HIGH-FLYING TELETYPE

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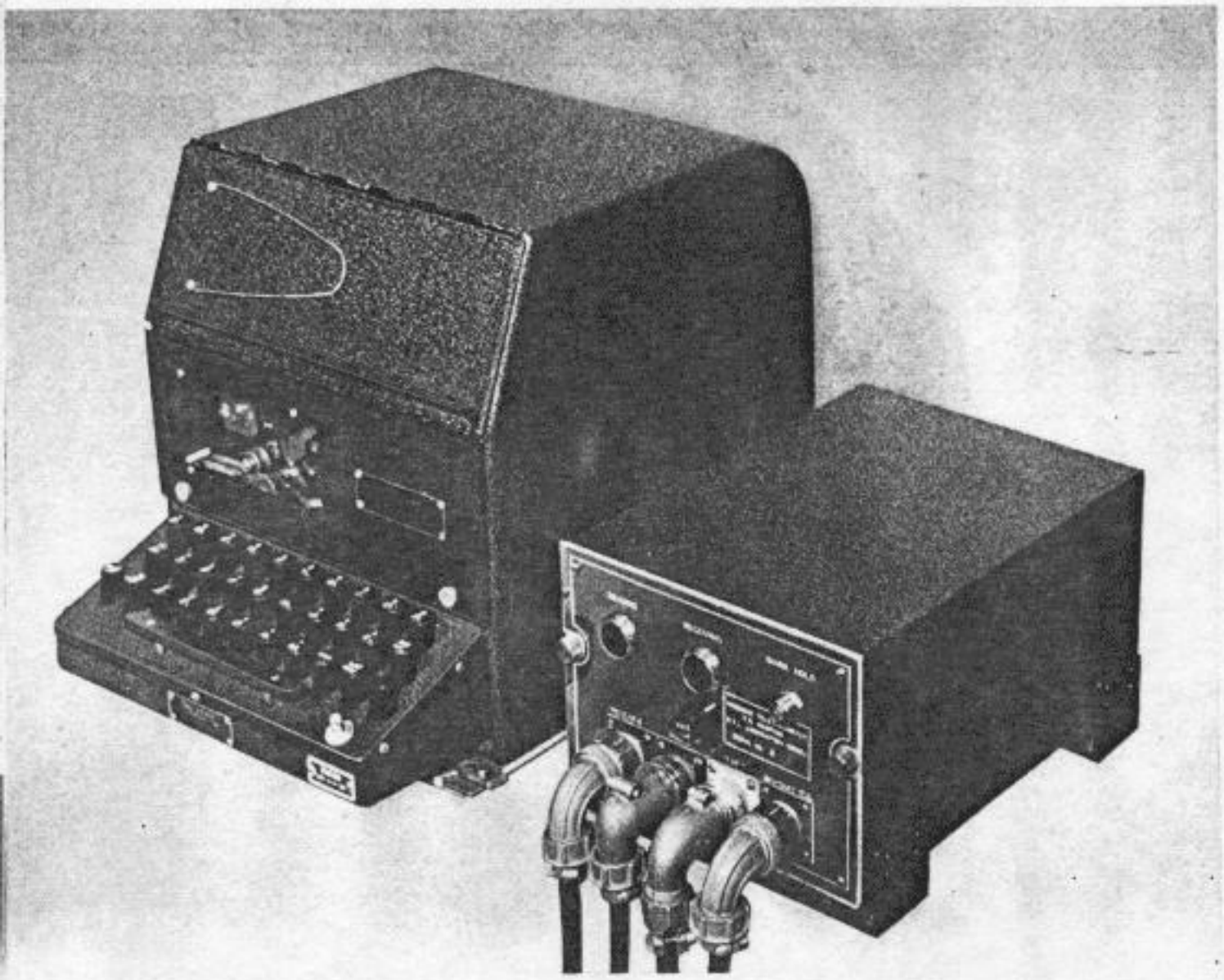
Telegraph
Development

Another milestone in the history of radio communications has been reached, for it is now practicable to send teletype messages to and from airplanes in flight. The equipment which makes this possible is the new lightweight Model 31 teletype printer, developed by the Teletype Corporation, and an associated converter-control unit, developed by the Laboratories.

