D. Y. Ow. TELEVISING

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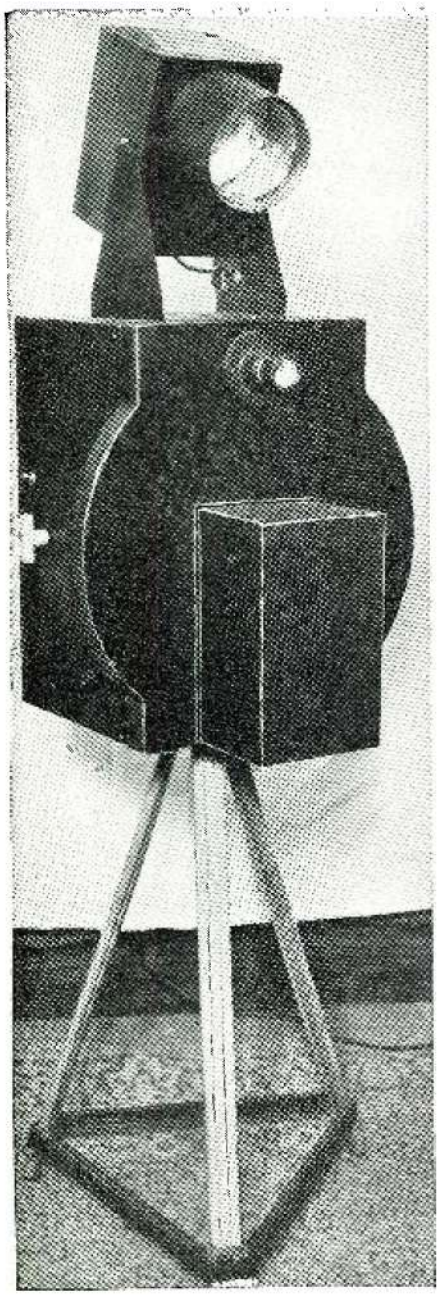
Any experimenter can do his own home televising by following the easy instructions and building the units described by the author herein.



INASMUCH as *high definition* electronic television cameras are not available to most amateurs because of the cost, an effort has been made to design a camera which would have enough detail to be interesting; be not too difficult to construct; and above all be as inexpensive as possible.

At first a 45 line flying-spot camera was built, using a pinhole disc with a 1,000 watt projection lamp and a bank of photo-electric cells. This camera would only pick up scenes about one foot square (close to the camera), such as faces of persons and drawings. Later, a camera was built using a 45 hole lens disc with an automobile headlight bulb and a bank of p. e. cells.

These cameras worked but their range of pickup was limited, the detail was not too good, and they had to be operated in a dark room. So it was decided to build a 60 line direct pickup camera which would take scenes either indoors or outdoors. It was thought by some that such a camera using a small scanning disc was impossible. However, several experiments proved it could be done. The difference in detail between a 45 line and a 60 line picture is more noticeable than between a 60 line and a 100 line picture. In fact, the detail of a good 60 line picture is great enough that when showing a car going by on the street such details as the windows, fenders, and spare tire can be seen.

This camera when used with either a scanning disc or c. r. tube receiver offers the technician an opportunity to profit by his experience in television at once by giving demonstrations at stores, theatres, and fairs. It would also be good advertising for a service shop. Admission may be charged or the store may pay the technician for his time as operator and the use of the equipment. As examples of this are the demonstrations given at the Chicago World's Fair and the Dallas Centennial. Following is a description of the camera and method of construction:

The camera box is made of plywood covered with sheet aluminum. The edges of the aluminum are bent over the edges of the plywood to hold them together. A 1,000 watt, 110 v. spotlight is mounted on top the camera to provide light for indoor or studio scenes. This spotlight is in an aluminum box which can be tilted up or down. When the camera is turned to shift from one scene to another the spotlight will follow the camera. For outdoor shots in daylight the spotlight is not used.

A 5″ lens mounted in the lamphouse is used to focus the light on the subject. The inside back wall of the lamphouse is left unpainted to act as a reflector behind the light.

Projection spotlight bulbs of the type

Left, the completed television camera with its spot-light. Right shows how the camera box is constructed.

used have a concentrated filament and must be well ventilated to have a normal life. Spotlight bulbs with the filament in a half circle evidently have a longer life than the regular projection lamps. Large holes in the top and bottom of the lamphouse provide sufficient circulation of air.

