OFFICE OF THE DIRECTOR

SECURITY INFORMATION - [redacted]

UNITED STATES DEPARTMENT OF JUSTICE

FEDERAL BUREAU OF INVESTIGATION

WASHINGTON 25, D. C.

December 4, 1952

PERSONAL AND CONFIDENTIAL
VIA LIAISON

Mr. John W. Ford
Chief, Division of Security
Department of State
Washington 25, D. C.

Dear Mr. Ford:

Enclosed herewith are two copies of the final technical report which has been compiled in connection with research as a result of the finding of a new type listening device in the residence of the U. S. Ambassador in Moscow. The final report consists of three parts as follows:

a. The report of the FBI Laboratory's analysis and experiments.

b. A detailed scale drawing of the Russian cavity microphone and photographs of the device and its various parts. This also contains photographs of the wooden seal in which the device was found.

c. The report of the Naval Research Laboratory with the theoretical development and complete discussions and diagrams of the special receiving equipment designed and constructed for the detection of these devices.

In the event there are any matters in this connection in which we can help, please feel free to call upon me.

Sincerely yours,

J. Edgar Hoover

Enclosures (2)

SECURITY INFORMATION - [redacted]

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SECURITY INFORMATION

DRAWING AND PHOTOGRAPHS RUSSIAN RESONANT CAVITY MICROPHONE

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
UNITED STATES DEPARTMENT OF JUSTICE
JOHN EDGAR HOOVER, DIRECTOR

~~TOP SECRET~~

SECURITY INFORMATION

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~~TOP SECRET~~ - SECURITY INFORMATION

This folder contains a scale drawing of the Russian resonant cavity microphone followed by photographs of the assembled unit and the unit taken apart.

There are also contained herein pictures of the wooden Great Seal of the United States in which the cavity microphone was concealed. These pictures show the front of the seal and a close-up of the area where small pin holes permitted sounds to reach the microphone diaphragm. These are followed by pictures of the interior hollowed-out portions which are exposed by removing the wooden back. The resonant cavity microphone was concealed in the front carved portion of the seal, but as the photographs show, there is also a larger hollow. The back portion of the seal contains a far more extensive hollow. These additional hollows may have contained a previous device.

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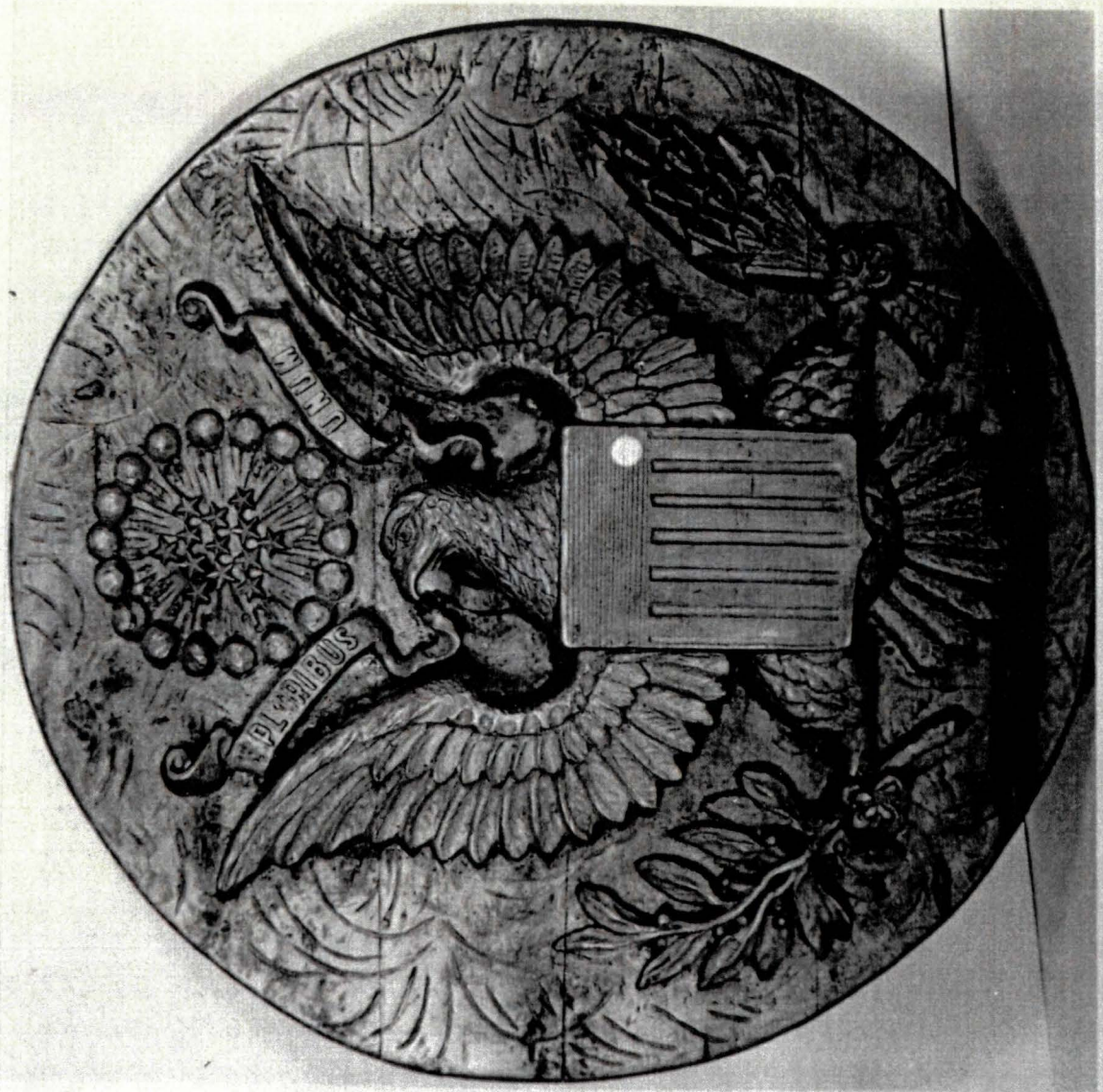
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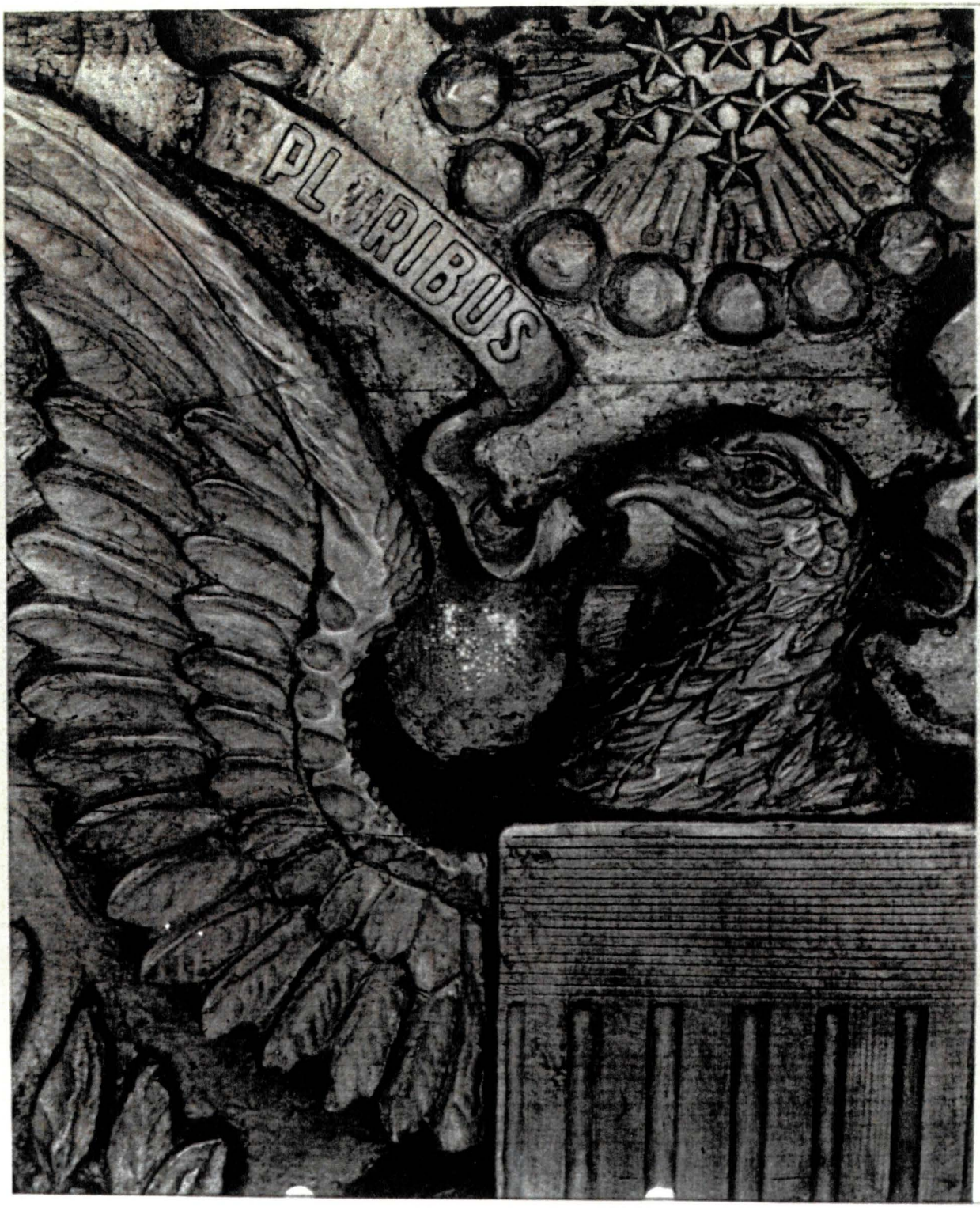
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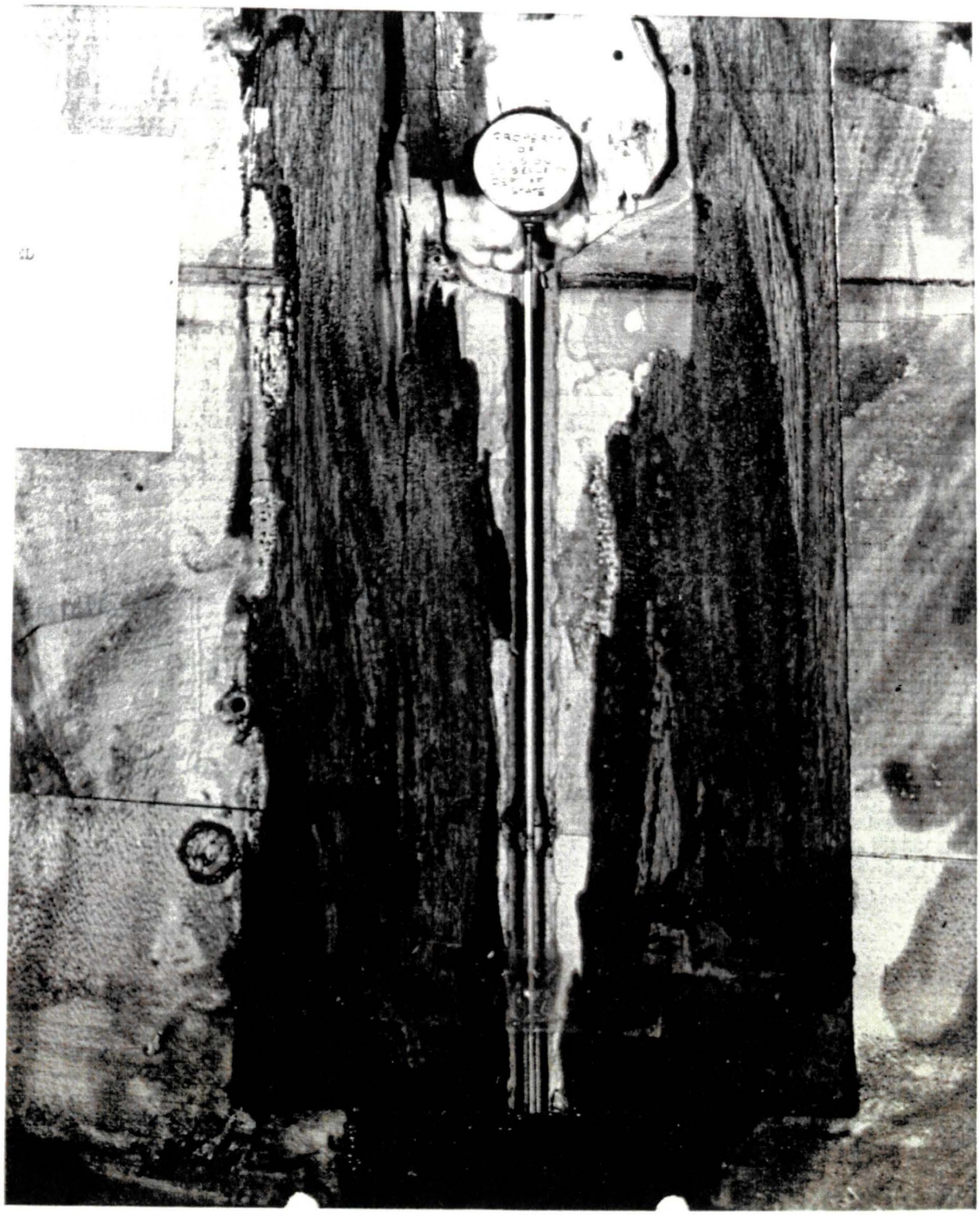

