 21, 22, and 23) was always 50 kHz above the first channel in the group. In the newer channels, the spacing is 10 kHz between each channel. To make up for this change, we need two additional low oscillator crystals, one operating on 5.705 MHz for transmitting and one operating on 6.160 MHz for the receive position. We would also need four additional oscillator crystals for the high oscillator. In other words, we would have to add six crystals. Therefore, instead of needing 14 crystals we would need 20 crystals. This is an improvement on using a separate crystal for each channel on transmit and receive, which could require 80 crystals, but there is still a better solution. That is to use what is called a digital frequency synthesizer.

The oscillator in the digital frequency synthesizer is a voltage controlled oscillator (VCO). A VCO is an oscillator that can be made to operate on the exact frequency by the control voltage fed to it. The output of the VCO is fed through what is called a programmable divider. The programmable divider simply divides the output frequency of the VCO to a frequency that can be compared with an accurately controlled reference frequency. The two signals are fed into a phase detector which detects any difference in frequency or phase between the two signals.

If the VCO is off frequency, the phase detector will develop a dc voltage which will be fed to the VCO to correct the error and keep the VCO operating exactly on the correct frequency. This is the arrangement used in modern 40 channel CB transceivers. It reduces the required number of crystals to a minimum and at the same time provides the accuracy and stability obtained from crystal oscillators. The Johnson Model 4140 40 channel CB transceiver used in the new NRI CB

CHANNEL	FREQUENCY (MHz)
24	27.235
25	27.245
26	27.265
27	27.275
28	27.285
29	27.295
30	27.305
31	27.315
32	27.325
33	27.335
34	27.345
35	27.355
36	27.365
37	27.375
38	27.385
39	27.395
40	27.405

FIGURE 3. FREQUENCIES ASSIGNED CHANNELS 24 THROUGH 40.

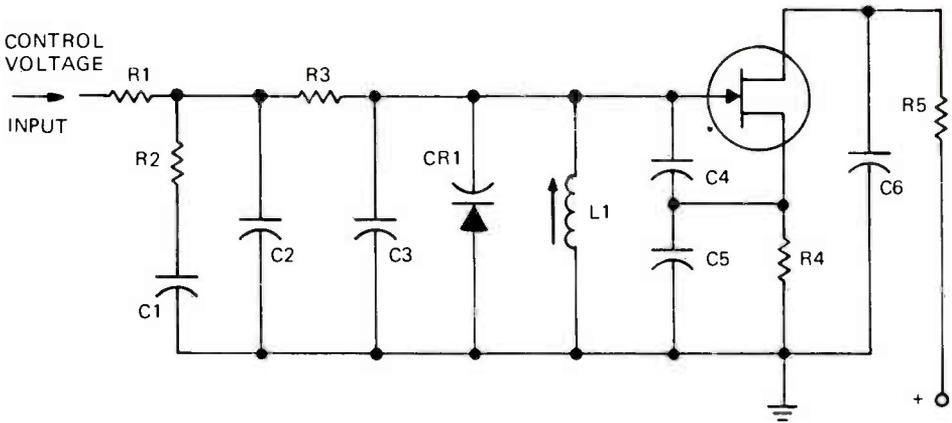


FIGURE 4. SCHEMATIC DIAGRAM OF THE VCO.

course uses a frequency synthesizer with three crystals. We are going to discuss briefly how it works.

Before going into detail on how the 40 channel frequency synthesizer works let's look into the VCO circuit shown in Fig.4. First, the VCO is a voltage controlled oscillator. This is simply an oscillator with a varactor diode (CR1 in Fig.4) in the frequency controlling circuit. A varactor diode is a diode manufactured to take advantage of the fact that changes in the voltage across the junction of the diode change the capacity of the diode.

Varactor diodes are normally operated under a reverse bias condition. Increasing the reverse bias reduces the capacity of the diode and reducing the reverse bias increases the capacity of the diode. Thus, if the frequency is too low when a varactor diode is used in an oscillator circuit, increasing the negative or reverse bias across the junction will reduce the capacity of the diode and cause the frequency to increase. Conversely, if the frequency is too high, reducing the bias will cause the capacity of the diode to increase which, in turn, will reduce the frequency of the oscillator.

In the circuit shown in Fig.4, C3, the series connected capacitors, C4 and C5,

and the varactor diode, CR1, are all in parallel with L1 and determine the frequency at which the oscillator operates. The control voltage fed through the filter network R1, R2-C1, and R3 is used to vary the capacity of CR1 and thus the oscillator frequency.

Block diagrams of the frequency synthesizer used in the Johnson Model 4140 CB transceiver are shown in Fig.5 and Fig.6. Figure 5 shows the synthesizer set up to transmit on Channel 1 and Fig.6 shows how it is set up to receive on Channel 1.

Before going into detailed explanation of how the frequency synthesizer works, let's first discuss the digital synthesizer. This circuit is all contained in a 16 pin, integrated circuit. The circuitry in the digital synthesizer includes an oscillator, two divider networks, and a phase detector.

First, notice the 5.120 MHz crystal that is used in both the transmitting and receiving positions. The actual oscillator circuit is inside of the digital synthesizer. The signal from the 5.120 MHz oscillator is fed to Q102, the offset mixer. It is also fed to a divider circuit inside the digital synthesizer. A divider circuit is simply a circuit used to divide the input frequency

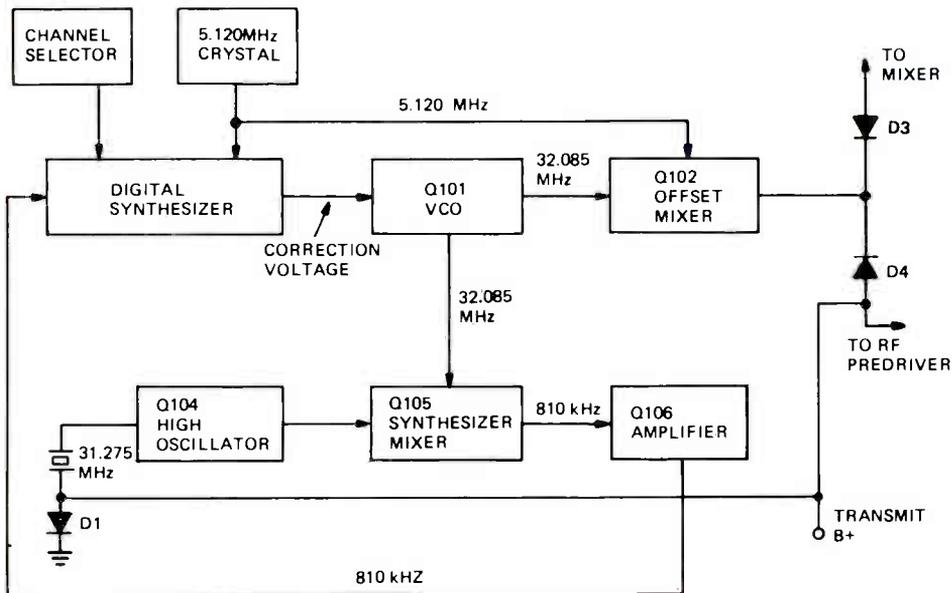


FIGURE 5. THE FREQUENCY SYNTHESIZER IN THE CHANNEL 1 TRANSMIT POSITION.

by some multiple. In the case of this divider circuit, it divides by 512 so that at the output of the divider circuit, we have a 10 kHz signal. This 10 kHz signal is fed to a phase detector. It is the reference frequency that is used to keep the frequency synthesizer operating on the correct frequency in both the transmit and receive positions.

