or voltage requires a higher quality component. A handy device that can simplify the ever present interfacing problem is a patch board with several different types of connectors. While experimenting or changing the station layout, this board can be quite helpful.

Audio patching is the most common situation the amateur encounters. The addition of a tape recorder or another aid to the station should be a simple process. Some tape recorder audio-output circuits are low impedance and could, without suitable coupling, undesirably load the circuit that is being interfaced. A coupling technique often used is that of a resistor (100KΩ) and blocking capacitor (.001 μF) in a series combination. Experimentation is necessary until the circuits are properly matched. The transmitted signal quality of the two units operating in unison should be checked thoroughly.

Often it is convenient to have another headphone jack for a visitor. An audio splitter is shown in Fig. 23-2 that will handle this function. The use of the two potentiometers allows each listener to set his own audio level. If the operator desires to listen to two receivers, at the same time or individually, the reverse of the described system and appropriate switch contacts are required.

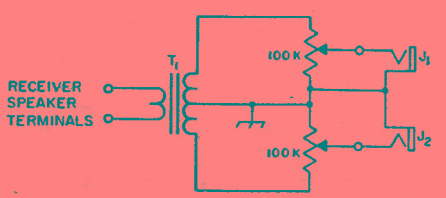


Fig. 23-2 — Diagram of the headphone splitter. The transformer, T1, is a universal output type. J1 and J2 are phone jacks. This circuit allows two sets of headphones to be operated from one receiver; each channel has its own volume control.

The amateur station can become quite sophisticated. As an aid to the operator and any one else within the family, a written record of all wiring is essential. Diagrams of the station wiring, ac voltage lines, rf and af cabling will reduce troubleshooting time or redesigning of the station. Documentation of all changes in antennas, transmitters, receivers, or amplifiers will keep the operator from going over the same road again.

SAFETY

Of prime importance in the layout of the station is the personal safety of the operator and of visitors, invited or otherwise, during normal operating practice. If there are small children in the house, every step must be taken to prevent their accidental contact with power leads of any voltage. A locked room is a fine idea, if it is possible; otherwise housing the transmitter and power supplies in metal cabinets is an excellent, although expensive solution. Lacking a metal cabinet, a wood cabinet or a wooden framework covered with wire screen is the next-best solution. Many stations have the power supplies housed in metal cabinets in the operating room or in a closet or basement, and this cabinet or entry is kept locked — with the key out of reach of everyone but the operator. The power leads are run through conduit to the transmitter, using ignition cable for the high-voltage leads. If the power supplies and transmitter are in the same cabinet, a lock-type main switch for the incoming power line is a good precaution.

An essential adjunct to any station is a *shorting stick* for discharging any high voltage to ground before any work is done in the transmitter. Even if interlocks and power-supply bleeders are used, the failure of one or more of these components may leave the transmitter in a dangerous condition. The shorting stick is made by mounting a small metal hook, of wire or rod, on one end of a dry stick or bakelite rod. A piece of ignition cable or other well-insulated wire is then run from the hook on the stick to the chassis or common ground of the transmitter, and the stick is hung alongside the transmitter. Whenever the power is turned off in the transmitter to permit work on the rig, the shorting stick is first used to touch the several high-voltage leads (plate rf choke, filter capacitor, tube plate connection) to insure that there is no high voltage at any of these points..

Some items which should be included in the station for safety reasons are a fire extinguisher and flashlight. Both should be convenient to reach. The fire extinguisher must be a carbon dioxide type to be effective in electrical fires. The flashlight batteries should be checked regularly. The extinguisher should likewise be inspected on a regular basis. A carbon dioxide type of extinguisher is recommended because it will cause the least amount of damage to equipment.

Family members should be instructed in the use of mouth-to-mouth resuscitation. A sign posted in

If space is available, a neat console can be constructed to house various types of station components. Surplus computer furniture can be used as well. Access to the equipment is through the back of the console. This station belongs to W7VRQ.

Voice operated control (VOX) used in conjunction with a microphone placed on a boom makes operating a nearly "hands-off" affair. This arrangement enables the operator, WB6DSV, to handle paperwork and watch meters and other important controls. This station is owned by W6OKK.

the station describing the necessary procedures to be followed in the event of an emergency should be pointed out to the family. Telephone numbers of the local police, fire department, and doctor should be included on this sign.

Fusing

A minor hazard in the amateur station is the possibility of fire through the failure of a component. If the failure is complete and the component is large, the house fuses will generally blow. However, it is unwise and inconvenient to depend upon the house fuses to protect the lines running to the radio equipment, and every power supply should have its primary circuit individually fused, at about 150 to 200 percent of the maximum rating of the supply. Circuit breakers can be used instead of fuses if desired.

Wiring

Control-circuit wires running between the operating position and a transmitter in another part of the room should be hidden, if possible. This can be done by running the wires under the floor or behind the base molding, bringing the wires out to terminal boxes or regular wall fixtures. Such construction, however, is generally only possible in elaborate installations, and the average amateur must content himself with trying to make the wires as inconspicuous as possible. If several pairs of leads must be run from the operating table to the transmitter, as is generally the case, a single piece of rubber- or vinyl-covered multiconductor cable will always look neater than several pieces of rubber-covered lamp cord, and it is much easier to sweep around or dust.

Solid or standard wire connected to a screw terminal (ac plug, antenna binding posts) should either be "hooked" around a *clockwise* direction, or, better yet, be terminated in a soldering lug. If the wire is hooked in a counter-clockwise position, it will tend to move out from under the screw head as the screw is tightened.

The antenna wires always present a problem, unless coaxial-line feed is used. Open-wire line from the point of entry of the antenna line should always be arranged neatly, and it is generally best to support it at several points. Many operators prefer to mount any antenna-tuning assemblies right at the point of entry of the feed line, together with an antenna changeover relay (if one is used), and then link from the tuning assembly to the transmitter can be made of inconspicuous coaxial line. If the transmitter is mounted near the point of entry of the line, it simplifies the problem of "What to do with the feeders?"

The station components which are located outside must be as safe as the arrangement in the shack. All antenna structures should be protected so that no one will be injured. There should be no low hanging wires or cables. A guard around a tower base is important to keep small children from climbing it. Several ways of protecting the tower base are possible. Cutting a sheet of 1/2-inch plywood lengthwise into three pieces and placing hinges on two edges and pad lock on the third edge will allow the entire structure to be stood up and wrapped around the tower base. The pad lock is essential. Other methods use hardware cloth (heavy mesh) with holes too small to get feet or hands through. Vertical antennas should be protected in a similar fashion, except use a wooden structure or fence.

Open-wire line should be insulated where it can be reached by someone. All control cables or other cables, if possible, should be buried underground or placed high enough so as not to be reached. If antenna work is planned, all cables leading to the tower should be disconnected and *power must be shut off.* Rotator controls should be unplugged. Any electrical wiring or contacts which are exposed to the outdoor environment must be protected from the weather. A water-tight box or a plastic bag will provide such protection. Corrosion to electrical contacts can cause TVI or RFI, poor connections, or losses in vital circuitry. Another

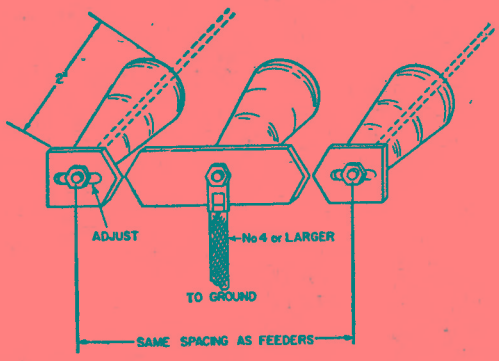


Fig. 23-3 — A simple lightning arrester made from three stand-off or feedthrough insulators and sections of a 1/8 × 1/2-inch brass or copper strap. It should be installed in the open-wire or Twin-Lead line at the point where it is nearest the ground outside the house. The heavy ground lead should be as short and direct as possible. Gap setting should be minimum for transmitter power.

consideration for control cables is rf bypassing. A strong rf field can cause a circuit to be actuated which could disrupt normal operation.

Where guyed towers are used, the guy wires should be arranged so as not to cause danger to someone walking through the area. If this is not possible, planting a shrub or tree near the guy anchor will tend to keep people clear of the vicinity.

LIGHTNING AND FIRE PROTECTION

The National Electrical Code (NFPA No. 70) adopted by the National Fire Protection Association, although purely advisory as far as the NFPA is concerned, is of interest because it is widely used in law and for legal regulatory purposes. Article 810 deals with radio and television equipment, and Section C treats specifically amateur transmitting and receiving stations. Some pertinent paragraphs are reprinted below.

810-13. Avoidance of Contacts with Conductors of Other Systems. Outdoor antenna and lead-in conductors from an antenna to a building shall not cross over electric light or power circuits and shall be kept well away from all such circuits so as to avoid the possibility of accidental contact. Where proximity to electric light and power service conductors of less than 250 volts between conductors cannot be avoided, the installation shall be such as to provide a clearance of at least two feet. It is recommended that antenna conductors be so installed as not to cross under electric light or power conductors.

810-15. Grounding. Masts and metal structures supporting antennas shall be permanently and effectively grounded, without intervening splice or connection.

810-56. Protection Against Accidental Contact. Lead-in conductors to radio transmitters shall be so located or installed as to make accidental contact with them difficult.

810-57. Lightning Arrestors – Transmitting Stations. Each conductor of a lead-in for outdoor antenna shall be provided with a lightning arrestor or other suitable means which will drain static charges from the antenna system.

Exception No. 1. When protected by a continuous metallic shield which is permanently and effectively grounded.

Table 810-52

Size of Amateur-Station Outdoor Antenna Conductors

Material	Minimum Size of Conductors When Maximum Open Span Length Is Less than 150 feet	Minimum Size of Conductors When Maximum Open Span Length Is Over 150 feet
Hard-drawn copper	14	10
Copper-clad steel, bronze or other high-strength material	14	12

Exception No. 2. Where the antenna is permanently and effectively grounded.

In some areas the probability of lightning surges entering the home via the 117/230 volt-line may be high. A portion of the lightning surges originating on an overhead primary feeder can pass through the distribution transformer by electrostatic and electromagnetic coupling to the secondary circuit, even though the primary is protected by distribution-class lightning arresters. Radio equipment can be protected from these surges by the use of a "secondary service lightning arrester." A typical unit is the G.E. Model 9L15CCB007, marketed as the Home Lightning Protector. It is mounted at the weatherhead or in the service entrance box.

The best protection from lightning is that of completely disconnecting all equipment from antennas, and all ac receptacles. Eliminate the possible paths for any lightning stroke. Rotator cables or any other control cable from the antenna location should be disconnected during severe electrical storms.

Experiments have indicated that a high vertical conductor will generally divert to itself direct hits that might otherwise fall within a cone-shaped space of which the apex is the top of the conductor and the base a circle of radius approximately two times the height of the conductor. Thus a radio mast may afford some protection to low adjacent structures, but only when low-impedance grounds are provided.

This modern station belongs to JA1BRK which is set up to operate the hf and vhf bands. The equipment most often used is on the lower shelf, while the upper shelf holds auxiliary apparatus used for monitoring other frequencies. The large overhead lamp is especially useful.

Operating a Station

Good on-the-air operating practices are important to every amateur for at least three good reasons: to assure compliance with regulations, to permit a large volume of activity to be conducted as efficiently and as simply as possible, and as a matter of personal pride and competence. Good practices is a very bewildering subject at first to many new amateurs, but as in so many other fields, it soon becomes apparent that there is a sound basis of custom and tradition which has produced a body of standard practices. These have evolved over more than a half-century of experience. One of the League's important functions has been to formalize, to foster and to encourage good standard practices so that they have become universal and accepted. Some of our standard practices go back a long time; others have been developed to meet changing circumstances, requirements and technology.

It used to be that one standard was all that was required. Today, things are different. There are standard operating practices for cw, voice, RTTY and repeaters, with additional standards for ATV not too far away. Those for cw and voice are pretty firmly established, but RTTY is newer and repeater operation newer still. Your League will take a crack at all of them. If its recommendations don't "take hold," they will be changed until they become acceptable to a majority in a particular operating specialty. This has been the pattern on cw and phone and will be the pattern on RTTY, repeaters, satellites and whatever else comes along in the future. Operating is better than 50% of most amateurs' lives. Better learn to do it *right*.

Initially, we'll talk about phone and cw, because they can be covered together. RTTY and repeaters will be handled separately.

ESTABLISHING A CONTACT

The best way to do this, especially at first, is to *listen* until you hear someone calling CQ, and call *them*. This requires a little patience, but that's something else all amateurs must learn if we are to share our bands in harmony. Tune around near your own frequency. If you hear a CQ, put your vfo on that frequency (*without* putting a signal on the air), wait until he indicates he is listening, then call him, thus: "W6ZRJ, W6ZRJ, this is W7PGY, W7 Papa Golf Yankee calling, Over" On cw: W6ZRJ W6ZRJ DE W7PGY W7PGY $\overline{AR}$. If no answer (to anyone) this may be repeated; brief, repeated calls are preferred to long drawn out ones. Chances are, if he is to hear you at all, he will hear your first brief call; most amateurs seldom tune far from their transmitting frequency to listen after a CQ. Note the ending signals. These have a special significance of their own to indicate to a casual listener the "status of the contact."

In answer to your call (assuming you are heard), the called station will reply: "W7PGY from W6ZRJ, roger . . ." and then go into conversation. On cw, it would be W7PGY DE W6ZRJ R . . . . That "roger" (R) means that he has received your call correctly. That's *all* it means – RECEIVED. It does not mean correct, I agree, I will comply. It is not sent unless everything was received correctly. Note also that "roger" is the phonetic equivalent of the letter R only in this usage. The regular phonetic for R is "Romeo."

Perhaps W6ZRJ heard W7PGY but did not catch his call. In this case, he might come back with "The W7 station, please repeat your call, this is W6ZRJ, over." On cw: QRZ? W7? DE W6ZRJ $\overline{AR}$. The presence of interference (QRM) and atmospherics (QRN) in the amateur bands makes use of this procedure fairly frequent. The contact (QSO) can then continue. Please note the FCC requirements on identification (97.87).

CALLING CQ

If you hear no CQ, you may wish to make such a call yourself. Refrain from CQing unless you are willing to establish contact with whoever calls. CQ means "I wish to contact *any* amateur station." If this is not your desire, then don't CQ, or be specific in doing so. A CQ call can be somewhat longer than a call to a specific station, because you are trying to attract the attention of casual listeners, including those tuning around looking for someone to call. However, please avoid the common operating discrepancy of calling CQ endlessly; it clutters up the air and drives off potential "customers." The average call would go something like this: "Hello CQ, CQ, CQ, calling CQ, this is WØPAN, W zero Papa Alpha November, Bloomington, Minnesota, calling CQ and listening, go." On cw: CQ CQ CQ DE WØPAN WØPAN WØPAN K. After a brief standby for replies, if no

OPERATING ABBREVIATIONS AND PREFIXES

Q SIGNALS

Given below are a number of Q signals whose meanings most often need to be expressed with brevity and clearness in amateur work. (Q abbreviations take the form of questions only when each is sent followed by a question mark.)

QRG Will you tell me my exact frequency (or that of . . .)? Your exact frequency (or that of . . .) is . . . kHz.

QRH Does my frequency vary? Your frequency varies.

QRI How is the tone of my transmission? The tone of your transmission is . . . (1. Good; 2. Variable; 3. Bad).

QRK What is the intelligibility of my signals (or those of . . .)? The intelligibility of your signals (or those of . . .) is . . . (1. bad; 2. poor; 3. fair; 4. good; 5. excellent.

QRL Are you busy? I am busy (or I am busy with . . .). Please do not interfere.

QRM Is my transmission being interfered with? Your transmission is being interfered with . . . (1. nil; 2. slightly; 3. moderately; 4. severely; 5. extremely.

QRN Are you troubled by static? I am troubled by static . . . (1-5 as under QRM).

QRO Shall I increase power? Increase power.

QRP Shall I decrease power? Decrease power.

QRQ Shall I send faster? Send faster (. . . wpm).

QRS Shall I send more slowiy? Send more slowly (. . . wpm).

QRT Shall I stop sending? Stop sending.

QRU Have you anything for me? I have nothing for you.

QRV Are you ready? I am ready.

QRW Shall I inform . . . that you are calling him on . . . kHz? Please inform . . . that I am calling on . . . kHz.

QRX When will you call me again? I will call you again at . . . hours (on . . . kHz).

QRY What is my turn? Your turn is number . . .

QRZ Who is calling me? You are being called by . . . (on . . . kHz).

QSA What is the strength of my signals (or those of . . .)? The strength of your signals (or those of . . .) is . . . (1. Scarcely perceptible; 2. Weak; 3. Fairly good; 4. Good; 5. Very good).

QSB Are my signals fading? Your signals are fading.

QSD Are my signals mutilated? Your signals are mutilated.

QSG Shall I send . . . messages at a time? Send . . . messages at a time.

QSK Can you hear me between your signals and if so can I break in on your transmission? I can hear you between my signals; break in on my transmission.

QSL Can you acknowledge receipt? I am acknowledging receipt.

QSM Shall I repeat the last message which I sent you, or some previous message? Repeat the last message which you sent me [or message(s) number(s) . . .].

QSN Did you hear me (*or* . . .) on . . . kHz? I did hear you (*or* . . .) on . . . kHz.

QSO Can you communicate with . . . direct or by relay? I can communicate with . . . direct (or by relay through . . .).

QSP Will you relay to . . . ? I will relay to . . .

QSU Shall I send or reply on this frequency (*or* on . . . kHz)? Send or reply on this frequency (*or* on . . . kHz).

QSV Shall I send a series of Vs on this frequency (or . . . kHz)? Send a series of Vs on this frequency (or . . . kHz).

QSW Will you send on this frequency (or on . . . kHz)? I am going to send on this frequency (or on . . . kHz).

QSX Will you listen to . . . on . . . kHz? I am listening to . . . on . . . kHz.

QSY Shall I change to transmission on another frequency? Change to transmission on another frequency (or on . . . kHz).

QSZ Shall I send each word or group more than once? Send each word or group twice (or . . . times).

QTA Shall I cancel message number . . . ? Cancel message number . . .

QTB Do you agree with my counting of words? I do not agree with your counting of words; I will repeat the first letter or digit of each word or group.

QTC How many messages have you to send? I have . . . messages for you (or for . . .).

QTH What is your location? My location is . . .

QTR What is the correct time? The time is . . .

Special abbreviations adopted by ARRL:

QST General call preceding a message addressed to all amateurs and ARRL members. This is in effect "CQ ARRL."

THE R-S-T SYSTEM

READABILITY

1–Unreadable.
2–Barely readable, occasional words distinguishable.
3–Readable with considerable difficulty.
4–Readable with practically no difficulty.
5–Perfectly readable.

SIGNAL STRENGTH

1–Faint signals barely perceptible.
2–Very weak signals.
3–Weak signals.
4–Fair signals.
5–Fairly good signals.
6–Good signals.
7–Moderately strong signals.
8–Strong signals.
9–Extremely strong signals.

