The Use of the Charactron with ERA 1103

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THE Charactron[1,2] tube was invented by Joseph T. McNaney and developed by Convair since 1950. The main purpose for installing a Charactron on Convair's ERA *1103* computer was for real time simulation. However, other valuable uses for the Charactron on the *1103* have been found.

Physical Characteristics

This Charactron, with its cathode-ray display tube, type *C7A*, can display alphanumeric characters at a rate of 10,000 characters per second. The equipment which includes a cathode-ray tube with 7-inch-diameter screen can be used with either one of two cameras, easily interchangeable in a matter of a few minutes. Fig. 1 shows the Charactron with a Beattie camera using 35-millimeter film in a magazine. It is possible to remove the exposed film without removing or exposing the unexposed film. Fig. 2 shows the type of construction of the main body of the equipment. Fig. 3 shows the tube mounted vertically and viewed by the camera using a mirror mounted at 45 degrees to the camera lens and to the tube screen. The screen may be viewed through a filter during operation without impairing the results. The four drawers contain the power supplies.

The second camera, the Kenyon camera shown in Fig. 4, is a camera and photo laboratory combined. All operations, exposing, developing, fixing, and projecting, are performed in parallel. While the computer is calculating and displaying one page of answers, the camera is fixing and developing the previous pages. This process takes about 2 seconds, and if the calculations take more than 2 seconds a page, then the fixing and developing does not hold up the process at all. The finished film is extruded and can immediately be viewed on a film reader such as a Recordak. Editing can be done at this point to determine which frames are to be enlarged and printed. Fig. 5 shows the Charactron, with Kenyon camera attached, connected to the ERA *1103*. A test generator is also included in this unit which enables alignment adjustments to be made without the use of the computer.

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A 6-bit code is used to select the proper alphanumerical character from a matrix in the Charactron tube. These characters are in a 6-by-6-array. Three bits are used for horizontal selection and 3 for vertical. A 20-bit code is used to position the characters on the face of the tube. Ten of these are used for horizontal selection and ten for vertical. Thus, a total of 26 bits defines the alphanumerical character and its position on the face of the tube. The *IOB* buffer on the *1103* has a capacity of 36 bits. The characters we chose to display are the numbers 0 through 9 and the alphabet not including the letters O or I. (The numbers zero and one do double duty.) A decimal point and a minus sign complete the list of characters.

Applications

As an aid in debugging, it can display the contents of memory, Fig. 6. Another common technique used in debugging a floating point program is a trace or automonitor, Fig. 7. This is an example of a concurrent trace giving the address, the command, and the result of each command. The trace operates at a rate of better than ten lines per second. The Charactron can also be used to edit input data. In this case, while the computer is calculating the results, the input data are plotted. Cases that show up with points obviously

Fig. 1

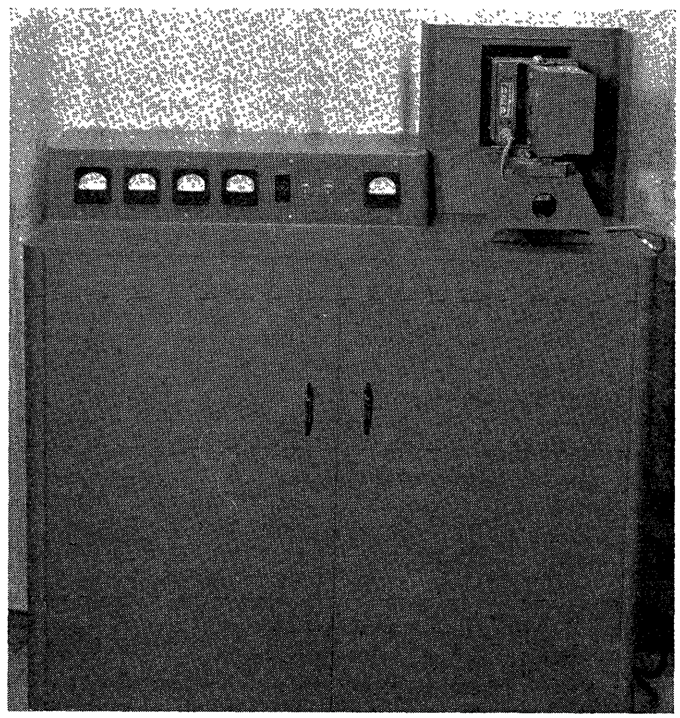
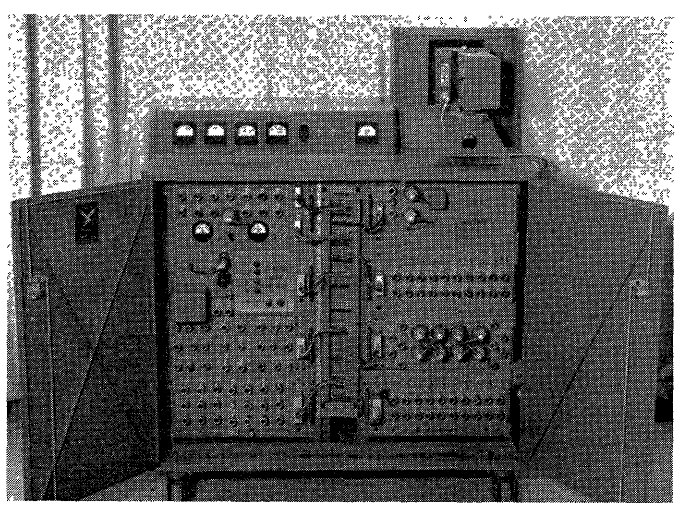


