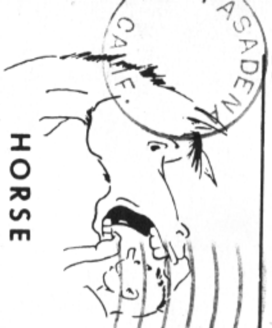
RTTY

The W9TCJ Automatic Start RTTY Printer

RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY

NEWS OF AMATEUR RTTY

JUNE, 1957
25 Cents
Vol. 5, No. 6



HORSE TRADES

This page of the Bulletin is for use of amateurs who have RTTY EQUIPMENT FOR SALE OR [...]DE and those lookin[...] ment to buy[...] is a free se[...] be the m[...] someone on

FOR SALE—28 vdc Solenoids for Automatic Line Feed and Carriage Return. Circuits, parts list, template drawings and photos of installed units W6LDG

WANTED:Model 14 TD W7JLF

FOR SALE: 1-A Xmit Head-Reperforator and Distributor with Sync Motor W2MIB

WANTED: Cover only for Model 14 Non-Typing Reperf. Model with reel in top W6DOU

FOR SALE: Oiled Wheatstone Perforator Tape Sixe 15/32" wide W6DOU

WANTED: Feb., Aug. and Sept. 1953 RTTY's W1RR

FOR SALE OR TRADE: AC governed motor for Model 15, comp with lamp and switch, Brand new. Make offer W4EHU

RTTY is the Official Publication of the RTTY SOCIETY OF SO. CALIF., INC. and is published for the benefit of all RTTY Amateurs and Experimenters
Subscription Rate $2.50 per year

RTTY, Inc.
372 WEST WARREN WAY
Arcadia, California
Return Postage Guaranteed

"Automatic Start" — Remote Control of Unattended Radio-Teleprinters

BY ROBERT H. WEITBRECHT—W6NRM/W9TCJ

PART 1

1—INTRODUCTION:

One useful feature of the art of printing telegraphy — control of unattended teleprinters — has thus far not been employed much by RTTY amateurs. Designs have been made by various individuals — notably W2BFD, W6AEE and W6IZJ — towards so-called "autostart systems," but for various reasons they have not been generally adopted by the amateur RTTY fraternity. Systems in the past have suffered from complexity, nonselectivity, time-restrictions, frequency drift, liability to running "wild" in absence of a RTTY signal and the like. Also most people prefer to have their printers turned on a directed control basis than to have them operate on any and all RTTY signals. This obviously conserves paper and machinery, and hence is of more utility than the mere desire of some individuals to "read other people's mail."

2—AUTOSTART METHODS—LANDLINE AND RADIO:

The usual landline control of unattended printers takes place in three steps: First, an initial "line-break" signal is transmitted—a space signal is sent for an instant and results in startups of printers on the line. Next, the message is sent. When this is finished, a "stop" signal is sent as the last keyboard manipulation (upper case "H"), resulting in shutdown of printer motors. This system is usable on landline circuits because they are "solidly" reliable with negligible chances of false-signals coming upon the circuit to start up printers.

Attempts to apply this landline procedure to radio circuits are fraught with many problems. First of all, radio communications are notoriously subject to the vagaries of propagation, fading, interference and noise. This is especially true in amateur radio, and hence other control methods are needed. Two systems have apparently been proposed and employed by a few individuals, as mentioned in the introduction. The W2BFD system uses a time-clock programmer which checks the radio channel at periodic intervals—and if there is a mark-signal present, a subsequent circuit turns on the printer motor, readying it to take the message. These "periodic intervals" are of the nature of a one-minute monitoring on every exact hour, and so it imposes a time-restriction upon the transmitting operator. Furthermore a certain mark-signal has to be transmitted once every minute if the operator desires to keep the unattended printer going during a long one-way transmission. This other special signal was designed in order to enable the printer to shut down by itself after one minute, to assure shutdown in case of disappearance of the received signal.

The other system as employed on the west coast accepts any RTTY signal at any time and hence may operate the machine more or less all day every day —receiving uninteresting and tiresome tidbits of information originated by "ragchewer" RTTY stations. In other words this is a nonselective autostart system..

What the RTTY fraternity needs is some form of SELECTIVE calling or starting of the unattended printers. In this way directed calls can be made to specific stations, with as simple auxiliary equipment as possible, yet with reasonable chance for successful unattended reception. With such a set-up, one then can be away from home or otherwise engaged; and his printer will be on continuous monitoring duty, ready to take any messages directed to it. Later the fellow can check the printer to see what has been received, and he could answer the message in return via autostart to the initiating operator. In this way busy people could keep in touch with each other, making use of machine-telegraphy's great asset—the ability to print and store information for later perusal—as well as the ability to "call" the called party by machine by use of "BELL" signal. It then is not necessary to continuously monitor a sqawky and noisy radio receiver for a friend's signal; let the machine take care of it. It is well to keep our precious machines in as constant use as possible—on monitoring duty or otherwise—so our friends will be able to contact us even if we are not as active on the air as we should be. Hence, AUTOSTART!

3—A Selective Control System for RTTY Autostart Printer:

A good RTTY autostart system ought to have the following features:

1. Selective calling and starting of specific unattended printers, using a simple transmitted signal.

2. Must be reasonably proof against QRM and QRN yet to be able to print 100 percent on any RTTY signal under reasonable conditions, on any specified frequency.

3. Must be on a continuous 24-hour monitoring basis so messages can be received at any time, with a minimum of clock timing problems.

4. Simple circuitry, with a minimum of power-consuming components.

5. A printer shutdown circuit, that is controllable by the transmitting operator and more importantly, that will shut down the printer automatically in case of signal disappearance or similar situations.

The first consideration—selective calling and starting—means that only directed messages will be accepted at a given unattended printer — when the transmitting operator knows the exact procedure necessary. Ordinary RTTY or CW traffic, as well as noise, that happen to be on the autostart channel then do not operate the system and the printer is quiet.

The second desriatum implies need for proper design of the overall receiving equipment. This takes in such factors as frequency stability, automatic gain control, and fairly selective mark and space filters. The design ought to be applicable for low frequency amateur RTTY circuits as well as on VHF. After the radio-frequency control problem is solved, the autostart system can be used on any specific frequency on 80, 40, 20, 15 or 2 meters, for instance. With such a design freedom, the system would be of general utility—for FSK or AFSK circuits.

The third item is obvious. Taking due consideration of signal propagation conditions on the autostart channel (and also checking beforehand to make sure the channel is clear) the transmitting operator then can start up, "leave a message," and shut down the remote unattended printer at any convenient time.

The fourth one is necessary inasmuch as 24-hour monitoring is involved. The equipment, including receiver, terminal unit, etc ought to be designed for low power consumption, with as few tubes and parts as possible. Ideally, during standby (but on monitoring basis) the total power consumption by the entire system should not exceed say 30 or 40 watts, even when using present-day available tube equipment. Transistors could and will no doubt be eventually employed and thus result in greatly reduced power consumption, coupled with greater versatility.

The final consideration is inherently simple. It should be that any prolonged space-signal condition—such as due to operator shutting down printer or to QRM—will be certain to shut down the system. Of course this means that any CW signal that happens to be on space-signal frequency is apt to shut down the printer; or, likewise "hold the printer running" if on mark-signal frequency. This is tied up with item 2, above and it will be the transmitting operator's responsibility to evaluate the chances of successful autostart by listening on the channel beforehand. If necessary, the whole procedure could be repeated a little while later to make sure the message is "delivered." Finally there is the problem of wild printing in case of cessation of received signal; or in other words, on noise. The entire system needs to be properly designed with this possibility in mind.

4a—The W9TCJ Autostart: Starting Signal Considerations:

Following the general concepts presented above, an autostart system was designed and built early in 1956 at W9TCJ. First, we must consider the question of a suitable start-signal. This could be of one of a number of forms, such as a special teleprinter character, or a series of mark-space reversals at a certain low frequency.

The former scheme—i.e. a special teleprinter signal—would require a continuously running teleprinter receiving distributor, which is undesirable in the light of its known mechanical characteristics. The other scheme was inspired by the use of "reed relays" in some remote control applications such as calling of specific taxicabs by radio, without disturbing other cabs. Some such reed relays were obtained from Joe Juel, W9 BGC, and work was conducted with them, noting particularly the high "Q" of the resonant spring reed and need for "magnetic bias." As these reeds were tuned to specific odd-valued frequencies in the region 100 to 300 cps, efforts were expended in devising "mixer" circuits, fed by local oscillators, so that the input frequency for "autostart buzzing" could be exactly a chosen frequency, say 60 cps, the powerline frequency. However it was decided to try building a 60 cps reed relay; and this was done, with highly gratifying success, requiring only easily obtainable materials at W9TCJ.

4b—Reed Relays—Construction and Tuning:

A reed-Relay consists of three main parts as shown in Figure 1; a clock-spring-type metallic reed, a magnetic exciting coil energized by an input signal, and a pair of contacts for operating subsequent circuits when the reed is caused to vibrate near maximum amplitude by the signal of proper frequency applied to the exciting coil. The reed may be compared to a high Q "L-C" circuit or a pendulum—the system responds sharply to a certain vibrational frequency. Reeds are employed in panel frequency meters for indicating, say, power line frequency, displaying one of a row of steel reeds vibrating at maximum amplitude, giving exact indicated frequency. A number of manufacturers make "reed-relays" but they seem to be only in the higher frequencies, above 100 cycles or so, and are relatively difficult to obtain.

