The Story of...

U.S. NAVAL TELETYPEWRITER SYSTEM

A CONCISE HISTORY OF THE U. S. NAVAL TELETYPEWRITER SYSTEM (NTX) DURING WORLD WAR II

When war loomed on the horizon, many months before the fateful 7th of December 1941, it became the monumental task of the U. S. Naval Communications Service to provide the mechanism that would permit rapid and efficient coordination of the vast energies that went into the mobilization, building up and movement of the American battlefleets.

Personnel had to be shifted rapidly and on iron-bound schedules from training schools to fighting ships. Orders to steel mills, ship yards and armament plants had to be transmitted swiftly and accurately to insure that the paraphernalia of war would arrive where needed and on time. Reports in staggering numbers had to be sent to and from the whole vast Naval establishment. In short, the job of expediting the administrative affairs of a fighting Navy fell largely upon the shoulders of Naval Communications.

Brass-pounding radiomen struggled valiantly with the rising tide of dispatch traffic they were called upon to send over point-to-point manual radio circuits. Commercial firms, such as Western Union and the Telephone Companies, were swamped by the deluge of War dispatch traffic that suddenly was dumped in their laps. Navy traffic contributed its share to this deluge.

It became obvious, even before Pearl Harbor, that existing Naval Communication channels would be totally inadequate to handle the traffic which the advent of war would bring and that commercial facilities could not be substituted with any degree of efficiency since these facilities would also be overloaded.

Prior to 1940 Navy facilities within the continental limits consisted of but several point-to-point radio circuits, and one landline simplex Morse telegraph circuit connecting New London, New York, Philadelphia and Washington between the hours of Ø8ØØ and 2ØØØ. All Navy dispatches or messages that could not be handled by the above facilities had to be transferred to the commercial communication companies.

And so, in June of 1940 -- that was the month that the German Army had overrun Belgium and France -- there came a proposal from the Office of the Chief of Naval Operations to establish a "skeleton war-time teletypewriter service" to supplement certain point-to-point radio circuits along the Eastern seaboard.

The first TWX (commercial teletypewriter exchange service) network that developed in July 1940 from that proposal, provided teletype facilities at the Navy Department in Washington, the Naval Academy, the Naval Air Station at Anacostia, the Navy Yard at Washington and the Marine Barracks at Quantico.

In a letter from Chief of Naval Operations, describing the TWX network, there was this word of caution:

"Due to the expense involved, the use of this service should, for the present, be restricted to emergency, or other important communications for which the existing Navy facilities are not fast enough, and, in some instances, to replace long distance toll telephone calls where practicable."

Today, this "skeleton" is a robust, streamlined composite of the most modern military and commercial communication systems known as "NTX" -- the U. S. Naval Teletypewriter System -- embracing over 100,000 miles of wire and radio teletype channels which crisscross the continent and extend overseas to Guam, Pearl Harbor, Balboa, Adak and San Juan, serving in all more than 1,000 offices by direct connection. The traffic handled by this system built up to more than 150,000 high speed messages per day!

To illustrate very briefly the rapid strides taken in the past few years by modernized Naval Communications, three hours was formerly the accepted average speed to complete the handling of a routine dispatch from one continental Naval District to another. Now, if it takes more than 15 minutes for the same dispatch to travel from an originator's office on the East Coast to the office of designation on the West Coast, somebody is bound to check up to see what was wrong!

The story of the growth of the NTX System from those first tentative proposals to establish a "skeleton war-time teletypewriter service" is a refreshing story of how men with ideas overcame the

prejudices of tradition and ingrained outmoded methods of handling traffic and established a whole new technique of communications that combined speed with accuracy, dependability and high capacity.

It is also a story of the ingenious use and modification of standard equipment to meet the needs of service, the engineering of networks and the establishment of simple procedures that would not require long, exhaustive training of personnel.

The present NTX System, with its thousands of miles of channel and high speed Navy-owned and leased equipment, developed from a nucleus in 1941 of ten TWX stations and two leased circuits totalling 773 miles serving only nine stations. By 1945, NTX comprised 535 TWX stations and 1120 private line stations served via 508 leased circuits covering 129,000 miles. This system also served an additional 110 overseas stations via 14 radio teletypewriter circuits covering 38,300 miles, making a total of 1765 continental and overseas stations or offices in all which were served directly by this system. (See PLATE I). The total cost to the Navy of the 1941 layout, including TWX tolls, was $17,091.00; in 1945 the annual cost was $2,037,036.00. However, during this period from 1941 to 1945, though of secondary importance to achieving victory, the actual cost of handling an individual message was reduced from 57¢ to 8.8¢. (See PLATE II).

During a busy day in 1941, the Navy Communication Office and wire room in Washington would handle a total of about 4,250 messages

and consider it an exhausting day. In 1945, the combined Relay Center and Wire Room in Washington handles 50,000 transmissions a day as a matter of routine. (See PLATE III).

In 1941, when a continental activity wanted to send a message to Com 14 at Pearl Harbor, considerable preparation was necessary to get the message in shape for radio transmission. Today, even a part-time stenographer in the office of an Inspector of Naval Materiel can prepare a message in proper NTX form for relay to Pearl Harbor over domestic landlines and overseas radio teletype channels without further processing by Naval Communications personnel, anywhere along the way.

The job is done by a chain of two primary relay offices, 14 major relay offices and 33 minor relay offices, comprising the backbone of the NTX System. (See PLATE IV). How these relay offices function, why they were established, the equipment they employ will be described below.

After the establishment of the first "skeleton" wartime TWX network in July of 1940, the advantages of this form of speedy communication became more generally recognized. However, lack of funds did not permit extending this network until Public Bill 671, authorizing the transfer of funds from any appropriation to "other expenses" including communications, was passed by Congress. This permitted five Navy Department bureaus to install TWX printers during the early part of 1941.

It wasn't until May 1941, however, that the Navy's first private teletypewriter line was installed, replacing the old Morse line connecting New York, Philadelphia and Washington. Norfolk was connected 30 days later. Upon these two private lines, No. 7003 and No. 7005, the NTX "empire" was founded.

Early in 1942, the first teletype circuit was installed along the West Coast connecting San Francisco, San Diego and Seattle. However, between the two coasts traffic was still handled by point-to-point radio, TWX and commercial facilities. March 21, 1943 was a history making date in shore communications. On that day, teletypewriter circuit No. 7006 was activated, linking San Francisco and Washington for the first time.

The Navy's continental landline system was emerging from infancy, but still further improvements were necessary. Long delays on jammed or overloaded circuits, considerable reprocessing of traffic being passed from circuit to circuit, and hand repunching at every point of relay were the general rule and obviously had to be corrected.

In the Autumn of 1943, discussions were started looking toward the establishment of something new, something different. All teletype messages had to go through a long, tedious repunching process which consumed time and required large numbers of personnel. The teletypewriter equipment then in use consisted of the standard Model 19 and Model 15 machines which were excellent for originating

and receiving traffic but were entirely inadequate to handle relays. A system that would eliminate excessive paper work, laborious processing, which had become the bane of every shore communicator's existence, was needed immediately. Such a system was to be found through the use of semi-automatic equipment.

Even while these discussions were in progress, more circuits were installed, more stations set up. Though the framework of NTX was becoming tangible, there still wasn't a single typing reperforator to permit semi-automatic relay on the entire network.

