NOVEL MODIFICATIONS TO THE PYE 2014 IMAGE ORTHICON CAMERA

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THE written history of the image orthicon television camera is certain to include the Pye 2014. The mechanical design and operational features were so unique that many camera manufacturers are just beginning to employ some of them today. The remote iris control, motorised lens change, servo controlled focus system, modular construction and integral filter ring are a few of the features which were unique among television cameras in the United States in the early 1950s. Many of these units are still in use and this paper will explain how they may be updated to provide additional service.

Three Pye 2014 cameras have been in use at the American University in Washington, DC, during the past several years. The newest of these is eight years old and the oldest is ten. Maintenance and operating difficulties have led to some modifications which have improved the operation of the cameras and provided some of the most modern features which were not available at the time of original manufacture. The modifications included a mechanical lens change system, electronic lens cap, manual focus system, ten filament defeat circuit, and electronic image orbiting.

Mechanical lens change system

The original cameras were equipped with a push button lens selector switch and turret motor. The system proved to have two drawbacks which became noticeable in some studio situations. The turret motor was noisy which prevented camera operation close to an open microphone, and the lens change speed was slow under some studio conditions featuring fast shot sequences.

A new system was devised to correct both of these deficiencies. Flexible shafting, similar to the type used in car speedometers, was used to connect a manual actuating handle to the lens turret to permit changing lenses from the rear of the camera. Two difficulties were immediately encountered. An odd gear ratio was required so that one turn of the manual crank would change the turret one lens. A special gearbox was designed with a ratio of 1 to 2 1/12 turns which delivered the correct number of turns to the turret drive gear. The flexible shaft had enough backlash so as to make impractical an actuating handle detent. The original mechanical detent at the lens turret was retained to provide turret indexing.

The lens change circuitry was removed from the camera including the motor, gearbox, rectifier, cam switches, push-button selectors, and some of the interconnecting wires. One set of cam switches was retained for the turret position indicator lights. The wiring running to the rear of the camera frame was retained for use with other modifications.

New lens change gearboxes were designed to bolt directly into existing holes in the camera frame. The turret gearbox was fitted in place of the original turret drive gearbox. The output spindle was designed to accommodate the original turret gear drive. The input shaft was oriented under the IO lightshield so that the flexible shaft would fit inside the camera frame under the IO carriage assembly, Fig. 1.

The actuator gearbox was located at the rear of the camera to permit lens changing with the side cover of the camera open. The shaft was routed inside the camera along the bottom of the housing and out through the hole vacated by the remote focus and lens change selector connector. The shaft was connected to the two gearboxes and pinned with small taper pins. The final system is almost completely internal with the exception of the actuator gearbox, Fig. 2.

The flexible shaft chosen for this system was 0·188 in. diameter bi-directional material made from phosphor bronze. The shaft was fitted into a 0·437 in. diameter flexible casing with appropriate ferrules at each end. Complete assemblies of this type are available from a number of manufacturers. It is important that the shaft be of the bi-directional type and made for low speed manual use. The casing must be sturdy enough to withstand the flexing of the shaft under the tension of turning.

Flexible shafts should be run as fast as possible to reduce backlash and operating torque. The system described will not work properly if the shaft is made to operate at the actuator handle speed (one revolution per lens change). Running the shaft at turret gear speed keeps the backlash low and the shaft torque rating is not exceeded. It would have been desirable to run the shaft at a higher speed but

