# A STEP FORWARD IN PRINTING TELEGRAPHY

by

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# A Step Forward in Printing Telegraphy

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**Synopsis:** Recent commercial and military printing telegraph communication requirements could not be fully met in an efficient and economical manner with existing equipment. This paper describes the objectives being reached in the development of a new integrated line of Teletype apparatus especially designed to adequately serve present and future printing telegraph applications and particularly covers the Teletype Model 28 Direct Keyboard Page Printer Set, Fig. 1. This set consists of a page typing unit, keyboard, electrical service unit, and their motor drive and cabinet housing. The other units which will soon be available are the tape perforator, tape typing unit, and transmitter distributor, which with the keyboard and page typing unit are so designed as to be readily arranged in many combinations to meet specific applications. Fig. 2 indicates the basic units and a few representative combinations.

## History of Printing Telegraphy

COMMERCIAL telegrams were transmitted using printing telegraph machines as early as 1851, seven years after the commercial introduction of Morse. Modern printing telegraphy got its start in 1910, with the invention by Howard L. Krum[1] of the start-stop method of synchronization applied to printing telegraphy. Commercial success came in the early twenties, at which time such equipment was primarily used by the commercial telegraph companies and press associations. In 1930 printing telegraph moved rapidly into the business field, and since 1940 we have witnessed the extensive use of that form of communication in military service.

The original applications presented no great problems. Direct circuits were set up between telegraph offices or between press sending stations and receivers located in newspaper offices. Forty-word per minute speeds were considered adequate, messages were printed on plain paper fed from a roll or on individual blanks inserted by operators, and due to the fact that equipment was concentrated in largecenters, only a relatively small number of maintenance men were required.

As the business-field applications grew, the speed went up to 60 words per minute and new requirements were introduced, which resulted in the development of various accessories which were attached to existing units or installed separately. Since the original design of the units did not anticipate many of these functions, the parts for a given mechanism were placed wherever there was space with the result that the equipment was somewhat difficult to maintain. These added features included sprocket feed, horizontal and vertical tabs, motor control, contacts for various switching and control purposes, etc. The space for these mechanisms was limited and it soon became necessary to use external units to provide the multiplicity of control functions.

The 60-word-per-minute speed became too slow for certain applications and the equipment was modified for 75-word operation. Attempts were made to increase the speed to 100 words; however, high maintenance costs severely limited this use. The installation of printing telegraph equipment on ships, planes and

**Fig. 1. The model 28 printer set**

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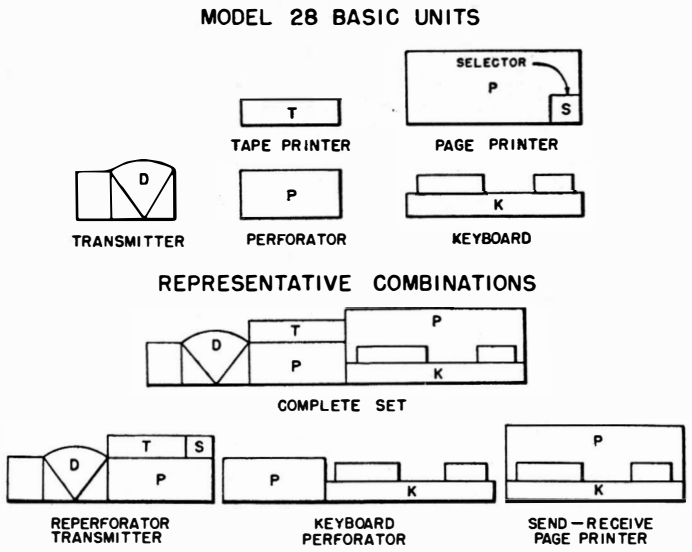