These reed-relays however can easily be constructed and tuned to any specific frequency using ordinary tools and materials available to RTTY amateurs, and such was done at W9TCJ. I used a piece of clock spring and a 5000 ohm relay coil, both mounted on a heavy weighted metal base; the reed being solidly anchored at one end, and the coil mounted to that its pole-piece is close to the steel spring near its supported end. Application of an AC signal of proper frequency to the energizing coil then causes this reed to vibrate to maximum amplitude. Due to its high-Q (typically, several hundred) the vibrational frequency is quite critical, it has to be within 0.2% of the natural reed frequency, and this feature is all to the good, as it determines the autostart's ability to reject undesired signals, QRM, RTTY, CW, etc. anything that is not supposed to turn on the printer. Furthermore, in order to enable the reed to follow the fundamental frequency input of the signal, some amount of biasing DC is required in the energizing coil. More of this later.

There is the problem of picking up a signal from the reed when it vibrates near maximum amplitude. The manufactured reed-relays employ tiny contacts which are quite apt to get out of order and also impaires the mechanical "Q" of the reed to an extent. I could use a pair of contacts mounted on the reed-assembly like on a Vibroplex bug-key, but instead I hit upon the idea of using a photoelectric pickup device. As it turned out, it is a neat solution—all that is required is a radio dial lamp run on low voltage for a light source and a cadmium sulphide photo-cell. These two items then take place of the mechanical contacts and at the same time leaves the reed "Q" unaffected. The lamp and cell are placed at the free end of the reed so that when the latter vibrates to maximum amplitude, light is allowed upon the cell and results in "contact." This is shown in Figure 2, and an "exploded view" is shown in Figure 3.

The frequency of the reed is adjusted by varying the length of free-vibrating portion of the spring. I used a piece of clock spring (such as from an old alarm clock of the Big Ben variety) about 4 inches long by 3/8 inch wide wide. The clamping device is designed so as to permit adjustment of the free-vibrating length. Applying 60 cps to the energizing coil (along with a little DC for magnetic bias) the length was adjusted until maximum amplitude was achieved. This is a very critical operation much like aligning a high selectivity i-f amplifier, and in the final tuneup, the reed is exactly tuned by filing away at the free-end or adding solder upon it. The reed, thus tuned, has so much "Q" that if the frequency differs by 0.1 or 0.2 cps from 60.0 cps there is a marked decrease in vibrational amplitude. And if the frequency is as much as half a cycle off, there is no response at all! This points up the importance of a stable 60.0 cps source; and so far as been determined the public utility source appears to hold very closely to 60.0 cps. (Recent monitoring measurements indicates deviations no greater than 0.01 cps at W9TCJ's QTH. It is believed that this kind of frequency stability can be expected of any large public utility power source at any place in the United States).

Continuing with the discussion, one advantage of such a sharp reed is the possibility of setting up certain buzz-frequencies for specific stations to be called, using the same radio-frequency channel. Frequencies of 61.0, 62.0, 63.0, etc, could be chosen and transmitted, using simple reed-oscillators, to activitate certain printers only. The power line frequency, 60.0 cps, could perhaps be employed as an universal autostart signal. Each autostart printer would have two reed-relays; one of the universal autostart frequency and the other for its assigned buzz-frequency. Utility of such features are obvious in communication work, wholesale bulletin reception as well as individual calling.

This reed-relay is the heart of the whole W9TCJ autostart system and hence why we went into some detail on this device, pointing up its characteristics and advantages. Such relays, by the way, are coming into wide use for remote controls in communications and industry.

4c—Printer Motor Control and Message Reception:

The photocell pickup on the reed-relay is fed into a single biased triode stage, fitted with a relay in its plate circuit. When light falls upon the cell, as during reed vibration, the triode conducts and closes the aforementioned relay; its contacts then cause "pick-up" of the main motor-start relay. An extra pair of contacts on the latter keeps it locked up so the motor runs. On the plate circuit relay is another pair of contacts, this is employed to hold the printer magnet closed (on mark) during the starting up procedure so the machine does not run wild during the rest of the buzzing interval.

Upon cessation of buzzing, the message may now be transmitted. The reed-relay decays down rapidly; and in a second or so, the triode stage cuts off, plate relay opens and releases the printer magnet to be keyed by the incoming intelligence.

4d—Printer Shutdown Control:

As it is of course necessary to close down the printer after a message is sent, a "steady-space" signal is sent for a few seconds. This is accomplished by pressing the "Break" button on the transmitting keyboard. Installed in the printer magnet-line is a RC charging network, with rectifier, and its output feeds into another relay that is kept closed if the incoming signal is on mark a great portion of the time—as it always is for a normal transmitting teleprinter signal. This RC network has its time constant so adjusted that if a space signal is continued on the circuit longer than approximately one-fourth to one-half second, the network loses its charge and its relay opens. Its contacts then open the lockup circuit in the motor relay, allowing it to open, thus shutting down the printer motor.

This method of shutdown is simple and straighforward. It is noted that this same "break" system would be for starting up a landline printer, but here it shuts down the RTTY printer. This way assures that the autostart system just described will close down in case of cessation of signal or QRM on space-channel.

5—Reasons for Choice of 60.0 cps for Initial Autostart Signal:

The choice of 60.0 cps as a buzzing frequency was decided upon early in the design period due to several factors to-wit: (1) This is the powerline frequency, available everywhere with some high degree of precision, as was indicated. (2) The 60 cps frequency can be easily injected into a RTTY circuit. (3) 60 cps is low enough in frequency to be passed with little attenuation through RTTY converters when superimposed upon a radio carrier. In other words, 60 cps mark-space reversals reproduce themselves in the output from the TU's discriminator. Higher frequencies may not pass through well due to certain "low-pass filter action" in printer circuits, while lower frequencies are apt to ontroduce long build-up time in reed-relay, possibility of false starts due to various causes (mechanical shock to reed, high-speed CW) and other factors.

(4) Also another factor enters the picture. In order to avoid possible false starts due to RTTY signal or high speed CW signal on the channel, the circuit response should be sharp and at a quite high frequency. This implies need for a "high-Q-system"—the tuned reed, and appreciable buildup time, this then automatically resulting in discriminatioin against undesired signals on the channel.

All in all, 60.0 cps is a logical frequency to begin with, a reed tuned to that value has a sufficiently short build-up time (1.5 to 2 seconds) in response,