Fig. 2



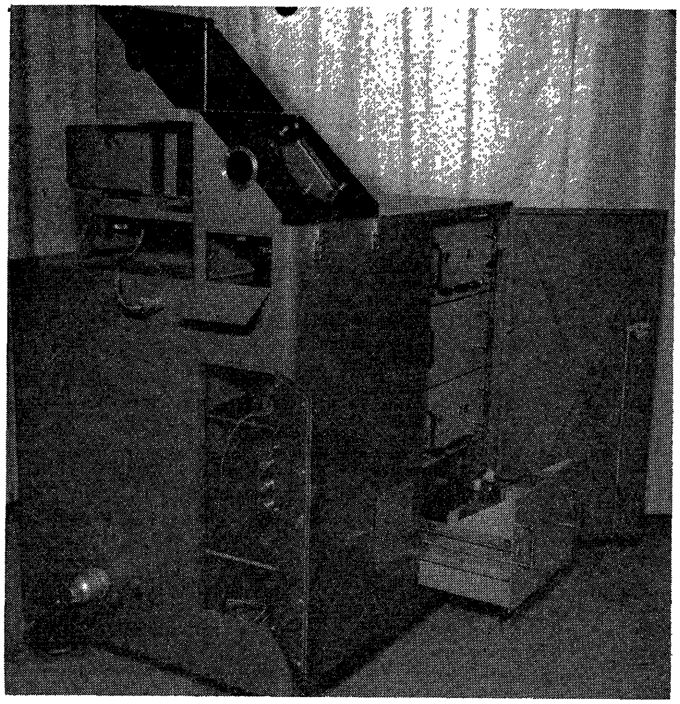


Fig. 3

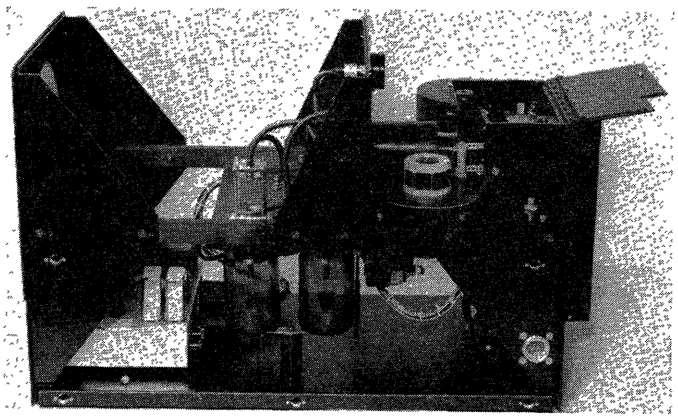


Fig. 4

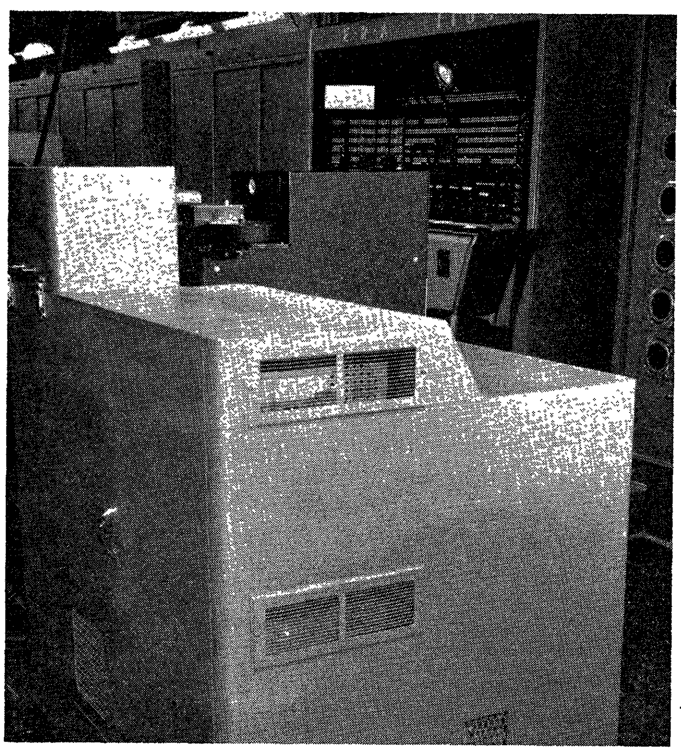


Fig. 5

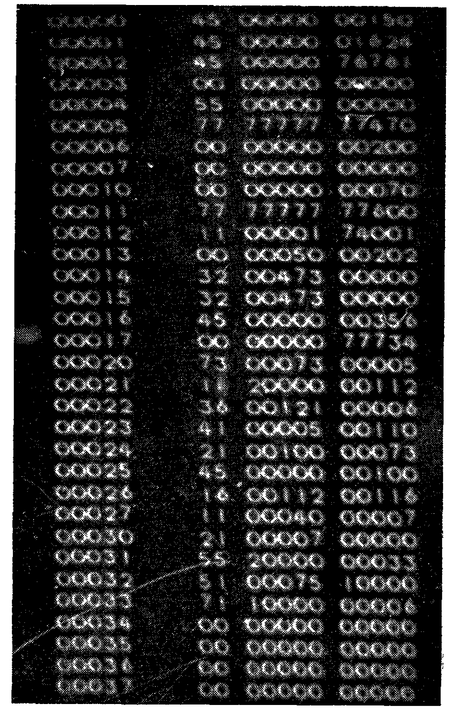


Fig. 6

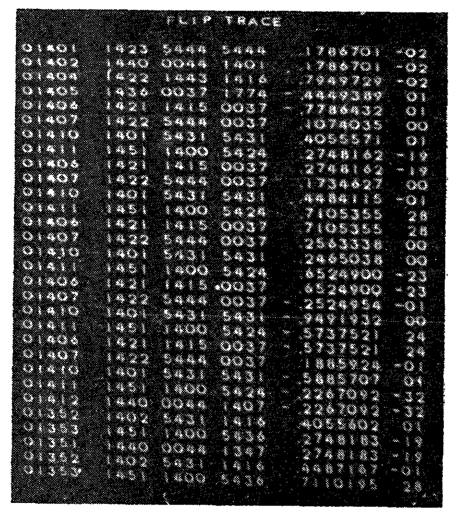


Fig. 7

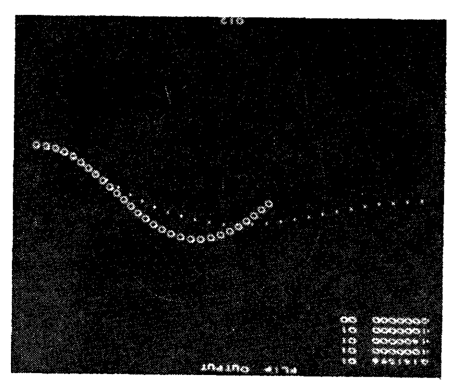


Fig. 8

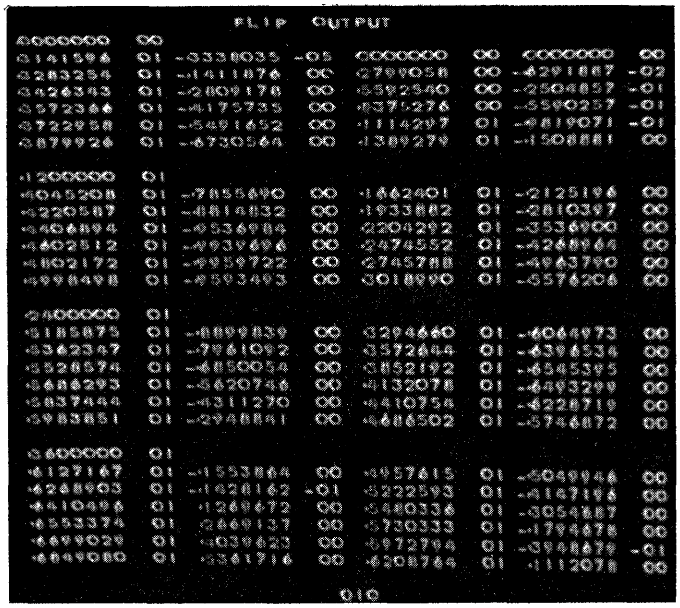


Fig. 9

out of line can be corrected and rerun.

Any of the characters can be used to plot graphs. Multiple graphs can be plotted on the same frame, Fig. 8. The input parameters can also be displayed on the same frame. These graphs represent the solution to two simultaneous differential equations. A table of the values plotted could be separate, Fig. 9.

A question often asked is, "How many characters can be displayed on one horizontal line?" With this installation 50 characters can be displayed horizontally. A Charactron with a 7-inch tube has been built which can display 100 characters per line with very fine definition and sufficient intensity for photographing at a rate better than 20,000 characters per second. It should be noted that the format is not limited with a Charactron. Answers can be printed in vertical columns. Each column, for example, could represent all variables at one time interval of integration.

Early this year, Convair expects to tie together a very large analogue computer with the ERA *1103*. Between the two will be the conversion equipment—analogue to digital and digital to analogue. This setup is for a real time