SURPLUS

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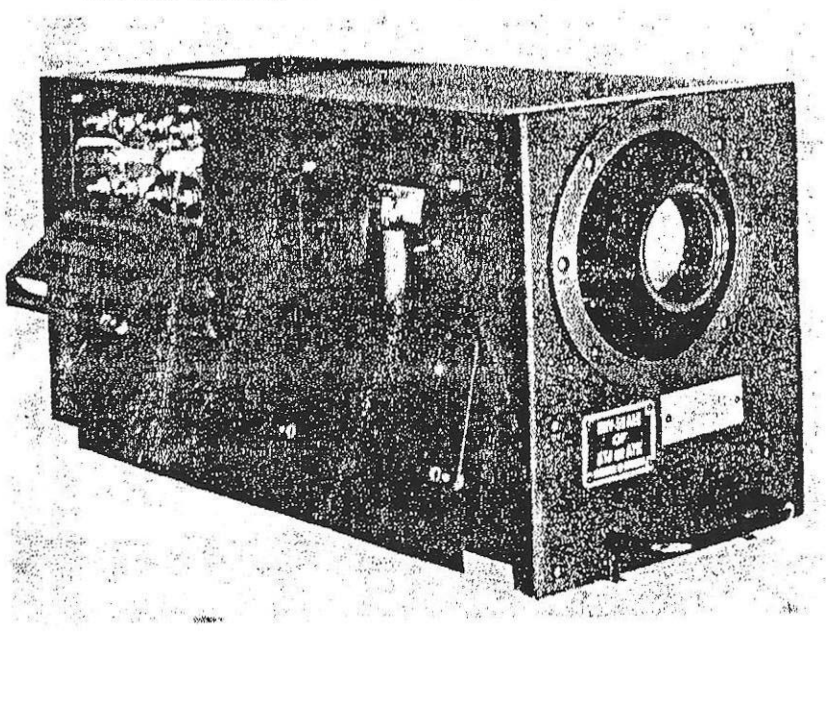
Many of the old timers will no doubt remember the "rash" of interest that was shown in amateur television before the Second World War. Many experimenters constructed cameras from articles by Lamb that appeared in early 1940 issues of QST Magazine. These cameras were rather simple devices, but produced extremely good pictures in view of the techniques at that time. Interest subsided, more or less, until 1950 when Popkin Cluarman, W2LNP, wrote his "Simplified Ham TV Station" series for Radio and Television News. This system used the "flying spot scanner" technique to produce pictures from photographic negatives. A few years ago, QST again printed an article on a modern version of the 1940 cameras using the RCA 5527 iconoscope.

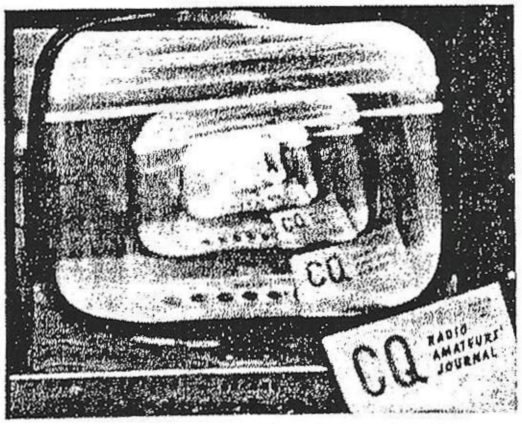
With the exception of these few articles, little has been presented on the construction of equipment for amateur television use. Although interest in amateur television appears to be on the upswing, lack of communications between interested parties has prevented an exchange of information on "who is doing what." Several months ago, I tossed out a few "feelers" to see if there was any interest in a conversion of a war surplus "guided missile camera." Needless to say, the response was overwhelming and as a result of these letters, and the interest shown by the writers, CQ Magazine is presenting the conversion of the war surplus ATJ/ATK Block III television camera. These cameras, designated the CRV-59AAE, were built by RCA for use in early guided missiles on pilotless aircraft.

Actually, the original purpose of using the cameras in a guided missile has fallen by the wayside. As planned, a "pilot" riding in a mother plane would direct the missile against an enemy aircraft by remote control while watching a television monitor. However, the missile speed was usually so great the reaction time of the "pilot" produced a rather poor "batting average." Television cameras have found many other applications in the military, though. Drone planes, using cameras of the ATJ variety, were used in the South Pacific to collect air samples during the atomic bomb and hydrogen bomb tests. Even today, television cameras are being used to study control surfaces on airplanes and guided missiles. Cameras are even used to monitor mid-air refueling operations so that both pilots can see the mating of the fuel receptacle.

