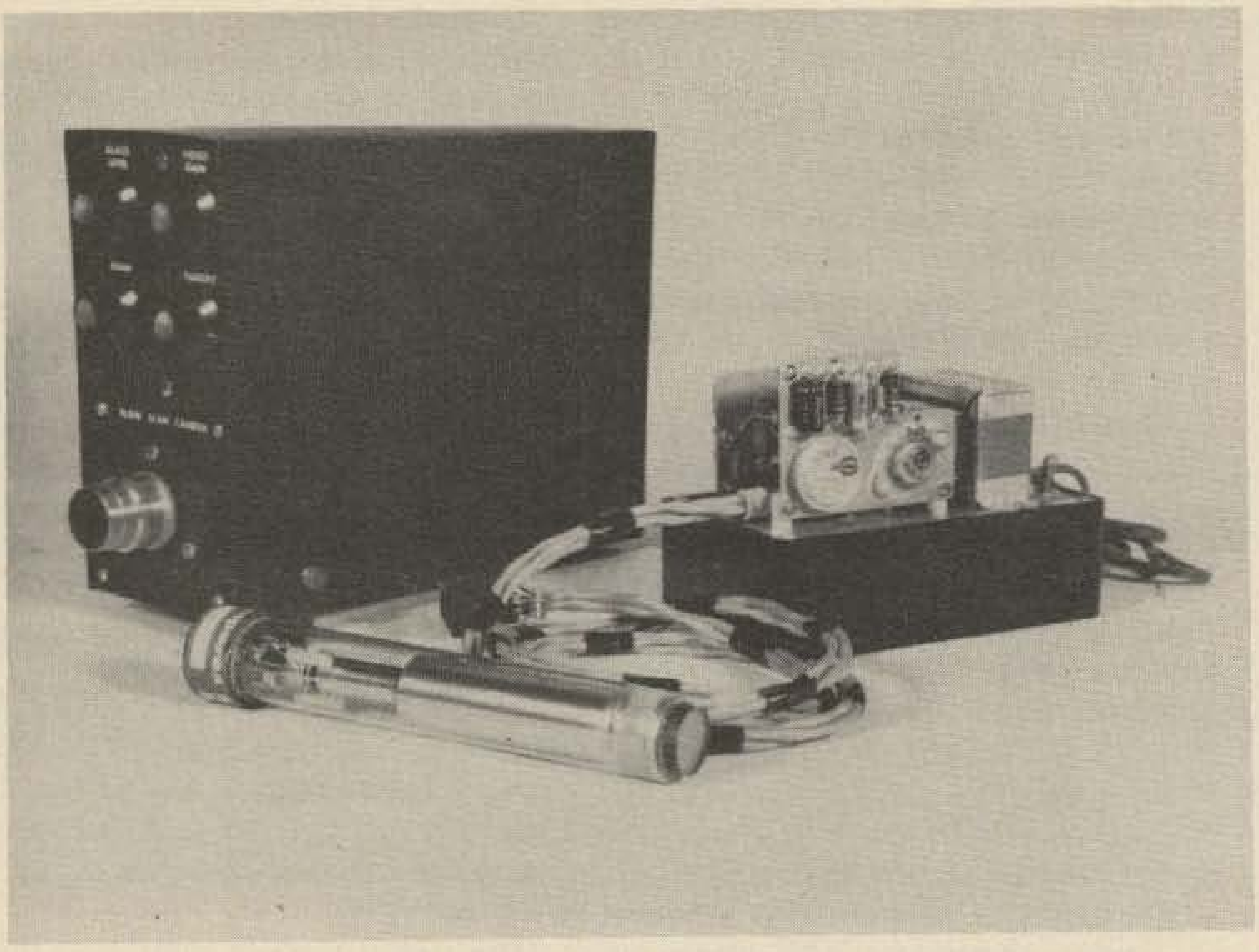

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Construction of a PLUMBICON SSTV Camera

Introduction

The use of fast scan vidicons in slow scan TV cameras was described by Taggart in *QST* for December, 1968 and by Hutton in *73* Magazine for February, 1969. Several amateurs have experimented with fast scan vidicons in SSTV camera circuits but the overall results have not been as good as expected. The problem is one of dark current, i.e. the inability of the vidicon's target to discharge properly when scanned at slow rates causing a picture to be gray and white, not black and white. The resulting pictures do not have the full range of gray scales as those generated with a flying spot scanner or a 7290 vidicon slow scan TV camera. The only sucessful use of a fast scan vidicon in the slow scan mode has been in the sampler type of operation as described by Stone in *Ham Radio* for July, 1971, or by Miller in *CQ* for August, 1969.

A new camera tube suitable for use in amateur SSTV cameras has appeared on the scene and is called a Plumbicon[1]. This tube was developed in Europe by The Phillips Company and is used in many color TV cameras in this country. The first use of this tube in a SSTV camera known to me is by Art Backman SMØBUO and was briefly described in *ATA International* for May 1969. Bob Taylor W4YHC was able to acquire several of these tubes and I, along with several other SSTV experimenters, have been building cameras using the Plumbicon. The camera described in this article is the results of experiments carried on by Bill Briles W7ABW and me. The pictures produced by this camera are of the same quality as that produced by a 7290 vidicon equipped SSTV camera. The construction is very straightforward and the adjustment is no more critical than for any vidicon equipped camera.