Smaller and lighter than a standard typewriter, this printer uses the regular teletype keyboard and signaling code. The converter-control unit at a station which is sending changes this code into frequency-shift signals in the audio-frequency range for transmission over existing radio-telephone equipment. At a station which is receiving, the converter-control unit changes these frequency shift signals into electrical impulses for operating the receiving-typing part of the printer.

An interesting feature in connection with

Teletypewriter and converter-control unit for use with radio-telephone system

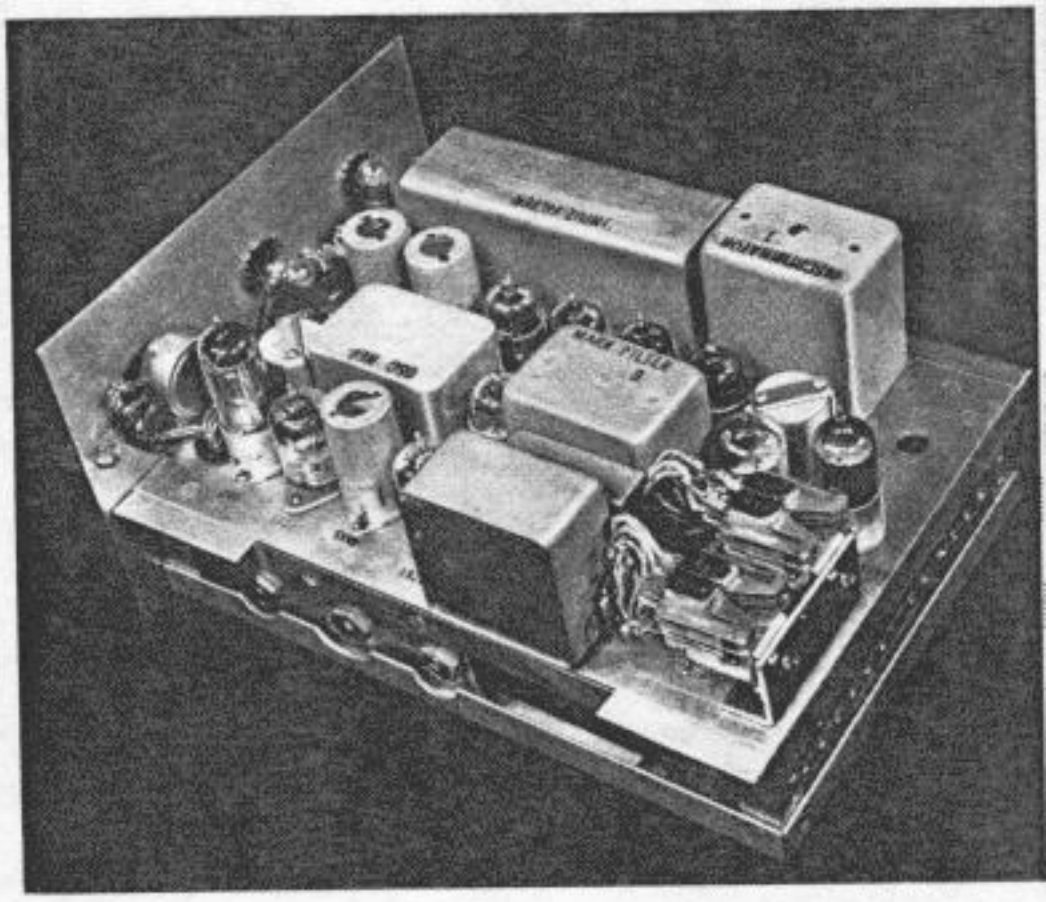


work with any existing radio-telephone installation capable of carrying on satisfactory two-way voice communication. This, of course, means that by the simple addition of the radio teletype equipment, weighing less than thirty-five pounds, and without any modification of the radio-telephone equipment, two-way, typed communication, with all its advantages, may be achieved. The normal use of the radio-telephone equipment is in no way affected by the installation of the radio teletype.