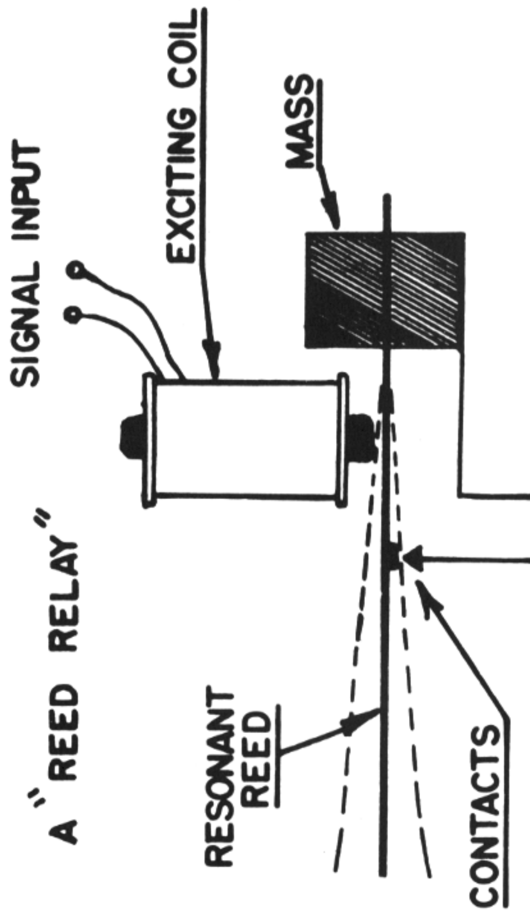

A "REED RELAY"
SIGNAL INPUT
EXCITING COIL
MASS
RESONANT REED
CONTACTS
OUTPUT

FIG. 1

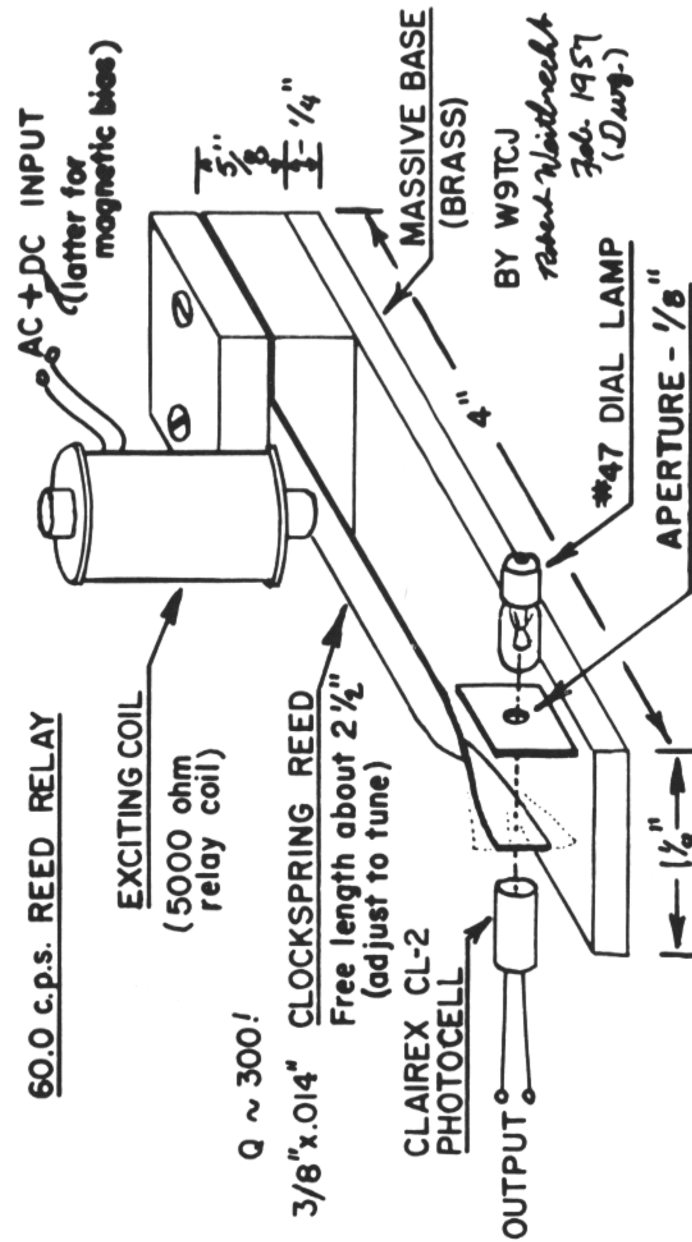
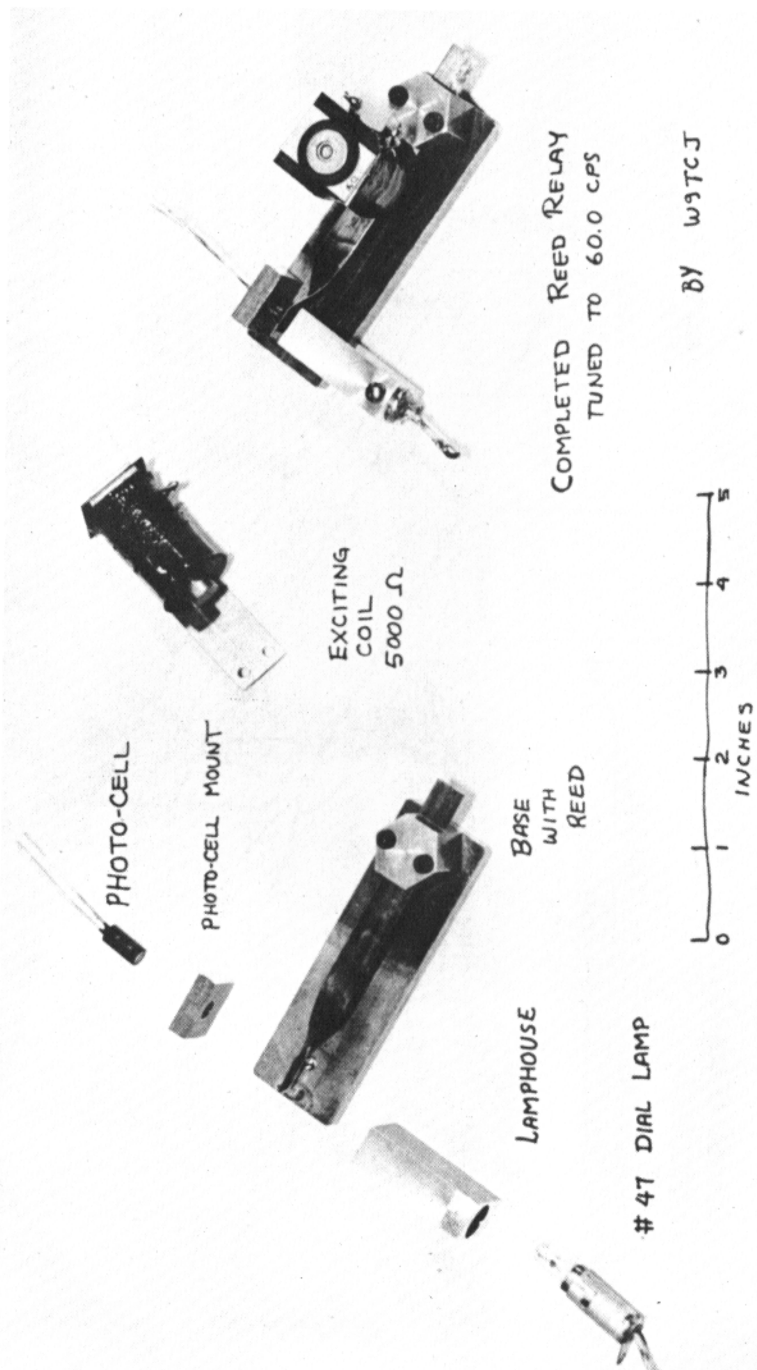

60.0 c.p.s. REED RELAY
Q ~ 300!
3/8"x.014" CLOCKSPRING REED
Free length about 2½" (adjust to tune)
AC + DC INPUT (latter for magnetic bias)
EXCITING COIL (5000 ohm relay coil)
CLAIREX CL-2 PHOTOCELL
OUTPUT
5/8"
1/4"
MASSIVE BASE (BRASS)
4"
#47 DIAL LAMP
APERTURE - 1/8"
1⅛"
BY W9TCJ
Robert Weitbrecht Feb. 1957 (Dwg.)

FIG. 2

FIG. 3—EXPLODED VIEW OF REED RELAY



and the frequency is available everywhere with close tolerance to operate the high-Q reed. And such a reed-relay can be easily constructed at low cost.

6—The WØBP Resonant Reed "Autocall:"

Here we will digress for a moment and mention an interesting development that Boyd Phelps, WØBP, has done along this line of autostart-autocall. During our discussions about systems using the resonant reed principle of selective response, Beep proposed and constructed a 6.1 cps hacksaw-blade reed, and vibrated (like a Vibroplex key) by a relay coil placed near the reed. He adjusted the length of this reed, weighted on its free end, so it responded to a frequency of 6.1 cps, the frequency of the teleprinter signal transmitting letter "O" repeatedly (key held down and transmitting cam allowed to revolve continuously). Subsequent circuits were installed to ring a bell, light a lamp, and start a clock upon receipt of such a 6.1 cps signal after a few seconds buildup to maximum amplitude. Beep says that it is for "autocall" purposes only for the present. However I feel, that, with some further development, this system could be used for printer autostart; however the low frequency of 6.1 cps coupled with the necessarily high-Q characteristic of the reed make for a relatively long buildup time for the latter to get to full amplitude for energizing other circuits. This means at least 10 - 15 seconds of letter "O" repeats. This objection, however, may be minimized somewhat by transmitting the letter "I" which gives a frequency of 12.2 cps, feeding into a 12.2 cps reed with shorter buildup time. And with the 60 cps reed-relay in the W9TCJ autostart, about 2 seconds of buzzing results in motor start.

7—Terminal Unit Design:

Having described the manner of operation of the W9TCJ autostart system, it remains to investigate the signal circuits needed for the system to function properly. This part will discuss only general principles and characteristics; the actual circuit will be in the second part of the paper.

Inasmuch as the signal circuits will handle either the usual teleprinter signal or the automatic start "buzzing" signal, it follows that the circuit could be of almost any standard terminal unit design. The buzzing signal is of not much higher frequency than that of the third harmonic involved in the teleprinter square-waves. Hence the TU ought to have reasonably broad mark and space band-pass filters — not only for good square-wave response but also to accommodate slight frequency drifts or misalignment on either or both transmitter or receiver. A good value for such band-passes is 250-300 cps centered about mark and space frequencies. Any value wider than that only invites trouble due to QRM from adjacent channels.

8—Radio Frequency Control.

Now we are faced with a major problem, "radio frequency control," before we can achieve successful FSK autostarts on the low frequency amateur bands. While the mark and space bandwidths in the autostart TU are of the order of 300 cps, relatively wide by audio standards, it is more of a problem to set a FSK carrier exactly on the autostart channel so that the mark and space frequencies will be properly hetrodyned and caused to fall squarely through these audio filters. This definitely calls for stable receivers and transmitters, plus the operator's ability to set up desired autostart frequencies to the degree of precision required. For an estimate, one should be able to set up to within 50 cycles of the specified frequency. This is very easy to accomplish with a little auxiliary equipment and a proper procedure. In fact, with the aid of a 100 kc crystal standard plus a 10 kc multivibrator, one can adjust his transmitter frequency to within several cycles of 7140.000 kc, for example, taking only a few seconds to accomplish the line-up. The surplus LM frequency meters also would serve excellently when carefully calibrated.

The best way of achieving radio frequency control — i.e. calibration and stability — is to employ crystal control throughout in both transmitter and receiver. Standard crystal FSK circuits exist, and inexpensive crystals are obtainable that have excellent calibration holding properties. An autostart channel can be set up on a specified frequency and thereafter the operator only need transmit a buzz-signal for a few seconds in order to start up a distant printer. All in all, such a set-up is ideal for intercity RTTY circuits. Several separate autostart channels can be set up on each band, in addition to the several discrete buzzing-frequencies and thus realizing the equivalent of "picking up a telephone dialing a number, and talking to your friend at the other end." It has been many times demonstrated that properly aligned crystal-controls have more than the required degree of accuracy for general auto-start work with a minimum of frequency control worries.