**Fig. 2. Model 28 basic units and representative combinations**

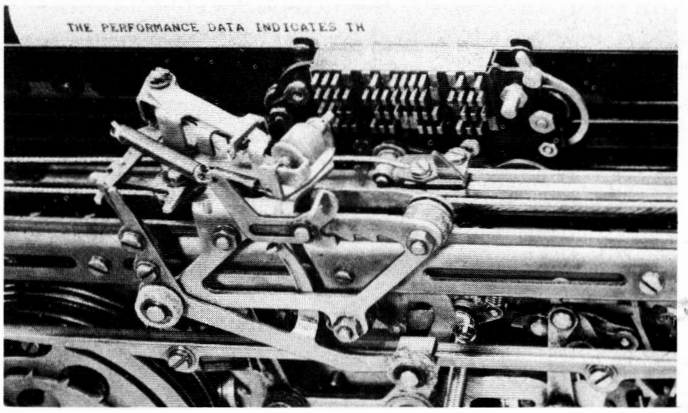


**Fig. 4. When the typebox is in the desired position, the printing hammer drives the type pallet against the ribbon and paper**

trucks imposed requirements of satisfactory operation at various inclinations and under conditions of great vibration.

As business expanded the use of printing telegraph techniques, the systems became larger and more complicated. Automatic switching was introduced and printers were installed in hundreds of offices of a single user. The Bell System Teletypewriter Exchange Service (TWX) which is similar to telephone exchange service, except that printers are connected through switchboards for typewritten communication, now has more than 35,000 Teletype sets distributed over the entire country. Each of these fields of use required new types of equipment. In almost all cases the equipment was wanted in a hurry, and since the future demand was uncertain, each new piece of equipment was generally provided by modifying an existing machine. This obviously did not result in an orderly development of standardized equipment.

## Objectives of New Model 28 Line of Equipment

It became evident that a new line of equipment was needed which would meet the following prime objectives:

1. An integrated group of component units
2. Lower maintenance costs
3. Quieter operation
4. Increased speed.
5. Greater capacity for additional functions
6. Decreased weight

A review of the typing mechanisms used in Teletype units of various kinds and those developed by other printing telegraph producers indicated that they were generally unsuited to meet the new requirements. Typebar carriages were considered too heavy and typewheels difficult to index at high speeds. Existing clutch designs similarly were considered inadequate; felt clutches having always been troublesome due to heat and loss of lubricant and positive clutches subject to breakage due to impact. It was therefore decided to design new elements to specifically meet the requirements of today and the next 10 to 20 years.

## Some of the New Elements of the Model 28 Page Printer Set

The printing mechanism is the most obvious of the several improvments in the new machine. The type pallets, instead of being mounted on bars in the conventional manner are carried in a small rectangular box about 1/2 inch thick, 1 inch wide and 2 inches long, Fig. 3. Sixty-four pallets are arranged in four horizontal rows, each row having a capacity of 16 characters. To type a character, the typebox is moved to bring the desired character to the printing point, and a printing hammer, shown in Fig. 4, operates to drive the type pallets against the typewriter ribbon and paper. Each pallet is provided with a return spring that restores the pallet to its normal position after printing. After the printing hammer has operated, the typebox returns to its initial position below the printed line on the paper, so that the typing becomes visible.

Characters in the left half of the box are letters; those in the right half are figures. A shift mechanism is used to change from letters to figures. The normal position of the typebox for letters

