Setting up an ITV CAMERA

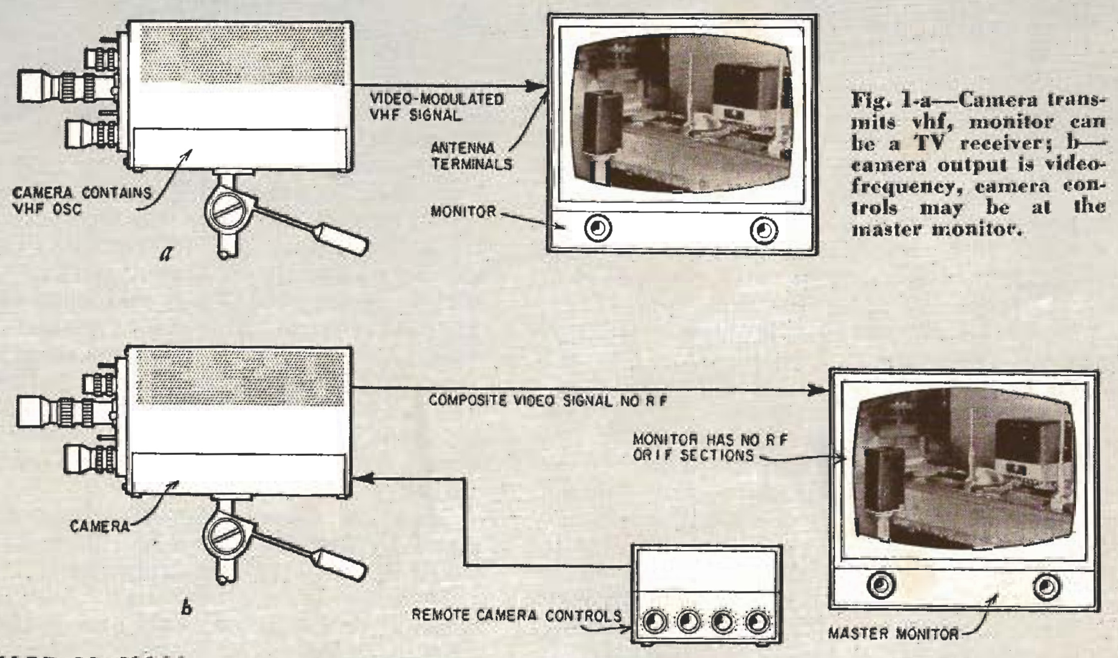

Fig. 1-a—Camera transmits vhf, monitor can be a TV receiver; b—camera output is video-frequency, camera controls may be at the master monitor.

By EDWARD M. NOLL

INDUSTRIAL television is the "seeing eye" of industrial electronics; many automatic operations depend on the remote viewing facilities of closed-circuit TV. A number of processes can be monitored from a single central control point with industrial television, and controlled from the same point with industrial electronic equipment.

New uses for closed-circuit TV systems are constantly appearing in commerce, education and business. It is doubly unfortunate that so few independent service organizations or technicians have displayed any initiative or confidence in this field. Neither industrial television nor industrial electronics has been pushed—or even welcomed—by the average technician. Yet installing and servicing industrial TV and electronic equipment is no more difficult than many regular service assignments, and certainly much simpler than most color TV receiver servicing.

An industrial TV setup must be properly installed and adjusted if the owner is to be happy with it—or even able to use it. Electronic controls, lighting and optical systems must be set precisely to insure good, reliable pictures on a long-term basis. Cameras must require a minimum of attention, and the entire system should be able to run unattended for long periods of time.

The first step in securing the best operating conditions is to adjust the pre-set controls of cameras and monitors. Correct camera adjustment is important in obtaining a high-quality picture and insuring the best life for the vidicon tube.

Two important considerations are positioning the camera and selecting an optical system suited to the duties expected. There must be enough field of view and depth of focus to include the necessary data in the picture. Lighting must be adequate to render a clear well-defined picture. Mounting positions and the intensity of the light are significant factors.

Monitor adjustment

The monitor is the first unit of an industrial television system that must be adjusted. The two most common types of closed-circuit TV systems are shown in Fig. 1. In the first one (Fig. 1-a), the monitor is a standard receiver. The television signal formed by the camera is used to modulate a high-frequency oscillator operating in the vhf television band. The vhf signal is then used as a carrier to convey the signal from the camera to the monitor. The signal is fed directly to the receiver's antenna terminals and the selector knob is set for the channel covered by the vhf oscillator.