It wasn't until the late Fall of 1943 that engineers of the New England Telephone Company, together with Navy traffic and technical personnel, started development of the first leased semi-automatic relay installation ever used by the Navy at the Boston Communication Office. By re-wiring three type-100, six-key telephone switching cabinets and associating them with a Model 19, a Model 15 and a Model 14 typing reperforator, the Boston Communication Office was able to concentrate the terminals of 18 tributary teletypewriter circuits within a single operating position. This installation was commissioned in its final form in February 1944.
(See PLATE V).

A jury rig at first, this ingenious concentrator position soon became the preliminary pattern for the equipment layout and method of operation now standard in every NTX major and certain minor relay offices. It enabled one operator to send and receive message

tapes over 18 circuits, and relay without processing. This cut relay time by 250 per cent and virtually eliminated the possibility of textual error introduced by manual repunching.

Coincident with the Boston installation (Feb. 1944), the Washington Communication Office was provided with temporary facilities to permit semi-automatic operation. The trunk circuits feeding into Washington, normally terminating in Model 19 teletypewriters, were also equipped with typing reperforators associated with the 19's. These reperforators, available in meager quantities at first, enabled the Washington office to receive perforated tape copies of messages simultaneously with the page copies and, where such messages had to be relayed, the tapes were passed directly to the outgoing circuits, thus eliminating the need of repunching. At last, the bottleneck of manual reprocessing was about to be smashed completely.

The final plans were completed during the second quarter of 1944 when the huge program of establishing and modernizing a chain of NTX relay offices was initiated. Primary relay offices were engineered and installed at San Francisco and Washington. (See PLATE VI). Major relay offices were established in all the Naval District Headquarters. (See PLATE VII and VIII). Minor relay offices were set up at heavy traffic concentration points within the districts.

A concerted drive was launched to obtain the necessary equipment, particularly typing reperforators which manufacturers were already way behind on and without which no relay system could operate. The

traffic loads and circuit arrangements in each district had to be thoroughly analyzed. Equipment had to be purchased outright or leased. Allocation of equipment had to be made. New space had to be obtained in every case and floor plans had to be engineered. Ordering specifications for terminal equipment arrangements had to be standardized. Personnel had to be procured and trained. Operating routines and manuals had to be established and published--routines that were simple and easily understood by personnel without formal training in Naval Communications.(See PLATE IX). Field representatives from Op-20-B were sent out to all the districts to engineer and help in getting these new relay facilities established.

Well underway by the Spring of 1944 was the procurement of modern Navy-owned semi-automatic console equipment for the two primary relay offices at Washington and San Francisco, and, later for Pearl Harbor.

As additional equipment, procured on a rigid priority basis, became available, capacity of the system increased and traffic snowballed, making it necessary to provide thousands of additional square feet of floor space. The Washington relay center, for instance, was moved entirely from the old combined wire room and communication office to 2,200 square feet of new floor space in order to permit the installation of the necessary equipment to handle the traffic load.

In May 1944, the first installation of semi-automatic equipment was completed for the Washington primary relay office. This installation was leased from the American Telephone and Telegraph Company, and through their cooperation, special tables for mounting standard typing reperforators and transmitter-distributors were developed, which permitted the utilization of full tape relay with only a minimum of processing.

Shortly thereafter, the Navy-owned semi-automatic console equipment began arriving in Washington. Teams of installation men worked day and night wiring the Relay Center and on 15 Sept. 1944, the consoles began operating, supplementing the leased facilities which had served to inaugurate tape relay. Later, the original leased installation was revised with more modern equipment that further increased the overall efficiency of this office.

The greatest advance toward streamlined operation and the elimination of unnecessary "paper work" in NTX relay offices occurred on 28 July 1944 when the Secretary of the Navy approved the Judge Advocate General's opinion that "at points where the automatic method of relaying teletypewriter messages is used it is not necessary to maintain a record of such relayed messages."

Outside of Washington and San Francisco, however, there still was considerable paper work or processing, in connection with routing, which prevented full utilization of the relay speed inherent in the semi-automatic equipment.

This bottleneck was broken with the development of NTX routing indicators. The routing indicator was merely a two-letter combination for primary and major relay offices and a three-letter combination for minor relay offices. Each message sent over the system was preceded by the two or three-letter indicator for the final relay office serving the addressee. These letters enabled relay personnel to tell at a glance the channel over which any message should be routed to get it to the final relay office. Thus, if a relay operator at the New York office (GN) received a message tape preceded by the indicator BM, the relay operator would know that the message was to be transmitted over the channel to BM, or Boston.

Each office on the network was governed by a basic channel routing doctrine which specified the exact routing, according to indicators, of every message transmitted over the system.

The assignment of two and three-letter routing indicators to the relay offices was followed by the assignment of routing indicators to <u>every activity</u> served by the NTX System. Thus, the first two or three letters of each individual routing indicator were the same as the routing indicator of the relay office serving it. The next letter of the individual routing indicator designated the channel out of the relay office to the activity, and the last letter designated the office or individual user served by that channel.

Now, it was possible for relay office personnel to route a message from the originator to the office of the addressee merely by

following the letters of the routing indicator, without reference to hard copy, or processing in any way.

The final step to complete semi-automatic operation was taken on 11 December 1944. On that date, the NTX System made full use of the routing indicator principle, basic routing doctrine and tape relay. The physical transformation that occurred in relay offices throughout the chain was apparent. The yellow page copies which, until then, blanketed routing desks, file tables and operating positions at final relay offices almost completely vanished. Tape traffic began moving directly from receivers to transmitters in a steadily growing stream.

With the system finally established, refinements were instituted. To increase the capacity of existing circuits, a program was undertaken to convert 60-word-a-minute teletypewriter equipment to 75 and 100 word-a-minute operation. Streamlined concentrator equipment was standardized for all major and certain minor relay offices so that numerous tributary circuits could be concentrated in fewer operating positions which permitted operators to efficiently handle traffic on an overall circuit load basis rather than moving each circuit individually. To increase the efficiency on all main trunk circuits special semi-automatic equipment known as package units, compactly housing in one unit tandem transmitters, receiving reperforator tape monitor reel and numbering tape, were installed in all major and certain minor relay offices. (See PLATE X).

Automatic numbering devices were installed on trunk circuits that had consistently heavy loads, in order to eliminate the need for numbering tapes, also special service switch or jack boards. (See PLATE XI).

Within two or three months after inauguration of full NTX with semi-automatic tape relay, the system was functioning smoothly. Enthusiasm for this fast method of communication was high even among the old-timers who were convinced by what they saw. Early objections from those who were reluctant to accept this modern method of handling traffic because Naval Communications never operated that way, were dissipated as the rising volume of traffic cleared swiftly, accurately and economically over NTX circuits.

Transmissions over the NTX System in October of 1944 averaged 70,500 a day, while by the Summer of 1945, the daily total was up to more than 156,000 transmissions. Following V-J Day, the daily total dropped to about 138,000 transmissions, but demobilization traffic caused the curve to rise again.

NTX made the long jump across the Pacific to Pearl Harbor on June 1945 when the first overseas radio teletype channel was activated. This was a banner day for those who had striven so hard to establish the NTX landline system on a "paying basis." For it showed conclusively that NTX was no longer a stepchild of Naval Communications, nor was its use limited to the confines of the continental United States. The same principles that governed

operation of the domestic NTX System applied to operation of the overseas radio teletype link.

Throughout the period of growth and expansion of the NTX System a vigorous drive was conducted to modernize not only the equipment in all Naval communication offices but also the methods of traffic handling. In this regard, a weekly "NTX Traffic Memorandum" service was inaugurated to keep all hands up to date. The equipment was arranged according to carefully designed plans which took into consideration circuit loads, traffic flow and personnel efficiency in order that wasted steps and excess manual labor would be reduced to a minimum. New ideas were freely solicited from the field and the response indicated that enthusiasm for NTX was running high.