1. Plumbicon is a registered trademark of the North American Phillips Company.

How It Works

In the camera block diagram, the vertical oscillator and amplifier is used to generate a sweep voltage at 1/8 Hz to deflect the

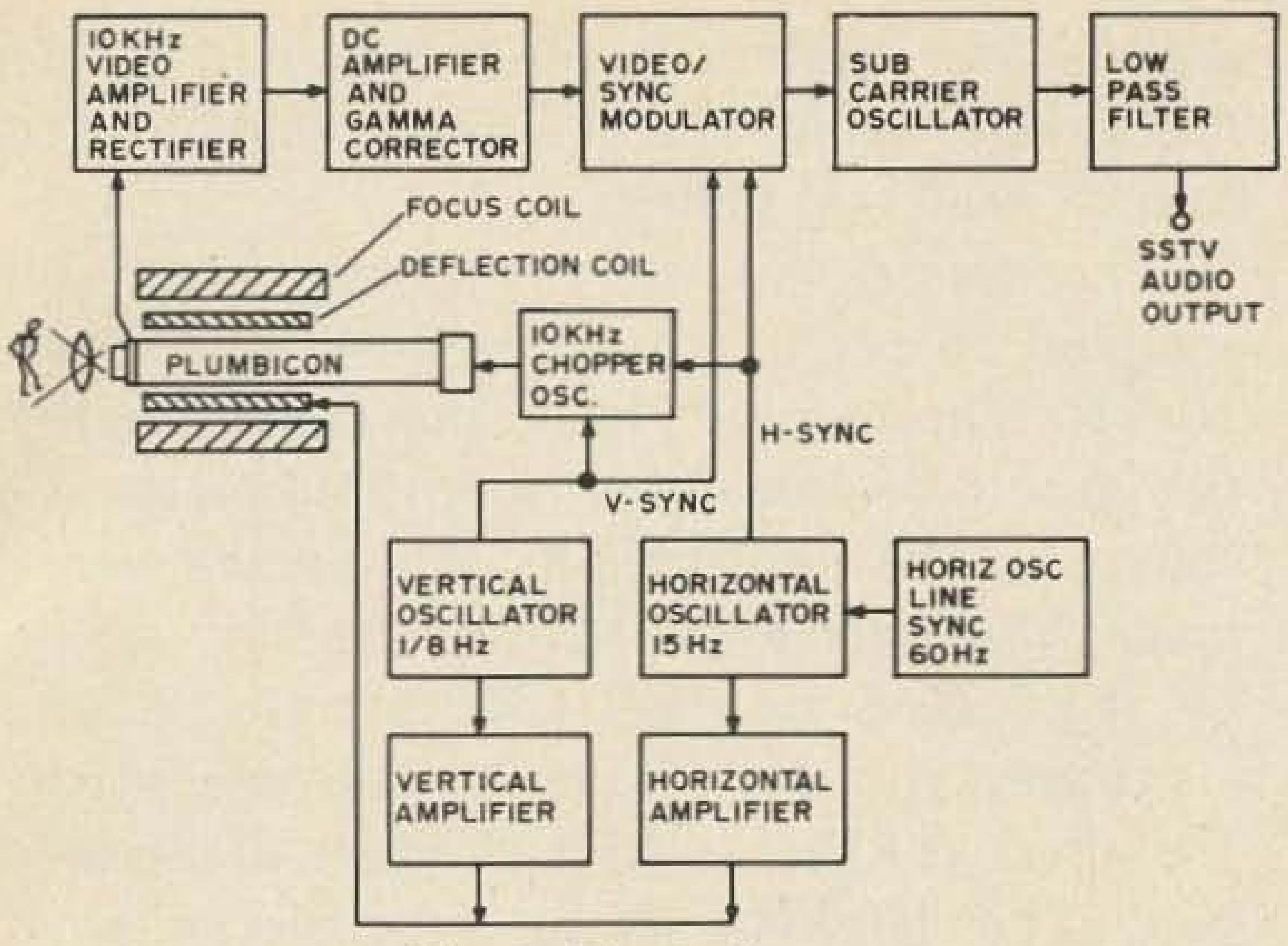


Fig. 1. Block diagram.

electron beam in the Plumbicon vertically. The horizontal oscillator which is synchronized to the 60 Hz power line is amplified in the horizontal amplifier and is used to deflect the electron beam in the horizontal direction at 15 Hz. This deflection will generate a scanning raster on the back side of the camera tube target of 200 lines in 8 seconds. The electron beam is chopped at a 10 kHz rate by the sync keyed 10 kHz oscillator.