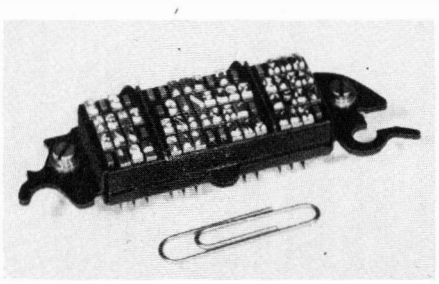

**Fig. 3. The typebox, shown in comparison with an ordinary clip**

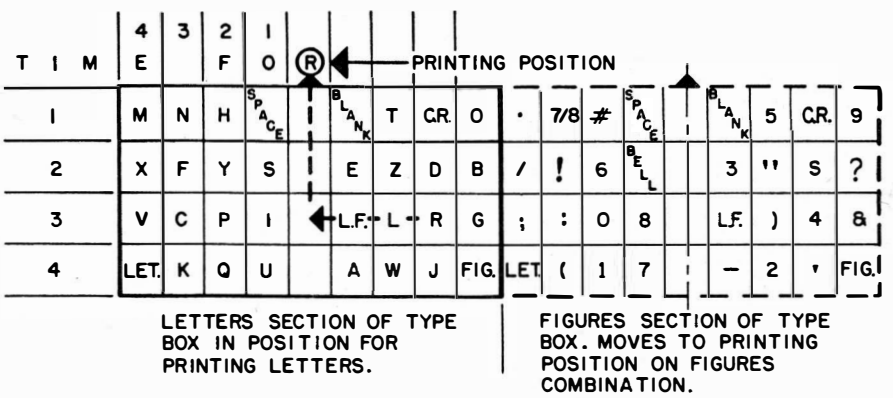


**Fig. 5. Typebox arangement and printing method**

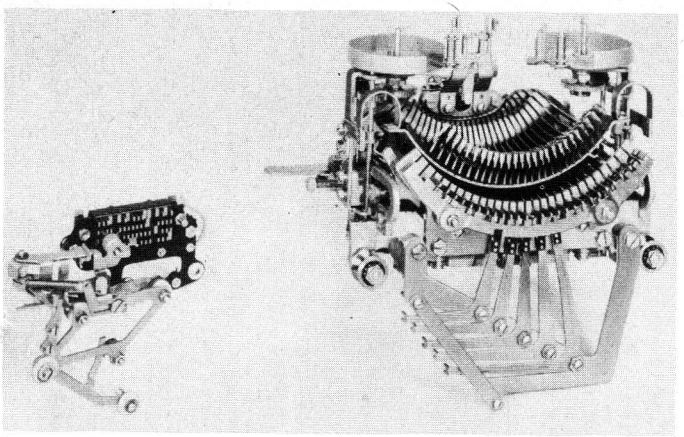

**Fig. 6. The new typebox assembly weighs only a tenth of the older moving type basket carriage**

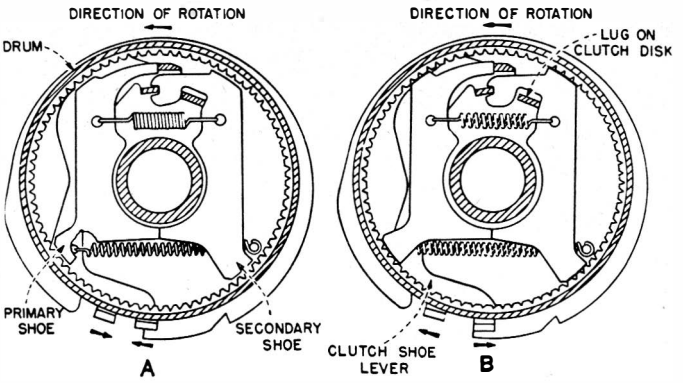


**Fig. 7. The clutch is an internal expansion friction clutch**

A. Disengaged
B. Engaged

selection is as shown in Fig. 5. When figures are to be printed, the centerline of the figures group is moved to the printing position. Movement of the typebox, in selecting the desired character to be printed, is controlled by two index mechanisms, one controlling the vertical motion to select the proper row of type, and the second controlling the horizontal motion to select the desired character in that row. These motions together form a rectangular co-ordinate system for all the 32 permutations of the standard five unit telegraph code.

The five elements of the code are used to position the pallet in a different manner than on other telegraph apparatus units. The first two elements of the code are used to determine the vertical position of the box; in other words, the nos. 1 and 2 impulses, by their presence or absence in the code permutation, will cause the printer to select one of four levels on the typebox for printing. The no. 3 impulse determines which way the box will move from either the letters or figures centerlines; that is, either to the right or left. The nos. 4 and 5 impulses determine how far the box will move in the selected direction; there are four locations in each. The code combination for *R*, as shown in Fig. 5, causes the box to move upward three levels, then to establish the leftward direction, and finally to move three spaces in that direction, thereby bringing the *R* type pallet in line with the printing hammer.