In conclusion the frequency control problem just discussed stems from the need for "dropping" the audio mark and space frequencies right through the filter "hatches" of the receiving TU. We wish to keep these hatches quite narrow to obtain all possible freedom from interference by adjacent channel signals. We can zero-in on spot frequencies easily yet exactly, using auxiliary equipment or crystal control. There is no valid reason why this cannot be done by those really desiring reliable unattended printer operation. The discipline and techniques needed will be of considerable benefit to the RTTY amateurs, generally and is definitely good for the progress of the radio art. Witness the need for careful tuning on SSB phone signals as well as on RTTY signals, especially on short-shift.

It is obvious that this system of auto-start can be used to advantage on VHF, using AFSK (tone modulated radiotelephony) emissions. Assuming that the transmitting operator has the proper 2125 and 2975 cps tones set up, there is a much-relaved attitude about radio frequency control here, and both transmitter and receiver need only be set that at least the AM or FM signal gets through.

In the next part we will describe the W9TCJ autostart printer system, with circuits shown, including description of a stable receiver necessary for low-frequency amateur autostart work on a 24 hour basis, for 80, or 40 spot frequency set-up And the final part will include some hints for frequency spotting and adjustment, along with a circuit for injecting the 60.0 cps buzzing signal into the RTTY transmitter.

PART 2—DESCRIPTION OF THE W9TCJ AUTOSTART PRINTER SYSTEM

In the first part, some discussion was given on principles and design criteria underlying the automatic start system using the reed-relay method of selective response. The following material gives down to earth practical information on the circuits used in the W9TCJ system, together with appropriate discussions pertaining to particular features as they come up in the paper. We will now begin with the signal input to the receiver and work towards the final result—a message received on unattended basis.

1—The Radio Receiver:
First of all, we have to keep in mind the need for "radio frequency control" and find out how we may achieve such a stable receiver that can be relied upon to monitor the given channel and accept any and all directed RTTY signals within a specified tolerance of plus or minus 50 cps. One receiver that would fill the above bill is a Collins 75A; it being a double conversion superhet with a crystal controlled front end feeding into a first i-f amplifier. After this latter amplifier, there is a mixer fed by a permeability tuned oscillator covering a range in the 2 mc region and this latter oscillator is very stable primarily from the fact that its frequency is low and residual drifts are of minor importance. However such a receiver is very expensive and really should not be "assigned" to monitor a single frequency at all times. What one needs is a simpler and ideally spot-frequency receiver for that kind of monitoring duty.

There is the possibility of using fixed-tune radio receivers, such as the Wilcox CW-3's. This is a quite good idea, because the front-end is crystal controlled and can be relied on to be highly stable for our purposes. However the i-f of such a receiver is quite broad and will take in interfering signals that happen to be adjacent to our autostart channel; and more seriously, the "audio-image" signals (from other side of zero beat). This suggests that such a receiver system will need Q-5er i-f selectivity and it could be installed using a low frequency i-f as an extra on the receiver itself. The final combination would give us about the right equipment needed for our autostart set-up. Furthermore, as the terminal unit, here, has no limiter stage, we shall want AVC in our receiver design in order to maintain the audio signal level fairly constant when receiving RTTY.

Speaking of the "Q-5er" why not make use of a BC-453, 190-500 kc Command receiver and fit it with a crystal controlled converter? All that is required is to build the converter and one then comes up with the "made to order" autostart receiver! A most excellent description of such a set-up appeared recently in the January, 1956 CQ magazine, by Don Stoner, W6TNS.

A very similar set-up is used with the W9TCJ Autostart system and I have found it highly satisfactory and exceptionally stable; in fact the continuously running receiver can be set on channel and it will stay to within a few cycles for days and weeks on end without re-tuning. I heartly recommend this kind of receiver for spot-frequency working as it is so very stable and yet costs little to construct, all that is needed is a BC453 receiver in good condition, with a crystal and a few small parts for the converter and power supply.

Of course my receiver has a few differences from the W6TNS model. In order to always have the crystal frequency lower than the signal frequency, to avoid ending up with "upside-down FSK signal output at receiver audio" I use separate crystals, namely 3200 and 6700 kc, in the 6BE6 oscillator when working 80 or 40 meter bands. The rf amplifier, using a 6BJ6, is entirely conventional; and coils for both that and the mixer are separate and switchable for either band. The Command receiver is tuned to near 400 kc when receiving RTTY signals on either band, and that i-f frequency is appreciably high enough to minimize image problems. I have not had any trouble with images on either band, and yet the ability to TUNE such a receiver anywhere in a band and still have a stable system makes the above combination a highly desireable one.

The BC453 itself has been modified. The AVC line is returned to work right off the diode detector load (use 2 meg. resistor in series with AVC line to this point) instead of from the grid of the last 85 kc i-f stage. Bakelite pins on top of the three 85 kc transformers have pulled up and the latter's alignment have been touched up in order to acheive an optimum i-f selectivity response for RTTY work. The audio stage has been modified to the extent of removal of the bypass capacitor that is across the output transformer as we want to have good output at 3 kc as well as at 2 kc from this stage. In regard to the BFO, it has been readjusted (Install a 40 mmf ceramic capacitor from BFO plate to ground. This shifts the BFO frequency low enough to set the mark and spoce signals symmetrically around the if peak). The series resistor that feeds B power to the BFO has been adjusted to obtain reduced BFO injection level; in order to (1) minimize the BFO effect upon the AVC and (2) to regulate the amount of heterodyning in the second detector. (Actually, the original 20,000 ohm resistor will probably be adequate because the further offsetting of BFO frequency from i-f peak cuts down on the injection quite markedly and happens to be about right amount in my set-up). In fact, with such a limited BFO level, the audio output remains fairly constant even if the i-f signal level varies. This feature, coupled with AVC action, aids in providing a constant level of audio output power over a wide range of rf input signal intensities, a necessity for working into a limiterless terminal unit.

Other receiver modifications include re-wiring the heater circuit and installation of a power supply of sufficient capacity for operating the entire receiver, converter and terminal unit (except magnet keyer stage). Selenium rectifiers (this saves ten watts drain that otherwise results with a rectifier tube filament) are employed with a transformer (Stancor PM-8419), and feeding into a single 20-30 henry choke backed up by a 40 mfd electrolytic capacitor. The voltage output from this supply is some 180 volts at about 50 mils overall drain, the voltage being low enough so that there is no strain on receiver components, thus aiding in long-term reliability. No voltage regulator tubes have been found necessary. The selenium rectifiers are 120 volt 65 ma units and four of them are employed; two in each HV secondary leg with a 500 ohm series resistor to limit surge through the rectifiers. As in the original Command receiver setup, a 20,000 ohm potentiometer is installed to handle the currents from the rf and i-f amplifier cathodes; this is a supplementary gain control and is employed to adjust the autostart receiver sensitivity threshhold. A switch is installed to short the AVC line to ground, in order to disable the AVC when it is necessary to do so as in during receiver tuneups.

Recapitulating on the receiver portion:

1. BC453 receiver with xtal controlled converter, run on selenium power supply, transformer operated.
2. AVC line returned to diode detector, through a 2 meg resistor. AVC line has a switch so it can be shorted ground whenever necessary.
3. BFO offset from i-f peak and injection level adjusted if necessary. 40 mmf. capacitor installed.
4. Pull up i-f transformer bakelite pins and realign if necessary.
5. In the converter, take note that error in the Jan. '56 article which has caused consternation, namely; in