TONE

1–Sixty-cycle a.c. or less, very rough and broad.
2–Very rough a.c., very harsh and broad.
3–Rough a.c. tone, rectified but not filtered.
4–Rough note, some trace of filtering.
5–Filtered rectified a.c. but strongly ripple-modulated.
6–Filtered tone, definite trace of ripple modulation.
7–Near pure tone, trace of ripple modulation.
8–Near perfect tone, slight trace of modulation.
9–Perfect tone, no trace of ripple or modulation of any kind.

The "tone" report refers only to the purity of the signal, and has no connection with its stability or freedom from clicks or chirps. If the signal has the characteristic steadiness of crystal control, add X to the report (e.g., RST 469X). If it has a chirp or "tail" (either on "make" or "break"), add C (e.g., 469C). If it has clicks or noticeable other keying transients, add K (e.g., 469K). Of course a signal could have both chirps and clicks, in which case both C and K could be used (e.g., RST 469CK).

one answers and the frequency is still clear, you can try again. Short calls and frequent standbys are the best way to establish contact with the minimum QRM. This kind of procedure is easy to use when using VOX or keying through your VOX relay, or using cw break-in procedure.

THE QSO

During the contact, be sure to observe the FCC identification rules (see ARRL *License Manual*) Aside from that, there are no legal limits to what you can talk about, although it is recommended that controversial subjects connected with politics and morality be avoided. Keep everything on a friendly and cordial level, remembering that the conversation is not private and many others, including possibly members of the lay public, may be listening. Try to avoid the habitual utterances, procedures and inanities which so often make amateur radio contacts boring – things such as the drawn out 'ahhhhhh' to keep the VOX relay closed, or repeated "double dash" (dahdidididah) sign on cw, or hackneyed expressions such as "there" (referring to the other fellow) and "here" referring to yourself, or "we" when you mean "I." Both on cw and voice it is possible to be informal, friendly and conversational, and this is what makes an amateur radio QSO enjoyable. During the QSO, when you stand by the recommended signal is "go only" on voice, $\overline{KN}$ on cw, meaning that you want only the contacted station to come back to you. If you don't mind someone else breaking in, just "go" or K is sufficient. Of course, using VOX or break-in the conversation can proceed as it would face to face, without ending signals after each transmission; this is more normal in a voice contact than in a cw QSO.

ENDING THE QSO

When you decide to end the contact, *end* it. If the other fellow indicates a desire to end it, don't keep on talking, don't say "I won't hold you," then hold him. Express your pleasure at having contacted him and sign out, thus "W1QV from W6KW, clear." If you don't want further contacts, say "clear and leaving the air." On cw, it's $\overline{SK}$ W1QV DE W6KW, and, if leaving the air, CL.

All these things establish amateur radio as a cordial and fraternal hobby at the same time they foster orderliness and denote organization. Most of them have no legal standing; FCC regs say little about our internal procedures. The procedures we ourselves adopt are even more important than that, because they indicate that we are not just a bunch of hobbyists playing around in random fashion, but that we are an established communications *service* with distinct and distinctive procedures tailored to our special needs.

COURTESY

One thing that is considered the height of ill manners and "liddy" procedure in amateur radio is to tune up or make any transmission on a frequency which is already occupied. In some cases this is necessary, in others inadvertent; but it should always be avoided where possible. For example, if you are committed to a legal one-way transmission or schedule with a friend on a certain frequency at a certain time, it is sometimes unavoidable to cause temporary inconvenience to a going contact or even a net. In another situation, you may not hear another station on the frequency because of "skip," in which case an inquiry "Is the frequency in use?" or, on cw, the Morse letter C (didit dit) should bring a response if you are interfering with a station which you cannot hear. Use the same procedure in tuning up your antenna (use a dummy antenna for testing your rig) – don't *ever* fire up the rig and start tuning it without first turning on the receiver and checking the frequency. The amateur bands are crowded; consideration for the other guy will make things better for everybody.

RTTY PROCEDURES

On radioteletype, the methods of transmission and reception are somewhat different, so slightly different procedures are required. Voice is seldom a "written" mode and cw need not be, but RTTY always is. You type your transmission on a keyboard and it is received at the other end in printed form. Thus, most cw abbreviations can be used to good effect. In addition, such things as line feeds and carriage returns must be considered, as well as shifts for "letters" and "figures." These are nonprinting functions nevertheless essential for teleprinter operation.

Because of wide variations in RTTY machines, different mechanical procedures can often be used, but if you don't know the machine at the other end it is best to assume that it has none of the refinements.

As in other operating, the best thing to do is *listen*. The typical beadle-beadle of RTTY is familiar enough that it can be tuned in with an ordinary communications receiver, then put through the converter to copy on your printer. Some typical calls can be identified just by their sound, such as RY (the RTTY "test") and CQ and even your own call. The procedure is much the same as for cw – zero your vfo while copying and call your station on the same frequency. Even though he finishes his CQ with a carriage return (CR) and line feed (LF), it is a good idea to get into the habit of transmitting these functions, to "clear the machine." Thus: (2CR) (LF) K6DYX K6DYX K6DYX DE W1AW W1AW $\overline{AR}$ (2CR) (LF).

To initiate a CQ, find an unused point in the band, activate your carrier and transmit: (2CR) (LF) CQ CQ CQ DE K6DYX K6DYX K6DYX K (CR) (LF).

During the QSO, when you come to the end of a line (or the end-of-line indicator on tape equipment), send 2CR, LF, 2LTRS. That is, after your carriage return and line feed at the end of a line, the two nonprinting "letter" pulses serve to allow sluggish machines to get ready for the next line, and take less than a second to send. This is

especially important with tape transmissions at the higher machine speeds – 75 and 100 wpm.

Most stations equipped for RTTY are also equipped with tape equipment. While RTTY can be sent manually from a keyboard, the use of tape for material which can be prepared ahead of time is much preferable, since it allows the machine to run at an even speed, faster than it could be typed by hand even by an expert typist. The tape is punched on a perforator and fed into a transmitter-distributor (TD) which is motor-driven. Thus, CQ calls or other prepared text (including message traffic) can be made up in advance. It is also fairly common practice to punch tape in ordinary QSOs, keeping ahead of the TD with the perforator. Many operators start punching their reply tape while they are still receiving from the operator at the other end, thus getting ahead far enough so that even if their typing speed is below the speed of the machine (usually 60 wpm) there is enough leeway to allow for the difference. Taped transmissions have no pauses, which can be irksome in manual transmissions.

RTTY equipment operates at different speeds and with different frequency shifts, depending on the sophistication of the equipment. Most amateurs, however, operate at a standard 60 wpm and 850-Hertz shift, and those with 100 wpm and 170-Hertz shift capability can usually switch to the standard. The considerate RTTY operator will be glad to do so whenever called upon, just as a considerate cw operator will slow down to the speed of his QSO.

REPEATER OPERATING

Although repeater operation is generally voice operation, it has some ramifications that are not present in the type of operation used in direct (i.e. not through a repeater) contact on phone. Most repeaters are of the "open" type where anyone with appropriate equipment operating on the repeater's input and output frequencies can participate. Such repeaters usually are accessed simply by depressing the mike button. Some "machines" have limited access, such as by means of a tone, a series of tones or pulses, or some other means to prevent their being triggered by a casual signal.

The primary purpose of repeaters is to extend the coverage for mobile and hand-held units. Fixed-station operation should be held to a minimum. Repeaters lend themselves very well to public service communications such as highway-accident reporting, and emergency-preparedness activities.

A repeater has to be built or purchased by somebody, installed by somebody, and maintained by somebody, usually at considerable expense and trouble. Sometimes this "somebody" is an individual but more often it is a group, either organized for the purpose or undertaking repeater operation as an additional club project. So a first point of repeater operating, not exactly an on-the-air concept, is to lend some kind of support to the group or individual that sponsors the repeater you use regularly.

Here are a few "dos" and "don'ts" put forward by repeater groups that may serve as useful guidelines for repeater operation:

1) Monitor the repeater you plan to use. Each system has its own peculiarities. Don't "key up" a repeater until you're familiar with its operation.

2) Identify properly. When operating mobile, you're required to indicate the call area you are in. Thus, "This is WA1RDX mobile one" would be proper. It is considered poor practice (indeed illegal) to key a repeater without identifying yourself.

3) When desiring to make a contact, all that is necessary is to indicate that you are on frequency. On some machines this may be accomplished by "This is WA1RDX mobile one monitoring." On others, standard practice calls for a single CQ followed by identification. Never send a long CQ; any respondent will be listening on frequency and hear the short call.

4) Keep transmissions short and thoughtful. Don't monopolize the repeater. Most repeaters go off automatically (time out) after a certain length of transmission (usually three minutes or less) and must be rekeyed. Remember, what you say may be monitored by many listeners using public-service band receivers. Don't give a bad impression of ham radio.

5) During a repeater contact, always pause a few seconds before transmitting to allow other stations access to the repeater. Someone may have an emergency to report or priority traffic.

6) Don't break into a contact unless you have something to add. Interrupting is no more polite on the air than it is in person.

7) Use simplex (i.e. direct contact, not through a repeater) operation whenever possible. This frees the repeater for use by stations unable to communicate directly.

8) Use the minimum power necessary to maintain communications. Not only is this an FCC requirement; it's also common courtesy.

9) Many repeaters have autopatch facilities, which is an interconnection between the repeater and the telephone system, to provide a public service. It is strictly forbidden to use the autopatch for anything that could be construed as business communications. Nor should the autopatch be used to simply avoid a toll call. Do not use an autopatch where regular telephone service is available. Abuses of autopatch privileges can lead to their loss.

The ARRL makes available an annually revised repeater directory listing all repeaters which have been registered. For details on how to obtain a copy, check recent issues of *QST*.

CW PROCEDURE

Cw operating procedure has been developing for over a century, for our present International (Continental) Code had its beginnings on the telegraph wire lines. There is more to talk about in cw procedures than any other mode for this reason, not because it is the most popular mode.

Phone many years ago outstripped cw as the most popular mode. But cw is far from dead. A listen to a rare DX pileup in the cw bands, or the cw section of any contest will demonstrate that conclusively. And it has many advantages over any other mode. Any amateur who avoids the use of cw because he is too lazy to become proficient enough in the code to realize its full benefits is missing almost half of amateur radio pleasure.

Good Sending

In many ways, cw can be compared with the spoken word. For the proficient cw man, it is indeed equivalent to this. But just as enunciation must be precise for best understanding in speaking, proper character formation and spacing is required in sending the code. And the learning processes are also similar. The beginning cw operator is subject to the same stresses and pressures as the child learning to talk, and can learn bad habits. He becomes subject to outside influences to his own possible detriment in everyday operating

Actually, it is far easier to learn code today than it was, say, forty years ago when nearly all amateur operation was by cw, because there are more helps available. On the other hand, there is less reason to learn it today than there was then. True, the licensing requirement still exists, but once you have your license if you prefer (and many amateurs do), you can spend 100 percent of your amateur operating time on voice or other modes that require no knowledge of the code. In the 1930s, you needed the code to communicate, not just to get your license. There are also, today, a great many gadgets on the market that, while seeming to make code easier only serve really to instill bad habits on the operator. Some teachers for example, would have you start out with an electronic keyer, but this weds you to such a device forever more. The best way to start is with an ordinary straight key, learning characters by their sound, and striving to imitate machine sending by learning to control the muscles used in manipulating this key. This makes "graduating" to a bug or an electronic key much easier at a later date.

In order to make your sending good, you have to know what good sending sounds like. The way to acquire this is to copy W1AW's bulletins and code practice, or other perfect sending, then strive to imitate it Sometimes you can get a copy of the practice text (it's listed in advance in *QST*), and try to send along with W1AW. Most amateur cw operators today have difficulty maintaining proper spacing, probably because so much equipment in use demands that we key through a VOX relay. On cw the control for this relay is usually set for minimum delay, so it will close quickly and open just as quickly; but on most equipment it still doesn't close quickly enough, so a part of the first dit or dah of the first character is cut off. This has a tendency to cause the operator to run his words together so the relay will stay closed while he is sending but open immediately when he stops, making his sending very difficult to copy.

Nobody's sending is perfect, and therefore *every* operator should continually strive for improvement. Watch out for the customary pitfalls as your cw proficiency develops. Do you ever send Q for MA, or P for AN? Do you have a "swing?" Yes, even on an electronic key you can develop personal idiosyncrasies. Be your own worst critic, and make sure your sending, at whatever speed, is beyond reproach.

Break-In

On cw you can have true break-in – the ability to hear the signal of the other station while you are keying your transmitter. Technical considerations are covered elsewhere in this manual. Once this part of it has been accomplished, the full advantages and benefits of break-in can be realized. Long calls are unnecessary, because you can hear immediately if the station being called comes back to someone else. Much QRM is thus eliminated. If both stations in a QSO are using break-in, no station transmits unnecessarily; if the transmitting station is not being received, the receiving station "breaks" him and transmission stops. If another signal comes on the frequency, it can be heard immediately and any appropriate action taken. If message or other recorded traffic is being transmitted, any material missed can be filled immediately because the transmission can be interrupted just by the tap of a key. You can even call a CQ using break-in, and stop the moment someone hears you and starts calling. The customary procedure is CQ CQ CQ DE WØPAN WØPAN BK (pause) CQ CQ CQ . . ., until someone breaks or until it seems obvious no one is going to. Alternatively, the Q signal QSK can be used, either in sending CQ or at the beginning of a QSO to indicate to the other station that you are equipped for break-in and invite him to use it. QSK

Voice-Operating Hints

1) Listen before calling.
2) Make short calls with breaks to listen. Avoid long CQs; do not answer over-long CQs.
3) Use push-to-talk or voice control. Give essential data concisely in first transmission.
4) Make reports honest. Use definitions of strength and readability for reference. Make your reports informative and useful. Honest reports and *full* word description of signals save amateur operators from FCC trouble.
5) Limit transmission length. Two minutes or less will convey much information. When three or more stations converse in round tables, brevity is essential.
6) Display sportsmanship and courtesy. Bands are congested . . . make transmissions meaningful . . . give others a break.
7) Check transmitter adjustment . . . avoid a-m overmodulation and splatter. On ssb check carrier balance carefully. Do not radiate when moving VFO frequency or checking nbfm swing. Use receiver BFO to check stability of signal. Complete testing before busy hours!

is the mark of a well-equipped and well-operated cw station.

VOICE OPERATING

The use of proper procedure to get best results is just as important as in using code. In telegraphy words must be spelled out letter by letter. It is therefore but natural that abbreviations and shortcuts have come into use. In voice work, however, abbreviations are not necessary, and have less importance in our operating procedure.

The letter "K" is used in telegraphic practice so that the operator will not have to pound out the separate letters. The voice operator can *say* the words "go" or "over."

One laughs on cw by sending HI. On phone, *laugh* when one is called for.

The matter of reporting *readability* and *strength* is as important to phone operators as to those using code. With telegraph nomenclature, it is necessary to spell out words to describe signals or use abbreviated signal reports. But on voice, we have the ability to "say it with words." "Readability four, strength eight" is the best way to give a quantitative report, but reporting can be done so much more meaningfully with ordinary words: "You are weak but I can understand you, so go ahead," or "Your signal is strong but you are buried under local interference."

Voice Equivalents to Code Procedure

Voice	*Code*	*Meaning*
Over	$\overline{AR}$	After call to specific station
End of message	$\overline{AR}$	End of transmission or record message
Wait; stand by	$\overline{AS}$	Self-explanatory
Roger	R	*All* received correctly
Go	K	Any station transmit
Go only	$\overline{KN}$	Addressed station only transmit
Clear	$\overline{SK}$	End of contact or communication
Closing station	CL	Going off the air

Phone-Operating Practice

Efficient voice communication, like good cw communication, demands good operating. Adherence to certain points "on getting results" will go a long way toward improving our phone-band operating conditions.

Use VOX or push-to-talk. If you use VOX (most home stations do), don't defeat its purpose by saying "aaahhh" to keep the relay closed. If you use push-to-talk (common on mobiles so traffic noises won't affect transmission), let go of the button every so often to make sure you aren't "doubling" with the other fellow. Don't be a monologuist – a guy who likes to hear himself talk.

Listen with care. It's natural enough to answer the loudest signal who calls, but do a little digging, if necessary, to answer the *best* signal instead, where there is a choice. Every amateur can't run a kilowatt, but there is no reason why every amateur cannot have a signal of the highest quality. Don't reward the guy who cranks up his gain and splatters by answering his call if another station is calling.

Interpose your call frequently. Say it often and distinctly, in measured tones. Too often, identification is muffled or slurred. The fastest voice communication doesn't come from the guy who talks fastest; it comes from the operator who speaks distinctly. Your call especially is important, you can be cited for improper identification if it cannot be understood.

Listen before transmitting. Make sure the frequency isn't being used before you come barging onto it. Our voice bands are pretty crowded and QRM is inevitable. But this is a reason for *more* courtesy, not less.

Keep modulation constant. By turning your gain "wide open" you are subjecting anyone listening to all kinds of extraneous noises that don't belong on the air. Speak as closely to the mike as you can without breath modulation, turn your gain down so that only your voice can be heard. A good stunt is to hold the mike at the corner of your mouth and talk across it, rather than into it. If you use a stationary mike, turn it so that your breath goes across it, not into it; otherwise, your "explosives" will distort your speech.

Have a pencil and paper always handy. Take notes on the other guy's conversation while he's talking, so you can answer him or comment on the things he has said; otherwise he might get the wrong impression that you are deliberately ignoring some of his remarks.

Avoid repetition. Don't repeat back what the other fellow has just said. Just *say* you received everything, don't try to prove it.

Avoid inanities. There are many of them in phone operation, and they are contagious. "That's a roger." "Yeeeaaah!" "By golly." The phoney laugh. The affected speech. If you must parrot, parrot the polished operator, not the affected or idiotic one.

Steer clear of such controversial or suggestive subjects as politics and sex, and of profanities, even those considered acceptable in today's permissive society.

Use phonetics only as required. When clarifying genuinely doubtful expressions and in getting your call identified positively we suggest use of the International Telecommunication Union list. However, don't overdo its use.

The speed of radiotelephone transmission (with perfect accuracy) depends almost entirely upon the skill of the two operators involved. One must learn to speak at a rate allowing perfect understanding as well as permitting the receiving operator to copy down the message text, if that is necessary. Because of the similarity of many English speech sounds, the use of word lists has been found necessary. All voice-operated stations should use a *standard* list as needed to identify call signals or unfamiliar expressions.

A – ALFA	N – NOVEMBER
B – BRAVO	O – OSCAR
C – CHARLIE	P – PAPA
D – DELTA	Q – QUEBEC
E – ECHO	R – ROMEO
F – FOXTROT	S – SIERRA
G – GOLF	T – TANGO
H – HOTEL	U – UNIFORM
I – INDIA	V – VICTOR
J – JULIETT	W – WHISKEY
K – KILO	X – X-RAY
L – LIMA	Y – YANKEE
M – MIKE	Z – ZULU

Example: W1AW . . . W 1 ALFA WHISKEY . . . W1AW

Round Tables. The round table has many advantages if run properly. It clears frequencies of interference, especially if all stations involved are on the same frequency, while the enjoyment value remains the same, if not greater. By use of push-to-talk, or vox, the conversation can be kept lively and interesting, giving each station operator ample opportunity to participate without waiting overlong for his turn.