A radio teletype network installed in aircraft and ground stations operates very much like a press-to-talk radio-telephone network, except that instead of spoken words it handles typed messages. No manual operation of a "press-to-talk" control is required since the radio transmitter is turned on automatically when the first teletype character is sent. As in standard land wire teletype equipment, two signaling conditions, commonly referred to as "marking" and "spacing," are used for transmission of teletype signals. The unit of time during which a character is transmitted is broken into seven intervals. Each character begins with a spacing "start" interval and ends with a marking "stop" interval. During these intervals all printers which are receiving are synchronized with the printer which is sending. During each of the five time intervals between the start and stop intervals, the signaling condition may be either marking or spacing, depending on the teletype character being transmitted, so that thirty-two different signaling combinations are possible. By assigning one combination for "upper case" and one for "lower case," any or all of the remaining thirty combinations may be used for the transmission of either of two characters or symbols so that there are enough combinations for all characters and symbols on the keyboard of the teletypewriter.

Circuits in the converter unit provide an automatic closure to condition the radio-telephone equipment for transmission when the first teletype character is sent. This function is disabled when a message is being received. Other control circuits provide for holding the selector magnet circuit of the teletype printer in a marking condition

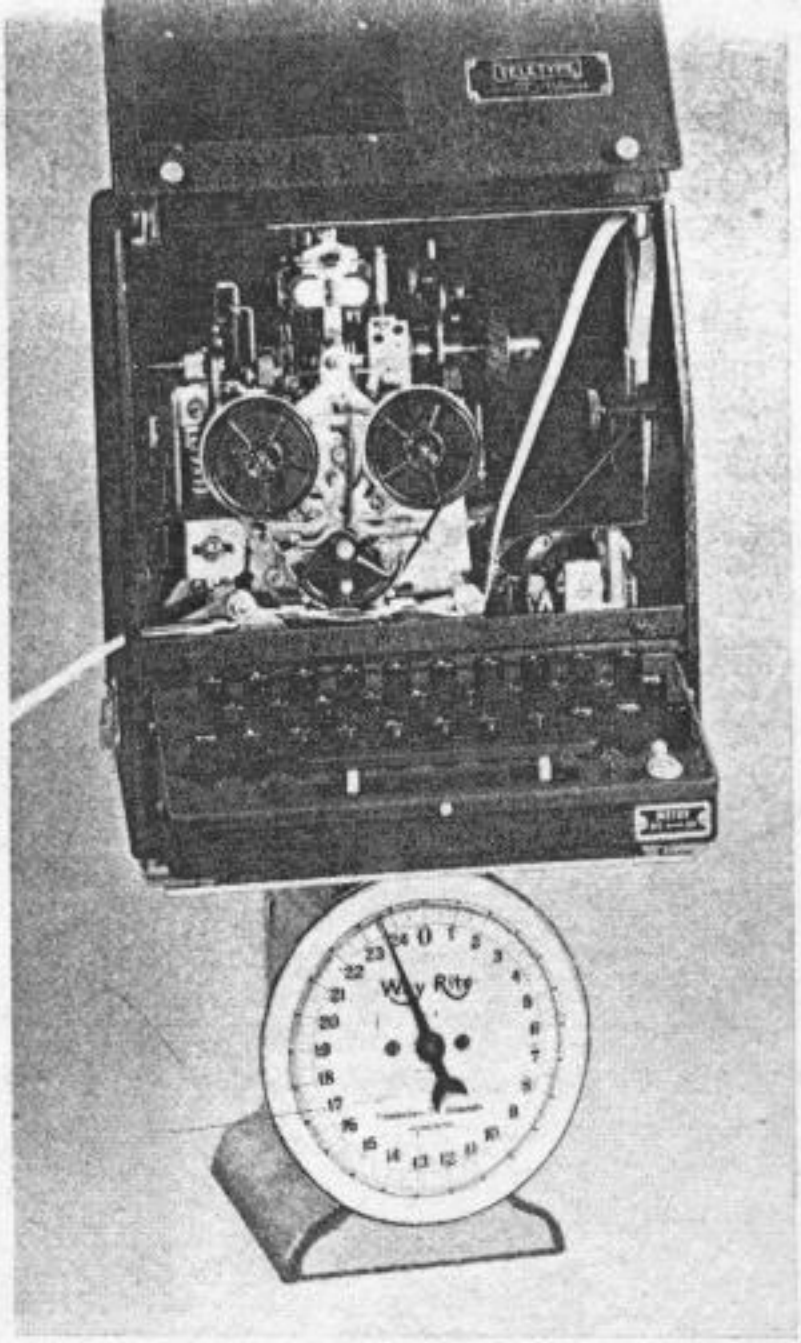
radio noise will not cause false characters to be printed, and to light lamps to indicate whether the terminal is in a transmitting or a receiving condition.