The target voltage appearing at the output of the Plumbicon is an ac signal which is amplified in a two stage amplifier. The output of the "video" amplifier is rectified and the signal is then amplified in a dc amplifier whose response is controlled by a Gamma corrector. This is done to correct the response of the camera tube to that more like the human eye. (Similar to the standard vidicon response). The amplified dc signal is fed to the video/sync modulator where the polarity of the video signal will cause the subcarrier oscillator to swing anywhere between black (1500 Hz) and white (2300 Hz) depending upon the picture content. Vertical and horizontal sync pulses are sent from the sweep oscillators to the video/sync modulator which causes the subcarrier oscillator to swing down to 1200 Hz during the presence of either a vertical or horizontal sync pulse. The square wave output of the subcarrier oscillator (a free running multivibrator) is filtered in the output and the SSTV audio signal is now ready for transmitting over the air on a SSB transmitter, monitoring, or recording on a tape recorder.

Construction

The camera shown in the photographs is the second version constructed. The first

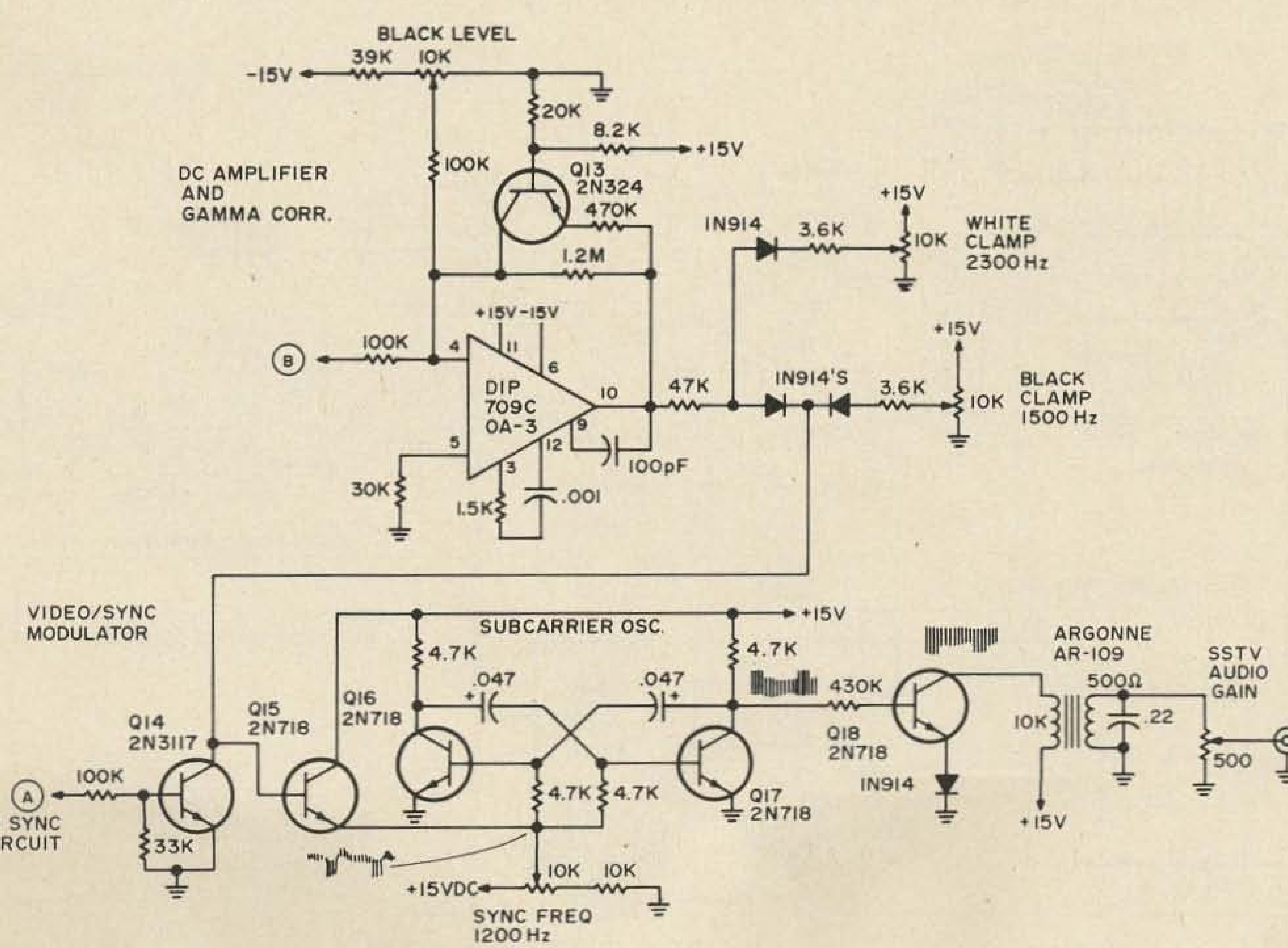
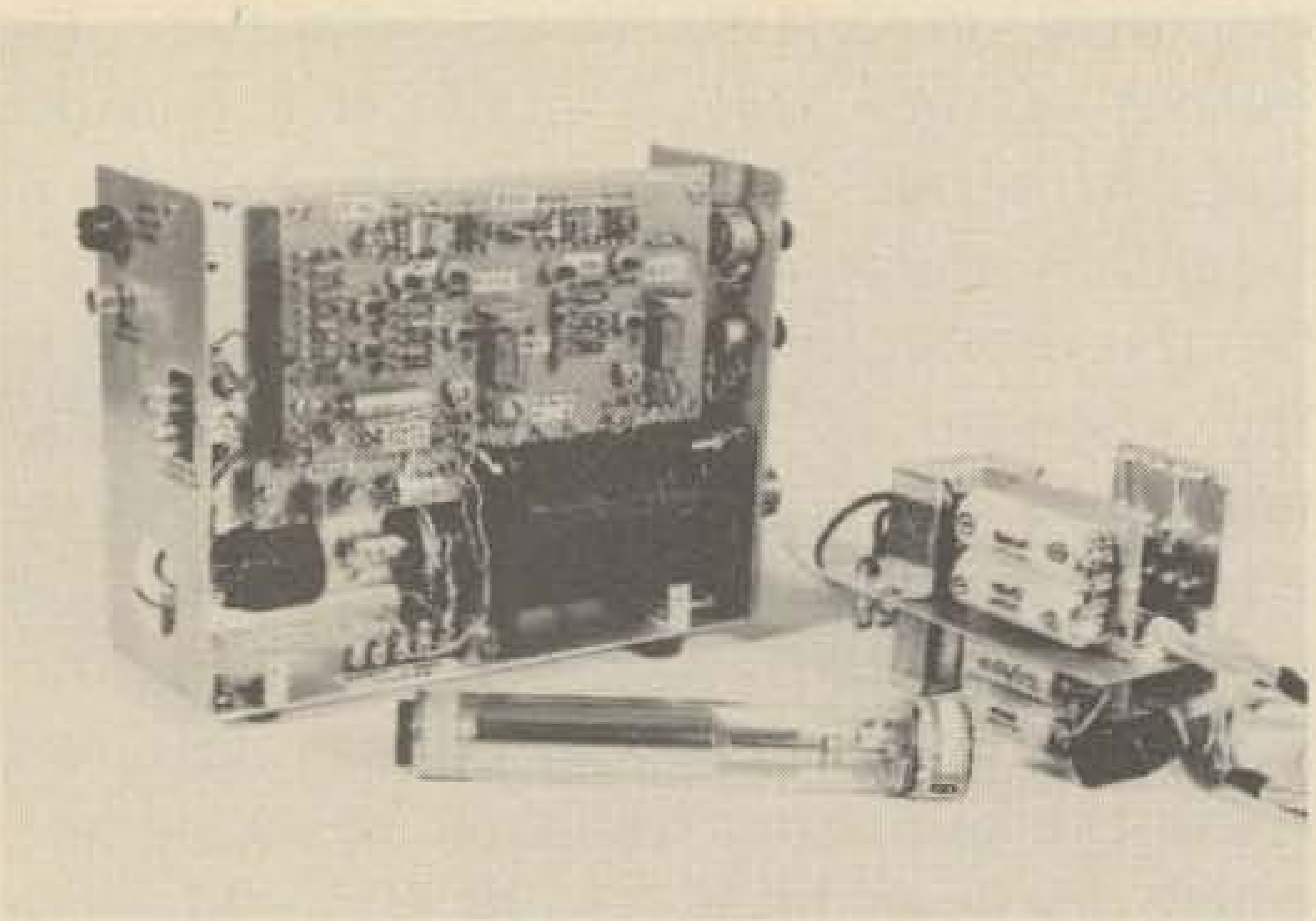