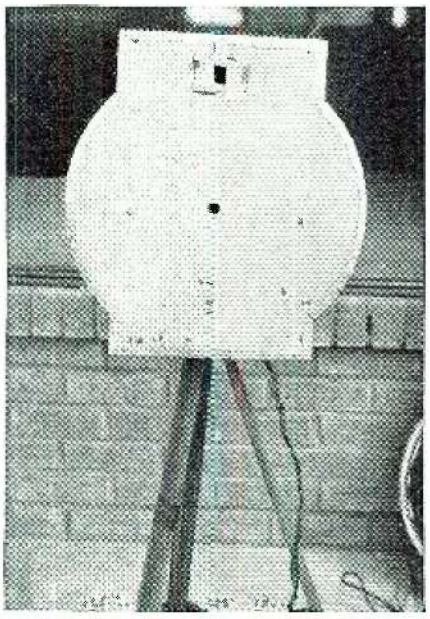
Four small 45 v. "B" batteries and five No. 6 dry cells in the bottom of the camera box supply power for the two preamplifier stages and the p.e. cell, all of which are mounted in the camera.

The p.e. cell and preamplifier tubes are in a tin box which is "light tight" except for the window in front of the p.e. cell. A piece of screen wire must be soldered over this window to shield the p.e. cell.

The preamplifier box (or head amplifier) *floats* on an inch of sponge rubber, and has a narrow strip of sponge rubber around the p.e. cell window, which is pressed against the wall at the back of the disc, to keep out stray light. Due to the high sensitivity of the amplifiers any sharp vibrations of the preamplifier box coming from the motor will cause hum in the amplifier.

One source of hum was located as coming from vibration of the top of the amplifier box. A thin aluminum cover with a heavy coat of paint removed the hum. All of the tubes in the amplifier are mounted horizontally by means of metal brackets on the tube sockets. The camera is so mounted on the tripod that it can be tilted or turned in any direction.

After trying several types of p.e. cells, some of which were not sensitive enough to work at all, the Cetron type C. E. 7 was found to be the most efficient. This is a gas-filled cell (manufactured by the Continental Electric Company of Geneva, Illinois) which has a drop in sensitivity of about 2 d.b. at 10,000 cycles. With the added capacity of the circuits and tubes the output of the amplifiers at 40,000 cycles would be very low, if ordinary resistance-capacity coupled amplifiers were used, resulting in a serious loss of detail in the picture. However with *compensated amplifiers* a reasonably *flat frequency response* can be obtained.



The scanning disc is enclosed in a light-proof case. Note the aperture. The lens is mounted over aperture.

For ordinary demonstration purposes with the 60 line camera, the simplest way of sending the picture is by shielded cable to the receiver. The cable is a low-capacity type single shielded wire, with the shield grounded to the head amplifier and the camera box. It may be up to 50 feet in length.

The lens system of the camera is composed of two small magnifying glasses 1¼ inches in diameter mounted together. These lenses may be obtained at variety stores for about 25 cents each. When mounted together the lenses should have a focal length of about 2 or 2½ inches. This is easily found by focusing a spot from the sun on a piece of paper. The distance from the lens to the paper is the focal length.

The lens barrel was made of two pieces of brass threaded together, and turned out on a lathe. Strips of paper and water-proof cement were used to fix the lenses in the barrel. The lenses must be set straight in the barrel to prevent blurring of the picture.

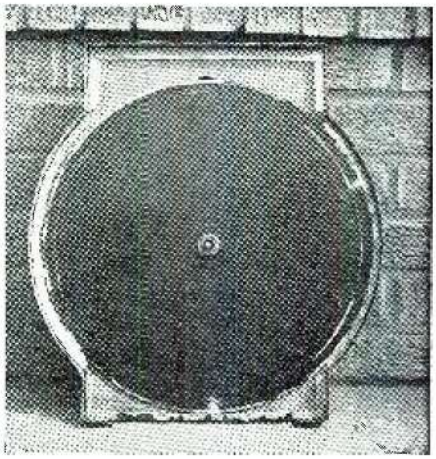
The lens barrel and motor are mounted on the front wall or side of the camera. A strip of aluminum running all the way around the camera holds the front side to the wall behind the disc.

Two toggle switches are mounted on the sides of the camera for the "A" and "B" batteries.

