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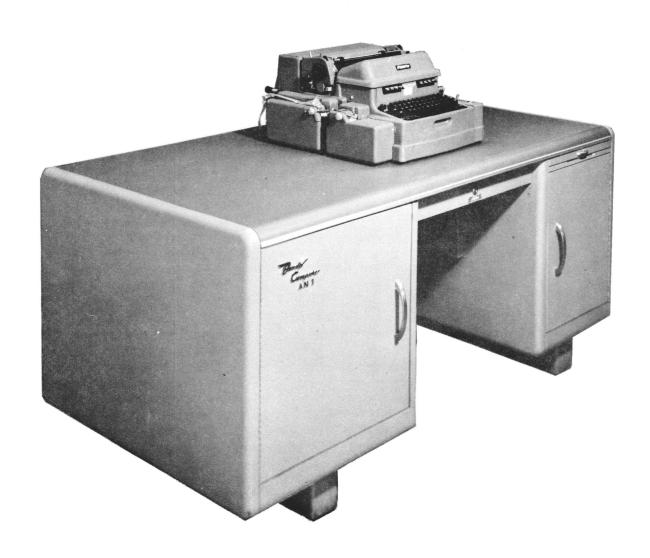
UNIVERSAL CODE

**ACCESSORY AN-1** 

# UNIVERSAL CODE ACCESSORY AN-1 FOR THE BENDIX G-15 COMPUTER

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AN-1 UNIVERSAL CODE ACCESSORY WITH 35-4 FLEXOWRITER

#### INTRODUCTION

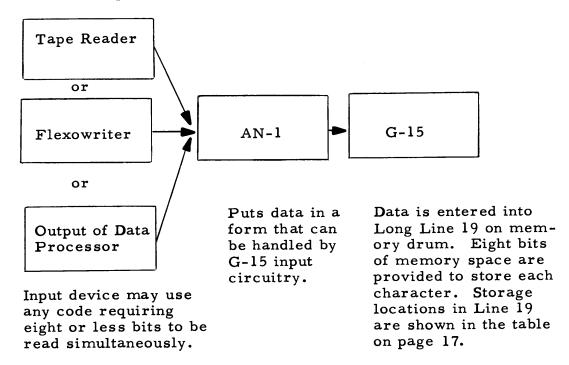
The Universal Code Accessory AN-1 for the G-15 Computer provides compatibility between the computer and external, data-processing equipment and also prepares tape for machine tool control.

For data-processing, alphanumeric or numeric input in any code of eight bits or less per character is accepted and then entered directly into the computer's memory.

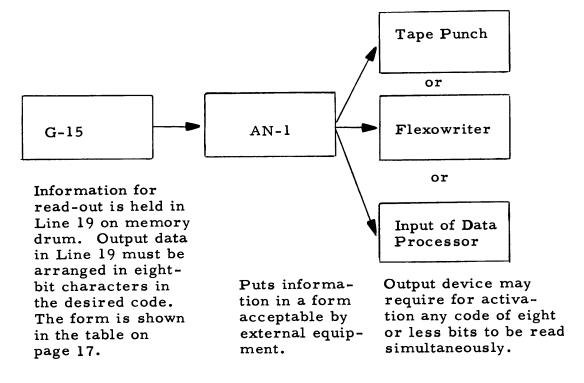
To use the accessory, it is necessary to set the controls on the AN-1 according to the input requirements, to program the computer for use of the accessory, and, before output, to set the AN-1 controls according to the output requirements. The switch settings on the AN-1 for input and output may be identical.

The directions and specifications for the normal use of the AN-1 are described in the section "Operating Instructions". The section "Functional Description" indicates other ways of using the accessory. This section contains a functional description of the AN-1 and control information, so that the programmer may adapt operation to specific requirements.

The AN-1 permits almost any code, alphanumeric or numeric, to be used as input to the G-15 Computer.



After the information is processed within the computer, the AN-1 permits the results to be read out in numeric or alphanumeric form to external data-handling equipment.



#### OPERATING INSTRUCTIONS

## To Set the AN-1 for Output

#### STOP and RELOAD Switches

The control panel of the AN-l contains three sets of toggle switches, a rotary switch and four separate independent switches. For output, only the settings of the RELOAD, STOP, BLANK FRAME (BLNK FRAME), 20-100 and the CONTROL TAPE toggle switches are important; the other switches may be in any configuration.