Chief of Naval Operations
Division of Naval Communications
Shore Station Section
November 1945

NTX

NAVAL TELETYPEWRITER SYSTEM

PERCENT INCREASE IN
MESSAGE LOAD
1940 - 1945

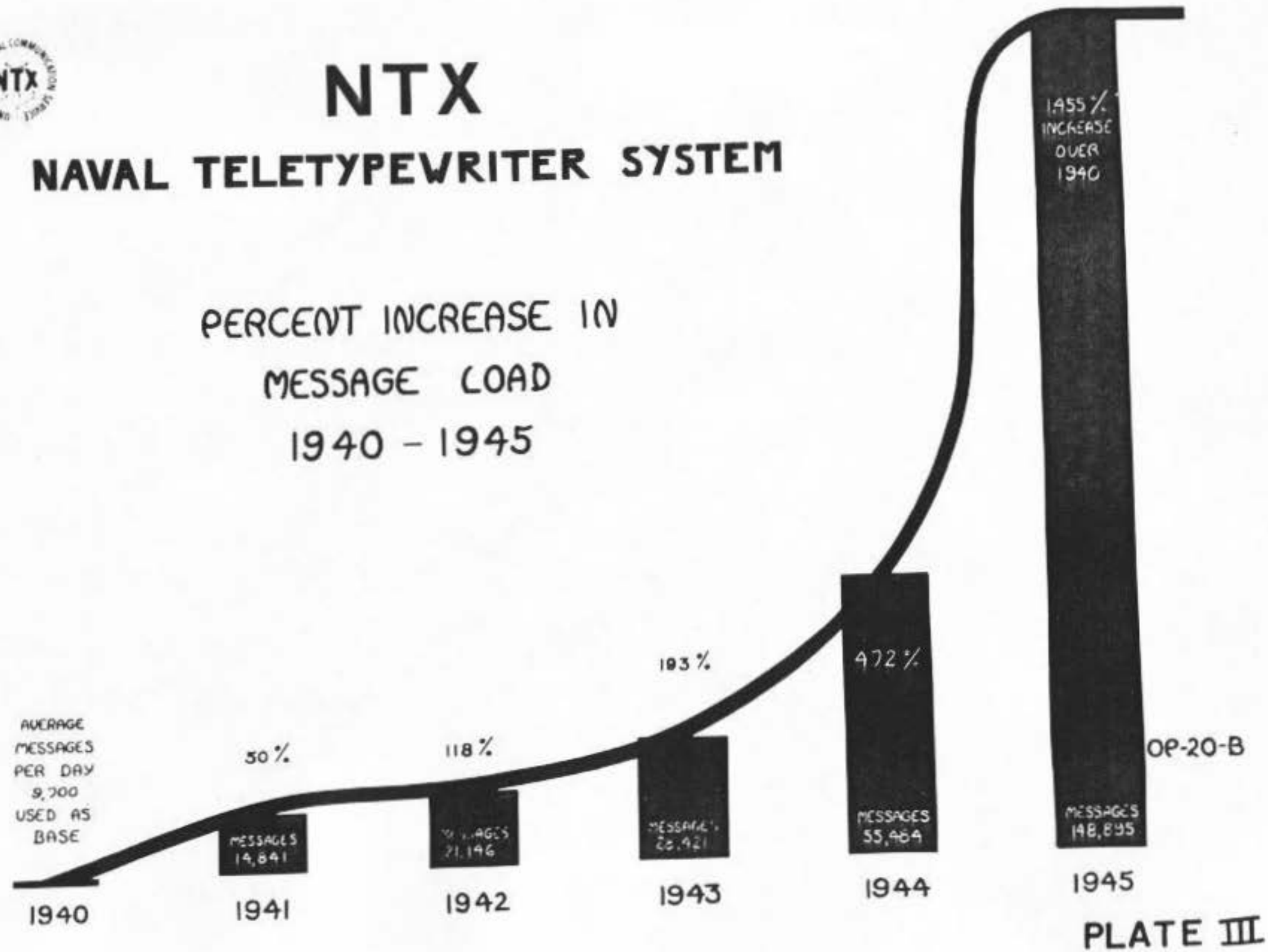
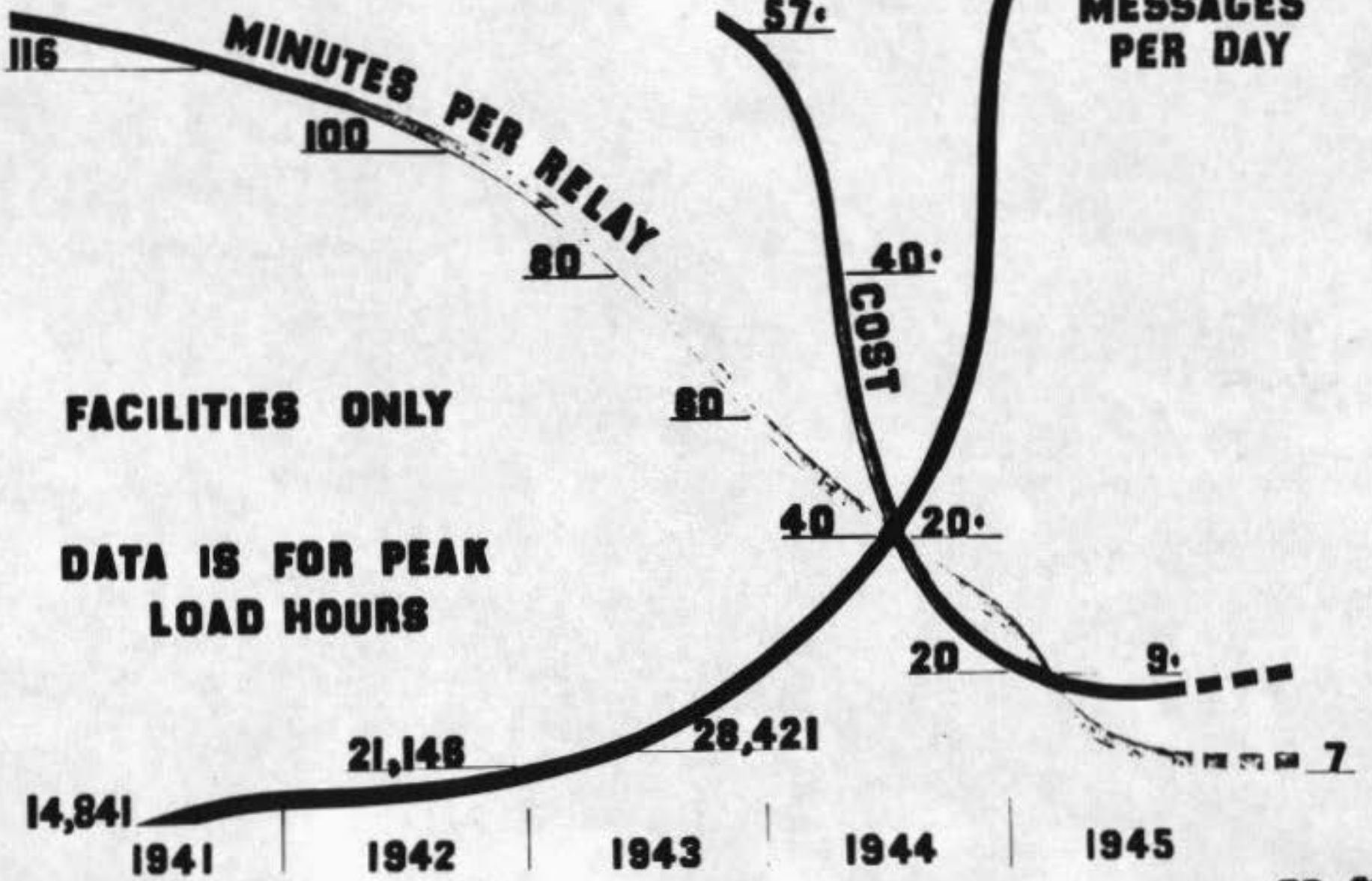


