NOVELTIES IN SHIP FITTINGS.

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Amongst a number of improvements and developments in the fittings of naval vessels which have been systematically carried on in the Construction and Repair Department of the Brooklyn Navy Yard in the past few years, I have selected a few items for description, accompanied by illustrations, which appear to be of general interest to the profession of naval architects, viz:—

1. A water-tight bulkhead door operated by electric power. Always under control by hand or power at the door and capable of being closed by power from any selected distant station.
2. A non-conducting, non-inflammable, non-splinterable sheathing for use on the sides of steel ships in living quarters.
3. A metallic folding berth for ships' staterooms.
4. A water-tight metal skylight for use over mess-rooms and staterooms.

I should have been pleased to extend this list of items considerably, in order to give an adequate idea of the work done at the Brooklyn yard to improve and standardize the fittings of naval vessels, but restriction of space alone deters me.

Safety Electric Water-tight Door.

First in order of importance is unquestionably the Safety Electric Water-tight Door. The members of this society are doubtless familiar with previous literature on water-tight doors, and are impressed with the importance and necessity of doors that are reliably water-tight. Only two years ago this matter was very ably presented in these proceedings by a member of this society; therefore, I shall only briefly review the requirements, necessary and desirable, which were aimed at in the design of this door.

The desirable requirements are:—

(*a*) That it should be possible to close by power from the bridge,

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or from one or more central or emergency stations, *all* the doors simultaneously.

(*b*) That there be at some selected station an accurate and reliable indicator or tell-tale to show that the doors are closed.

The necessary requirements are:—

(*a*) That the door should *raise* or *lower*, by *power* or by *hand*, by one operator at the door on *either* side of the bulkhead.

(*b*) That the door should close either against a rush of water, or against a rush of mixed water and coal, or through coal on the door sill due to first opening of a full bunker.

(*c*) That the operation of the emergency closing should in no way interfere with the usual methods of operation at the door.

(*d*) That while the door is closing by an operator at the distant emergency station, it should be possible for a man at the door to stop it for egress.

Electricity was at once selected as the source of power because of the *certainty* of *control*. Cutting off the current absolutely cuts off the power; there is no expansion of the fluid, no leakage by valves, or in the main. That the electrical transmission of energy possesses many advantages over other systems of power transmission for uses on board ship, where the power is only required intermittently, is now generally admitted. The advantages claimed for electrical transmission are that the power is under perfect control; certain and accurate in operation; there is no waste of energy when the motors are not running; the motor is clean, quiet, and gives off neither heat nor odor; the conductor is clean, has no moving parts, can be run anywhere, and can be bent around sharp corners without frictional losses, thereby avoiding interference with locations of other fittings; having passed the experimental stage, it is reliable and durable, seldom getting out of order; and when a conductor is broken it is not accompanied either by steam, water, or noise.

It is not argued that the safety electric operating apparatus can be applied to all the doors of a ship without increasing the capacity of the electrical plant. A suitable increase in the electrical output would be recommended for a complete installation, or in applying the apparatus to a new ship. As the doors are operated only intermittently, it is evident, however, that by arranging the doors to close singly, or in small groups, the safety electric apparatus can be applied to the more important doors of a ship within the overloads recognized as permissible for short periods and required by actual tests of all standard electrical generators.

Should it be desired to cheapen the installation, the distant emergency control circuit might be omitted, and a push button fitted at the door. As before, an operator would still be required for every door, but the ship would have a reliable power door. Captain, The Right Honorable Lord Charles Beresford, R. N., in a paper on "Water-tight Doors, and Their Danger to Modern Fighting Ships," read before the British Institution of Naval Architects in 1896, says:—"The principle that should be enforced is that it should be possible to shut the door, and secure it, in one movement." This proposed arrangement fully meets this requirement; but *one movement*, consuming but a fractional part of a second, is required of the operator at the door; he presses a button, when power immediately closes the door water-tight.

The electric installation presents another advantage, particularly important for vessels of war. Every door is complete in itself; it has its own power line from the dynamo-room, and its own motor. Should any derangement occur, but one door would be put out of power operation; this door could be operated at once by hand without stopping to close a valve in the branch, while all other doors would continue to work under power operation as before. With hydraulic transmission, should a break occur either in the central station plant, in the main line, or in a branch, power is at once cut off throughout the system, and the power apparatus of all the doors rendered inoperative. With pneumatic transmission, should a break occur either in the central station plant or in the main line, power is at once reduced in parts of the system beyond the break, rendering power operation of doors beyond the break very doubtful.