The monitor for such an installation can be adjusted by using a signal from a standard television broadcast. Linearity and size adjustments can be made and the vertical and horizontal synchronization circuits aligned in the same manner that you would adjust a television broadcast receiver. If a standard TV broadcast cannot be received, use a bar or cross-hatch generator to tune up the monitor and viewers.

The monitor must be correctly tuned because it will be used as a standard when adjusting the camera. The camera tube requires horizontal and vertical deflection waveforms just as does the monitor. So camera linearity, size and

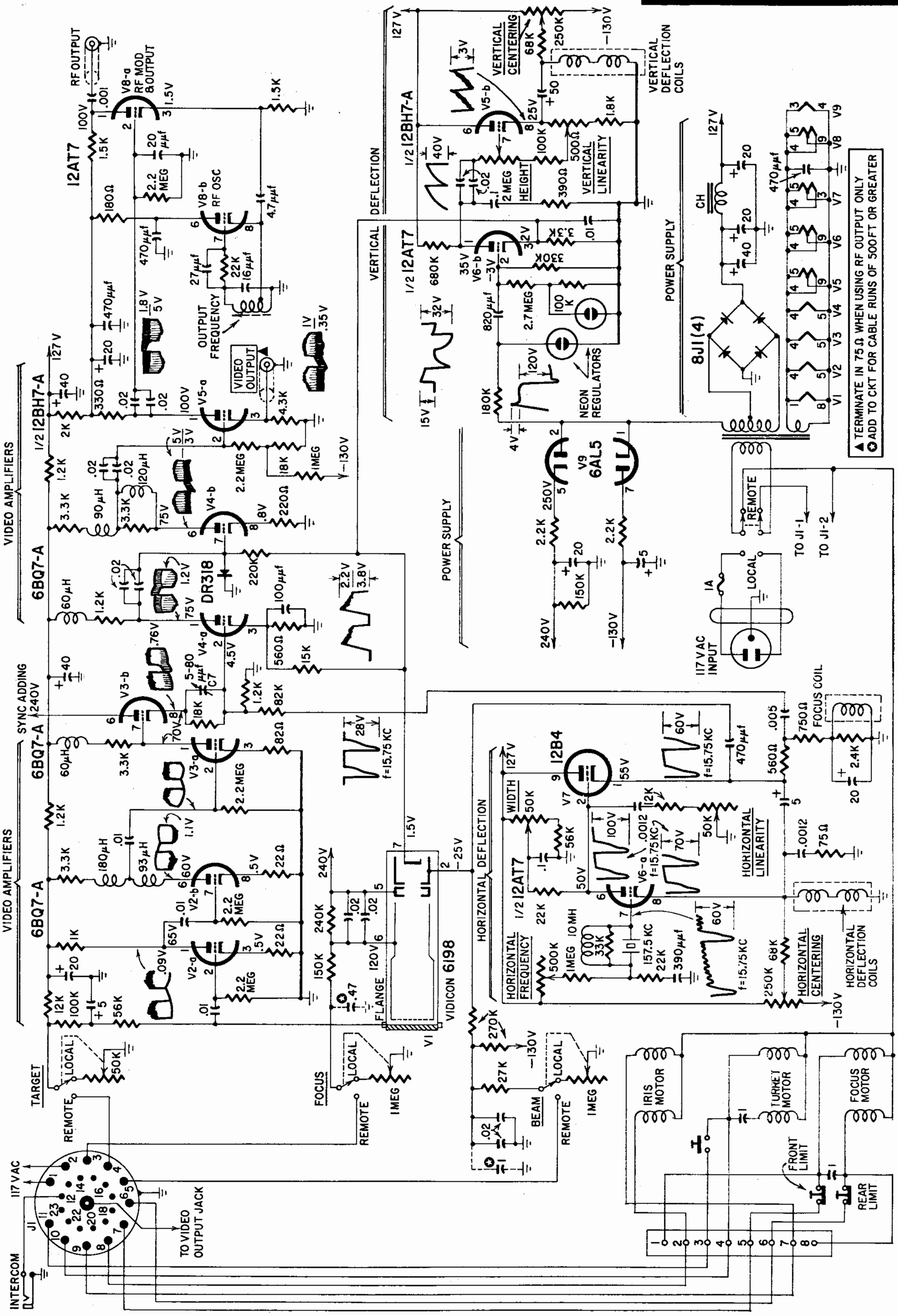

Fig. 2—Circuit of the General Precision Laboratory model PD-500 camera.