Output from the computer, and also from the AN-1, consists of binary-coded information and control signals. One of two control signals is generated in the computer after each group of four words has been read out of Line 19. The control signals are called RELOAD and STOP.

RELOAD\* is the control signal normally generated by the G-15 at the end of each four words of output. STOP is a control signal generated by the G-15 in place of the RELOAD signal when Line 19 has been emptied of information.

In the output from the AN-1, the RELOAD and STOP signals take the form of an arbitrary eight-bit code. The bits of the code are specified by the RELOAD and STOP toggle switches, whenever a STOP or RELOAD signal is generated by the G-15. The STOP and RELOAD toggle switches should be set to any desired code configurations irrespective of the G-15 code configuration (see illustration on page 4.)

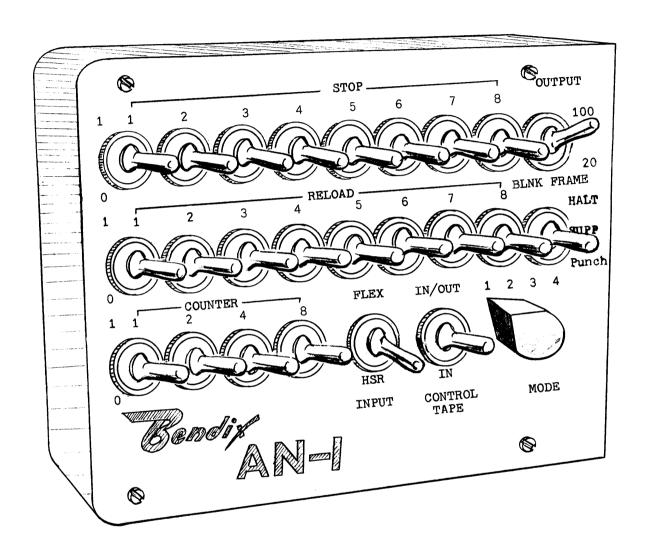
#### **OUTPUT** Switch

The upper position is for the Bendix High Speed Punch, Model HSP-8 (100 characters per second). The lower position is for the Friden 8-channel punch (20 characters per second).

Blank Frame (BLNK FRAME) Switch

In the PUNCH position, punching proceeds until there is a gap in output information, at which time blank tape is fed.

\*A RELOAD code is required for input for notifying the G-15 to transfer Line 23 to Line 19. It is, therefore, required on output if the tape is to be read back into the computer.



AN-1 CONTROL PANEL

In the Suppress (SUPP.) position, all blank frames are suppressed, that is, the information that otherwise would be punched in the frame following a blank frame is punched in the blank frame.

When using the 20 character per second punch (OUTPUT switch to "20"), the BLNK FRAME Switch in the STOP position will cause the punch to halt if there is no information punched in any frame.

#### CONTROL TAPE Switch

The CONTROL TAPE switch has three settings: Neutral (middle position), IN/OUT, and OUT. When set in either of the latter two settings, the operation of the STOP and RELOAD switches are inhibited on output in that no character is punched for STOP and RELOAD, not even a blank code. The STOP and RELOAD switches can then be in any configuration.

The CONTROL TAPE switch is used for punching tape in the format required for Bendix Machine Tool Control Systems. When used for this purpose, tape of a different format from that being punched will be read through the AN-1, requiring the RELOAD and STOP switches to have a certain configuration. Since RELOAD and STOP must not be punched on output, the CONTROL TAPE switch obviates the necessity for resetting of the switches to all OFF between input and output.

#### To Set the AN-1 for Normal Input

Normal input to the computer (CONTROL TAPE Switch in Neutral) via the AN-1 occurs in one of three forms. The proper switch settings for each of the three is described below.

## Mode 1

To use as input to the AN-1 a tape that has been punched by the computer via the AN-1, or tape with a coding system including assignments for both RELOAD and STOP:

Put the Selector switch in Mode 1.

Set the STOP and RELOAD toggle switches to the configurations determined for them.

(The setting of the COUNTER toggle switches is immaterial.)

#### Mode 2

To use as input to the AN-1 an externally prepared tape, a Flexowriter, or any other data-processing device having a control code signifying STOP at intervals equal to or less than 378 characters:

Put the Selector switch in Mode 2.

Set the first eight toggle switches to the same configuration as that of the control code signifying STOP.

Set the COUNTER toggle switches labeled "8", "4", and "2" to the upper position. Set the COUNTER toggle switch labeled "1" to the lower position.

(The setting of RELOAD toggle switches is immaterial.)