The conversion presented here modifies the camera to operate from the 117 volt power lines and provides a 1.4 peak to peak video signal that can be used to modulate a 420 megacycle



RCA TV Unit.



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television transmitter. It is not within the scope of this article to describe transmitters for the 420 band, but a simple Channel 3 transmitter is described that will allow you to test the camera on your television receiver or the ATJ can be used as a "closed circuit device."

How it Works

Let's take a closer look at this fabulous device for creating TVI (television images). Starting with the lens, light passes through an F1.9 telephoto and is focused on the mosaic of an 1846 iconoscope. Most of the stock cameras have an orange filter operated by a shutter. This can be switched in by remote control to clear up the image when the drone is flying through clouds and haze. The mechanism should be removed unless desired. The focused light falling on the mosiac of the pick-up tube places a charge on the "globules" that compose the light sensitive surface. When the mosaic is scanned by a beam from the electron gun, these globules release secondary electrons that are collected by a signal ring around the perimeter of the iconoscope. The current flow through the signal resistor (R114) is in direct proportion to the amount of light striking the mosaic. This very tiny signal (the video signal) is amplified by five video amplifiers, 4-6AC7's and 1-12SN7. The second half of the 12SN7 (V115) is used as a cathode follower and has no gain. The output of this tube produces about 1.4 volts peak to peak across a 75 ohm terminating resistor located at the end of the video cable.

Two 12SN7's are used as a *random interlace sync generator*. V111 functions as a vertical oscillator and vertical blanking generator. V112 is used to generate the horizontal sweep and the horizontal blanking pulses. The output of V111, which is a poor sawtooth wave, is fed to ½ V108 which acts as the vertical discharge. The output of the discharge tube is of the correct waveshape to drive the vertical scanning amplifier, V104, a 12SN7. The output of V104 is impedance matched to the deflection yoke and drives the scanning beam in a vertical direction. The output of the horizontal oscillator also acts in a similar manner. V112 drives a discharge tube for sawtooth wave shaping, and this in turn drives the horizontal output tube, V105, a 6L6. A 6X5 is used as a damper tube to suppress horizontal ringing. Another 6X5, V103, is used to rectify the horizontal scanning pulses to produce high voltage for the iconoscope. The horizontal scanning pulses are coupled to the deflection yoke and scan the iconoscope in a horizontal direction.

An operational defect of the iconoscope is its inability to produce an evenly illuminated output from all areas of the mosaic. To avoid or minimize this fault, horizontal and vertical signals are modified to produce plus/minus sawtooth waves and plus/minus parabola waves. These signals are applied to the grid of the first video amplifier (V102) through R114 and used to counteract variations in *shading*.

Synchronizing is obtained by shaping the vertical and horizontal square waves so that a proper blanking shape is obtained. This blanking signal is applied to the plate of the 5th video (½ 12SN7) and is used to blank the monitor during retrace time. The blanking signal is also differentiated, shaped and fed to the sync output jack. Sync time, therefore, corresponds to the leading edge of the blanking signal.

Special filament ckt

One unusual aspect of these cameras is worth noting. To avoid pickup of "crud," in the video amplifiers, from the filament of the iconoscope, they were heated by high frequency a-c. Since most aircraft electrical systems contain noise and since the video amplifiers have about 80 db of gain, it was necessary to build a high frequency oscillator to supply filament voltage for the "ike." The 6L6, V109, is used for this. Some variations in cameras exist at this point. In the camera that I have, the 6L6 filament generator receives driving power from the horizontal oscillator running at 15,750. In effect, the heater generator amplifies what ever frequency is generated by the horizontal oscillator. Other models of this camera have a horizontal oscillator coil in the grid of the heater generator. This coil is shown on the camera schematic as L115. In this model, the heater generator is the master oscillator and provides master sync to the horizontal oscillator. You can establish which type of camera you have by locating a coil to the rear of the 6L6 heater generator. If your camera does not have this coil, the heater generator derives its sync from the horizontal oscillator, not vice-versa. Conversion differences will be described later.

Converting the Camera

I say this about all conversions, but *this one* is actually quite simple. The camera itself can be converted in an hour or so. Another four hours to construct the power supply and the camera is ready to adjust.