The door as finished fulfills all the necessary and desirable requirements as above enumerated, besides the general ones of simplicity, reliability, and durability. The completed system is particularly remarkable for its simplicity and for its capacity to endure neglect. There are few moving parts, the connections are simple, and the door is not liable to get out of order. The three elements present no experimental features. The door is an improvement over the door originally fitted on the Atlanta, which was of a thoroughly tried type which had proved water-tight when closed. Electric motors are in general use afloat as well as ashore. Electric control is in everyday use upon hundreds of elevators.

The original conception of the system was wholly that of Naval Constructor Francis T. Bowles, U. S. Navy, and the electric control has been effected under the auspices of Frank J. Sprague, Technical Director of the Sprague Electric Company.

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The door illustrated in the accompanying plates is a vertical sliding door adapted for the engine-rooms, fire-rooms, and coal bunkers of vessels. Plate No. 70 is a front view of the door partly opened; 71, a rear view of the door partly opened; 72 and 73 show electrical features; 74 shows the door after closing through a wooden packing box and folded newspaper on the door sill; while Plates Nos. 75, 76, and 77 show the door operating through coal.

MECHANICAL FEATURES.

The clear opening of the door can be as desired; for coal bunkers it is generally 4′ 6″ by 2′. The door proper, or sliding part, is a steel plate riveted to a rim or sliding frame. The bulkhead, or guide frame, is rigidly built of bronze, through bolted to the bulkhead, the guides being tapered one-tenth of an inch to the foot. The sliding frame is made with eleven wedges, of same taper as the guides (four on each side, two on the top, and one on the bottom), which take up in the last half inch of travel. The surfaces nearest the bulkhead of both guide frame and sliding frame are scraped surfaces, thus making a water-tight joint by the wedge action in the last half inch of closing. The guide frame is open along the lower edge, thus preventing jambing or clogging by wet soft coal. The door plate carries a bronze rack into which gears a pinion keyed to a horizontal shaft across the top of the guide frame. This pinion engages a smaller pinion keyed to a second horizontal shaft, to either end of which shaft outside the guide frame is keyed a worm wheel, which in its turn engages a worm. The worm shaft passes normally through the bulkhead, and is driven by an electric motor in a water-tight casing on the opposite side of the bulkhead. For hand operation, cranks are provided which ship over the hexagonal ends of worm shaft. The use of the worm and worm wheel does away with any possibility of *creeping*, so objectionable to the user of a door.

ELECTRICAL FEATURES.

The motor used is one H. P., compound wound, of the short shunt type, the short shunt coils being relatively weak, and wound outside the series coils. The circuits are so arranged that for raising the door, only the series coils are in circuit, giving quick and easy starting, while for closing the door where it may be necessary to cut through coal, the shunt and series coils are both in circuit.

The electric current taken from the mains passes through a three-point spring lever switch. Moving the lever to the right or left completes the

circuit through the motor and raises or lowers the door. The shaft of the switch handle pierces the bulkhead so that the switch may be thrown from either side. A spring returns this lever to its central position, and when in this position, the door-closing circuit may be completed from one or more distant stations in any part of the ship. The door-opening circuit can be completed *only* at the door, and when completed cuts out the closing circuits.

Beyond the spring lever switch, the circuit contains a limit switch opened by a bell crank lever when the door reaches either of its extreme positions. The shaft of the pinion that engages in the door rack, carries at its end another pinion that gears into a spur wheel keyed to a shaft that carries the bell crank levers for working the limit switches. The position of these levers may be adjusted for varying the lift of the door.

Beyond the limit switches, the circuit contains two Sprague solenoid gravity controllers which throw in either the series or the series and shunt fields of the motor. These controllers have carbon and copper contacts, which prevent pitting of the copper bars, but necessitate occasional adjustment of the carbon tips. The controllers are fitted in a water-tight receptacle with a hand hole and glass cover; this allows constant inspection of the carbons, and their adjustment when necessary, without removing the front of the receptacle. The working of the controllers is easy and simple, and there are no springs or pins; the copper bars are carried on phosphor-bronze flexible plates allowing for a little wear of the carbons without readjustment, and ensuring good contacts.

