NATIONAL BUREAU OF STANDARDS REPORT

2079

Two Warehouse Panel Fasteners
manufactured by
U. S. Thermo Control Company and Hussman Corporation

by

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C. W. Phillips
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NBS

U. S. DEPARTMENT OF COMMERCE
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- Office of Basic Instrumentation
- Office of Weights and Measures.

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NBS PROJECT		NBS REPORT
1003-40-4700	November 25, 1952	2079

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to

Procurement Section
Headquarters, U. S. Marine Corps
Department of the Navy
Washington 25, D. C.

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ABSTRACT

Specimens of warehouse panel fasteners manufactured by the Hussman Corporation and the U. S. Thermo Control Company were tested for load-deflection of the spring, maximum load of the spring assembly, torque load of the cam assembly, and the maximum load of the cam assembly. It was found that the load required to produce a given deflection of the U. S. Thermo Control spring was much lower than that for the Hussman spring, but that the Hussman spring would take a permanent set when loaded enough to cause a deflection of 1/8-inch. The breaking strengths of the two fastener assemblies were approximately equal. The U. S. Thermo Control Company spring assembly and cam assembly were each essentially vapor-tight whereas the Hussman components were not.

I. INTRODUCTION

In accordance with a request by Headquarters, United States Marine Corps, in a letter dated July 24, 1951, comparative tests were made of two makes of warehouse panel fasteners, one manufactured by the Hussman Corporation of St. Louis, Missouri, the other manufactured by U. S. Thermo Control Company of Minneapolis, Minnesota. Mechanical tests were made of the load-deflection of the spring, the maximum load of the spring assembly, the torque load of the cam assembly, and the maximum load of the cam assembly. A total of six panel fastener assemblies, three each made by the respective manufacturers, were submitted for test. Four of the assemblies were destroyed during tests.

II. DESCRIPTION OF TEST SPECIMEN

The panel fasteners are used in the assembly of prefabricated, demountable warehouses. The various sections or panels of these warehouses are held together by the panel fastener assemblies. Each panel fastener assembly consisted of two separate parts, the spring and eye assembly and the cam and hook assembly, with each of the two parts being built into the edge of one of the two warehouse panels to be held together. The cam assembly of the

fastener was built to receive a hexagonal , 3/8" Allen-type lock-wrench, which, when turned, caused engagement and tightening of the hook of the cam assembly with the eye of the spring assembly, thus locking the warehouse panels together, and compressing the gaskets to prevent entry of air and water vapor.

The panel fasteners submitted for tests were identified as follows:

NBS Specimen 60-51
Three samples furnished by Hussman Company

NBS Specimen 61-51
Three samples furnished by U. S. Thermo Control Company

Fig. 3 shows the Hussman specimen 60-51 as submitted. Fig. 4 is a view of the same specimen after rupture, which occurred during the test to determine the breaking strength of the component parts. Specimen 61-51, manufactured by U. S. Thermo Control Company, is shown in Fig. 5, as submitted. The same specimen after rupture can be seen in Fig. 6.

It should be noted that all the figures referred to are composite, and the two mating pieces are not shown in a true size relationship. The Hussman fastener in Figures 3 and 4 and the U. S. Thermo Control fasteners, in Figures 5 and 6 had the following approximate dimensions:

	Hook Section			Eye Section		
	Length	Width (incl. Allen Wrench Socket)	Depth (incl. extended hook)	Length	Width	Depth (incl. eye)
Hussman	5-7/8"	4"	4-1/2"	3-1/2"	2-3/8"	2"
U.S. Thermo Control	5"	4-1/2"	4"	4-3/8"	2"	2-1/2"

The weight of the complete Hussman fastener was 1 lb-7oz. (Hook 1 lb.-1 oz., Eye 6 oz.) whereas the weight of the U. S. Thermo Control fastener was 1 lb-12 oz. (Hook 1 lb.-1/2 oz., Eye 11-1/2 oz.)

III. TEST PROCEDURE

A load-deflection test was made on each of the spring assemblies. This was done by loading the springs with known weights and observing the amount of deflection.

Tests to determine failure of the panel fasteners were run separately for each assembly of the fasteners.