Fig. 2. Schematic (Part 1).



Innards of Plumbicon camera.

model had an integral power supply, but it gave nothing but trouble from its strong magnetic field. Extensive shielding of the transformer compartment with conetic material failed to reduce the interference to an acceptable level. The Plumbicon is very susceptible to stray magnetic fields which show up in the monitor as vertical stripes. The power supply was moved to a separate chassis and the camera rebuilt. It then produced excellent hum-free pictures. The camera electronics assembly is 3½" wide by 7½" high by 9¾" deep. The power supply is built on a plastic instrument case 3¾" wide by 2" high by 6¼' deep. Power from the unit to the camera head is provided by a multi-wide cable and a Jones plug at the camera head rear panel.

The electronics for the camera was assembled on perfboards using push pins. The 10 kHz chopper oscillator and video amplifier should be assembled in shielded boxes as shown in the photographs. The boxes were made from galvanized tin and are 3¾" wide by 4¼" deep by 1¼" high for the video amplifier, and 1¼" wide by 4¼" deep by 1¼" high for the 10 kHz chopper oscillator box. The 10 kHz chopper oscillator, the video amplifier, the dc amplifier and gamma corrector, the subcarrier oscillator, the video and sync modulator, and the SSTV audio output stage are mounted on one side of the camera. On the other side of the unit, the circuit board containing the 60 Hz line sync, vertical and horizontal sweep oscillators and amplifiers, the magnetic and electrostatic focus circuit are mounted.

Sockets for Plumbicons are usually difficult to locate, so one was easily made from an old octal socket, by drilling out the center to pass the glass seal on the base of the camera tube and also, drilling out one of the socket pins for the alignment pin.