Round tables can become very unpopular if they are not conducted properly. The monologuist, off on a long spiel about nothing in particular, cannot be interrupted; *make your transmissions short and to the point.* "Butting in" is discourteous and unsportsmanlike; *don't enter a round table, or any contact between two other amateurs, unless you are invited.* It is bad enough trying to copy through prevailing interference without the added difficulty of poor voice quality; *check your transmitter adjustments frequently.* In general, follow the precepts as hereinbefore outlined for the most enjoyment in round tables as well as any other form of radiotelephone communication.

DX OPERATING CODE

(For W/VE Amateurs)

Some amateurs interested in DX work have caused considerable confusion and QRM in their efforts to work DX stations. The points below, if observed by all W/VE amateurs, will go a long way toward making DX more enjoyable for everybody.

1. Call DX only after he calls CQ, QRZ?, signs $\overline{SK}$, or phone equivalent thereof.

2. Do *not* call a DX station:

a. On the frequency of the station he is working until you are *sure* the QSO is over. This is indicated by the ending signal $\overline{SK}$ on cw and any indication that the operator is listening, on phone.

b. Because you hear someone else calling him.

c. When he signs $\overline{KN}$, $\overline{AR}$, CL, or phone equivalents.

d. Exactly on his frequency.

e. After he calls a directional CQ, unless of course you are in the right direction or area.

3. Keep within frequency-band limits. Some DX stations operate outside. Perhaps they can get away with it, but you cannot.

4. Observe calling instructions of DX stations. "10U" means call ten kHz *up* from his frequency, "15D" means 15 kHz *down*, etc.

5. Give honest reports. Many foreign stations *depend* on W and VE reports for adjustment of station and equipment.

6. Keep your signal clean. Key clicks, chirps, hum or splatter give you a bad reputation and may get you a citation from FCC.

7. *Listen* for and *call* the station you want. Calling CQ DX is not the best assurance that the *rare* DX will reply.

8. When there are several W or VE stations waiting to work a DX station, avoid asking him to "listen for a friend." Let your friend take his chances with the rest. Also avoid engaging DX stations in rag-chews against their wishes.

WORKING DX

Most amateurs at one time or another make "working DX" a major aim. As in every other phase of amateur work, there are right and wrong ways to go about getting best results in working foreign stations, and it is the intention of this section to outline a few of them.

The ham who has trouble raising DX stations readily may find that poor transmitter efficiency is not the reason. He may find that his sending is poor, his calls ill timed, or his judgment in error. Working DX requires the know-how that comes with experience. If you just call CQ DX you may get a call from a foreign station, but it isn't likely to be a "rare one." On the other hand, unless you are experienced enough to know that conditions are right, your receiver is sensitive and selective enough and your transmitter and antenna properly tuned and oriented, you may get no calls at all, and succeed only in causing some unnecessary QRM.

The call CQ DX means slightly different things to amateurs on different bands:

a) On vhf, CQ DX is a general call ordinarily used only when the band is open, under favorable "skip" conditions. For vhf work, such a call is used for looking for new states and countries, also for distances beyond the customary "line-of-sight" range on most vhf bands.

b) CQ DX on our 7-, 14-, 21-, and 28-MHz bands may be taken to mean "General call to any foreign station." The term "foreign station" usually refers to any station on a different continent. If you do call CQ DX, remember that it implies you will answer any DX who calls. If you don't mean "general call to any DX station," then listen and call the station you do want.

Snagging the Rare Ones

Once in a while a CQ DX will result in snagging a rare DX contact, if you're lucky. This seldom happens, however; usually, what you have to do is listen – and listen – and then listen some more. *You gotta hear 'em before you can work 'em!* If everybody transmits, nobody is going to hear anything. Be a snooper. Usually, unless you are

lucky enough to be among the first to hear him, a rare DX station will be found under a pileup, with stations swarming all over him like worker bees over a queen. The bedlam will subside when the DX station is transmitting (although some stations keep right on calling him), and you can hear him. Don't immediately join the pack, be a little cagey. Listen a while, get an idea of his habits, find out where he is listening (if not zero on himself), bide your time and wait your chance. Sometimes "tail-ending" works. This is the practice of waiting until the station your DX is working starts his sign-off, then just transmitting your own call. Be careful however; this could backfire. If your DX station doesn't respond to such tactics, best to avoid it. Some of them don't like it.

Make your calls short, snappy. No need to repeat his call (he knows it very well, all he needs to know is that you are calling him), but send your own call a couple of times. Try to find a time when few stations are calling him and he is not transmitting; then get in there! With experience, you'll learn all kinds of tricks, some of them clever some just plain dirty. You'll have no trouble discerning which is which. Learn to use the clever ones, and shun the dirty ones. More than you think depends on the impressions we make on our foreign friends!

Codes and Ethics

One of the most effective ways to work DX is to know the operating habits of the DX stations sought, and to abide by the procedures they use. Know when and where to call, and for how long, and when to remain silent waiting your chance. DXing has certain understood codes of ethics and procedures that will make this popular amateur pursuit more fun for everybody if everybody follows them. One of the sad things about DXing is to listen to some of the vituperation and abuse that goes on, mostly by stations on "this" side, as they trample on each other trying to raise their quarry. DX stations have been known to QRT in disgust at some of the tactics.

If W and VE stations will use the procedure in the "DX Operating Code" detailed elsewhere on these pages, we can all make a good impression on the air. ARRL has also recommended some operating procedures for DX stations aimed at controlling some of the thoughtless practices sometimes used by W/VE amateurs A copy of these recommendations (Op Aid No. 5) can be obtained free of charge from ARRL Headquarters .

Choosing Your Band

If it does nothing else in furthering your education, striving to work DX will certainly teach you a few things about propagation. You will find that four principal factors determine propagation characteristics. (1) The frequency of the band in which you do your operating. (2) The time of day or night. (3) The season of the year (4) The sunspot cycle. The proper choice of band depends pretty much on the other three factors. For example, the 3.5-4.0-MHz band at high noon in the summertime at the "node" part of the sunspot cycle is the poorest possible choice, while the same band at midnight during the wintertime at the 'null' part of the cycle might produce some very exciting DX. Similarly, you will learn by experience when to operate on which band for the best DX by juggling the above factors using both long-range and other indications of band conditions. WWV transmissions can also be helpful in indicating both current and immediate-forecast band conditions.

Conditions in the transmission medium often make it possible for the signals from low-powered transmitters to be received at great distances. In general, the higher the frequency band the less important power considerations become, for occasional DX work. This accounts in part for the relative popularity of the 14-, 21- and 28-MHz bands among amateurs who like to work DX.

QSL CARDS AND BUREAUS

Most amateurs who work another station for the first time, especially a foreign station, will later send the station a postcard confirming the contact. These cards are known as QSLs, taken from the international signal meaning, "I acknowledge receipt." A number of printing firms specialize in producing these postcards, following standard designs, or following the directions of an individual amateur. Advertisements of these printers appear each month in *QST*, ARRL's official journal.

Since it is rather expensive, for a foreign station especially, to send a QSL separately to each U.S. or Canadian station he's worked, ARRL has set up a system of QSL Bureaus, manned by amateur volunteers in each call area. The bureaus get packages of cards from overseas, which are sorted by call. Individual amateurs may claim their cards by sending a supply of stamped, self-addressed envelopes to the QSL manager in their call area. *QST* carries the addresses of these bureaus nearly every issue. Or write to ARRL Hq. for information.

KEEPING AN AMATEUR STATION LOG

Although recent FCC rulings have eliminated the legal necessity for detailed logging, you'll still want to maintain a log to preserve a record of your own activity within amateur radio, to be able to send QSLs, and to protect yourself. You'll be confident of meeting all of these by recording: (1) the date and time of each transmission, (2) all calls and transmissions made, whether contacts resulted, or not, (3) the input power to the last stage of the transmitter, (4) the frequency band used, (5) the time of ending each contact (QSO), and (6) the signature of the licensed operator. Written messages handled in standard form must be included in the log or kept on file for a period of at least one year.

But a log can be more than just a legal record of station operation. It can be a "diary" of your amateur experience. Make it a habit to enter thoughts and comments, changes in equipment, operating experiences and reactions, anything that might make enjoyable reminiscences in years to come. Your log is a reflection of your personal

DATE TIME (GMT)	STATION CALLED	CALLED BY	HIS SIGNAL RST	MY SIGNAL RST	FREQ	EMISSION TYPE	POWER INPUT WATTS	TIME OF ENDING QSO	OTHER DATA	NAME	QSLs S	QSLs R
16MAR.												
2300	W3EML	x	589	579	3.5	A1	250	2309	RCD. S	BILL	—	
2315	CQ	x			7							
16	x	W5NW	469	479	"	"	"	2330	CNDX POOR	SOUPY	✓	
35	K2SJC	x	57	59	3.8	A3A	150	2359	SKED		—	
17MAR												
0005	UA9OH	x	579	589	14	A1	25	0012	NOVOSIBIRSK	VLADIS	✓	
0013	x	UW9PT	579	579	"	"	"	0020	"	VIK	✓	
1200	CQ	x			"	"	"					
02	x	VK3NR	579	579	"		"	1217	MELBOURNE	NOEL	✓	

KEEP AN ACCURATE AND COMPLETE STATION LOG AT ALL TIMES. FCC REQUIRES IT.

A page from the official ARRL log is shown above, answering every FCC requirement in respect to station records. Bound logs made up in accord with the above form can be obtained from Headquarters for a nominal sum or you can prepare your own, in which case we offer this form as a suggestion. The ARRL log has a special wire binding and lias perfectly flat on the table.

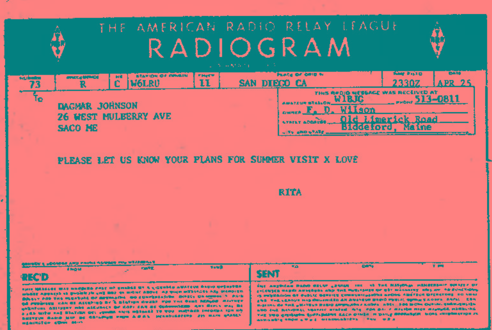
experience in amateur radio. Make it both neat and complete.

ARRL headquarters stocks log books and message blanks for the convenience of amateurs.

PUBLIC SERVICE OPERATING

Amateurs interested in rendering public service in operating under ARRL sponsorship have formed the Amateur Radio Public Service Corps (ARPSC). This organization has two principal divisions. One is the Amateur Radio Emergency Corps (AREC), an emergency-preparedness group of approximately 30,000 amateur operators signed up voluntarily to keep amateur radio in the forefront along preparedness lines. The other is the National Traffic System (NTS), a message-handling facility which operates daily (including weekends and holidays) for systematic handling of third-party traffic.

Also recognized by ARRL as a part of the organized amateur radio public service effort are the Radio Amateur Civil Emergency Service (RACES), a part of the amateur service serving civil defense under a separate sub-part of the amateur regulations; the Military Affiliate Radio Service, sponsored by the armed services to provide military training for amateurs; and numerous amateur groups organized into nets by individuals, clubs or other amateur entitites for public service and registered with the League. The detailed workings of ARPSC and RACES are covered briefly herein and explained in somewhat more detail in *Public Service Communications*, *Operating an Amateur Radio Station*, available to interested amateurs without charge, and *The Radio Amateur's Operating Manual.*


THE AMERICAN RADIO RELAY LEAGUE
RADIOGRAM

73 | R | C | W6LRU | 11 | SAN DIEGO CA | 2330Z | APR 25

TO
DAGMAR JOHNSON
26 WEST MULBERRY AVE
SACO ME

THIS RADIO MESSAGE WAS RECEIVED AT
AMATEUR STATION W1BJC PHONE 513-0811
OWNER F. D. Wilson
STREET ADDRESS Old Limerick Road
CITY AND STATE Biddeford, Maine

PLEASE LET US KNOW YOUR PLANS FOR SUMMER VISIT X LOVE

RITA

REC'D

SENT

Here is an example of e plain-language message as it would be prepared for delivery. If the message were for relay instead of delivery, the information at the bottom would be filled in instead of that in the box.

MESSAGE HANDLING

Amateur operators in the United States and a few other countries enjoy a privilege not available to amateurs in most countries – that of handling third-party message traffic. In the early history of amateur radio in this country, some amateurs who were among the first to take advantage of this privilege formed an extensive relay organization which became the ARRL.

Thus, amateur message-handling has had a long and honorable history, and like most services, has gone through many periods of development and change. Those amateurs who handled traffic in 1914 would hardly recognize it the way some of us do it today, just as equipment in those days was far different from that in use now. Progress has been made and new methods have been developed in step with advancement in communication techniques of all kinds. Amateurs who handled a lot of traffic found that organized operating schedules were more effective than random relays, and as techniques advanced and messages increased in number, trunk lines were organized, spot frequencies began to be used, and there came into existence a number of traffic nets in which many stations operated on the same frequency to effect wider coverage in less time with fewer relays; but

the old methods are still available to the amateur who handles only an occasional message.

Although message handling is as old an art as is amateur radio itself, there are many amateurs who do not know how to handle a formal message and have never done so. As each amateur grows older and gains experience in the amateur service, there is bound to come a time when he will be called upon to handle a written message, during a communications emergency, in casual contact with one of his many acquaintances on the air, or as a result of a request from a non-amateur friend. Regardless of the occasion, if it comes to you, you will want to rise to it! Considerable embarrassment is likely to be experienced by the amateur who finds he not only does not know the form in which the message should be prepared, but does not know how to go about putting it on the air.

Traffic work need not be a complicated or time-consuming activity for the casual or occasional message-handler. Amateurs may participate in traffic work to whatever extent they wish, from an occasional message now and then to becoming a part of organized traffic systems. This chapter explains some principles so the reader may know where to find out more about the subject and may exercise the message-handling privilege to best effect as the spirit and opportunity arise.

Responsibility

Amateurs who originate messages for transmission or who receive messages for relay or delivery should first consider that in doing so they are accepting the responsibility of clearing the message from their station on its way to its destination in the shortest possible time. Forty-eight hours after filing or receipt is the generally-accepted rule among traffic-handling amateurs, but it is obvious that if every amateur who relayed the message allowed it to remain in his station this long it might be a long time reaching its destination. Traffic should be relayed or delivered as quickly as possible.

Message Form

Once this responsibility is realized and accepted, handling the message becomes a matter of following generally-accepted standards of form and transmission. For this purpose, each message is divided into four parts: the preamble, the address, the text and the signature. Some of these parts themselves are subdivided. It is necessary in preparing the message for transmission and in actually transmitting it to know not only what each part is and what it is for, but to know in what *order* it should be transmitted, and to know the various procedure signals used with it when sent by cw. If you are going to send a message, you may as well send it right.

Standardization is important! There is a great deal of room for expressing originality and individuality in amateur radio, but there are also times and places where such expression can only cause confusion and inefficiency. Recognizing the need for standardization in message form and message transmitting procedures, ARRL has long since recommended such standards, and most traffic-interested amateurs have followed them. In general, these recommendations, and the various changes they have undergone from year to year, have been at the request of amateurs participating in this activity, and they are completely outlined and explained in *Operating an Amateur Radio Station*, a copy of which is available upon request or by use of the coupon at the end of this chapter.

Clearing a Message

The best way to clear a message is to put it into one of the many organized traffic networks, or to give it to a station that can do so. There are many amateurs who make the handling of traffic their principal operating activity, and many more still who participate in this activity to a greater or lesser extent. The result is a traffic system which spreads to all corners of the United States and covers most U.S. possessions and Canada. Once a message gets into an organized net, regardless of the net's size or coverage, it is systematically routed toward its destination in the shortest possible time.

Amateurs not experienced in message handling should depend on the experienced message-handler to get a message through, if it is important; but the average amateur can enjoy operating with a message to be handled either through a local traffic net or by free-lancing. The latter may be accomplished by careful listening for an amateur station at desired points, directional CQs, use of recognized calling and net frequencies, or by making and keeping a schedule with another amateur for regular work between specified points. He may well aim at learning and enjoying through doing. The joy and accomplishment in thus developing one's operating skill to the peak of perfection has a reward all its own.

If you decide to "take the bull by the horns" and put the message into a traffic net yourself (and, more power to you if you do!), you will need to know something about how nets operate, and if on cw, the special Q signals and procedure they use to dispatch all traffic with a maximum of efficiency. The frequency and operating time of the net in your section, or of other nets into which your message can go, is given in ARRL's Net Directory. This annually-revised publication is available on request. Listening for a few minutes at the time and frequency indicated should acquaint you with enough fundamentals to enable you to report into the net and report your traffic. From that time on you follow the instructions of the net control station, who will tell you when and to whom (and on what frequency, if different from the net frequency) to send your message. Cw nets use the special "QN" signals, so it may be helpful to have a list of these before you (available from ARRL Hq., Operating Aid No. 9).

Network Operation

About this time, you may find that you are enjoying this type of operating activity and want to know more about it and increase your proficiency. Many amateurs are happily "addicted" to traffic handled after only one or two brief

exposures to it. Much traffic is at present being conducted by cw, since this mode of communication seems to be popular for record purposes – but this does not mean that high code speed is a necessary prerequisite to working in traffic networks. There are many nets organized specifically for the slow-speed amateur, and most of the so-called "fast" nets are usually glad to slow down to accommodate slower operators.

It is a significant operating fact that code speed alone does *not* make for efficiency – sometimes the contrary! A high-speed operator who does not know procedure can "foul up" a net much more completely and more quickly than can a slow operator. Cw net operation provides an excellent opportunity to increase code speed. Given a little time your speed will reach the point where you can easily hold your own. Concentrate first on learning the net procedures.

Voice modes are also very popular for traffic work. Procedure is of paramount importance on phone, just as it is on cw. Procedure differs in that standard phonetics are an important ingredient in phone operation and *Q* and *QN* signals are not used. However, nets on all modes share the need for concise operation.

Teamwork is the theme of all net operation. The net which functions most efficiently is the net in which all participants are thoroughly familiar with the procedure used, and in which operators refrain from transmitting except at the direction of the net control station, and do not occupy time with extraneous comments, even the exchange of pleasantries. There is a time and place for everything. When a net is in session it should concentrate on handling traffic until all traffic is cleared. Before or after the net is the time for rag-chewing and discussion. Some further details of net operation are included in *Operating an Amateur Radio Station*, mentioned earlier, but there is no substitute for actual participation.

The National Traffic System

To facilitate and speed the movement of message traffic, there is in existence an integrated national system by means of which originated traffic can normally reach its destination area the same day the message is originated. This system uses the state or section net as a basis. Each section net sends a representative to a "region" net (normally covering a call area) and each "region" net sends a representative to an "area" net (normally covering a time zone). After the area net has cleared all its traffic, its members then go back to their respective region nets, where they clear traffic to the various section net representatives. By means of connecting schedules between the area nets, traffic can flow both ways so that traffic originated on the West Coast reaches the East Coast with a maximum of dispatch, and vice versa. In general, evening section nets function at 1900, evening region nets at 1945, evening area nets at 2030 and the same or different regional personnel again at 2130. Some section nets conduct a late session at 2200 to effect traffic delivery the same night. Local standard time is referred to in each case.