The ATJ camera filament circuit was operated from the aircraft d-c system, originally. The only part of the low voltage circuit that *must* be operated from d-c is the centering circuit and the bias light. Therefore, in this conversion, the d-c circuits were separated from the filaments and the tube heaters supplied with 24 volts a-c. To further simplify the camera power supply, the d-c for the centering and bias light was obtained across a resistor in the B minus lead of the high voltage (plus 405) power supply. In addition to these changes, the time constant of the oscillators were modified so they would run at the standard frequencies i.e. 15750 and 60 cycles. To avoid extra dangling cables, the video was connected to a spare lug on J101. All signal and power leads connect to J101 which requires only one cable to connect the camera up.

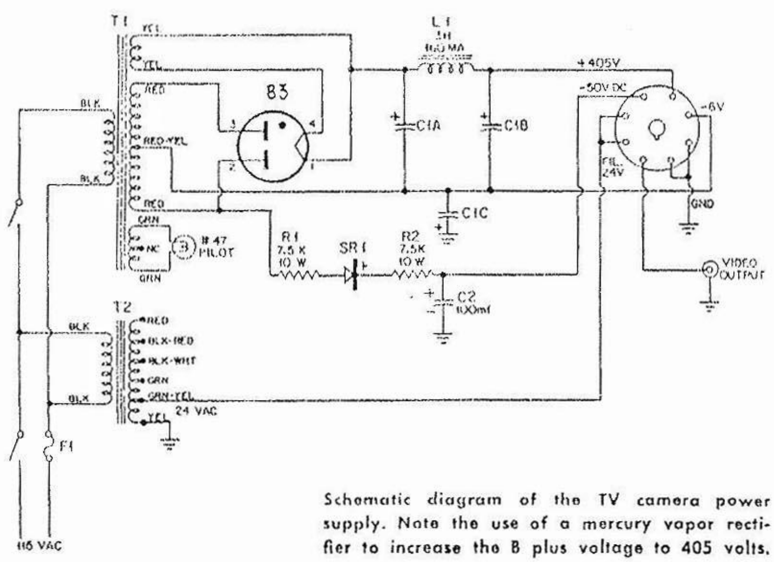
Start the conversion by replacing the two 56 ohm resistors across V103 and V107 filaments with two 22 ohm, 2 watt resistors. Remove R200, 18 ohms, mounted below V117, the VR-150-30. Disconnect the wire from TB-112 to the shutter assembly and remove this assembly. Also, if your camera has a lens heater, remove this too. Next, clip the black wire that is soldered to TB-112, pull the wire back and re-route it through the hole in the chassis nearest V117. Connect this black wire to pin 4 of V117. Now, B minus flows through the centering pots and is connected to pin E of J101. Locate pin 7 of V113 and note that there are two brown wires on this terminal. One of the wires goes to the front of the camera and the other goes to the rear. Remove the one that goes to the front of the camera and connect it to pin 4 of V117. This supplies the B minus voltage to the bias light. Next, remove the jumper between pins A and F of connector J101. F should connect to the chassis for a camera ground. Connect pin A to the video jack adjacent to J101. The lead from pin A to the power supply now carries video.

To change the frequency of the horizontal oscillator, replace C132 (180 mmf) with a 100 mmf silver mica. This capacitor is located between pins 1 and 5 of V112. The frequency of this oscillator can be varied by adjusting either C137, R171 or both, as necessary to bring the horizontal oscillator up to 15,750 cps.

The vertical oscillator frequency may be changed to 60 cycles and locked to the power line at the same time by connecting a 1 meg resistor from pin 1 of V111, the vertical oscillator to pin 7 of the same tube. This supplies approximately 12 volts R.M.S. of 60 cycle signal to the vertical oscillator. This effectively clamps the oscillator to the power line and the frequency cannot be varied even by rotating R164, the vertical speed control. This completes the modifications to the camera. Next step, wire up the power supply.

Parts list for the camera power supply

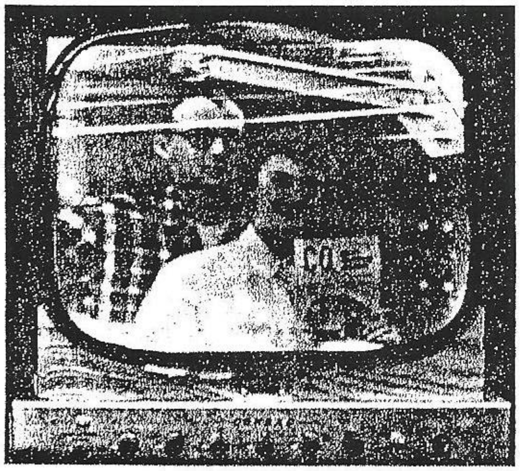
- C1a—10 mfd. 450 volts (Sprague TVL-3762)
- C1b—30 mfd. 450 volts (part of C1)
- C1c—150 mfd. 50 volts (part of C1)
- C2—100 mfd, 50 volt electrolytic
- F1—3 amp slo-blo fuse and fuse holder
- L1—3 Henry, 160 ma filter choke (Triad C-13X)
- PL1—8 pin male plug (Amphenol 86PM8-11)
- P12—Mate to J101 (usually supplied with camera)
- R1, R2—7.5 K. 10 watt resistor
- S1, S2—SPST toggle switch
- SO1—8 pin tube socket (Amphenol 108-015)
- SR1—50 ma selenium rectifier
- T1—700 volt ct. @ 160 ma., 5 volts @ 3 amp., 6.3 volts @ 5 amps. (Triad R-16A)
- T2—24 volts @ 3 amps filament transformer (Triad F-61U)
- V1—83 mercury vapor rectifier tube



