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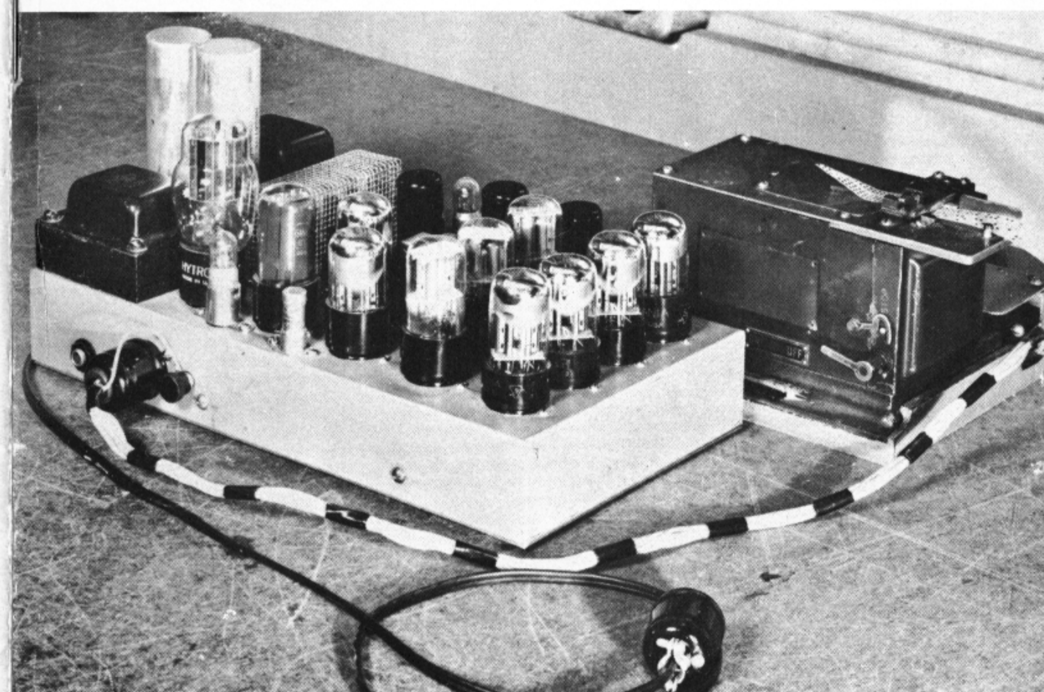

by

W6NRM - W8TCJ ELECTRONIC TAPE DISTRIBUTOR

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NEWS OF AMATEUR RTTY

JANUARY 1954
25 Cents
Vol. 2, No. 1

W6NRM-W9TCJ *Electronic Tape Distributor*

By ROBERT H. WEITBRECHT,* W6NRM - W9TCJ

INTRODUCTION:

Various electronic distributor designs have been proposed and constructed from time to time. As will be apparent, they merely are devices designed to accomplish the function, of, for example; a motor driven rotary switch. Such mechanical devices are found in the Model 12 transmitting and receiving distributors, segmented-disc tape distributors, and the like. They, for instance, give the function of translating a "parallel presentation" (all-at-once) of a certain combination of on-and-off voltages as set up by a keyboard manipulation into a "sequential form" (one-after-the-other on a certain time base) for transmission over a pair of wires or by radio to a receiving station. At the latter place, the situation is reversed by the receiving distributor whch receives the signal and sorts it out into the five basic bauds for subsequent "parallel" operation of a mechanical translation device to cause the imprint of a typewritten character.

The electronic distributor can be of several designs. One logical design consisting of a series of one-shot multivibrators was proposed by W2BFD[1] for a transmitting distributor. An adaptation of this system was tried out as a receiving distributor for a model 21-A printer by W6ZBV[2]. These circuits are of a general design in which each of the various signal portions (bauds) is generated by an independent timing device such as a one-shot multivibrator. As a consequence, there are at least seven separate timing adjustments, any or all of which may drift over a period of time, thus causing obvious trouble, unless very carefully designed.

A different system was constructed by W6IZJ, using a ring-counter scheme for use as a tape distributor[3] and also for a keyboard distributor.[4] In comparison with the series-of-one-shot-multivibrators design, having seven separate timing adjustments, the ring counter system is attractive because of its one overall adjustment—that of the driving oscillator frequency. Thereby with such a single-oscillator circuit, the teleprinter signal is properly generated, along with its start, five bauds, and stop signal portions exactly measured in time sequence.

THE FLIPFLOP-MATRIX SYSTEM

There is one other way by which the scanning function may be accomplished, yet using a single driving oscillator. Eccles-Jordan multivibrators, which are variously called "flipflops" or bistable multivibrators, can be employed to drive switching devices arranged in a certain pattern,[5] called a "matrix," so as to cause the desired sequential scanning function. The basic system is illustrated in Figure 1 which compares the circuit with a mechanical distributor switch. It will be noted that both systems each show eight input signal wires and an output signal wire. These particular systems are set up for eight input signals only to illustrate the scheme, inasmuch as the basic teleprinter signal requires at least 7.43 units per cycle and, furthermore, the number 8 is readily generated by three cascaded flipflops driving a matrix. ($2^3=8$, three flipuops). Actually any number of signal inputs can be scanned with the general arrangement shown, adding more flipflops and switching devices as required to get $2^n=$ the maximum number of inputs for **n** number of cascaded flipflops. For numbers not equalling exactly 2^n, an additional reset circuit can be used, if necessary, to restrict the scanning cycle to a certain number of signal inputs.

Such an eight-unit distributor was designed and constructed by the author for operation of a tape sending device. This was mentioned in a note[6] and was a first model, constructed to explore the possibilities of this circuit. It had a generating speed of 341 operations per minute instead of the 368 value, but otherwise performed as ir:ended. The reduction in speed is a consequence of

(Continued on page 4)

[1] John E. Williams, communication in 1951.

[2] Cecil Craft, "Electronic Distributor for 21-A Printer," **RTTY,** May 1953.

[3] Ed Phillips, "Electronic Distributor for Transmitting," **RTTY,** June 1953.

[4] Ed Phillips, "Keyboard Adapter for the Electronic Sending Distributor," **RTTY,** July 1953.

[5] Brown and Rochester, "Multiposition Switching," **Proceedings of the IRE,** Feb. 1949.

[6] W6NRM-W9TCJ, "Electronic Tape Distributor," **ARTS Bulletin**, No. 24, June 1953.

Also see picture of experimental model in January 1953 **CQ,** page 30.