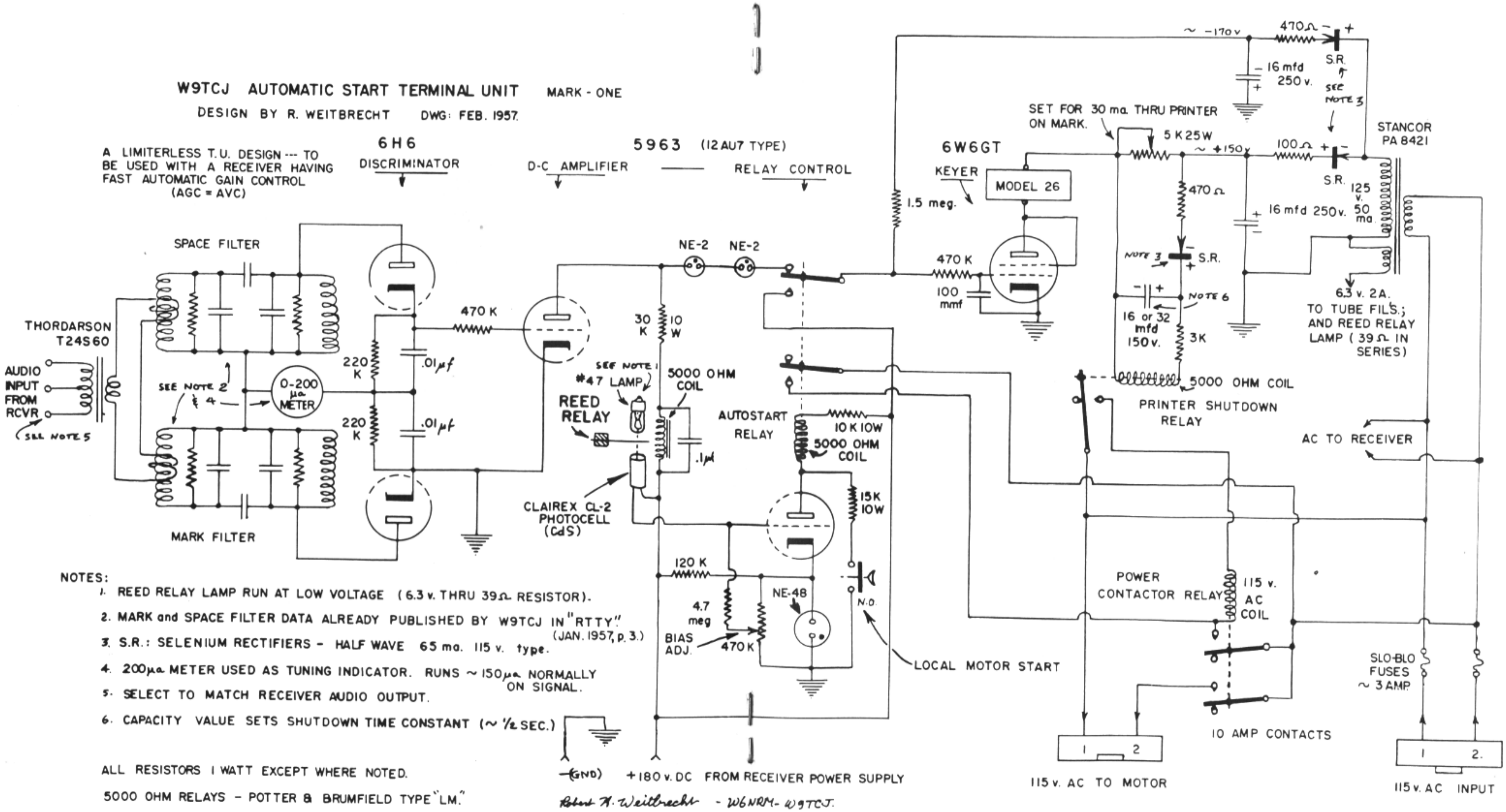

W9TCJ AUTOMATIC START TERMINAL UNIT MARK - ONE
DESIGN BY R. WEITBRECHT DWG: FEB. 1957.
A LIMITERLESS T.U. DESIGN --- TO BE USED WITH A RECEIVER HAVING FAST AUTOMATIC GAIN CONTROL (AGC = AVC)
6H6 DISCRIMINATOR
5963 (12AU7 TYPE)
D-C AMPLIFIER —— RELAY CONTROL
6W6GT KEYER
MODEL 26
SPACE FILTER
MARK FILTER
THORDARSON T24S60
AUDIO INPUT FROM RCVR
SEE NOTE 5
SEE NOTE 2 & 4
0-200 μa METER
220 K
220 K
.01μf
.01μf
470 K
NE-2
NE-2
30 K
10 W
SEE NOTE 1
#47 LAMP
5000 OHM COIL
REED RELAY
.1μf
CLAIREX CL-2 PHOTOCELL (CdS)
AUTOSTART RELAY
10 K 10W
5000 OHM COIL
15K 10W
120 K
4.7 meg
NE-48
BIAS ADJ.
470 K
N.O.
LOCAL MOTOR START
1.5 meg.
470 K
100 mmf
~ -170 v.
470 Ω
S.R.
16 mfd 250 v.
SEE NOTE 3
SET FOR 30 ma. THRU PRINTER ON MARK.
5 K 25W
~ +150 v.
100 Ω
S.R.
STANCOR PA 8421
125 v. 50 ma.
470 Ω
16 mfd 250v.
NOTE 3
S.R.
NOTE 6
16 or 32 mfd 150v.
3K
5000 OHM COIL
PRINTER SHUTDOWN RELAY
6.3 v. 2A. TO TUBE FILS.; AND REED RELAY LAMP (39 Ω IN SERIES)
AC TO RECEIVER
POWER CONTACTOR RELAY
115 v. AC COIL
10 AMP CONTACTS
SLO-BLO FUSES ~ 3 AMP.
1 2
115 v. AC TO MOTOR
1 2.
115 v. AC INPUT
NOTES:
1. REED RELAY LAMP RUN AT LOW VOLTAGE (6.3 v. THRU 39Ω RESISTOR).
2. MARK and SPACE FILTER DATA ALREADY PUBLISHED BY W9TCJ IN "RTTY" (JAN. 1957, p. 3.)
3. S.R.: SELENIUM RECTIFIERS - HALF WAVE 65 ma. 115 v. type.
4. 200μa METER USED AS TUNING INDICATOR. RUNS ~ 150μa NORMALLY ON SIGNAL.
5. SELECT TO MATCH RECEIVER AUDIO OUTPUT.
6. CAPACITY VALUE SETS SHUTDOWN TIME CONSTANT (~ ½ SEC.)
ALL RESISTORS 1 WATT EXCEPT WHERE NOTED.
5000 OHM RELAYS - POTTER & BRUMFIELD TYPE "LM."
-(GND) +180 v. DC FROM RECEIVER POWER SUPPLY
Robert H. Weitbrecht - W6NRM- W9TCJ.

FIGURE 4.

stead of the .005 mf capacitor called for in the 6BE6 oscillator circuit, use a 50 mmf unit, and then the crystal will oscillate.

6. Have a 20,000 ohm volume control on the receiver, to adjust the current through the cathodes of rf and i-f amplifier stages, as a means of sensitivity threshold.

7. Audio bypass capacitor omitted. Output transformer impedance placed on high point.

In short, following the above hints will give you a very fine little receiver for spot frequency operation. Overall power drain is about 30 to 40 watts, so leave it on continuously in order to have 24-hour monitoring and at same time have a well warmed up and stabilized receiver. One other item I would like to try out soon is a product detector to replace the diode second detector in the receiver to see if it might give an improvement. You might want to consider that, too.

2a—The Terminal Unit with Autostart: Figure 4 shows the circuit of the terminal unit, employing a total of three tubes, for keying the teleprinter magnet as well as for autostart. In the interests of simplicity and low power consumption as well as for other reasons, no limiter stage nor bandpass filter is used in this circuit. Audio selectivity is then dependant upon the toroidal filters used for mark and space discrimination. These 88 mh telephone toroids were described in January, 1957 RTTY. together with a discriminator circuit and some operating notes. The BC453 receiver audio stage feeds directly into the mark and space filters via an impedance matching transformer, Thordarson T-24S60. The outputs from the filters go into a pair of diodes, in the form of a 6H6 and this detector circuit is arranged so as to yield a total swing of 40 volts which next feeds into a triode DC amplifier. On mark the rectifier delivers negative 20 volts with respect to ground and on space it is positive 20 volts; assuming that things are properly adjusted at the receiver.

The DC amplifier serves double duty, one for amplifying the DC swing enough to properly operate the maget keyer tube and the other, for driving the exciting coil of the reed-relay. This 5000 ohm coil is a part of the amplifier's load resistance and thus the flowing plate-current provides the needed "magnetic bias" to cause the reed to follow the fundamental frequency input. One triode thus suffices for both purposes and this is contained in one-half of a type 5963 tube, a 12AU7 type tube with special processing to prevent "sleeping sickness" due to long periods of bias cut-off. The other section is employed for operating the autostart relay in its plate circuit; this relay serving two functions, to operate the motor-start circuit and to "shut off" the magnet keyer during the buzzing period. In order to operate this other triode circuit, a cadmium sulphide photocell, Clairex type CL-2, is mounted on the reed-relay assembly so that it "looks" at a radio dial lamp running at reduced voltage when the reed is vibrating at nearly full amplitude. This photocell functions as a light-sensitive variable resistance; it then dropping in value from many megohms in dark to some 500,000 ohms when exposed to light. One side of the photocell is connected to B plus, and the other side feeds into a load resistor. The resulting voltage drop then feeds into the grid of the relay triode, driving it positive and causing the triode to conduct. During "dark" i.e. no buzzing, the triode is biased to cut-off by means of a NE-48 lamp placed in its cathode. As a partial provision for autostart sensitivity adjustment, a potentiometer is connected across the neon lamp, and the photocell load resistor is returned to the pot's moveable contact: in this way, the amount of negative bias is controlled on the relay tube's grid.

2b—The Magnet Keyer Circuit and Motor Shutdown System:

Returning to the first section of the 5963; i.e. the DC amplifier, the plate-swing output from the mark and space signal is fed to the grid of the 6W6GT magnet keyer tube via a couple of NE-2 "voltage steppers" and a pair of contacts on the autostart relay. The latter is needed in order to connect the grid of the keyer to a positive source of voltage and thus keep the keyer conducting on steady mark during the buzzing period and resulting motor startup. When the reed-relay stops vibrating, light is cut off from the photocell; and this causes the aforementioned relay to open, thus releasing the grid of the keyer to be controlled by the incoming intelligence.