Now let's look at Fig. 5. This shows the transceiver in the transmit position. In this position, the transmit B+ is fed to the diode connected in series with the 31.275 MHz crystal and turns this diode on so that the crystal is connected into the high oscillator circuit. At the same time, the transmit B+ places a forward bias on D4 so that this diode will conduct and any signals coming from the offset mixer will be fed on to the rf predriver.

In the Channel 1 position, the VCO operates at a frequency of 32.085 MHz. This signal is fed into Q102, the offset mixer, along with the 5.120 MHz signal. In the mixer, the signals mix producing a

difference frequency of 26.965 MHz. This is the transmitting frequency required for Channel 1. This is fed through D4 to the first stage in the rf amplifier which is called the rf predriver.

At the same time, the 32.085 MHz signal from the VCO is fed to Q105, the synthesizer mixer. Also, we have a 31.275 MHz signal from Q104, the high oscillator. These two signals are mixed in the synthesizer mixer producing a difference frequency of 810 kHz.

This 810 kHz signal is amplified by Q106, and then fed to a programmable divider built inside of the digital synthesizer. The programmable divider is simply a divider that can be programmed to divide by the required multiple. In this case, the channel selector programs the programmable divider to divide by 81. The resulting output signal is a 10 kHz signal which is fed to the phase detector where it is compared with the 10 kHz signal obtained from the output of the divide-by-512 divider. If there is any

difference in frequency or phase, the correction voltage fed to Q101, the VCO, changes to bring the VCO to the correct operating frequency of 32.085 MHz:

In the receive position, shown in Fig. 6, the 5.120 MHz crystal oscillator signal is again fed to the divide-by-512 divider so that we have a 10 kHz reference signal which is fed to the phase detector. Meanwhile, the VCO operates on a frequency of 31.630 MHz. This signal is fed into Q102, the offset mixer, along with the 5.120 MHz signal producing a difference frequency of 26.510 MHz. Notice that this is 455 kHz below the transmit frequency. Thus, a Channel 1 signal being received will mix with this signal to produce a 455 kHz i-f. Notice that in the receive position, the diode D3 is forward biased so the signal from the offset mixer can pass through it to the receiver mixer.

In the receive position, diode D2 is forward biased so that the 30.820 MHz crystal is switched into the high oscillator

circuit. This 30.820 MHz signal is fed to Q105, the synthesizer mixer, along with the 31.630 MHz signal from the VCO. Here the two mix and a difference frequency of 810 kHz, the same difference frequency that was produced in the transmit position, is produced and fed to Q106. Q106 amplifies the signal which is fed to the programmable divider, which is set up to divide by 81 so that the output is a 10 kHz signal. This signal is again fed to the phase detector where it is compared in frequency and phase with the 10 kHz reference signal. If there is any difference between the two, a correction voltage is fed to Q101 to adjust the frequency of the VCO to bring it to the correct operating frequency of 31.630 MHz.

When the transmitter is switched from Channel 1 to Channel 2, the output frequency of the VCO increases to 32.095 MHz in the transmit position. This signal is mixed with the 5.120 MHz signal in the offset mixer producing the

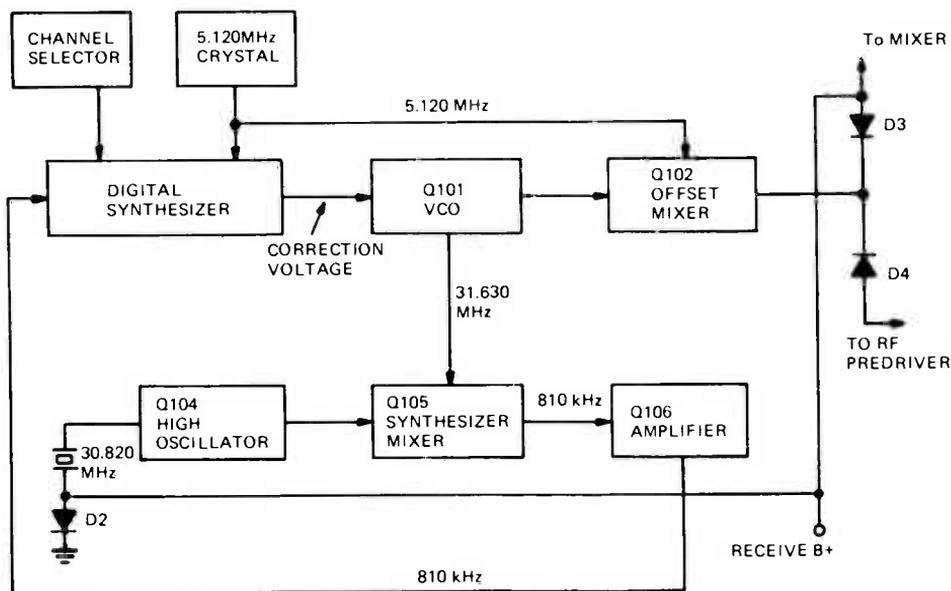


FIGURE 6. THE FREQUENCY SYNTHESIZER IN THE CHANNEL 1 RECEIVE POSITION.

required transmit frequency of 26.975 MHz. At the same time, the 32.095 MHz signal is fed to the synthesizer mixer where it is mixed with the 31.275 MHz signal from the high oscillator producing a difference frequency of 820 kHz. This signal is amplified and fed back to the programmable divider which has now been switched by the channel selector to divide by 82 so that the output once again is a 10 kHz signal which can be fed to the phase detector and compared with the 10 kHz reference signal.

In the receive position on Channel 2, the output of the VCO switches to 31.640 MHz. This signal is fed to the offset mixer and mixed with the 5.120 MHz signal to produce a difference frequency of 26.520 MHz. Notice that this signal is once again 455 kHz below the transmit frequency. At the same time, the 31.640 MHz signal is fed to the synthesizer mixer where it is mixed with the 30.820 MHz signal from the high oscillator producing a difference frequency of 820 kHz. This signal is amplified and once again fed to the programmable divider where it is divided again by 82 to produce a 10 kHz signal.

As you switch from channel to channel, the VCO frequency is changed and the programmable divider is changed. The VCO is switched to provide the correct frequency to mix with the 5.120 MHz signal to produce the desired frequencies in the transmit and receive positions. The programmable divider is switched so that it always divides by the correct number so that the output is a 10 kHz signal which is fed to the phase detector. For example, when you go up to Channel 40, the correct operating frequency is 27.405 MHz. To operate on this frequency in the transmit position, the VCO operates on 32.525 MHz. The signal is mixed with the 5.120 MHz signal in the offset mixer to produce the correct transmitting frequency of 27.405 MHz. At the same time, the 32.525 MHz signal

is fed to the synthesizer mixer where it mixes with the 31.275 MHz signal to produce a difference frequency of 1250 kHz. The 1250 kHz signal is amplified and fed to the programmable divider which divides by 125 and produces a 10 kHz signal that is fed to the phase detector.

