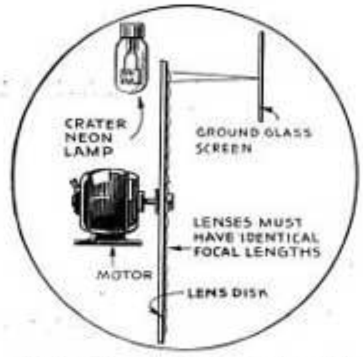


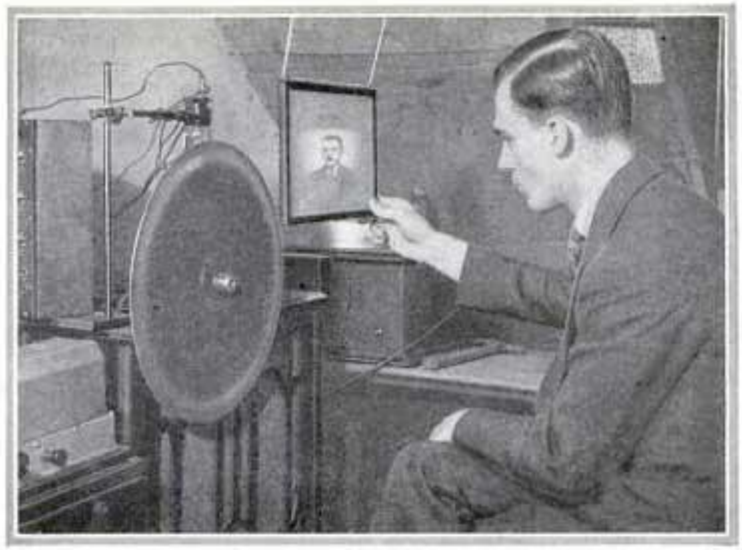


Fig. 1. The author operating a lens disk receiver. *Above:* How parts are arranged

Enlarging TELEVISION Pictures

with a LENS DISK and a CRATER NEON LAMP

By GEORGE H. WALTZ, JR.

DON MARSHALL, my neighbor, who is a television experimenter and a radio expert, led me down the stairs to his well-equipped basement workshop.

"Have you ever tried to cement glass to metal?" he asked as he snapped on the light. "It's some job—unless you know just how to do it. I've just completed my first lens scanning disk," he added, pointing to his television receiver (see Fig. 1), "and believe me I worked plenty hard over the problem of fastening the lenses in place until I hit on the idea of using a transparent cellulose household cement."

"So that's a lens scanner," I said as I examined the metal disk studded with tiny lenses (see Fig. 4). "How does it work?"

"Just like an ordinary 'peephole' disk," Don replied; "only instead of the usual square plate neon lamp, you use a special crater lamp that gives you a brilliant spot of light. Having a point light source, you can project the television images, by means of lenses, on a ground glass screen. I've gotten post card size pictures with that disk, and they were bright enough to be viewed in a room only partially darkened."

As Don spoke, I studied the crater neon lamp more closely. "Funny looking thing, isn't it? The insides look like the cylinder of a motorcycle engine. What are they, cooling fins?" I said, smiling as I pointed to the small ringlike projections on the working end of the gadget supported inside the glass tube (see Fig. 2).

"That's not as funny as you meant it to be," Don replied. "Those fins do offer a greater radiating surface and tend to keep the temperature of the cathode down. Here, I'll draw a cross section of the tube and try to explain how it works.

"A crater neon tube," Don pointed out as he made the sketch shown in Fig. 2, "consists of a cylindrical cathode or negative electrode having a small hole in its forward end. The anode, which is a positively charged plate, also has a hole and is so placed that this hole is directly in front of the hole in the cathode. As in the simple neon lamp, the slight emission of electrons starts ionization which causes the cathode to glow. To confine this glow to the front of the cathode, the sides are covered with a ceramic insulator."

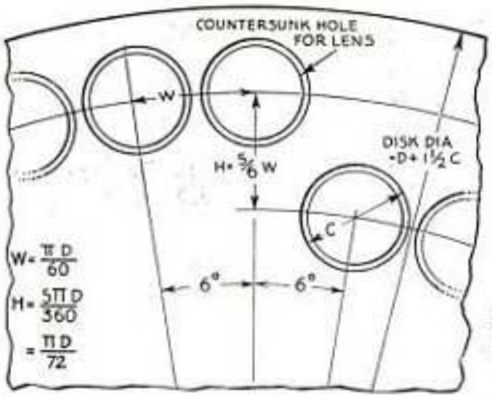
"Why is it called a crater neon lamp?" I asked.

"For the simple reason that the cathode glow takes the form of a crater arc at the mouth of the small hole in the cathode. The light from the crater," Don continued, indicating the position with the point of a pencil, "is projected through the small hole in the anode plate, through the lenses, and to the ground glass screen."

"And the fins," I suggested, remembering what Don had said, "give additional radiating surface to the cathode."