The magnet keyer circuit uses a 6W6GT arranged so that the tube functions as a switch, with the Model 26 teleprinter magnet in its plate circuit. DC power is supplied by a small transformer operated selenium power supply, entirely separate from that of the receiver and running some 150 volts at 30 mils, as well as providing a small amount of current to the NE-2 "keep-alive" circuit at -170 volts. This too assures that the 6W6GT grid will swing negative cut-off on space transitions. This is an effective magnet keyer and is in use also in other W9TCJ terminal units. By adjusting the series resistance shown and if necessary by using somewhat larger components, 60 mils can be obtained for operating a Model 15 if that is desired. As the W9TCJ system stands, it is used with a Model 26 that has not been rewired; i.e. the signal output from the magnet keyer is merely hooked into the printer's signal line as it was originally employed for landline work. This makes the keyboard circuit available for making tests on the printer and for locally shutting down the machine merely by pressing the keyboard "break button."

Now that mention has been made of the provision for "local printer shutdown," it is well to discuss this in some detail and show how it is accomplished, not only locally but remotely. Pressing the "break" button opens the printer signal line and causes it to go on a steady space condition for the duration that the button is down. Shown in Figure 4 is a simple R-C network, equipped with a rectifier, that feeds into a printer shutdown relay which contacts in turn control the lockup circuits on the motor relay. The R-C network is placed in the signal line of the printer magnet keyer circuit and if a prolonged space (no current) condition is present, the charge on the capacitor is lost through the relay, and then it opens, thus releasing the motor relay. On mark, current flows thus charging the capacitor and keeping it supplied with energy so that the relay is held closed, thus keeping the motor relay lockup circuit closed. The selenium rectifier is used as a "one-way valve" to prevent the capacitor from emptying its charge back into the signal line in case of space transitions of a normal teleprinter signal. The time constant of the R-C network is adjusted so as to open the motor lockup circuit when a porlonged space signal is received, over one quarter or one half second. This is a simple yet effective method of printer shutdown, depending upon the fact that during a normal transmission, mark is always present a great portion of the time; and moreover the longest space signal in any teleprinter character is the "blank" consisting of 132 milliseconds.

This R-C system is hooked across the series resistance that regulates the printer line-current so the voltage drop that exists across that resistor energizes the circuit. It only takes about 5 mills from the line (adjust the resistance until at least 30 mills flows through the printer magnet itself) and tests have shown that there is no effect on the printer's range (20 to 110, centered on 65). The capacitor is a 16 mfd electrolytic and it supplies energy through a resistor to the coil of the relay thus keeping it closed, so long as there are some mark energy pulses coming through the rectifier to keep the charge replenished.

Thus, the printer shutdown control is described and it is obvious that it is under the distant tranmitting operator's direction; all that he need do is to transmit at least 5 seconds of steady-space, merely by holding down his keyboard "break" button.

2c—Motor Control Circuits:

This portion of the system is largely self-explanatory, as references have been made to various relays used for motor control. There are four relays directly involved; (1) the reed-relay, which upon receipt of a buzz-signal of the proper frequency, causes the closure of (2) the autostart relay via phototube and triode relay stage. This relay closes the circuit to the (3) power contactor or motor relay, thus starting up the motor in the printer. During this time, and as long as the buzz is on, the autostart relay holds the magnet line on steady mark to prevent wild printing. The motor relay has a pair of contacts that keep it locked up after cessation of buzzing, and the printer is now ready to take the message. And when the printer is to be shut down, the steady-space signal allows the (4) printer shutdown relay to open the lockup circuit, resulting in motor relay opening and and shutting down the motor. The model 26 teleprinter power cord is merely plugged into the motor control circuit, and no modification of any sort have been done to the machine or its table wiring, as it presently stands.

3—Conclusion:

The entire W9TCJ autostart, employing a method of selective response and useable on h-f amateur bands with FSK emission, is described and circuits have been shown. The equipment was designed with the factor of ease of control-signalling foremost in mind; and using a simplified terminal unit with autostart. The readily available 60.0 cps. "signal" from the power line serves excellently for the "buzzing signal" that is easily injected into the RTTY transmitter as mark-and-space reversals. The selective control is obtained by using a reed-relay that can be constructed at low cost, and, furthermore, it could be extended to some other specific buzzing frequencies — resulting in a versatile individual-station calling system. Not only can different buzz-frequencies be used, but different radio-frequency channels as well, thus multiplying the number of discrete stations that can be called. The 60 cps frequency could and should for the time being used as an "universal" buzz-frequency — and this brings up another idea.

It is entirely possible that a system could be arranged, along these lines, so that the 60 cps buzzing signal results in motor starts on all printers within range. Now, as it is desired to operate only a certain printer on a directed control basis, one could transmit a special "teleprinter call-code" consisting of a combination of two letters, such as RWRW. A pair of microswitches mounted so as to sense the code on the typing unit of the one "RW" printer called would then energize a lockup circuit to keep the machine running. All the rest of the printers would close down, controlled by automatic shutdown delay circuits, operating after say 15 seconds. In this way a message could be sent to a specific printer that is one of a multitude of machines using the same channel and buzz-frequency. Give this a thought.

This W9TCJ autostart was first placed into operation in June, 1956, and tests were made to the home-printer from the Starved Rock Hamfest at Ottawa, Illinois just 100 miles south. The regular station was taken down there and set up for demonstration of ham RTTY. On 3622.5 kc a number of calls were made to the home-printer — resulting in successful unattended printer reception there. My mother received these messages and was so enthused that she put in a long distance telephone call to Ottawa to let me know that my one-way messages were recorded.

Since then, the equipment has been on more or less continuous monitoring basis and has received some messages from WØBP and, more recently, from W8SDZ Keith Peterson of Swanton, Ohio, to whom my sincere thanks must be expressed for all the efforts that he went to to make a great many one-way transmissions to aid me in evaluating and adjusting the autostart system for best performance. Keith has proved his ability to set his transmitter close enough in frequency to cause hightly reiable autostart receiption here at W9TCJ.

The system is immune to false-starts due to CW or RTTY signals that happen to be on frequency, as well as to noise. One could ask now whether a 60 cps buzz of any kind that happens to get into the system could start it, and the answer is a "qualified no." The reed-relay and autostart circuits have been adjusted so that nearly the full 40 volts of discriminator swing is required to bring the reed-relay to near maximum amplitude of vibration; and to cause that a FSK signal is required, containing 60 cps equalized mark and space reversals, and with a 850 cycle shift, properly

centered in the autostart channel. This is one design consideration aimed at avoiding false starts from such noise as "ITV" television receiver noise (horizontal oscillator) that is rampant on the lower frequency amateur bands in locations where there are nearby TV nabors. Actually as such a noise sweeps through the autostart channel, the printer will, very rarely, start up and run wild for just five or ten letters, then shut itself down. This happens on the average of once a week or less often, and there are three TV sets within 50-100 feet of the W9TCJ QHT. The tuning meter on the autostart receiver will respond and show such signals. I am not worried about this problem as it is inconsequential and the printer has never been found to be running for hours on no-signal; its printer shutdown circuit has such a short time-constant that if one quarter or one half second of steady space is had, it operates. And the simplified terminal unit has a slight no-signal spacing bias tendency that serves to aid in shutdown. In fact, when a strong RTTY signal is taken off the air, the system shuts down by itself "at once" because the AVC in the receiver takes a certain time to re-adjust itself: and hence when carrier is cut, the audio disappears from the TU and the aforementioned spacing-bias tendency comes into play to shut down the printer. In regard to ITV and noise in general, the gain control on the BC453 receiver is adjusted so as to cause a barely perceptible reading on the tuning meter on no-signal. This way, one assures shutdown, and the threshhold is such that signals from stations nearby (of order of 300 miles or more) have sufficient signal strength to operate the W9TCJ system, on a relatively short indoor antenna wire.

As for quality of printing. On good steady signals, the system prints 100 percent perfect, as has been proved by reception from stations such as WØBP and W8SDZ, both stations some 300 to 400 miles from here, as well as from stations closer by. On weak rapidly QSBing signals, often the system will print tolerably well, yielding messages that have occasional hits, even though such a signal may print perfectly on another TU that has an efficient limiter on its input. So here in this present TU design, compromises have been taken in interests of simplicity, low power-drain, reliable shutdown. I tried a limiter on this autostart TU and discovered that the added circuit generates so much noise that the discriminator,DC amplifier loses its characteristic no-signal spacing bias tendency. The printer then tends to run continuously, printing wild on no signal. Additional circuits are being devised to assure this printer shutdown on noise alone, and this is part of some current development work I am doing, on a "Mark II" autostart TU.

In retrospect; it seems that machine telegraphy is at its best in two fields: (1) Wholesale message traffic handling, where the high machine printing speed is beneficial in transmitting large amounts of information over a circuit in the shortest possible time, and with the people who are relatively unskilled in "Morse Code," they only need be good enough typists to operate these teleprinters. (2) Automatic unattended printer operation, where messages can be transmitted to and left upon such machines without anybody being present during reception, thus a kind of "message recorder," akin to a postman leaving a letter in one's mailbox while addressee is out or otherwise occupied. In this latter application, autostart printer are abviously of utility. And speaking of Amateur Radio, as one well knows, this game is a "catch as can catch" affair, when one wants to talk to a particular station, he has to keep previously arranged "sked" or take a chance that the other fellow happens to be on the air at that particular time. I suppose that various ways have been devised by hams to enable instant call and answer possibilities to be realized on phone or CW but with varying degrees of success. And here, with our RTTY equipment, we have a golden opportunity to put our teleprinters on "instant call" at all times.