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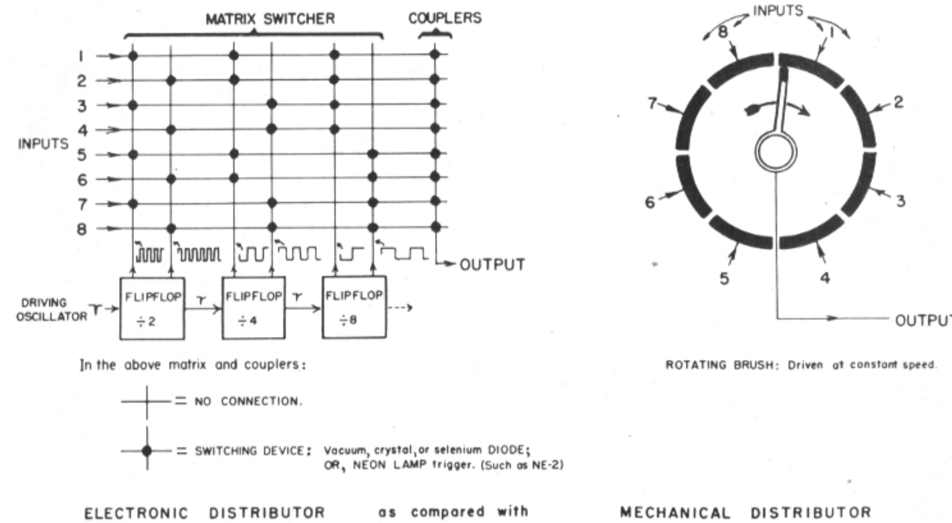
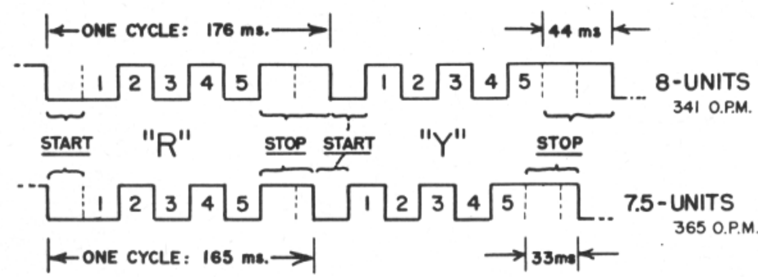


Fig. 1



EACH UNIT ("BAUD") IS 22 MILLISECONDS IN LENGTH.
THE "STOP" PULSE ONLY DIFFERS AS FOLLOWS:
2 UNITS LONG IN 8-UNITS, and
1.5 UNITS LONG IN 7.5-UNITS.
(1.43 UNITS LONG IN 7.43-UNITS.)←Standard Teletype dimension 368 O.P.M.

Fig. 2

(Continued from page 2)

extending the "stop-pulse" length to 44 milliseconds (two 22-ms units), as will be noted in signal diagram of Figure 2, for the 8-unit signal. The scanning cycle then took 176 milliseconds (8x22 ms), and hence resulted in 341 OPM. In comparison, the regular 7.43 unit dimension has six 22 ms plus a 31 ms "stop" unit, totalling 163 ms, corresponding to 368 OPM.

The 7.5-unit signal shown in the figure is a close compromise to the 7.43-unit, and also lends itself readily to use of a flip-flop-matrix scanning circuit. The "stop-pulse" is set to be 33 ms long, resulting from 22 ms plus 11 ms.

FLIPFLOPS:

Referring back to Figure 1, we have three "flipflops" driving the matrix. They are in reality 1:2 frequency dividers, each stage dividing in half the incoming pulse frequency from the preceding stage. Using one double-triode, each flipflop has two plate outputs, which are always out of phase to each other, i.e., if one plate has say 90 volts, then the other plate measures 30 volts. Injection of a pulse into this flipflop will cause a reversal of the two plate voltages, so the first plate now has 30 volts and the other 90 volts. Succeeding input pulses cause an alternation of the two plate voltages and thus generate a square wave, looking at one plate of the stage. Briefly, the flipflop possesses "two conditions-of-equilibrium" and it can be locked to either one by the injection of a pulse signal into the proper grid circuit. As a result, these circuits are incapable of self oscillation and are exceptionally reliable once properly set up. There are manifold uses for such circuits in distributors, precision timers, pulse counters, Geiger-Muller scaling circuits, electronic digital computers and the like. An excellent paper on the subject[7] appeared recently, and it is urged that the reader consult it, paying particular attention to the circuit hints outlined there.

For the system in Figure 1, the driving oscillator delivers sharp pulses, of one polarity, spaced 22 milliseconds apart, and thus causes the activitation of the scanner circuit. Each of the eight input signals is sampled for exactly 22 milliseconds per cycle, and all the eight inputs are scanned sequentially (in order) through the action of the matrix switcher shown. This is the basic scanner used in the first model mentioned. To generate 22-millisecond pulses, the driving oscillatór has to run at a 45.5 cps. rate.

For the generation of the 7.5-unit signal, an additional flipflop stage is required and would be placed ahead of the three flipflops shown in Figure 1. A pulse reset loop would be connected so as to cause an added "flip" in the first stage, kicked by the output from the fourth (last) flipflop for each scanning cycle. In other words, a pulse is added to the system, normally a "scale-of-16" ($2^4=16$, four flipflops), so it is converted into a "scale-of-15." As the extra flipflop divides the basic oscillator frequency by 2, this results in a $15/2=7.5$ basis for the last three flipflops driving the matrix switcher. Figure 3, the block diagram, will show this arrangement, which includes the "pulse-reset-loop." The driving oscillator system is designed to generate pulses spaced 11 milliseconds apart, for the activitation of the four-flipflops system. The basic oscillator frequency is thus 91 cycles per second, and, in itself, is the only important frequency adjustment. It is very stable, being set by a two-terminal LC oscillator circuit.