Tests to determine the torque-load characteristics of the cam assemblies were made at two different positions of the cam hook. A torque of 500 lb-in. was applied to the cam wrench and the pull exerted by the cam hook under this condition was measured on a testing machine. The tests were made with the cam assemblies in approximately an open position and in approximately a half-closed position.

IV. TEST RESULTS

The following table summarizes the results obtained for all tests except the load-deflection tests of the spring assemblies:

RESULTS OF TESTS OF PANEL FASTENERS

Test	Specimen 60-51 Hussman	Specimen 61-51 U.S. Thermo Control
Maximum load sustained by the spring and eye assembly, lb.	2980 (a)	1870 (b)
Maximum load sustained by the hook and cam assembly, lb.	2210 (c)	3850 (c)
Pull exerted by hook with 500 lb-in. applied to cam wrench, lb.		
Assembly open (d)	1200	960
Assembly half-closed (d)	890	1040

(a) eye failed
(b) spring seat in the housing pulled out
(c) hook failed
(d) approximate positions, not directly comparable

The results of the load-deflection tests of the spring assemblies are shown in Figures 1 and 2 for specimen 61-51 and 60-51, respectively. A comparison of these two graphs shows that the U. S. Thermo control spring required a much smaller loading than the Hussman spring to obtain the same amount of deflection. The springs of both specimens came to a mechanical stop after a deflection of approximately 1/8", hence the loads were not increased after a deflection of about 0.12 inches was reached. Fig. 2 shows that a permanent set occurred in the Hussman spring after having been loaded sufficiently to cause a deflection of about 0.12 inches.

Fig. 2 shows that a break in the initial deflection curve occurred at a loading of about 800 lb. It is believed that this was the elastic limit of the spring material. The load of 1200 lbs. exerted by the Hussman cam assembly, as shown in the table of results, when a 500 lb-in. torque was applied to the cam wrench should be considered a maximum value since this is simply the stationary load as exerted on the testing machine. It is not known how much of the exerted torque would be lost in friction when the cam- and spring assemblies are actually being engaged.

In actual use, the amount of spring deflection and whether or not any permanent set would occur in the Hussman spring, would depend on the load-deflection characteristics of the gasket material used between the panels. A torque of 500 lb-in. or more could probably be exerted on the cam wrench under some circumstances, and if the deflection resistance of the gaskets reached values approaching 1150 lb. for the Hussman spring or 230 lb. for the U. S. Thermo Control spring before the hook was fully closed, the springs would be deflected against the permanent mechanical stop. Such circumstance might arise if the panels were warped or were being assembled with ice or dirt around the edges that prevented drawing the panels together on the gaskets readily.

The spring deflection of 1/8 inch would provide a safety factor against breakage of the fasteners by conditions that tended to pull the panels apart after assembly in warehouses that were satisfactorily assembled without deflecting the spring. In design of panels that are to use these fastener assemblies attention should be given to the compression required for the gaskets so the spring deflection of the fasteners will not occur while compressing the gaskets during normal assembly.

The U. S. Thermo Control spring was a coil spring, and its recovery characteristics under compression were better than those of the Hussman spring. It should be pointed out, though, that at 0.12" deflection the pull of the U. S. Thermo Control fastener would be only 230 lbs. as compared with 1025 lbs. for the Hussman as indicated on the recovery curve.

The breaking strength of the total panel fastener assemblies was very nearly alike for both specimens submitted. As can be seen from the table, the spring assembly of the U. S. Thermo Control fastener failed at a loading of 1870 lbs. The cam assembly of the Hussman fastener failed at a loading of 2210 lb., a difference of 340 lb. between the two makes of fasteners. The results in the table also indicate that the mechanical advantage of the Hussman cam assembly decreased about 25 percent between the open and half-closed positions whereas it increased slightly for the U. S. Thermo Control cam assembly between the same two positions of the hook.

An additional feature of the Hussman fastener that would be of assistance in actual erection of warehouses was the provision of a mechanical stop which prevented the hook from dropping completely below the eye during assembly to a position where it could not engage the eye. In the case of the U. S. Thermo Control fastener, it was possible for the hook to drop completely below the eye. If this happened to one or more hooks during panel erection, it would be necessary to release all other fasteners and separate the panels before any of these hooks could be returned to a position for proper engagement.