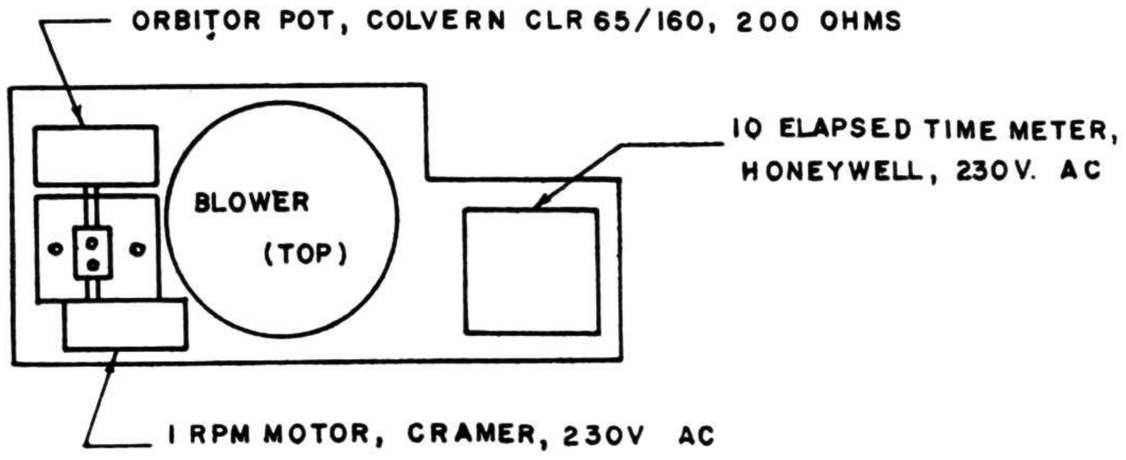


Fig. 6. Physical layout of orbitor chassis

the size limitations placed upon the turret gearbox made this difficult.

One set of the original turret cam switches was used to provide voltage to four turret position indicator lights at the rear of the camera. The lights were placed in the empty spaces left by the former lens change pushbuttons, Fig. 3.

Electronic lens cap

Aside from protecting the lenses from dirt, television cameras are capped to prevent image electrons from reaching the target. The electrons may be biased off electrically to achieve the same result as with a mechanical cap. Electronic lens capping can be installed in the Pye 2014 camera by breaking the image circuit at SK2 and grounding the 47k resistor, R67 through a switch, Fig. 4. The electronic cap switch may be located in the hole which was originally occupied by the focus range switch. The capping circuit described here has proved satisfactory for studio use where light entering the camera is of low intensity. When the circuit is to be installed in a camera which will be used outside in the bright sunlight a bias voltage may need to be applied to the image section or to the target to ensure complete cut-off of the image electrons.

Manual focus system

One of the most significant improvements made in the 2014 camera is the new focus system. The system was installed to eliminate the noise created by the focus motor and geartrain in the original design. After removing the servo motor and top section of the gearbox and associated parts, a flexible shaft was coupled to the original helix gear used to drive the IO carriage. The cable was bent so as to come through the side of the camera where a two-speed planetary speed reducer was connected. This provided for both coarse and fine focusing with very little backlash and enough drag to keep the IO carriage from creeping during normal camera operation. The flexible shaft was identical with that used in the lens change system except for length and end fittings on the shaft which were 0·25 spindles.

The original focus knobs were removed from the viewfinder and the viewfinder side plates were replaced with new covers. The iris control switches were removed from the viewfinder and a new single pole, double throw, spring loaded toggle switch was installed at the rear of the camera to replace their function. The layout of the new focus system is shown in Fig. 5. All parts of the system were obtained from local commercial sources except for the mounting hardware, main focus knob, and handle which were fabricated.

The planetary drive was obtained from the Waldom Company, USA, and provided a 1 : 1 and 5 : 1 ratio for two speed focusing. The drive was disassembled and the shaft reversed before installation to make it fit properly. It would be possible to construct the focus system without the planetary drive but focusing might prove difficult on short lenses since the system is linear.

IO filament defeat circuit

Image orthicon tubes are warranted by the number of hours of filament use. Warranted life of the tube may therefore be extended by turning the filament off during extended stand-by periods or maintenance. Since the warm-up characteristics of the IO tube are not stabilised in the 2014 it is necessary to allow the camera to operate with the filament on even after the rest of the camera has been on for several hours. A filament defeat switch may be located in any convenient place and connected in series with the IO filament to perform the defeat function. The University cameras provide for filament defeat in the third position of the cap switch but this has led to some difficulty when cameramen have turned off the filaments by accident while attempting to cap lenses.