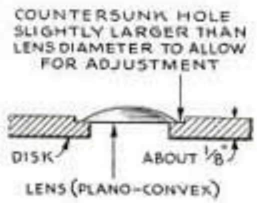
"That's right," Don agreed. "Of course,

Fig. 2. Three types of crater neon lamps and a simplified sketch showing the construction of the anode and cathode. The cathode fins offer added radiating surface



HOW TO LAY OUT A LENS DISK

Fig. 3. *At left:* Diagram of layout, where *D* is diameter of circle through the center of the extreme lens. *Below:* How the lenses fit in the countersunk holes



this sketch shows only the fundamentals of the tube. There are other refinements; but as I've explained it, that's the basis on which it operates. And by the way," he added, "the crater lamp is connected into the receiver in just the same way as an ordinary square plate neon lamp."

"It must have been some job laying out that lens disk," I said admiringly. "It was hard enough planning that simple 'peephole' disk of mine. Remember the trouble I had? It was like pulling teeth to get one that was accurate enough to use."

"You won't have that much trouble with a lens disk," Don assured me with an encouraging smile. "You see, each one of those lenses can be shifted to just the right position. It allows more leeway in drilling."

"Yes, but how do you locate the lenses in the first place?" I asked.

"You can start in either of two ways," Don explained. "You can design the disk to a specified diameter and then buy lenses to meet the requirements, or you can pick the lenses up at a bargain sale and design the disk to accommodate them."

"How do the lenses have anything to do with the size of the disk?" I asked.

"Well, naturally you can't have the lenses overlap, so the disk has to be large enough to take sixty lenses placed one beside the other in a spiral. Besides that, you've got to leave some space between the lenses to allow for fastening them in place. In other words," Don continued to explain, "the first lens at the outer end of the spiral will have to be placed on a circle whose diameter is equal to sixty times the diameter of the lenses plus sixty times the distance between adjoining lenses divided by pi (3.1416). Of course, to hold the lenses in place, you'll have to have some metal outside the extreme circle, so you'll have to add the lens diameter plus twice the width of the desired border of metal to obtain the disk diameter." (See Fig. 3.)

"I CAN see that all right. How do you find out where to place the lenses?"

"Since you know the lens diameter and desired distance between lenses, you can figure the distance between the optical centers of adjoining lenses, can't you? Well, that gives you the theoretical width of the image, and five sixths of that gives the theoretical height of the image, which is equal to the pitch of the spiral. You know what the five sixths is, don't you?" Don asked.

"Yes, that's the ratio of the height to the width of the image sent out by the transmitter," I replied. "The five sixths comes from the theoretical dimensions—seventy-two units wide and sixty units high."

"Well then, that gives you the dimensions for the spiral, so all you have to do is scribe in the spiral, draw in sixty radial lines each six degrees apart, and the intersections of the spiral and radial lines give you the locations of the lenses."

"How do you locate the lenses when you want a disk of a specified dimension?" I asked.

"First, you draw in a spiral that will fit on the size disk you want, and locate the sixty centers just as if you were designing a 'peephole' disk," Don said. "Then you figure a convenient size of lens that will allow sufficient space between lenses for fastening them in place. I prefer this method to the other because you can use a 'peephole' disk by using the holes already drilled as the center points for the lenses. That's what I did with this disk."

"What do you do after you've located the centers? Drill holes and set the lenses in?"

"Not exactly," Don said as he made a cross section sketch of the disk through one of the lenses. "First you drill one hole, slightly smaller than the diameter of the lenses; then you countersink it with a drill larger than the lens. The countersink, being oversize, allows for correction in placing each lens." (See Fig. 3.)

"How can you tell where each lens belongs? I should think it would be better to make the hole just the right size, and then when the lens was fastened in place you'd know it was right."

Fig. 4. Detail showing the crater neon lamp and the top of the spiral of tiny lenses. The disk rotates clockwise

"It can be done that way," Don agreed, "but you have to be sure that the optical and physical centers of your lenses agree. In a lens disk the optical center, not the physical center, must be in just the right position."

"What do you do," I asked, "test each lens in some sort of optical instrument and then place each accordingly?"

"NO," DON replied, "it's not as hard as all that. All you have to do is mount the disk on a shaft in a horizontal position and put a bright light source under the disk in the position that will be occupied by the crater neon lamp. Then, by figuring the size of the projected image for those conditions, sketch off on a piece of paper sixty-one lines representing the paths that will be traveled by the sixty spots of light. After that, it's a simple matter, by lining up the screen at the start so that the thirtieth spot just fits between the thirtieth and thirty-first lines, to move each lens to such a position that its spot will cover just the right area between the lines on the chart. The spots should also line up, one below the other, on a vertical line drawn down the center of the chart."

"I see," I said when the idea had penetrated. "First you line up the screen so the lens in the middle of the spiral is right, and then you revolve the disk slowly and shift each of the other lenses so that they are in the right positions."

"That's it, and when the lenses are in the right positions you carefully cement them in place. It pays to check them over and over before fastening them in place for good," Don added.

"You haven't said much about the lenses, Don. What kind of a lens do you use?"

"To start out with, of course, they all must have the same focal length. In this disk," Don pointed out, indicating one of the lenses, "I used plano-convex lenses with the plane side toward the crater lamp. It's a matter of opinion, though, which side should be placed outward."

This is the tenth of a series of articles telling of Mr. Waltz's experiences as an amateur television experimenter. The first article appeared in the July, 1931, issue.

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