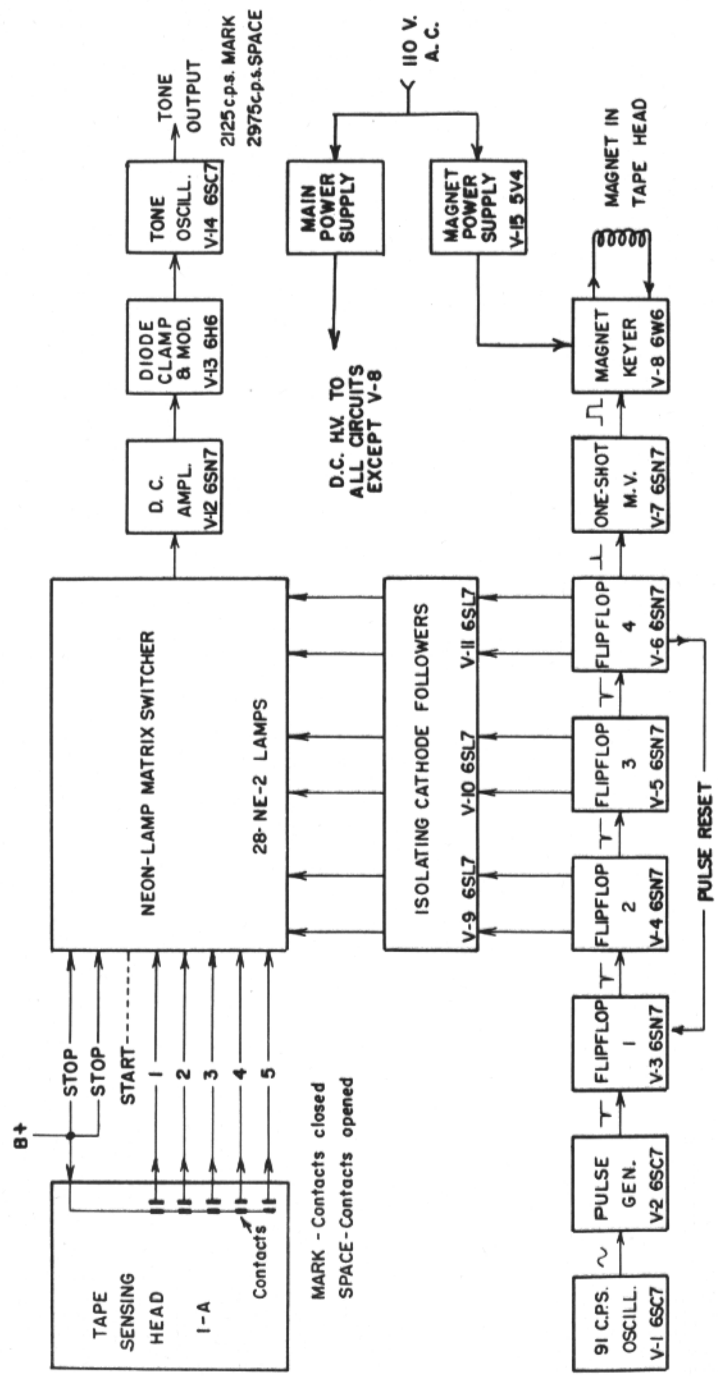
THE MATRIX

For the matrix, various types of switching devices can be employed, such as vacuum or germanium diodes.[5] However, from a cost standpoint, there being perhaps 32 such devices in the pattern, it is desirable to use some inexpensive substitute. A suitable device is the small neon lamp, such as a NE-2, available for eight cents each. Numerous tests and long continued operation have proved the neon lamp system as being reliable and yet inexpensive to install, when the overall circuit is properly designed to take advantage of the neon lamp's trigger characteristics, for low frequency operation.

The two trigger characteristics, as mentioned, of any neon lamp are its starting (ignition) voltage and its running voltage; typically 80 and 60 volts respectively. For the matrix application it is desirable that these two voltages be as close to each other as possible, so that, for the group of neon lamps as a whole, depending snap-action switching action is had. In other words, what is desired is a positive-in-action clamping

(Continued on page 6)

[7]Erwin Levey, "Electronic Counter," **Radio and Television News,** September 1953.



BLOCK DIAGRAM - ELECTRONIC TRANSMITTING DISTRIBUTOR for TAPE
7.5 UNIT BAUDOT CODE W6NRM - W9TCJ

Fig. 3

(Continued from page 4)

device to hold down a voltage level whenever its driving circuit informs it to do so, just as clamping or DC restorer circuits do in pulse or television circuits.

The reference cited gives an adequate explanation of how the switching action of a flipflop-matrix system is accomplished; however, it is desirable to at least mention how the neon lamps act as clampers in the matrix here. To a given input signal wire, say one wire fed by a high impedance voltage source such as 230 volts through a 820 K resistor, let us connect one of the electrodes of a neon lamp. The other electrode is then connected to a voltage source of low impedance; say a 30-volt or a 90-volt battery, both positive potentials with respect to ground, and either selectable by a switch S, as shown in Figure 4. The switch thus places the lower electrode of the lamp at either voltage. The neon lamp glows at all times if the 230-volt signal is coming through. The output will be either at 90 volts or 150 volts, respectively as to whether the vertical (driving) line is connected to either the 30 volt or the 90 volt potential via S.

The switch, in the application, is one of the two plate outputs of a flipflop. The other plate is connected to a similar line, with a differently placed neon lamp as would be placed in a second input-signal wire. The matrix is thus built up as shown in Figure 1, adding succeeding flipflops and neon lamps as needed to provide enough signal wires for the application. In operation all lamps contribute to the task of preventing transmittal of the eight input signal voltages, except, by the action of a proper combination of flipflop actions, each signal is permitted to "come through" and feed into a colector bus during its proper time of the scanning cycle. Thus sequential scanning is accomplished.

In order to prevent the reactions in any one signal wire from affecting other signal or driving wires, isolating or coupling devices are used. Here, the neon lamps find their places and serve to feed the pulses, as scanned, into a common output signal bus (the "collector bus" of preceding paragraph) which yields the final DC (teleprinter) signal ready for transmission. In Figure 4, the horizontal signal input wire thus feeds into a neon coupler which in elect subtracts from the potentials existing on the wire, yielding 30 volts or 90 volts, respectively, for the output potentials on the bus. The output, from all the inputs via the matrix and coupler system, is fed into a direct coupled amplifier whose operating point is set to be at 60 volts, midway between the 30 and 90 volt points.

As shown in Figs. 3 and 5, the 230-volt power is applied to the eight (actually seven) inputs via a set of contacts in a tape sensing head. The voltage will come through on a given wire only if its contact is closed, thus giving mark indication. The voltage is off for space indication. As there are five signal elements in the teleprinter code, so there are five sets of contacts and five signal input wires thus connected. Two other signal input wires are permanently connected to 230 volts; this yields the "stop interval" (mark, permanent). There is a "missing" wire; this is for the start-signal of the teleprinter code as this is always a space unit; that is, no voltage is required as a signal and so that wire is not needed. This will be referred to later on. All in all, this completes the consideration of the input wires to the matrix from the tape sensing head.

TEST EQUIPMENT

The possession of adequate test equipment plus a thorough knowledge and understanding of such instruments are essential for any serious work with electronic distributor designs, and for that matter also with teleprinter equipment. Having such facilities, one can easily analyze the station equipment, make adjustments for optimal operation, and trouble-shoot with the least wear and tear upon his human faculties.

Pulse techniques are employed in electronic distributors and in all teleprinter equipment as in radar and television circuits. Therefore the first indispensable test instrument is a good oscilloscope having features adequate for the application. For the present RTTY work, the 'scope should have direct-coupled vertical and horizontal amplifiers of moderate gain, say 1 or 2 volts per inch-of-deflection. It should also have a slave-free sweep capable of sweer rates down to perhaps 2 cps. Such an instrument[8] has been described by the writer and has proven its usefulness many times over during the period of time since its original construction. Most of the usual oscilloscopes available on the market can be used although it may be necessary to

[8]Robert H. Weitbrecht, "A 'Scope for the Hamshack," **QST,** February 1948.

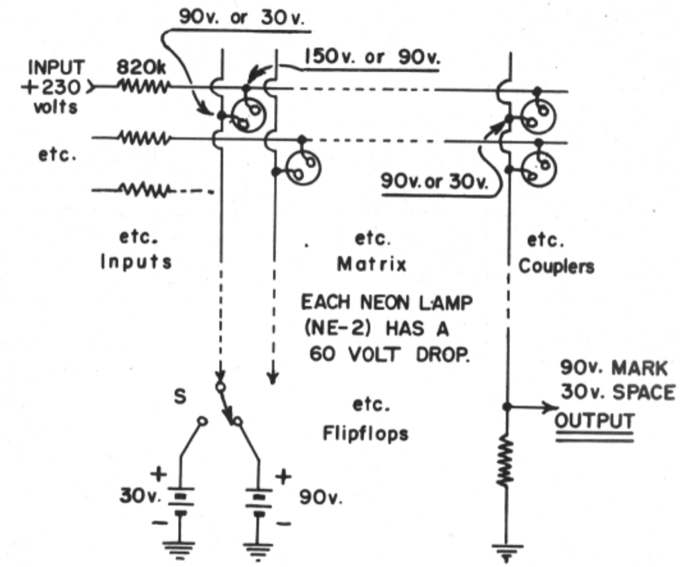


Fig. 4

lower the limit of the sweep range to several cps by the addition of an appropriate capacitor to the sweep generator circuit. This point is stressed because frequencies as low as 6 cps are involved in teleprinter operation, and it is an advantage to be able, for instance, to see the whole teleprinter signal waveform on the screen as the former repeats itself at 6.1 cps (368 OPM). However, when using a thus-modified commercial oscilloscope, the low frequency response characteristics of the 'scope amplifiers must be kept in mind when interpreting the patterns at very low sweep rates. All in all, direct-coupled 'scope amplifiers are to be preferred.