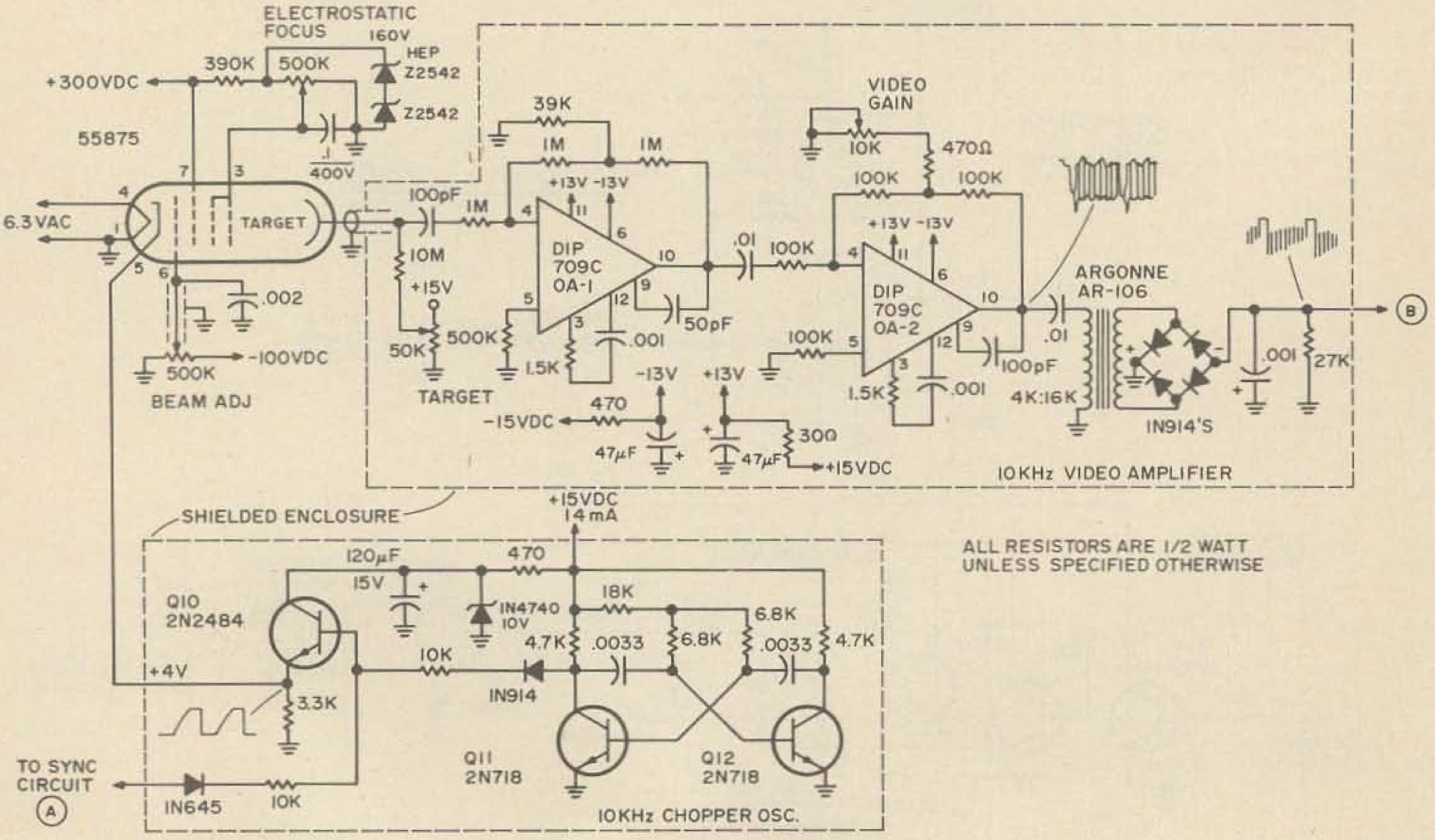
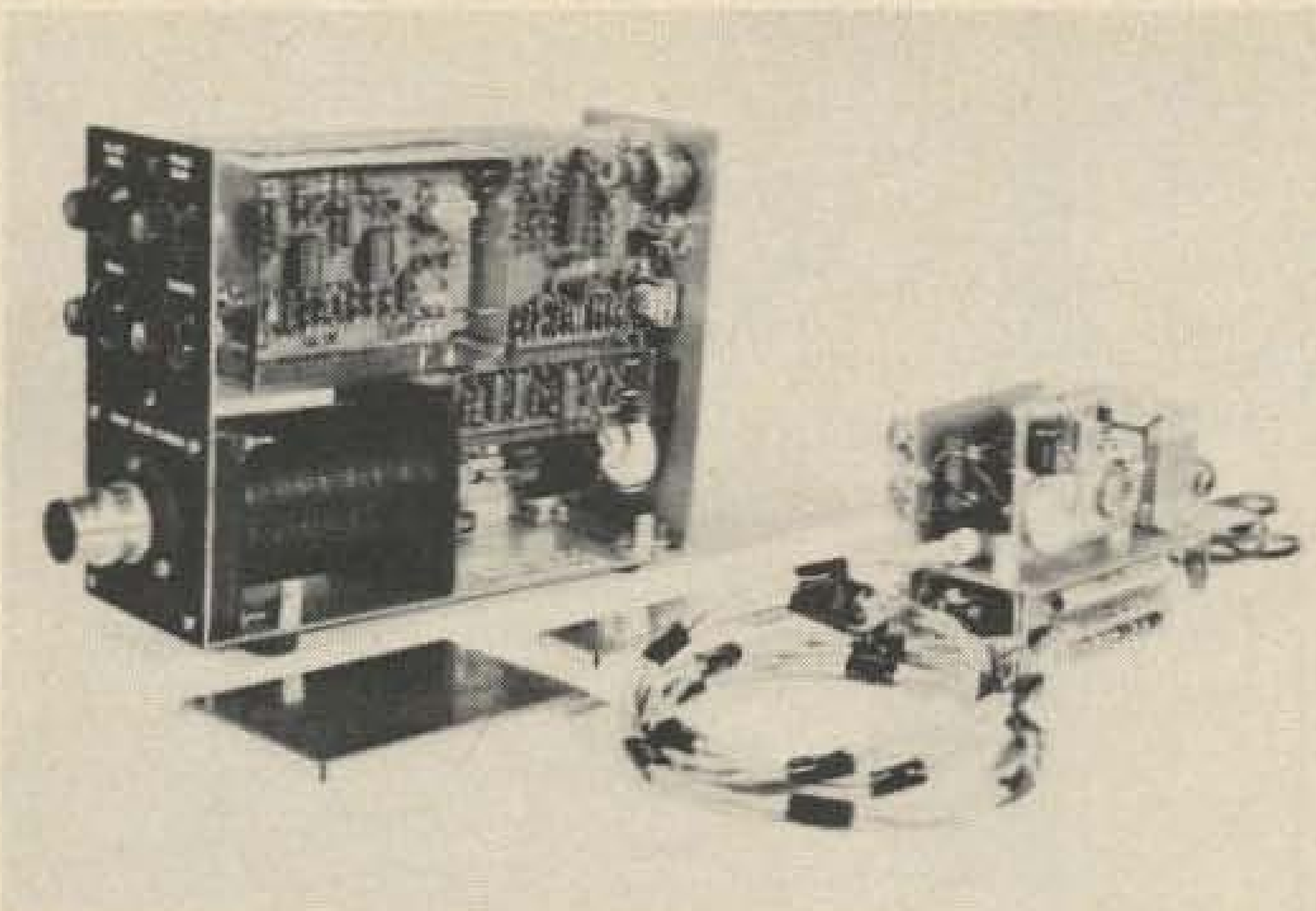