In the receive position, the VCO operates on 32.070 MHz, which is mixed with the 5.120 MHz signal in the offset mixer to produce a 26.950 MHz signal that is 455 kHz below the transmit frequency. At the same time, the 32.070 MHz signal is fed to the synthesizer mixer where it mixes with the 30.820 MHz signal from the high oscillator to produce a 1250 kHz signal in the output. This signal is again divided by 125 in the programmable divider to produce the 10 kHz output signal.

This article is meant to be only a brief look into the world of CB radio. However, it shouldn't take too much imagination for the alert individual to see the opportunities in CB servicing. With the number of licenses increasing at such a fantastic rate and with each license usually resulting in two or more transceivers, it has already become a problem to get a CB transceiver serviced.

However, the transmitter portion of the CB transceiver can be serviced only by individuals holding a Second Class or higher Radiotelephone License from the Federal Communications Commission. Persons servicing a transmitter without the required license are running the risk of a fine or imprisonment or both.

NRI has been offering a CB Specialist Course for some time. This course is designed to teach you how to repair CB transceivers and also to get your FCC Radiotelephone License. If you would like to receive information about this course, simply contact NRI. They will be most happy to send you information to get you started in CB servicing *now*.

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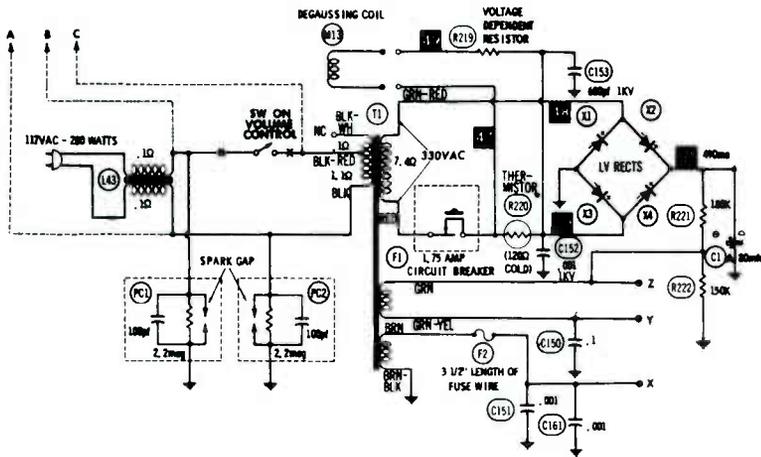
*by
J.B. Straughn*

RCA CTC 25

When I first saw this set, the color was all messed up – purple at the bottom of the picture and green at the top. I diagnosed this as magnetization of the picture tube. When the set was degaussed, good color was restored and I returned the set to the customer.

Three days later, the customer called with a complaint that the trouble was

back. I degaussed the tube again and noted that more hum than normal was present in the sound. When I got home I pulled out the schematic and looked at the degaussing circuit, shown in Fig.1. I decided that there must be something wrong with the degaussing coil, resistor R220, or the voltage dependent resistor, R219. I bought a pair of these resistors, which come in a package, are fairly universal, and are usually inexpensive.



Courtesy Howard W. Sams

FIGURE 1. THE LOW VOLTAGE POWER SUPPLY AND DEGAUSSING CIRCUITRY OF RCA CTC 25.

When I got back to the set I found that the resistors were at the rear of the chassis where they could easily be worked on. First, I unplugged the degaussing coil and checked it for continuity. It checked out fine. Then I clipped one lead of each resistor for an ohmmeter check. I found nothing wrong. However, you can't really check a voltage sensitive resistor with an ohmmeter and find out anything of value. I figured that as long as I had already cut two leads I might as well cut the two remaining leads and tack the new parts to the leads extending up through the circuit board.

When I grabbed R220, which was still connected to the circuit board by one lead, I could turn it 360 degrees! This meant that the connection on the other side of the board was unsoldered. I decided this had to be the original cause of the trouble. I pulled the remaining lead of R220 out of the board and tinned the lead of the new part that was to go into this hole. I hoped to be able to heat the lead enough so that a soldered connection on the other side of the board would be made. I got the lead through the hole and held the soldering iron on the lead above

the board to get the solder melted at the connection point. Then it was only a matter of soldering the remaining leads to the stubs coming up through the board.

I degaussed the set again and told the customer I would call her next week to see if the cure worked. It didn't. She said that the first time the set was turned on the trouble returned. I decided that my under-the-board connection had not held up, so I went back with the necessary tools and removed the chassis. I shortened the leads of both resistors and properly soldered them on the foil side of the board. This turned out to be a permanent cure. What had happened was that with R220, open current flowed at all times through the degaussing coil and this magnetized the picture tube. After all that, I charged \$25 and lost a little money on my time. You can't win them all!

CLOVIS MODEL 122-1004

This set came in with the explanation that it had been dropped. I could hear a tube or something rattling around in the cabinet. I almost decided that I wouldn't

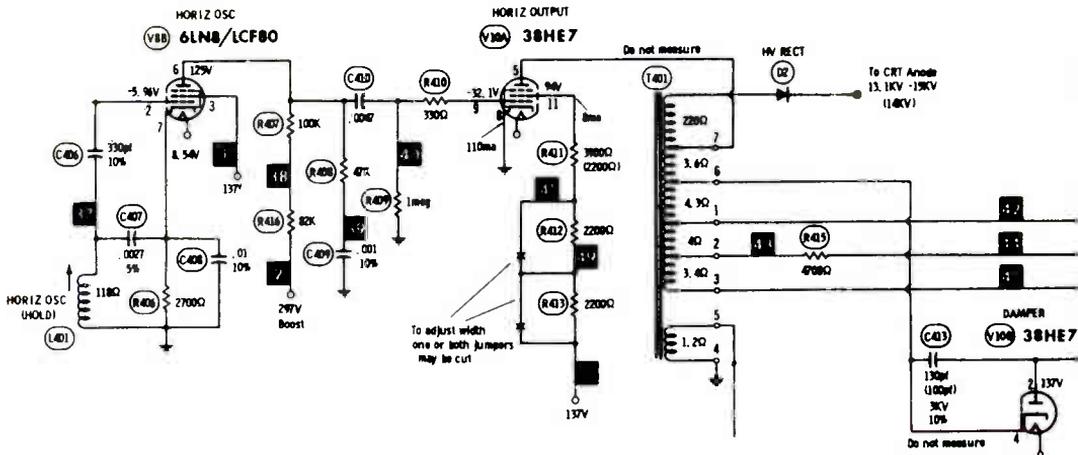


FIGURE 2. THE HORIZONTAL OUTPUT CIRCUIT OF CLOVIS MODEL 122-1004.

work on it after I got the back off. I couldn't figure out where the loose tube belonged or what the number of the missing tube was, to say nothing of the vertical hold control that was broken off! There was no map pasted inside the cabinet or on its bottom showing the numbers or locations of the tubes. Who ever heard of a set named Clovis? I soon found out that Sams Photofact had, and the diagram was in Sams' set No. 1130, a fairly recent model.