Interior view of the converter-control unit

Openings and closures of the printer transmitting contacts which occur as the keyboard is operated are applied to the sending circuit and shift the frequency of an oscillator between 1,615 and 1,275 cycles as required by the marking and spacing elements of the character to be transmitted. The output of the sending circuit modulates the radio transmitter in the same manner as a voice signal. A small amount of energy from the sending circuit is applied to the receiving circuit in which it functions in the same manner as a signal received from a distant station. In this way, a local copy of the teletype characters being transmitted is obtained. During transmission, the auxiliary contacts of the teletypewriter close during each character and, operating through the control circuit, cause the press-to-talk control circuit of the radio transmitter to close at the beginning of transmission and remain closed as long as at least one character is sent every five seconds.

Release of the mark-hold circuit during a



Interior view of the Model 31 teletypewriter. It weighs less than 24 lbs.

receiving condition causes a green-capped REC lamp to light. At the same time that the marking hold is released, the sending control circuit is disabled to prevent accidental operation of the keyboard from interfering with the incoming signals. During the transmitting condition, a red-capped SEND lamp is lighted and the circuit for lighting the REC lamp is disabled.

When signals are being received, the 1,615-cycle marking and 1,275-cycle spacing tones, together with the important side band components resulting from signaling, are passed by the input band pass filter to a fast-acting amplitude-limiting circuit and applied to frequency-discrimination circuit. The output of the discriminator circuit is a positive voltage for marking and a negative voltage for spacing signals which result in a current of 20 milliamperes in the selector magnet for a marking condition and zero current for a spacing condition. The output of the amplitude limiter is also applied to the "mark-hold" circuit. The marking elements of the first teletype character to be received cause the marking hold on the output circuit to be released so that subsequent signals may pass through the output circuit to the printer selector magnet.