Electronic image orbiting

A simple image orbitor was built into the cameras using the stripped focus servo amplifier chassis as a mounting base. The system is similar to that used in the newest Pye cameras. The IO target heater was replaced with an orbiting coil made by General Electric, USA, and the coil driven with a one cpm sine wave. The sine wave was derived

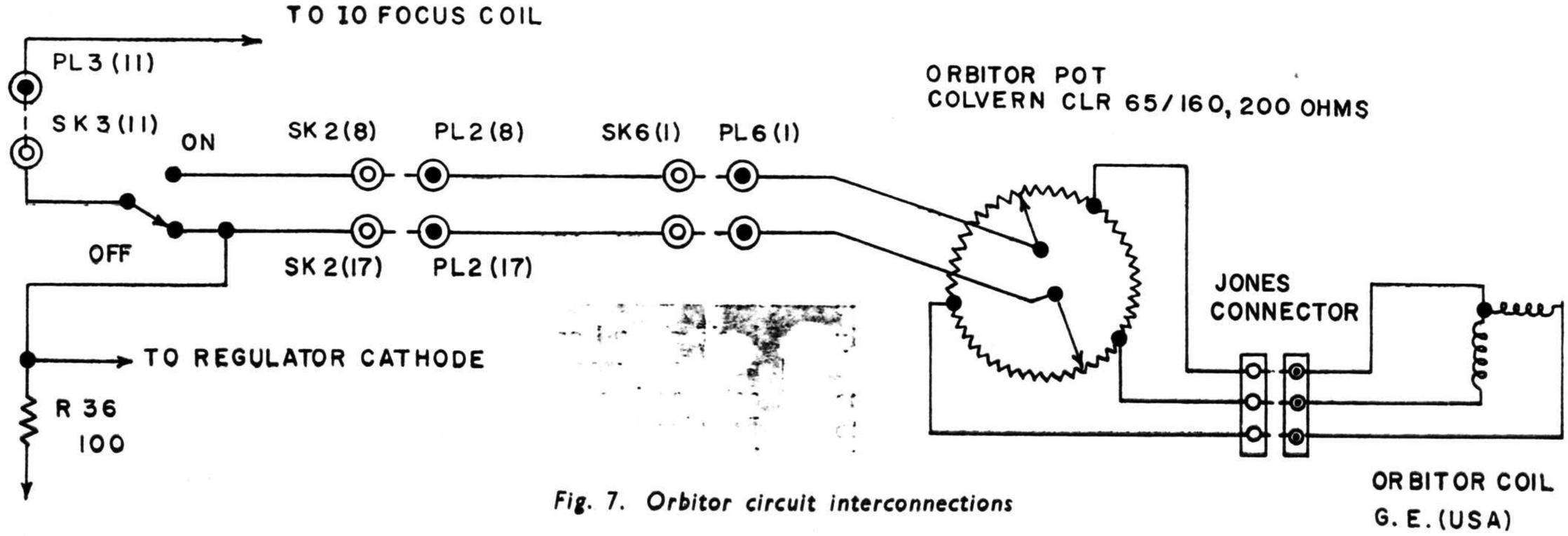


Fig. 7. Orbitor circuit interconnections

from a tapped potentiometer, the rotor of which was connected to the IO focus circuit. The pot. was driven by a one rpm geared synchronous motor. The physical layout of the orbitor chassis is shown in Fig. 6. A slip clutch was provided on the orbitor motors to provide for orbitor synchronisation between cameras. The orbitor on-off switch was located under the small door at the rear of the camera in the hole left by the removal of the focus selector switch. Note that the camera focus current is shunted around the orbitor coil when the orbitor switch is in the off position to prevent permanent magnetisation of the IO focus coil cover or mask, Fig. 7.