Schematic diagram of the TV camera power supply. Note the use of a mercury vapor rectifier to increase the B plus voltage to 405 volts.

The Power Supply

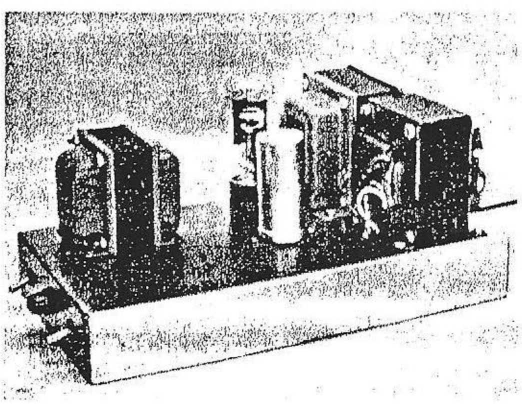
The 28 volt a-c filament circuit requires



W6TNS and XYL

approximately 2.8 amperes and this voltage is supplied by a F-61U Triad Dry Disc rectifier transformer. A B plus potential of 405 volts at 150 mils is required to operate the camera. This voltage with such a current requirement is a little awkward and I was unable to obtain it using the same power transformer with a 5U4GB rectifier. It was determined that the voltage "lost inside the rectifier" accounted for the inadequate B plus voltage and a type 83 mercury vapor rectifier was installed. When the VR-150's were removed, the B plus voltage rose to about 420 volts. Upon re-inserting the VR-150's the voltage dropped to a very smooth and well regulated 405 volts.

The B minus voltage flows through the wire between J101-E and pin 6 of the 8 pin power connector on the power supply. Once the camera conversion has been made, the complete circuit for B minus is through the two centering resistors, R102 and R103. The current flow through these resistors develops approximately 6 volts across them which is more than enough to accomplish centering. The total current drain of the camera is a surprisingly low 150 ma under normal operation. The power supply also provides minus 50 volts for the bias circuits. This voltage is obtained by rectifying a small amount of the high voltage a-c in a 50 ma selenium rectifier. The long time constant of R2 and C2 supplies almost pure d-c to the camera. Pin 1 of the 8 pin camera power plug (which connects to pin A on the camera plug) provides a video outlet at the power supply. This lead will supply video information to a monitor, ham band transmitter, or to the Channel 3 transmitter to be described later. To operate the camera, the filament switch should be energized first. If S2 is operated first, nothing will happen, for the switches are in series. The camera filaments should be allowed to warm up for at least 2 minutes before turning S2 on. You will notice that when voltage is applied to V1, the 83 rectifier, there will be a blue flash inside the tube. Thi is th ignition of the mercury vapor and is normal. Although the 83 should work into an inductive load i.e. choke input, the old war surplus 83 has functioned for about 50 hours in the camera power supply and shows no sign of stopping.



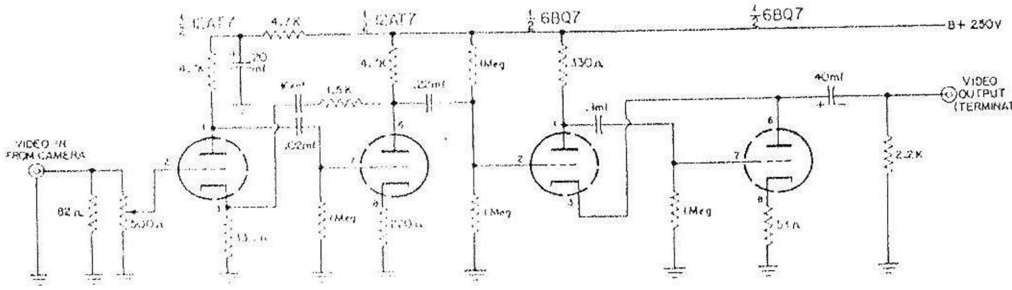
The 117 volt ac power supply for the ATJ/ATK television camera. The Channel 3 transmitter could be constructed in the clear area forward of the electrolytic.