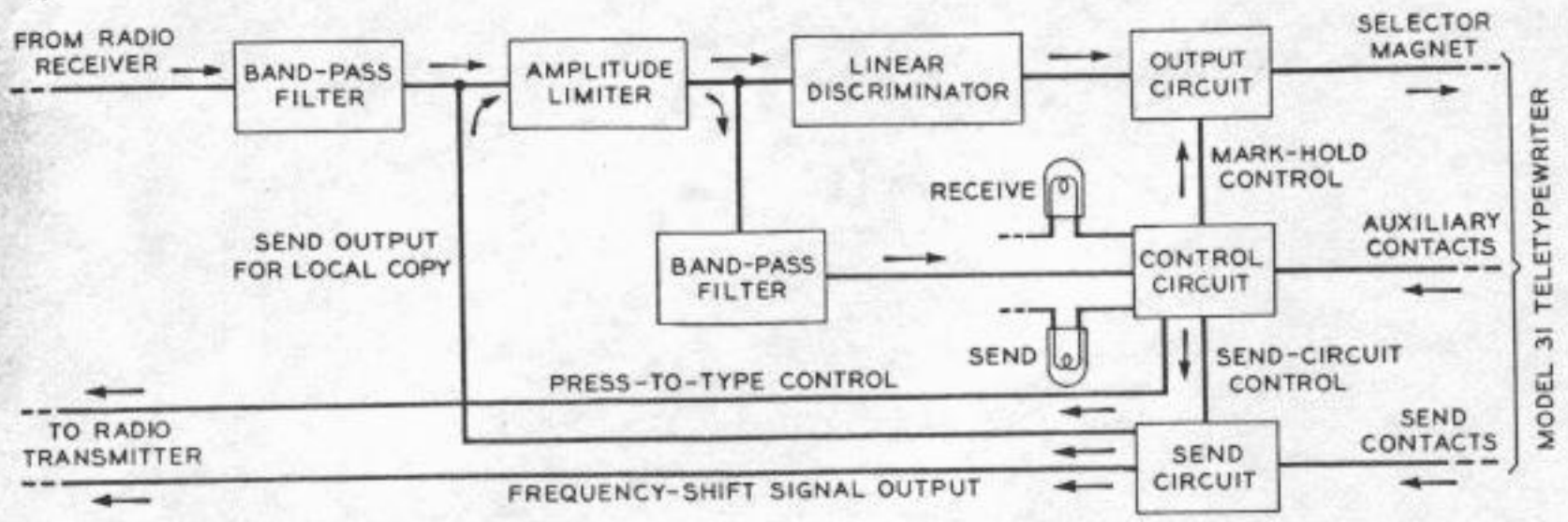
The primary source of power for the converter-control unit and the Model 31 teletype is the 26.5-volt battery commonly used in airplanes. Plate voltage supply of +250 volts for the converter-control unit is normally obtained from a generator winding on the teletype driving motor. This high-voltage supply is also used for an electronic speed regulating circuit that is incorporated in the printer.

Tubes having 6.3-volt heaters are used in the converter-control so that this unit could be adapted for vehicles having a 6-volt battery by reconnecting the filament circuits. A vibrator type high-voltage supply circuit operating from 6-volt battery has been constructed for supplying plate voltage to the converter-control unit.

The Model 31 teletype printer is only 10½ inches high, 10 inches wide and 13½ inches deep, and weighs only 24 pounds. The converter-control unit is 5 inches high, 7 inches wide and 9 inches deep, and weighs 8 pounds. This makes it possible to provide teletype service over existing press-to-talk radio-telephone circuits by adding less than 35 pounds to the weight of the communications equipment. No modification of the radio-telephone equipment is necessary. An additional feature of importance to aircraft operation is the fact that this equipment will operate in any position, even upside down.

With teletype operation, a printed record of all communications is available at all stations in the network. Messages may be handled easily and accurately by inexperienced personnel, and are received without attention from the operator. Since a standard teletype code is used, messages may be sent from any other teletype station such as a land-wire "weather" network. In international service code groups of teletype characters could be standardized to cover all routine phases of weather reporting, take-off, landing and other instructions to be given to the plane.

The new lightweight terminal equipment has special application to other fields in



Block schematic of a telegraph terminal

which the large size and weight of standard equipment has prevented the use of teletype methods of operation. These fields include mobile service to trucks, cars and harbor craft and military applications to landing operations and forward command posts of advanced echelons of a battle force. Of particular importance in these uses is the advantage of making a record of instructions or other data without continuous attention from an operator. Also of importance is the fact that messages may be handled easily and accurately by inexperienced operators.

THE AUTHOR: R. A. VANDERLIPPE attended the University of Omaha and the University of Nebraska from 1925 to 1930, receiving the degree of B.Sc. in E.E. from the latter. While attending Nebraska he also worked as toll-test boardman and equipment engineer. He joined the Laboratories in 1930, and worked on voice-frequency carrier telegraph and d-c telegraph circuit design problems. Later he supervised laboratory testing of telegraph transmission circuits and laboratory and field testing of private line telegraph switching systems. During World War II he was concerned with the development of voice-frequency carrier telegraph systems used by the Army and of long-haul radio teletype apparatus and systems used by the Army and Navy. At present Mr. Vanderlippe is a supervisor responsible for the development of radio teletype systems and of special electronic circuits that are used in these and other telegraph systems.