Complete diagrams covering the orbitor chassis and the camera frame are shown in Figs. 8 and 9. Since the wiring arrangement differs among some 2014 cameras it will be necessary to correct the diagrams for the particular camera under modification. This may be done by checking the plug and socket connections against the proper Pye drawings that came with the particular camera.

One of the cameras at the American University has been modified completely as described in this article. The two others have been completely modified except for the lens change systems which were working properly.

The advantages of these modifications are : more silent operation, lighter weight, reduced power supply drain, fewer electrical transients during lens changing and focusing, cooler operation, improved operating characteristics, and lower maintenance of the camera chain. Future modifications may include the installation of a beam rocker circuit to aid in camera alignment, and a video preamp. An improved detent may also be devised for the manual lens change system to provide more positive indexing of the turret.

The modifications described in this article are designed specifically for the Pye 2014 image orthicon camera. There is no reason, however, why the electronic lens cap circuit, filament defeat circuit, and image orbitor could not be installed in any IO camera and it is hoped that these modifications may be of interest to those who are operating cameras which are not so equipped.

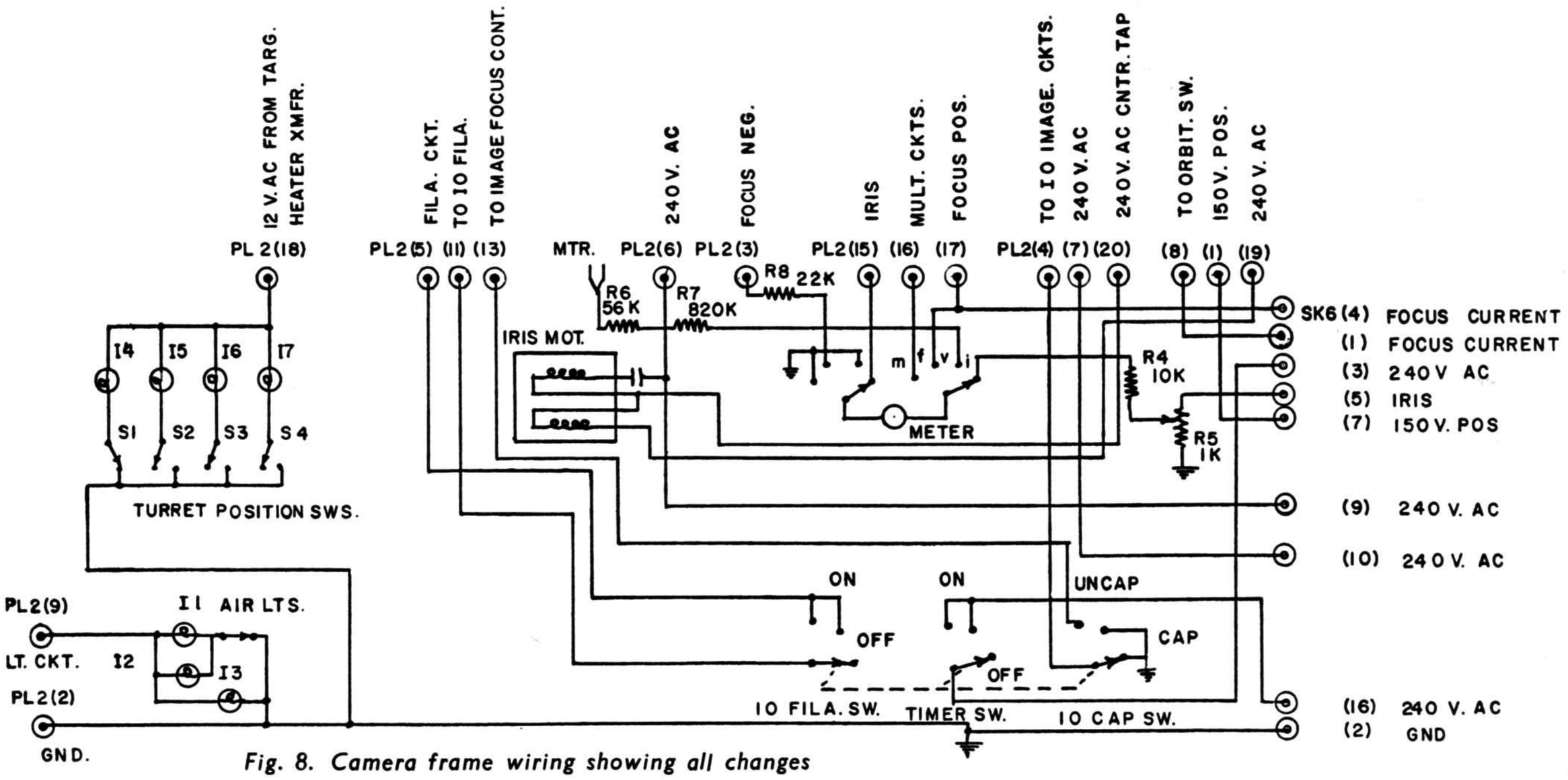


Fig. 8. Camera frame wiring showing all changes

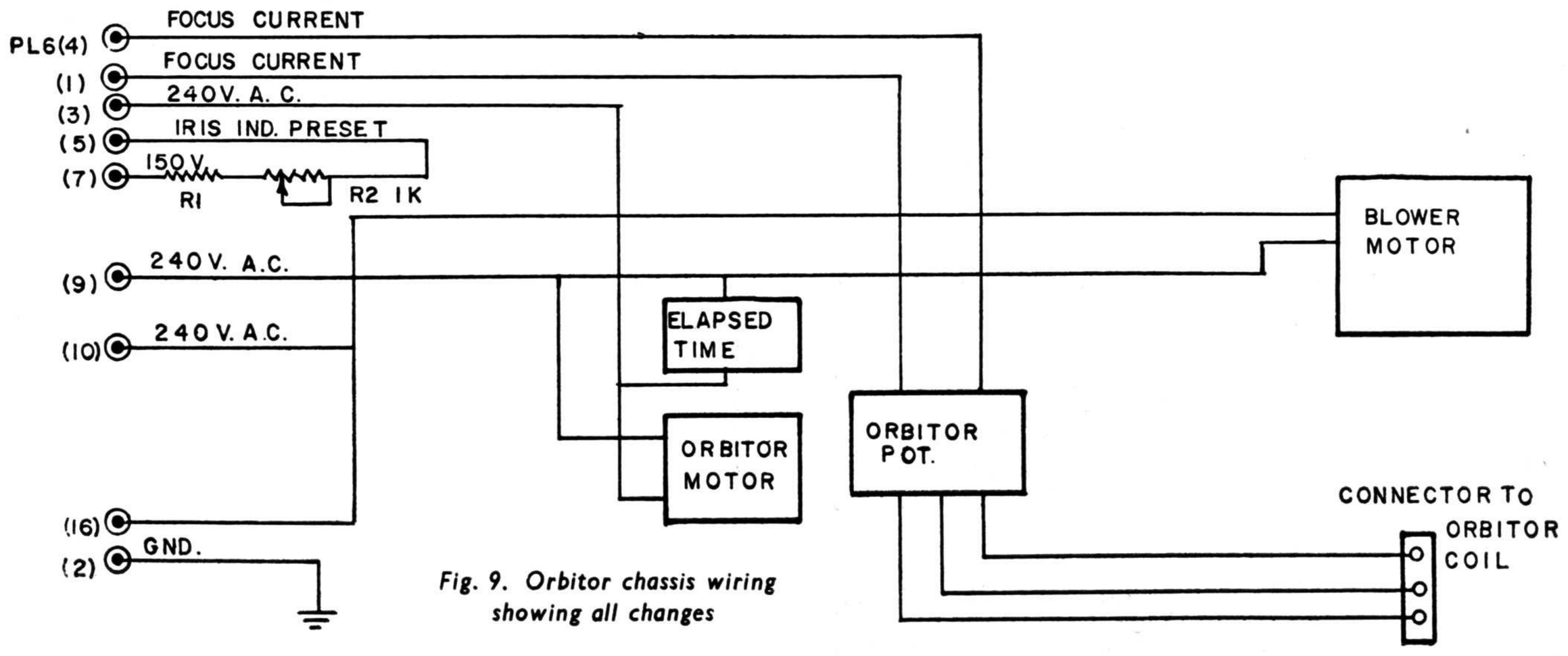


Fig. 9. Orbitor chassis wiring showing all changes

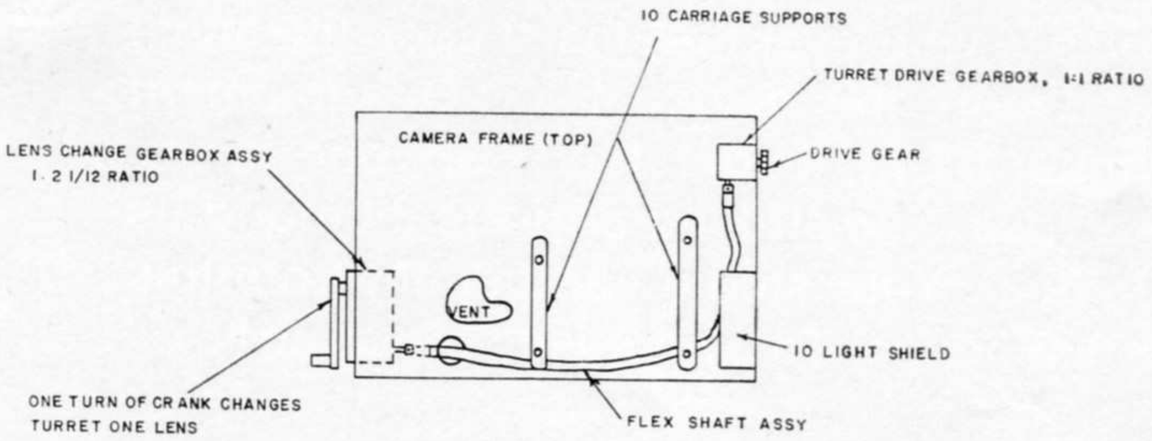
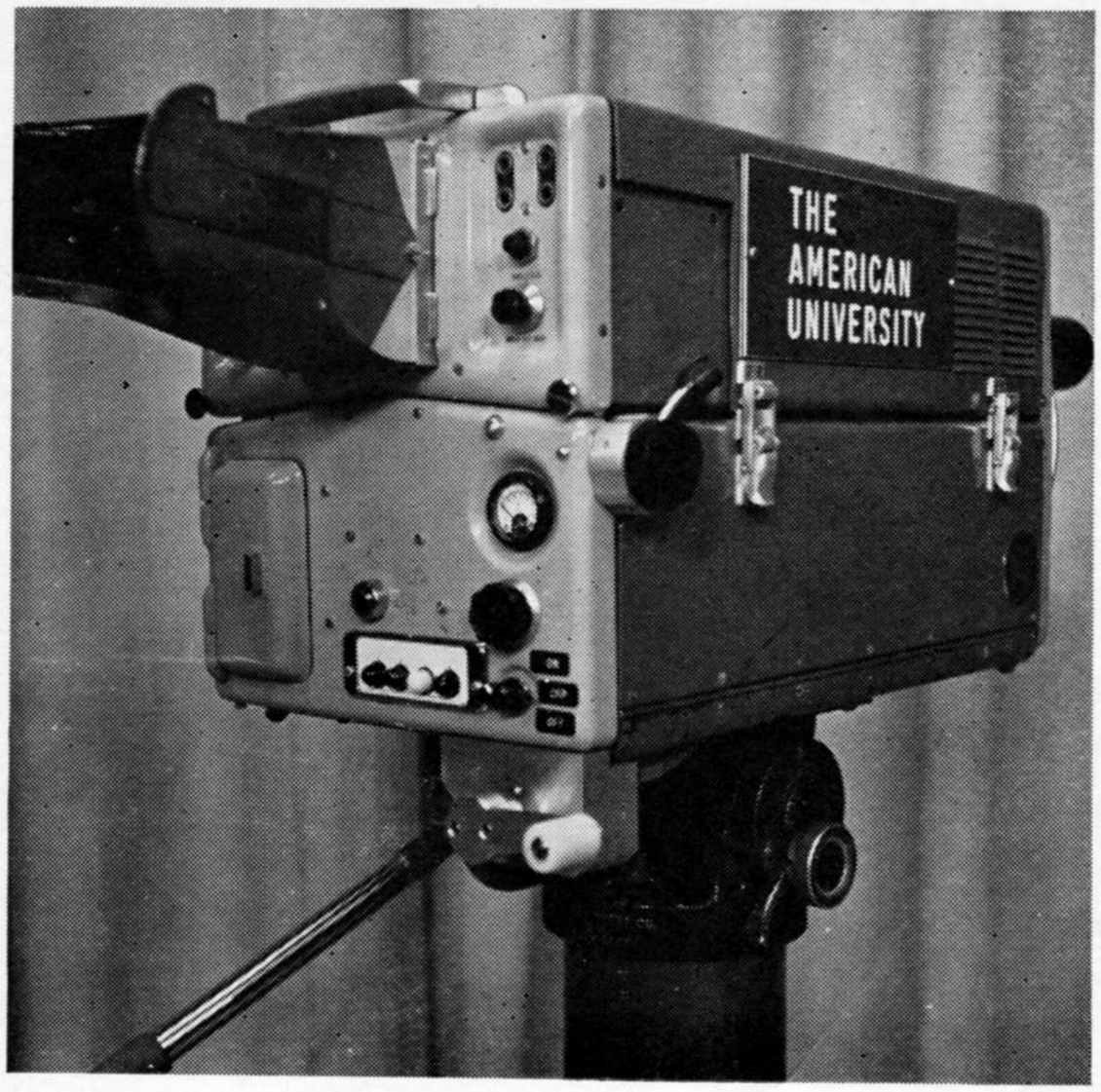