When wiring the power supply, be careful to connect the 10 mfd section of C1 in the A position (filter input), the 40 mfd section to the filter output (B position) and the 150 mfd, 50 volt capacitor should be connected in the C position. Interchanging these capacitors, or operating the supply without the camera connected would undoubtedly ruin the C section of the capacitor.

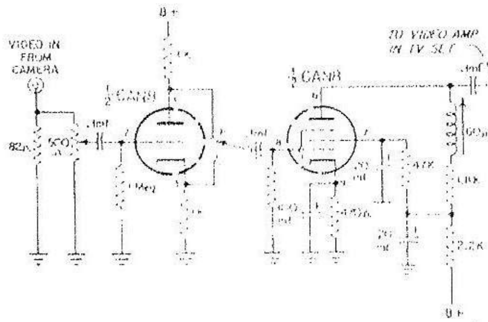
If the camera is to be used directly into a monitor, it is unnecessary to provide sync pulses. However, if the picture is to be transmitted over the air, it will be necessary to place sync pulse on top of the blanking pedestal. If you use the AXT-2 companion transmitter modified for 420 operation, this is accomplished automatically. For other systems, sync can be inserted by installing a 7-45 mmf rotary ceramic trimmer between pins D and A of the monitor power connector, J102. This inserts a small amount of sync into the video output and is adjustable by varying the setting of the capacitor.

Adjusting the Camera

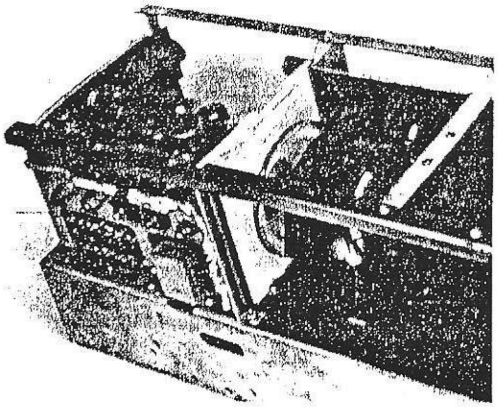
The camera should be aimed at a sunlit object for the preliminary adjustments. Before applying power to the camera, turn the bias potentiometer to full counter clockwise. Also, turn the filament voltage potentiometer (R172) to full counter clockwise. Turn on the filament switch and allow the filaments time to warm up. After two minutes or so, turn on the plate power switch. Allow another minute for the filament generator to warm up. Connect an



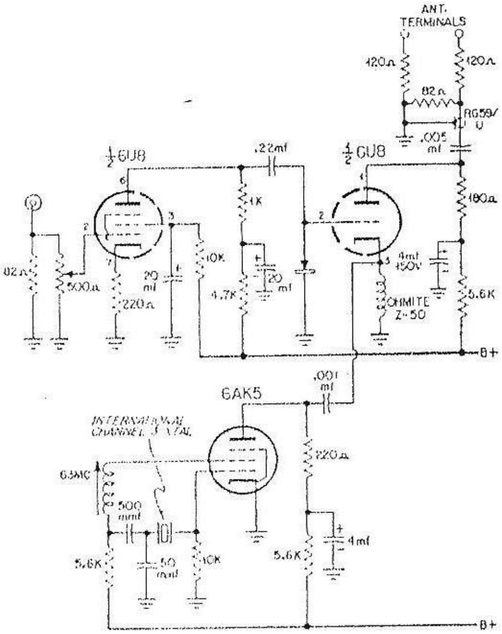
Unity gain distribution amplifier for long coaxial lines.



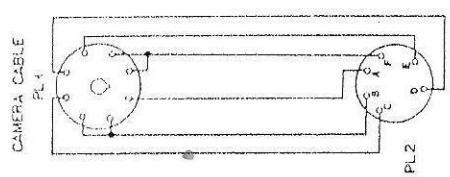
A video coupler for connecting to a standard TV set. The fixed grid resistor is 500 ohms, not 82. The pot is 100 ohms not 500. The second resistor is 470K.



Side removed to show adjustment controls.



Channel 3 video transmitter. The fixed input grid resistance is 500 ohms, not 82. The pot is 100 ohms, not 500. Make sure —+— is ground on the grid rectifier.