A unique toggle-type coupling mechanism is provided in the drive system so that the typebox can be stopped in various positions in a gentle manner and without noticeable impact. With this mechanism, the movement of the typebox toward its final position is at high speed, but as the typebox approaches the selected position, the toggle mechanism reduces its speed. At the end of the typebox travel, where further motion is blocked by the index mechanism, the speed of the typebox is about one fifth of that at which it would have passed this position.

Elimination of the conventional type basket greatly reduces the size and weight of the carriage that travels back and forth across the page, starting and stopping for each character printed. A comparison of the old and new type assemblies is illustrated in Fig. 6. In a standard model 15 typing unit, the moving carriage assembly weighs slightly over 5 pounds; the carriage assembly in the model 28 has a total weight of 8 ounces. This 10-to-1 weight reduction results in a very fast carriage return, the carriage returning easily within time of two character intervals (signals received for carriage return and paper feed) at 100 words per minute. Gravity has no significant effect on the carriage motion. The machine can be operated safely on shipboard or in other locations where it might not be in a level position.

Since the pallets are carried in an accurately made box instead of at the ends of the type bars, as in the older machine, type alignment is controlled by manufacture of the parts with no further adjustment required. Stability of alignment, too, is greater, and this should reduce maintenance. This small lightweight carriage also makes possible an over-all reduction in size and weight of the machine, and permits the use of stamped sheet-metal framing instead of the massive cast framework used on the older machines. The weight of the model 28 Teletype printer set is 38 pounds, not including the cabinet and accessories.

At the right end of the typebox, a small manually operated clamping lever holds the box in its supporting carriage. This clamping lever may be released with a light finger motion so that the typebox can be withdrawn from the machine without using tools. Thus the box may easily be cleaned without brushing dirt into the mechanism of the machine. Also, the typebox may be exchanged in a matter of seconds for another having different character faces. On older types of equipment with individual type, it is necessary to solder type pallets to typebars and realign them.

Since each character is separately

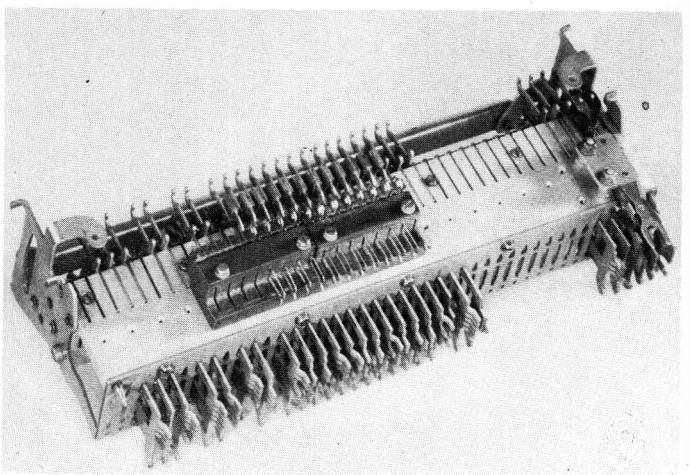

**Fig. 8. The stunt box contains code bars for performing nonprinting operations such as line feed, carriage return, shift, etc.**