All the parts are enclosed in water-tight boxes.

WEIGHT.

Because of the deflections which have been noted in practically every instance where main bulkheads have been subjected to water pressure, either designedly for purposes of test, or by reason of accident, (and such deflections have been found to be not inconsistent with practical water-tightness), *absolute rigidity* of closing plate and bulkhead frame becomes an essential requirement of a water-tight door. In order to ensure this rigidity, no attempt whatever has been made to reduce weight. For the experimental door, the weights were as follows:—

Sliding door	291 lbs.
Frame and gear	600 "
Actuating apparatus and fixtures	492 "
Total weight of door complete	1,383 "

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It is believed that experience with this door will prove it practicable to materially lighten the door frame, and possibly other parts of the door, with consequent decrease in weight and cost. For purely local reasons, all parts of the experimental door, except the closing plate, were made of composition; but it is not intended, in the manufacture of the door, to restrict the builder in his selection of materials, as the expense of manufacture of the door in quantities can be materially reduced, without injury to the efficiency of the door, by the use of cast steel for certain parts.

ELEMENTS OF OPERATION.

a. The door can be raised or lowered by hand from either side of the bulkhead by using a crank on the worm shaft, as already described. There is thus provided a *positive* hand control of the door which cannot get out of order. One man using one hand operates the door easily, though slowly.

To close the door through six inches of fine loose coal on the sill requires one minute fifteen seconds.

To open the door, with about one foot of loose coal behind it, requires one minute twenty-five seconds.

b. The door can be raised or lowered by electric power from either side of the bulkhead by the holding of a spring lever or pressing a button. The experimental door, and the doors now fitted on the Atlanta, are operated by a spring lever.

To open the door fully, with fine bituminous coal stowed against the back of the door to within six inches of the top, requires eight seconds, the motor making eleven hundred and fifty revolutions per minute.

To close the door from full opening, with eleven inches of fine bituminous coal on the sill, requires nine seconds, the motor making thirteen hundred revolutions per minute.

Careful observations of current and voltage were taken, with the following results:—

	Amperes.	*Volts.*
To start the door down	13¼	115
Steadying while closing at	3¼	113

	Amperes.	*Volts.*
To start the door up	22	115
Steadying while opening at	11	113

With fine bituminous coal heaped against the back of the door to within six inches of the top:—

	Amperes.	*Volts.*
To start the door up	24½	115
Steadying while opening at	11	113

On opening the door wide, the coal ran through the doorway, and the door was then closed through this coal lying eleven inches deep on the sill:—

	Amperes.	*Volts.*
To start the door down	14	115
	13.5	115
Cutting through coal and within an inch of seating, steadied at	3	113
	3	113
While driving loose coal through the hollow sill, the ammeter jumped to	52*	115
	49*	113

c. The door can, if desired, be closed from one or more distant or central stations, and these stations can be arranged to close doors in different parts of the ship, either singly, in groups, or simultaneously. On pressing a button at the distant station, thus completing the distant closing circuit, the door immedately starts down. When the door is closed, the current is cut off this circuit by the limit switch.

d. The closing of the distant control does not prevent operating the door by power at the door, because throwing the door lever to open cuts out the distant circuit and closes the door-opening circuit. As the door raises, and the man passes through, he releases the spring lever, which returns to its central position, completes the closing circuit from the distant control station, and the door closes.

e. An accurate and reliable indicator that a group of doors, or single doors, as desired, are closed, can be provided at one or more selected stations. In the distant closing circuit at the selected station, a small signal lamp is installed. On completing the distant closing circuit, this signal lamp either lights or remains dark. If the lamp lights, we have a positive indication that current is passing through the apparatus, and that the door must be closing. When the signal lamp goes out, or if it remains dark, the observer knows that no current is passing through the closing circuit, showing clearly either that the door is closed, or that the door-opening circuit is in

*Which was of the nature of an impulse, and of a fractional part of a second duration.

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operation, or that power is cut off from the actuating apparatus. If the door-opening circuit is in operation, immediately after the man passes through the door, he releases the spring lever, which returns to its central position, and completes the closing circuit, thus lighting the signal lamp. The possible uncertainty that power is cut off from the actuating apparatus is removed by leading one of the power lines through the selected station, and introducing an instrument to show power in the line. With the signal lamp dark, and power shown by the instrument through the line, there can be *no question* but that the door is closed.