#### Mode 3

To use as input to the AN-1 an externally prepared tape or data processing device that does not provide STOP codes:

Set the Selector switch at Mode 3.

Set the COUNTER toggle switches labeled "8", "4", and "2" to the upper position. Set the COUNTER toggle switch labeled "1" to the lower position.

(The setting of STOP and RELOAD toggle switches is immaterial.)

# To Set the AN-1 for Input of Control Tape Data

The AN-1 permits the G-15 Computer to punch and read tapes that are used with Bendix three-dimensional Machine Tool Control Units. Information from an engineering specification sheet or process card is typed on a Flexowriter, and a six-channel tape is prepared in standard Flexowriter code. The Flexowriter tape is then read into the AN-1 via the tape reader. The AN-1 transmits the information to the G-15. The computer, by means of a special program, makes the necessary computations and causes the AN-1 to punch a control tape. The control tape may then be inserted in the machine tool control unit, which will direct the machine tool in fulfilling the original engineering specifications.

Control tape is characterized by a series of blocks of arbitrary length. The end of each block is marked by any character with a bit in the sixth level on the tape.

To read back into the computer tapes that are punched for use on machine tool control units:

Set the CONTROL TAPE switch to the IN/OUT position.

Set the Selector switch to Mode 3.

## To Program the G-15 for Use with the AN-1

## Mode 1 or 2 and CONTROL TAPE Neutral

If the Selector switch is at Mode 1 or Mode 2 and the CONTROL TAPE switch is in the neutral position, the following steps must be programmed:

- 1. Execute the command to read information from the AN-1.
- 2. After the STOP code has stopped input into Line 19 (before or when Line 19 is full), transfer the contents of Line 19 to some other drum channel.
- 3. Repeat Steps 1 and 2 until sufficient data is in the computer.
- 4. Change the numerical pattern of the input data into the binary code of the G-15 by means of a subroutine.
- 5. Compute with the data.
- 6. Upon completion of computation, reconvert the information that is to be read out to the external code by means of a subroutine.
- 7. Transfer information to be read out to Line 19.
- 8. Read out the contents of Line 19 into the AN-1.
- 9. Repeat Steps 7 and 8 until all desired information has been read out.

## Mode 3 and CONTROL TAPE Neutral

If the Selector switch is at Mode 3 and the CONTROL TAPE switch is in the neutral position, the following steps must be programmed:

- 1. Execute a set of commands to read information from the AN-1 into Line 19 twenty-seven times. (This set of commands will fill Line 19 with input information.)
- 2. Transfer the contents of Line 19 to some other drum channel.
- 3. Proceed as in Steps 3 through 9, listed under "To Program the G-15 for Use with the AN-1" on page 7.

## Mode 1 or 2 and CONTROL TAPE OUT

If the Selector switch is in Mode 1 or 2 and the CONTROL TAPE switch is in the OUT position, the following operations must be programmed:

- 1. Information representing the end points of a machining operation are punched off-line on a tape-preparation device. The nature of the specific device determines the coding used, hence, determines the choice of input mode (1, 2, 3).
- 2. A command will be executed which will commence input of information punched on the above-described tape.
- 3. After the stop code halts this input, the information will be in Line 19 and may be used in computations leading to preparation of information to be punched on a control tape.
- 4. The series of 8-bit characters to be so punched will be placed in Line 19. Each such character will have at least one binary "one" in it, while character locations in Line 19 not having information will be cleared to zero. The last character punched, and it alone, will have a bit in the sixth position. (Non-zero characters in Line 19 need not be contiguous.)
- 5. Execute the output command which will result in only those characters placed in Line 19 being punched out.
- 6. Repeat Steps 2 through 5 until the tape has been completed.

# Mode 3 and CONTROL TAPE OUT

If the Selector switch is in Mode 3, and the CONTROL TAPE switch is in the OUT position, the operation is as follows:

1. Tape will have been prepared as in Step 1 above.

- 2. A command will be executed which will result in 14 or less characters (depending on the setting of the COUNTER switches) being read into Line 23 and Line 19, after which the input will be halted.
- 3. Step 2 is repeated until all information regarding one machining end-point is in the computer.
- 4. Information read in Steps 2 and 3 will be used in computations as in Step 3 of the previous section, "Mode 1 or 2 and CONTROL TAPE OUT.
- 5. Steps 4 and 5 of the same section will then be executed.