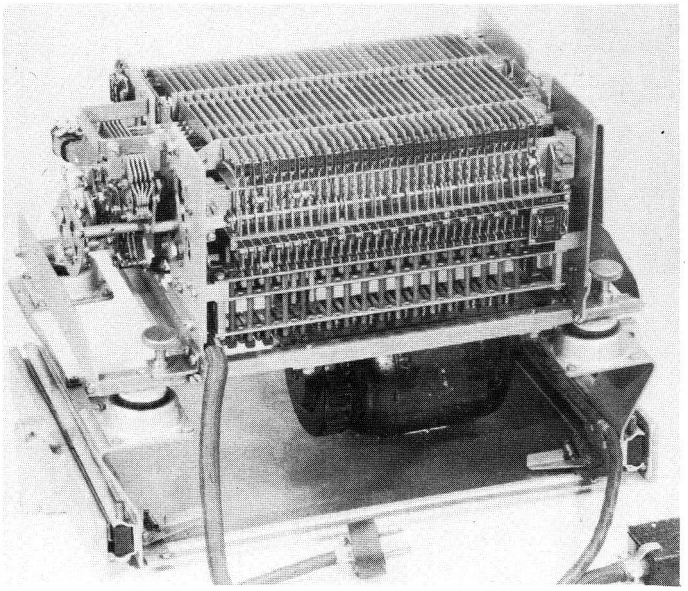

**Fig. 9 (left). The sequential selector, which is replaced by the stunt box in the model 28 set**

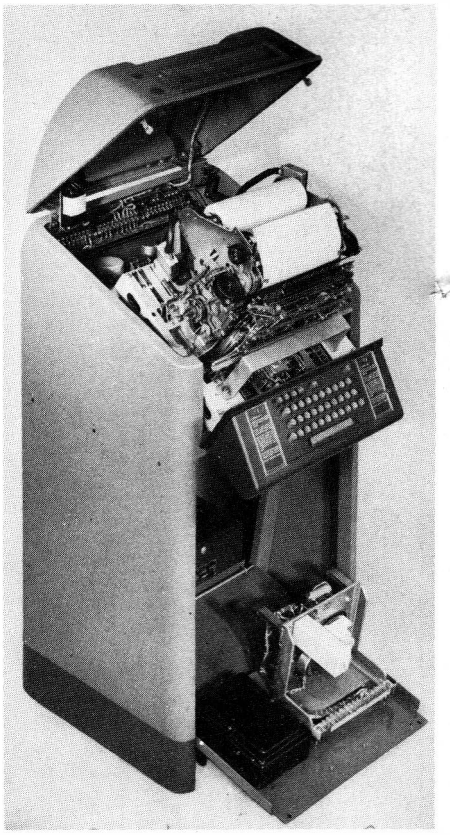

**Fig. 10. The equipment is pivotally mounted in the cabinet and swings outward for maintenance. Incoming wires are connected to terminal blocks behind the typing unit**

mounted on an individual type pallet, only one operates at a time. In the older machines, with two characters on a single pallet, there is a possibility of printing part of the other character on a pallet if the adjustment is not exact, or if one of the characters is worn, or if several carbon copies are being made so that the surface of the paper is somewhat spongy. The model 28 is capable of making the same number of carbon copies as present machines, and because the same hammer blow is applied for all characters, the printing impression is more uniform than that of a type-bar machine. This characteristic is very important when a large number of copies are being made. The printing blow can readily be increased for multiple copy work by adjusting the tension of a spring by means of a manually operated position lever, Fig. 4. Due to the simplicity of the printing mechanism, it is possible to make the shift from figures to letters and vice versa within the printing mechanism rather than by raising and lowering the platen roller. This simplifies paper handling and improves the readability of the printed record, since the paper remains stationary at all times except during line feed.

*The ribbon spools* are mounted on the machine itself rather than on the type carriage, thus providing a straight course for the ribbon travel. This not only facilitates changing ribbons, since the path is obvious and the number of guides is a minimum, but in combination with the more gentle blow of the new type hammer, it results in increased life of the ribbon as compared to the older machines.

*A newly designed clutch* is another machine element that improves operation, reduces maintenance, and contributes to good receiving margins; that is, ability to tolerate distortion of signal pulses. Clutches of the new design are used not only for driving the selector cams, but for the various other power actions, such as moving the typebox, feeding the paper, spacing, etc. This clutch is an all-steel internal-expansion friction clutch, that disengages in the stopped condition, whereas the older clutch depends upon slippage between felt washers and steel plates when a stop is interposed, so that the driven member is mechanically held from turning. Fig. 7 illustrates the method of operation. The continuously rotating driving member is a steel drum, the inner surface of which is grooved, hardened, and ground to give a flat surface on the tops of the grooves. The grooves between the flat surfaces permit wear products to fall away from the working surfaces. Within this drum, two hardened steel members act as drive shoes and are pressed into contact with the rotating drum by a spring-operated pry bar. The leverage system is so designed that through a system of very rigid force-multiplying levers, a small spring produces high normal pressure between the hardened steel friction surfaces. Since the clutch disengages in the idling position, the load on the motor at that time is very small. Life of the clutch equals that of the rest of the machine.