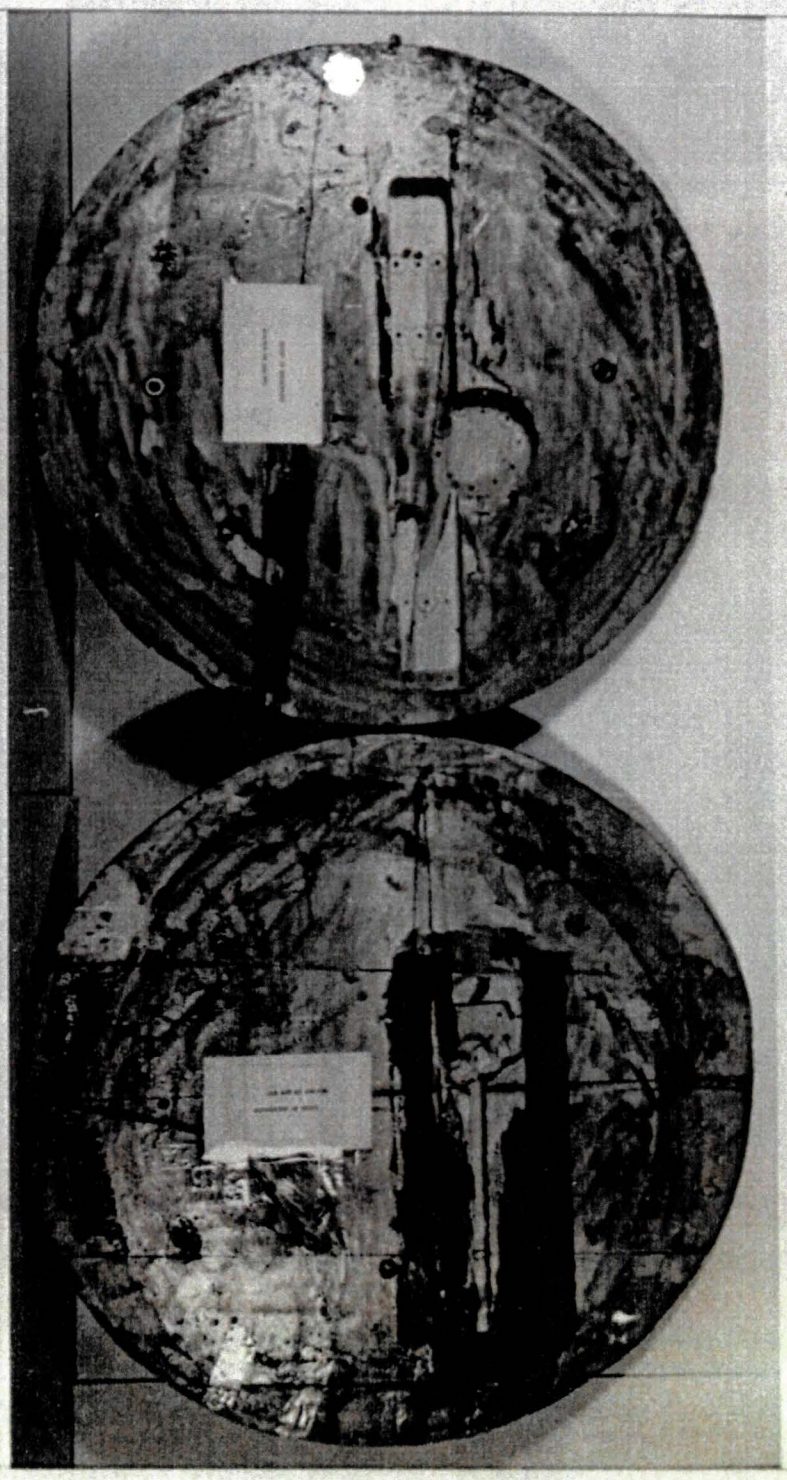

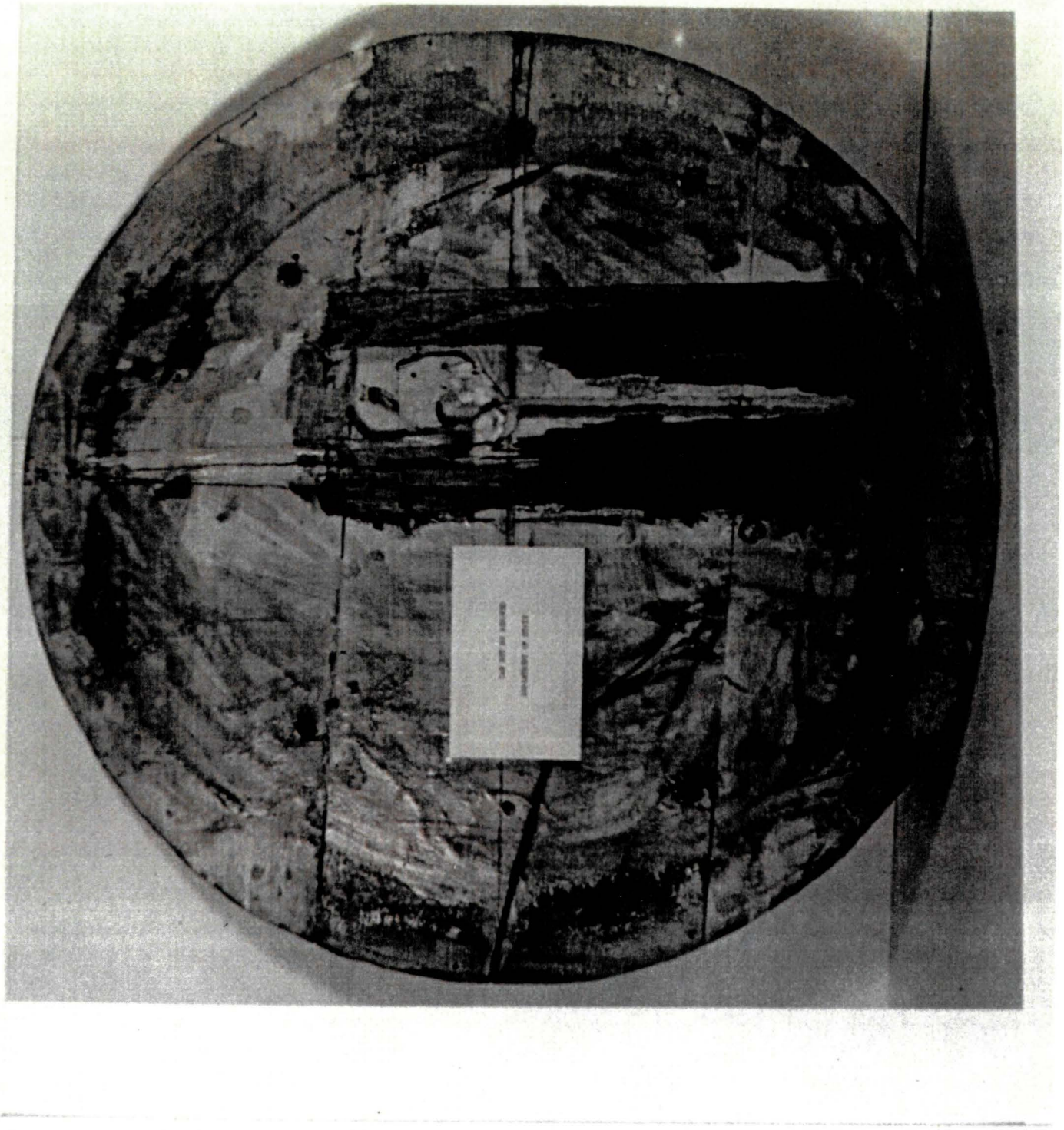

PRELIMINARY

On a number of occasions over a period of more than a year, voices of United States' and British Embassy officials in Moscow have been heard by fellow employees of the Embassy staffs on high frequency radio receivers indicating the presence of a clandestine listening device. On September 11, 1952, the U. S. State Department advised that a technician assigned to the U. S. Embassy in Moscow heard the voice of the Ambassador on a receiver and after searching, located a new type microphone device concealed in a hollowed-out space within the wooden Great Seal of the United States in the library of the Ambassador's residence, Spaso House. The device was removed and flown to Washington where it was shown to the President by the Secretary of State. On the instructions of the President that immediate steps be taken to explore this device and develop suitable countermeasure equipment, the microphone was turned over to this Bureau to coordinate the technical study and develop countermeasure equipment. The device was received on September 15, 1952, from Deputy Assistant Secretary of State W. K. Scott, Mr. John W. Ford, Chief, Division of Security, and Mr. Fred C. Snider of the Security Division of the Department of State. The wooden seal in which the microphone device was concealed was received in the Laboratory of this Bureau on November 12, 1952, from Mr. Robert C. Ecker, Division of Security, Department of State. A scale drawing of this microphone device together with photographs of both the device and the seal are attached to this report.

LABORATORY EXAMINATIONS

An examination was immediately started in this Laboratory. A visual examination of its design indicated that it probably functioned as a high frequency resonant cavity. It therefore required no visible source of power, but would be energized by a remote transmitter. The device would rebroadcast a signal to be received at a remote point and the rebroadcast signal would be modulated by sounds within the area wherein the device was located. With equipment that was immediately available, the instrument was made operative and found to be resonant at a

frequency of approximately 1700 megacycles. Since the modulation is produced by a condenser-type microphone, the audio response was found to be excellent.

The operating frequency of 1700 megacycles is within the general range of low radar frequencies and it became immediately obvious that extensive facilities and experience in this particular field would be necessary to design and construct the needed countermeasure equipment. Assistance was therefore requested of the Naval Research Laboratory where an excellent and most exhaustive project has been completed. The comprehensive report of the Naval Research Laboratory will be referred to hereinafter.

A physical examination of the microphone in the FBI Laboratory showed that the unit is approximately one inch in diameter and 3/4 inch long having extended from its circumference an antenna approximately nine inches in length. The exact dimensions are set forth in the schematic drawing which is contained in Attachment #1 with accompanying photographs. The entire unit has a weight of 1.1 ounces (31.386 grams). It consists of a hollow cylinder machined from copper, the interior of which is polished and silver plated, the exterior being silver plated without polishing. The silver plating is .0015 inches in thickness. One end of this cylinder has exterior threads to receive a ring composed of bronze over which is fastened a diaphragm of silver plated metal foil. Prior to the exploration of this device, it was necessary to replace the original diaphragm which had become damaged. The replacement diaphragm is of nickel .00025 inches thick, which has been silver plated on the inside. By screwing the diaphragm ring on the cylinder, the foil can be stretched to insure a flat diaphragm surface. The end of the cylinder opposite the diaphragm has interior threads into which there is screwed a plate machined from solid copper and silver plated. In the center of the interior surface of this plate there is machined a post on the end of which is a disk. These are integral parts of the plate and all are silver plated. Screwing in the plate adjusts not only the size of the cavity, but positions the disc close

to the interior of the diaphragm to form the condenser microphone. Two holes in the plate serve as a spanner wrench adjustment as well as an air escape to avoid compression within the cylinder and there is also a small hole drilled through the center of the disc, post and plate as will be seen from the photographs. The surface of the disc is grooved. The cylinder proper is completed with a slip-fit cap on each end which is composed of brass and silver plated. The cap on the plate end is solid, whereas the cap over the diaphragm serves as a protective grill. A hole through the circumference of the cylinder has a polystyrene plug to insulate the antenna from the cylinder. The antenna is a silver plated brass rod projecting into the interior of the cylinder and threaded through the polystyrene plug. The antenna rod projecting into the cylinder has a brass plate attached. It is interesting to note that "N 11" is scratched into the circumference of the cylinder.