I bought a \$4 manual, a 1 megohm vertical hold control, and the missing tube (which was an 11BM8). The printed circuit board was sticking part way out of the cabinet and I had visions of its being cracked. However, it was okay and I managed to work it back into place. I installed the new vertical hold control and put the tubes in their correct sockets, and to my surprise, got both picture and sound. The picture was weak, but a new 3GK5 in the tuner fixed that. However, my troubles had just begun. Across the face of the picture tube there were broad vertical bars, like those you would get with a color bar generator connected to a black-and-white set. The trouble had to

be centered around the horizontal circuit, or so I thought. See Fig. 2.

I vaguely remember something of the sort when I was involved in the design of a 19" black-and-white set for inclusion in an NRI course. The trouble was due to a capacitor somewhere in the horizontal but that must have been 20 years ago. I had another vague idea of calling up Ted Beach, as we worked together on that old set, but I decided that my memory was probably as good as his. Besides, he is up to his ears in ham stuff these days.

I tried changing the screen voltage on the 38HE7 by cutting the shorting wires across the two series screen resistors — mainly because it was easy to do. This didn't help and I couldn't see where this changed either the width or the brightness so I left the wires open, giving somewhat less screen voltage. Next, since it was staring me in the face, I decided the capacitor across one half of the horizontal yoke winding might be open. I shunted it with another, with no effect on the vertical bars.

Then I thought there might be something wrong with the wave shaping network consisting of the series 47k-ohm

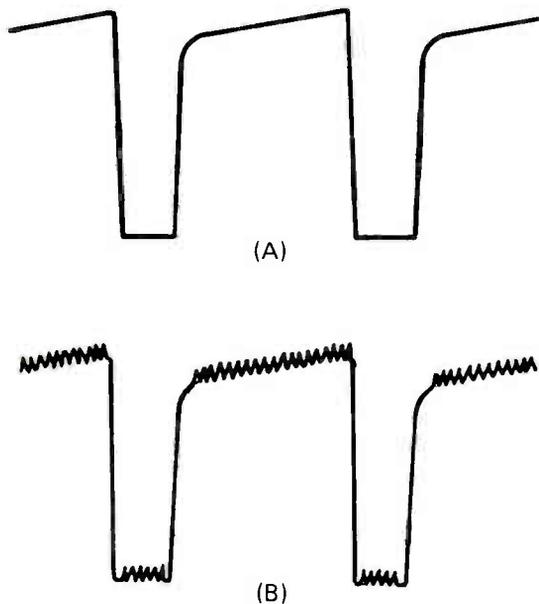


FIGURE 3. (A) THE NORMAL PATTERN. (B) THE PATTERN MY SCOPE SHOWED.

resistor and 0.001 μf capacitor between the 6LN8 plate and ground. I rigged up a similar arrangement and tried it from the control grid of the 38HE7 to ground, with no effect. I figured it might be a good idea to look at the input wave shape at the 38HE7 grid with my scope. The results are shown in Fig.3. This didn't give me any ideas, as I was now confident that the ringing was taking place in the 38HE7 plate circuit and was being fed back to the grid. I was just about ready to say the heck with it. The bars didn't show up much with a strong signal and I thought maybe I could get away with leaving it alone. However, considering the size of the bill I now had in mind I kept on.

There were three more capacitors buried away in the front of the circuit board, which for some reason (laziness I think) I didn't want to remove. I found that with the set turned upside down enough of the circuit board was exposed to show socket pin contacts 2 and 4 of the 38HE7 tube across which a 130 pf

capacitor was connected. Here was a chance to test something. I found a 160 pf 6 kV capacitor and tried touching its leads to pins 2 and 4 of the tube while looking at the raster. After several attempts, I got my hands and head in sync and made a connection. To my delight, the vertical bars had vanished! I shortened the leads of the test capacitor and tacked them with solder to pins 2 and 4 of the tube socket on the bottom of the circuit board. The set worked just fine. I don't think the original capacitor was open, but I didn't dig into the set to remove it. I have learned through hard experience to sometimes let well enough alone and this was one mystery I was content to live with.

I might add that the additional capacitor had no visible effect on raster size or on the picture tube anode voltage. I added rabbit ears and a uhf loop antenna to the set and made a charge of \$32.50. I hope the customer will pick up his set soon, as I have eight others repaired and waiting to go.

RCA COLOR PORTABLE CTC 51XAB CTC 52.....

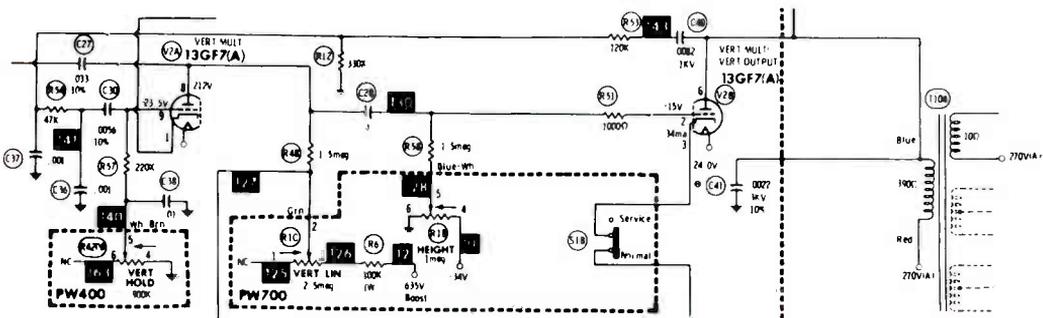
This set has been in the shop for over a year and is being sold for \$125 — a low, but fair price. When this set first came in it was dead, and had a blown 5 amp fuse and a defective circuit breaker. With these parts replaced, a sizzling sound could be heard and bits of fire were visible on the circuit board. Investigation revealed that the ceiling of the room where the set was placed had been painted, and no drop cloth had been put over the set. Splattered paint had come through the louvers in the cabinet and settled here and there on the horizontally mounted circuit board.

This board had printed circuitry on both sides with the copper circuits covered with a thin laquer. This laquer, when combined with the conductive paint, could not withstand the normal voltages between different circuits — hence the breakdowns with sparking and holes burnt in the board. I spent considerable time in cutting out the charred portions of the board and, where necessary, replacing the damaged copper circuits with hookup wire. Each time I thought I had things fixed and the set playing nicely, sputtering and fire would break out someplace else on the board! I

told the customer that I would have to order a new board from RCA and that it would take about three months, as RCA was on strike. The repair bill was going to be \$67, to which the customer agreed.

The first board I got was wrong and I sent it back for another. When the right board came in I had to shell out \$46! How could I make a profit? I couldn't get out of the deal, as the board was not returnable. Looking the chassis over I could see that the replacement job would be difficult and time-consuming. I tried the set out one more time and to my great surprise, the set did not break down again. After a week of letting the set play while I was around, I decided that no more arcing would occur. I put the new board aside, though, just in case.

Another trouble, which had been present all along, now made itself apparent. When the set was first turned on, the picture would roll and was hard to control with the vertical adjustment. After it warmed up for about a half hour, the rolling stopped; however, the adjustment of any of the vertical controls was touchy, particularly the sync control. The tendency to roll was made worse if the brightness control was adjusted. I knew that the vertical output tube would sometimes cause this unless it was thoroughly hot so I tried another 13GF7. See Fig.4. I also resoldered all the ground-to-chassis



Courtesy Howard W. Sams

FIGURE 4. THE VERTICAL MULTIVIBRATOR AND OUTPUT CIRCUIT OF RCA CTC 51XAB/CTC 52.