PLATE III

NTX
SPEED OF SERVICE
COST PER MESSAGE



OP-20-B

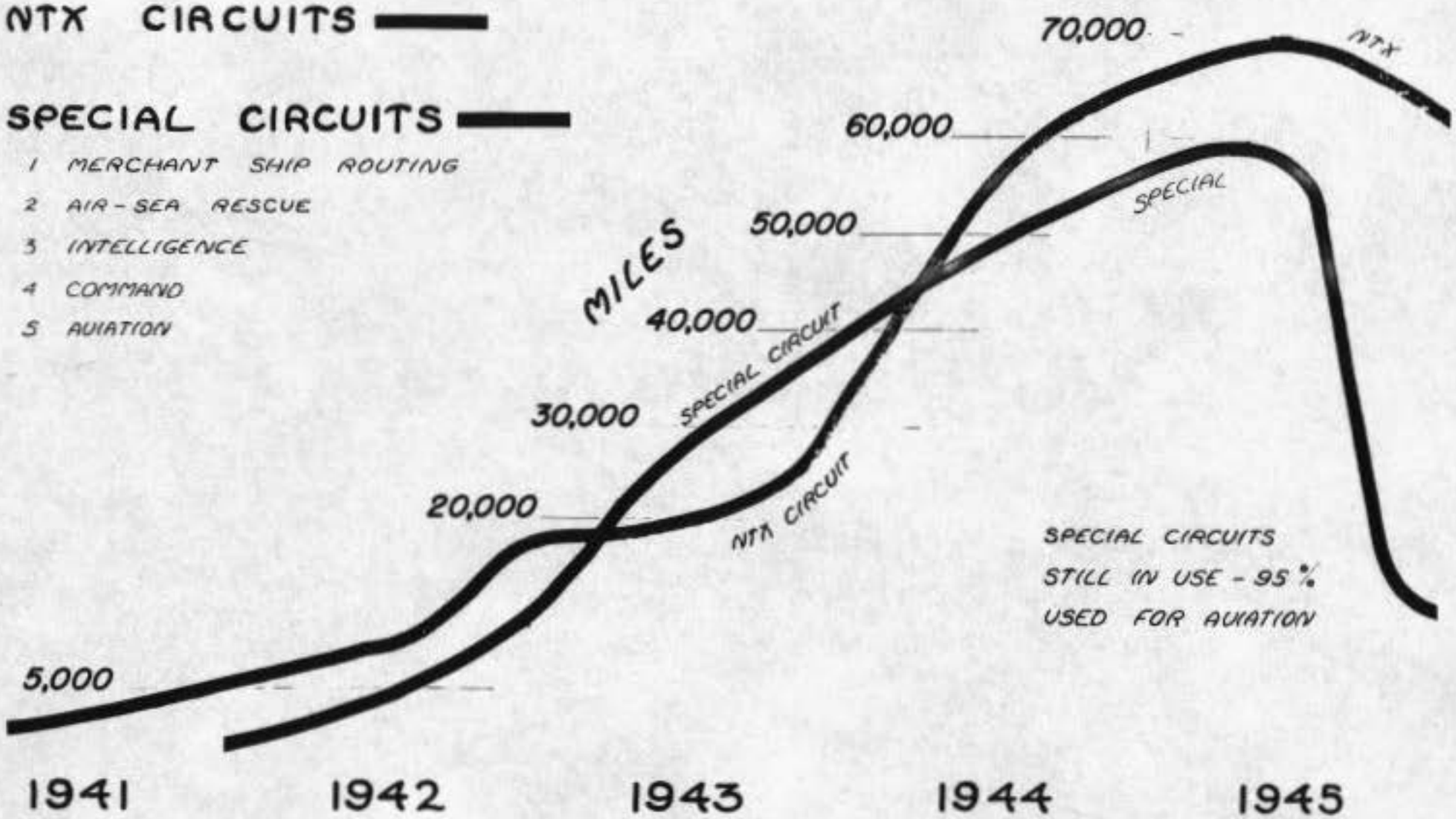
PLATE II

TELETYPEWRITER CIRCUIT LINES
CONTINENTAL UNITED STATES

NTX CIRCUITS ——

SPECIAL CIRCUITS ——

1 MERCHANT SHIP ROUTING
2 AIR-SEA RESCUE
3 INTELLIGENCE
4 COMMAND
5 AVIATION



OP-20-B

PLATE I

N T X

U.S. NAVAL TELETYPEWRITER SYSTEM