Fig. 3. Schematic (Part 2).



Plumbicon camera with video amplifier and 10 kHz chopper oscillator exposed.

The Plumbicon deflection yoke and focus coil were handmade, as there are no kits for this type of assembly. Information on the techniques of making camera tube deflection components may be found in *ATV Anthology* available from *73* Magazine. The focus coil form was made from a cardboard mailing tube 4½" long with an inside diameter of 2". The focus coil plywood end bells are 3-1/8" by 3-1/8" by 1/4" thick, and are glued over the ends of the cardboard tube making the coil winding area 3¾" long. This form was wound with approximately 5000 turns of number 32 wire. The dc resistance was around 400 plus 50 or minus 100 ohms.

Due to the lower vertical and horizontal sweep frequencies used in SSTV, the deflection coils will contain more turns of wire than those used in fast scan TV. The deflection coil window form was 1½" by 3/4" by .050" thick. Each vertical coil has approximately 620 turns of #36 wire. Each horizontal coil has approximately 800 turns of #36 wire. The series dc resistance of the two vertical deflection coils is 320 plus or minus 20 ohms and the resistance of the two horizontal coils in series is 220 plus or minus 20 ohms. The important thing is that each pair of coils be matched in individual resistance (same number of turns) or you will have unequal deflection in that particular plane. The Plumbicon is a bit larger in both diameter and length than the standard vidicon and will require a deflection coil form with an inside diameter of approximately 1¼". Such a form may be found inside a box of plastic sandwich bags, and should be cut to a length of around 5 inches. Install the Faraday shield, and deflection coils on the form as per the procedures in the *ATV*