Examination of the Great Seal itself showed the Seal to be composed of two sections, front and back, both of hard maple. Hard maple is available in the United States and most foreign countries having cool climate. The exterior surface of the front portion of the Seal on which is carved the Great Seal of the United States is coated with a transparent finish similar to shellac. Several wooden dowels, 3/8 inch in diameter, were located at various places in the Seal which were necessary to its construction. One of these dowels was examined and found to be birch which is a wood widely used for dowels. In its present condition the Seal has a diameter of approximately 22 inches and is approximately 3 3/4 inches thick.

The microphone device was found to have been placed in a circular-shaped hollow in the rear of the front section with another groove cut into the wood to accommodate its antenna. A piece of plywood and cotton were used to secure the device on the sides, and a thick piece of walnut veneer was glued over it, thereby separating the device from the cavity in the rear section of the Seal.

The microphone was positioned in the Seal so that the diaphragm was located in the area of the depression

under the eagle's bill. The antenna extended downward. Only a very thin layer of wood covered the diaphragm of the microphone and this thin layer of wood was penetrated by numerous pin holes which would normally escape detection, but which are emphasized in the photograph by shining a light through these holes from behind the Seal.

Into the rear plate of the Seal, which is composed of three boards, 1 5/16 inches thick, glued side by side, a hollow has been drilled and chiseled. This hollow is generally rectangular in cross section, approximately 2 inches wide, 16¼ inches long and 1 1/8 inches deep. The long dimension is vertical when the Seal is oriented in the proper position for mounting on a wall. An extension of this recess projects sidewise from the approximate center of the rectangular hollow. This extension is roughly circular in shape, 3 3/8 inches in diameter, and the same depth as the main recess. The rear surface of the front section of the Seal has been cut out to correspond with the 3 3/8 inches circular recess in the back. However, only a shallow groove about one inch wide and one-quarter inch deep has been chiseled out to correspond to the 2 x 16¼ inches recess in the back.

Due to the absence of discernible discolorations of the surfaces of the wood of the Seal and of the recesses, the relative times in which the recesses were cut could not be determined.

The large recess in the Seal has the appearance of the work of a professional wood worker and would even then have required several hours to complete. The smaller recess cut into the Seal for the antenna of the device is a crude, unfinished groove. Cutting this groove and taking the steps necessary to install the device (cutting, gluing, and pegging in the plywood piece and gluing on the walnut veneer) could have been accomplished in less than two hours. To this time, however, must be added the time necessary to remove and replace the trim from around the Seal, separate and reglue the back to the front, and finish the edge of the Seal to conceal the tampering marks.

Inset into the back section of the Seal were two nuts, apparently placed therein to secure two bolts from which the Seal was hung. Examination of these nuts showed that they were 5/16 inch nuts having 20 "V" type threads per inch. The physical dimensions of the nuts are similar to those of nuts manufactured in the United States.

With regard to the larger recess cut in the Great Seal, it is noted that this recess is considerably more extensive than required for the resonant cavity device which was actually found. Accordingly, it appears probable that this larger recess has contained earlier microphone devices, either of a battery power radio transmitter type, or possibly of an earlier resonant cavity type similar to the present one, but operating on a lower frequency and therefore larger in physical size. The geometry of the larger recess suggests the possibility of a radio antenna with the microphone device located in the center of the antenna rather than being located at the end of the antenna as is the case with the device which was actually found.

COUNTERMEASURE EQUIPMENT

The immediate, initial steps taken by the Naval Research Laboratory were directed toward producing one complete set of detection and jamming equipment for use by the State Department. This objective was completed on October 3, 1952. Subsequent work was then directed toward refining the design of the first equipment, exploring more fully the theoretical aspects of the microphone device, and checking such theory by experimental verification. The detailed results are incorporated in Naval Research Laboratory Report, #4087.

Briefly, it is noted that the resonant cavity microphone device is designed to be activated by a beam of radio waves directed toward it. No batteries, wires, or other similar accessories are required at the microphone location. Upon striking the microphone device, a portion of the impinging radio energy may be thought of as being continuously absorbed and then retransmitted by the device; however, upon retransmission, the radio energy sent out from the microphone device is modulated by, and thus carries with it, any sounds which were present at the microphone location. These sounds,

therefore, may be recovered by receiving the retransmitted signals on suitable radio receiving equipment, which may be located either in the immediate vicinity of the microphone device or which may be located at a distance.