In 1972, the groundwork was begun for a daytime segment of NTS (DNTS). Operation began with a national net meeting on 20 meters and region nets which have the same boundaries as the previously existing region boundaries. Nets have also been started at the area level, and there are several section nets meeting during the daytime. *QST* covers the details of DNTS as they unfold.

The NTS plan somewhat spreads traffic opportunity so that casual traffic may be reported into nets for efficient handling one or two days or nights per week; or the ardent traffic man can operate in both daytime and evening segments to roll up impressive totals and speed traffic reliably to its destination. Old-time traffic men who prefer a high degree of organization and teamwork have returned to the traffic game as a result of the new system. Beginners have shown more interest in becoming part of a system nationwide in scope, in which *anyone* can participate. The National Traffic System has vast and intriguing possibilities as an amateur service. It is open to any amateur who wishes to participate.

The above is but the briefest resume of what is of necessity a rather complicated arrangement of nets and schedules. Complete details of the System and its operation are included in the ARRL *Public Service Communications* Manual.

EMERGENCY COMMUNICATION

One of the most important ways in which the amateur serves the public, thus making his existence a national asset, is by his preparation for and his participation in communications emergencies. Every amateur, regardless of the extent of his normal operating activities, should give some thought to the possibility of his being the only means of communication should his community be cut off from the outside world. It has happened many times, often in the most unlikely places; it has happened without warning, finding some amateurs totally unprepared; it can happen to *you*. Are you ready?

There are two principal ways in which any amateur can prepare himself for such an eventuality. One is to provide himself with equipment capable of operating on any type of emergency power (i.e., either ac or dc), and equipment which can readily be transported to the scene of disaster. Mobile and hand-held equipment is especially desirable in most emergency situations.

Such equipment, regardless of how elaborate or how modern, is of little use, however, if it is not used properly and at the right times; and so another way for an amateur to prepare himself for emergencies, by no means less important than the first, is to *learn to operate efficiently*. There are many amateurs who feel that they know how to operate efficiently but who find themselves considerably handicapped at the crucial time by not knowing proper procedure, by being unable, due to years of casual amateur operation, to adapt themselves to snappy, abbreviated transmissions, and by being unfamiliar with message form and

procedures. It is dangerous to overrate your ability in this; it is better to assume you have things to learn.

In general it can be said that there is more emergency equipment available than there are operators who know properly how to operate during emergency conditions, for such conditions require clipped, terse procedure with complete break-in on cw and fast push-to-talk or VOX on phone. The casual rag-chewing aspect of amateur radio, however enjoyable and worth-while in its place, must be forgotten at such times in favor of the business at hand. There is only one way to gain experience in this type of operation, and that is by practie. During an emergency is no time for practice; it should be done beforehand, as often as possible, on a regular basis.

This leads up to the necessity for emergency organization and preparedness. ARRL has long recognized this necessity and has provided for it. The Section Communications Manager (whose address appears on page 6 of every issue of *QST*) is empowered to appoint certain qualified amateurs in his section for the purpose of coordinating emergency communication organization and preparedness in specified areas or communities. This appointee is known as an Emergency Coordinator for the city or town. One should be specified for each community. For coordination and promotion at section level a Section Emergency Coordinator arranges for and recommends the appointments of various Emergency Coordinators at activity points throughout the section. Emergency Coordinators organize amateurs in their communities according to local needs for emergency communication facilities.

The community amateurs taking part in the local organization are members of the Amateur Radio Emergency Corps (AREC). *All* amateurs are invited to register in the AREC, whether they are able to play an active part in their local organization or only a supporting role. Application blanks are available from your EC, SEC, SCM or direct from ARRL Headquarters. In the event that inquiry reveals no Emergency Coordinator appointed for your community, your SCM would welcome a recommendation either from yourself or from a radio club of which you are a member. By holding an amateur operator license, you have the responsibility to your community and to amateur radio to uphold the traditions of the service.

Among the League's publications is a booklet entitled *Public Service Communications*. This booklet, while small in size, contains a wealth of information on AREC organization and functions and is invaluable to any amateur participating in emergency or civil defense work. It is free to AREC members and should be in every amateur's shack. Drop a line to the ARRL Communications Department if you want a copy, or use the coupon at the end of this chapter.

The Radio Amateur Civil Emergency Service

Following World War II there was established within our government the Federal Civil Defense Administration (FCDA), which, at the behest of ARRL and other amateurs, considered the role of the amateur in civil defense communication should the U.S. become embroiled in another war. This resulted, in 1951, in the establishment of the Radio Amateur Civil Emergency Service (RACES) with rules promulgated by FCC as a part of the Amateur Radio Service. FCDA has evolved into the present Defense Civil Preparedness Agency, part of the Department of Defense, and although the RACES rules have undergone several minor changes they are still essentially the same as originally put into effect.

RACES is intended solely for civil defense communication during civil emergencies, through the medium of amateur radio, and is designed to continue operation during any extreme national emergency such as war. It shares certain segments of frequencies with the regular (i.e., normal) Amateur Service on a nonexclusive basis. Its regulations are a subpart of the familiar amateur regulations (Part 97) and are included in full in the ARRL *License Manual*.

If *every* amateur participated, we would still be short of the total operating personnel required properly to implement RACES. As the service which bears the responsibility for the successful

Before Emergency

PREPARE yourself by providing emergency power for your station.

TEST your emergency equipment and operating ability in the annual Simulated Emergency Test and Field Day.

REGISTER with your ARRL Emergency Coordinator. If none, offer your services to local and civic relief agencies and explain what amateur radio can do during disasters.

In Emergency

LISTEN before you transmit, *always*!

REPORT to your Emergency Coordinator so he will have latest data on your facilities. Offer local civic and relief agencies your services directly in the absence of an EC.

RESTRICT all on-the-air work in accordance with FCC regulations, Sec. 97.107.

SOS is the International Distress Call for a dire emergency. The phone equivalent is MAYDAY. Use these calls for *emergency only*. False distress calls are unlawful.

RESPECT the fact that success in emergency depends on circuit discipline. The net control station is the supreme authority.

COOPERATE with those we serve. Be ready to help, but stay off the air unless there is a specific job to be done that you can handle more efficiently than any other station.

COPY bulletins from W1AW. During emergencies, special bulletins are transmitted.

After Emergency

REPORT to ARRL Headquarters promptly and fully so that the Amateur Service can receive full credit.

implementation of this important function, we face not only the task of installing (and in some cases building) the necessary equipment, but also of the training of thousands of additional people. This can and should be a function of the local unit of the Amateur Radio Emergency Corps under its EC and his assistants, working in close collaboration with the local civil defense organization.

The first step in organizing RACES locally is the appointment of a radio officer by the local civil defense director, possibly on the recommendation of his communications officer. A complete and detailed communications plan must be approved successively by local, state and DCPA regional directors, and by FCC. Once this has been accomplished, applications for station authorizations under this plan can be submitted direct to FCC. A complete bibliography of *QST* articles dealing with the subject of civil defense and RACES is available upon request from the ARRL Communications Department.

In the event of war, civil defense will place great reliance on RACES for back-up radio communication. Even in peacetime, RACES can be of great value in natural disaster communications. As a part of our total amateur public service effort, it deserves our whole-hearted and enthusiastic support and will permit us to continue to function in the public service, as amateurs, in RACES in wartime as we function in AREC and NTS during peacetime. If interested, inquire of your local civil defense agency and get sighed up with your radio officer.

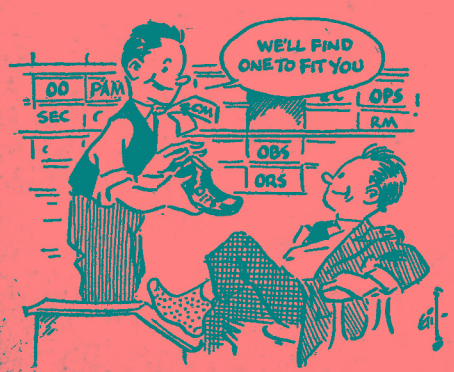
ARRL OPERATING ORGANIZATION

Amateur operation must have point and constructive purpose to win public respect. Each individual amateur is the ambassador of the entire fraternity in his public relations and attitude toward his hobby. ARRL field organization adds point and purpose to amateur operating.

The Communications Department of the League is concerned with the practical operation of stations in all branches of amateur activity. Appointments or awards are available for rag-chewer, traffic enthusiast, phone operator, DX man and experimenter.

There are seventy-four ARRL Sections in the League's field organization, which embraces the United States, Canada, and certain other territory. Operating affairs in each Section are supervised by a Section Communications Manager (SCM) elected by members in that section for a two-year term of office. Organization appointments are made by the SCMs, elected as provided in the Rules and Regulations of the Communications Department, which accompany the League's By-Laws and Articles of Association. SCM addresses for all sections are given in full in each issue of *QST*. SCMs welcome monthly activity reports from all amateurs in their sections, regardless of status.

Whether your activity embraces phone or telegraphy, or both, there is a place for you in the League organization.



LEADERSHIP POSTS

To advance each type of station work and group interest in amateur radio, and to develop practical communications plans with the greatest success, appointments of ARRL members holding Conditional Class licenses or better to serve as leaders and organizers in particular single-interest fields are made by the SCM. Each leadership post is important. Each provides activities and assistance for appointee groups and individual members along the lines of natural interest. Some posts further the general ability of amateurs to communicate efficiently at all times by pointing activity toward networks and round tables; others are aimed specifically at establishment of provisions for organizing the amateur service as a standby communications group to serve the public in disaster, civil defense need or emergency of any sort. The SCM appoints the following in accordance with section needs and individual qualifications:

PAM Phone Activities Manager. Organizes activities for voice operators in his section. Promotes phone nets and recruits Official Phone Station appointees. The appointment of VHF-PAM is open to Technician licensees.

RM Route Manager. Organizes and coordinates cw traffic activities. Supervises and promotes nets and recruits Official Relay Station appointees.

SEC Section Emergency Coordinator. Promotes and administers section emergency radio organization.

EC Emergency Coordinator. Organizes amateurs of a community or other local areas for emergency radio service; maintains liaison with officials and agencies served, also with other local communication facilities. Sponsors tests, recruits for AREC and encourages alignment with RACES. A Technician Class licensee may receive this appointment if a qualified higher class licensee is not available.

STATION APPOINTMENTS

ARRL's field organization has a place for every active amateur who has a station. The Communications Department organization exists to increase individual enjoyment and station effectiveness in

amateur radio work, and we extend a cordial invitation to every amateur to participate fully in the activities, to report results monthly, and to apply to the SCM for one of the following station appointments. ARRL membership and the conditional class or higher license or VE equivalent is prerequisite to all appointments, except where otherwise indicated.

OPS Official Phone Station. Sets high voice operating standards and procedures, furthers phone nets and traffic.

ORS Official Relay Station. Traffic service, operates cw nets; noted for 15 wpm and procedure ability. Open to RTTY traffickers.

ORS II Same as ORS, for the Novice operators, code speed minimum of 10 wpm.

OBS Official Bulletin Station. Transmits ARRL and FCC bulletin information to amateurs. Open to Technician licensees.

OVS Official VHF Station. Collects and reports vhf-uhf-shf propagation data, may engage in facsimile, TT, TV, work on 50 MHz and/or above. Takes part as feasible in vhf traffic work, reports same, supports vhf nets, observes procedure standards. Open to both Novice and Technician licensees.

OO Official Observer. Sends cooperative notices to amateurs to assist in frequency observance, insures high-quality signals, and prevents FCC trouble.

Emblem Colors

Members may wear the ARRL emblem with black-enamel background. A red background will indicate that the wearer is or has been SCM. SECs, ECs, RMs and PAMs may wear the emblem with green background. Observers and all *station* appointees are entitled to wear blue background emblems.

RADIO CLUB AFFILIATION

ARRL affiliation is available to any amateur society in one of three categories: Category 1, all "local" radio clubs having at least 51% licensed amateurs and at least 51% ARRL membership; Category 2, radio club "councils," and similar organizations of large geographic area, same requirements as category 1. Category 3, high school, college and youth-group clubs having at least one officer or trustee who is a licensed amateur and an ARRL member.

A "Club Kit" is available upon request from the Communications Department; this kit contains all papers necessary for affiliation application plus other materials of interest to clubs. Once the completed affiliation package is returned the affiliation process begins.

ARRL affiliated clubs receive a periodic bulletin from Headquarters and special information at intervals for posting on club bulletin boards or for relay to club members. A travel plan providing communications, technical, and legal/regulatorial contact from the Headquarters is worked out seasonally to give maximum benefits to as many as possible of the active affiliated radio clubs.

The ARRL Communications Department oversees the affiliated club program, under the direction of an Assistant Communications Manager. Material aimed at training and entertainment of club members is available, plus advise on club problems such as organization, conducting meetings and attracting new members.

Training services for clubs include films, slide collections, and quizzes, available upon request. These items are limited almost exclusively to affiliated clubs. Watch *QST* and Club Bulletins for details on these items, or write the ARRL for latest lists.

W1AW

The Maxim Memorial Station, W1AW, is dedicated to fraternity and service. Operated by the League headquarters, W1AW is located adjacent to the Headquarters offices on a seven-acre site. The station is on the air daily, except holidays, and available time is divided between the different bands and modes. Facilities for all commonly used amateur modes are provided for all bands from 1.8 to 144 MHz.

Operation is roughly proportional to amateur interest in different bands and modes with maximum legal power on most bands. W1AW's daily bulletins and code practice aim to give operational help to the largest number.

W1AW was established as a living memorial to Hiram Percy Maxim, to carry on the work and traditions of amateur radio. The station is on the air daily and is open to visitors at all times it is in operation. The W1AW schedule of operation and visiting hours is printed each month in the *Operating News* section of *QST*.

OPERATING ACTIVITIES

Within the ARRL field organization there are many, special activities. For all appointees and officials quarterly CD (Communications Department) Parties are scheduled to develop operating ability and a spirit of fraternalism.

In addition, ARRL sponsors various other activities open to all amateurs. The DX-minded amateur may participate in the Annual ARRL International DX Competition during February and March. This popular contest may bring you the thrill of working new countries and building up your DXCC totals; certificate awards are offered to top scorers in each country and ARRL section (see page 6 of any *QST*) and to club leaders. Then there is the very-popular Sweepstakes in November. Of domestic scope, the SS affords the opportunity to work new states for that WAS award. A Novice activity is planned annually. Both a 10- and 160-Meter Contest are scheduled for early December. The interests of vhf enthusiasts are also provided for in contests held in January, June and September of each year. Where enough logs (three) are received to constitute minimum "competition" a certificate in spot activities, such as the "SS" and vhf party, is awarded the leading newcomer for his work considered only in competition with other newcomers.

As in all our operating, the idea of having a good time is combined in the Annual June Field Day with the more serious thought of preparing ourselves to render public service in times of emergency. A premium is placed on the use of equipment without connection to commercial power sources. Clubs and individual groups always enjoy themselves in the "FD" and learn much about the requirements for operating under knockabout conditions afield.

ARRL contest activities are diversified to appeal to all operating interest, and will be found announced in detail in issues of *QST* preceding the different events.

AWARDS

The League-sponsored operating activities, heretofore mentioned, have useful objectives and provide much enjoyment for members of the fraternity. Achievement in amateur radio is also recognized by various certificates offered through the League and detailed below.

WAS Award

WAS means "Worked All States." An amateur, anywhere in the world, who succeeds in getting confirmed contacts with all fifty U.S. states and sends them in for examination, may receive this award from the League. For W/VE members and DX stations, there is a $3 fee which includes return of the cards by registered mail. The fee for W/VE non-members is $6.

You can make the contacts over any period of time and on any or all amateur bands. If you wish, you may have your WAS award issued for some special way in which you made it, such as all cw, all phone, all on one band, all with lower power, etc. – only providing all cards submitted plainly show that a contact took place under the special circumstances for which you wish the award issued.

Before you send your cards, drop the ARRL Communications Department a line requesting a copy of the rules and an application blank.

5BWAS

The Five Band Worked All States Award became effective January 1, 1970. Only contacts made after that date count. Contacts must be confirmed with all 50 states on each of five amateur bands. Rules require applicants in the U.S. and possessions, Puerto Rico and Canada, to be a full member of ARRL. Basic WAS rules apply, with the addition of a $15 fee for W/VE League members and DX stations which includes return of the cards by registered mail and a plaque. The award is not available to W/VE non-members.

DX Century Club Award

The DXCC is one of the most popular and sought-after awards in all of amateur radio, and among the more difficult to acquire. Its issuance is carefully supervised at ARRL headquarters by two staff members who spend full time on this function alone.

To obtain DXCC, an amateur must make two-way contact with 100 "countries" listed on ARRL Operating Aid No. 7, which also contains the complete rules. Written confirmations are required for proof of contact. Such confirmations must be sent to ARRL headquarters, where each one is carefully scrutinized to make sure it actually confirms a contact with the applying amateur, that it was not altered or tampered with, and that the "country" claimed is actually on the ARRL list. Further safeguards are applied to maintain the high standards of this award. A handsome king-size certificate is sent to each amateur qualifying.

The term "country" is an arbitrary one not necessarily agreeing with the dictionary definition of such. For DXCC purposes, many bodies of land not having independent status politically are classified as countries. For example, Alaska and Hawaii, while states of the U.S., are considered separate "countries" because of their distance from the mainland. There are over 300 such designations on the ARRL list. Once a basic DXCC is issued, the certificate can be endorsed, by sticker, for additional countries by sending the additional cards in to headquarters for checking.

Separate DXCC Awards are available for mixed modes, all phone and all cw.

There are fees charged for the DXCC award and for endorsements. Before applying, familiarize yourself with full information. Application forms (CD164) and the ARRL Countries List (detailing rules/charges) may be obtained from Headquarters for a stamped addressed envelope.

Five-Band DXCC

Entirely separate from DXCC, ARRL also offers a Five-Band DXCC (5BDXCC) Award for those amateurs who submit written proof of having

made two-way contact with 100 or more countries on each of five amateur bands since January 1, 1969. Only full ARRL members are eligible in the U.S., possessions and Canada; elsewhere, any amateur may apply.

A charge of $20 (U.S.) is made for application forms; this covers the cost of returning cards by first class registered mail and issuance of a personalized engraved plaque for those qualifying.

For a copy of the complete rules, drop a line to ARRL Headquarters, 225 Main St., Newington, CT 06111.

WAC Awards

The WAC award, Worked All Continents, is issued by the International Amateur Radio Union (IARU) upon proof of contact with each of the six continents. Amateurs in the U.S.A., Possessions and Canada should apply for the award through ARRL, headquarters society of the IARU. Those elsewhere must submit direct to their own IARU member-society. Residents of countries not represented in the Union may apply directly to ARRL for the award. Two basic types of WAC certificates are issued. One contains no endorsements and is awarded for cw, or a combination of cw and phone contacts; the other is awarded when all work is done on phone. There is a special endorsement to the phone WAC when all the confirmations submitted clearly indicate that the work was done on two-way ssb. Special endorsements are also available for RTTY and SSTV. The *only* special band endorsements are for 1.8, 3.5, and 50 MHz.