V. CONCLUSIONS

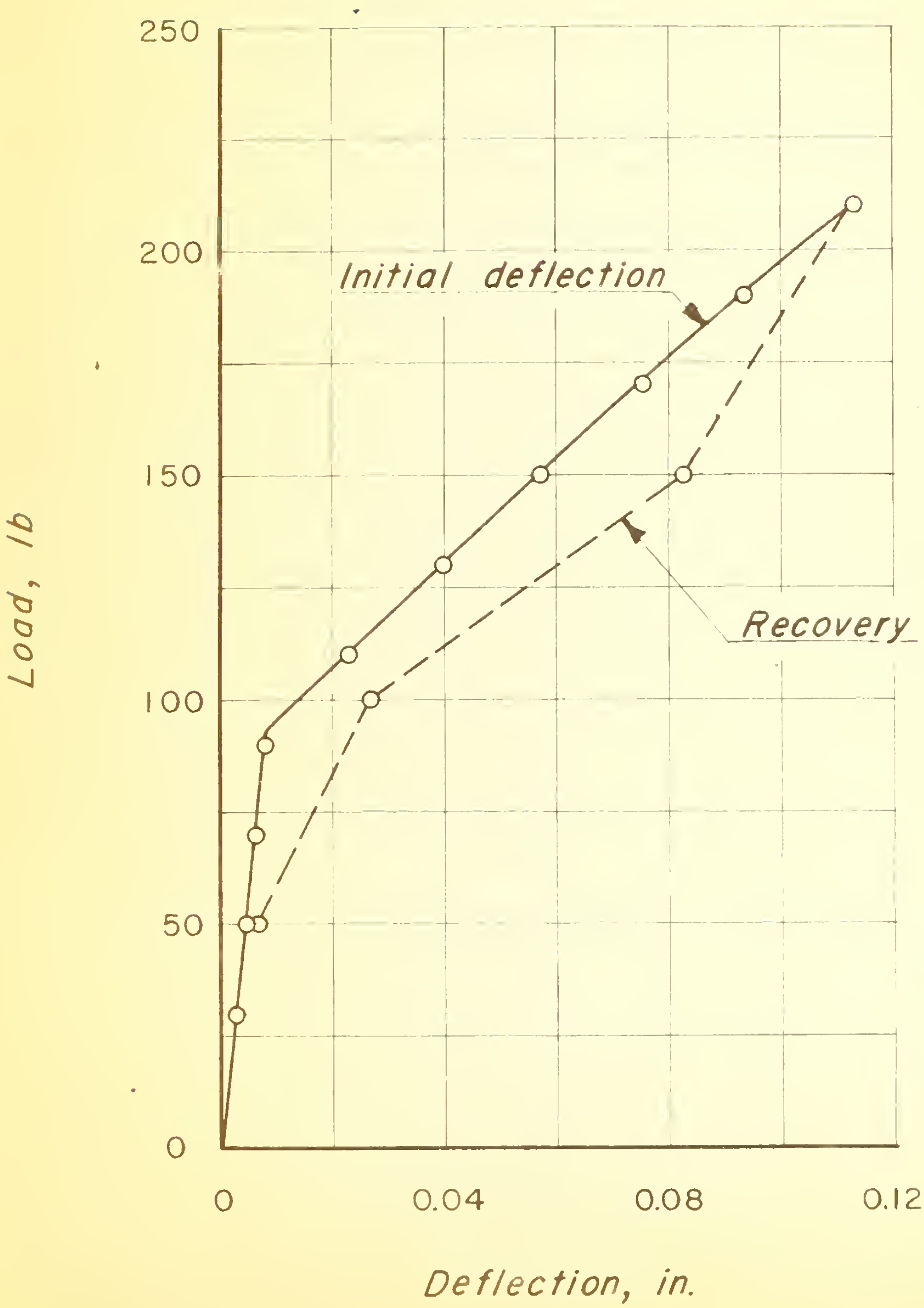
Based on the test results quoted above, it is believed that the two makes of panel fasteners as submitted, are satisfactorily equivalent for the intended purpose. The small differences in the breaking strengths and the mechanical advantages of the cam assemblies are not considered to be significant when viewed in the light of the overall usefulness of the two devices.