CHANNEL ROUTING GUIDE
FOR RELAY OFFICES

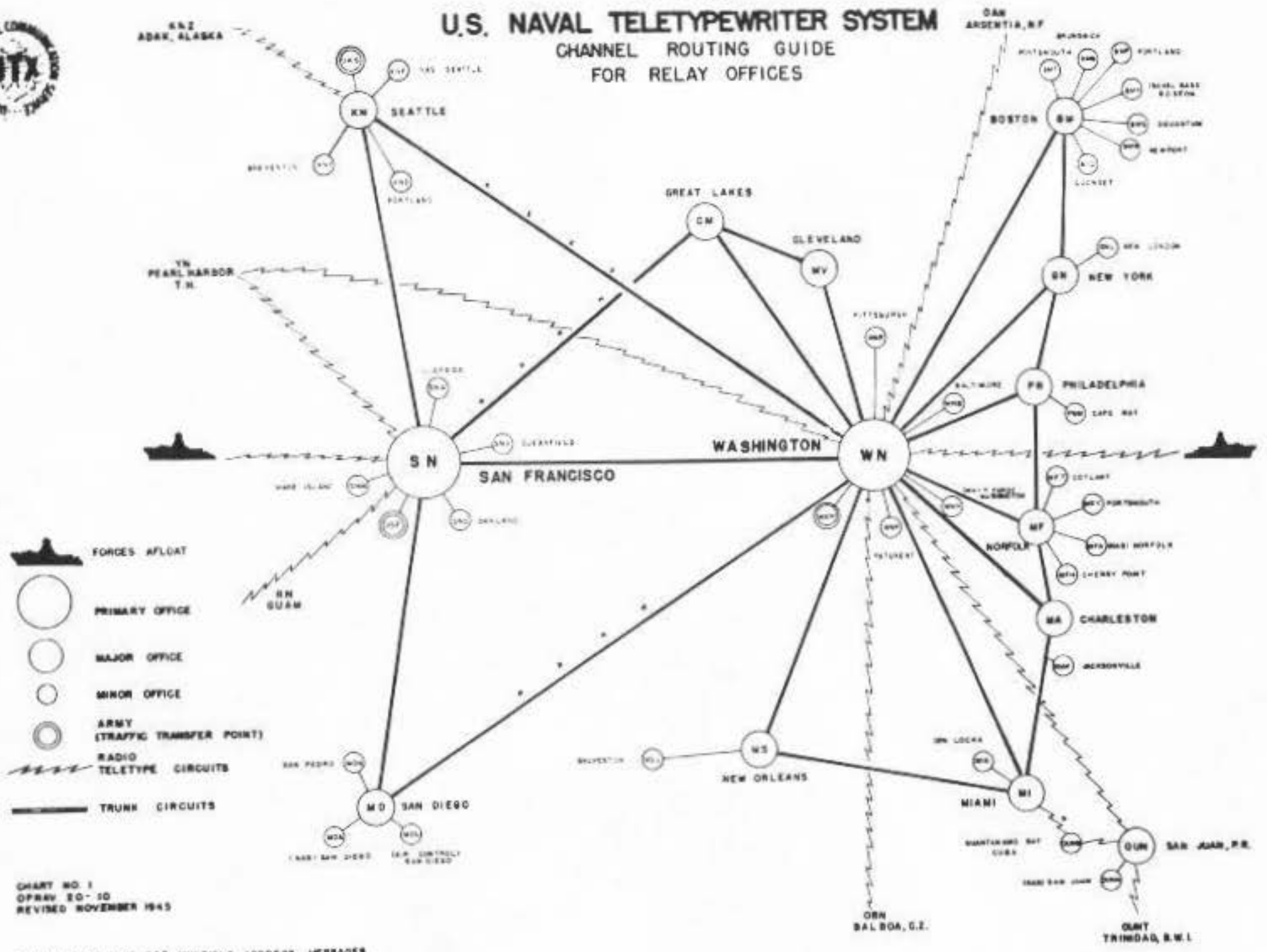


CHART NO. 1
OPNAV 20-10
REVISED NOVEMBER 1945

*NOT TO BE USED FOR MULTIPLE ADDRESS MESSAGES
EXCEPT IN ACCORDANCE WITH OPNAV 20-9

PLATE IV

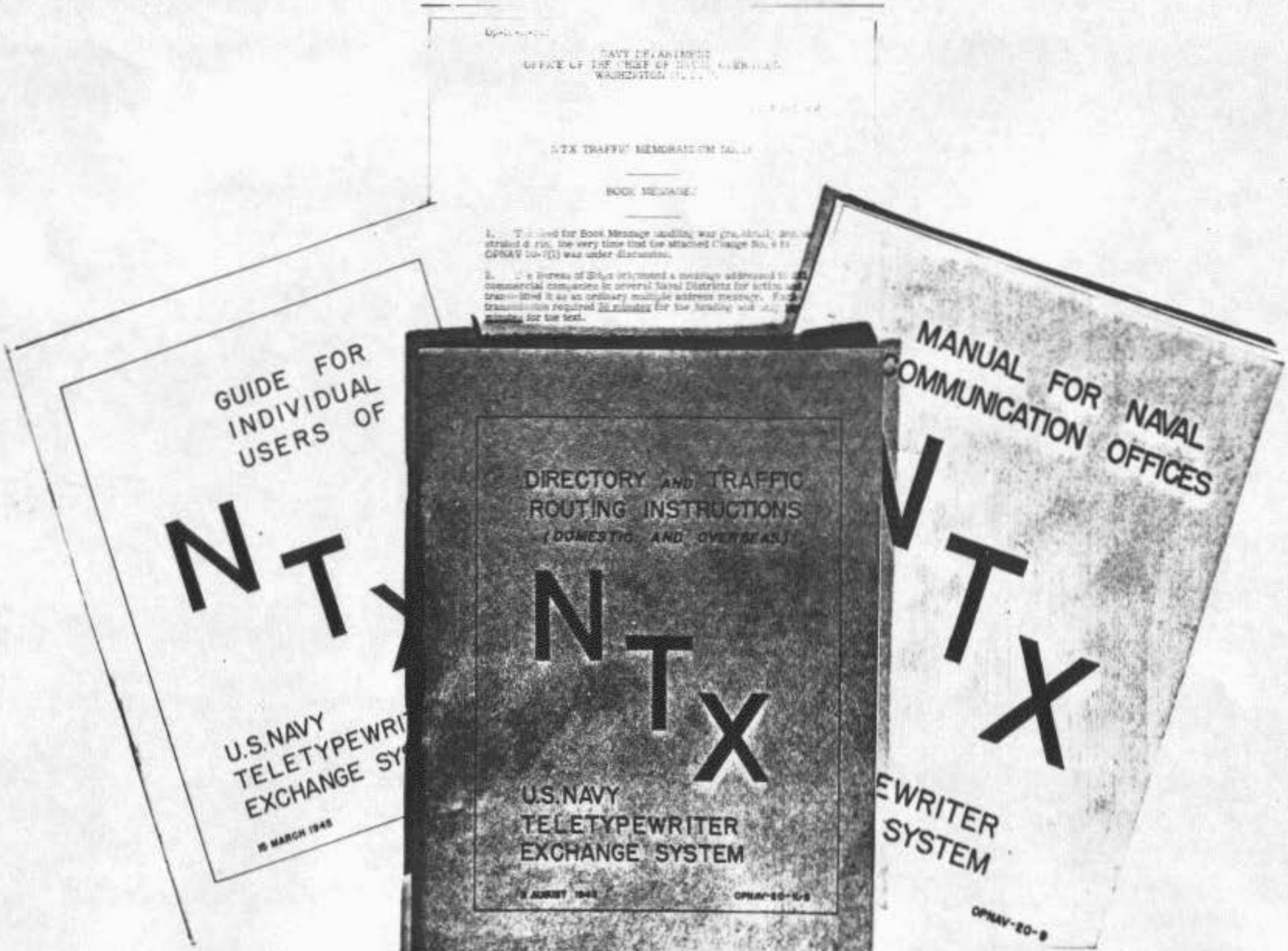


PLATE IX NTX publications provided for use by all offices served by the NTX System.

