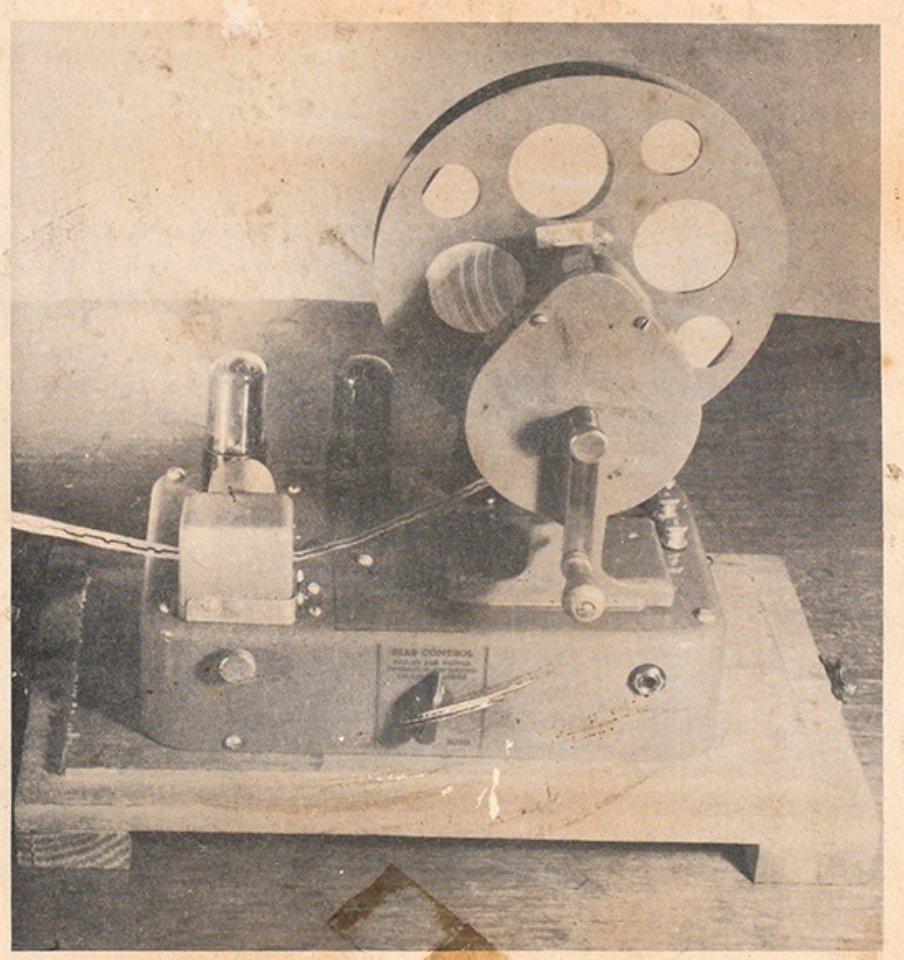
McELROY MANUFACTURING CORP.



USE AND OPERATION

KEYER MODEL G-813-742

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OPERATION:

The principal operating characteristic of the G-813 electronic keyer is that a tone is sounded *only when the photo-electric cell is dark.*

Thus, as the tape is scanned a tone is sounded *when the inked signal line cuts the light beam.*

This characteristic of the keyer becomes obvious if, while the instrument is in operating condition, the hinged lamphouse is thrown back. The light exciting the photoelectric cell is removed and the oscillator tone is heard in the phones or loudspeaker. When the light is swung back into place, the tone ceases.

If an opaque area is put between the photoelectric cell and the light, the tone is generated. If the lamp is turned out or removed from its socket, the keyer will sound the tone.

The scanning must, of course, be set for the *upper* signal-line and not the lower line, which is the no-signal line. The signal line is upper when the tape is held and read from left to right.

A method of keying, opposite in principle to the G-813-742, has had some application. This is the method of using the inked line to *darken* the photocell so that, when a break in the line passes between the light and the cell, and the cell is excited, a tone is sounded. But several advantages are obtained by the McElroy method which gets a tone-response *from the inked line;* and several difficulties arise when the tone-response is obtained by *breaks* in the inked line.

When the ink-line gives the tone response:

1. A minimum demand is placed upon the ink-line. If the ink-line *between* signals is broken or thin or wavering, the keying is not affected. Only the dot-and-dash elements need to be well printed in order to get perfect response from the McElroy keyer.

2. If a keyer is devised so that it responds when the light passes through a break in the inked line, the *inside* areas of the signal representations make the response; and they may be uneven and out of proportion. The dots are too rapid, relative to the signal spacing and the length of the dashes.

3. The McElroy keyer does not generate tone constantly when the tape is removed from the machine; it responds only when the scanning light beam is *broken.* Other keyers, which make the signal by permitting *passage* of the scanning light, oscillate continuously at the beginning of a practice or examination tape, until scanning is adjusted to the ink-line. This is unnerving to the subjects and very undesirable.