Other desirable instruments include an audio oscillator, a vacuum tube voltmeter, and a multimeter in addition to the usual tools. Equipped with all the items above, one is prepared to tackle the construction and operation of RTTY pulse circuits with confidence and assurance of success.

The block diagram in Figure 3, together with the circuit diagram in Figure 5, present the entire circuit of the 7.5 unit electronic tape distributor. A layout diagram is shown in Figure 6, as well as the accompanying photographs showing views of the general chassis setup and of the interior of the chassis with matrix switcher panel installed.

The 91 cycles-per-second oscillator tube uses a 6SC7 double triode, V-1, in a two terminal arrangement. The tuned L and C elements consist of an inductance of the filter-choke kind and a paper capacitor of sufficient size to tune the oscillator system to the abovementioned frequency. The circuit is stable and holds its frequency to an accuracy of well within one-percent, a stability which is adequate for the application.

The output from the oscillator, being a near-sine wave, must next be converted into sharp pulses for proper energization of the scanning circuit. This function is taken care of by a pulse generator circuit, consisting of another 6SC7 double triode, V-2, in a sine-wave flipflop circuit. The sine wave from the oscillator drives one of the grids directly and thus forces the stage to shift between its two conditions-of-equilibrium at the oscillator frequency. As a result, the output, taken from one of the plates, consists of a square wave with steep leading and trailing edges. It is fed into a RC differentiating circuit, consisting of a 200 picofarad coupling capacitor and a combination of resistors in the first flipflop stage. The pulses therein fed are narrow, with a rise-time of several microseconds, and total length being of the order of ten microseconds. The pulses delivered are of both polarities, but the succeeding flipflop stages respond only to negative polarity pulses as an inherent feature of their design.

The four flipflops, consisting of four 6SN7GT double triodes, V-3 to V-6 inclusive, are cascaded and function as a scale-of-15, using the pulse reset loop shown. The circuit of one flipflop stage is shown in the box of Figure 5, and all four stages are wired alike. During tests, the pulse reset loop can be left out and the whole circuit will function as a scale-of-16. The operation of the individual stages can then be checked using a 'scope. As has been mentioned before, each stage is a 1:2 frequency divider and the square-wave frequency will be divided by half per stage if everything is working properly. Furthermore, if the pulse reset loop is left out, the distributor scans on an 8-unit basis and generates the teleprinter signal at 341 OPM.

The matrix receives its six driving voltages from the outputs of the last three flipflops, V-4, V-5, V-6, via cathode followers in the form of three 6S7GT double triodes, V-9, V-10, V-11. The latter are employed in the interests of isolation of the flipflops from the surge effects in the matrix and of low impedance drive upon the matrix's vertical wires. The input signal wires are fed in from the tape sensing head and B plus as shown. It will be noted however, that there is no input wire for the start-unit as there is no voltage here for that signal, the latter being a space unit. Hence, there is no need for this particular input wire with its four neon lamps. That is why that wire was dashed in on the diagram, just so as to preserve the neon lamps' pattern for ease in following the circuit. During the construction of the matrix panel, a piece of tin was placed behind the former and insulated therefrom, to serve as a grounded shield to keep pulses from meddling in with other circuits placed immediately beneath in the chassis. Solder lugs are riveted to the panel with horizontal and vertical wires strung as shown in the photograph, and the 820 resistors and neon lamps mounted thereon. Take care that the criss-crossing wires do not short into each other! Reference will be made to selection of the neon lamps for the matrix later on.

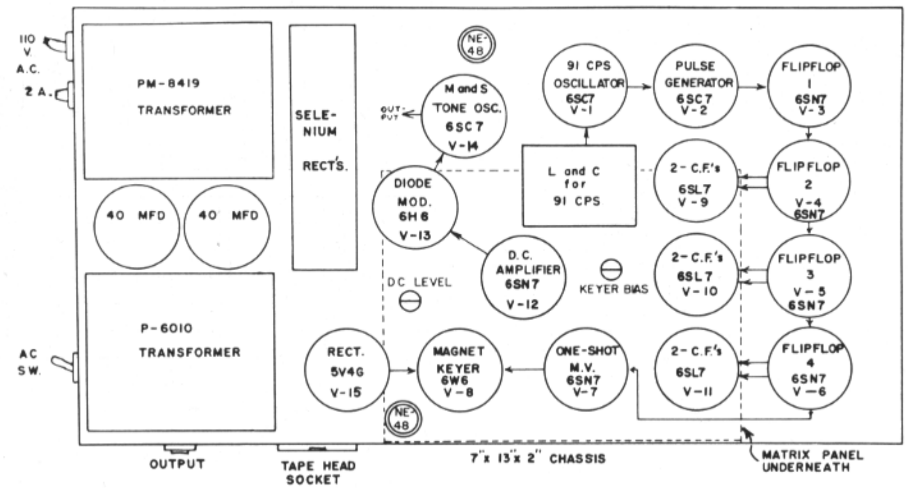
The scanned pulse elements are collected together in the output signal bus via the neon-lamp couplers and fed into a two-stage direct-coupled amplifier, 6SN7GT, V-12. The first triode section has a direct-current voltage level control which adjusts the cathode voltage level and, hence, the operating point with respect to the mark and space voltage levels existing in the matrix's output signal bus. The control is set to a point midway between the two above-mentioned levels, or, simply, to the point midway between limits where the signal cease to be properly generated. The second section of V-12 receives the amplified signal from the plate of the first section, via two NE-2 voltage steppers, and reinverts it before delivery to the tone oscillator circuit. A RC low pass filter is inserted in the second-section's grid circuit to remove the sharp spikes, caused by matrix operation, from the final output. Such spikes are caused by the fifinfiite (that is, appreciable) ionization and de-ionization times of neon lamps, and are akin to those generated in a rotating brush distributor as its contact sweeps over the insulated intervals between adjacent segments thus causing clicks.

The output signal voltage is fed into a combined clamp and diode modulator, 6H6, V-13, via two NE-48 voltage steppers. The latter two neon lamps maintain a constant 110-volt (approx.) drop and, aided by the negative bias voltage supply, transfers the signal swing down so it oscillates either side of ground (chasis) potential. This is a necessity for proper functioning of the diode modulator, as a negative voltage (for space) is needed to cut it cleanly off. During mark, the signal is swung positive and feeds directly into the modulator via the series diode shown. The two NE-48's are mounted on top of the chassis and serve as convenient indicators of proper overall operation.