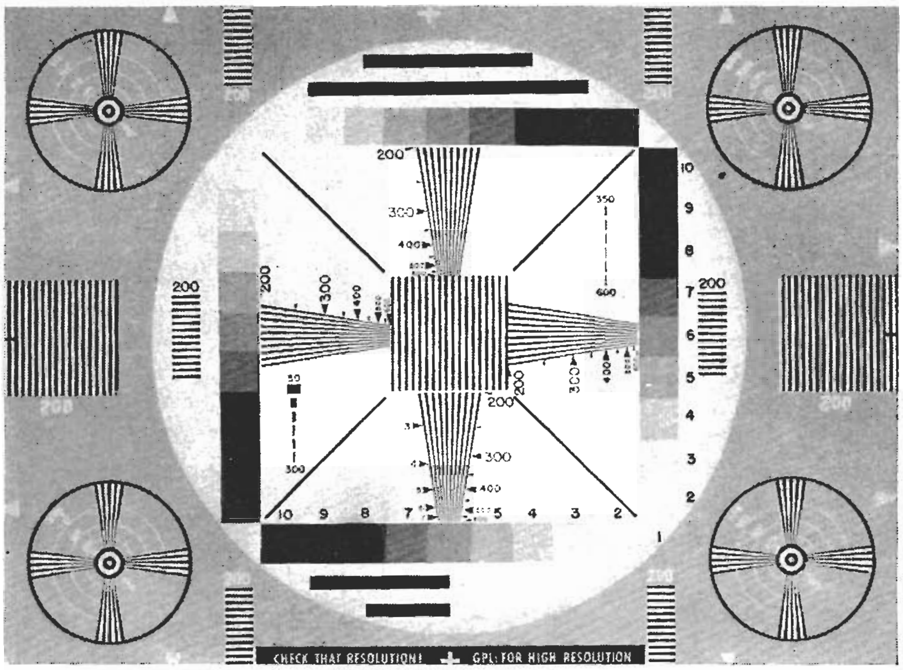

Fig. 3—Test chart used in adjusting the camera.

centering must also be adjusted. This can be done exactly only if some deflection standard is available. A correctly adjusted monitor can fill the bill.

The second arrangement (Fig. 1-b) is becoming an even more common type of industrial television installation. In it the camera controls are located at the master monitor. Thus they can be adjusted and the results observed at the master monitor. (However, there are preset camera controls that must be aligned too.) This arrangement permits mounting the camera in a fixed out-of-way or inaccessible position. It is generally much more convenient because the camera's operating characteristics can be adjusted by the person watching the picture on the master-monitor screen.

Most installations of this type do not use an rf carrier method. Instead, a composite video signal is sent over a coaxial cable to the master-monitor position. The monitor and viewers do not contain rf and if sections and the composite video signal is fed directly to the monitor's video amplifier and sync separator.

In such a system it is sometimes difficult to adjust monitor deflection correctly. The problem can be circumvented in two ways. One is to use a bar or cross-hatch generator very carefully, making certain of width and height adjustments.

The second method is to use a TV tuner and if section to receive a local television broadcast signal. The output of this tuner and if strip can then supply a composite television signal of proper amplitude to the antenna input of the master monitor. Now the television broadcast signal can be used in setting up the master monitor and viewer.

The monitor where the camera controls are located is called the master monitor or viewer. Additional monitors and viewers are called remote or slave viewers.

Camera preset adjustments

To provide as definite a procedure as possible for setting up a camera, let us consider the adjustments recommended for the General Precision Laboratory model PD-500 camera whose circuit is shown in Fig. 2. The procedures to be followed are typical for most industrial TV cameras. As cameras are shipped factory-aligned and adjusted, they can usually be put in operation and made to deliver a satisfactory picture by following the suggested operating procedure.