# Mode 3 and CONTROL TAPE IN/OUT

If the Selector switch is in Mode 3, and the CONTROL TAPE switch is in the IN/OUT position, the operation is as follows:

- 1. Control tape will have previously been prepared.
- 2. Line 23 must be cleared.
- 3. A command will be executed which will result in the number of characters set on the COUNTER switches (presumably 14) to be read into Line 23 and Line 19, or read until an end of block code is encountered on the tape, whichever occurs first.
- 4. At the completion of input according to Step 3, the program will test to see if the last character read into Line 23 (word 0, bits 1 through 8) has an end of block marker in it (bit 6).
- 5. If such is not the case, Steps 2 through 4 are repeated.
- 6. When the end of block marker occurs, the program will reposition the last characters read, those in Line 23, to correspond to the requirements of the programmer, since, in general, less than 14 characters will have been read the last time.
- 7. Computations then proceed in any desired manner, presumably to check the data recorded on the control tape.
- 8. If new control tape is to be punched, Steps 4 and 5 of the section, "Mode 1 or 2, CONTROL TAPE OUT are repeated.

#### INPUT-OUTPUT DEVICES

There are a variety of devices which can be used in conjunction with the AN-1 for supplying alphanumeric information to the G-15 and accepting alphanumeric information from the G-15. Some of these are standard units available from Bendix while others are special, depending upon the customer application.

# High-Speed Punch (HSP-8) and Reader (HSR-8) Units

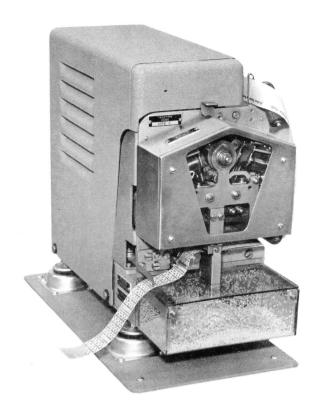
Standard punch and reader accessories are available from Bendix Computer Division as independent units. The model HSP-8 transistorized punch permits one-inch paper tape, with 8 or fewer channels, to be punched out of the AN-1 at a rate of 100 characters per second. The model HSR-8 reader permits one-inch tape, with 8 or fewer channels, to be read into the AN-1 at a rate of 60 characters per second.

## Flexowriter (Model 35-4)

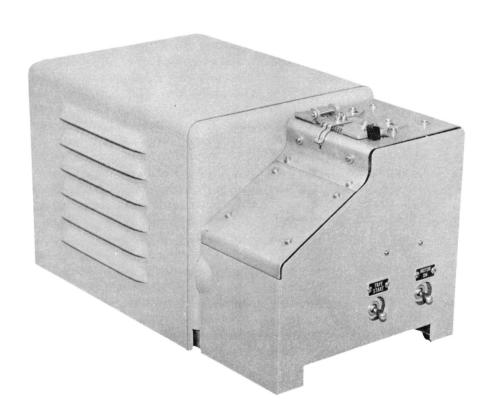
A Flexowriter unit, consisting of an electric typewriter, a paper tape reader, and a paper tape punch all operating at the rate of 10 characters per second, is available for direct connection to the AN-1. The unit is capable of off-line, independent operation for preparing tape for input to the G-15 through the AN-1 or directly through the G-15 photo-electric, paper tape reader. The unit also accepts tape produced by the G-15 through the AN-1 or through the G-15 standard punch.

When directly connected to the AN-1, the Flexowriter is capable of supplying information to the AN-1 directly from the keyboard with manual typing, or from the paper tape reader on the Flexowriter. The AN-1 will also supply information to the typing mechanism of the Flexowriter, which in turn can be punched on tape by means of the Flexowriter punch, provided that the PUNCH ON switch on the Flexowriter is depressed. If input is required from the Flexowriter, the INPUT switch on the AN-1 must be set in the FLEX position.

An HSP, HSR and a Flexowriter may be connected simultaneously. The setting of the INPUT switch selects the unit to be used for input, as previously indicated. Selection of the unit for output is accomplished by program control in a manner to be described.



HIGH-SPEED PUNCH (HSP-8)



HIGH-SPEED READER (HSR-8)

## Other Punches and Readers

It is possible to connect any arbitrary paper tape punch and/or paper tape reader to the AN-1 provided that the signals between the two are compatible and the connections on the plugs of the reader and punch match those of the AN-1. Friden Systems Division manufactures motorized paper tape punches and motorized paper tape readers that are almost directly compatible with the AN-1.