Camera connecting cable.

accurate a-c voltmeter to pins 3 and 4 of T104. *Do not* use a multimeter with a chemical rectifier (copper oxide, etc.) Rather use an accurate, wide frequency vacuum tube voltmeter such as the Heath V-7A and slowly turn R172 clockwise until the filament voltage reads 6.3 volts. Make this adjustment very carefully for, if you burn out the filament, a new tube will cost about 50 dollars. Most surplus stores check filaments before shipping the cameras, so one would have trouble "conning" them out of a replacement.

If you are observing the video output of the camera on a monitor, you will no doubt have series of near horizontal lines on the screen. Since the vertical is locked to the power line, you do not have to worry about locking it. Adjust the horizontal hold control (R171) until these black lines "stand up straight", or lock in with the monitor. If your camera has the oscillator coil in the heater generator circuit, adjust this coil rather than R171 for synchronization. R171 will then act as a rear panel vernier for the oscillator coil.
[*continued on page 98*]

Surplus [*from page 33*]

Once you have a synchronized raster turn up the video gain for overload. If you are unable to overload the monitor, it indicates that you are not getting 1.4 volts peak to peak out of the camera. Check the cable going to the monitor. It should be 75 ohm coax such as RG-59/U and *must* be terminated with a 75 ohm resistor. It might be a good idea to check the tubes also. The 1649's (low microphonic 6AC7's) are operated very close to their ratings and I have found several weak ones in the various cameras that have been converted.

Next, peek in the side cover of the camera case, and focus the scene on the mosaic of the 1846. Now, slowly advance the bias control until some semblance of a picture is obtained. Keep this control as low as possible to avoid damaging the iconoscope. Adjust the electrical focus (R111) for the sharpest picture, then readjust the optical focus by sliding the lens back and forth. Adjust the height (R152), width (L105), horizontal centering R102 and vertical centering (R103) for approximately the same picture on the monitor as is seen on the iconoscope mosaic. The parabola and saw-tooth controls should be adjusted next. The vertical saw-tooth control R118, controls the shading of the top with respect to the bottom and vice versa. The vertical parabola controls the shading of the center of the picture with respect to both the top and bottom. The horizontal controls work in exactly the same manner but the shading is in a horizontal direction. If everything seems to be working correctly, it is time to televise a test pattern. If you do not have a satisfactory test pattern you might obtain one from the Radio Electronic Television Manufacturers Assn. in Washington. They have excellent large test patterns at very low cost. The camera should be adjusted optically so that the pattern is centered on the mosaic with the circles in the corners just touching the edge of the mosaic. Repeat the preceding adjustment only more carefully for the best picture.

You will notice that the shading controls will have to be varied with changing lighting conditions. This is built into an iconoscope tube and there is not too much that can be done about it. The shading controls should have enough range to correct for all lighting conditions. If more range is needed on the shading pots, a slight readjustment of the "leveling pulse" with C151 should do the trick. If black or white streaking is noted, a slight readjustment of the "high peaker" capacitor (C124) will eliminate it.

There are many improvements that can be made in the television camera. Don't forget this camera was designed and manufactured long before our present day techniques were born. For instance a cascode video preamplifier, with a 417 or 6BZ7, using regular VHF techniques would make a tremendous improvement in the signal to noise ratio of the video system. The video response can be widened out quite a bit also. Reducing the video plate load resistors to 1800 ohms and repeaking the coils would produce 450 lines of resolution. The iconoscope and the video amplifiers determine the vertical resolution and the *system* is capable of 600 lines or more. Naturally, the horizontal resolution is limited to 262 lines because of the frequency standards. If the camera lacks resolution, always check the coaxial cable terminations and the unit for coupling signal to the monitor or television receiver. The accompanying photos show about what you can expect from a converted ATJ camera. Several "recommended circuits" are also reproduced here. A unity gain amplifier for long cable runs, a "video coupler" for standard TV sets, and a Channel 3 transmitter are illustrated.

By the way, amateur television fans will be interested in this. The British hams are making us look like pikers! I received a copy of the publication "CQ-TV" which is the official organ of The British Amateur Television Club. This club has 300 active members and some of the setups get pretty elaborate. When I say piker, I mean these gents even have a mobile unit! The "conveyance" is an ancient London taxi and carries a Staticon camera and a V antenna, both on the roof, while the petrol generator is carried on the luggage grid. This magazine really has a lot of information packed into it with helpful hints on getting an amateur system going. Because of cost considerations, the British favor the flying spot scanner and they appear to have it down to a fine art. Slide projectors and film cameras are also used. The column titled "What the Other Chap is Doing" was of particular interest for we could sure use something like that over here. CQ-TV is available at 10 Shillings a year in Britain plus postage to the States from The British Amateur Television Club, 10 Baddow Place Avenue, Gt. Baddow, Chelmsford, Essex, England. The BATC also has a book titled "An Introduction to Amateur Television Transmission" available for 50 cents from the same address. What say we give it a bloody go, chaps?