The tone oscillator again uses the two-terminal circuit and has one of the "little gems"[9] filter chokes as part of its tuned system. For this application the frame and I-laminations are removed entirely from the choke assembly, and the latter mounted on a piece of bakelite with provision made .or adjustment of the coil on its E-laminations. The whole stage is tuned up to 2975 cps with an .005 mfd capacitor and by adjustment of the coil as described in the reference. Then the injection of the "mark" volt-

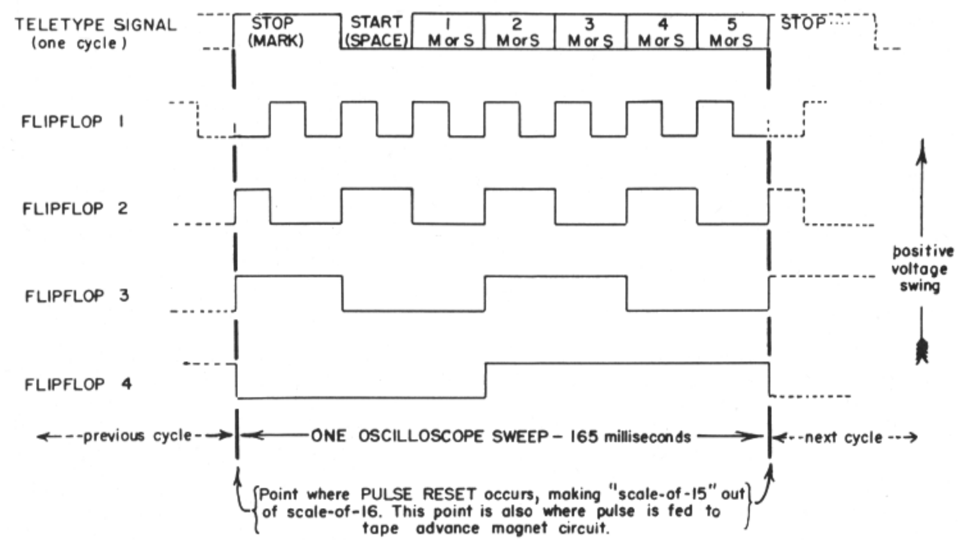
(Continued on page 12)

[9]Robert Weitbrecht, "Little Gems from Electronic Surplus," **RTTY,** April 1953.



TOP VIEW — ELECTRONIC DISTRIBUTOR CHASSIS W6NRM-W9TCJ

Fig. 6



SWEEP TRIGGERED BY + PULSE FROM ② (FLIPFLOP 4).

VOLTAGE WAVEFORMS AT POINT ⑤ OF EACH FLIPFLOP.