4. If tone is produced by exciting the photocell, the filament of the exciter lamp must burn at white heat so that the filament does not cool at the zero-current point between alternations and set up an a c response. Since this white-hot filament temperature is *off* the response curve of the photocell, the cell does not work efficiently and the potential difference it develops when it is excited to produce the tone is very low and must be greatly amplified.

If tone is produced by the opposite effect, when the cell is dark, the fact that the photocell has an ac modulated response when it is excited does not matter; for there is no *audio* response during the time the cell is excited, anyway. The exciter lamp can burn at low temperature toward the red end of the spectrum, which gives maximum excitation to the cell.

The circuit of the G-813 keyer is fairly complex, but not unnecessarily so and it is very stable. The first two beam-power tubes are biasing stages.

When the photocell is excited, the flow of energy through it puts a positive bias on the first stage tube. The high transconductance of the tube with this bias divides a biasing potential which would otherwise give a positive potential to the screen grid of the second tube; consequently, there is no transconductance from the oscillating circuit through the second stage to the final output amplifier.

When the photocell goes dark, the positive potential on the control grid of the first tube drops. Its transconductance decreases. The current flow through it finds a path of lesser resistance, to the screen grid of the second tube. The transconductance of the second tube is raised. This second tube is the channel through which the oscillator is coupled to the final amplifier. When the *first* bias stage swings the *second* to a positive potential by *itself* falling off, it gives a path to the oscillator *through* to the final amplifier stage.

The illumination for the cell in the G-813-742 is so efficient and ample, at the orange-red filament temperature, that it is not necessary to concentrate or focus it. The whole tape is flooded with light; and discrimination is achieved by the very small aperature in the scanning slide over which the signal line of the tape passes.

The smallness of the aperature approximately focuses and projects the light over the entire surface of the photocell target. This gives maximum excitation to the cell and, because the light is not concentrated in a single spot, the life of the tube is lengthened.

Because there is a high potential difference between the heater and beam-power cathode of the first bias stage, the rectifiers of the last three tubes, which supply plate and bias potential to the system, also give filtered d.c. to the heater of the first stage. This eliminates any possibility of modulating the oscillator with stray a.c.

The heater of the first tube acts as a part of the voltage divider which lowers the positive bias of the second tube to cutoff while the energy from the photocell holds the positive bias of the first tube. The section of the divider assumed by this tube heater must pass a large value of current and, were use not made of the tube heater, a large resistor which would radiate much heat would have to be used.

The oscillator in the G-813-742 is constant and is not started and stopped by the keying; instead, the output of the oscillator is shut off from the final stage by the bias cutoff. This gives a tone which has no chirps and keyclicks.

USE:

There are no interacting moving parts in the G-813-742 keying unit. The tape is drawn through the keyer by a McElroy tape puller, TP-890-742, which is aligned with the keyer.

The tape is drawn from the takeoff reel with the ink-line face up and so that the tape passes across the surface of the scanning oval piece kept in close contact to the surface of the piece, by the two holding pins on both sides of the scanning assembly.

In the puller the tape goes:

1. Over the first pulley.

2. Under the second pulley.

3. Over the drive pulley on which the idler rides.

4. Under the final pulley.

5. Up to the tape take-up reel.

When the two units, the keyer and the tape puller, are connected to a power source and the tape is put through ready for running, the motor of the puller should be started *with the idler pulley thrown back* so that the tape is not pulled through.

Allow plenty of time for the motor to get up to speed, while the G-813-742 is warming up. *The G-813-742 will go through two stages while warming up:*

1. Within from 30 to 45 seconds after power is on, the audio tone will be heard. During this phase, the photoelectric cell will not control the tone.

2. After power has been on for 60 to 90 seconds, and the bias adjuster is set correctly, the audio tone will cease.

Because the operating voltage of the photocell is more critical than for the rest of the circuit, a potentiometer regulator is provided at the back of the G-813-742 chassis. After the system has warmed up, make a permanent setting of this control so that while the light is *on* the cell, no signal is heard.

This will require setting of the bias control on the front of the chassis. If this setting is too far to the right, the tone will sound continuously. Before the tape has started through the machine, set both controls so that the tone responds *only when the lamp is hinged back and the photocell is dark.* The tape is then ready to be run through.

As the tape starts through, set the scanning so that only the *top* of the ink-line passes over the aperature in the scanning oval. Only the rises in the line - the representations of the dots and dashes - will pass over this aperture. By passing over the scanning aperature and breaking the beam of light to the photocell keying is effected by the dot and dash lines.