Accordingly, the complete detection equipment requires:

1. A source of radio signals to illuminate the area under search with radio waves, thereby energizing any concealed devices of the cavity type. (This source must be capable of being varied between the limits considered probable for the cavity microphone technique, in the present instance considered to be from approximately 65 to 3000 megacycles.)

2. A source of sound within the area being searched to provide the necessary sound excitation of the microphone.

3. Suitable radio receiving equipment to detect the radio signal reradiated, or scattered, by the microphone device.

When attempting to detect the presence of such microphone device without regard to whether the enemy may become aware of such detection processes, the complete detection equipment as described above would be used. If, however, it were desired to detect the presence of such device without enemy knowledge of such detection, the source of sound (Item #2 above) would have to consist of conversation or other sounds normal to the area under search, and the source of radio waves (Item #1 above) would have to be that normally used by the enemy while operating the device for their own listening purposes, since any other source of radio waves could be subject to detection by the enemy. Accordingly, only Item #3 of the detection equipment, namely, the receiver, would be actively used by the searchers under such conditions.

PROCUREMENT OF COUNTERMEASURE EQUIPMENT

The critical element of the above detection equipment

is the receiver (Item #3) and such a receiver has been designed in complete detail by the Naval Research Laboratory and fully described in Naval Research Laboratory Report, #4087. A suitable sound source (Item #2) consisting of a simple tone generator, likewise has been incorporated in the cabinet containing a portion of the receiver equipment. The information contained in Naval Research Laboratory Report, #4087, is set forth in sufficient detail to serve as the basis for construction or procurement of additional similar units. The remaining element, namely, the source of radio signals, (Item #1) may be obtained through adaptation of commercially available signal generators or related equipment, or preferably, through the procurement of signal generators designed specifically for the present purpose. In the initial detection equipment furnished to the State Department, the sources of radio signals consisted of three separate components as follows:

a. A General Radio type 1208A oscillator covering the range 65 to 500 megacycles.

b. A General Radio type 1209A oscillator covering the range 250 to 920 megacycles.

c. An oscillator portion of a military radio receiver, type R-111B/APR-5A, providing signals over the range 1000 to 3100 megacycles. (Although not immediately available for the initial equipment furnished to the State Department, it is noted that signal generators covering this general range are available from commercial sources.)

In the initial planning of this project the possibility was considered that it would be necessary to design and construct special transmitters for the illumination of devices of this type. However, since suitable oscillators were found for this purpose and types other than those supplied to the State Department are commercially available, the time and expense to construct such transmitters was not considered justified.

Minimum construction or procurement costs of the

receiver group equipment have been estimated to be approximately $1100 each. Commercially available signal generators (3 General Radio units) covering the range 200 to 2000 megacycles are estimated to cost approximately $900 for the set of three. These figures represent minimum costs and could easily double or even triple on urgent time procurement schedules.

It is understood that quantity procurement of the complete detection equipment is under study by a special committee.

RANGE

With reference to the distance possible between the microphone device and the point of enemy listening, the maximum range is considered theoretically on pages 25 through 28 of Naval Research Laboratory Report, #4087. As representative, the following specific examples are cited from that report:

> For activating transmitter power of 1 watt, and assuming operation in free space (no walls or other obstruction whatever in near vicinity) with top quality receiving equipment, the figure of 591 feet is obtained for the range between the microphone device and the listening point (both the activating transmitter and the receiver assumed to be located at the receiving point). For a transmitting power of 900 watts using high-gain antennas and again assuming optimum conditions, the figure of 15 miles range is obtained.

These ranges, of course, are decreased very rapidly by the presence of intervening absorbing material such as wall structure, buildings, et cetera. Low power tests using transmitter powers in the order of 4 watts or less are considered to be consistent with the theoretical development, when considered in light of equipment available and the presence of absorbing materials in the vicinity of tests conducted. For example, using a power estimated to be approximately two watts, and a receiver known to be substantially less sensitive than the optimum considered in the theoretical development, an experimental operating range of approximately 100 feet was obtained in the vicinity of buildings,

but with no walls directly intervening between the listening point and microphone device. The presence around the microphone device of even the wood contained in the Great Seal was found experimentally to reduce the range very greatly.

Therefore, because of the many variable factors involved and the serious decrease in range caused by intervening materials, it is not practical to predict the operating distance in any specific situation without an actual test.

COUNTERMEASURE LIMITATIONS

It is desired to here emphasize that the countermeasure equipment designed and constructed at the Naval Research Laboratory is for the specific purpose of detecting and locating the particular type of listening device submitted for study. Effective as the resonant cavity microphone may be, it is but one of many possible listening devices. Even the successful use of the countermeasure equipment in locating other similar microphones should not be accepted as assurance of security. Some consideration might be given to protective security measures as a means of countering this and other types of listening devices. It would be expected that any such measures would involve some expense and inconvenience. One suggestion offered involves the use of a portable or demountable enclosure which could be quickly erected within a room. Light weight acoustic wall tile or even a tent of heavy cloth would afford considerable protection against sounds within the enclosure reaching a microphone outside. Additional protection would be obtained by incorporating a metal foil or screen to shield against radio frequency radiation from within the enclosure. Another approach could involve small light weight headsets and microphones which could be interconnected and would permit two or more persons to engage in a discussion without producing the volume of sound of normal conversations.

The whole problem illustrates the difficulty of any attempt to counter any listening devices present without knowing the devices against which we are seeking protection.

SUMMARY

The resonant cavity microphone has been found to give excellent audio response, but to have inherent disadvantages with respect to its location and operation. It has the distinct advantage that no visible source of power is necessary for its operation. It, of course, does not originate a signal but when excited by a remote transmitter, a modulated signal is rebroadcast which can be received at a remote point at the same or a different place from the energizing transmitter.

Interim countermeasure equipment consisting of transmitters and a receiver especially designed and built at the Naval Research Laboratory was turned over to the State Department on October 9, 1952, in an effort to permit the energizing and locating of any additional devices of this type.

Technical study continued and has resulted in the final detecting and receiving equipment built by the Naval Research Laboratory which was turned over to the State Department on November 19, 1952, and in the exhaustive Naval Research Report, #4087.

This equipment is designed for the specific purpose of detecting and locating listening equipment of the general type under study and is not to be considered as assurance of security against other types of microphones or listening devices.

The complete report consists of this report and two attachments:

1. A drawing and photographs of the resonant cavity microphone and the Seal in which it was concealed.

2. The complete and final report of the Naval Research Laboratory, #4087, "Final Report - Semi-active Listening Device."


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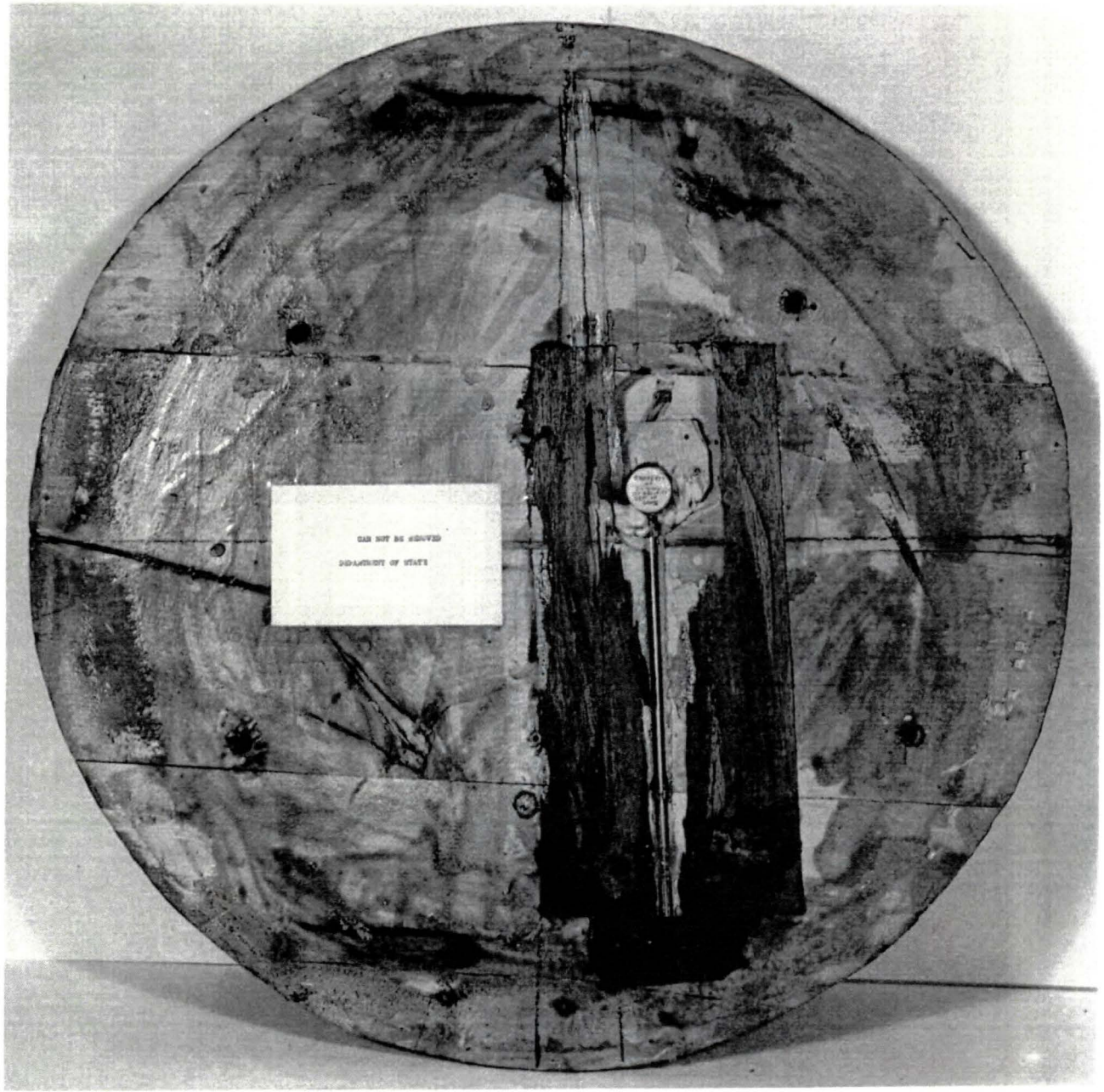
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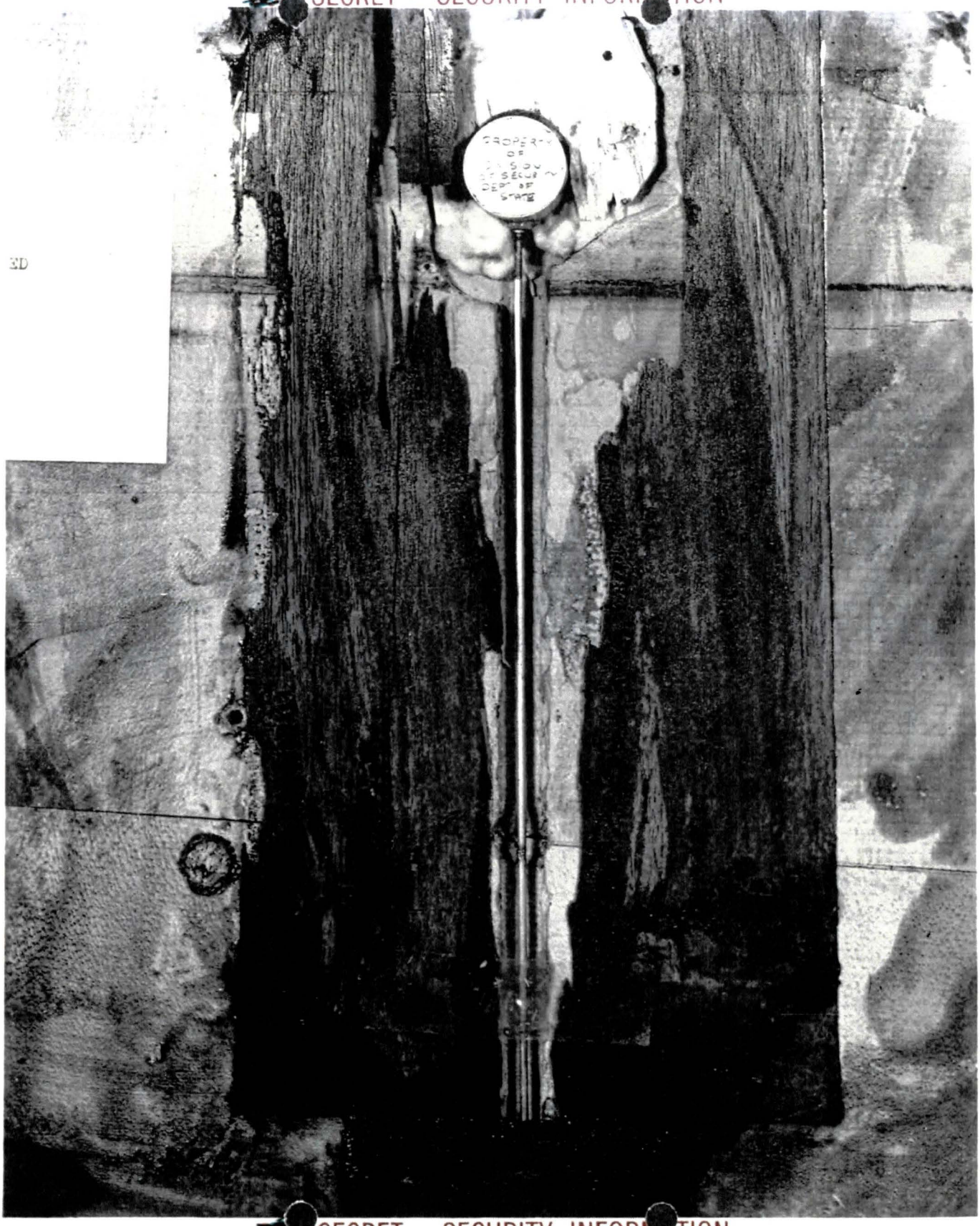