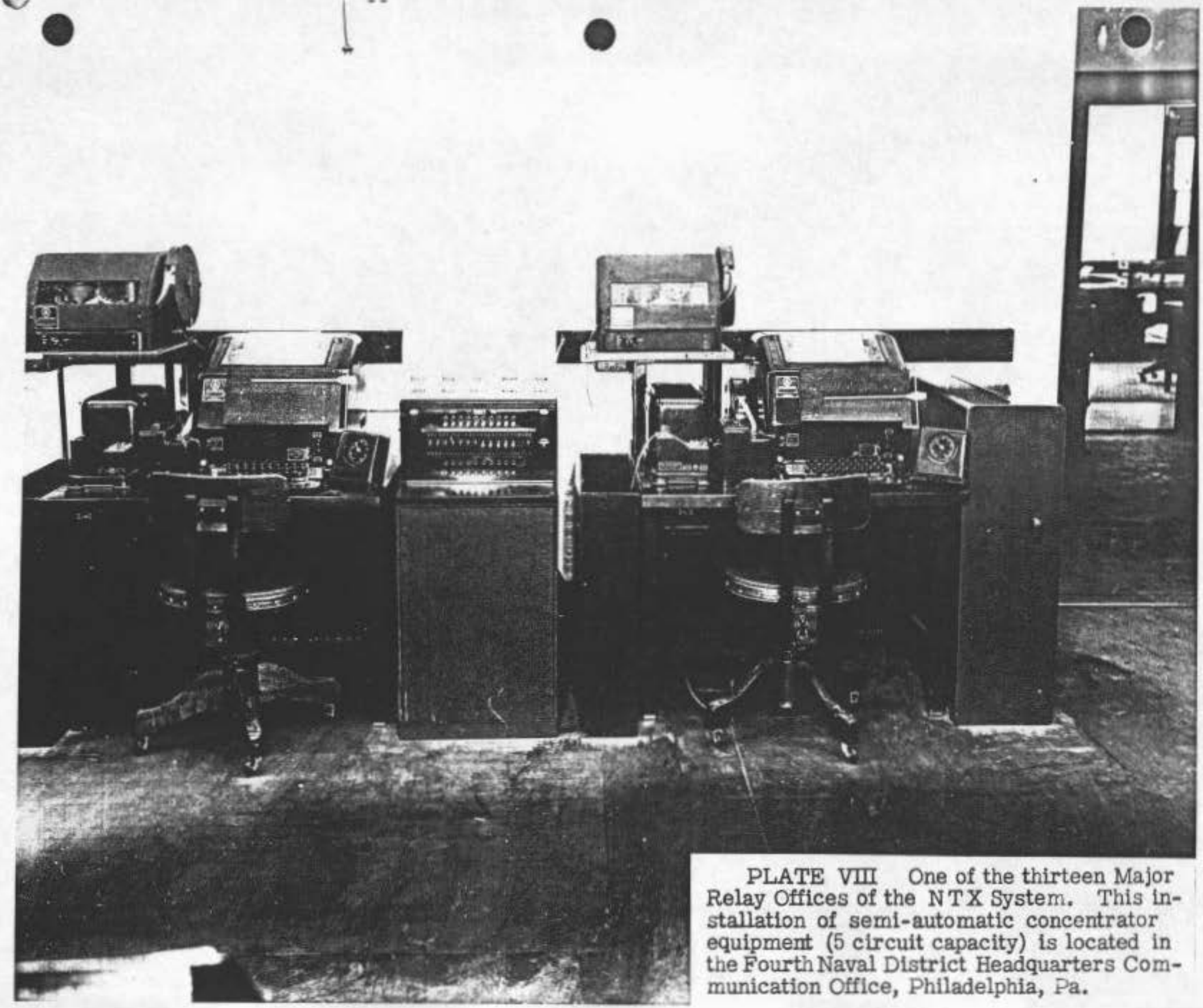


PLATE VIII One of the thirteen Major Relay Offices of the NTX System. This installation of semi-automatic concentrator equipment (5 circuit capacity) is located in the Fourth Naval District Headquarters Communication Office, Philadelphia, Pa.

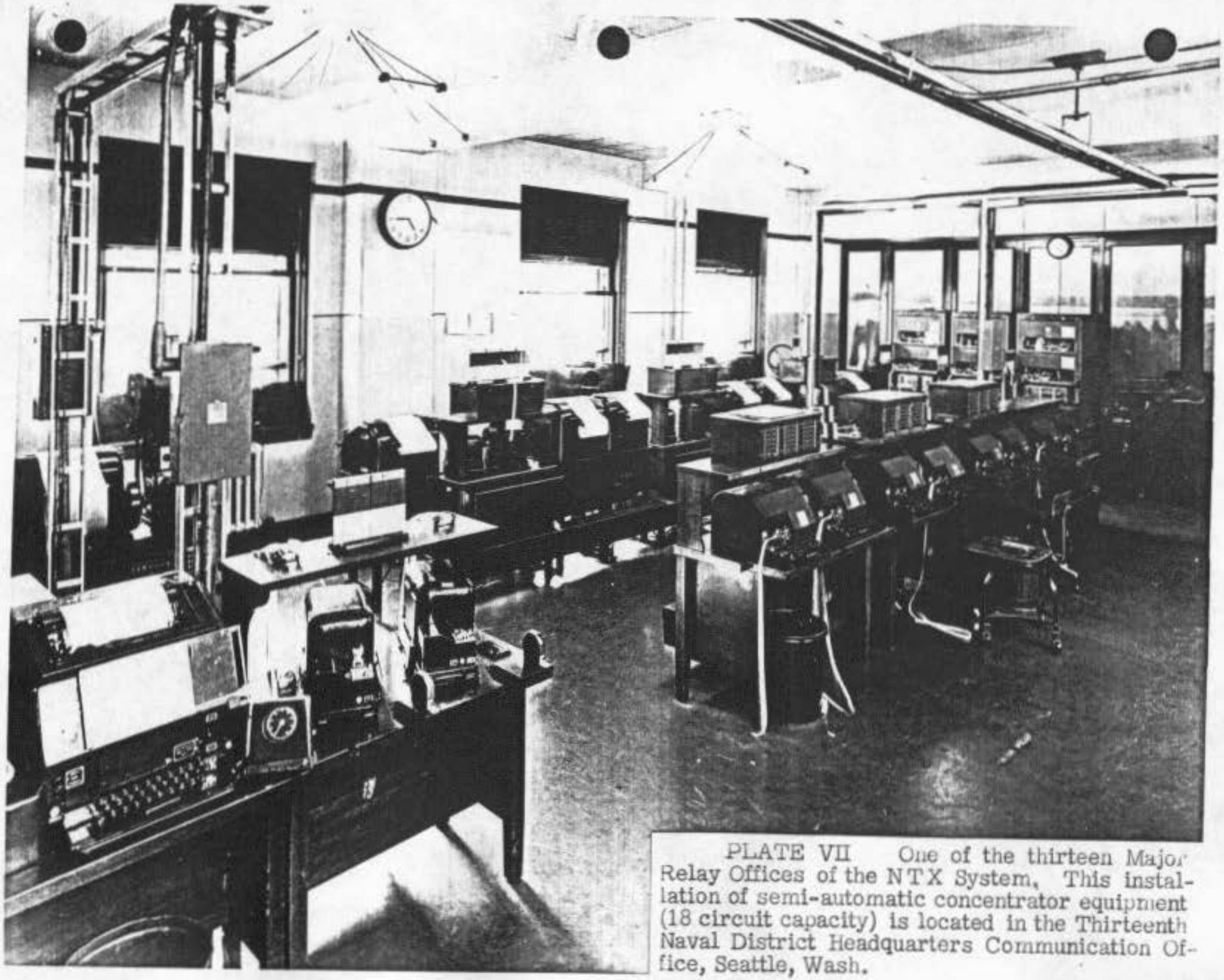


PLATE VII One of the thirteen Major Relay Offices of the NTX System. This installation of semi-automatic concentrator equipment (18 circuit capacity) is located in the Thirteenth Naval District Headquarters Communication Office, Seattle, Wash.