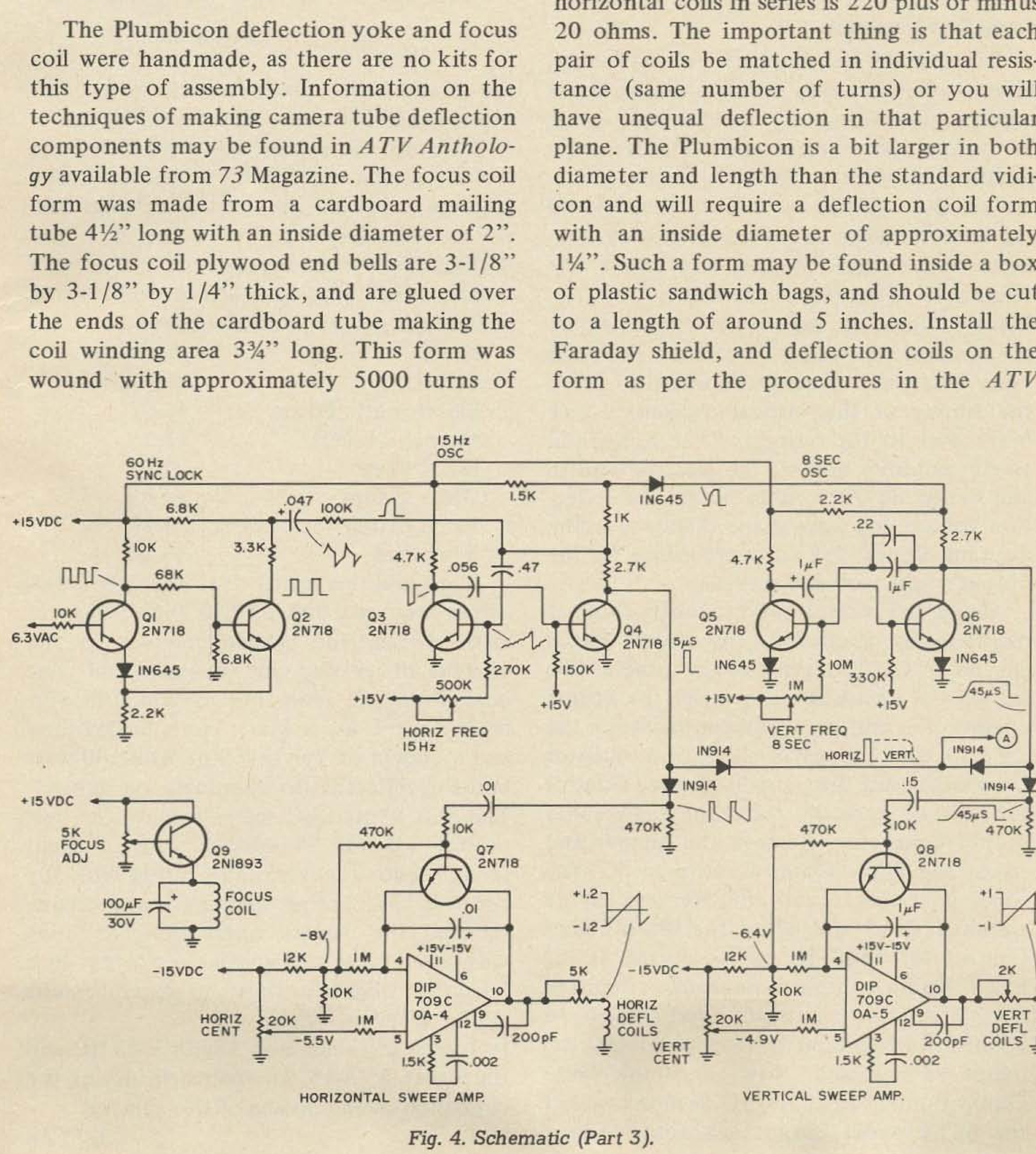


Fig. 4. Schematic (Part 3).

Anthology. Watch out when you phase those coils as I connected my vertical coils out of phase and had no vertical deflection when the camera was first tested. (I had built over a half dozen of these vidicon deflection assemblies and became over- confident!)

The lens of this camera was salvaged from a surplus gun camera. It is of 25mm FL and required a spacer of about 3/8" between the front of the focus coil assembly and the back of the front panel. The exact spacer required for each camera will depend upon the lens used and its focal length.