Five- and Six-Band WAC Awards are based on contacts made on or after January 1, 1974. Write ARRL Headquarters for details.

Satellite "1000" Award

Contacts made on or after December 15, 1972, via the Oscar communications satellites count for this unique "DX Achievement" award. Only one contact per station, regardless of mode. To earn the award you must amass 1000 points. Each contact with a new station counts 10 points, with a new country 50 points, with a new continent 250 points. The fee for W/VE members and DX stations is $2 which includes return of the cards by registered mail. W/VE non-members' fee is $3.

Code Proficiency Award

Many hams can follow the general idea of a contact "by ear" but when pressed to "write it down" they "muff" the copy. The Code Proficiency Award permits each amateur to prove himself as a proficient operator, and sets up a system of awards for step-by-step gains in copying proficiency. It enables every amateur to check his code proficiency, to better that proficiency, and to receive a certification of his receiving speed.

This program is a whale of a lot of fun. The League will give a certificate to any interested individual, who demonstrates that he can copy perfectly, for at least one minute, plain-language Continental code at 10, 15, 20, 25, 30 or 35 words per minute, as transmitted monthly from W1AW and W6OWP.

As part of the ARRL Code Proficiency program W1AW transmits plain-language practice material each evening and week-day morning at speeds from 5 to 35 wpm, occasionally in reverse order. All amateurs are invited to use these transmissions to increase their code-copying ability. Non-amateurs are invited to utilize the lower speeds, 5, 7 1/2 and 10 wpm, which are transmitted for the benefit of persons studying the code in preparation for the amateur license examination. Refer to any issue of *QST* for details.

Rag Chewers Club

The Rag Chewers Club is designed to encourage friendly contacts and discourage the "hello-good-bye" type of QSO. It furthers fraternalism through amateur radio.

Membership certificates are awarded to amateurs who report a fraternal-type contact with another amateur lasting a half hour or longer. This does not mean a half hour spent trying to get a message through or in trying to work a rare DX station, but a solid half hour of pleasant "visiting" with another amateur discussing subjects of mutual interest and getting to know each other. If nominating someone for RCC, please send the information to the nominee who will (in turn) apply to Headquarters for RCC.

Members sign "RCC" after their calls to indicate that they are interested in a chat, not just a contact. There is no fee for W/VE members and DX, a 25¢ fee for others.

Operating Aids

The following Operating Aids are available free, upon request: 4) Emergency Operating. 5) DX Operating Code. 6) Contest Duplicate Contact Record. 7) DXCC Countries List. 8) W A S Record. 9) ARRL Message Form. 13) Ready Reference Information. 14) A composite aid; Ending Signals, Time Conversion, Phonetic Alphabets, RST System and Steps in an Emergency.

A-1 Operator Club

The A-1 Operator Club should include in its ranks every good operator. To become a member, one must be nominated by at least two operators who already belong. General keying or voice technique, procedure, copying ability, judgment and courtesy all count in rating candidates under the club rules detailed at length in *Operating an Amateur Radio Station.* Aim to make yourself a fine operator, and one of these days you may be pleasantly surprised by an invitation to belong to the A-1 Operator Club, which carries a worthwhile certificate in its own right.

Brass Pounders League

Every individual reporting more than a specified minimum of official monthly traffic totals is given an honor place in the *QST* listing known as the Brass Pounders League and a certificate to recognize his performance is fur-

nished by the SCM. In addition, a *BPL Traffic Award* (medallion) is given to individual amateurs working at their own stations after the third time they "make BPL" provided it is duly reported to the SCM and recorded in *QST*.

Public Service Honor Roll

A new listing, supplementing the BPL, was started in 1970. It takes into account the many public service functions of amateurs in addition to the handling of record messages. Points can be claimed for checking into and participating in nets, for serving as net control stations, as liaison between nets, for handling phone patches, for making BPL, for handling real emergency traffic and for serving as a net manager. Each such function has a maximum number of points per month so that nobody can make the PSHR by performing a single type of function, except handling emergency traffic. Versatility in public service is encouraged and rewarded. See *QST* for details.

Old Timers Club

The Old Timers Club is open to anyone who holds an amateur call at the present time, and who held an amateur license (operator or station) 20-or-more years ago. Lapses in activity during the intervening years are permitted.

If you can qualify as an "Old Timer," send an outline of your ham career. Indicate the date of your first amateur license and your present call. If eligible for the OTC, you will be added to the roster and will receive a membership certificate.

INTERNATIONAL PREFIXES

AAA-ALZ	United States of America
AMA-AOZ	Spain
APA-ASZ	Pakistan
ATA-AWZ	India
AXA-AXZ	Commonwealth of Australia
AYA-AZZ	Argentine Republic
BAA-BZZ	China
CAA-CEZ	Chile
CFA-CKZ	Canada
CLA-CMZ	Cuba
CNA-CNZ	Morocco
COA-COZ	Cuba
CPA-CPZ	Bolivia
CQA-CRZ	Portuguese Overseas Provinces
CSA-CUZ	Portugal
CVA-CXZ	Uruguay
CYA-CZZ	Canada
DAA-DTZ	Germany
DUA-DZZ	Republic of the Philippines
EAA-EHZ	Spain
EIA-EJZ	Ireland
EKA-EKZ	Union of Soviet Socialist Rep.
ELA-ELZ	Liberia
EMA-EOZ	Union of Soviet Socialist Rep.
EPA-EQZ	Iran
ERA-ERZ	Union of Soviet Socialist Rep.
ESA-ESZ	Estonia
ETA-ETZ	Ethiopia
EUA-EWZ	Bielorussian Soviet Socialist Rep.
EXA-EZZ	Union of Soviet Socialist Rep.
FAA-FZZ	France and French Community
GAA-GZZ	United Kingdom
HAA-HAZ	Hungarian People's Republic
HBA-HBZ	Switzerland
HCA-HDZ	Ecuador
HEA-HEZ	Switzerland
HFA-HFZ	People's Republic of Poland
HGA-HGZ	Hungarian People's Republic
HHA-HHZ	Republic of Haiti
HIA-HIZ	Dominican Republic
HJA-HKZ	Republic of Colombia
HLA-HMZ	Korea
HNA-HNZ	Iraq
HOA-HPZ	Republic of Panama
HQA-HRZ	Republic of Honduras
HSA-HSZ	Thailand
HTA-HTZ	Nicaragua
HUA-HUZ	Republic of El Salvador
HVA-HVZ	Vatican City State
HWA-HYZ	France and French Community
HZA-HZZ	Saudi Arabia
IAA-IZZ	Italy
JAA-JSZ	Japan
JTA-JVZ	Mongolian People's Republic
JWA-JXZ	Norway
JYA-JYZ	Jordan
JZA-JZZ	Western New Guinea
KAA-KZZ	United States of America
LAA-LNZ	Norway
LOA-LWZ	Argentine Republic
LXA-LXZ	Luxembourg
LYA-LYZ	Lithuania
LZA-LZZ	People's Republic of Bulgaria
MAA-MZZ	United Kingdom
NAA-NZZ	United States of America
OAA-OCZ	Peru
ODA-ODZ	Lebanon
OEA-OEZ	Austria
OFA-OJZ	Finland
OKA-OMZ	Czechoslovakia
ONA-OTZ	Belgium
OUA-OZZ	Denmark
PAA-PIZ	Netherlands
PJA-PJZ	Netherlands Antilles
PKA-POZ	Republic of Indonesia
PPA-PYZ	Brazil
PZA-PZZ	Surinam
QAA-QZZ	(Service abbreviations)
RAA-RZZ	Union of Soviet Socialist Rep.
SAA-SMZ	Sweden
SNA-SRZ	People's Republic of Poland
SSA-SSM	United Arab Republic
SSN-STZ	Sudan
SUA-SUZ	Arab Republic of Egypt
SVA-SZZ	Greece
TAA-TCZ	Turkey
TDA-TDZ	Guatemala
TEA-TEZ	Costa Rica
TFA-TFZ	Iceland
TGA-TGZ	Guatemala
THA-THZ	France and French Community
TIA-TIZ	Costa Rica
TJA-TJZ	Republic of Cameroon
TKA-TKZ	France and French Community
TLA-TLZ	Central African Republic
TMA-TMZ	France and French Community
TNA-TNZ	Republic of Congo (Brazzaville)
TOA-TQZ	France, French Community
TRA-TRZ	Republic of Gabon
TSA-TSZ	Tunisia
TTA-TTZ	Republic of Chad
TUA-TUZ	Republic of the Ivory Coast
TVA-TXZ	France and French Community
TYA-TYZ	Republic of Dahomey
TZA-TZZ	Republic of Mali
UAA-UQZ	Union of Soviet Socialist Republics
URA-UTZ	Ukrainian Soviet Socialist Rep.
UUA-UZZ	Union of Soviet Socialist Republics
VAA-VGZ	Canada
VHA-VNZ	Commonwealth of Australia
VOA-VOZ	Canada
VPA-VSZ	British Overseas Territories
VTA-VWZ	India
VXA-VYZ	Canada
VZA-VZZ	Commonwealth of Australia
WAA-WZZ	United States of America
XAA-XIZ	Mexico
XJA-XOZ	Canada
XPA-XPZ	Denmark
XQA-XRZ	Chile
XSA-XSZ	China
XTA-XTZ	Republic of the Upper Volta
XUA-XUZ	Khmer Republic
XVA-XVZ	Viet Nam
XWA-XWZ	Laos
XXA-XXZ	Portuguese Overseas Provinces
XYA-XZZ	Burma
YAA-YAZ	Afghanistan
YBA-YHA	Republic of Indonesia
YIA-YIZ	Iraq
YJA-YJZ	New Hebrides
YKA-YKZ	Syria
YLA-YLZ	Latvia
YMA-YMZ	Turkey
YNA-YNZ	Nicaragua
YOA-YRZ	Roumanian People's Republic
YSA-YSZ	Republic of El Salvador
YTA-YUZ	Yugoslavia

YVA-YYZ	Venezuela
YZA-YZZ	Yugoslavia
ZAA-ZAZ	Albania
ZBA-ZJZ	British Overseas Territories
ZKA-ZMZ	New Zealand
ZNA-ZOZ	British Overseas Territories
ZPA-ZPZ	Paraguay
ZQA-ZQZ	British Overseas Territories
ZRA-ZUZ	Republic of South Africa
ZVA-ZZZ	Brazil
2AA-2ZZ	Great Britain
3AA-3AZ	Monaco
3BA-3BZ	Mauritius
3CA-3CZ	Equatorial Guinea
3DA-3DM	Swaziland
3DN-3DZ	Fiji
3EA-3FZ	Panama
3GA-3GZ	Chile
3HA-3UZ	China
3VA-3VZ	Tunisia
3WA-3WZ	Viet Nam
3XA-3XZ	Guinea
3YA-3YZ	Norway
3ZA-3ZZ	People's Republic of Poland
4AA-4CZ	Mexico
4DA-4IZ	Republic of the Philippines
4JA-4LZ	Union of Soviet Socialist Rep.
4MA-4MZ	Venezuela
4NA-4OZ	Yugoslavia
4PA-4SZ	Ceylon
4TA-4TZ	Peru
4UA-4UZ	United Nations
4VA-4VZ	Republic of Haiti
4WA-4WZ	Yemen
4XA-4XZ	State of Israel
4YA-4YZ	International Civil Aviation Org.
4ZA-4ZZ	State of Israel
5AA-5AZ	Libya
5BA-5BZ	Republic of Cyprus
5CA-5GZ	Morocco
5HA-5IZ	Tanzania
5JA-5KZ	Colombia
5LA-5MZ	Liberia
5NA-5OZ	Nigeria
5PA-5QZ	Denmark
5RA-5SZ	Malagasy Republic
5TA-5TZ	Islamic Republic of Mauritania
5UA-5UZ	Republic of the Niger
5VA-5VZ	Togolese Republic
5WA-5WZ	Western Samoa
5XA-5XZ	Uganda
5YA-5ZZ	Kenya
6AA-6BZ	Arab Republic of Egypt
6CA-6CZ	Syria
6DA-6JZ	Mexico
6KA-6NZ	Korea
6OA-6OZ	Somalia
6PA-6SZ	Pakistan
6TA-6UZ	Sudan
6VA-6WZ	Republic of the Senegal
6XA-6XZ	Malagasy Republic
6YA-6YZ	Jamaica
6ZA-6ZZ	Liberia
7AA-7IZ	Indonesia
7JA-7NZ	Japan
7OA-7OZ	South Yemen Popular Republic
7PA-7PZ	Lesotho
7QA-7QZ	Malawi
7RA-7RZ	Algeria
7SA-7SZ	Sweden
7TA-7YZ	Algeria
7ZA-7ZZ	Saudi Arabia
8AA-8IZ	Indonesia
8JA-8NZ	Japan
8OA-8OZ	Botswana
8PA-8PZ	Barbados
8QA-8QZ	Maldive Islands
8RA-8RZ	Guyana
8SA-8SZ	Sweden
8TA-8YZ	India
8ZA-8ZZ	Saudi Arabia
9AA-9AZ	San Marino
9BA-9DZ	Iran
9EA-9FZ	Ethiopia
9GA-9GZ	Ghana
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9KA-9KZ	Kuwait
9LA-9LZ	Sierra Leone
9MA-9MZ	Malaysia
9NA-9NZ	Nepal
9OA-9TZ	Republic of Zaire
9UA-9UZ	Burundi
9VA-9VZ	Singapore
9WA-9WZ	Malaysia
9XA-9XZ	Rwanda
9YA-9ZZ	Trinidad and Tobago
A2A-A2Z	Republic of Botswana
A3A-A3Z	Kingdom of Tonga
A4A-A4Z	Oman
A5A-A5Z	Bhutan
A6A-A6Z	United Arab Emirates
C2A-C2Z	Republic of Nauru
C3A-C3Z	Principality of Andorra
L2A-L9Z	Argentina
S2A-S3Z	Bangladesh

ABBREVIATIONS FOR CW WORK

Abbreviations help to cut down unnecessary transmission. However, make it a rule not to abbreviate unnecessarily when working an operator of unknown experience.

AA	All after
AB	All before
ABT	About
ADR	Address
AGN	Again
ANT	Antenna
BCI	Broadcast interference
BCL	Broadcast listener
BK	Break; break me; break in
BN	All between; been
BUG	Semi-automatic key
C	Yes
CFM	Confirm; I confirm
CK	Check
CL	I am closing my station; call
CLD-CLG	Called; calling
CQ	Calling any station
CUD	Could
CUL	See you later
CUM	Come
CW	Continuous wave (i.e., radiotelegraph)
DLD-DLVD	Delivered
DX	Distance, foreign countries
ES	And, &
FB	Fine business; excellent
GA	Go ahead (or resume sending)
GB	Good-by
GBA	Give better address
GE	Good evening
GG	Going
GM	Good morning
GN	Good night
GND	Ground
GUD	Good
HI	The telegraphic laugh; high
HR	Here; hear
HV	Have
HW	How
LID	A poor operator
MA, MILS	Milliamperes
MSG	Message; prefix to radiogram
N	No
NCS	Net control station
ND	Nothing doing
NIL	Nothing; I have nothing for you
NM	No more
NR	Number
NW	Now; I resume transmission
OB	Old boy
OM	Old man
OP-OPR	Operator
OT	Old timer; old top
PBL	Preamble
PSE	Please
PWR	Power
PX	Press
R	Received as transmitted; are
RCD	Received
RCVR (RX)	Receiver
REF	Refer to; referring to; reference
RFI	Radio frequency interference
RIG	Station equipment
RPT	Repeat; I repeat
RTTY	Radioteletype
SASE	Self-addressed, stamped envelope
SED	Said
SIG	Signature; signal
SINE	Operator's personal initials or nickname
SKED	Schedule
SRI	Sorry
SVC	Service; prefix to service message
TFC	Traffic
TMW	Tomorrow
TNX-TKS	Thanks
TT	That
TU	Thank you
TVI	Television interference
TXT	Text
UR-URS	Your; you're; yours
VFO	Variable-frequency oscillator
VY	Very
WA	Word after
WB	Word before
WD-WDS	Word; words
WKD-WKG	Worked; working
WL	Well; will
WUD	Would
WX	Weather
XMTR (TX)	Transmitter
XTAL	Crystal
XYL (YF)	Wife
YL	Young lady
73	Best regards
88	Love and kisses

▲ *Operating an Amateur Radio Station* covers the details of practical amateur operating. In it you will find information on Operating Practices, Emergency Communication, ARRL Operating Activities and Awards, the ARRL Field Organization, Handling Messages, Network Organization, "Q" Signals and Abbreviations used in amateur operating, and other helpful material. It's a handy reference that will serve to answer meny of the questions concerning operating that arise during your activities on the air.

▲ *Public Service Communications* is the "bible" of the Amateur Radio Public Service Corps. Within its pages are contained the fundamentals of operation of the Amateur Radio Emergency Corps (AREC), the National Traffic System (NTS), and the Radio Amateur Civil Emergency Servica (RACES), including diagrams of how each is orgenized and how it operates. The role of the American Red Cross and FCC's regulations concerning amateur operation in emergencies also come in for some special attention.

The two publications described above may be obtained without charge by any *Handbook* reader. Either or both will be sent upon request.

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Vacuum Tubes and Semiconductors

For the convenience of the designer, the receiving-type tubes listed in this chapter are grouped by filament voltages and construction types (glass, metal, miniature, etc.). For example, all miniature tubes are listed in Table I, all metal tubes are in Table II, and so on.

Transmitting tubes are divided into triodes and tetrodes-pentodes, then listed according to rated plate dissipation. This permits direct comparison of ratings of tubes in the same power classification.

For quick reference, all tubes are listed in numerical-alphabetical order in the index. Types having no table reference are either obsolete or of little use in amateur equipment. Base diagrams for these tubes are listed.

Tube Ratings

Vacuum tubes are designed to be operated within definite maximum (and minimum) ratings. These ratings are the maximum safe operating voltages and currents for the electrodes, based on inherent limiting factors such as permissible cathode temperature, emission, and power dissipation in electrodes.

In the transmitting-tube tables, maximum ratings for electrode voltage, current and dissipation are given separately from the typical operating conditions for the recommended classes of operation. In the receiving-tube tables, ratings and operating data are combined. Where only one set of operating conditions appears, the positive electrode voltages shown (plate, screen, etc.) are, in general, also the maximum rated voltages.

For certain air-cooled transmitting tubes, there are two sets of maximum values, one designated as CCS (Continuous Commercial Service) ratings, the other ICAS (Intermittent Commercial and Amateur Service) ratings. Continuous Commercial Service is defined as that type of service in which long tube life and reliability of performance under continuous operating conditions are the prime consideration. Intermittent Commercial and Amateur Service is defined to include the many applications where the transmitter design factors of minimum size, light weight, and maximum power output are more important than long tube life. ICAS ratings are considerably higher than CCS ratings. They permit the handling of greater power, and although such use involves some sacrifice in tube life, the period over which tubes give satisfactory performance in intermittent service can be extremely long.

