Consumer electronics

Japan aims one-gun tube at U.S. color tv market

First transistorized color receiver for the consumer market uses an improved version of the Lawrence tube

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With an eye on the American market, the Yaou Electric Co. of Japan has introduced a transistor-operated color television set with an eight-inch picture, a one-gun picture tube and no convergence circuits.

Yaou has applied for patents in the United States and five other foreign countries. It has also built into its set two features necessary for sales here: space for a uhf as well as a vhf tuner, and compliance with U.S. regulations on spurious radiation.

The company says that the receiver’s picture is brighter than that of standard American makes, and that the set is almost as simple to service as black-and-white sets.

The receiver will sell next fall for $375. Quantity sales in the U.S. could allow reductions to about $275, the company says.

Why now? Several factors caused Yaou to introduce the set now. A picture tube and circuits suitable for a portable set were developed and transistors cheap enough and stable enough had become available.

Yaou uses a tube said to be an improvement of the Lawrence tube [p. 89]. Another Japanese manufacturer, the Sony Corp., has let it be known that it will begin production in three months of a Chromatron-type color tube, another one-gun device based on the Lawrence tube. Sony has not indicated whether it will make small tubes for transistorized sets or large ones for 17-inch pictures.

At present, most of Japan’s color tv sets and all of the standard 16-inch color tubes are produced by two companies, the Tokyo Shibaura Electric Co. (Toshiba) and the Matsushita Electric Industrial Co.

Toshiba, like Sony, has been working on a small Chromatron-type tube, but has disclosed no details. Meanwhile it produces about 1,000 sets a month, using a 70° deflection, shadow-mask tube.

Matsushita makes about 500 color sets monthly with a 90° tube and plans to expand its output this month.

A new challenger. Mitsubishi Shojo Kaisha, Ltd., has begun selling a six-inch, three-picture-tube set. It is making 1,000 of these sets a month, but expects sales to taper off when conventional sets are in greater supply. The three different-colored pictures are combined optically, and the viewer has the impression of peering into a knothole.

Among other manufacturers, Hitachi, Ltd., is developing a 16-inch, 90° shadow-mask tube and set, and Nippon Columbia has a new 11-inch shadow-mask picture tube with a 70° deflection angle.

Anticipating increased sales of color tv as a result of the Olympic Games in Tokyo this fall, Japan has boosted monthly production from about 500 in January to 1,266 in March and is aiming at a 5,000-a-month rate by 1965. Color picture tubes are still in short supply.

How colornet works

Yaou’s “colornet” system of reception uses a line-sequential presentation instead of the dot-sequential system used in the U.S. The
Japanese system switches color after each horizontal line. Yaou says this presentation requires 10 fewer transistors than a conventional circuit. There are 47 transistors in the Yaou set.

The color-switching signal is one-third of the horizontal scan frequency (3,250 cps). It is a three-level, step-type signal that goes to lowest level after highest level to give a continuous-color-sequence picture. Because of the low frequency, very little switching power is required, and radiation and other problems associated with switching at 3.58 megacycles are eliminated.

The picture-tube screen is composed of vertical color strips [see p. 89]. Since three lines are required for one color cycle, the picture is somewhat coarser than when using the shadow-mask tube. The use of lines limits the size of the set to about 12 inches. The company believes that for a larger set, the conventional three-gun, dot-sequential tube is more satisfactory.

A color for each line

In the Yaou set, each horizontal line activates one of the three primary phosphor colors. The color difference signal applied to the first grid of the picture tube must be changed for each line. To obtain the required signal, an offset subcarrier demodulator is used.

The frequency of the crystal oscillator in the receiver is offset from the subcarrier frequency by one-third of the horizontal scanning frequency, the crystal oscillator frequency being below that of the carrier.

The crystal oscillator is synchronized with the color-synchronizing signal in the received signal. When synchronized, the phase of the crystal oscillator will coincide with that of the synchronizing signal once every three lines. The crystal oscillator phase will then advance or lag the color sync signal by 120° for each succeeding line, so that at the end of three lines the lag will reach 360° and the two signals are again in phase.

Advancing phase. To understand the color detector, assume that the phase of the crystal oscillator advances with respect to the sub-
carrier. Then the phase of the color synchronization signal and that of the crystal oscillator will coincide at the start of the first horizontal line. At the second line, the crystal oscillator phase will lead that of the synchronization signal by 120°.

At the start of the third line, the phase difference will be 240°. At the start of the fourth line, they will again coincide.

The same phase relationship occurs when the crystal oscillator output is phase-modulated with a suitable sawtooth wave whose repetition frequencies obtain a signal whose phase varies in steps. Output phase advances 120° during the interval between horizontal lines. These axes are normally used for color signal demodulation for one-gun picture tubes. In this line-sequential receiver, it is thus possible to switch primary colors at the end of each horizontal line.

Because the crystal oscillator is highly stable, it is not feasible to phase-modulate it. Phase modulation is done in a buffer amplifier stage by varying the capacitance of a varactor diode.

This type of receiver cannot use a conventional automatic phase control circuit, to control the phase of the offset subcarrier oscillator. A three-interval control circuit was developed to synchronize the oscillator at every third line. To obtain the three-level step signal for the color-switching grids, a simple storage counter circuit is used, driven by the horizontal return pulse.

Magnetics minimized. The use of vertical color strips in the picture tube minimizes the defocusing
Purer and Cheaper

Like the Chromatron, the color tv tube made by the Kobe Kogyo Corp. is based on the Lawrence one-gun system. But Kobe has introduced some refinements to increase color purity and reduce production costs.

Both tubes use a single electron beam to activate, in sequence, strips of different-colored phosphors on a color screen. But the Chromatron depends on a color-switching grid to focus the beam onto a particular color strip. The grid, whose potential is lower than the phosphor screen, acts as a convergent lens. Since the crossover point is between the grid and the screen, some of the beam's electrons may strike adjacent color strips, degrading color purity.

Kobe uses an adjustable focusing grid of vertical wires directly behind a vertical-wire color-switching grid. The focusing grid acts as a divergent lens; in combination with the color-switching grid, it necks down the beam to land precisely on one color strip. The color strips are also vertical.

The Chromatron also is expensive to produce because light shining through a uniformly spaced optical mask cannot be used to bake the phosphors on the screen. To ensure that the beam's landing positions and the screen-line positions coincide, the Chromatron's beam itself must be used in fabrication. This requires evacuation of the tube each time one of the three colors is deposited. Excess phosphor must be washed off after each baking operation.

In the Kobe tube, however, the focusing grid prevents the electron beam from hitting more than one color phosphor. It also guides the beam to the right phosphors at the edges of the screen, where the beam bends.

Therefore, light can be used for baking the phosphors. Kobe makes the screen on an auxiliary glass plate, using masked light. Since the entire screen is produced outside the tube, manufacturing costs are sharply reduced. The screen, 7½ inches across, is installed in a 9-inch bulb.

But Kobe holds out little hope for making large-screen color tubes with its new process. It notes that large color-switching grids tend to be microphonic and produce interference, and that the picture becomes coarser as size increases.

effect of variations in the earth's magnetic field, Kobe Kogyo says. This helps make the set portable, since it need not be readjusted when it is moved. The earth's field tends to expand the vertical cross-section of the electron beam. An expanded beam can be tolerated by vertical strips, but might overlap horizontal color strips.