*Performance of nonprinting operations*, such as line feed, carriage return, and shift, is controlled by a new mechanism contained in a separate subassembly called a *stunt box*. This unit, which is accessible from the rear, extends across the full width of the typing unit, and engages code bars that also extend across the machine. The function bars, Fig. 8, of the stunt box engage notches in the code bars. The stunt box has 42 slots, each of which may hold a function bar capable of responding to an assigned code, making it possible to control 42 functions. Approximately 10 are reserved for the common functions, such as line feed, carriage return, and shift, and the remaining 32 are available for special purposes. Stunt boxes are interchangeable. The stunt box may be arranged to perform the functions of the sequential selector unit, shown in Fig. 9, which controls circuits from groups of character combinations sent in a predetermined sequence.

*The keyboard mechanism* in the model 28 is also different from earlier designs. When the operator depresses a key, a latch is tripped which permits the code bars to move endwise by spring action. In the older machines, depressing a key moved the code bars directly, so that there was considerable variation in the forces required for different code combinations. Thus the new action results in a lighter, shallower, and more uniform key touch.

When the key lever is depressed, one of the bars that moves longitudinally trips the clutch latch and allows the clutch to engage a cam-operated mechanical distributor. This causes the code pattern to be translated into a start-stop

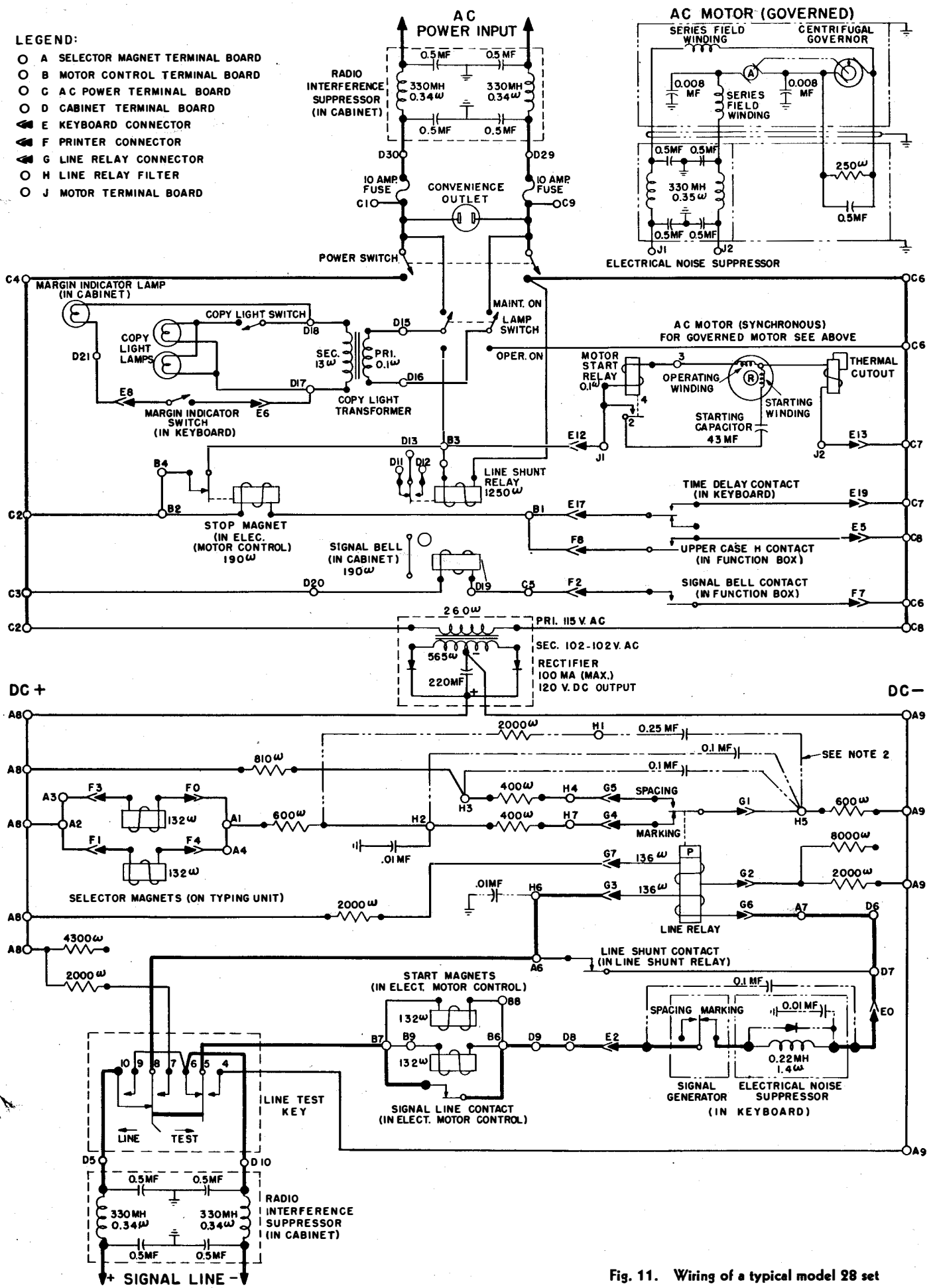


Fig. 11. Wiring of a typical model 28 set

electric signal, the signal itself coming from the signal generator.

*The signal generator* is a single contact assembly mechanically operated by the distributor. This contact has the form of a transfer switch and therefore permits either open or closed signal transmission or transmission of signals of alternate polarity. The contact is mounted in a metal box for mechanical protection and shielding against radio interference, and requires no adjustment other than in positioning the box itself.