However, there was a marked difference in regard to the vapor seal feature between the two makes of panel fasteners, as submitted. The construction of the Hussman fastener would permit passage of water vapor through either the spring or the cam assembly, whereas the two assemblies of the U. S. Thermo Control fastener were comparatively tight. If there were a need to obstruct the flow of water vapor through the panel fasteners, the U. S. Thermo Control fastener would be definitely superior.

The importance of the vapor seal characteristics offered by the hardware alone would be determined by the relative vapor transmission resistance of the wood breaker strips at the edges of the panels including all the cuts for hardware, and the type of joint between the breaker strip and the panel face materials. If the outer gasket provided a good vapor-tight joint, the vapor resistance of the panel edges would not be important. If the outer gasket was not tight, the vapor resistance of the entire panel edge, rather than the hardware alone, becomes significant.

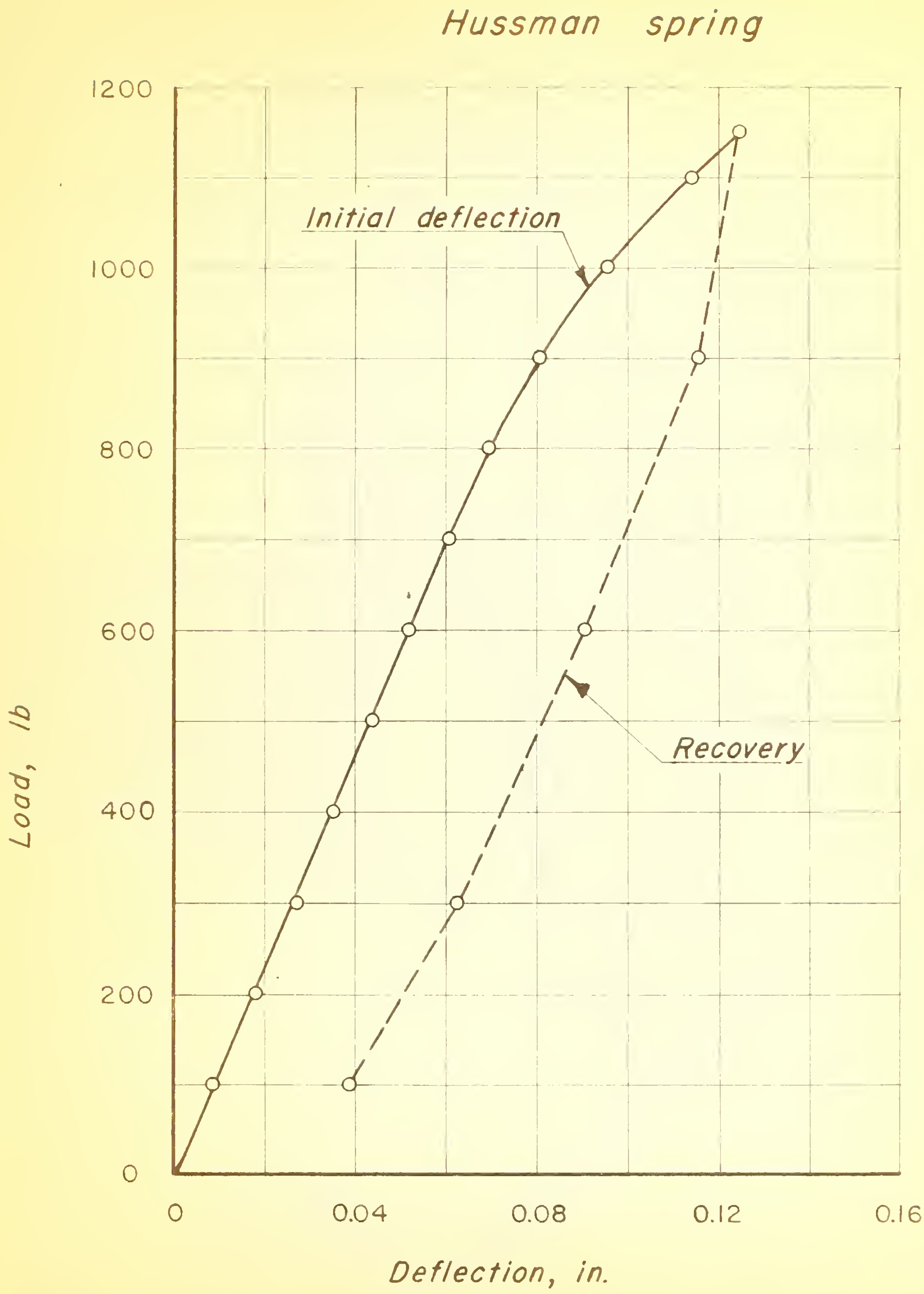
Since with present construction the gaskets may be damaged by handling of the panels, either the inner or outer gasket is likely to offer the greater resistance to vapor transmission for any particular erection of a warehouse. Therefore, the vapor resistance characteristics of the panel fasteners should be comparable to that of the breaker strip and its joints with the facing materials. A panel fastener with poor vapor resistance in a good breaker strip construction could be a cause of panel failure, whereas a panel fastener with superior vapor resistance in a breaker strip construction of poor vapor transmission resistance might not be justified economically.