The ATJ cameras are available from several sources. The prices vary with the condition of the camera. I have seen them for $50.00 less the ike, $100 used, and $200 brand new. When you compare this with the four digit prices for the Vidicon systems it is a pretty good deal. ATJ's are available on the West Coast from Alvaradio Radio Industries, P. O. Box 151, North Hollywood, Calif. Monitors are also available for the ATJ/ATK if you do not have a suitable one.

I would like to thank Mr. Harry Gartsman W6ATC, of Alvaradio Radio Industries for the assistance that he provided in the preparation of this conversion article.

The following are some of the letters received from Amateur TV enthusiasts:

Mike Vore, W3CCV, 359 Whitfield Road, Catonville 28, Md.

V. A. Vicksell, WØMAQ, 4329 E. 49th North, Kansas City 16, Mo.

Larry A. Olson, KØAHW, Route 1, Erie, Kansas.

Fred Chapman, W4CHT, 404 Fisher Drive, Falls Church, Va.

Jesse F. Lee, W5GCJ, Route #3, Box 49D, Pine Bluff, Arkansas.

If I missed anyone, my apologies. That about winds things up for this month. We are planning conversions of some portable equipment in view of the coming Summer weather. Candidates are the BC-654 and Navy TBX-8 which are 80 and 40 meter transmitter receiver and possibly a (gasp) TBY conversion.