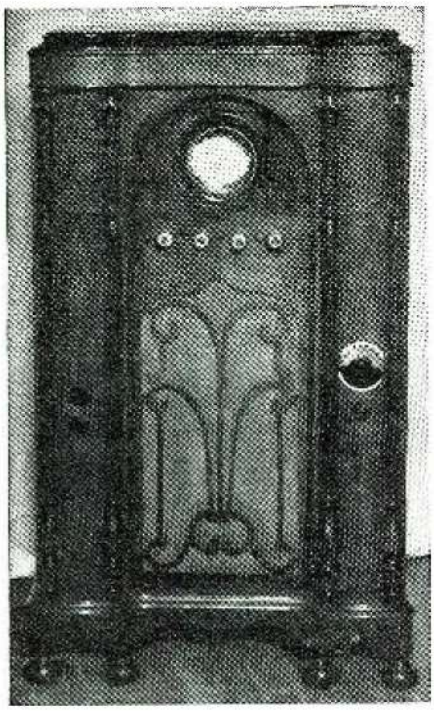
The motor (manufactured by A. H. Pohl, 2123 Hubbard, Detroit, Michigan) is a special combination sync and brush type with two switches. The lower switch turns the motor *on* and connects the armature winding in *series* with the two field windings. When the motor is at the approximate running speed the upper switch is turned, which shorts the brushes to cut out the armature winding, and also pushes the brushes away from the commutator. The motor will then be running as a truly sync motor. As any sync motor approaches correct speed it will "hum or grunt rapidly," the "grunting" slowing down and finally stopping at synchronism. When such a motor hunts, a slow grunting will be heard.

In this camera, a 14 inch disc (made by A. H. Pohl, Detroit) with square holes is used. Until recently the amount of light coming through the small holes in this size disc was not sufficient to work the p.e. cell. But with late types of cells the camera is sensitive enough to take any size scene in daylight. The only limiting factor being the comparative loss of detail when too large a scene is being taken.

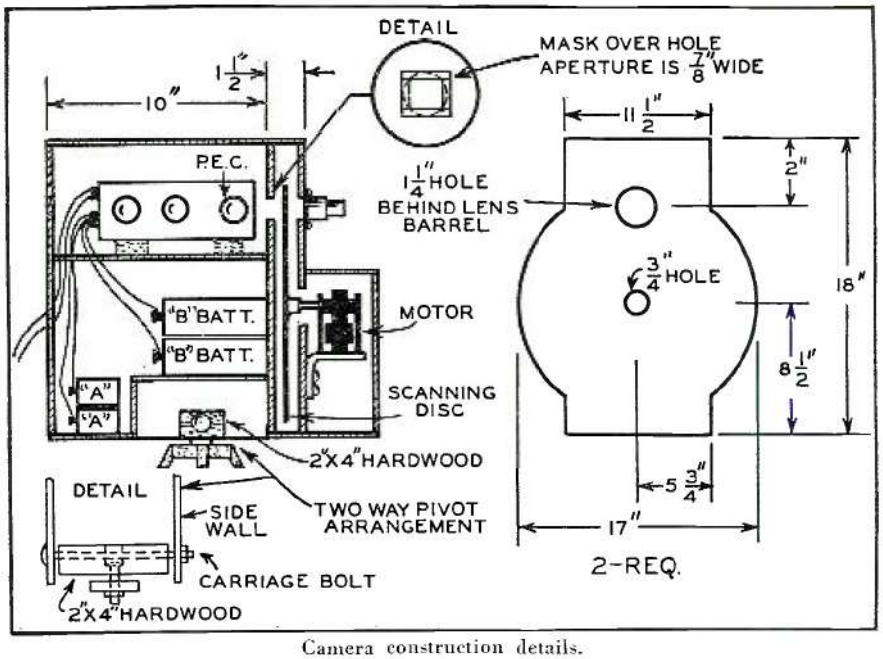
The spotlight on the camera gives enough light for studio work with objects about one foot square. With this, close-ups of faces, cartoon work and



Above, the scanning disc exposed for examination. Below, the latest type receiver developed by the author.



This first tele-ceiver was used by the author for direct wire pick-up.



Camera construction details.

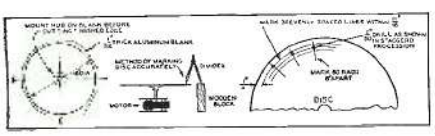
pictures taken from magazines can be taken. Retouched pictures from magazines provide excellent program material. The retouching should be done with a dull black crayon or black india ink, not with a pencil.