RCA COLOR PORTABLE

Didn't get the model number on this set, but this is of no importance, as you will see. I happened to meet a doctor I know and he immediately tried for some free consultation. (I do the same thing to him.) It seemed that his little girl pushed his portable back on its stand and gave it quite a bump. Since then, the color had been all out of whack.

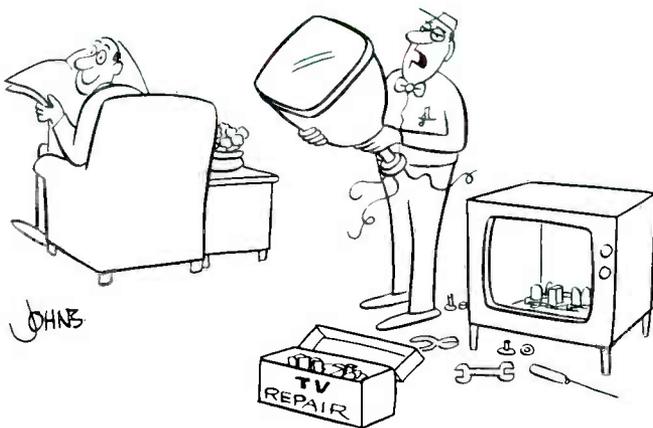
I told him I would look it over for him and loaded up what I thought I would need in the way of tools, including my color bar-cross hatch generator. I had visions of the convergence needing major readjustment. When I got there, I found that the color was indeed a mess and I thought that degaussing might even be in order. Of course, I hadn't brought my degaussing coil.

This time I was lucky. I took the back off the set and while it was still face down on the carpet, I noticed that the wing nuts holding the yoke in its plastic case were too far to the rear — near the socket end of the picture tube. The nuts were quite loose so I just pushed the yoke

up as far as it would go and tightened the wing nuts to hold the yoke in its proper position. When I turned the set on, I found that the color was fine, as attested by Doc's wife.

For those who don't know, the yoke must be movable so purity can be adjusted. This is done by killing the blue and green guns and pulling the yoke as far back as it will go. Then the rings (corresponding to the centering rings in a black-and-white set) are adjusted so that the red fire ball is in the center of the raster. Then the yoke is moved forward so that the entire screen is red with no other color contamination. The wing nuts are then tightened to hold the yoke in place. With the red gun turned off, the blue and green guns are checked individually for color purity.

I debated what a ten-minute service call was worth. After much thought, I charged \$25 for my time. I don't want to make house calls any more than a doctor does, so I figured that this was quite reasonable. If I could work all day at that rate, I could soon buy that farm tractor I have my eye on.



" I FOUND YOUR TROUBLE — IT WAS JUST ONE OF YOUR TUBES "

NRI HONORS PROGRAM AWARDS

For outstanding grades throughout their NRI courses of study, the following March and April graduates were given Certificates of Distinction with their NRI Electronics Diplomas.

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Lee Cronk, Harlem, MT
Johnny Eng, Oakland, CA
Roger W. Hinds, Paxton, IL
Walter Robinson, Franklin, MA
George Viktorson, Redmond, WA
Lenny E. Vitko, Mineral Point, PA
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Stephen Garner, Calgary, AB, Canada
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Howard R. Hatmaker, Morristown, TN
Richard P. Hayes, Mt Airy, MD
Gerald W. Heck, Middletown, MD
Jeffrey G. Henault, Webster, MA
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Lawrence W. Holtgreffe, Cincinnati, OH
Donald L. Huber, Temple, TX
Oliver J. Hunt, Dequincy, LA
Ralph E. Hyde, Warsaw, IN
George Kubota, Culver City, CA
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J. Lamborn, Newark, DE
Robert C. Loman, Bethesda, MD
Marvin H. Luke, Dover, DE
Allan J. MacLean, Jr., Florence, NS, Canada
Frank W. Maile, Jacksonville, AR
Richard A. McCluskey, Lake Charles, LA
Joseph J. McGinley, Philadelphia, PA
Ronald McLoughlan, Churchill Falls, NS, Canada
Michael J. Mountain, Shubenacadie, NS, Canada
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Terence J. Petras, Brockport, NY
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Desmond H. St. Denis, FPO Seattle
Harold P. Tatom, Shreveport, LA
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Ronald Tripp, Allegan, MI
Richard T. Vodvarka, Pleasant Hills, PA
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Jung W. Woo, Arlington, VA

John C. Young, Memphis, TN
Randy L. Young, Washington, GA

WITH HONORS

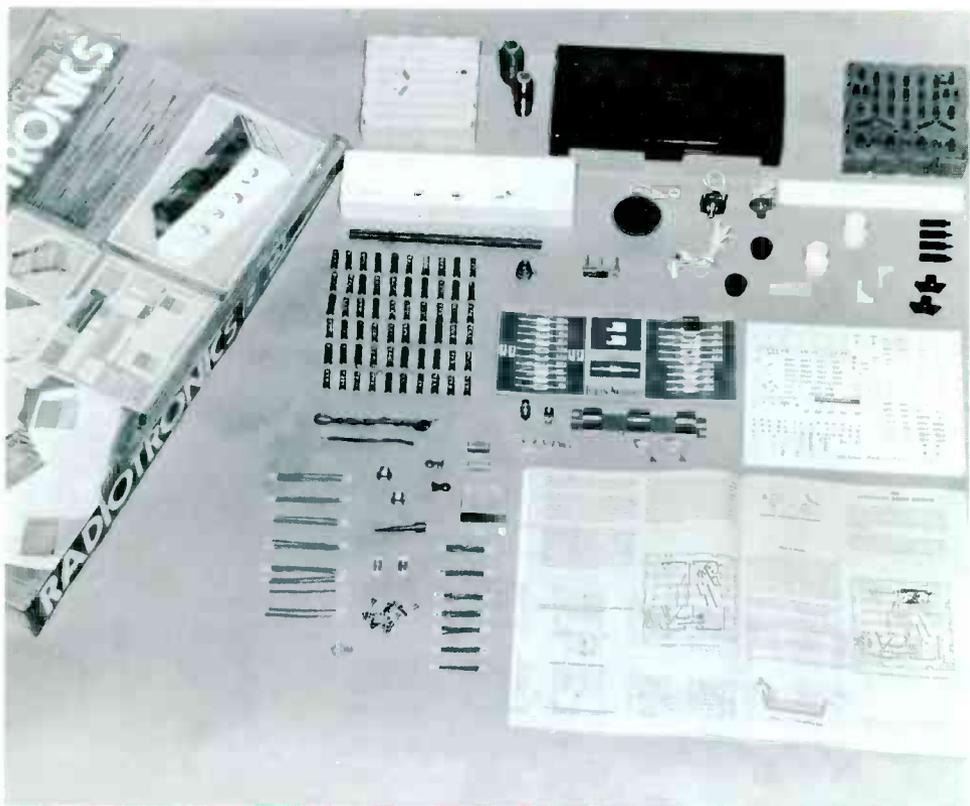
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Henry V. Albaro, Gardena, CA
Ethel Allison, Hurst, TX
Terry L. Baker, Bedford, IN
Gene F. Bauer, Rapid City, SD
Bob Bays, Jasper, MO
Lucien E. Belisle, Winooski, VT
Kirk H. Benish, Page, AZ
L. W. Blackledge, Alpena, MI
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HAM NEWS



By **Ted Beach** **K4MKX**

One of the biggest problems in trying to service a home study course in Amateur Radio is the constant change of the FCC Rules and Regulations. It seems that just about every time you turn around there are new rules or there are rules that have been changed “slightly” to make some of the material in the related lesson texts obsolete. We try to catch as many of these changes as possible when the lessons are reprinted. However, there is always the uncertainty of how many people have been on the receiving end of some “misinformation” in our texts (which was *not* misinformation when we printed it).