*The cabinet for the new machine* was designed to suppress machine noise, improve operating convenience, and provide better appearance. The equipment is housed in a new floor model, Fig. 1, with all mechanical controls brought to the front so that the machines can be mounted side by side in rows. Even the manual platen crank has been eliminated and replaced with a rapid motor-driven feedout controlled by a button on the keyboard. A lamp within the cabinet illuminates the copy, and the angle of the window above the copy has been chosen so that glare is practically eliminated. The upper section of the cabinet swings open to provide access for insertion of paper and ribbons and for maintenance. Fig. 10 illustrates how the equipment may be swung upward and forward to give access to both sides and rear of the machine.

## Electrical Features and Circuits

*Electric accessories* such as the line relay, motor control relay, rectifier, fuses, etc., have been placed in a box behind the machine. The interconnections between the several units have been made simple and flexible, which permits installation of a standard machine where circuit termination requirements vary. In the cabinet below the printer there is a shelf on which a front panel is pivotally mounted, as shown in Fig. 10, providing mounting surfaces for auxiliary equipment if this is desired.

The equipment is driven by a synchronous motor when 110-volt regulated alternating current is available, or by a governed motor when unregulated alternating current or direct current is available. Printing telegraph equipment requires speed control of $\pm 1$ per cent. The governor used on the model 28, which is of new design will maintain the speed, and once adjusted, it will generally hold speed for the life of the motor brushes, even if the governor contacts wear or pit considerably. The older-type of governor requires frequent readjustment and maintenance and is subject to speed change due to comparatively slight wear or pitting of contacts.

*The wiring* of the model 28 Teletype set described herein, equipped with the most commonly used electrical features, is shown in Fig. 11.

## Conclusion

Since operating experience indicates the model 28 page printer set requires less maintenance than other printing telegraph equipment, it is expected that its field of use will be extended to include more remote locations. The other units of the new line: the tape printer, perforator, and reperforator transmitter, have undergone extensive tests, which indicate they will give the same service as the page printer. These units also have new and novel features and will be available in the near future to serve the needs of printing telegraph users.

## Reference

1. **Howard L. Krum.** *United States Patent No. 1,286,351.* 1919.