## Arbitrary External Data-Handling Devices

A paper tape reader and high-speed paper tape punch or a Flexo-writer are standard equipment with Accessory AN-1. However any type of equipment, which satisfies the following criteria may be used for input-output.

- The rate of input to the AN-1 must not exceed 200 characters per second, if the Selector switch is at Mode 1 or Mode 2. Rate of input must not exceed either 200 or 14 characters per second if the Selector switch is at Mode 3, depending on conditions listed below.
- 2. If the Selector switch is at Mode 1 or Mode 2, the input device must be able to start and stop under control of an "actuate" signal from the computer. If the Selector switch is at Mode 3, and the input device is also able to operate under control of an actuate signal from the computer, rate of input must not exceed 200 characters per second. If the Selector switch is at Mode 3, and the input device cannot start and stop itself under computer control, input must not exceed 14 characters per second.
- 3. The output device must supply a return signal which informs the AN-1 that the character has been accepted and another can be supplied. (In the high-speed punch, this is in the form of magnetic pick-ups).
- 4. Input-output signal levels for the data-handling equipment must be 0 volts and -20 volts.

#### FUNCTIONAL DESCRIPTION

The operating specifications that have been stated are not the only ones permissible. Other switch settings would specify other operating conditions. A description of the equipment and its control is presented below to clarify use of the switches.

## Input to the Computer

Alphanumeric input from tape is started by the execution of the G-15 command L<sub>2</sub> N 1 12 31. The external data is entered into the AN-1 in any code which has 8 or fewer bits per character, that is, with 8 or fewer parallel channels. This code would probably be that of some external data-processing equipment. If there are fewer than eight bits per character, operation will occur as if an 8-bit code were being used with zeros in the unused bit positions. The eight-bit characters are split into two four-bit groups, one preceding the other. Each four-bit group will be entered into Short Line 23 on the G-15 memory drum. Fourteen eight-bit characters will be entered into Line 23 in this manner. The bit positions for the 14 characters in Line 23 would be shown by the table (page 17) if word positions 03,02,01 and 00 of the short line were substituted in the table for word-positions 107, 106, 105, and 104, respectively.

After a group of 14 or fewer characters have been entered into Line 23, a control signal, which is called RELOAD, is supplied to the computer by the AN-1. This signal causes the contents of Short Line 23 to be transferred to word positions 00, 01, 02, and 03 of Long Line 19.

Another group of 14 or fewer characters enters Line 23; another RELOAD signal is supplied to the computer; the second group of characters is then transferred to word positions 00, 01, 02, and 03 of Long Line 19 and the first group is transferred from word positions 00, 01, 02, and 03 to word positions 04, 05, 06, and 07. The process continues; new input data enters Line 19 in word positions 00, 01, 02, and 03, and all earlier-entered data in the line shifts to the word positions numbered four greater.

The process is halted when the AN-1 supplies a STOP signal to the computer. The STOP signal must be provided either when, or before, all 108 word positions of Line 19 are filled with input information. If the STOP signal occurs after twenty-seven groups of 14, or fewer, characters have been entered into the computer, the first

group of input characters will be found in the word numbers shown in the table. When the STOP signal occurs, an instruction may be programmed to transfer the contents of Line 19 to some other channel on the drum, and the input process may be repeated.

#### Mode 1

The RELOAD and STOP signals may be obtained in more than one manner. If the Selector switch on the AN-1 is at "Mode 1", then these signals must be supplied by input characters as specific RELOAD or STOP codes; whenever the input code is at a configuration corresponding to the setting of the RELOAD toggle switches on the AN-1, a RELOAD signal will be supplied to the computer; whenever the input code is at a configuration corresponding to the setting of the STOP toggle switches on the AN-1, a STOP code will be supplied to the computer.

There are eight RELOAD and eight STOP toggle switches. In each case, the eight toggle switches are set to correspond to the desired code: A toggle switch pushed up signifies a one; a toggle switch pushed down signifies a zero; a toggle switch in the neutral or center position specifies that the bit may be either a one or a zero.

#### Mode 2

In Mode 2, the STOP signal is still supplied by an input code configuration as in Mode 1, but the RELOAD signal is internally generated in the AN-1. Mode 2, consequently, permits a wider variety of input media than does Mode 1. The RELOAD signal is sent to the computer at fixed intervals determined by the setting of the COUNTER toggle switches; the number of characters between RELOAD signals is equal to the sum of the weights of the switches in the upper position. Fourteen is the maximum permissible number of characters between RELOAD signals.