The plate dissipation values given for transmitting tubes should not be exceeded during normal operation. In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is approximately 66 percent of the value listed and will rise to the maximum value under 100 percent sinusoidal modulation.

Typical Operating Conditions

The typical operating conditions given for transmitting tubes represent, in general, maximum ICAS ratings where such ratings have been given by the manufacturer. They do not represent the *only* possible method of operation of a particular tube type. Other values of plate voltage, plate current, etc., may be used so long as the maximum ratings for a particular voltage or current are not exceeded.

Detailed information and characteristic curves are available from tube and semiconductor manufacutrers, in books sold through radio dealers or direct from the factory.

Semiconductors

The semiconductor tablulation in this chapter is restricted to some of the more common diodes and transistors. The units listed were selected to represent those types that are useful for most amateur radio experimental applications. These diodes and transistors were chosen for their low cost and availability. Most of them can be obtained from the large mail-order houses or from the local manufacturer's distributor. Because there are thousands of diode and transistor types on today's market, this list is by no means complete.

INDEX TO TUBE TABLES

INDEX TO VACUUM-TUBE TYPES

Base-diagram section pages V5-V15. Classified data pages V16-V34.

Type	*Page*	*Base*
00-A	—	4D
01-A	—	4D
0A2	V19	5BO
0A3A	V19	4AJ
0A4G	—	4V
0A5	—	Fig. 19
0B2	V19	5BO
0B3	V19	4AJ
0C2	V19	5BO
0C3A	V19	4AJ
0D3A	V19	4AJ
0G3	—	5BO
0Y4	—	4BU
0Z4	—	4R
0Z4A	—	4R
0Z4G	V19	4R
1	—	4G
1A3	—	5AP
1A4P	—	4M
1A4T	—	4K
1A5GT	—	6X
1A6	—	6L
1A7GT	—	7Z
1AB5	—	5BF
1AB6	—	7DH
1AC6	—	7DH
1AE4	—	6AR
1AF4	—	6AR
1AF5	—	6AU
1AH5	—	6AU
1AJ4	—	6AR
1AX2	—	9Y
1B3GT	V19	3C
1B4	—	4M
1B5	—	6M
1B7GT	—	7Z
1B8GT	—	8AW
1C3	—	5CF
1C5GT	—	6X
1C6	—	6L
1C7G	—	7Z
1C21	—	4V
1D5GP	—	5Y
1D5GT	—	5R
1D7G	—	7Z
1D8GT	—	8AJ
1DN5	—	6BW
1E3	—	9BG
1E4G	—	5S
1E5GP	—	5Y
1E7G	—	8C
1EP1-2-11	—	11V
1F4	—	5K
1F5G	—	6X
1F6	—	6W
1F7G	—	7AD
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1G4GT	—	5S
1G5G	—	6X
1G6GT	—	7AB
1H4G	—	5S
1H5GT	—	5Z
1H6G	—	7AA
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1J5G	—	6X
1J6GT	—	7AB
1K3	—	3C
1K3	V19	3C
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1L6	—	7DC
1LA4	—	6AD
1LA6	—	7AK
1LB4	—	5AD
1LB6	—	8AX
1LC5	—	7AO
1LC6	—	7AK
1LD5	—	6AX
1LE3	—	4AA
1LF3	—	4AA
1LG5	—	7AO
1LH4	—	5AG
1LN5	—	7AO
1N5GT	—	5Y
1N6G	—	7AM
1P5GT	—	5Y
1Q5GT	—	6AF
1R4	—	4AH
1R5	—	7AT
1S4	—	7AV
1S5	—	6AU
1SA6GT	—	6CA
1SB6GT	—	6CB
1T4	—	6AR
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1U4	—	6A
1U5	—	6BR
1U6	—	7DW
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1W4	—	5BZ
1X2	—	9Y
1X2A	—	9Y
1X2B	—	9Y
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2A5	—	6B
2A6	—	6G
2A7	—	7C
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2B4	—	5A
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2C21	—	7BH
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2C25	—	4D
2C26A	—	4BB
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2C36	—	Fig. 21
2C37	—	Fig. 21
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2C43	V20	Fig. 11
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2C52	—	8BD
2D21	—	7BN
2E5	—	6R
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2E24	—	7CL
2E25	V22	5BJ
2E26	V22	7CK
2E30	—	7CQ
2EA5	—	7EW
2EN5	—	7FL
2G5	—	6R
2S/4S	—	5D
2V2	—	8FV
2V3G	—	4Y
2W3	—	4X
2X2-A	V19	4AB
2Y2	V19	4AB
2Z2	V19	4B
3A2	—	9DT
3A3	—	8EZ
3A4	—	7BB
3A5	—	7BC
3A8GT	—	8AS
3ACP1-7-11	—	14J
3AP1-4	—	7AN
3AP1A	—	7CE
3AQP1	—	12E
3B4	—	7CY
3B5GT	—	7AP
3B7	—	7BE
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3B26	—	Fig. 18
3B27	—	4P
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3C4	—	6BX
3C5GT	—	7AQ
3C6	—	7BW
3C22	—	Fig. 17
3C23	—	3G
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3CP1	—	11C
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3D6	—	6BB
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3DK6	—	7CM
3DX3	—	Fig. 24
3E5	—	6BX
3E6	—	7CJ
3E22	—	8BY
3E29	V22	7BP
3EA5	—	7EW
3EP1	—	11N
3FP7	—	14B
3FP7A	—	14J
3GP1-4-5-11	—	11A
3GP1A	—	11N
3GP4A	—	11N
3JP1—12	—	14J
3JP1A—11A	—	14J
3KP1-4-11	—	11M
3LE4	—	6BA
3LF4	—	6BB
3MP1	—	12F
3Q4	—	7BA
3Q5GT	—	7AP
3RP1-4	—	12E
3RP1A	—	12E
3S4	—	7BA
3SP1-4-7	—	12E
3UP1	—	12F
3V4	—	6BX
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3-50A4	—	3G
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4C34	—	2N
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4DK6	—	7CM
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4EW6	—	7CM
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5A6	—	9L
5ABP1-7-11	—	14J
5ADP1-7-11	—	14J
5AMP1	—	14U
5AP1-4	—	11A
5AQP1	—	14G
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5AU4	V20	5T
5AW4	V20	5T
5AX4GT	—	5T
5AZ4	—	5T
5BC3	—	9NT
5BP1	—	11A
5BP1A	—	11N
5BP7A	—	11N
5CP1-11	—	14B
5CP1A	—	14J
5CP1B-11B	—	14J
5CP7A	—	14J
5CP11A	—	14J
5CP12	—	14J
5D22	V23	5BK
5DJ4	—	8KS
5EA8	—	9AE
5FV8	—	9FA
5GP1	—	11A
5HP1-4	—	11A
5HP1A	—	11N
5JP1A-4A	—	11S
5LP1A-4A	—	11T
5MP1-11	—	7AN
5NP1-4	—	11A
5R4GY	V20	5T
5R4GYA	V20	5T
5RP1A-4A	—	14P
5SP1-4	—	14K
5T4	—	5T
5U4G	V20	5T
5U4GA-GB	V20	5T
5UP1-11	—	12E
5V3A	V20	5T
5V4GA	V20	5L
5VP7	—	11N
5W4GT	—	5T
5X3	—	4C
5X4G	—	5Q
5XP1	—	14P
5XP1A-11A	—	14P
5Y3-G-GT	V20	5T
5Y4-G-GT	—	5Q
5Z3	V20	4C
5Z4	V20	5L
5-125B	V23	7BM
5-500A	V23	—
6A3	—	4D
6A4	—	5B
6A5GT	—	6T
6A6	—	7B
6A7	—	7C
6A8	V18	8A
6AB4	—	5CE
6AB5	—	6R
6AB6G	—	7AU
6AB7	—	8N
6AB8	—	9AT
6AC5GT	—	6Q
6AC6G	—	7AU
6AC7	V18	8N
6AD5G	—	6Q
6AD6G	—	7AG
6AD7G	—	8AY
6AD8	—	9T
6AE5G	—	6Q
6AE6G	—	7AH
6AE7GT	—	7AX
6AE8	V24	8DU
6AF3	—	9CB
6AF4A	V16	7DK
6AF5G	—	6Q
6AF6G	—	7AG
6AF7G	—	8AG
6AG5	V16	7BD
6AG6G	—	7S
6AG7	V18	8Y
6AH4GT	—	8EL
6AH5G	—	6AP
6AH6	V16	7BK
6AH7GT	—	8BE
6AJ4	V16	9BX
6AJ5	—	7BD
6AJ7	—	8N
6AJ8	—	9CA
6AK5	V16	7BD
6AK6	V16	7BK
6AK7	—	8Y
6AK8	—	9E
6AL3	—	9CB
6AL5	V16	6BT
6AL6G	—	6AM
6AL7GT	V19	8CH
6AM4	V16	9BX
6AM5	—	6CH
6AM6	—	7DB
6AM8A	—	9CY
6AN4	—	7DK
6AN5	V16	7BD
6AN6	—	7BJ
6AN7	—	9Q
6AN8A	V16	9DA
6AQ4	—	7DT
6AQ5A	V16	7BZ
6AQ6	V16	7BT
6AQ7GT	V19	8CK
6AQ8	—	9AJ
6AR5	V16	6CC
6AR6	V19	6BQ
6AR7GT	V19	7DE
6AR8	—	9DP
6AS5	—	7CV
6AS6	V16	7CM
6AS7GA	V19	8BD
6AS8	—	9DS
6AT6	V16	7BT
6AT8A	—	9DW
6AU4GT	—	4CG
6AU5GT	V19	6CK
6AU6A	V16	7BK
6AU7	—	9A
6AU8A	—	9DX
6AV4	V20	5BS
6AV5GA	—	6CK
6AV5GT	—	6CK
6AV6	V16	7BT
6AV11	—	12BY
6AW7GT	—	8CQ
6AW8A	—	9DX
6AX4GT	—	4CG
6AX5GT	V20	6S
6AX6G	—	7Q
6AX7	—	9A
6AX8	—	9AE
6AZ8	V16	9ED
6B4G	—	5S
6B5	—	6AS
6B6G	—	7V
6B7	—	7D
6B8	V18	8E
6B10	—	12BF
6BA6	V16	7BK
6BA7	V16	8CT
6BA8A	—	9DX
6BC4	V16	9DR
6BC5	—	7BD
6BC7	—	9AX
6BC8	—	9AJ
6BD4A	—	Fig. 80
6BD5GT	—	6CK
6BD6	—	7BK
6BD7	—	9Z
6BE6	V16	7CH
6BE7	—	9AA
6BE8A	V16	9EG
6BF5	V16	7BZ
6BF6	V16	7BT
6BG6GA	—	5BT
6BH5	—	9AZ
6BH6	V16	7CM
6BH8	V16	9DX
6BJ5	—	6CH
6BJ6A	V16	7CM
6BJ7	V16	9AX
6BJ2	V16	9ER
6BK5	—	9BQ
6BK6	V16	7BT
6BK7A	—	9AJ
6BK7B	V16	9AJ
6BL7GTA	V19	8BD
6BL8	V16	9DC
6BM5	—	7BZ
6BN4A	V16	7EG
6BN6	V16	7DF
6BN7	—	9AJ
6BN8	V16	9ER
6BQ5	V16	9CV
6BQ6GTB/ 6CU6	V19	6AM
6BQ7A	V16	9AJ
6BR7	—	9BC
6BR8A	V16	9FA
6BS5	—	9BK
6BS7	—	9BB
6BS8	V16	9AJ
6BT6	—	7BT
6BT8	—	9FE
6BU5	—	8FP
6BU6	—	7BT
6BU8	—	9FG
6BV7	—	9BU
6BV8	—	9FJ
6BW4	V20	9DJ
6BW6	—	9AM
6BW7	—	9AQ
6BW8	—	9HK
6BW11	—	12HD
6BX4	V20	5BS
6BX6	—	9AQ
6BX7GT	V19	8BD
6BX8	V16	9AJ
6BY5G	V20	6CN
6BY6	—	7CH
6BY7	—	9AQ
6BY8	—	9FN
6BZ6	V16	7CM
6BZ7	V16	9AJ
6BZ8	V16	9AJ
6C4	V16	6BG
6C4	V20	6BG
6C5	—	6Q
6C6	—	6F
6C7	—	7G
6C8G	—	3G
6C10	—	12BQ
6CA4	V20	9M
6CA5	—	7CV
6CB5A	V19	8GD
6CB6A	V16	7CM
6CD6GA	V19	5BT
6CE5	V16	7BD
6CF6	—	7CM
6CG6	V16	7BK
6CG7	V16	9AJ
6CG8A	—	9GF
6CH6	—	9BA
6CH7	—	9EW
6CH8	—	9F
6CJ6	—	9AS
6CK4	V19	8JB
6CK6	—	9AR
6CL5	V19	8GD
6CL6	V16	9BV
6CL8A	—	9FX
6CM6	—	9CK
6CM7	—	9ES
6CM8	—	9FZ
6CN7	—	9EN
6CQ6	—	7DB
6CQ8	—	9GE
6CR6	—	7EA
6CR8	—	9GJ
6CS5	—	9CK
6CS6	—	7CH
6CS7	—	F9E
6CS8	—	9FZ
6CU5	—	7CV
6CU6	V19	6AM
6CU8	—	9GM
6CW4	V16	12AQ
6CW5	—	9CV
6CX7	—	9FC
6CX8	V16	9DX
6CY5	V16	7EW
6CY7	—	9EF
6CZ5	—	9HN
6D4	—	5AY
6D6	—	6F
6D7	—	7H
6D8G	—	8A
6D10	—	12BQ
6DA4A	—	4CQ
6DB5	—	9GR
6DB6	—	7CM
6DC6	—	7CM
6DE4	V20	4CG
6DE6	—	7CM
6DE7	—	9HF
6DG6GT	—	7S
6DJ8	V16	9AJ
6DK6	V16	7CM
6DN6	V19	5BT
6DN7	V19	8BD
6DQ5	V19	8JC
6DQ6B	V19	6AM
6DR7	—	9HF
6DS4	V16	12AQ
6DS5	—	7BZ
6DT5	—	9HN
6DT6	V16	7EN
6DT8	—	9DE
6DV4	—	12EA
6DW5	V16	9CK
6DX4	—	7DK
6DX8	—	9HX
6DZ4	—	7DK
6DZ7	V19	8JP
6E5	V19	6R
6E6	—	7B
6E7	—	7H
6E8G	—	8O
6EA5	—	7EW
6EA7	V19	8BD
6EA8	V16	9AE
6EB5	—	6BT
6EB8	V16	9DX
6EF6	V19	7S
6EH5	V16	7CV
6EH7	V16	9AQ
6EH8	V16	9JG
6EJ7	V16	9AQ
6ER5	V16	7FN
6ES5	—	7FP
6ES8	V17	9DE
6EU7	V17	9LS
6EU8	V17	9JF
6EV5	—	7EW
6EW6	—	7CM
6EW7	—	9HF
6EX6	—	5BT
6EY6	V19	7AC
6EZ5	V19	7AC
6EZ8	V17	9KA
6F4	V20	7BR
6F4	V25	7BR
6F5	—	5M
6F6	V18	7S
6F7	—	7E
6F8G	—	8G
6FD7	—	9HF
6FG5	—	7GA
6FG7	—	9GF
6FH5	—	7FP
6FH6	V19	6AM
6FJ7	—	12BM
6FM7	—	12BJ
6FM8	—	9KR
6FQ5A	—	7FP
6FS5	—	7GA
6FV6	V17	7FQ
6FV8A	—	9FA
6FW8	—	9AJ
6FY5	—	7FN
6G5	—	6R
6G6G	—	7S
6GC5	V17	9EU
6GE5	—	12BJ
6GF5	—	12BJ
6GH8A	—	9AE
6GJ5	—	9NM
6GJ8	V17	9AE
6GK5	V17	7FP
6GK6	V17	9GK
6GM6	V17	7CM
6GM8	—	9DE
6GN8	V17	9DX
6GS8	—	9LW
6GT5	—	9NZ
6GU5	—	7GA
6GV8	—	9LY
6GW5	—	7GK
6GW6	V19	6AM
6GY8	—	9MB
6GZ5	—	7CV
6H4GT	—	5AF
6H5	—	6R
6H6	—	7Q
6H8G	—	8E
6HA5	—	7GM
6HB5	—	12BJ
6HB6	V17	9PU
6HB7	—	9QA
6HF5	—	12FB
6HF8	—	9DX
6HG5	—	7BZ
6HJ8	—	9CY
6HK5	—	7GM
6HM5	—	7GM
6HQ5	—	7GM
6HS6	—	7BK
6HS8	—	9LW
6HZ6	—	7EN
6HZ8	—	9DX
6J4	V17	7BQ
6J5	V18	6Q
6J6A	V17	7BF
6J6A	V20	7BF
6J7	V18	7R
6J8G	—	8H
6J11	—	12BW
6JB6	—	9QL
6JC6A	—	9PM
6JC8	—	9PA
6JD6	—	9PM
6JE6	—	9QL
6JE6A	—	9QL
6JF6	—	9QL
6JH6	—	7CM
6JH8	—	9DP
6JK8	—	9AJ
6JN8	—	9FA
6JT8	—	9DX
6JV8	—	9DX
6K5GT	—	5U
6K6GT	V19	7S
6K7	V18	7R
6K8	V18	8K
6K11	—	12BY
6KD6	—	12GW
6KD8	V17	9AE
6KE8	V17	9DC
6KM6	—	9QL
6KR8	V17	9DX
6KT6	V17	9PM
6KT8	V17	9QP
6KV8	—	9DX
6KY6	—	9GK
6KZ8	V17	9FZ
6L4	—	7BR
6L5G	—	6Q
6L6GA	—	7S
6L6GB	V18	7S
6L6GX	—	7S
6L7	V18	7T
6LF6	—	12GW
6LJ8	V17	9GF
6LM8	—	9AE
6LQ6	—	9QL
6LY8	V17	9DX
6M5	—	9N
6M6G	—	7S
6M7G	—	7R
6M8GT	—	8AU
6M11	—	12CA
6MQ8	—	9AE
6MU8	V17	9AE
6N4	—	7CA
6N5	—	6R
6N6G	—	7AU
6N7GT	V18	8B
6N7GT	V20	8B
6N8	—	9T
6P5GT	—	6Q
6P7G	—	7U
6P8G	—	8K
6Q4	—	9S
6Q5G	—	6Q
6Q6G	—	6Y
6Q7	V18	7V
6Q11	—	12BY
6R4	—	9R