This can be a real problem — one not found in our theory and other technically oriented texts. After all, who is going to change Ohm’s law after all these years? Anyway, at the rate that the FCC is coming out with proposed rules changes, it is quite likely that we will have many more obsolete lesson texts out in the field before the FCC decides to issue a new version (revised edition) of the new single booklet Part 97 offering, dated March 24,

1976. They have *not* distributed updating transmittal sheets as they did in the past when Part 97 was incorporated in Volume VI of their Rules and Regulations.

In an attempt to keep some sort of timeliness in our course material, we will be publishing a list of changes that have been made by the FCC to Part 97 in the *NRI Journal*. This first offering will be a bit sketchy as I have not personally seen the exact wording of the rules changes (in some cases), and since I do not always know exactly which section of Part 97 is directly involved since the rule changes could be attributed to more than one section.

At any rate, we will continue to publish the list of changes which have become effective since the March 24, 1976 edition of Part 97. Hopefully by the next *Journal* there will have been another edition of Part 97 printed (as it’s supposed to be annually!) and we will be able to give the exact wording and cite the correct affected section(s) of Part 97. In the meantime, here’s the first list:

RULE CHANGE	DATE EFFECTIVE
1 Conditional Class License eliminated. Novice power limit upped to 250 W.	6/25/76
2 Technicians given Novice privileges.	7/23/76
3 No new distinctive Novice call signs, although Novices may sign "/N."	10/1/76
4 No requirement to sign "portable" or "mobile" except foreign operators using reciprocal licenses.	11/26/76
5 First "comprehensive" cw exam given in Washington D.C. office. No solid copy for one minute requirement.	1/1/77
6 Court case "temporarily" suspends all license fees.	1/1/77
7 New "interim" licenses issued upon upgrade of license class at an FCC office.	3/1/77
8 Secondary station licenses eliminated.	3/3/77
9 97.95(a)(2) deleted. No notification of new address required.	3/9/77
10 New emission purity standards. All spurious emissions down 30 db for transmitters operating below 30 MHz, down 60 db for transmitters of 25 watts or more operating between 30 MHz and 235 MHz. (97.73)	4/15/77

In future editions of the *Journal*, we will set these changes in table form, cite all affected sections, and try to give the exact wording of the new rules.

On the computer front, it looks like I just might get the teletype operation going sooner than expected. I have had a couple of offers for used machines that I am looking into, and as soon as I can get my hands on one that is working, I think I should have the system up and running. I did a sort of about-face on this project a while ago. Originally I had thought to use the TTY only as a printer for the computer, using my home brew ASCII keyboard for data input. However, after I did a little investigating into the "software UART" the KIM-1 has resident in its operating system, I decided that it would be no trick at all to use the keyboard of the TTY as well. The only real problem is

that of remembering to use the proper shift (LETTERS or FIGURES) for the different characters. This is a problem that any TTY operator faces, and should prove to be good mental discipline for my addled brain. The computer has no trouble whatsoever keeping track of such trivial details.

The secret to the whole process is to pretend that the computer is reading and writing ASCII instead of BAUDOT. ASCII is eight bits long (seven data bits and a parity bit) whereas the BAUDOT character is five bits long. Both have a START bit and one or more STOP bits. Well, for BAUDOT, we send the START bit, five data bits, and then *five* STOP bits, to make the character just as long as the ASCII character. Simple, eh? The only problem with this is that the already slow printer will be even slower, since we

have added all those unnecessary STOP bits to fool the computer into thinking it is sending and receiving ASCII. That's okay – the price is right!

The system is programmed such that the computer keeps track of the LETTERS and FIGURES received, and converts the BAUDOT characters into equivalent ASCII characters by means of a Table lookup. In addition, the computer recognizes the BAUDOT Null character as meaning that the next character received from the TTY is to be converted to an ASCII CONTROL character. This condition will continue until a SPACE character is received. This gives us a chance to decode the 32 BAUDOT characters into 96 ASCII characters, since the Null is in effect a third “shift” character to the computer. Sneaky.

The same Table lookup is used by the computer to send out BAUDOT characters. However it is used in an “indexing” mode rather than a “lookup” mode. When an ASCII character is to be sent out, the computer searches through the Table in an indexing manner until it finds the character. The index register then

contains the BAUDOT equivalent of the ASCII character which is then dumped out to the TTY. Control characters are ignored.

All in all, the required program is fairly short (less than 256 bytes, including the Table). So far, I have tested most of the subroutines in the program. Of course, the acid test comes when the actual interface to the TTY is made. Hopefully this will happen in a week or so. Wish me luck!

Now, let's see who we have heard from since last time. As usual, those listed first in the Rogue's Gallery are those students and graduates of the Amateur Courses. Those at the end of the list are students and graduates of other NRI courses.

Virginia, WA4QWC, who has written us before from Winchester, Virginia is justifiably proud of her new General License. She is a graduate of our Amateur Course, and has been quite active in recruiting new people to the amateur ranks. This she does by cajoling and nagging the wives of members of her radio club, saying that if she can do it, anyone can! I'll bet that's not true, Virginia. You

Bill	WA4MDU	G*	Birmingham AL
Virginia	WA4QWC	G*	Winchester VA
Allen	WB4UTP	G*	Jacksonville Beach FL
Roy	WD5BGX	T	Austin TX
John	WB9RPV	G*	Des Plaines IL
Douglas	VE6CJP	–	Redcliff AB Canada
Albert	WA1YYO	G*	Torrington CT
Al	WA2MNJ	G*	Princeton Jct. NJ
Steve	WD4EWA	T	Shalimar FL
Ulysses	WD5CCM	N	Franklin LA
Joe	K5DQT	–	La Marque TX
Roy	WB5ZAU	N	Shawnee OK
Dick	W6BKY	–	Palo Alto CA
Larry	WB6VZU	N	El Monte CA
Sandy	WD8EGH	T	Elyria OH
Chuck	WB8VWJ	G	Mansfield OH

* Just upgraded – congratulations!

surely don't nag people.

Now that John, WB9RPV, has his new General ticket, he says that he hopes to have time to complete his course! John is spending quite a bit of time using his FT101E and Icom 22 these days. That's what it's all about, John, but we do hope you finish the course!

VE6CJP writes that he has not seen any VE's listed in about a year and just wanted to let us know that he had gotten his first Amateur License in April. Fine business, Douglas, and I'm very sure that it won't take you too much more time to get the higher license class.

Look at all those upgrades this time. I can't recall when I have seen quite so many in such a short list of people. Must be an epidemic!