Since it is the STOP signal which permits the transfer of the contents of Line 19 to some other channel of the drum, a STOP code must occur at the AN-1 input either when or before Line 19 is full. Therefore, the number of characters between STOP codes must be limited to the number which will fill Line 19. This number is 378 characters.

## Mode 3

Mode 3 is designed for use when neither RELOAD nor STOP codes are available from the input device. In Mode 3, STOP signals are generated in the AN-1 at the same intervals at which RELOAD signals are generated during Mode 2. Since a STOP signal, as well as a RELOAD, transfers the contents of Line 23 to Line 19, RELOAD signals become unnecessary. Again, the interval between STOP signals is determined by the setting of the COUNTER toggle switches, and in Mode 3 the maximum permissible number of characters between STOP signals is fourteen.

## Flexowriter Input

The INPUT switch must be in the FLEX position. Alphanumeric input from the Flexowriter keyboard (manual input) is started by the command:

When set for manual input, it is not possible for the Flexowriter tape reader to operate. If alphanumeric input from the Flexowriter reader is desired, the command:

must be obeyed. The INPUT switch must be in the FLEX position.

## Alphanumeric Input

Alphanumeric input from the HSR-8 reader or any other compatible reader is initiated by the command:

The INPUT switch must be in the HSR position.

## Standard Input

Tape punched in the standard G-15 format (four bits per character) may be read through the AN-1 by the execution of the command:

This is similar to input through the standard G-15 photo-reader.

# Output from the Computer

The output from the computer into the AN-1 may be in standard form (that is, four bits per character) or in the alphanumeric form for which the AN-1 was primarily designed. The command for standard output is:

Standard output through the AN-1 is similar to standard output without the AN-1.

The command for alphanumeric output to tape is:

The command for output to the Flexowriter is:

<sup>\*</sup>These commands must not be executed during word-times u4 through u7.

For alphanumeric output, Line 19 must be loaded with information to be read out in the form shown in the table on page 17. The command for alphanumeric output causes information transfer four bits at a time, first from Line 19 into Line 23 and then from Line 23 into the AN-1. Accessory AN-1 combines pairs of four-bit groups into eight-bit characters; the eight bits of each character appear in parallel at the AN-1 output.

The computer generates a RELOAD signal at the end of each four words of output. This signal will enter the AN-1 after a group of 14 characters, and the AN-1 will emit a RELOAD character. The RELOAD character that appears at the output of the AN-1 is in the form of an arbitrary eight-bit code; the bits are determined by the position of RELOAD toggle switches one through zero.

Information is transferred from Line 19 to Line 23 in four-word groups, beginning with words 104, 105, 106, and 107. As information is transferred from Line 19 to Line 23, it is removed from Line 19. When Line 19 is empty of information, a STOP signal is generated in place of the RELOAD signal. The code configuration representing STOP, provided at the AN-1 output, may be selected in a similar manner to the selection of the RELOAD code, that is, by the setting of the STOP toggle switches.

The table "Storage Locations in Line 19" shows the contents of words 107, 106, 105, and 104. Each lower-numbered group of four words in Line 19 may hold input-output information in similar form. Each group of four words holds 14 characters.

The second group of characters would be held in the same bit positions as the first group, but in word numbers 103, 102, 101, and 100. Similarly, 25 additional groups of 14 characters may be held in word numbers 00 to 99.

Word Number	Bit Positions	Character
107	22-29	1
107	14-21	2
107	6-13	3
107 106	1-5 27-29	4
106	19-26	5
106	11-18	6
106	3-10	7
106 105	1-2 24-29	8
105	16-23	9
105	8-15	10
105 104	1 - 7 29	11
104	21-28	12
104	13-20	13
104	5-12	14
104	1-4	Not used to hold input information.

STORAGE LOCATIONS IN LINE 19

## Physical Details

The AN-1 is housed in a standard secretarial desk, 29 inches high, 60 inches wide and 31 inches deep. The logic panel is mounted on slides in the pedestal of the desk. The High Speed Punch (HSP-8) and High Speed Reader (HSR-8) are located in the typewriter compartment of the desk.

The AN-1 connects to the receptacle at the back of the G-15 Computer labeled "PUNCHED TAPE".

Power requirements are 115 volts, 60 cycles. Power consumption is 1.17 kva. Power must be obtained from a source capable of supplying 15 amperes of current. (The service outlets in the back of the computer must not be used for this purpose.) The AN-1 is connected to the power source by a 15-foot cable.

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