Practice tapes can be produced with the RRD-900-742 McElroy recorder and the

tape puller. *Or the entire G-15-AA set of practice tapes are available.* This set of 15 tapes, developed by the U.S. Army signal corps, will give practice in Continental code from the beginning to the end of a training course.

The tape puller can be set to draw tape at any speed; but the G-15-AA tapes are designed so that the beginning tapes will transmit the practice signals, when the tapes are running at normal speed, at the rate of 20 words per minute; except that spacing is much wider *between* the signals than would be normal for 20 words per minute. It is recommended that, even to beginning learners not yet familiar with the code, the signals should be sent at this rate.

The extraordinary spacing *between* the signals will emphasize the wholeness of each signal to the learners, and they will hear each signal individually without confusing its transmission with following signals.

The signals are transmitted to learners at this rapid rate so that they cannot identify the signals by calculating the number and order of the dots and dashes, the signal elements, in the signals. They will begin by learning to recognize each signal by its own peculiar rhythm; not by calculating the number and order of dots and dashes in the signal.

Accomplished radiotelegraph operators must acquire this working technique, whether they are conscious of it or not; they recognize the signals by their rhythms. At working speeds, the signals come too fast for the accomplished operator to count "four dots" and then identify the signal as H, or "dash and two dots" and recognize the signal as D.

Unless learners are trained with automatic keying equipment and tapes such as the G-15-AA, *they do not begin use of the code with the working habits they must acquire finally to be skilled radiotelegraph operators.* They begin their course by memorizing the signals with so-called associative methods, such as by remembering first all the signals with dashes in them, then all the signals with dots, etc., etc.

While the learners are practicing with signals sent at five or six words per minute, they are able to count and calculate the elements of each signal; and by this means they identify the signals. *But when the speed of the signals is increased beyond 12 words per minute, this working habit no longer serves them.* At speeds greater than 12 words per minute, they no longer can calculate the number and order of the dots and dashes in the signals. They must abandon this working habit, and develop the method of identifying the signals by their sound rhythms.

Thus, when the learners are copying 10 or 12 words per minute and assume that they are nearly half way toward accomplishment of telegraphic skill, actually they are at a stage where they must begin all over again and learn a new technique.

It is during this phase of the training of radiotelegraph operators that most failures occur. A period of stagnation, called a learning plateau, becomes obvious. The learners make no progress and remain at the 12 words per minute rate for weeks. They struggle between the effort to apply their early working habits, no longer adequate for the higher speeds at which they are attempting to receive, and the effort to acquire a new and adequate working technique. The method by which the learners have *begun* to practice the code may actually get in the way of acquiring the working methods they must finally develop. Many fail the course.

But if, instead of hearing slow signals at the beginning of the course, the learners instead begin by hearing the signals transmitted at a speed which requires them to learn the signals by each signal's distinctive rhythm, then the learners *begin* with the working methods they must use when they are skilled telegraphers.

The first five tapes in the G-15-AA series introduce to the learners all the useful radiotelegraph signals, including the letters of the alphabet, the numerals and punctuation signs.

If the TP-890-742 tape puller is *adjusted to the right speed* before the tape is drawn through the keyer, the practice signals from the first tapes will be heard - each signal as though it were at a 20 word per minute rate - *but with wide and distinctive spacing from one signal to the next.*

The tapes following the first five, increase the transmission speed *by reducing the spacing between the signals.* This increase is graduated to carry the learners over the 12 word per minute plateau up to higher speeds.

Unless a carefully planned training and practice course, such as the course which is complete in this set of 15 tapes, is given to learners, practice with all the signals may be uneven. Certain characters in the alphabet occur more frequently in plain language than other characters. E for example appears with most frequency in the language; Z and X least frequently. But in order to be a skilled radiotelegraph operator, the learner must have had as much practice with the infrequent signals as with the frequent. Radio transmissions during wartime are necessarily mostly in codes and ciphers, in which no rule of letter frequency can apply. A skilled radiotelegrapher must have had evenly distributed practice with *all* the signals.

The McElroy G-813-742 keyer with the G-15-AA set of practice tapes, and McElroy RRD-900-742 recorder for school work, will provide the means for teaching skill in sending and receiving the radiotelegraph code to large classes of learners.

PARTS LIST FOR
ELECTRONIC KEYER G-813-742

NAMES OF PARTS	SPECIFICATIONS	TYPE NUMBERS AND QUANTITIES
CHASSIS AND CHASSIS FITTINGS		
Chassis		C-1
Chassis Bolts	Roundhead, 10-24 4 in., threaded 2 in., cadmium finish.	RHS-1-4
REWIND		
Machined-Gear	3 inch, S-2472	RG-1
Machined-Gear	1/2 inch, S-2418	RG-2
Housing	Bronze casting	RGH-1
Facing	Bronze casting	RGH-2
Spindle	Machined stock	RGH-3