If picture defects appear after following the operating procedures carefully (including lens and lighting instructions), it may be necessary to adjust some of the preset controls. When camera tube or circuit replacements are made, some of the preset controls will probably need attention.

Operating procedure

1. Set the camera for local operation. Many TV cameras have facilities for either remote or local operation.

2. Set TARGET control at No. 3 on its scale (see photo at head of article). The TARGET control regulates the dc voltage applied to the signal electrode segment of the photoconductive target area.

3. Bring up the beam voltage slowly until a picture appears. The BEAM control regulates the negative bias supply to the control grid of the gun section of the vidicon camera tube.

4. Focus the picture carefully. It will rotate slightly as the adjustment is made and, if the camera is operating normally, the picture will come into focus when it is exactly upright. The ELEC FOCUS control regulates the dc voltage applied to the wall electrode of the vidicon camera tube. If the picture does not come into focus, check both the monitor focus and the optical focusing of the lens system.

5. If a picture did not appear when beam voltage was increased, move the TARGET control to the next highest setting, improving its sensitivity. Repeat steps 3, 4 and 5 until a picture does appear.

Proper settings of beam and target voltages are important. Generally, the minimum possible target voltage required to produce a good-quality picture should be used. Although increasing the target voltage does improve sensitivity, there is a greater tendency toward image retention or stickiness. (If the camera is panned or tilted or a new lens switched into position quickly, an impression of the previous scene will persist for a short time.) Also, with stickiness it is more difficult to differentiate a fast-moving object, as an impression of the motion will hang on in the reproduced picture.

Under certain circumstances, a high target voltage can produce image burn-in—an image of the scene being televised under improper operating conditions will make an impression in the target surface which will persist for a long period of time and, if very serious, for the life of the tube. It is always advisable to use as much light as feasible and the widest lens aperture that can provide the proper depth of field. In this way the TARGET control can be set to a minimum value.

The BEAM control influences the ability of the camera tube to resolve the brightest portions of the scene and produce a picture with a good contrast ratio. It is generally turned up until the bright portions or highlights of the scene can be well differentiated. A good operating procedure is to find the lowest target voltage that will permit the BEAM control to resolve or wipe clean the brightest areas of the scene.

Use only enough beam current to resolve the highlights. When the top of the picture flickers, it often indicates that the beam setting is too high and the beam current excessive. If the picture becomes twisted or distorted or begins to roll vertically, it is often an indication of hum being introduced because of too high a target or beam setting. Dark lines at the top of the picture often imply too high a target setting.

If a camera must be used to view both brightly illuminated and dull subjects, vary the target voltage only. Set the BEAM control for the brightest subject and leave it there. Now you can lower the target voltage for bright scenes and increase it for low ambient lighting conditions and dull subjects.

If remote operation is included, the same operating procedure should be followed, using the remote controls wit' the camera set on remote. To summar the target setting should be set to the lowest value that will render an adequate picture. The more lighting, the lower this setting can be. Beam setting in turn depends on target setting—a higher target setting requires a higher beam setting. The BEAM control too should be operated as low as possible and at a setting that will just resolve the brightest portions of the picture.

If lighting levels are very low (under 15 or 20 foot-candles), the target must be operated at near maximum. Under these conditions there will be a great tendency for the highlights to stick with scene motion and some bright flare may exist at the edges of the picture. On the other hand, if TARGET and BEAM controls are set too low, picture contrast is lowered. Although contrast can be corrected to some extent by increasing the overall video gain of the system, noise content is also increased. Therefore, beam and target settings should be high enough to render a noise-free picture.

If a camera is used frequently, it is generally advisable to let it operate continuously if light levels and subjects do not change radically. The life of the camera tube and other vacuum tubes in the unit is usually longer because there is no frequent heating and cooling of the tube electrodes and no voltage surges due to turning equipment on or off.

Scanning adjustments

An important consideration in the operation of the vidicon camera tube is to make certain that the useful area of the target surface is scanned. When the target surface is not scanned fully, a permanent impression of the smaller raster section is burned into the vidicon target. Consequently, when normal scanning is restored, a burnt-in impression of the smaller area will appear in the reproduced picture. Furthermore, if the complete area is not scanned, full resolution cannot be realized from the vidicon camera tube. When the target surface is being scanned fully, the actual corners of the target barely appear in the picture on the monitor or can be made to appear with only a very slight adjustment of the vertical and horizontal centering controls at the rear of the camera.