Fig. 7

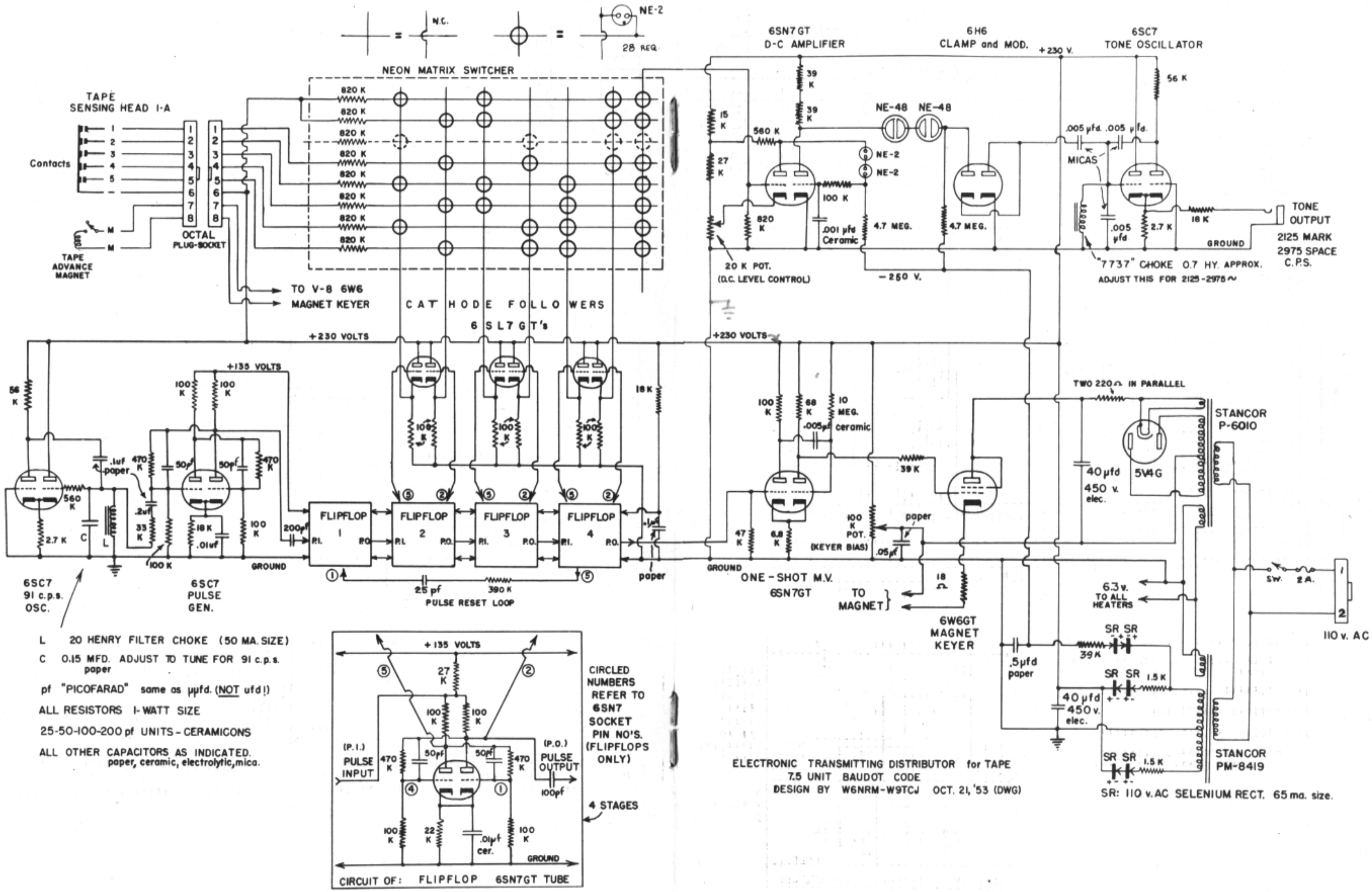

NE-2
28 REQ.
N.C.
NEON MATRIX SWITCHER
TAPE SENSING HEAD I-A
Contacts
TAPE ADVANCE MAGNET
OCTAL PLUG-SOCKET
820 K
TO V-8 6W6
MAGNET KEYER
CATHODE FOLLOWERS
6SL7GT's
+230 VOLTS
+135 VOLTS
FLIPFLOP 1
FLIPFLOP 2
FLIPFLOP 3
FLIPFLOP 4
PULSE RESET LOOP
6SC7
91 c.p.s.
OSC.
6SC7
PULSE
GEN.
GROUND
L 20 HENRY FILTER CHOKE (50 MA. SIZE)
C 0.15 MFD. ADJUST TO TUNE FOR 91 c.p.s. paper
pf "PICOFARAD" same as μμfd. (NOT ufd!)
ALL RESISTORS 1-WATT SIZE
25-50-100-200 pf UNITS - CERAMICONS
ALL OTHER CAPACITORS AS INDICATED. paper, ceramic, electrolytic, mica.
+135 VOLTS
(P.I.) PULSE INPUT
(P.O.) PULSE OUTPUT
CIRCLED NUMBERS REFER TO 6SN7 SOCKET PIN NO'S. (FLIPFLOPS ONLY)
4 STAGES
CIRCUIT OF: FLIPFLOP 6SN7GT TUBE
6SN7GT
D-C AMPLIFIER
6H6
CLAMP and MOD.
6SC7
TONE OSCILLATOR
NE-48
MICAS
20 K POT. (D.C. LEVEL CONTROL)
-250 V.
TONE OUTPUT
2125 MARK
2975 SPACE
C.P.S.
"7737" CHOKE 0.7 HY. APPROX.
ADJUST THIS FOR 2125-2975 ~
TWO 220 Ω IN PARALLEL
STANCOR P-6010
5V4G
40 μfd 450 v. elec.
ONE-SHOT M.V.
6SN7GT
TO MAGNET
(KEYER BIAS)
6W6GT
MAGNET
KEYER
6.3 v. TO ALL HEATERS
SW. 2A.
110 v. AC
STANCOR PM-8419
SR: 110 v. AC SELENIUM RECT. 65 ma. size.
ELECTRONIC TRANSMITTING DISTRIBUTOR for TAPE
7.5 UNIT BAUDOT CODE
DESIGN BY W6NRM-W9TCJ OCT. 21, '53 (DWG)

Fig. 5

(Continued from page 8)

age (a positive voltage with respect to chasis) into the diode modulator[10] effectively adds another .005 mfd capacitor and thus lowers the output frequency to 2125 cps. Adjustment of the mark and space tone frequencies is not at all critical and the one setting of the filter choke coil along its E-lamination core should suffice. The output from the tone oscillator is delivered to an output jack via an isolating resistor, ready for direct injection into the audio type of FSK converter or other equipment for on-the-air RTT use.

Finally, there is the question of the tape advance magnet in the tape sensing head. A positive pulse is obtained from the last flipflop, V-6, through its 100 picofarad capacitor and is applied to a one-shot multivibrator, 6SN7GT, V-7. This latter circuit is employed as a pulse lengthener to generate a positive rectangular voltage wave of 10 to 15 milliseconds in length for energization of the magnet keyer stage. If the pulse length, on test, seems short, it can be lengthened by adjustment of, say, the 10-megohm resistor shown to some other value. It should not be much longer or else the first baud of the code may become "chopped" by the late release of the magnet upon the pecker-pin switch system in the tape head.

The magnet keyer stage uses a 6W6GT power tube, V-8, connected as a high current cathode follower. The stage has its own high-voltage power supply and the latter is biased by means of the keyer-tube bias control so as to cut off the keyer's grid during the quiescent period of the preceding one-shot multivibrator stage. The control is set so the keyer's grid has a high negative bias voltage for cutoff; and when the one-shot multivibrator is "kicked," the grid is driven to about ten or twenty volts positive—all with respect to the magnet power supply negative lead. During this immediate operation, the magnet is energized by about two hundred milliamperes fed by the keyer through a 18 ohm parasitic suppressing resistor. During operation, this current is adjustable by means of the keyer bias control and is set for an optimal tape advance function.

There are two power supplies used on the chassis. One is the above-mentioned magnet power supply which has a 5V4G rectifier, V-15. This tube was chosen rather than a filament-type rectifier so that a delay is obtained in the application of the high voltage to the 6W6GT keyer, in the interest of aiding its cathode to get well warmed up. The other power supply delivers positive and negative voltages to the rest of the electronic distributor circuit and uses selenium ,rectifiers. The 6 volt filament windings on both transformers are paralleled and used to supply all the 6 volt tubes on the chassis. No voltage regulators are needed, as the circuit has been designed to operate properly even with moderate variations in powerline voltage, from 90 to 130 volts.

There are several reasons for using two separate small power supplies rather than one large one. The most important factor is adequate isolation of the surges existent in the magnet circuit from the rest of the distributor circuits. Having its own power supply, the magnet keyer stage is very easily biased to cutoff during quiescent periods, simply by "lifting" the supply negative lead above chassis ground. Plenty of filament power is available from two paralleled transformer six-volt windings to run all the six-volt tubes on the chassis.

[10]Robert Weitbrecht, "The Useful Diode Modulator,"**CQ**, April 1952.

NOTE ON CIRCUIT CONSTRUCTION AND OPERATION:

During the construction of the distributor it is well to keep a logical and straight-line order in the arrangement and wiring of the various stages, such as indicated in the layout diagram of Figure 6. This is conductive to short leads and direct wiring from stage to stage, an important factor in building pulse circuits. Care must be exercised when cabling wires because of excessive lead capacitances in some high-impdance signal circuits with the consequent possibility of pulses getting into wrong places. This does not, of course, apply to filament and power supply circuits but it is especially important in high impedance signal circuits as n the flpflops. It s permissible to cable the wires between the tape sensing head and the inputs to the matrix (820K resistors in the latter place) and also the magnet circuit. A ground wire is connected between the frame of the head and the chassis.

As the four flipflop stages employ the same circuit, shown in the box of Figure 5, it is well to mount all the parts the same way for each stage. Point-to-point wiring is vone as far as possible, and tie points used where necessary. The resistors used must be of good quality stock, checked for values with an ohmmeter. A tolerance of 10% is adequate. The capacitors should be of the ceramic kind, an inexpensive and reliable insurance against leakages or opens, which occur too often using micas or other. It is a good idea to check each 6SN7GT tube for emission balance in both sections. Finally, make sure that there is a grounded 0.1 microfarad capacitor connected to the 135-volt B line feeding the flipflops. Having followed these notes, the flipflops should perform in a reliable manner.

Approximately ten or twenty percent of the NE-2 neon lamps are unsuitable because of wide variations in characteristics. Therefore, it is well to purchase say 50 NE-2's and from this lot pick out the best lamps for the matrix and couplers. Selection of each lamp is based upon a voltage check and upon the appearance of the glowing electrode. For the first check, a power supply delivering say 250 volts d.c. is used to feed into a 470K resistor placed in series with one of the electrodes of the lamp under test, the other electrode connected to the other side of the power supply output. A VTVM or a 20,000 ohm-per-volt multimeter is connected across the neon lamp to measure its voltage drop, which should measure at least 50 to 60 volts. The lamp connections are reversed and the voltage checked again. For both times, the glow should be fairly uniform along the affected electrode wire with no bright concentrated spot. The voltage steppers used elsewhere in the circuit should also be of selected stock. Inasmuch as the currents through these neon lamps are low, they will last practically indefinitely and yet perform in a reliable manner. During installation, no more heat than necessary to make a quick and good soldered connection is applied to each lamp terminal. (Scrape the wire leads with a knife before tinning.) Figure 7 presents the signal waveforms at various points in the flipflop chain, using the pulse reset loop. It will be noted that half a cycle is advanced in the waveform of flipflop 1, for every scaning cycle. This is a consequence of the pulse reset system and thus results in a scale-of-15, or 7.5-unit scanning, as has been previously referred to. This extra "flip" is inserted at a time immediately after the scanning of the number five baud of the teleprinter code, and also is where the tape advance signal is obtained—all during the ensuing 1.5-unit "stop" interval. Of course, as has been previously mentioned, the pulse reset loop can be left out and thus give 8-unit scanning (2-unit "stop" interval) which gives a slower tape speed, 341 OPM, which might be of advantage under some conditions. A switch could be used to insert or break the loop if desired, and if installed, must be in a position as close as possible to the parts involved, as this particular portion of the circuit is a high impedance pulse feedback pont.