simulation problem. Of course, the output plotters on the analogue will be used, but the output of calculation from the ERA *1103* are also needed. This output must be very fast because of the real time simulation. Since the magnetic tapes have inertia start and stop times which make them too slow, and the drum may not be large enough to store all the answers before the problem is finished, it is felt that the Charactron with its extremely high speed may answer this challenge.

References

1. THE CHARACTRON, **Joseph T. McNaney.** *Proceedings*, Institute of Radio Engineers, New York, N. Y. March 1952.

2. THE TYPE C19K CHARACTRON TUBE AND ITS APPLICATION TO AIR SURVEILLANCE SYSTEMS, **Joseph T. McNaney.** *Ibid.*, March 1955.

A New Tape Handler for Computer Applications

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THE rapid advances made in digital computer design within the past few years have, unfortunately, not been accompanied by a corresponding advance in the design of input-output equipment of comparable performance. The increasing scope of computer applications has further intensified the limitations imposed by available input-output equipment.

Magnetic recording tape, as a storage medium for digital information, is assuming a role of ever-increasing importance, and is now unsurpassed as an input-output medium for the rapid transfer of information. In addition, magnetic tape equipment has become an important element in automatic data-reduction systems.

Many types of magnetic tape handlers have been designed in the past, the great majority to meet a more or less specific application. As a result, extensive modification has often been necessary to adapt these units for other applications. In recent years, more versatile designs have been evolved to meet the increasingly diversified requirements for digital recording equipment. Although the new equipments represent a step in the right direction, these pioneering efforts were at times overly complex, and consequently caused a sacrifice both of reliability and economy.

For many years Ampex has concurrently pioneered in the recording of analogue signals on magnetic tape. Many of the problems in this field are very similar in nature, if not in degree, to those in the computer field. In addition to their useful analogue function, standard instrumentation recorders have many times been modified for application to computer systems; this approach is obviously not the answer to the increasingly stringent and refined requirements of the computer industry.

Believing that its extensive past experience could be applied to solve many of the increasingly difficult problems in the application of input-output equipment, Ampex Corporation initiated a program to develop a magnetic tape transport for computer use, providing versatility and reliability equal to that of the instrumentation recorder. Briefly, the most desired requirements of a tape transport for computer use are as follows:

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