Fig. 1. Lens change system employing flexible drive shaft



Above : Fig. 2. Camera showing lens change gearbox and crank

Left : Fig. 3. Camera showing rear panel layout

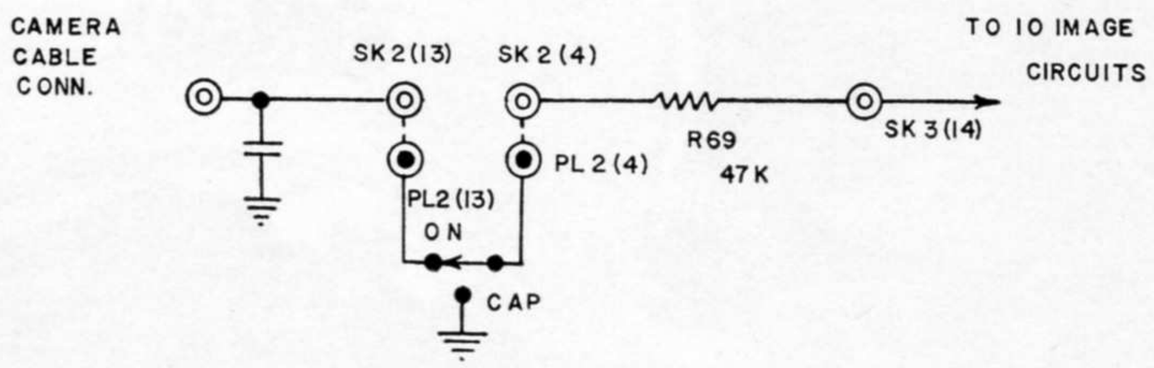


Fig. 4. Electronic lens capping circuit

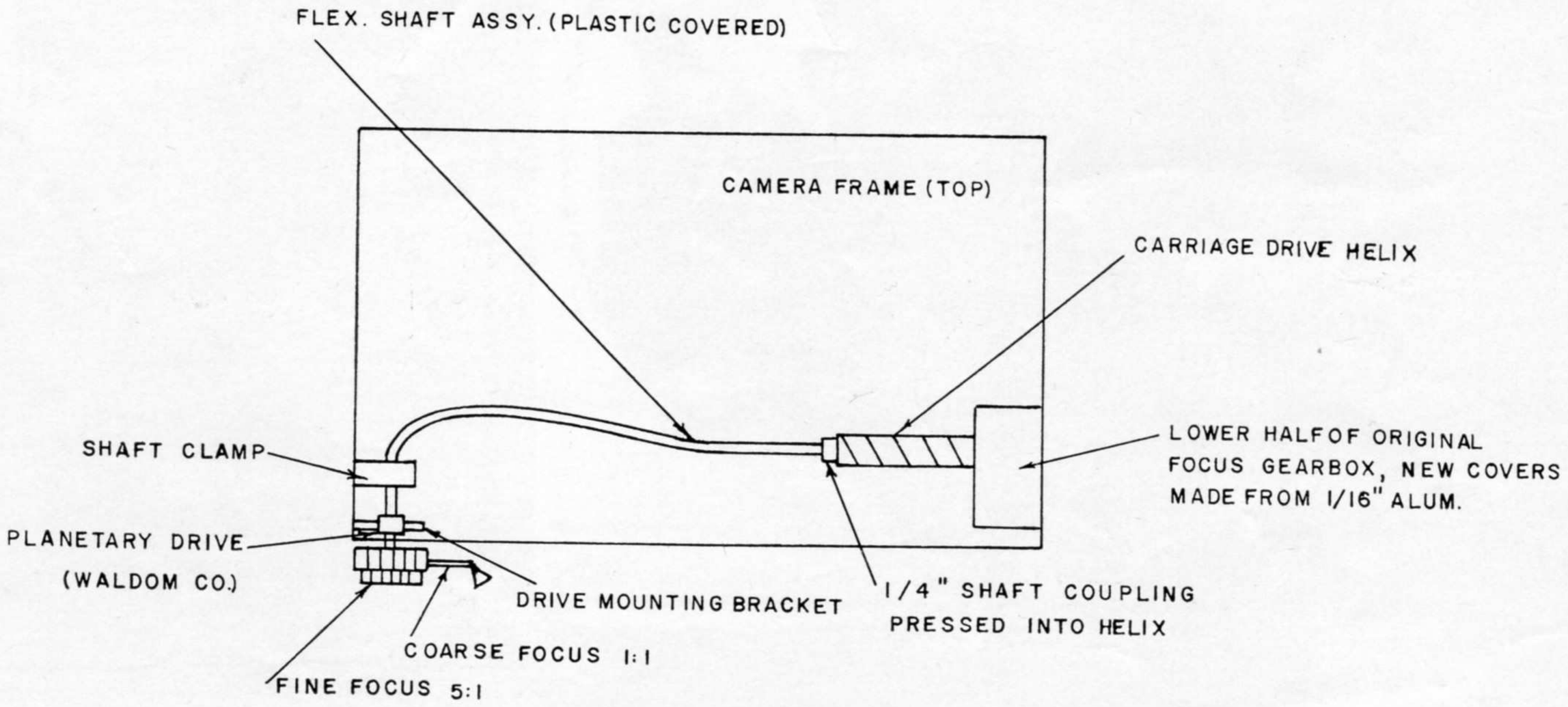


Fig. 5. Camera focus system employing flexible drive shaft