Having the oscilloscope connected to check the various waveforms in Figure 7, the signal from the output plate of V-12, second section, may now be fed into the vertical amplifier of the 'scope. Having adjusted both vertical and horizontal amplifier gains to show the whole of the pattern to best advantage on the screen, the waveform seen will be that for the teletype signal shown at the top of the waveforms-chart in the figure. This assumes that the distributor circuit has been adjusted and scanning properly, which then can be verified by trying various combinations of on-or-off voltages from the five sets of contacts in the tape sensing head. With the latter set up to scan "LTRS" (letters) character, the scope pattern should show just the start-signal unit, a downward rectangular wave somewhat a bit to the right from the beginning of the sweep. Each of the pecker-pins in the head should next be tried, i.e., pushed down, and the result noted on the screen. For the pins number 1, 2, . . . 5, the corresponding downward rectangular waves should appear in orderly progression to the right along the sweep baseline. Finally a tape should be tried and the overall operation noted upon the screen. As the tape runs through, the various mark and space units will come through in all sorts of combinations, but the only constant "signal" will be near the begining of the sweep, such signal portion consisting of, first, the 1.5 unit "stop" mark interval and then the "start" space interval. The latter stop and start portions are a permanent feature of the whole teletype signal and should be unvarying on the oscilloscope screen. If all this phenomena is observed, then the distributor is operating properly and one may next look at the tone output with the oscilloscope, the latter's sweep synced all the time to the pulse output from the last flipflop as indicated in Figure 7. The tone will now be seen. There is a slight variation in amplitudes of the mark and space tones but that is inconsequential as the AFSK converter

(Continued on page 15)

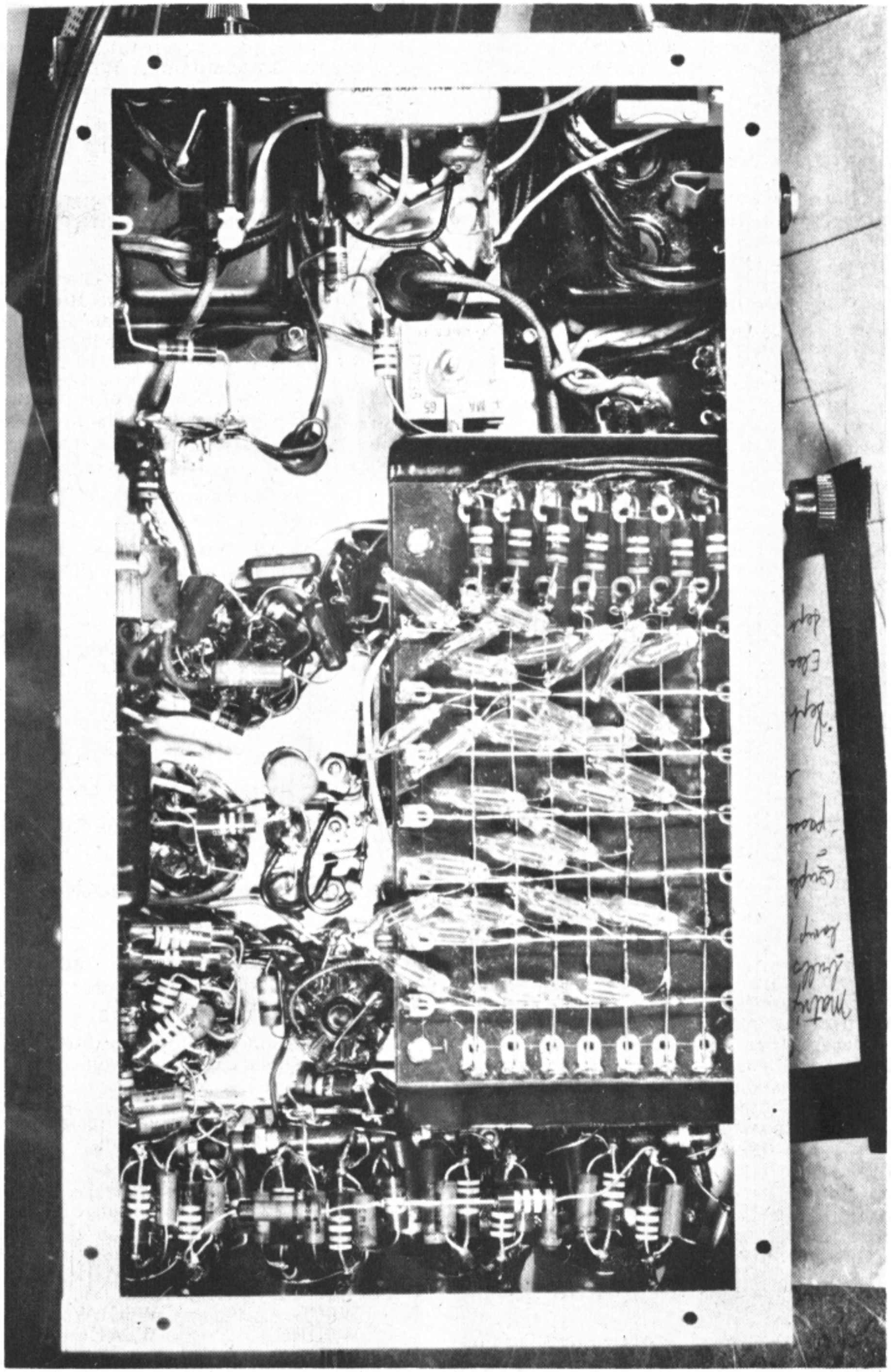


Fig. 8

(Continued from page 13)

will limit on both tones anyhow. During the tests, some spikes may be seen in the output from V-12, second section, but should not be in the final tone output.

CONCLUSION:

The entire circuit presented was designed with the factors of simplicity, accuracy, and reliability kept in mind. The equipment generates an accurate teleprinter signal, with all its different portions (bauds) precisely measured in time. This is a direct result of the use of one basic oscillator frequency for all the scanning and timing functions. The circuit, as is, is designed to operate continuously, scanning all the time, delivering a tone signal; whether the tape is on the sensing head or not. A lever switch, found at the base on the latter, is in series with the magnet coil and is employed to run or stop the tape-feed as desired. Although the output is in the form of a tone, it could be redesigned so as to operate a polar relay, if so desired.

Additional features planned for this electronic tape distributor include a "tight-tape switch" circuit which exerts direct control upon the scanning function; that is, to stop and start that function precisely. Other additions also are planned and all these will be presented in a subsequent paper. The aim of this present paper is to introduce the flipflop-matrix scanning system as a worthwhile addition to the list of scanning systems, and to demonstrate its use in a piece of practical operating equipment for use in RTTY work. Equipped with a controlled ringing oscillator drive, the basic flipflop-matrix can be adapted into a receiving distributor design for operating a model 12 or 21-A typing unit, with the incidental precision and reliability of single-oscillator drive. A logical combination of both electronic transmitting and receiving distributors would result in an all-electronic regenrative repeater with all its obvious advantages of generating a clean teleprinter signal for retransmission and versatileness for operation of auxiliary equipment tied therein.