A potentiometer on the back of the camera controls the voltage on the p.e. cell and thus the gain. Another gain control is used on the input of the main amplifier chassis. If the latter control is full on, noise coming from the first tube of the head-amplifier and the p.e. cell will show up in the picture as tiny black specks. The limit of usable amplification is reached when this noise begins to appear in the picture.

The electron emission of a tube is not entirely smooth and constant, rather the electrons leave the cathode in small bunches (especially with large plate current), giving rise to the *shot effect*. This together with *thermal agitation* in the wiring produces the undesired *noise level* of sensitive video amplifiers.

Late researches indicate that the noise level of a gas-filled p.e. cell is much higher than that of a vacuum cell, possibly due to thermal agitation of the gas. This noise level is higher than that of the wiring and even the internal noise of the first tube.

A sensitive vacuum cell was tried and proved to be just as sensitive for this application. Slight adjustments in the amplifiers were necessary to lower the high frequency response.



How the holes in the disc are made.

Sixty Line C.-R. Tube Receiver

As yet only a few sections of the country are able to receive the 441 line stations which are all on the ultra short wavelengths. This receiver can be used to pick up W9XG, Lafayette, Indiana, on 2050 K.C. which can be received in all parts of the country under favorable conditions, or it can be used with the 60 line camera. W9XG broadcasts from motion picture film on Tuesday nights at 7:30 and Thursday nights at 8:00 o'clock, for about 40 minutes. Those who have seen their pictures are always surprised at the amount of detail and the steadiness of the image due to the automatic synchronizing impulses sent with the picture.

When making the 60 line receiver, four decks are used in the receiver cabinet. The chassis for the c.r. tube and sweep tubes is on the top deck. The next deck holds the chassis for the r.f. and det. stages with their power supply. The second deck holds the video amplifiers. Two power supplies and the speaker are mounted on the bottom deck.

The top chassis has four volume control potentiometers on the front and four on the back. Two on the front control the frequency of the sweep circuits (number of lines and frames); one controls the intensity of the spot by varying the grid bias on the c.r. tube; and the other one the focus (first anode voltage) of the spot. Best detail is obtained when the lines are focused as small as possible, so that a thin black line appears between each two bright lines.

When using a comparatively low

(*Televise further on page* 54)

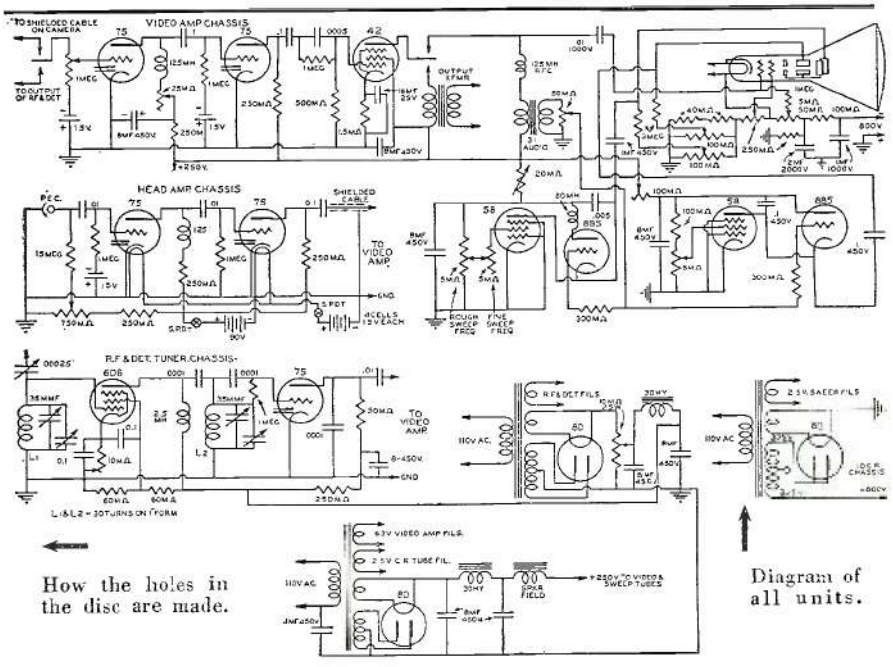


Diagram of all units.

clean cut operating of 18 years ago, as well as of today.

FP8AG, St. Pierre Island is putting in an R9 signal to the West Coast.

W6GY, our old friend, Ben McGlashan, is working Australians easily these days on phone.

K7GSC puts a fine signal into the West Coast from Alaska, and gives us another usable Alaskan on 20 meter phone. When he is on, he comes right through during the day, even at 9 or 10 A. M.