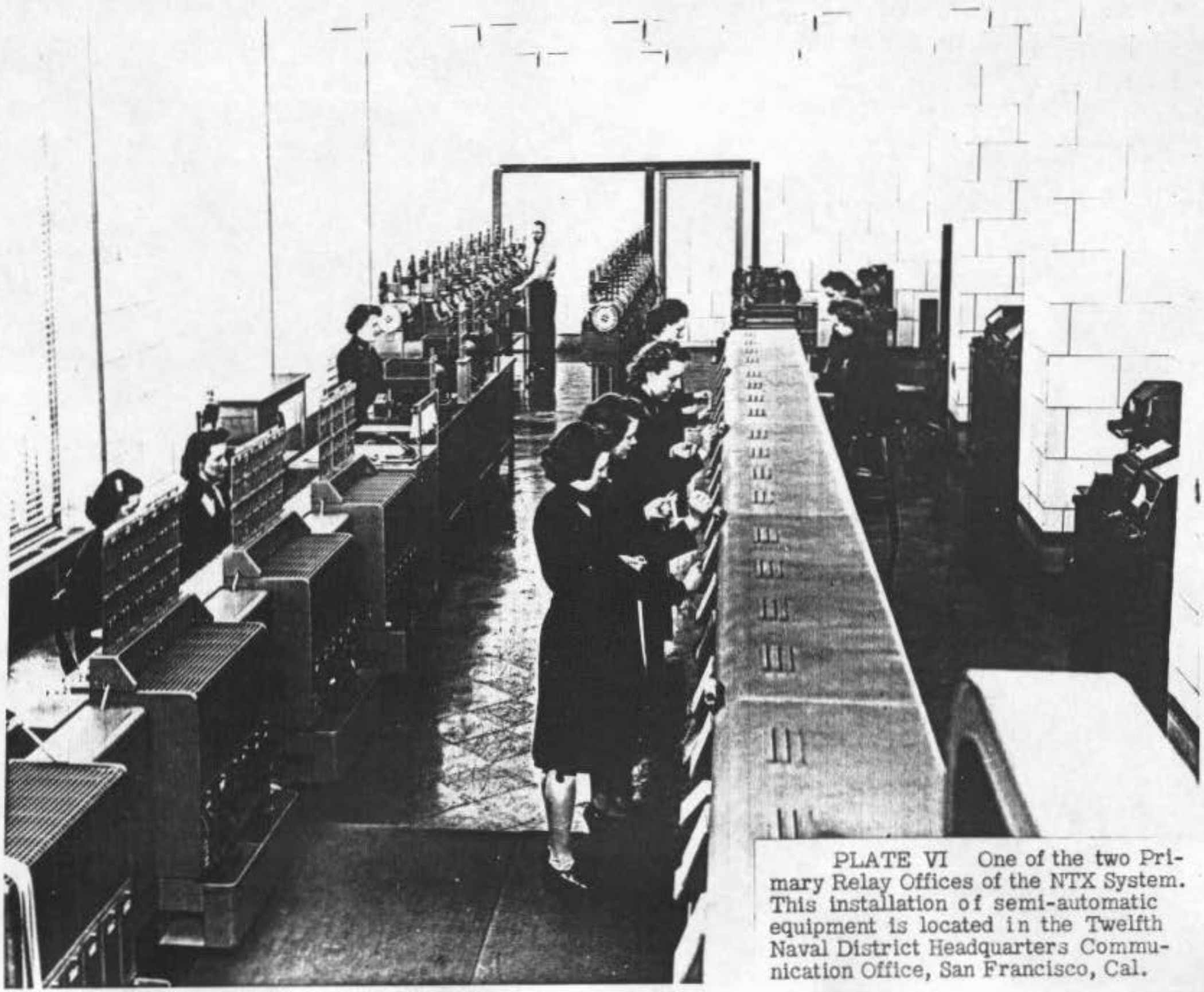


PLATE VI One of the two Primary Relay Offices of the NTX System. This installation of semi-automatic equipment is located in the Twelfth Naval District Headquarters Communication Office, San Francisco, Cal.

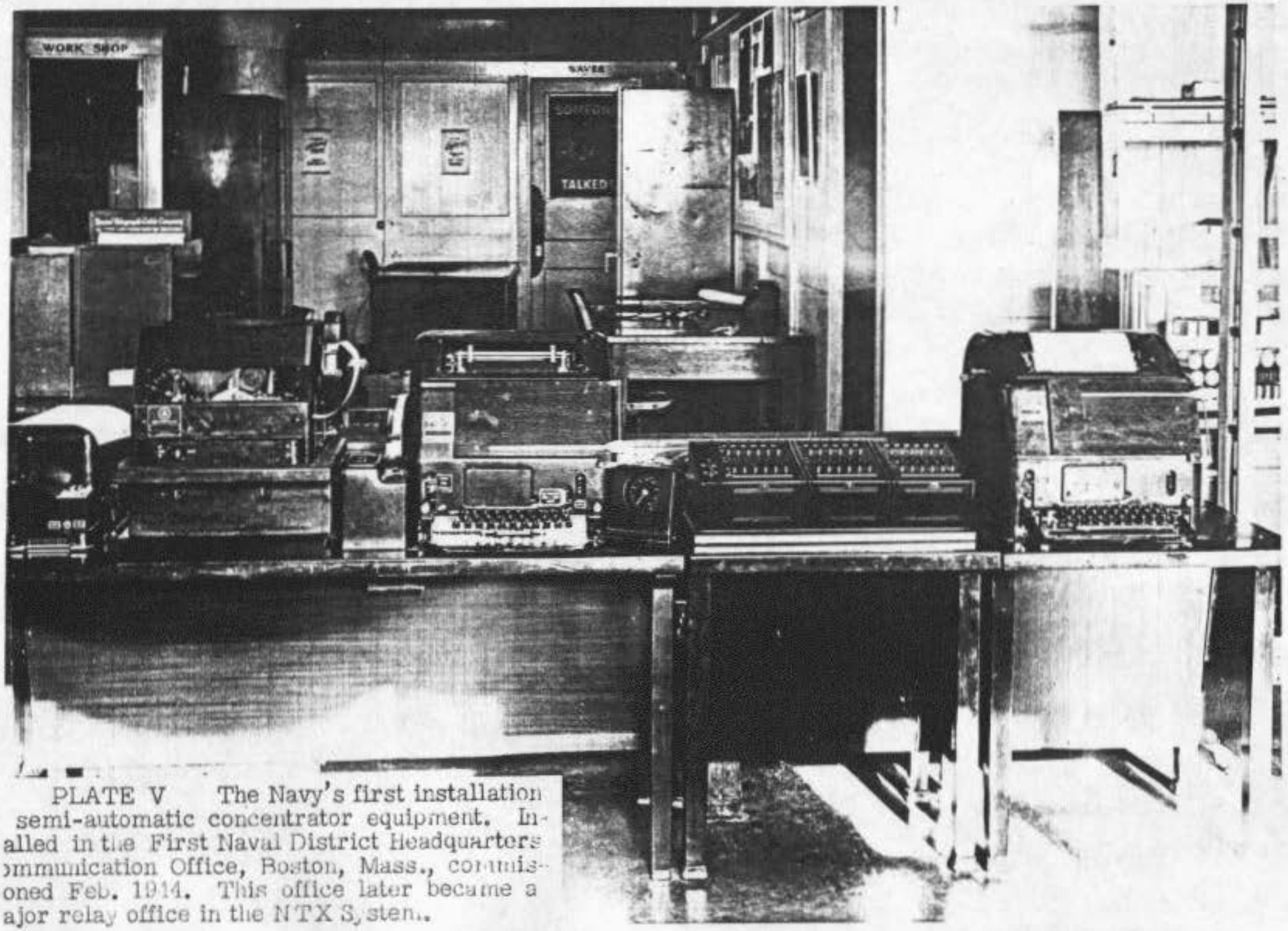


PLATE V The Navy's first installation semi-automatic concentrator equipment. Installed in the First Naval District Headquarters Communication Office, Boston, Mass., commissioned Feb. 1914. This office later became a major relay office in the NTX System.