A test chart such as the one in Fig. 3 is generally used when adjusting vidicon scanning. Such a chart not only provides a check of scanning, but also resolution, contrast and focus. For a general check of scanning linearity, check the trueness of the large center circle and the four corner circles. More specifically, the vertical sweep linearity can be judged by comparing the spacing of the short horizontal bars at both top and bottom of the chart with those of the middle bars. Horizontal linearity can be checked in a similar manner. Just compare the vertical bar spacing at each side with the center bar spacing. A true aspect ratio will not only reproduce the center circle faithfully, but the pattern formed by the gray scale will produce a perfect square as well.

To use the chart most effectively, a linear and properly adjusted monitor is needed. The chart, according to the instructions included with the camera, should be positioned at a prescribed distance from the camera with the proper lens in position and the camera directed toward the chart perpendicular and dead center. Then the camera can be set to use the full area of the target surface.

Scanning adjustment procedure:

▶ With the 1-inch lens in position, the test pattern provided should be mounted 14 inches from the end of the lens. Now proper scanning will exactly cover the whole chart. If the 2-inch lens is used, the chart should be mounted 28 inches from the lens edge. Be certain that the camera is positioned so its axis is lined up with the center of the chart. The optical focus should be adjusted for 14 inches or 28 inches, as required.

▶ Adjust the VERTICAL LINEARITY and HEIGHT controls for a full-size and linear picture vertically. The VERTICAL LINEARITY and HEIGHT controls are both in the vertical output stage.

▶ The WIDTH, HORIZONTAL LINEARITY and HORIZONTAL FREQUENCY controls interact and sometimes influence proper focus. If there appears to be a complete misadjustment, all three controls should be set to their mid-positions. Adjust the HORIZONTAL FREQUENCY control for proper lock-in of the picture on the monitor screen. Next adjust the WIDTH and HORIZONTAL LINEARITY controls for a full-size and linear picture in the horizontal direction. Then readjust horizontal frequency and focus for the best possible picture. The horizontal controls are in the camera's two-stage horizontal deflection pulse generator, tubes V6-a and V7.

Some interaction between adjustments should be expected because of the multiple functions of the horizontal and vertical deflection waveform generators. In these two stages all the necessary waveforms and pulses for the television system are formed. For example, the horizontal deflection system generates two other pulses in addition to the deflection waveform required by the horizontal deflection coils. Horizontal blanking pulses are formed as well as horizontal sync-blanking pulses that are added to the video information and conveyed to the monitor. At each monitor these pulses blank the picture tube and synchronize the horizontal deflection system. The vertical deflection generator performs the same function in terms of vertical deflection, blanking and sync-blanking.

▶ The centering controls should be adjusted to just pull the edges of the target out of the picture as viewed on the monitor. If this cannot be done, it sometimes indicates that a shield or iron wire wrapping has become permanently magnetized.

▶ If a tilted picture appears on the monitor screen, orient the camera's deflection yoke until the picture is straight.

High-peaker and cable compensation

The high-peaker stage of the camera's video amplifier compensates for the loss of highs at the output of the camera tube. The high-peaker has a rising gain characteristic with frequency. A control generally associated with this stage permits a more precise control over the bandwidth characteristic of the television system. Hence it is possible to make corrections for other frequency disturbances, both high and low, with the control facilities of a high-peaker. Usually the high-peaker is adjusted to get a picture with maximum possible resolution without the appearance of echoes or repeats in the picture information. These transients show up as vertical repeats behind abrupt changes in scene brightness.

In the GPL PD-500 camera, capacitor C7 and tube V3-b compensate for the influence of cable length between camera and viewer. The capacitor is adjusted for minimum streaking and smear in the reproduced picture.

The quality of picture in a closed-circuit system is always surprising, considering the few stages and simplicity of the units employed. In difficult television pickup locations, don't expect reproduction comparable to that of a television broadcast station. Remember, television studios are illuminated by batteries of lights and the television signal is developed and corrected in elaborate amplifier and control systems. To obtain a good-quality picture in industrial television application, the camera must be adjusted carefully and diligent attention must be given to proper lighting, lens arrangement and mounting position. END