Albert, WA1YYO, is another of those upgrades. He went from Novice (August, 1976) to General (April, 1977) and attributes his knowledge of electronics to his NRI course. Albert is currently using a National NCX3 and a dipole on 80 meters. He is planning to string up some more antennas for other bands.

I talked to Al, WA2MNJ, on the phone the other day and he told me quite a fantastic tale of his entry into the amateur ranks. Al got his Novice License in the middle of April of this year, took his Technician exam and passed it in the last week of April, and took and passed the General exam on May 18. That's a fast rise, and now that the Interim Licenses are available, there's no waiting at all. Al is looking forward to getting on two meters just as soon as he completes the rig from the new Communications Course he is taking.

When I first began writing about my efforts with microcomputers, I wondered just how much interest there would be for amateurs in this field. Well, I'm pleased to say that no fewer than four of the people who wrote in this time share my interest in this field. Actually, this is not too surprising, since the foremost

computer magazine, *BYTE*, was started by publisher Wayne Green who also is the guiding light at *73* magazine. *73* also continues to have a section entitled I/O that is dedicated to microprocessor information. I guess that there is some sort of natural affinity between the two fields. They sort of go together for many people.

At any rate, Steve, WD4EUA, is one of the ones who wrote saying that he had an interest in microcomputers, although his experiences so far have been a bit frustrating. He tried to load a program into a KIM computer using a teletype only to have the machine die halfway through the process. The ASR33 teletype is notorious for requiring constant maintenance, and his sure needed some adjusting as it began to input garbage instead of data. Better luck next time, Steve, and I'll be looking forward to seeing you when you're in Washington.

WD5CCM is a graduate of our Color Television course and just got his license in March of this year. Ulysses says that he is a young 55 years of age and really enjoys using his HW16 on the ham bands.

K5DQT built the antenna tuning unit described in the Ham News some time ago and discovered something I knew all along. As it was described, the unit will only take about 200 watts of rf. 900 watts causes things to arc and melt a bit. Anyway, Joe did a little research and came up with another design which he is presently using that can easily handle a full kilowatt and works very well throughout the hf band. If anyone would be interested in this redesign, we'll print a schematic and parts list here in the *Journal*.

Roy, WB5ZAU, writes that having just gotten his Novice License, he is now working hard to upgrade to General. At the present time, Roy is using a DX35 (elderly!) on 40 meters.

Sandy, WD8EGH, wrote us a nice long letter telling of her trials and tribulations pursuing her Amateur License. Sandy is a

student of the Mobile Communications Course, and thought it would be neat to “upgrade” from CB to amateur radio, even though she couldn’t talk her husband into joining her. Now, after getting her Novice and Technician tickets, Sandy tells all her friends how nice amateur radio is compared to CB, and if

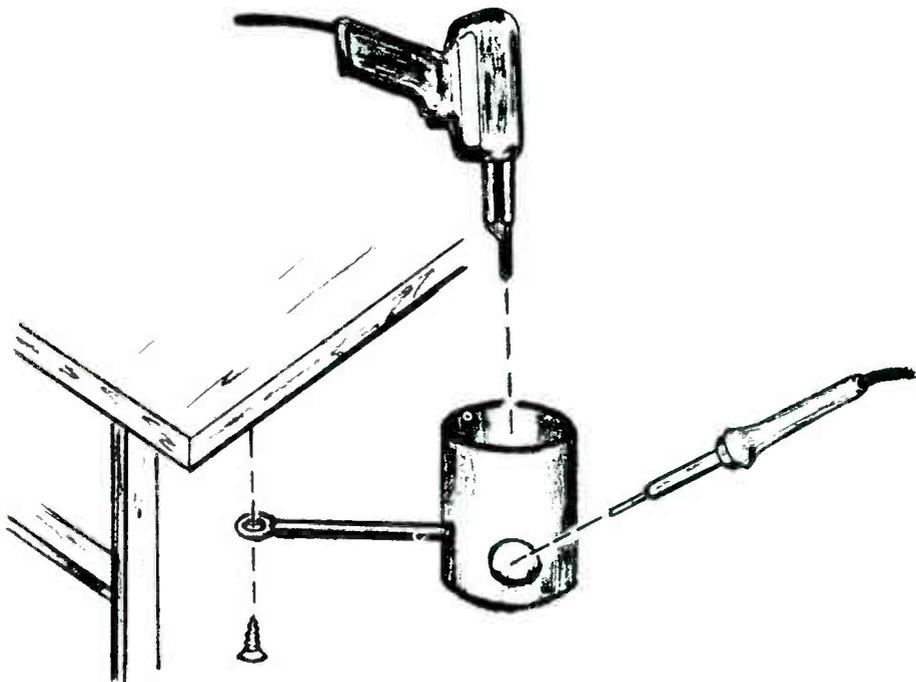
she can do it, by golly they can too! Fine business, Sandy, and perhaps one of these days you can persuade the OM to get a license too.

Well, that’s about it for this time, gang. Keep those cards and letters coming in – without them you have no column! Very 73, Ted – K4MKX

Helpful Hints 11

Holes in my pants and burns on my legs prompted this helpful hint. The soldering gun/iron holder shown below is easy to construct and convenient to use. And it will swivel out of the way when you don’t need it.

To Construct the Gun/Iron Holder, you need a piece of light-weight pipe or an old-fashioned tin can to form the cup; for the bracket, a metal rod with an eyelet on one end and threaded on the other so that you can screw two nuts on it. A bracket used to hold plant pots may be substituted for the metal rod. Mount the cup to the metal rod or bracket (with two nuts—one on either side) and attach it to your workbench with a lag bolt. Drill another hole for the soldering iron so that your iron will be slanted upward as it is in a soldering iron holder.



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SAN ANTONIO (ALAMO) CHAPTER meets at 7 p.m., fourth Thursday of each month, at the Alamo Heights Christian Church Scout House, 350 Primrose St., 6500 block of N. New Braunfels St. (three blocks north of Austin Hwy.), San Antonio. Chairman: Robert Bonge, 222 Amador Lane, San Antonio. All San Antonio area NRI students are always welcome. A free annual chapter membership will be given to all NRI graduates attending within three months of their graduation.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets at 8 p.m. on the last Wednesday of each month at the home of Chairman Daniel DeJesus, 12 Brookview St., Fairhaven, Mass. 02719.

SPRINGFIELD (MASS.) CHAPTER meets at 7:30 p.m. on the second Saturday of each month at the shop of Norman Charest, 74 Redfern Drive, Springfield, Mass. 01109. Telephone (413) 734-2609. Chairman: Preston Atwood.

TORONTO CHAPTER meets at McGraw-Hill CEC, 330 Progress Avenue, Scarborough, Ontario, Canada. Chairman: Branko Lebar. For information contact Stewart J. Kenmuir, (416) 293-1911.



FLINT/SAGINAW CHAPTER TO INSTALL ALARM SYSTEMS

At the March 30 meeting, Andy Jobbago gave a talk on his trip to Hawaii and how nice it was to get away from all the work at home and enjoy some of the paradise on the other side of the world. Next, the members had a great time setting up the color on three color sets, which provided an evening project that gave everyone a lot of experience.