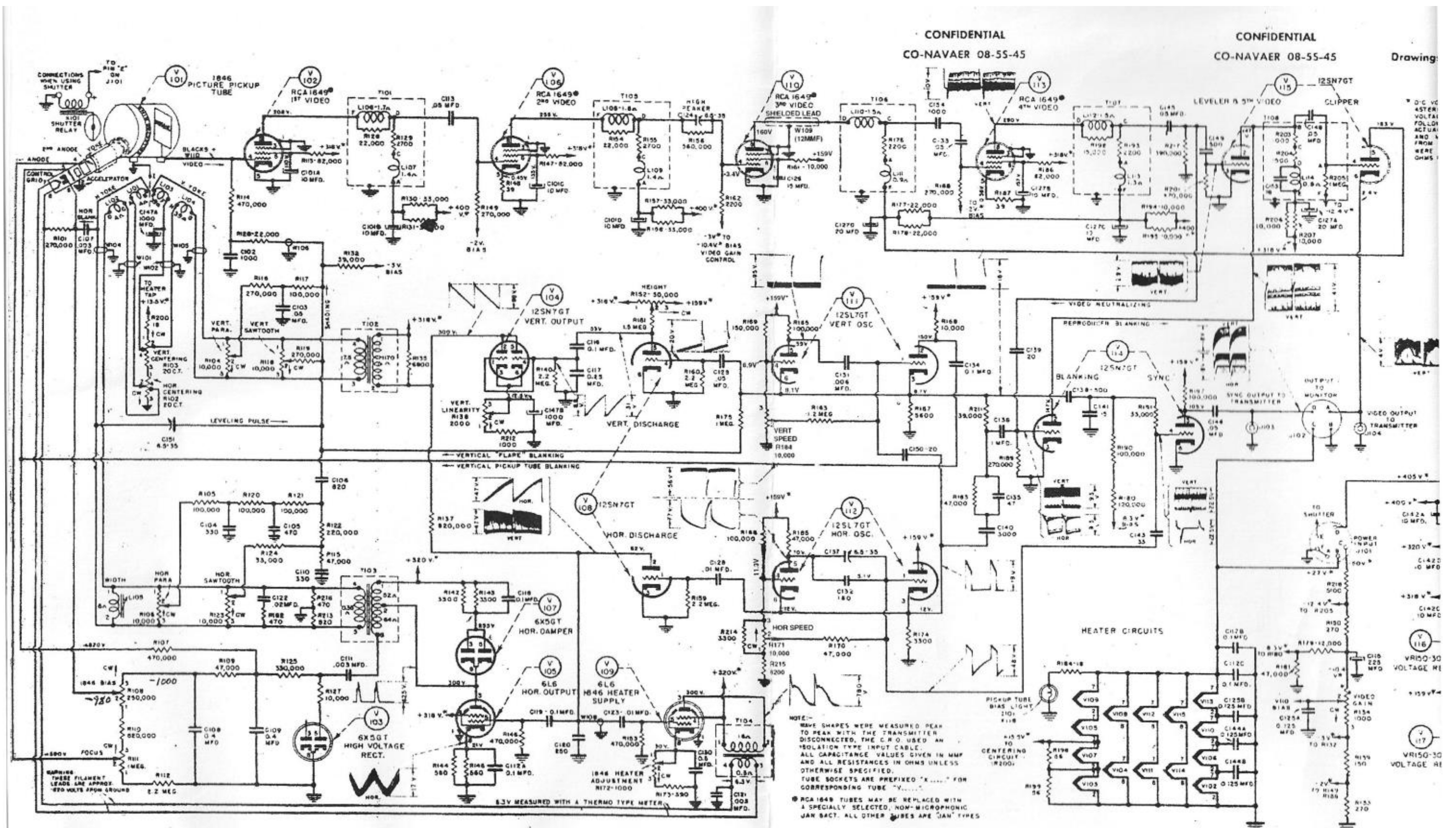


Figure 429—Conversion Unit CRV-[illegible] Diagram

EARLY MODEL W/O MASTER OSCILLATOR
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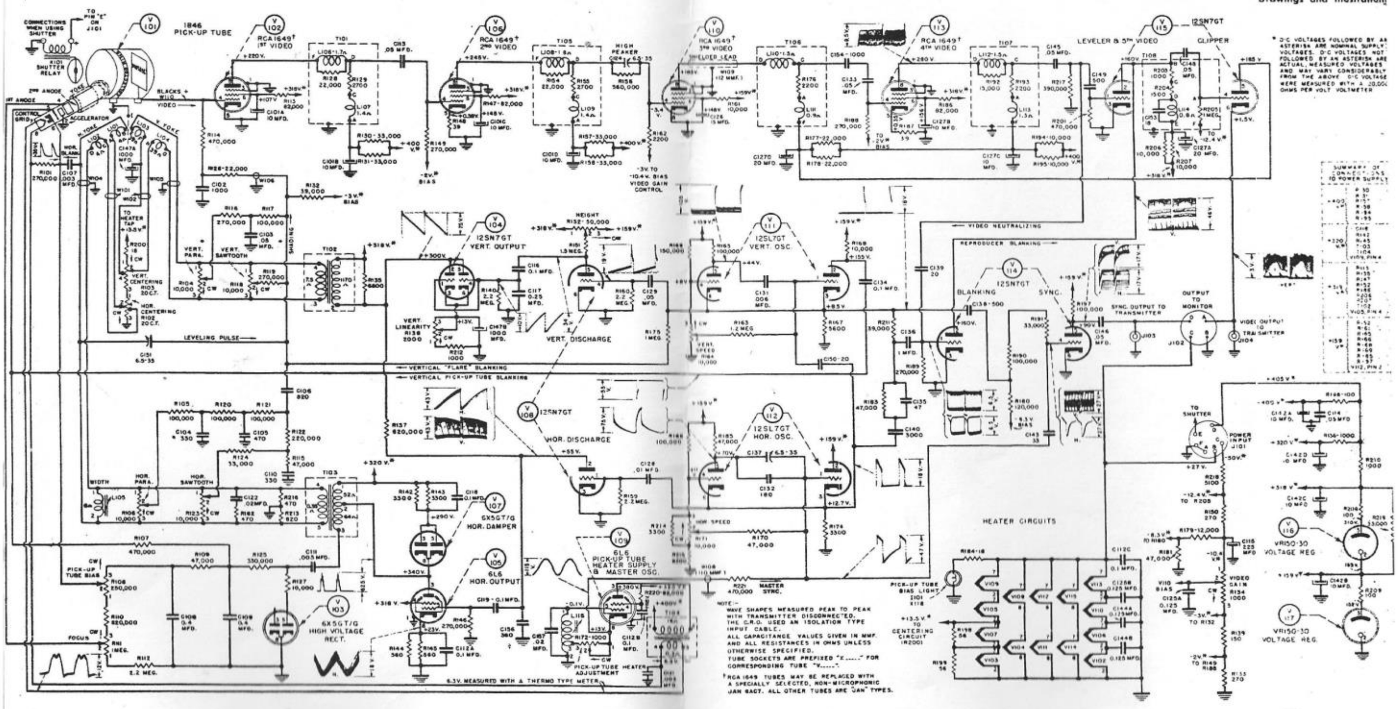

LATE MODEL WITH MASTER OSCILLATOR
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