Type	Page	Base
6R6G	—	6AW
6R7	V18	7V
6R8	—	9E
6S4	—	9AC
6S4A	—	9AC
6S6GT	—	5AK
6S7	—	7R
6S8GT	—	8CB
6SA7GT	V18	8R
6SB7Y	V18	8R
6SC7	V18	8S
6SD7GT	—	8N
6SE7GT	—	8N
6SF5	—	6AB
6SF7	V18	7AZ
6SG7	V18	8BK
6SH7	V18	8BK
6SH7L	—	8BK
6SJ7	V18	8N
6SJ7Y	V21	8N
6SK7	V18	8N
6SL7GT	V19	8BD
6SN7GTA	—	8BD
6SN7GTB	V19	8BD
6SQ7GT	V18	8Q
6SR7	V18	8Q
6SS7	—	8N
6ST7	—	8Q
6SU7GTY	—	8BD
6SV7	—	7AZ
6SZ7	—	8Q
6T4	V17	7DK
6T5	—	6R
6T6GM	—	6Z
6T7	—	7V
6T8	—	9E
6T8A	V17	9E
6T9	—	12FM
6U3	—	9BM
6U4GT	—	4CG
6U5	—	6R
6U6GT	—	7S
6U7G	—	7R
6U8	—	9AE
6U8A	V17	9AE
6V3	—	9BD
6V3A	—	9BD
6V4	V20	9M
6V5GT	—	6AO
6V6GTA	V18	7S
6V7G	—	7V
6V8	—	9AH
6W4GT	—	4CG
6W5G	—	6S
6W6GT	V19	7S
6W7G	—	7R
6X4/6063	V20	7CF
6X5GT	V20	6S
6X6G	—	7AL
6X8	—	9AK
6X8A	V17	9AK
6Y8G	—	4AC
6Y5	—	6J
6Y6G	—	7S
6Y6GA	V19	7S
6Y6GT	—	7S
6Y7G	—	8B
6Z3	V20	4G
6Z4	—	5D
6Z5	—	6K
6Z7G	—	8B
6ZY6G	—	6S
7A4	—	5AC
7A5	—	6AA
7A6	—	7AJ
7A7	—	8V
7A8	—	8U
7AB7	—	8BO
7AD7	—	8V
7AF7	—	8AC
7AG7	—	8V
7AH7	—	8V
7AJ7	—	8V
7AK7	—	8V
7B4	—	5AC
7B5	—	6AE
7B6	—	8W
7B7	—	8V
7B8	—	8X
7C4	—	4AH
7C5	—	6AA
7C6	—	8W
7C7	—	8V
7D7	—	8AR
7E5	—	8BN
7E6	—	8W
7E7	—	8AE
7EP4	—	11N
7EV6	—	7AC
7EY6	—	7AC
7F7	—	8AC
7F8	—	8BW
7G7	—	8V
7G8	—	8BV
7GP4	—	14G
7H7	—	8V
7J7	—	8BL
7JP1-4-7	—	14R
7K7	—	8BF
7L7	—	8V
7N7	—	8AC
7Q7	—	8AL
7R7	—	8AE
7S7	—	8BL
7T7	—	8V
7V7	—	8V
7VP1	—	14R
7W7	—	8BJ
7X6	—	7AJ
7X7	—	8BZ
7Y4	—	5AB
7Z4	—	5AB
8BP4	—	14G
9BM5	—	7BZ
9BW6	—	9AM
9NP1	—	6BN
10	—	4D
10EB8	—	9DX
10GP4	—	14G
10HP4	—	14G
10Y	—	4D
11/12	—	4F
12A4	—	9AG
12A5	—	7F
12A6	—	7S
12A7	—	7K
12A8GT	—	8A
12AB5	V17	9EU
12AB6	—	7CC
12AC6	—	7BK
12AD6	—	7CH
12AD7	—	9A
12AE6A	—	7BT
12AE7	—	9A

Type	Page	Base
12AF6	—	7BK
12AG6	—	7CH
12AH7GT	—	8BE
12AH8	—	9BP
12AJ6	—	7BT
12AL5	—	6BT
12AL8	—	9GS
12AQ5	V17	7BZ
12AT6	—	7BT
12AT7	V17	9A
12AU6	—	7BK
12AU7A	V20	9A
12AU7A	V17	9A
12AV5GA	—	6CK
12AV6	—	7BT
12AV7	V17	9A
12AW8	—	7CM
12AW7	—	7CM
12AX4GT	—	4CG
12AX4GTA	—	4CG
12AX7A	V17	9A
12AY7	V17	9A
12AZ7A	V17	9A
12B4	—	9AG
12B4A	—	9AG
12B6M	—	6Y
12B7	—	8V
12B7ML	—	8V
12B6GT	—	8T
12BA6	—	7BK
12BA7	—	8CT
12BD6	—	7BK
12BE6	—	7CH
12BF6	—	7BT
12BH7	—	9A
12BH7A	V17	9A
12BK5	—	9BQ
12BK6	—	7BT
12BL6	—	7BK
12BN6	—	7DF
12BQ6GA	—	6AM
12BQ6GT	—	6AM
12BQ6GTB	—	6AM
12BR7A	—	9CF
12BT6	—	7BT
12BU6	—	7BT
12BW4	—	9DJ
12BV7	—	9BF
12BX6	—	9AQ
12BY7	—	9BF
12BY7A	V17	9BF
12BZ6	—	7CM
12BZ7	—	9A
12C5	—	7CV
12C8	—	8E
12CA5	—	7CV
12CM6	—	9CK
12CN5	—	7CV
12CR6	—	7EA
12CS5	—	9CK
12CS6	—	7CH
12CT8	—	9DA
12CU5	—	7CV
12CU6	—	6AM
12CX6	—	7BK
12DB5	—	9GR
12DE8	—	Fig. 81
12DF5	—	9BS
12DF7	—	9A
12DK7	—	9HZ
12DL8	—	9HR
12DM7	—	9A
12DQ6A	—	6AM
12DQ7	—	9BF
12DS7	—	9JU
12DT5	—	9HN
12DT6	—	7EN
12DT7	—	9A
12DT8	—	9DE
12DU7	—	9JX
12DV7	—	9JY
12DV8	—	9HR
12DW5	—	9CK
12DW7	—	9A
12DW8	—	9JC
12DY8	—	9JD
12DZ6	—	7BK
12E5GT	—	6Q
12EA6	—	7BK
12EC8	—	9FA
12ED5	—	7CV
12EF6	—	7S
12EG6	—	7CH
12EK6	—	7BK
12EL6	—	7FB
12EM6	—	9HV
12EN6	—	7S
12F5GT	—	5M
12F8	—	9FH
12FK6	—	7BT
12FM6	—	7BT
12FP7	—	14E
12FQ8	—	9KT
12FR8	—	9KU
12FT6	—	7BT
12FX5	—	7CV
12FX8A	—	9KV
12G4	—	6BG
12G7G	—	7V
13C8	—	9CZ
12GA6	—	7CH
12GE5	—	12BJ
12GJ5	—	9NM
12GW6	—	6AM
12GN7	—	9BF
12GP7	—	14S
12H4	—	7DW
12H6	—	7Q
12HP7	—	11J
12J5GT	—	6Q
12J7GT	—	7R
12J8	—	9GC
12K5	—	7EK
12K7GT	—	7R
12K8	—	8K
12L6GT	—	7S
12L8GT	—	8BU
12Q7GT	—	7V
12R5	—	7CV
12S8GT	—	8CB
12SA7	—	8R
12SC7	—	8S
12SF5	—	6AB
12SF7	—	7AZ
12SG7	—	8BK
12SH7	—	8BK
12SJ7	—	8N
12SK7	—	8N
12SL7GT	—	8BD
12SN7GT	—	8BD
12SN7GTA	—	8BD
12SQ7	—	8Q
12SR7	—	8Q
12SW7	—	8Q

Type	Page	Base
12SX7	—	8BD
12SY7	—	8R
12U7	—	9A
12V6GT	—	7S
12W6GT	—	7S
12X4	V20	5BS
12Z3	—	4G
12Z5	—	7L
14A4	—	5AC
14A5	—	6AA
14A7	—	8V
14AF7	—	8AC
14AP1-4	—	12A
14B6	—	8W
14B8	—	8X
14C5	—	6AA
14C7	—	8V
14E6	—	8W
14E7	—	8AE
14F7	—	8AC
14F8	—	8BW
14H7	—	8V
14J7	—	8BL
14N7	—	8AC
14Q7	—	8AL
14R7	—	8AE
14S7	—	8BL
14V7	—	8V
14W7	—	8BJ
14X7	—	8BZ
14Y4	—	5AB
14Z3	—	4G
15	—	5F
15A6	—	9AR
15E	—	Fig. 51
16A5	—	9BL
17	—	3G
17Z3	—	9CB
18	—	6B
18FW6A	—	7CC
18FX6A	—	7CH
18FY6A	—	7BT
19	—	6C
19CL8A	—	9FX
19X3	—	9BM
19Y3	—	9BM
20	—	4D
20AP1-4	—	12A
20J3GT	—	8H
21A6	—	9AS
21A7	—	8AR
21EX6	—	5BT
22	—	4K
24-A	—	5E
24-G	—	2D
24XH	—	Fig. 1
25A6	—	7S
25A7GT	—	8F
25AC5GT	—	6Q
25AV5GA	—	6CK
26AV5GT	—	6CK
25AX4GT	—	4CG
25B5	—	6D
25B6G	—	7S
25B8GT	—	8T
25BK5	—	9BQ
25BQ6GA	—	6AM
25BQ6GT	—	6AM
25BQ6GTB	—	6AM
25C5	—	7CV
25C6G	—	7AC
25C6GA	—	7S
25CA5	—	7CV
25CD6G	—	5BT
25CD6GA	—	5BT
25CD6GB	—	5BT
25CU6	—	6AM
25D8GT	—	8AF
25DN6	—	5BT
25DQ6	—	6AM
25EC6	—	5BT
25EH5	—	7CV
25F5	—	7CV
25L6GT	—	7S
25N6G	—	7W
25S	—	6M
25SA7GT	—	8AD
25T	—	3G
25W4GT	—	4CG
25W6GT	—	7S
25X6GT	—	7Q
25Y4GT	—	5AA
25Y5	—	6E
25Z3	—	4G
25Z4	—	5AA
25Z5	V20	6E
25Z6	—	7Q
26	—	4D
26A6	—	7BK
26A7GT	—	8BU
26BK6	—	7BT
26C6	—	7BT
26CG6	—	7BK
26D6	—	7CH
25Z5W	—	9BS
27	—	5A
28Z5	—	5AB
30	—	4D
31	—	4D
32	—	4K
32ET5	—	7CV
32L7GT	—	8Z
33	—	5K
34	—	4M
34GD5	—	7CV
35/51	—	5E
35A5	—	6AA
35B5	V17	7BZ
35C5	—	7CV
35L6GT	—	7S
35T	—	3G
35TG	—	2D
35W4	V20	5BQ
35Y4	—	5AL
35Z3	—	4Z
35Z4GT	V20	5AA
35Z5G	V20	6AD
35Z6G	—	7Q
36	—	5E
36AM3	V20	5BQ
37	—	5A
38	—	5F
39/44	—	5F
40	—	4D
40Z5GT	—	6AD
41	—	6B
42	—	6B
43	—	6B
45	—	4D
45Z3	—	5AM
45Z5GT	—	6AD
46	—	5C
47	—	5B
48	—	6A

Type	Page	Base
49	—	5C
50	—	4D
50A5	—	6AA
50AX6G	—	7Q
50B5	V17	7BZ
50BK5	—	9BQ
50C5	—	7CV
50C6G	—	7S
50C6GA	—	7S
50DC4	V20	5BQ
50FK5	V17	7CV
50L6GT	—	7S
50T	—	2D
50X6	—	7AJ
50Y6GT	V20	7Q
50Y7GT	—	8AN
50Z6G	—	7Q
50Z7G	—	8AN
51	—	5E
52	—	5C
53	—	7B
53A	—	Fig. 53
55	—	6G
56	—	5A
56AS	—	5A
57	—	6F
57AS	—	6F
58	—	6F
58AS	—	6F
59	—	7A
70A7GT	—	8AB
70L7GT	—	8AA
71-A	—	4D
72	—	4P
73	—	4Y
75	—	6G
75TH	—	2D
75TL	—	2D
76	—	5A
77	—	6F
78	—	6F
79	—	6H
80	V20	4C
81	—	4B
82	—	4C
83	V20	4C
83-V	V20	4AD
84/6Z4	—	5D
85	—	6G
85AS	—	6G
89	—	6F
90C1	—	5BO
99	—	4D
100TH	V21	2D
100TL	V21	2D
111H	—	2D
112-A	—	4D
117L7GT	—	8AO
117M7GT	—	8AO
117N7GT	V20	8AV
117P7GT	—	8AV
117Z3	V20	4CB
117Z4GT	—	5AA
117Z6GT	—	7Q
128AS	—	5A
150T	—	2N
152TH	—	4BC
152TL	—	4BC
176A	V23	Fig. 78
182-B	—	4D
183	—	4D
203-A	—	4E
203-H	—	3N
204-A	—	Fig. 39
205-D	—	4D
211	—	4E
212-E	—	Fig. 43
217-A	—	4AT
217-C	—	4AT
227-A	—	Fig. 53
241-B	—	Fig. 44
242-A	—	4E
242-B	—	4E
242-C	—	4E
249-B	—	Fig. 29
250TH	V21	2N
250TL	V21	2N
254	—	2N
254-A	—	Fig. 57
254-B	—	Fig. 57
261-A	—	4E
270-A	—	Fig. 39
276-A	—	4E
282-A	—	Fig. 57
284-B	—	3N
284-D	—	4E
295-A	—	4E
300T	—	2N
303-A	—	4E
304-A	—	Fig. 39
304-B	—	2D
304TH	V21	4BC
304TL	V21	4BC
305-A	—	Fig. 59
306-A	—	Fig. 63
307-A	—	Fig. 61
308-B	—	Fig. 43
310	—	4D
311	—	4E
311CH	—	Fig. 32
312-A	—	Fig. 68
312-E	—	Fig. 44
327-A	—	Fig. 50
327-B	—	Fig. 50
342-B	—	4E
356-A	—	Fig. 55
361-A	—	4E
376-A	—	4E
408A	—	7BD
417-A	V17	9V
482-B	—	4D
483	—	4D
485	—	5A
527	—	Fig. 53
559	—	Fig. 10
572B	V21	3G
575-A	—	4AT
592	—	Fig. 28
705-A	—	Fig. 45
717-A	—	8BK
766	—	4D
800	—	2D
801A/801	—	4D
802	—	6BM
803	V23	5J
804	—	Fig. 61
805	—	3N
806	—	2N
807	V22	5AW
807W	V22	5AW
808	—	2D
809	—	3G
810	V21	2N
811	—	3G

Type	Page	Base
811A	V21	3G
812	—	3G
812A	V21	3G
812H	—	3G
813	V23	5BA
814	V22	Fig. 64
815	V22	8BY
816	V20	4P
822	—	3N
822S	—	2N
826	—	7BO
828	—	5JP
829	—	7BP
829A	—	7BP
829B	V22	7BP
830	—	4D
830B	—	3G
831	—	Fig. 40
832	—	7BP
832A	V22	7BP
833A	V21	Fig. 41
834	—	2D
835	—	4E
836	V20	4P
837	—	6BM
828	—	4E
840	—	5J
841	—	4D
841A	—	3G
841SW	—	3G
843	—	5A
844	—	5AW
849	—	Fig. 39
850	—	Fig. 47
852	—	2D
860	—	Fig. 58
861	—	Fig. 42
864	—	4D
865	—	Fig. 67
866	—	4P
866A-AX	V20	4P
866B	V20	4P
866Jr	V20	4B
871	—	4P
872A/872	V20	4AT
874	—	4S
878	—	4P
879	—	4AB
884	—	6Q
865	—	5A
902A	—	8CD
906P1-11	—	7AN
908A	—	7CE
909	—	5BP
910	—	7AN
911	—	7AN
914A	—	6BF
930B	—	3G
938	—	4E
950	—	5K
951	—	4M
954	—	5BB
955	—	5BC
955	—	5BC
866	—	5BB
957	—	5BD
958	—	5BD
958A	—	5BD
958A	—	5BD
959	—	5BE
967	—	3G
975A	—	4AT
1003	—	4R
1005	—	5AQ
1006	—	4C
1201	—	8BN
1203	—	4AH
1204	—	8BO
1206	—	8BV
1218A	—	7DK
1221	—	6F
1223	—	7R
1229	—	4K
1230	—	4D
1231	—	8V
1232	—	8V
1265	—	4AJ
1266	—	4AJ
1267	—	4V
1273	—	8V
1274	—	6S
1275	—	4C
1276	—	4D
1280	—	8V
1284	—	8V
1291	—	7BE
1293	—	4AA
1294	—	4AH
1299	—	8BB
1602	—	4D
1603	—	6F
1608	—	4D
1609	—	5B
1610	—	Fig. 62
1611	—	7S
1612	—	7T
1613	—	7S
1614	V22	7AC
1616	—	4P
1619	—	Fig. 74
1620	V18	7R
1621	—	7S
1622	—	7AC
1623	V20	3G
1624	—	Fig. 66
1625	V22	5AZ
1626	—	6Q
1627	—	2N
1628	—	Fig. 54
1629	—	6RA
1631	—	7AC
1632	—	7S
1633	—	8BD
1634	—	8S
1635	V19	8B
1641	—	Fig. 52
1642	—	7BH
1644	—	Fig. 4
1654	—	2Z
1802P1-11	—	11A
1805P1-4	—	11A
1806P1	—	11N
1851	—	7R
1852	V18	8N
1853	—	8N
2002	—	Fig. 1
2005	—	Fig. 1
2050	—	8BA
2051	—	8BA
2523N/128A	—	5A
4604	—	7CL
4652	—	Fig. 51
5514	—	4BO
5516	—	7CL