At the April 13 meeting, Steve Avetta brought in his old tube tester, which came in very handy to test 227's and 45's from an old 1928 Majestic radio.

Dale Keyes brought in six TV receivers, four color and two black-and-white. The newer members were then allowed to dismantle these units as a training session.

The Chapter has made contact with the Mountain West Alarm Company so that we may extend our business ventures into installing burglar alarms.

We have a new member, Jack Heilborn of Saginaw, Michigan. Welcome to the Chapter, Jack, and we will give all the help we can to yourself and to other new members.

NRIAA OFFICERS

J.B. Straughn	President
Eldred M. Breese	Vice President
Branko Lebar	Vice President
Joseph A. Crusco	Vice President
Les Lederna	Vice President
Tom Nolan	Executive Secretary

Alumni News

DETROIT CHAPTER DISCUSSES PRICING POLICIES FOR SERVICE WORK

Don Hughes presented information concerning a flat-rate price-indexing system for TV and audio repair technicians similar to one that is used at his place of employment in Ontario. He showed how the system can promote greater fairness and confidence between the customer and the service technician if used properly.

Some of the members will attend an audio seminar later this month in Detroit and will report on this at the next meeting of the Chapter.

Charles Cope brought in a reel stereo tape recorder that reproduced distorted sound through only one of its two speakers. Karl Ceruti discovered that the tone and balance controls were far out of adjustment, and when properly adjusted the recorder functioned perfectly.

Everyone is enthusiastically enjoying the current hands-on project of analyzing and diagnosing different sections of TV receivers. The theory is discussed at the same time.

SPRINGFIELD CHAPTER PLANS SUMMER PICNIC

At the April 9 meeting, a Zenith color TV was brought in which tripped the circuit breaker whenever the set was turned on. A short was found in the degaussing coil and the set was repaired.

A discussion was held concerning the annual Chapter picnic which is traditionally held in June. Time and place were decided upon, and a good turnout is expected.

The next meeting will deal with color TV set alignment and we hope everyone will attend.

TORONTO CHAPTER PLANNING FALL MEETING

A September meeting is planned for the Toronto Chapter, and anyone wishing information about the current address and meeting time should contact Stewart Kenmuir at 330 Progress Avenue in Scarborough, Ontario M1P2Z5. The telephone number is (416) 293-1911.

Stewart is working for a good turnout at the fall meeting and would appreciate your informing members across Canada.

PITTSBURGH CHAPTER CHECKS OUT COMPUTER

Bill Fisher, a Chapter member and a professional computer operator, brought in a demonstration computer and analyzed its operation for our members. Bill provided an interesting demonstration of computer operation and displayed its versatility.

At the May meeting, a talk was given on radio-controlled model airplanes and seaplanes. The speakers were George McElwain, Phil Stagno, and Roy Weber.

They explained in detail how the radio-controlled airplanes operate and discussed their cost, capabilities, and problems associated with these rapidly proliferating models. On display were five different models together with their associated radio control equipment.

The Chapter is looking forward to the annual visit of National Secretary Tom Nolan early in the summer.

SAN ANTONIA CHAPTER ENTERTAINS TOM NOLAN

At the May 4 meeting of the San Antonio Chapter, NRIAA Secretary Tom

Nolan presented a talk on CB radios, including their operation and maintenance. The talk was well received by the Chapter.

The following evening, the Chapter hosted a barbeque dinner for Tom and his wife, Janet. This was a most enjoyable evening, as is always the case when one is entertained by the San Antonio Chapter.

NORTH JERSEY CHAPTER PROVIDES LECTURE ON ZENITH COLOR TV

Al Mould, a technician for the Zenith Corporation and Chairman of the North Jersey Chapter, gave a lecture-demonstration on how to set up the Zenith Model H1316W 13-inch color set.

At the April meeting, a discussion was held concerning ways to improve future meetings, and a number of activities were planned which would increase membership. Repairs were accomplished on GE and Panasonic sets brought in by the members.

Our National Secretary, Tom Nolan, will visit the Chapter early in the summer.

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 Home Phone _____ How long at this address? _____ () Own home () Rent
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 No. dependent children _____ Previous address _____ How long? _____

WHERE DO YOU WORK?

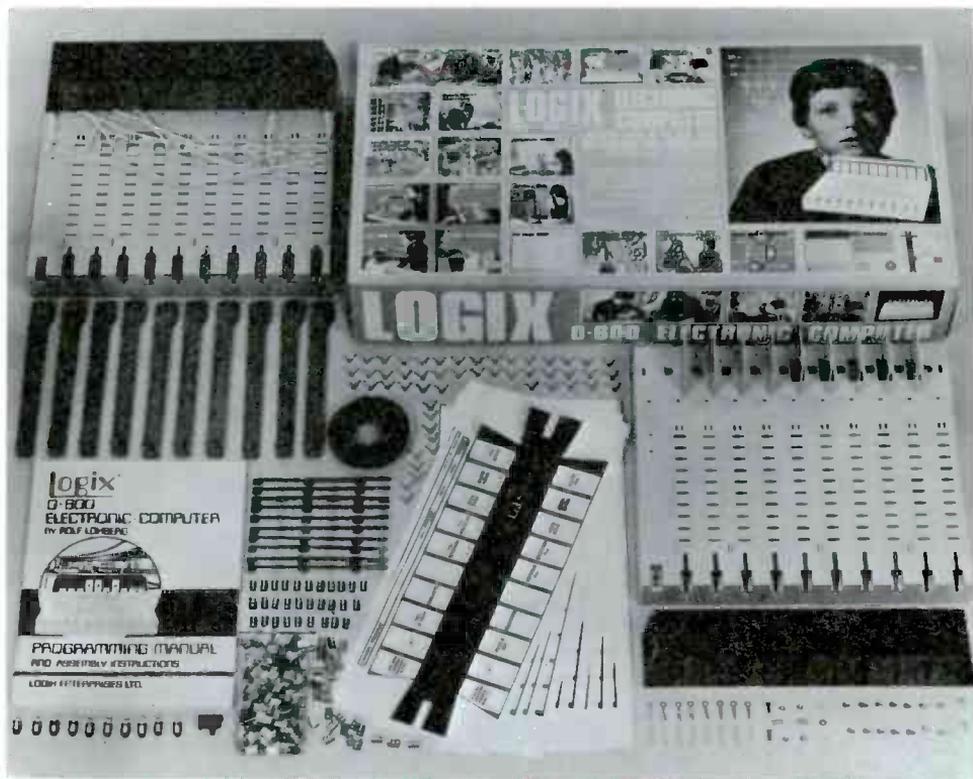
B ➔ Your employer _____ Monthly income \$ _____
 Employer's address _____
 How many years on present job? _____ Position _____
 Previous employer _____
 Wife's employer _____ Monthly income \$ _____

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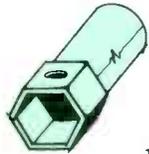
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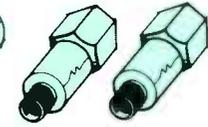
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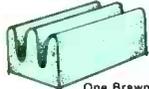
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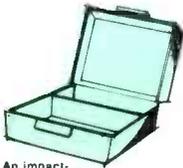
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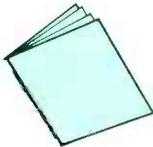
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