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W6FLW W6IZJ

For "RTTY" Information:
W6CL W6CLW
W6DEO W6AEE

Frequency Shift Keying on High Frequencies

By F. TED SWIFT, W6CMQ

1. At the present time many amateurs are connecting a smal capacitor from the hot point on the VFO tank coil or tank Capacitor circuit through a pair of diodes connected back to back to ground. The keyboard sending contacts are connected through a suitable RF filter in series with one diode. This method works well but has the disadvantage that the frequency shift is backwards and to obtain standard keying, a keying relay with back contacts is required.

2. The advantages of the above circuit may be retained but the keying reversed so that the sending contacts of the keyboard may be used to key the VFO directly without the use of relays by replacing the small (usually variable) capacitor of the keying circuit with a suitable variable inductance. In test at this station the slug tuned coils removed from the crystal oscillator circuit of a converted 522 receiver were found to be suitable when connected from the cathode tap through the diode circuit to ground.

I put the coil in place of the capacitor and as expected, the frequency shift is right side up. I have a variable potentiometer across the sending contacts and adjusting the potentiometer changes the amount of shift. Of course, the potentiometer is beyond the RF filters so only a little DC is in and it can be remotely located from the transmitter to adjust the actual amount of shift. It works like a charm. You can be fooled in the tests if the coil is too large it acts as a capacitor, like a choke with distributed capacity, and the shift is reversed, but if the coil has low enough inductance, it works right side up as a small amount of thought shows it must. Of course, the effect of inductance on the tuned circuit is just the reverse of capacity, that is all there is to it.

First Anniversary RTTY Sweepstakes

As announced in the November 1953 RTTY, the 1954 RTTY Anniversary Sweepstakes will be held during the weekend of 19th and 20th of February 1954. Contest starts 6:00 p.m., E.S.T. 19, February, and ends 3:01 a.m., E.S.T. on the 21st. The decision to extend the contest period was a result of the many comments received from participants in November SS Contest.

With the rapid increase in RTTY activity on all of the presently licensed amateur bands, this Anniversary S. S. should prove to be very interesting. At this time, more than five hundred amateurs are equipped to operate with RTTY (F-1 or A-2). Another point of interest is the high percentage of RTTY interested amateurs who are operating and quite active. The only detail holding down activity is lack of equipment.

Rules: Contest is open to all RTTY equipped amateur stations. Members may take part who have receiving equipment only as well as those who have both receiving and transmitting equipment. Contact in replying to RTTY being made by CW (A1)- Compliance with F.C.C. regulations with regards to Shift and other regulations is a necessary portion of scoring.

Bands to watch are eighty, forty, twenty F-1; eleven and two A-2.

Scoring: All contacts must be made during above contest period.

Each message sent and acknowledged counts one point. Each message received counts one point. Only two points can be earned b ycontacting any one station **on any one band.** An additional point may be scored for contacts which require either different receiving or transmitting equipment to make contact. Points scored as above multiplied by number of ARRL sections (for example page 6 November 1953 QST) provides total score.

An effort should be made to operate on all bands in order to achieve maximum score. Also those who have semi-automatic relaying facilities i.e.; 2 meters to 40 meters, etc., should use it to help the single band operators become acquainted with other RTTY operators.
—Ed.

Traffic Net News

EMILE DUVAL, W6FLW

The Southern California RTTY Society Net operates every Tuesday evening at 8:00 p.m. on 147.85 mc.

Activity for the month of December:

December 1—W6PNW, N. C.—9 Check

W6CAP	W6IZJ
W6CYR	W6SCQ
W6DMK	W6WYH
W6EV	W6ZBV
W6FLW	

December 8—W6EV, N. C.—12 Check

W6AEE	W6SCQ
W6CAP	W6NSS
W6FLW	W6IES
W6IIV	W6DMK
W6IZJ	W6KNI
W6NAT	W6CLW

December 15—W6KNI, N. C.—12 Check

W6AEE	W6NAT
W6CAP	W6NWM
W6CLW	W6SCQ
W6FLW	W6WYH
W6IIV	W6EV
W6IZJ	

December 22—W6CL, N. C.—9 Check

W6AEE	W6ORV
W6EV	W6IIV
W6FLW	W6WYH
W6IZJ	W6CAP
W6KNI	

December 29—W6IIV, N. C.—13 Check

W6AEE	W6NAT
W6CL	W6RL
W6CAP	W6ZBV
W6EV	W6NWM
W6FLW	W6BGM
W6IZJ	W6PNW
W6KNI	

TAPE OFF THE FLOOR

QST QST QST DE W6CMQ W6CMQ
Tuesday, 5 January 1954

My boss at the Mare Island Naval Shipyard at Vallejo, California telephoned today to say I would have to cut my leave short and return to Mare Island on 18 January. I expect to be there until 20 January when I will depart for a series of meetings in Pearl Harbor, Washington and the Philippines. Following the meetings, I expect to resume my regular assignment in the Philippines. Anyway, being home was fun while it lasted. Sig. Ted, W6CMQ.

. . . . RTNET de WCMQ Clear. Thanks Ga
Roger Ted sorry to hear you are leaving so soon.

So many thanks Jack for FB QSO and sure hope we will get together again before too many moons pass by!!!! WIBGW WIBGW de W9TCJ W9TCJ Williams Bay Wisconsin SK W SK

. . . . . W9TCJ W9TCJ de WIBGW WIBGW . . . Roger and fine Bob . . . Sure been long while sinse our last QSO . . . Don't usually turn on this early in the evening but guess I should judging by the strength of your sig. . . . Made some tape of your last Xmason with Bob so will run it thru for U QRX.

Ham, W6EV has bought my forty

meter transmitter and expects to take delivery tomorrow. I am building a new one, Hi—de W6CMQ.

". . . . Like the time I won a genuine hand key for being the bestest code sender—with my left foot—at a Ham convention. The missus has gone bowling with her pappy tonight. The young one is in the front room littering the place like a cyclone hit it, hi. I'm baby sittin' again.—de W5ENH"

"W8ZM de VE4QG located in Winnepeg going to QSY to 7150 or thereabouts when I come back AR K"

". . . . This is VE4QG in the land of Santa Claus and his Seven rain deers."

"DON'T FORGET THE ANNIVERSARY SS DATES, February 19th 6:00 p.m. E.S.T. thru 21st 3:01 a.m. E.S.T. MAKE PLANS TO TAKE PART."

". . . . I think I will have to work tonight as we are breaking in a new man and the other op may need some help HI HI. I guess we have spent too much time handling tfc can't even ragchew decent anymore. Well the XYL just came so have to run—W6UPY de K6FCT"

"W6AEE de W4MOP, Louisville, Ky." **". . . . RYRYRYRYRYRYRY W6AEE ES W8ZM de WONME Stratton, Nebr."**

"W6AEE WONME W8ZM de W6FLW" **". . . . W6FLW W8ZM WONME W6AEE de W6PNW" Note: This is the way round tables start.—Ed.**

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ART OFF THE FLOOR

This month it seems fitting that we add a new department known as "Art(?) Off The Floor." Here is what can be done with two fingers and three hours:

RYRYRYRYRY