W7FQV puts in a signal these days on 20 meter phone.

Rodger Jackson was elected president of the *Long Beach Poly Hi Radio Club*. Thirty or forty embryonic amateurs are making their radio debut by this means.

W7RT is rolling along with his marvelous set, and has been working lots of DX.

W6JRM is doing a good job as SCM of the San Diego Section.

W7KV is piloting for the United Air Lines as usual.

Present plans include 10 meter mobile on the high seas with W6AM at the mike and key, from July 4 to July 16. W6AM will be on the yacht *Contender*, enroute from Treasure Island to Honolulu, in the Honolulu Yacht Race. -30-

Do Your Televising

(*Continued from page 8*)

second anode voltage, focusing as fine as this may not be possible. In this case the focusing control is adjusted until the edges of the picture are sharp and not rounded, and also by watching the detail improve with correct adjustment. By using a high voltage and low beam current, ordinary oscilloscope tubes will focus down quite well for a 60 to 100 line picture. Other small tubes are available with extra fine focusing for 441 line images.

One of the controls on the rear of the c.r. tube chassis is for adjusting the synchronizing voltage, and one for the voltage on the sweep tubes (size of picture). The other two are for centering the picture on the screen.

A five inch lens placed in front of the 3 inch c.r. tube makes the picture appear about 4 inches square. A terminal strip (which should be shielded because of the danger of the high voltage) is mounted on the side of the chassis. Wires leading from this down to the power supply are covered with spaghetti tubing and taped together. The back half of the c.r. tube is covered by a shield which also supports the socket. The socket should also be shielded.

Power transformers must be placed as far as possible from the c.r. tube to prevent hum in the image. Even the magnetic field of the earth has a slight effect on the electron beam. If the c.r. tube and power supply are all on one chassis, the field of the transformers may extend all through the chassis, causing hum. The rectifier tubes usually warm up before the sweep tubes which allows the spot to stand still on the screen for a time. At any time the spot is standing still the intensity control should be turned down to avoid burning the screen.

In the sweep circuit tube (128A's or 885's) the grid is biased to or beyond, plate current cut-off. When the condenser builds up sufficiently to discharge through the tube (thus ionizing the gas) the grid loses control while the discharge is taking place. After the discharge the grid regains control. A synchronizing voltage of a few volts applied to the grid holds the oscillator in step with the transmitter.

The maximum average plate current for an 885 should not be more than 3 milliamperes. This does not usually give enough output to sweep the spot all the way across the screen, when the high voltage of the c.r. tube exceeds 500 volts. Inclusion of an inductance in the plate circuit of the sweep tube gives twice the voltage output, so that 1,200 to 1,500 volts may be used on a 3 inch c.r. tube without exceeding the rating of the sweep tube, and still give a full sweep. A higher second anode voltage on the c.r. tube requires more sweep voltage, but gives a finer focus.

Higher voltages on the c.r. tube help to eliminate hum. At 20 frames per second, hum on the grid of the c.r. tube causes three dark and three bright horizontal bands in the picture. Hum in the line frequency sweep circuit causes the sides of the picture to be wavy. Hum in the frame frequency sweep circuit causes the distance between lines to vary, some of the lines being close together and some far apart, giving an effect of six horizontal "bands." Several of these effects may be caused by hum in the high voltage supply. Hum on the grid of the c.r. tube may come from the high voltage supply or from the video amplifiers.

The grid coupling condenser for the c.r. tube must be a high voltage mica type, because the cathode of the tube, although negative, is at a high voltage point, the chassis being positive.

If the picture is upside down or words read backward, this may be corrected by either reversing the connection to the two "free" deflecting plates or by turning the tube, or both. Lines far apart at the top of the picture and close together or overlapping at the bottom indicate a non-linear frame frequency sweep. If the picture is crowded on one side and spread out on the other, the line frequency sweep is not linear. Phase shift is observed when the top of the picture leans to one side, caused by the low video frequencies arriving later than the highs, that is, when the picture has large dark or bright areas.

A good way to check the frequency response of the amplifiers in the camera and receiver is to hold a piece of black tape on a white background. This background may be a two foot square piece of cardboard placed on a music stand. While watching the received picture, hold the tape vertically and slowly turn it to a horizontal position. If it fades out of the picture when it is turned horizontally, the low frequencies are not coming through and the picture will be hard to synchronize. If the tape fades out in a vertical position the high frequencies are not coming through.

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