Busy people, as has been remarked before, can make good use of these automatic unattended message recording devices and also be able to call each other if necessary. In this way we can keep all our precious teleprinters on duty as much as possible, whether in actual communication or on standby monitoring on call. Let's go autostart, we have the machines, and I have presented one method of autostart in this write-up. Can we devise a simpler and more reliable autostart system? Such a system should have the desirable features of selective response, print well on directed signals at any reasonable time, and be immune to other signals and noise.

The third and final part will now concern itself with some methods of radio frequency control and buzz-signal injection into a RTTY transmitter.

PART III—RADIO FREQUENCY CONTROL AND BUZZING CIRCUIT

1—"Radio Frequency Spotting:"

As pointed out in the preceding pages, the major problem of "radio frequency control" if we are to achieve reliable FSK autostarts on low frequency amateur bands. Frequency settings and stabilities assume equal importance in both transmitter and receiver ends of a proposed autostart circuit. It has indicated that one should be able to set up a frequency, on either transmitter or receiver, to within a tolerance of plus or minus 50 cps; and that is quite easy to accomplish this with the proper auxiliary equipment.

In the second part, a description of a receiver that has satisfactory stability for this kind of work was given. It is indeed remarkable that the little BC453 receiver, equipped with a crystal controlled converter, has adequate stability and can be relied upon to monitor an autostart RTTY channel on a continuous basis; and to do this for days and weeks without any need for retuning. Again I repeat, I highly recommend this receiver set-up primarily because of its stability, selectivity, ease of tuning to different frequency, and low cost.

Now we will discuss the transmitter frequency control problem. We want to be able to "aim" the think with the required degree of precesion in order to score a direct hit upon the bullseye, so the autostart TU obtains its properly placed mark and space tones through the receiver as set up on the channel. one logical method is crystal control, and this is an ideal way when it is desired to have a complete autostart RTTY station that requires a minimum of attention of any sort once set up on a specified channel. In other words, only the teleprinter should be in plain view, equipped with the necessary controls for transmission, reception and the like—and the rest of the equipment placed out of the way in a locked cabinet. Life is getting complicated enough as it stands now-a-days and we desire to acheive the ultimate in simplicity and ease of operating our radio teleprinter equipment. We want to get rid of frequency control worries and problems in the simplest manner we each are able to do, and we will now discuss some various methods of frequency spotting.

An ideal frequency spotter is a 100 kc crystal standard, equipped with multivibrators for subdividing down to 10 kc, 2.5 kc and 2 kc. This instrument generates and places precise beats all the way through the radio spectrum, and when the 100 kc crystal harmonic is synchronized to zero beat on a signal from WWV, then one obtains calibration accuracy of one part in a million or better. It is then practical to get a desired "reference point" accurate to several cycles on the 80 meter band, for instance. Such standards are available in kit form or otherwise, from various sources (One source: International Crystal Mfg. Co., Oklahoma City) and do not cost much, yet are of tremendous usefulness and necessity for the amateur interested in precise frequency spotting.

Some of the higher priced receivers have built in crystal standards, and such are usable to correct the bandspread dial to obtain "direct frequency reading." Provided the dial is actually linear and does not deviate from indicated frequency points over the range between successive 100 kc points, such a receiver should be capable of precise frequency spotting. It is important that the dial be calibrated in steps of integral kilocycles (or better) and that the tuning mechanism be free from backlash. The Collins 75A receivers are supposed to be in this category and it is interesting to review some of the tests that Keith Petersen, W8SDZ and I conducted relative to frequency calibrations and spottings. In the Fall of 1956 Keith took interest in autostart and commenced tests and call to my equipment, depending on the dial calibration of this 75A receiver to align his transmitter VFO to the channel. Taking care to preset his receiver dial to a 100 kc spot from his internal 100 kc standard, he set the receiver next to 3624.0 kc mark and afterwards tuned up his transmitter VFO to that frequency. My observations of his resulting transmitter frequency, using my precise (used in ARRL FMT's) equipment indicated that he was able to hit the channel consistently within 50 or 100 cycles and resulted in many successful autostarts here at W9TCJ. In fact, hardly any message was missed and this all the more remarkable, considering the many adverse factors that can and do intrude to block the circuit between calling station and called station.

Keith employed that method above for some time until trouble developed in the PTO part of his receiver, necessitating replacement of that portion with a new unit obtained from the Collins factory. After the change was made, it turned out that the dial calibration became grossly nonlinear and the kilocycle divisions no longer indicated true frequency settings. Some dial settings were found to be as much as several hundred cycles off, especiaally when a ways from the 100 kc calibrating point. So this indicates that commercially available receiver equipment is not to be trusted too far as far as frequency calibration is concerned, even if equipped with 100 kc standards. For instance, most such dials only read to one kilocycle divisions and when one considers the 50 cps tolerance required in the autostart system, this means one has to estimate his dial setting to within 1/20th of a division! And extreme care has to be taken to avoid dial-scale parallax, that phenomenon of changing dial reading due to change in viewing angle upon dial from eye, with respect to the dial's fidicuial mark. Considering all the above factors it is really amazing that Keith succeeded so well in leaving messages on my unattended printer.

Keith went to crystal control on his transmitter on the autostart channel and is now consistently successful in leaving messages here. He uses an International Crystal FA-9 unit, calibrated to a frequency 0.6 kc lower than the desired channel mark frequency, in a standard Collins 709-D-1 type FSK circuit and obtains both the stability and full 850 cycle shift on the 80-meter frequency of 3624.000 kc mark high. Yes, indeed, full shift is available on such a low frequency and for the purpose of information, it was found that a plated crystal such as International's was capable of sufficient rubbery flexibility to go 850 cycle shift. FT-243 type units do not permit such a degree of shift as they are differently manufactured. Furthermore, the FSK oscillator circuit was altered to the extent of keeping the oscillator grid to ground capacity as low as possible to obtain sufficient shift at such a low frequency. Short leads were found necessary as well as proper parts placement. No trimmer capacitor to grid from ground, or at least a very small unit as was found needed by Keith in his circuit. All in all, crystal control as he demonstrates results in satisfactory transmitter frequency calibration holding and checks show his frequency to be well within 50 cycles, often 10 or 20 cycles from the channel frequency, plenty good enough! The plated crystals do not seem to drift or vary much with time, age, or even temperature changes so far as has been determined in the past few months of use in various applications. (I have about eight or ten such crystals in various places at W9TCJ; all by International).

About using a transmitter VFO. Sure, it can be used, provided that it is capable of reasonable short term stability, enough to get a message across, and that some means of frequency reference point is available, such as a 100 kc standard with proper multivibrators. Or, as presently employed in my station and at W9LDH's, a newcomer to the field of autostart, the same International Crystal FA-9 units, calibrated to 3624.4 kc, are operated on grid dipper (Colpitts type) oscillators, yielding a reliable reference point for 3624 kc. The grid dipper is tuned or adjusted so as to obtain that desired frequency, depending upon other standards (or over the air signal from W9TCJ) to get that spot. Knowing the dial setting on the dipper, Spence and I, each, are able to generate the exact frequency at any time we desire to have it. Furthermore such crystals will eventually be used in transmitter FSK exciters, so they are a fine investment at $3.00 each for the beginning RTTY autostarter.

So much for frequency standards. By far, the 100 kc standard with 10 kc. multivibrator will deliver precise points 10 kc apart all the way through the spectrum and therefore is a dependable piece of equipment, when properly employed. It would be desirable to add a 2.5 and 2 kc multivibrator; either value selectable by changing appropriate time constants in the MV stage, because usually a finer degree of frequency selection is desired, such as choosing 3624.000 kc or 7137.500 kc spots for autostart setups.

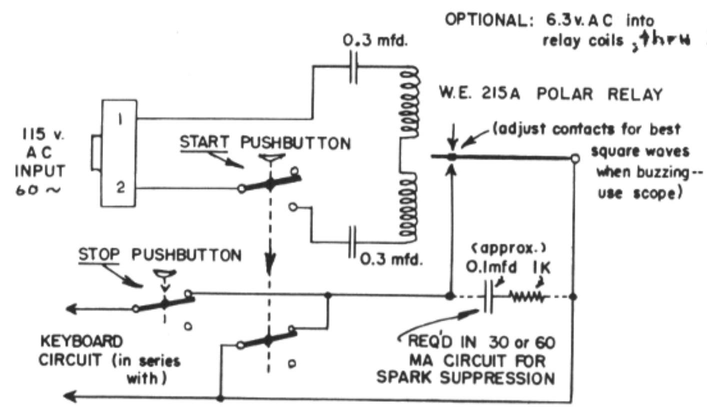
2—Transmitter Tuneup Methods:

Various methods of checking for zero in on selected frequencies are available. My method is to operate a standard radio receiver (such as a BC348Q) in its sharpest xtal selectivity position, i.e. Single signal with audio peaking and BFO circuits thrown in, and tune in a desired beat-signal from the standard. I ascertain I have the right signal by counting from the nearest 100 kc and/or 10 kc point and by reference to known receiver dial settings. Next, I adjust the VFO until its note beats against the standard signal. Several seconds of touch-up enables the VFO to be set to within a cycle or two of the standard beat. I do this daily in various measurement jobs and the experience gives me a clear understanding of what I am doing.