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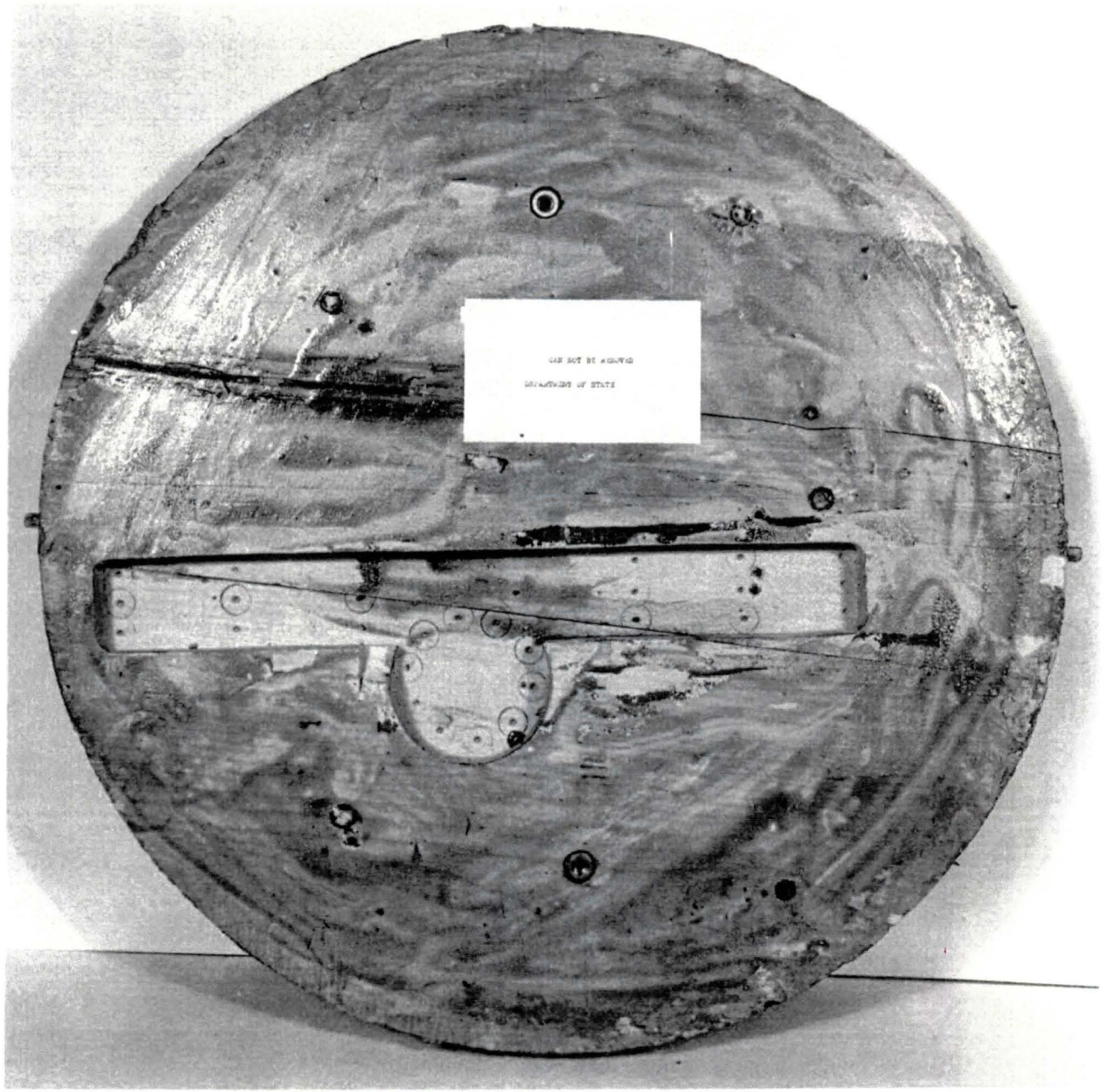
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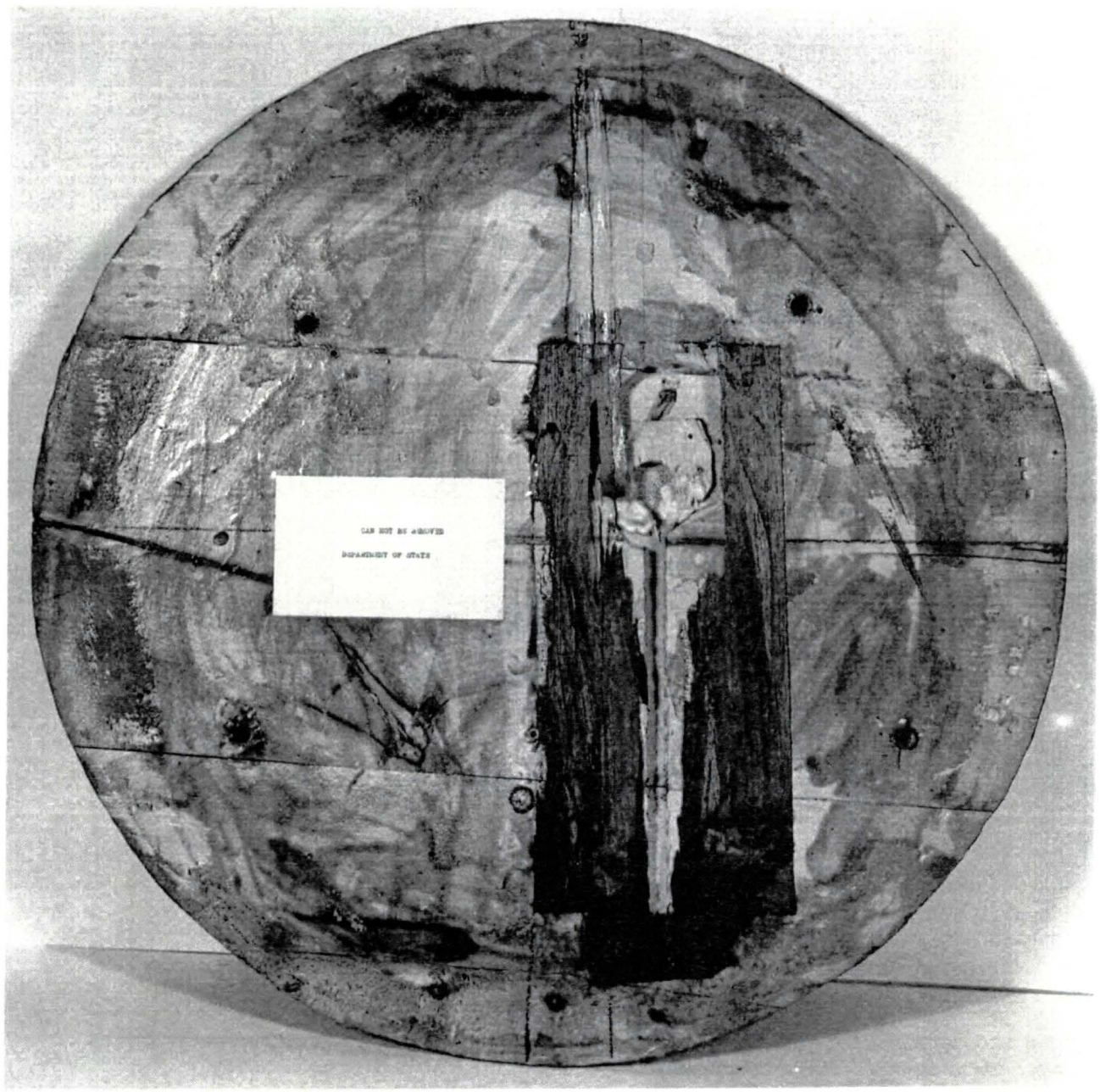
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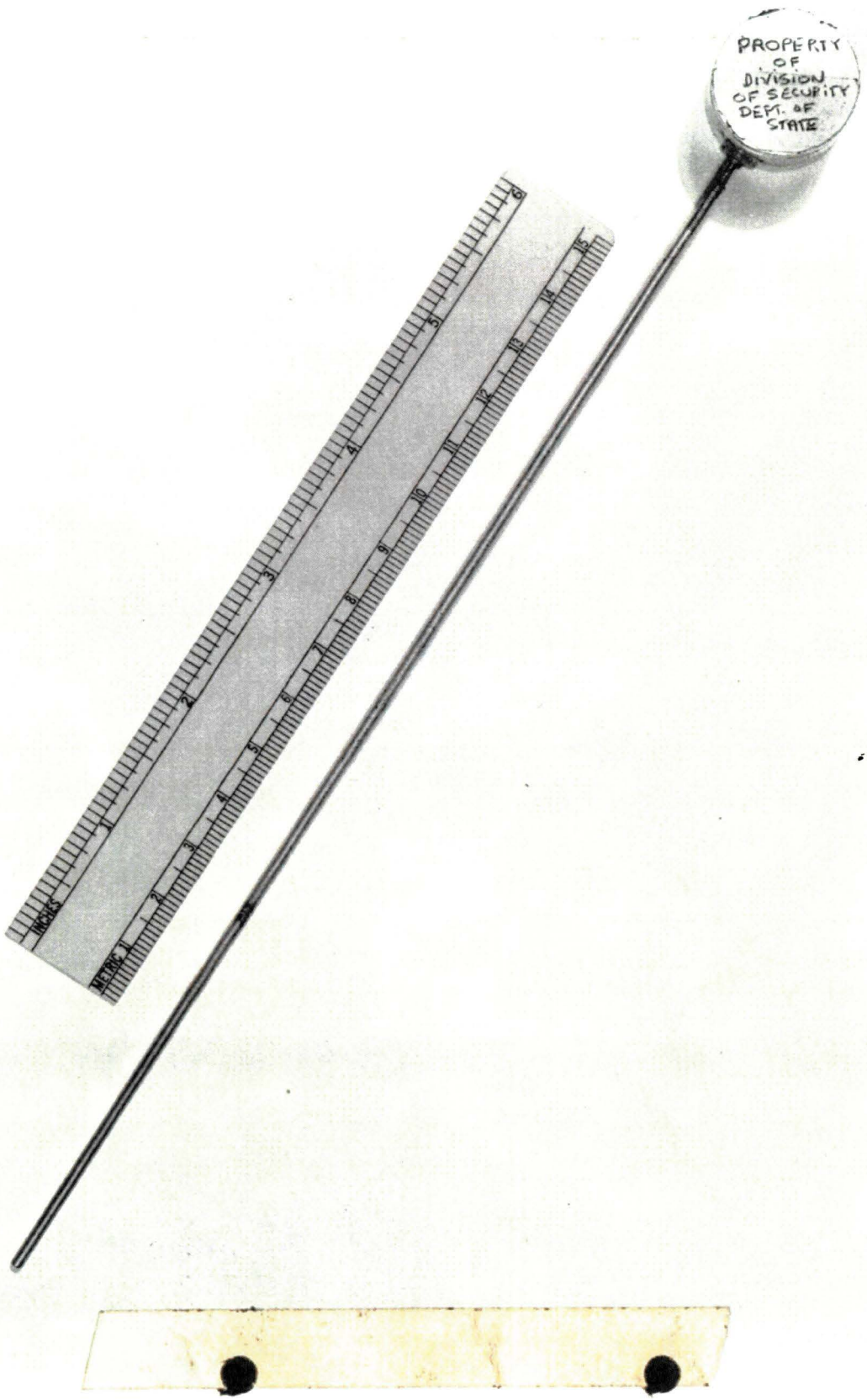