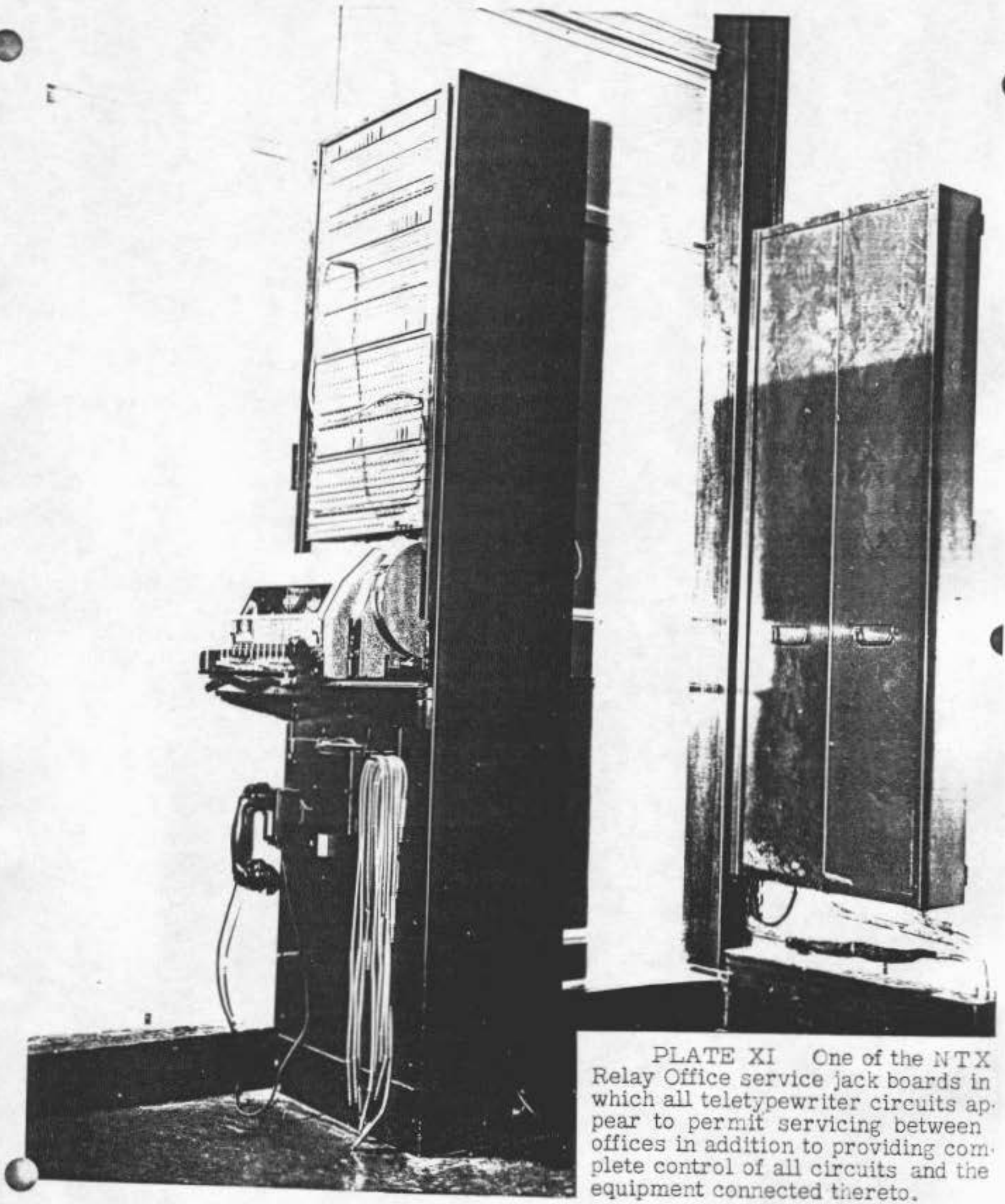


PLATE XI One of the NTX Relay Office service jack boards in which all teletypewriter circuits appear to permit servicing between offices in addition to providing complete control of all circuits and the equipment connected thereto.

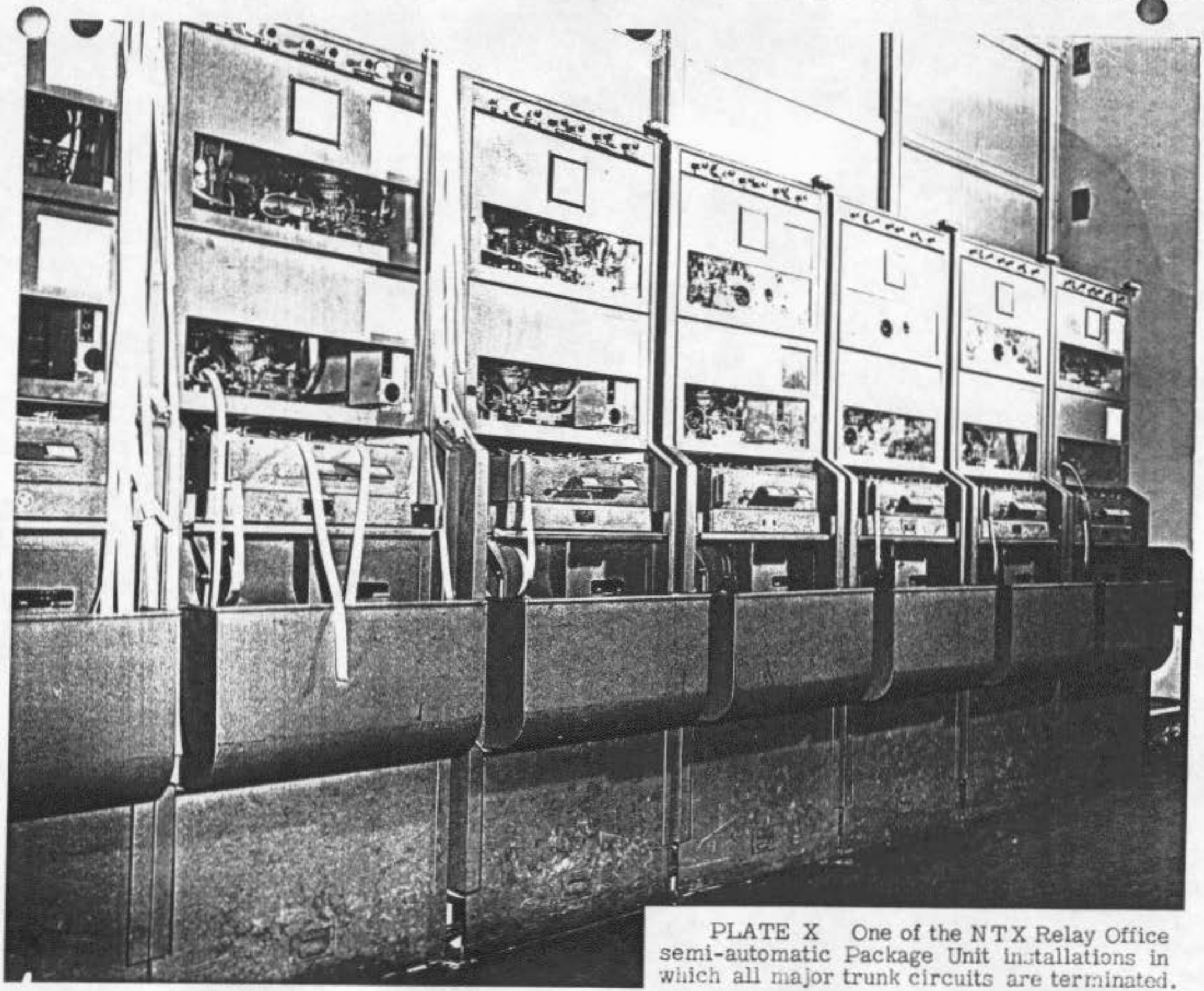


PLATE X One of the NTX Relay Office semi-automatic Package Unit installations in which all major trunk circuits are terminated.