One method, as presently employed by W9LDH, is merely to zero-beat the receiver upon the standard (3624 kc signal from xtal on a grid-dipper), getting the null between the two audio beat notes. Then the VFO is turned on, and it is zeroed in on the previously-set receiver. Depending on the lowest frequency passable by the receiver audio stages, one could get to within perhaps 20 or 30 cycles of the actual frequency.

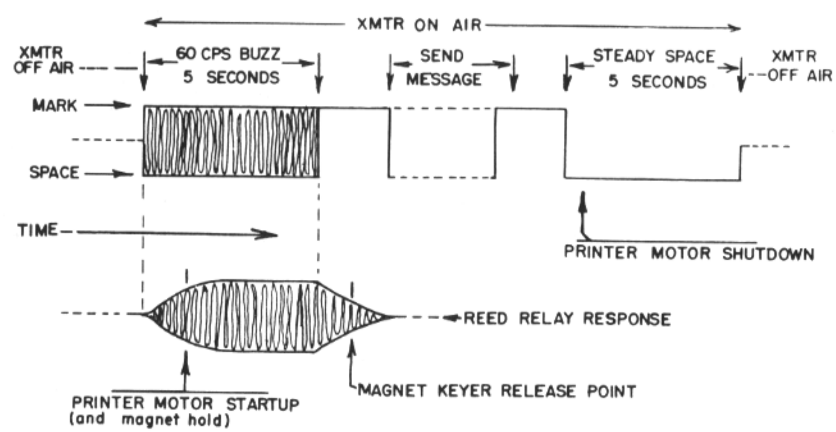
Still another method is to employ the standard RTTY tuning indicator system (scope, or magic eyes), having previously adjusted the receiver upon the standard signal to obtain maximum response on Mark and adjust the VFO so it gives maximum response to the same Mark frequency. My set-up includes a shift meter which, combined with the other indicators to show sense of shift, enables me to zero in to matter of several cycles in a short time.

No doubt, there are other equally acceptable methods of zero in, depending on the particular equipment and habits that a given experienced RTTYer has. It is only required to be able to get to within a few cycles of a certain specified frequency; and furthermore, the specification is always on Mark-High basis, so make sure your VFO is on mark when tuning it in.



60 CPS "BUZZING CIRCUIT" FOR XMITTING MARK-SPACE REVERSALS

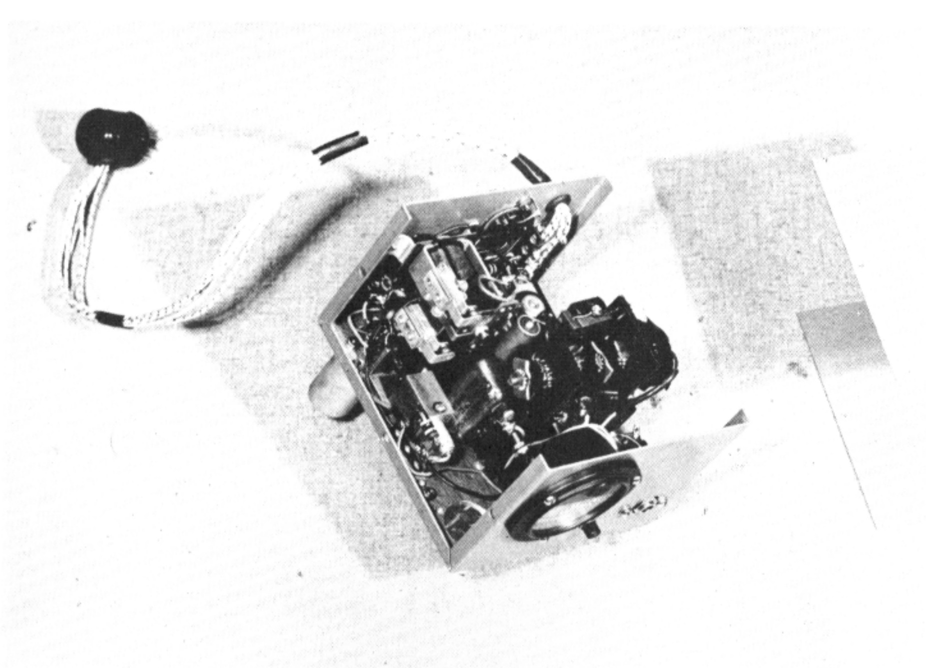
FIG. 5

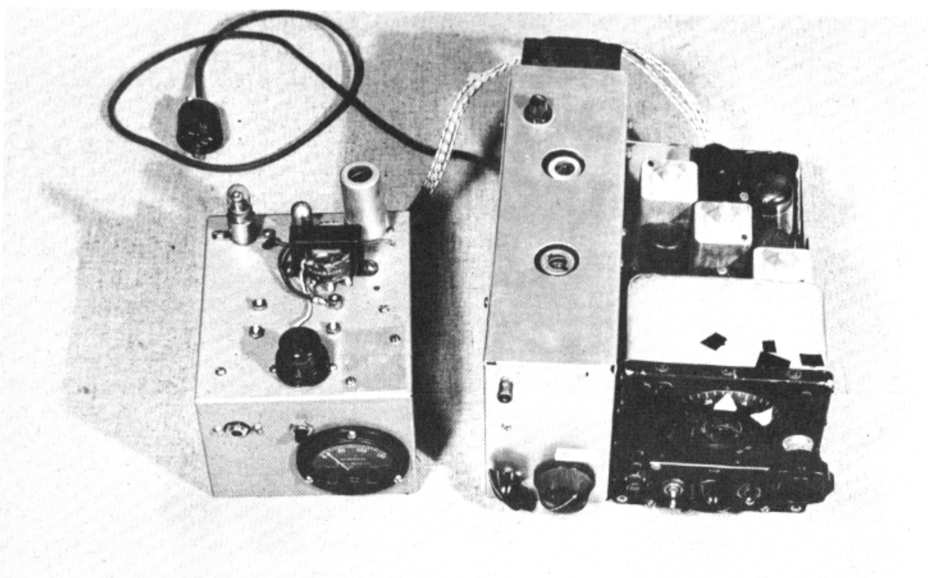


SIGNAL PATTERN FOR W9TCJ AUTOSTART SYSTEM

FIG. 6

Magnet Keyer and some other Relays are separate on another chassis, not shown, but all can be combined on one chassis





TERMINAL UNIT RECEIVER

3—Receiver Tuneup Method: with Reference to W9TCJ System:

Having a 3624 kc signal see up (as from a xtal dipper), the autostart receiver is merely tuned for maximum reading on the tuning meter (200 micro-ampere meter shown in Figure 4). In order to resolve the ambiguity as to sense (Mark or Space), the receiver knob is always tuned in a counter-clockwise direction until the first peak is reached on the meter; this is the Mark setting; the second peak being the Space setting. A little experience will show what is necessary to do to be sure of having the receiver on channel. A pair of NE-2 lamps could be readily wired into the TU so as to show Mark or Space sense during a tuneup and operation.

4—Buzzing Circuit:

Figure 5 shows a suggested circuit for introducing the 60 cps buzzing signal into the FSK circuit of a RTTY transmitter. The signal is obtained by vibrating a polar relay contact from off the AC powerline; the contacts involved then interrupt the keyboard circuit at a 60 cps rate thus generating square waves. It will be necessary to check and adjust the contacts for best reproduction; this is easily done beforehand by using an oscilloscope: feeding a little voltage, DC through the signal circuit and observing the waveform on the scope. This results in a satisfactory method of generating 60 cps mark-space reversals, and the whole thing could be built into a small wood box.

Alternately in some RTTY stransmitter circuits, employing direct electronic keying it is possible to introduce 60 cps voltage internally so as to transmit a buzz signal by means of a push button placed for that purpose. Such is done in the W9TCJ transmitter circuit merely by feeding a little voltage from the 6.3 volt line into the FSK Diode Driver grid. (Use series resistor to limit the current flow).

Anyhow, the idea is to transmit 60 cps mark-space reversals over the RTTY circuit to activate the reed-relay in the autostart receiver system. As shown in Figure 6, the signal pattern is such that at least five seconds of 60 cps buzzing is required before transmitting a message. This assures that the reed-relay has a reasonable chance to come up to full amplitude. And at the conclusion of the buzzing interval, the transmitted signal must rest on Mark; not on Space for even and instant or else the printer shutdown circuit may operate and thus close down the motor. The latter circuit has a purposely short time constant, of order of one half a second. This is the reason for the particular wiring of the start push-button in Figure 5, it is arranged so that when the button is up, it closes the keyboard loop.

After the message is sent, the shutdown procedure is simple. Hold the keyboard Break button down or the Stop button on the buzzing-box for at least five seconds; this transmits a steady Space signal for that duration.

5—Conclusion:

This concludes the three-part paper on the W9TCJ Autostart System, together with frequency setting and buzzing discussions. As it stands, the autostart system is in excellent operating condition and monitors the channel on a 24-hour basis, ready to accept and take any directed message at any time from other stations. The standby power drain is about 30 or 40 watts. The equipment is adjusted so for all practical purposes it is immune to false-starts due to noise, etc. In short, I am well pleased with the set up as it stands and I believe you would be as pleased with the system. How about going autostart, fellows?

Vive Autostart!

Vive Amateur Radioteletype!

Vive Amateur Radio!