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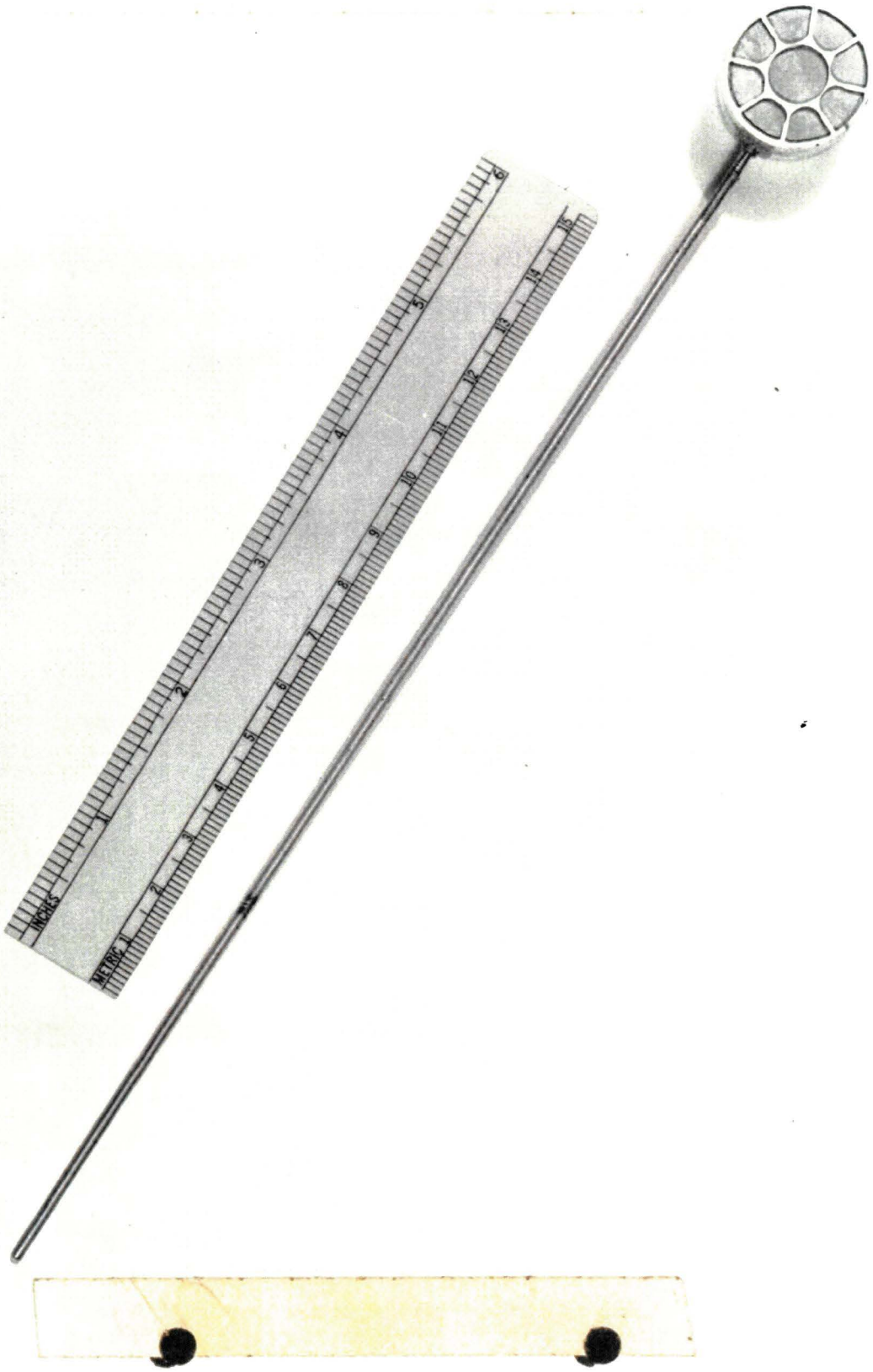
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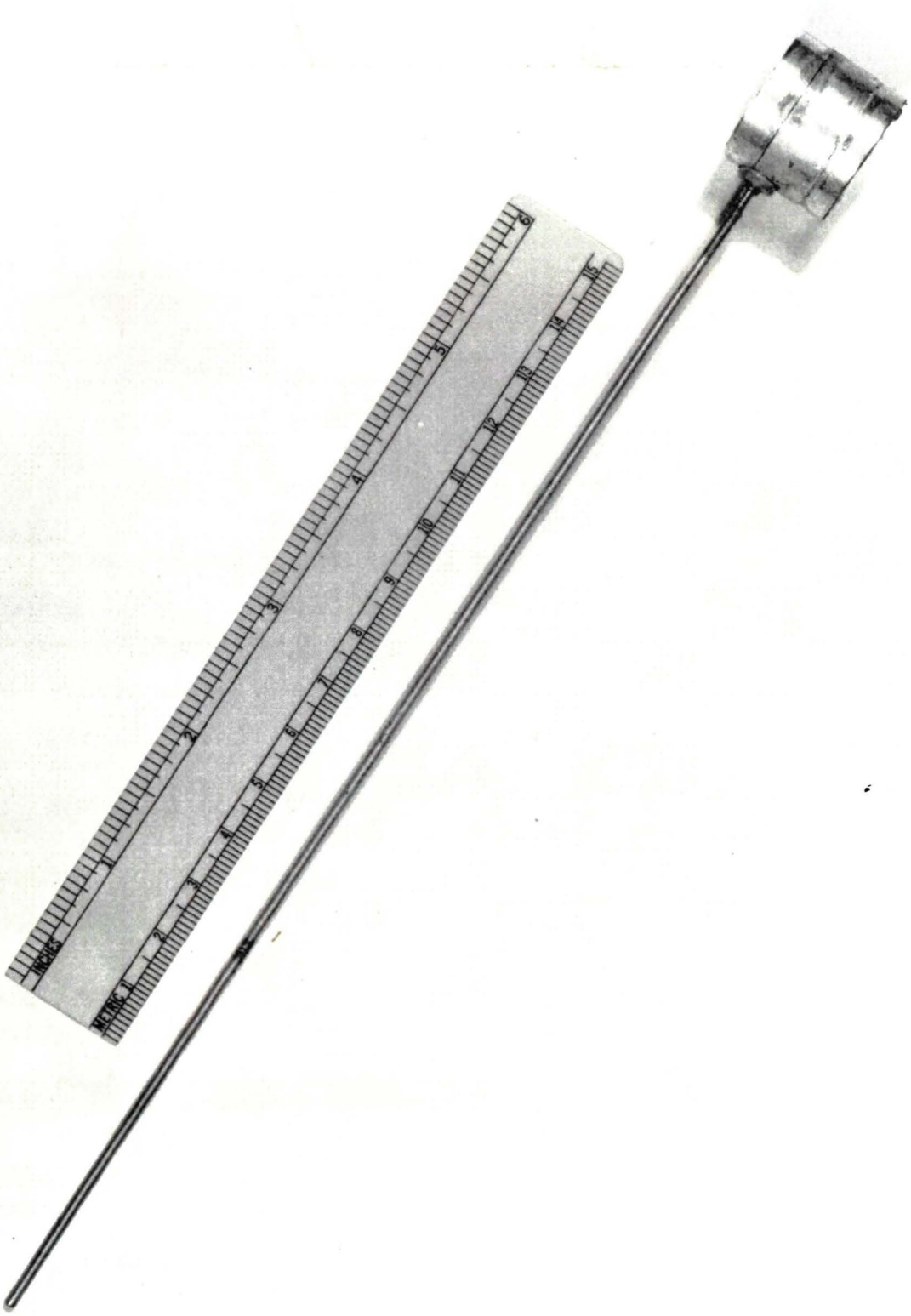
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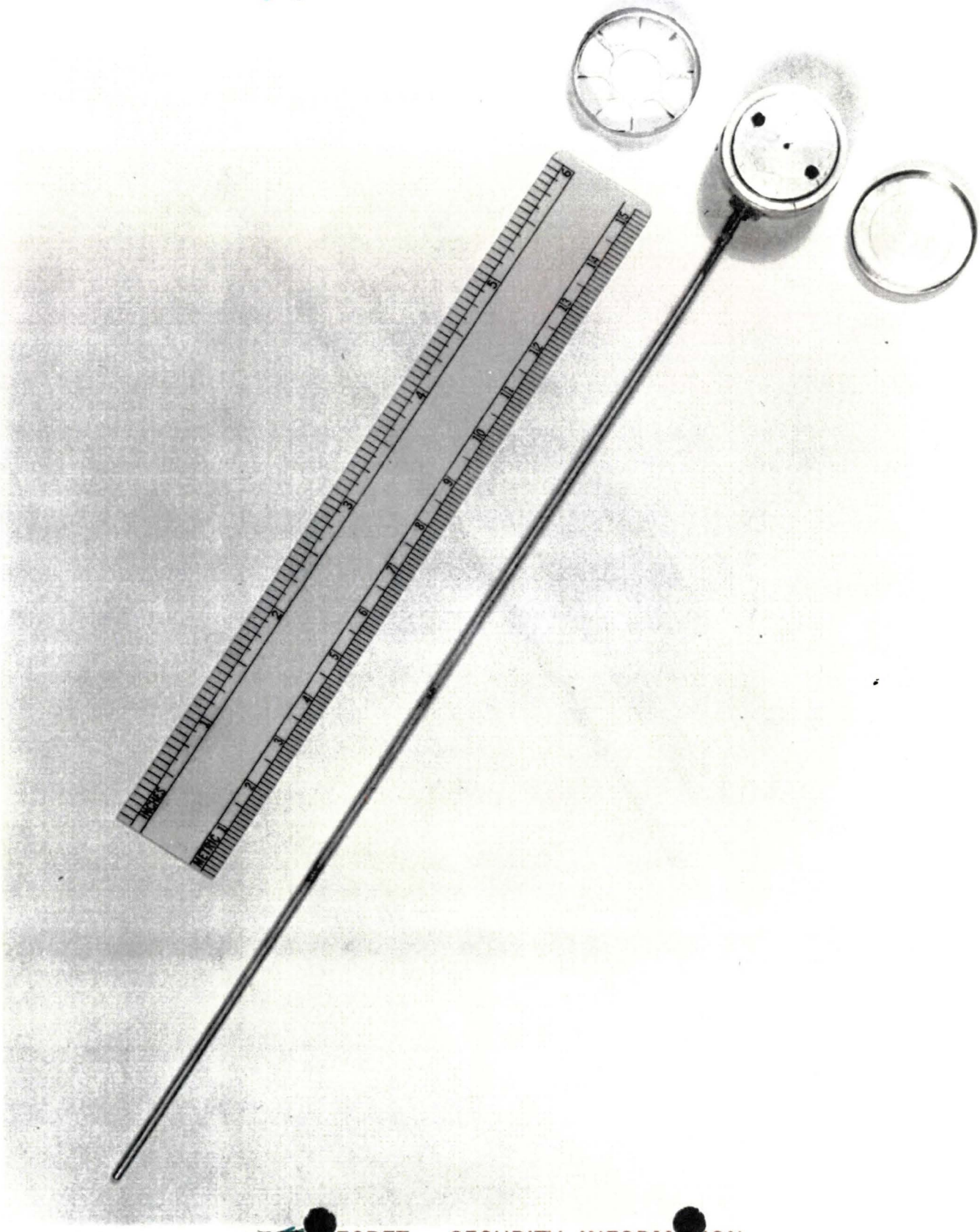