Thermo Control spring



6.4/10-643
G-6899

Fig. 1



6.4/10-643
G-6809

Fig. 2

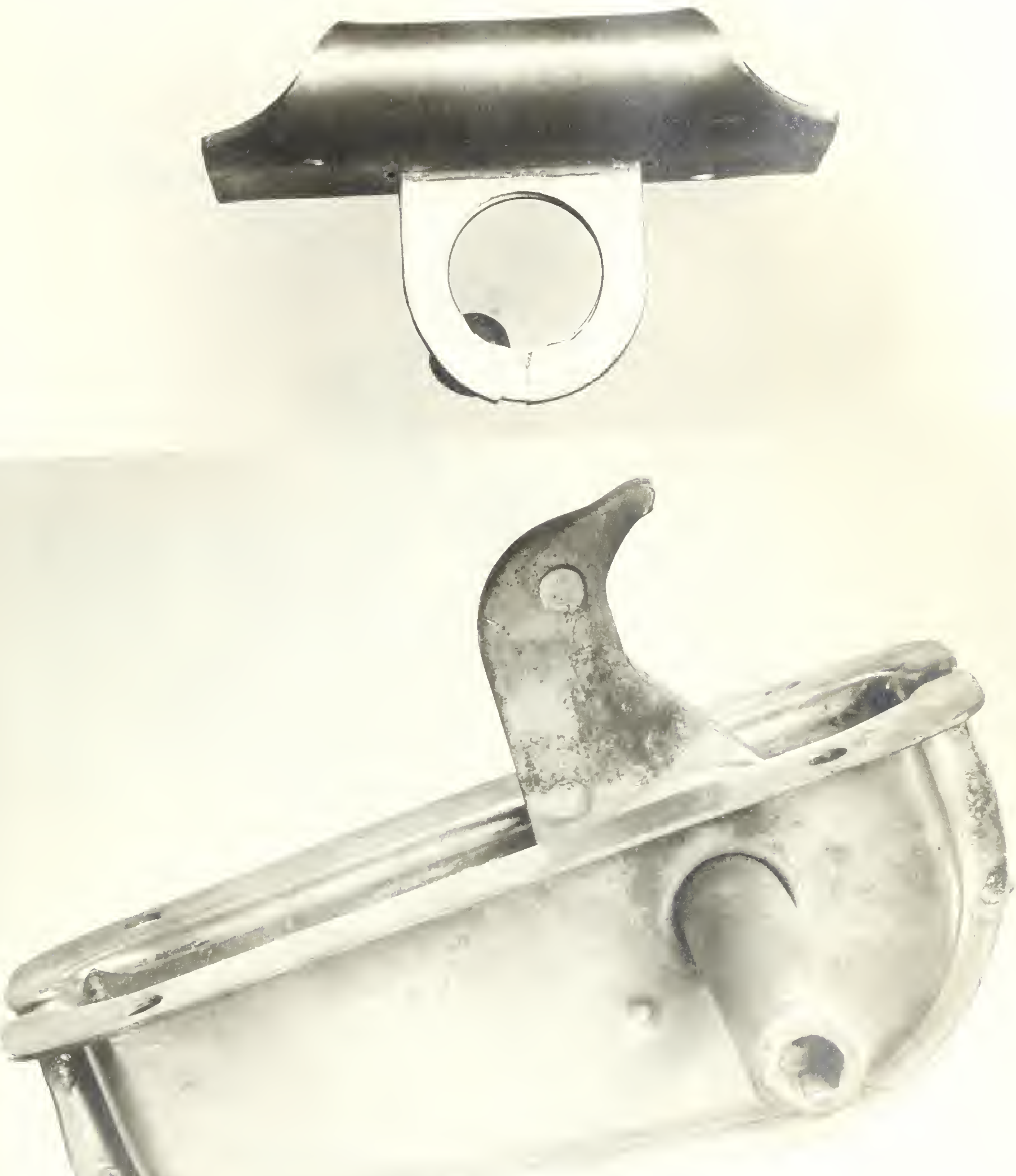


FIG. 4

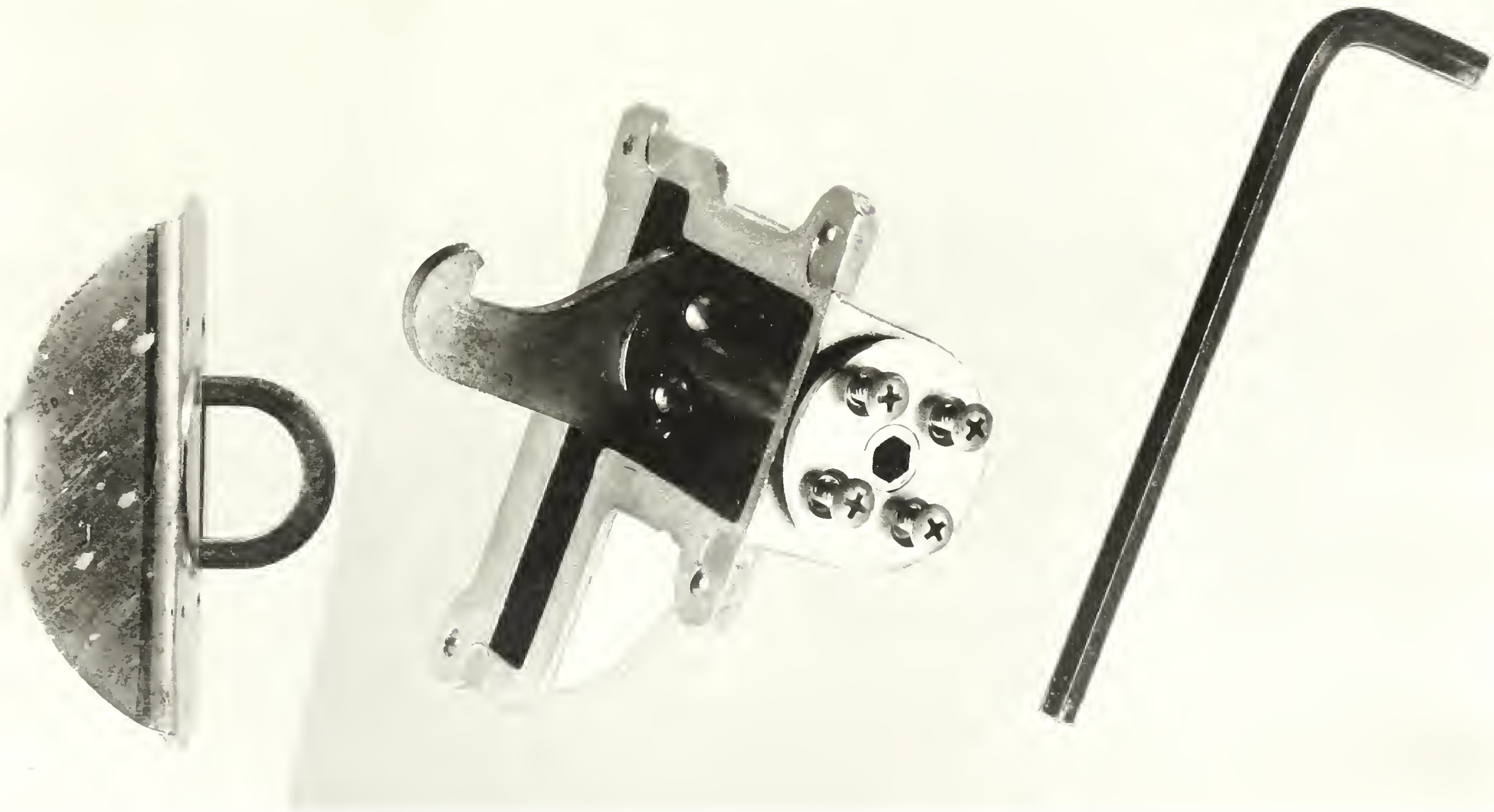


FIG. 5