Type	Page	Base
5517	—	5BU
5556	—	4D
5562	—	Fig. 30
5590	—	7BD
3391	—	7BD
5608	—	7BD
5608A	—	7B
5610	—	6CG
5618	—	7CU
5651	V19	5BO
5654	—	7BD
5656	—	9F
5662	V19	Fig. 79
5663	—	6CE
5670	—	8CJ
5675	V20	Fig. 21
5679	—	7CX
5686	V17	9G
5687	V17	9H
5690	—	Fig. 38
5691	—	8BD
5692	—	8BD
5692	V18	8N
5694	—	8CS
5696	V19	7BN
5722	V17	5CB
5725	—	7CM
5726	—	6BT
5727	V19	7BN
5781	—	5BC
5749	—	7BK
5750	—	7CH
5751	—	9A
5755	—	9J
5763	V22	9K
5764	—	Fig. 21
5765	—	Fig. 21
5766	See 2C37	
5767	See 2C37	
5768	—	Fig. 21
5794	—	Fig. 21
5812	—	7CQ
5814	—	9A
5823	V19	4CK
5824	—	7S
5825	—	4P
5839	—	6S
5842	V17	9V
5844	—	7BF
5845	—	5CA
5847	—	9X
5852	—	6S
5857	—	9AB
5866	V21	Fig. 3
5867	—	Fig. 3
5871	—	7AC
5876	—	Fig. 21
5879	V17	9AD
5881	—	7AC
5890	—	12J
5893	V20	Fig. 21
5894A	V22	Fig. 7
5910	—	6AR
5915	—	7CH
5920	—	7BF
5933	V22	5AW
5961	—	8R
5962	V19	2AG
5963	—	9A
5964	—	7BF
5965	—	9A
5993	—	Fig. 35
5998	V19	8BD
6005	—	7BZ
6023	—	9CD
6026	—	Fig. 16
6028	—	7BD
6045	—	7BF
6046	—	7AC
6057	—	9A
6058	—	6BT
6059	—	9BC
6060	—	9A
6061	—	9AM
6062	—	9K
6063	V20	7CF
6664	—	7DB
6065	—	7DB
6066	—	7BT
6067	—	9A
9072	—	9A
6073	V19	5BO
6074	V19	5BO
6080	—	8BD
6082	—	6BD
9033	—	Fig. 5
9084	—	9BJ
6085	—	9A
6086	—	9BK
6087	—	5L
6101	—	7BF
6132	—	9BA
6135	—	6BG
6136	—	7BK
6137	—	8N
6140	—	9BY
6141	—	9BZ
6146	V22	7CK
6146A	V22	7CK
6146B	V22	7CK
6155	V23	6BK
6156	V23	5BK
6157	—	Fig. 35
6158	—	9A
6159B	V22	7CK
6173	—	Fig. 34
6186	—	7BD
6197	—	9BV
6201	—	9A
6211	—	9A
6216	—	Fig. 37
6218	—	9CG
6227	—	9BA
6252	V22	Fig. 7
6263	—	—
6264	—	—
6265	—	7CM
6287	—	9CT
6308	—	8EX
6336A	—	8BD
6350	—	9CZ
6354	—	Fig. 12
6360	V22	Fig. 13
6374	—	9BW
6386	V17	8CJ
6417	V22	9K
6443	—	9BW
6485	—	7BK
6524	V22	Fig. 76
6550	V19	7S
6627	—	5BO
6660	—	7CC
6661	—	7CM
6662	—	7CM
6663	—	6BT
6664	—	5CE
6669	—	7BZ
6676	—	7CM
6677	—	9BV
6678	—	9AE
6679	—	9A
6680	—	9A
6681	—	9A
6816	V23	Fig. 77
6829	—	9A
6850	V22	Fig. 76
6883	V22	7CK
6884	V23	Fig. 77
6887	V17	6BT
6893	V22	7CK
6897	—	—
6907	—	Fig. 7
6939	V22	Fig. 13
6973	V17	9EU
7000	—	7R
7025	—	9A
7027A	V19	8HY
7034	V23	Fig. 75
7035	V23	Fig. 75
7054	—	9BF
7055	—	6BT
7056	—	6CM
7057	—	9AJ
7058	—	9A
7059	—	9AE
7060	—	9DX
7061	—	9EU
7077	—	—
7094	V23	Fig. 82
7137	—	7BQ
7167	—	7EW
7189A	V17	9CV
7247	—	9A
7258	V17	9DA
7270	V22	Fig. 84
7271	V22	Fig. 84
7308	—	9DE
7360	—	9KS
7408	—	7AC
7543	—	7BK
7551	V22	9LK
7558	V23	9LK
7581A	—	7AC
7586	V17	12AQ
7587	V17	12AS
7591	V19	8KQ
7695	—	9PX
7700	—	6F
7701	—	9MS
7717	—	7EW
7854	V22	Fig. 7
7868	—	9NZ
7895	V17	12AQ
7905	—	9PB
7984	—	12EU
8000	—	2N
8001	V22	7BM
8003	—	3N
8005	—	3G
8008	—	Fig. 8
3012	—	Fig. 54
5618-A	—	4P
3016	—	3C
3020	—	4P
8025	—	4AQ
8032	V22	7CK
8042	—	Fig. 51
8056	V17	12AQ
8058	V13	12CT
8072	V22	Fig. 86
8117	V22	Fig. 7
8121	V23	Fig. 86
8122	V23	Fig. 85
8163	V21	Fig. 3
8166/ 4-1000A	V23	—
8208	V22	12AQ
8295/172	V23	—
8298A	V22	7CK
8334	—	7DK
8393	V18	12AQ
8458	—	Fig. 13
8627	—	12CT
8628	V18	12AQ
8646	—	—
8677	V13	12CT
8808	—	Fig. 15
8873	V21	Fig. 87
8874	V21	—
8875	V21	—
8877	V21	—
9001	V18	7BD
9002	V18	7BS
9003	V18	7BD
9004	—	4BJ
9005	—	5BG
9006	V18	6BH
AT-340	—	5BK
AX9900	V21	Fig. 3
AX9001	—	Fig. 3
AX9903	V22	Fig. 7
AX9905	—	Fig. 2
AX9909	—	Fig. 5
AX9910	V22	Fig. 7
BA	—	4J
BH	—	4J
BR	—	4H
CE220	—	4P
CK1005	—	5AQ
CK1006	—	4C
CK1007	—	Fig. 73
DR3B27	—	4P
DR123C	—	Fig. 15
DR200	—	2N
ECC81	—	9A
ECC82	—	9A
ECC83	—	9A
EF50	—	9C
F123A	—	Fig. 15
F127A	—	Fig. 15
G84	V19	4B
GL2C44	—	Fig. 9
GL5C24	—	Fig. 15
GL146	—	Fig. 56
GL152	—	Fig. 56
GL156	—	Fig. 56
GL169	—	Fig. 56
GL446A	—	Fig. 11
GL446B	—	Fig. 11
GL464A	—	Fig. 9
GL559	—	Fig. 10
GL6442	—	—
GL6463	—	9CZ
GL8012A	—	Fig. 54
HD203A	—	2N
HF60	—	2D
HF75	—	2D
HF100	—	2D
HF120	—	4F
HF140	—	4F
HF175	—	Fig. 46
HF200	—	2N
HF201A	—	Fig. 15
HF250	—	2N
HF300	—	2N
HK24	—	3G
HK54	—	2D
HK57	—	Fig. 33
HK154	—	2D
HK158	—	2D
HK252L	—	4BC
HK253	—	4AT
HK254	—	2N
HK257	—	7BM
HK257B	—	7BM
HK304L	—	4BC
HK354	—	2N
HK354C	—	2N
HK354D	—	2N
HK354E	—	2N
HK354F	—	2N
HK454H	—	2N
HK454L	—	2N
HK654	—	2N
HV12	—	3N
HV18	—	2N
HV27	—	3N
HY6J5GTX	—	6Q
HY6L6GTX	—	7AC
HY24	—	4D
HY25	—	3G
HY30Z	—	4BO
HY31Z	—	Fig. 60
HY40	—	3G
HY40Z	—	3G
HY51A	—	3G
HY51B	—	3G
HY51Z	—	4BO
HY57	—	3G
HY60	—	5AW
HY61	—	5AW
HY63	—	Fig. 72
HY65	—	Fig. 72
HY67	—	Fig. 55
HY69	—	Fig. 64
HY75	—	2T
HY75A	—	2T
HY114B	—	2T
HY615	—	Fig. 71
HY801A	—	4D
HY866jr.	—	4P
HY1231Z	—	Fig. 60
HY1269	—	Fig. 65
HYE1148	—	Fig. 71
KT66	—	7AC
KY21	—	—
NU2C35	—	Fig. 23
PE340	—	5BK
PL172/8295	V26	—
PL177A	V22	Fig. 14
PL6549	—	Fig. 14
PL6569	V21	Fig. 3
PL6580	V21	5BK
RK10	—	4D
RK11	—	3G
RK12	—	3G
RK15	—	4D
RK16	—	6A
RK17	—	5F
RK18	—	3G
RK19	—	4AT
RK20	—	Fig. 61
RK20A	—	Fig. 61
RK21	—	4P
RK22	—	Fig. 52
RK23	—	6BM
RK24	—	4D
RK25	—	6BM
RK25B	—	6BM
RK28	—	5J
RK28A	—	5J
RK30	—	2D
RK31	—	3G
RK32	—	2D
RK33	—	Fig. 96
RK34	—	Fig. 70
RK35	—	2D
RK36	—	2D
RK37	—	2D
RK38	—	2D
RK39	—	5AW
RK41	—	5AW
RK42	—	4D
RK43	—	6C
RK44	—	6BM
RK46	—	Fig. 61
RK47	—	Fig. 64
RK48	—	Fig. 64
RK48A	—	Fig. 64
RK49	—	6A
RK51	—	3G
RK52	—	3G
RK56	—	5AW
RK57	—	3N
RK58	—	3N
RK59	—	Fig. 60
RK61	—	—
RK62	—	4D
RK63	—	2N
RK63A	—	2N
RK64	—	5AW
RK65	—	Fig. 48
RK56	—	Fig. 61
RK75	—	Fig. 61
RK100	—	Fig. 67
RK705A	—	Fig. 45
RK866	—	4P
T20	—	3G
T21	—	6A
T40	—	3G
T55	—	3G
T60	—	2D
T100	—	2D
T125	—	2N
T160L	V21	3G
T200	—	2N
T300	—	—
T814	—	3N
T822	—	3N
TB35	—	Fig. 30
TUF20	—	2T
TW75	—	2D
TW156	—	2N
TZ20	—	3G
TZ40	—	3G
UE100	—	2D
UE468	—	Fig. 32
UH35	—	3G
UH50	—	2D
UH51	—	2D
V70	—	3N
V70A	—	3N
V70B	—	3G
V70C	—	3G
V70D	—	3G
VR75	V19	4AJ
VR90	V19	4AJ
VR105	V19	4AJ
VR150	V19	4AJ
VT52	—	4D
VT127A	—	Fig. 52
WE304A	—	2D
X6030	—	Fig. 2
XXB	—	Fig. 6
XXD	—	8AC
XXL	—	5AC
XXFM	—	8BZ
ZB60	—	2D
ZB130	—	4E

SEMICONDUCTORS

Type	Page
1N21F	V24
1N34A	V24
1N35	V24
1N52A	V24
1N60	V24
1N64	V24
1N64A	V24
1N67A	V24
1N82A	V24
1N94	V24
1N270	V24
1N458A	V24
1N634	V24
1N645A	V24
1N914	V24
1N3754	V24
1N4001	V24
1N4002	V24
1N4004	V24
1N4719	V24
2N406	V24
2N441	V25
2N706A	V24
2N718A	V24
2N1179	V24
2N1302	V24
2N1306	V24
2N1491	V26
2N1970	V25
2N2102	V25
2N2157	V25
2N2222	V24
2N2270	V25
2N2631	V25
2N2869	V25
2N2876	V25
2N2925	V24
2N3053	V25
2N3055	V25
2N3119	V25
2N3391A	V24
2N3394	V24
2N3512	V25
2N3553	V25
2N3565	V24
2N3568	V24
2N3583	V25
2N3632	V25
2N3638	V24
2N3663	V24
2N3733	V25
2N3772	V25
2N3866	V24
2N3904	V24
2N3906	V24
2N3924	V25
2N3948	V25
2N4012	V25
2N4037	V25
2N4123	V24
2N4124	V24
2N4126	V24
2N4275	V24
2N4396	V25
2N4401	V24
2N4410	V24
2N4416	V25
2N4417	V25
2N4427	V25
2N4957	V24
2N4959	V24
2N5016	V25
2N5032	V24
2N5070	V25
2N5071	V25
2N5087	V24
2N5089	V24
2N5109	V24
2N5179	V24
2N5183	V24
2N5222	V24
2N5457	V26
2N5458	V24
2N5459	V26
2N5460	V25
2N5461	V26
2N5463	V26
2N5465	V26
2N5470	V25
2N5484	V25
2N5486	V25
2N5635	V25
2N5636	V26
2N5637	V25
2N5641	V25
2N5642	V25
2N5643	V25
2N5669	V26
2N5670	V26
2N5829	V24
2N5913	V25
2N5914	V25
2N5915	V25
2N5919	V25
2N5921	V25
2N5941	V25
2N5942	V25
2N5944	V25
2N5945	V25
2N5946	V25
2N5995	V25
2N5996	V25
2N6136	V25
2N40675	V25
3N128	V26
2N187	V26
3N200	V26
E300	V26
HEP51	V24
HEP58	V24
HEP58	V24
HEP801	V26
HEP802	V26
MBD101	V24
MJ480	V25
MMT3823	V26
MPF102	V26
MPF103	V26
MPF104	V26
MPF105	V26
MPF106	V26
MPF107	V26
MPF120	V26
MPF121	V26
MPF122	V26
MPS918	V24
MPS2926	V24
MPS3394	V24
MPS3668	V24
MPS3693	V24
MPS3694	V24
MPS3702	V24
MPS3706	V24
MPS6513	V24
MPS6514	V25
MPS6530	V25
MPS6534	V25
MPS6543	V25
MPS6569	V25
MPSA12	V25
MPSA55	V25
MPSU01	V25
MPSU51	V25
MSD7000	V24
TIS48	V22
TIS54	V23
TIXM10	V25
40231	V24
40235	V24
40600	V26
40601	V26
40602	V26
40603	V26
40604	V26
40673	V26

E.I.A. VACUUM-TUBE BASE DIAGRAMS

Socket connections correspond to the base designations given in the column headed "Base" in the classified tube-data tables. Bottom views are shown throughout. Terminal designations are as follows:

A = Anode	D = Deflecting Plate	IS = Internal Shield	RC = Ray-Control Eelectrode
B = Beam	F = Filament	K = Cathode	Ref = Reflector
BP = Bayonet Pin	FE = Focus Elect.	NC = No Connection	S = Shell
BS = Base Sleeve	G = Grid	P = Plate (Anode)	TA = Target
C = Ext. Coating	H = Heater	P_1 = Starter-Anode	U = Unit
CL = Collector	IC = Internal Con.	P_{BP} = Beam Plates	• = Gas-Type Tube

Alphabetical subscripts D, P, T and HX indicate, respectively, diode unit, pentode unit, triode unit or hexode unit in multi-unit types. Subscript CT indicates filament or heater tap.

Generally when the No. 1 pin of a metal-type tube in Table II, with the exception of all triodes, is shown connected to the shell, the No. 1 pin in the glass (G or GT) equivalent is connected to an internal shield.

* On 12AQ, 12AS and 12CT: index = large lug; • = pin cut off


2AG


2D


2N


2T

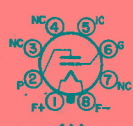

2Z


3C

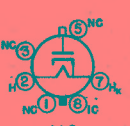

3G

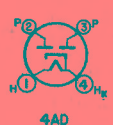

3N

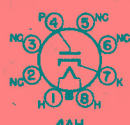

3T


4AA

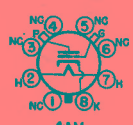

4AB


4AC


4AD


4AH

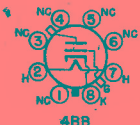

4AJ

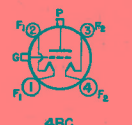

4AM


4AQ

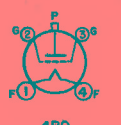

4AT


4B


4BB


4BC

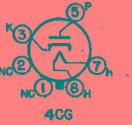

4BJ


4BO

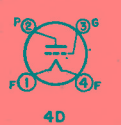

4BU


4C

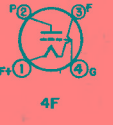

4CB


4CG


4CK


4D

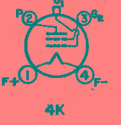

4E


4F


4G


4H

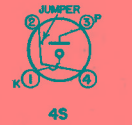

4J


4K


4M


4P


4R


4S


4V

4X

4Y

5Z

5A

5AA

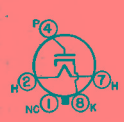
5AB

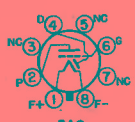
5AC

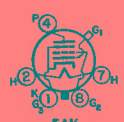
5AD

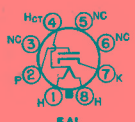
TUBE BASE DIAGRAMS

Bottom views are shown. Terminal designations on sockets are given on page V5.


5AF


5AG

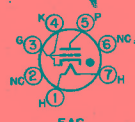

5AK


5AL


5AM


5AP


5AQ


5AS


5AW


5AY


5AZ

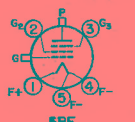

5B


5BA

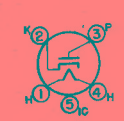

5BB


5BC


5BD


5BE

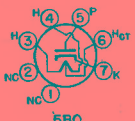

5BF


5BG


5BJ

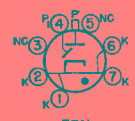

5BK

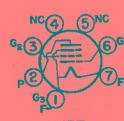

5BO


5BQ

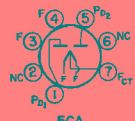

5BS


5BT

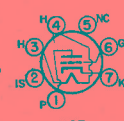

5BU

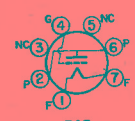

5BZ

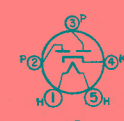

5C


5CA

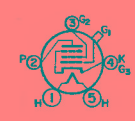

5CB


5CE


5CF


5D


5E


5F


5J


5K


5L


5M


5Q

5R

5S

5T

5U

5Y

5Z

6A

6AA

6AB

6AD

6AE

6AF

6AM

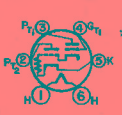
6AQ

TUBE BASE DIAGRAMS

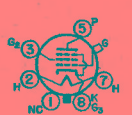
Bottom views are shown. Terminal designations on sockets are given on page V5.


6AP

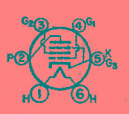

6AR


6AS


6AU


6AW


6AX

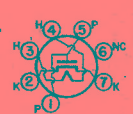

6B


6BA


6BB

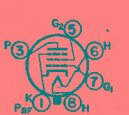

6BF


6BG


6BH


6BM


6BN


6BQ


6BT


6BW


6BX


6C


6CA


6CB


6CC

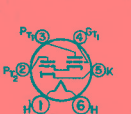

6CE

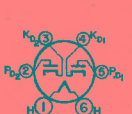

6CG

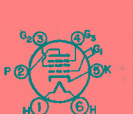

6CH


6CK


6CN


6D


6E


6F


6G


6H


6J


6K


6L


6M


6Q


6R


6RA


6S

6T

6W

6X

6Y

6Z

7A

7AA

7AB

7AC

7AD

7AG

7AH

7AJ

7AK

TUBE BASE DIAGRAMS

Bottom views are shown. Terminal designations on sockets are given on page V5.

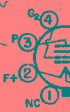

7AL


7AM


7AN


7AO


7AP


7AQ


7AT


7AU


7AV


7AX


7AZ


7B

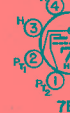

7BA

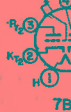

7BB

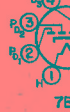

7BC


7BD


7BE

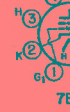

7BF

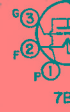

7BH

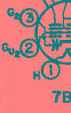

7BJ

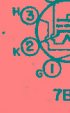

7BK

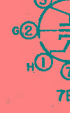

7BM


7BN


7BO


7BP


7BQ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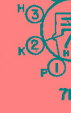
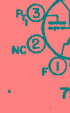
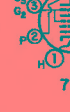

7BS

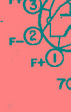

7BT


7BW

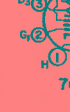

7BZ

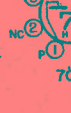

7C

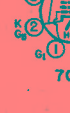

7CA

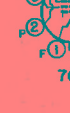

7CB

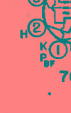

7CC


7CE


7CF


7CH


7CJ


7CK

7CL

7CM

7CQ

7CU

7CV

7CX

7CY

7D

7DB

7DC

7DE

7DF

7DH

7DK