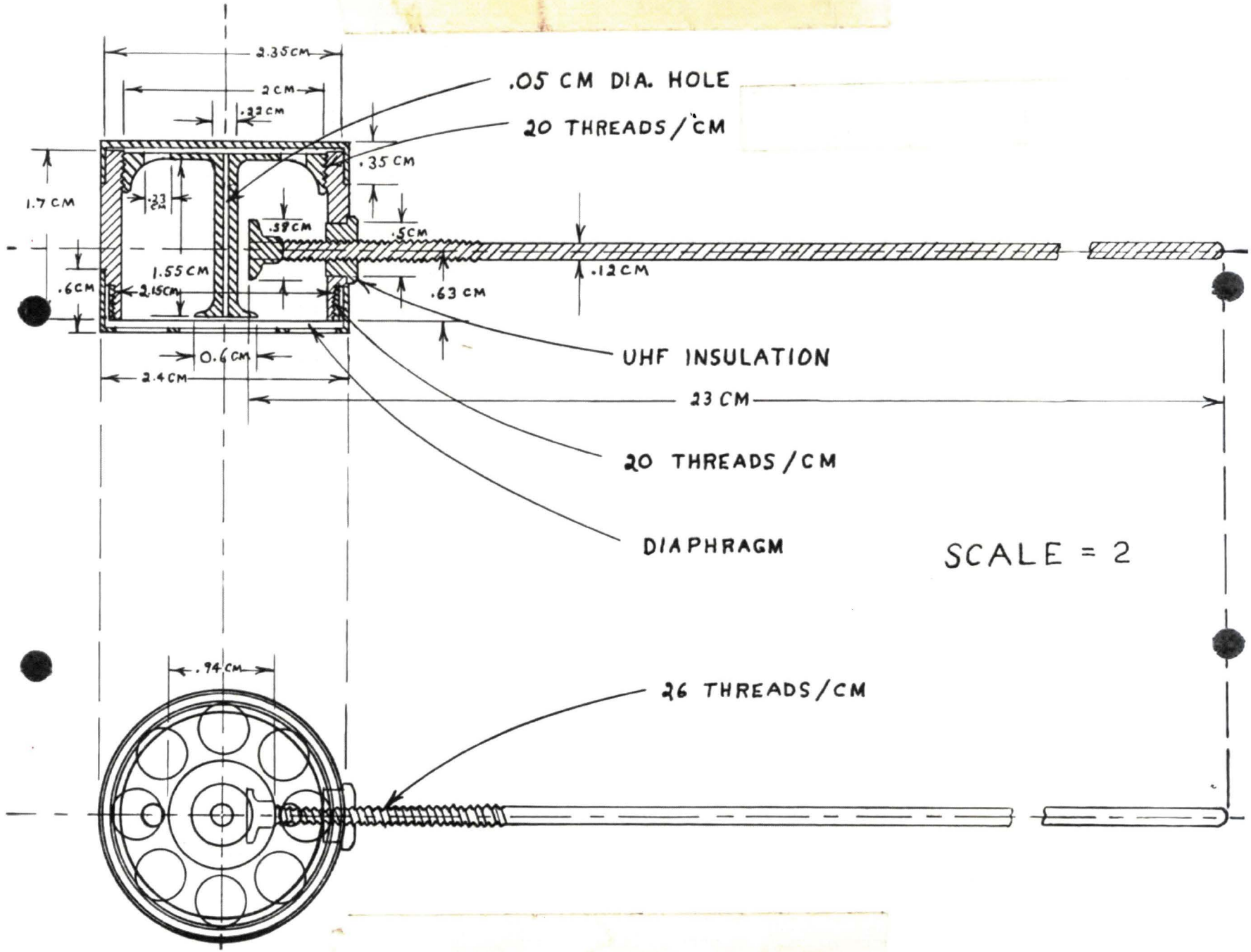
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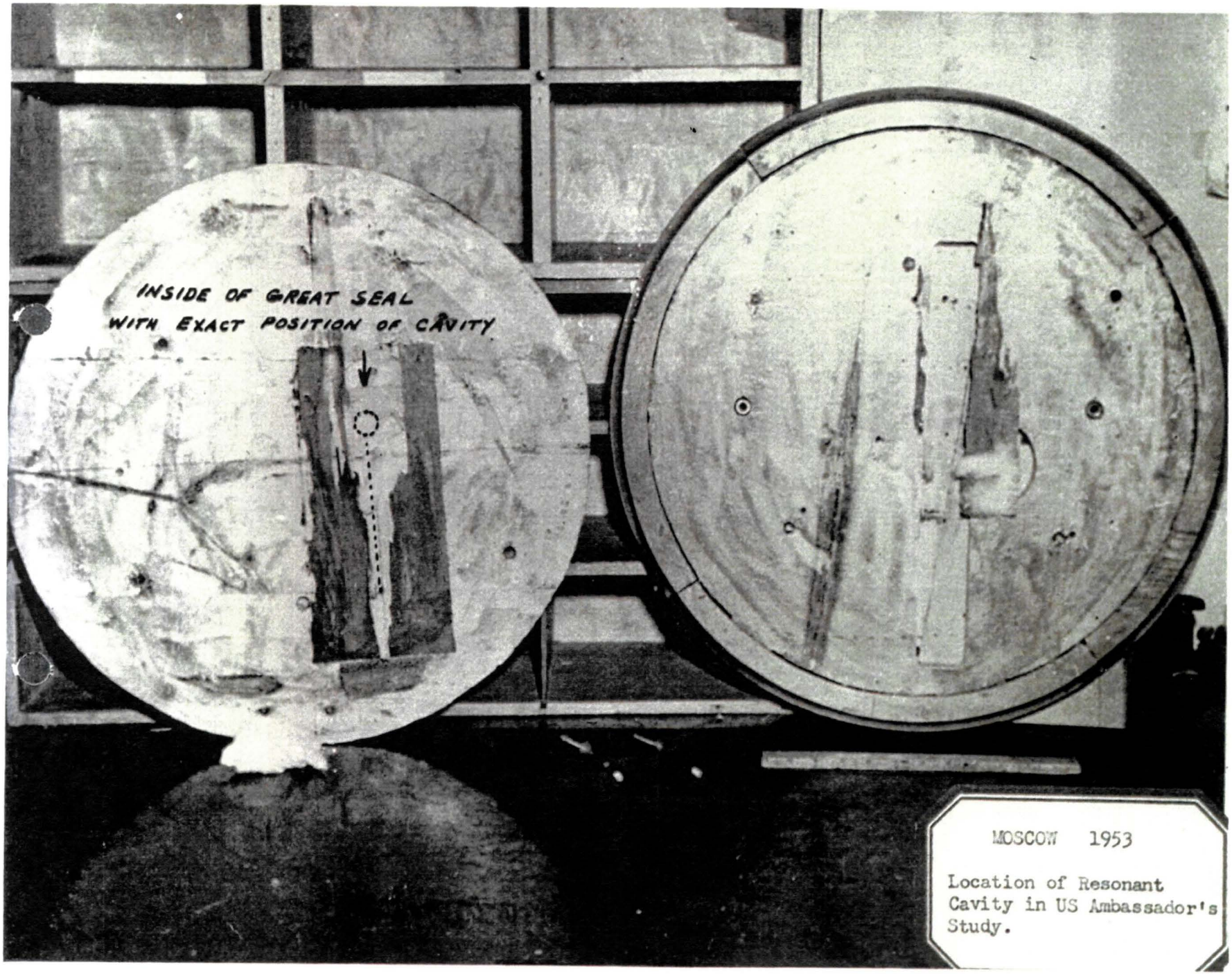
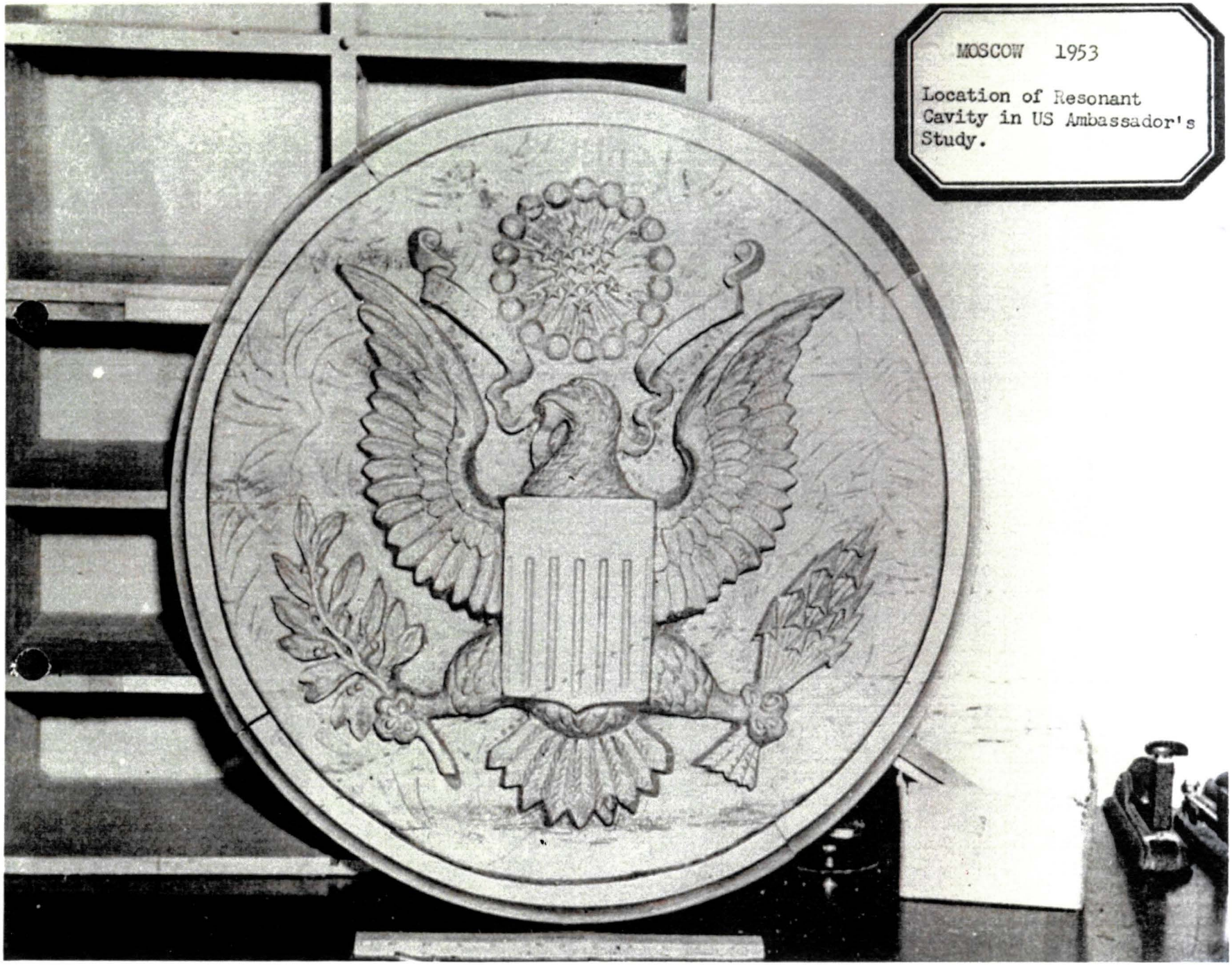


MOSCOW 1953

Location of Resonant Cavity in US Ambassador's Study.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