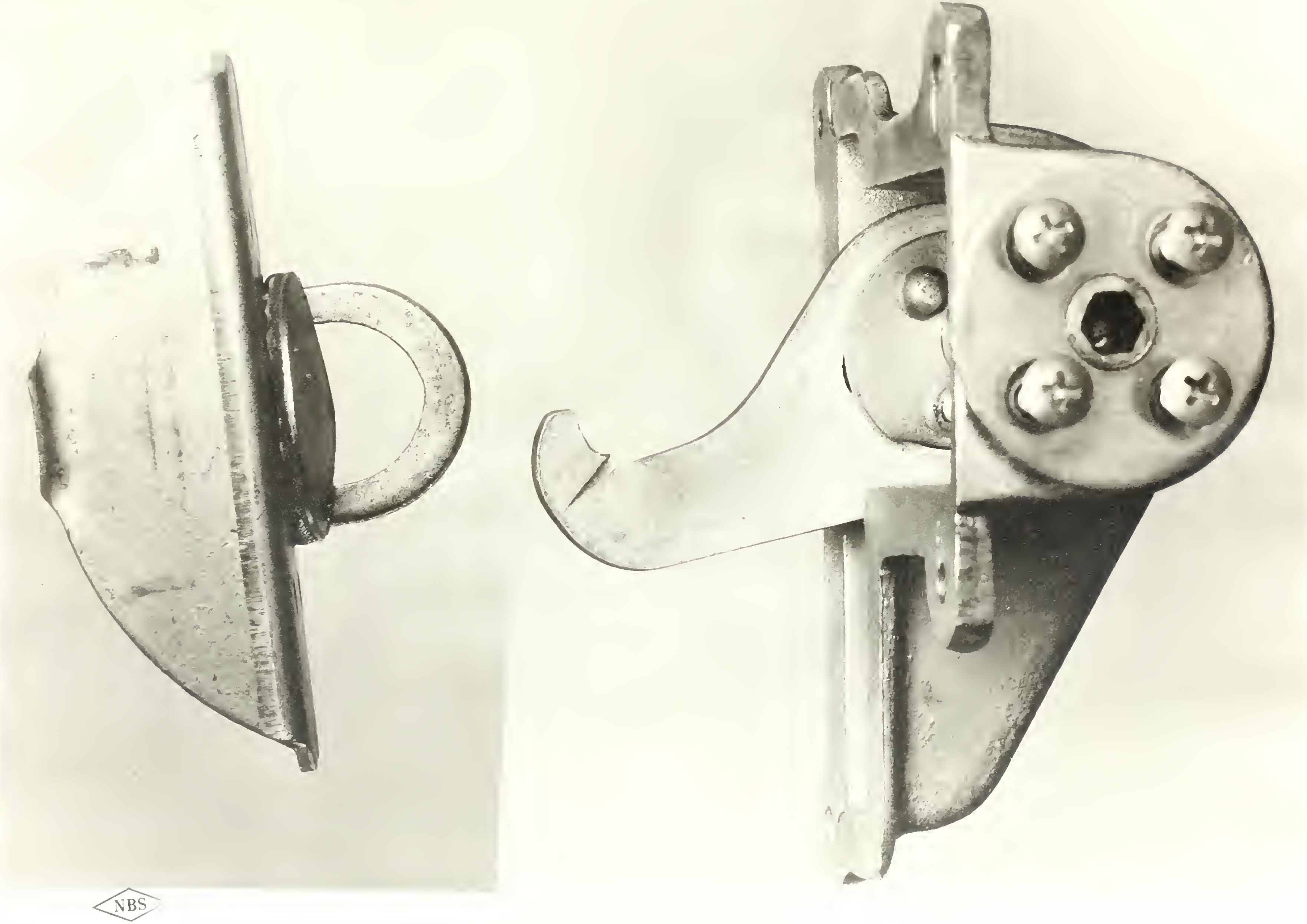


FIG. 6

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards ($1.00). Information on calibration services and fees can be found in NBS Circular 483, Testing by the National Bureau of Standards (25 cents). Both are available from the Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.

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