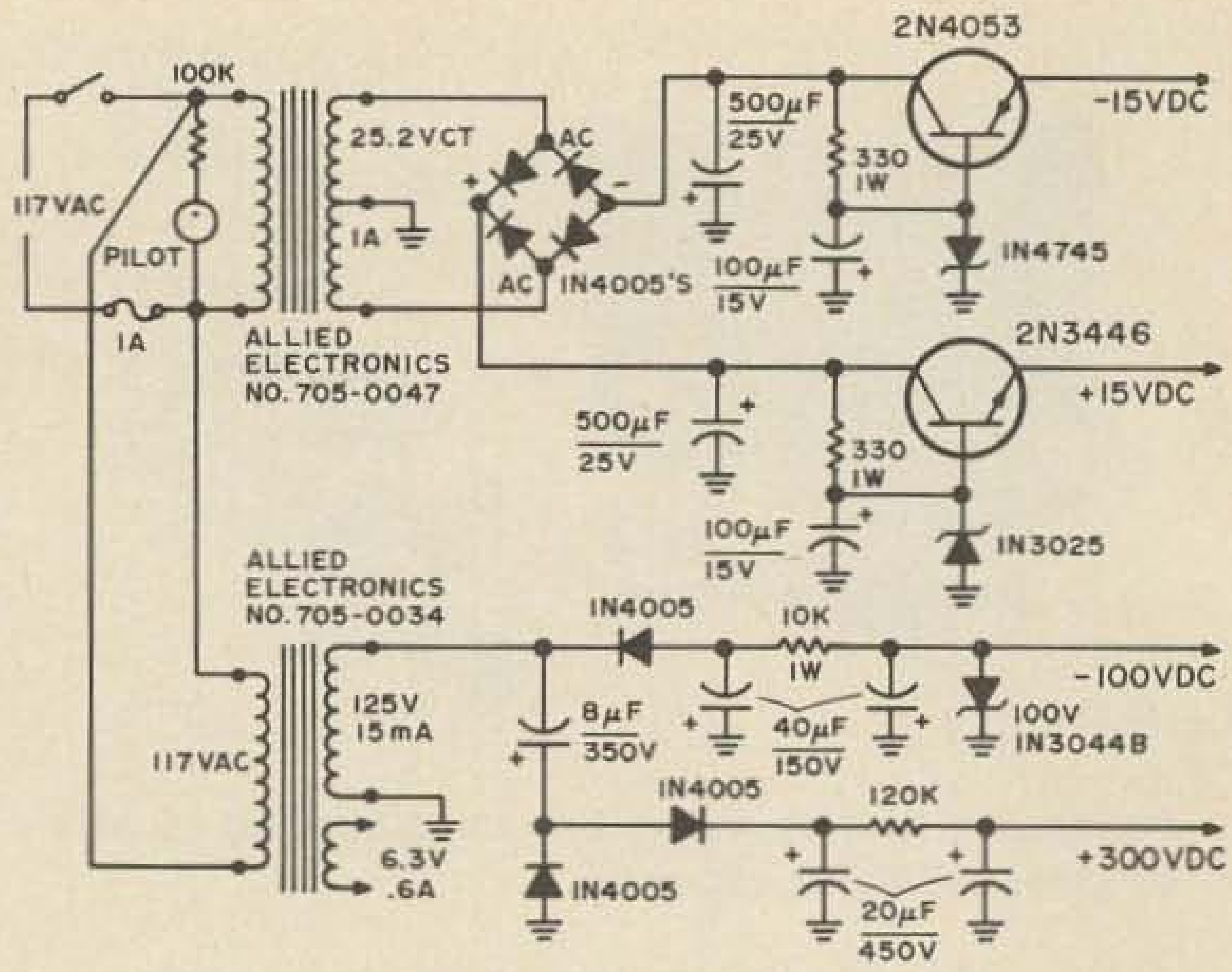


Fig. 5. Power supply unit.

Camera Adjustment

It is a good idea to check out the various circuits of the camera before plugging in the camera tube. Using a dc oscilloscope, check for proper wave forms and voltages at the junction of the two resistors in the collector of Q-2. This is to confirm that the 60 Hz lock-in pulses are being generated. Observe the output of Q-4 and adjust the Horizontal Frequency Control to 15 Hz. While monitoring the output of Q-6, adjust the Vertical Frequency Control to one pulse every 8 seconds. I use a stop watch to check the timing of the vertical oscillator. Now move over to the output of the horizontal sweep amplifier and set the Horizontal Size and Centering Controls to obtain the deflection voltage and wave shape as shown on the diagram. Repeat the same procedure for the output of the vertical amplifier.

Check the output of the 10 kHz chopper oscillator by monitoring the output at the emitter of Q-10, or pin 5 of the camera tube socket. To adjust the subcarrier for proper operation, connect a jumper between the collector and emitter of the sync modulator Q-14 and adjust the Sync Frequency Control for 1200 Hz as monitored at the SSTV audio output connector. Remove the jumper and adjust the White Clamp Control so that the wiper is at the 15 volt end. Remove the dc amplifier OA-3 and adjust the Black Clamp Control for 1500 Hz as monitored at the SSTV audio output connector. Reinstall OA-3 and adjust the Black Level Control to about 2/3 of its control rotation toward the minus 15 volt end. Now adjust the White Clamp Control for 2300 Hz as monitored at the SSTV audio output connector. Adjust the Black Level Control back to a point where the SSTV audio output is 1500 Hz.

Turn off the power now, and install the socket on the camera tube. The following table is a list of the control settings and voltages at critical points as found in the K7YZZ SSTV camera. They will provide the builder with a good starting point when beginning final tests and adjustments.

Beam	-41.5V
Target	+15V
Electrostatic Focus	+62V
Magnetic Focus	+5.3V
Black Level	-.40V
White Clamp	+4.8V
Black Clamp	+3.8V
Sync Freq	+3.0V

It should be noted that there is interaction between the optical focus, electrostatic focus, and magnetic focus in the process of getting the sharpest and best quality picture from the camera. For portrait work I use a black cloth background and a couple of Sylvania Soft White 40 watt bulbs in reflectors to illuminate the subject. The Soft White light seems to have the best output for the Plumbicon tube. I spent around two weeks experimenting with the controls and lighting, learning how each one affected the camera operation. The thing with slow scan cameras is to not get in a hurry but take your time and the end results will be very gratifying.

I wish to thank Bob Taylor W4YHC and Bill Briles W7ABW for their help during the construction and testing of this camera.

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