Non-Combustible Fittings.

The lesson of the Chinese-Japanese War for the naval architect was the danger of destruction of war vessels by conflagration in action. If further proof were required as to the absolute necessity for discontinuing the use of all combustible material in the construction and equipment of war vessels, it was abundantly furnished by the battles of Manila and Santiago. The official reports on the battle of Santiago state that the Infanta Maria Teresa, the Almirante Oquendo, and the Vizcaya were destroyed by conflagration, caused by explosion of shell in the interior, which set fire to the woodwork. The strongest evidence as to the importance of this question, and likewise illustrative of the intensity of the fire, and the rapidity with which it spreads, is given by the fact that on these vessels men were driven from loaded guns, not by projectiles, but by conflagration. That conflagration is more destructive than gun fire was likewise emphasized by examination of the Spanish vessels after the battle of Manila.

That the battle of the Yalu marked a step in shipbuilding practice, which was fully appreciated by the naval architect, is demonstrated by a comparison of the living quarters in vessels finished as recently as five years ago and those building or refitting now. Particularly in officers' quarters are the changes most noticeable. Six years ago the divisional bulkheads were of untreated wood, likewise the ceiling overhead, and the ceiling or sheathing against the side of the ship. The berths, lockers, and all the furniture, including a closed-in wardrobe, also the ship's ladders, shelving everywhere, etc., were of untreated wood. Now, the constant endeavor is to reduce woodwork everywhere to a minimum, steel or some other non-combustible material being substituted wherever practicable, and where wood is used at all, it is required to be subjected to an approved fireproofing process. The present practice at Brooklyn Navy Yard is as follows:—The unnecessary overhead ceiling is altogether omitted. In crew's quarters the outboard

sheathing is omitted, but in officers' quarters asbestos sheathing is fitted. All divisional bulkheads are built of light corrugated sheet metal (first fitted on the Texas in 1892) and finished with a sheet-metal cornice (first fitted on the Atlanta). The uncleanly wooden berth is replaced by a compact and cleanly metal folding berth. The wooden ladders are altogether done away with, and metal ladders with some form of non-slipping tread are in general use. For the unsatisfactory wooden skylights over mess-rooms and inboard staterooms a water-tight metal skylight is substituted. At the present time the desks, chairs, tables, and chiffoniers used on naval vessels are made of fireproofed wood, but samples of metal furniture, by which the use of wood for this purpose will be entirely dispensed with, are now being prepared at the Brooklyn Navy Yard for the purpose of selecting types for naval use. All lockers supplied to the Atlanta, including rifle lockers, petty officers' lockers, and marines' lockers, are of metal, and the Atlanta's cabin has been fitted with a metal roller-top desk. The marked contrast between early and present practice is made very plain by reference to Plates 78 and 79, which show the interior of the Atlanta's cabin before and after present refitting.

The remarkable immunity from fire which is characteristic of vessels recently completed or refitted is due largely to the liberal and far-seeing policy of the Navy Department, which has consistently encouraged suggestions and experiments and approved, regardless of expense, every reasonable proposal tending to secure the desired immunity from conflagration. In the development of non-combustible fittings, the Construction Department of the Brooklyn Navy Yard has taken an active part, and it is to certain non-combustible fittings originated at that yard that your attention is next directed.

Asbestos Sheathing.

A non-conducting, incombustible, splinter-proof covering for use in living spaces on the inside surface of the outer shell of steel vessels, and for magazines, coal-bunker, and boiler-room bulkheads, has been developed in conjunction with the H. W. Johns Manufacturing Company. The wooden sheathing or panelling at first used in such places was replaced because of its combustible qualities by a light steel sheathing which has been a source of constant complaint of discomfort and danger to health. Because of the numerous complaints, the asbestos sheathing was developed to meet the objections to both steel and wood sheathing. This it fully does. The finished sheathing possesses the primary requirements of a non-conducting,

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incombustible, splinter-proof covering; it is light in weight; in appearance it is clean, neat, and ornamental, as shown by Plates 80, 81, and 82; further, it adds to the comfort and habitability of living spaces, being warm in winter and cool in summer. The total weight of the completed sheathing, including framework and fastenings, averages 6½ pounds per square foot. I regret that the work was in such condition as not to allow of temperature experiments during the extreme heat of summer, but data taken during the mild heat of September show that the effect of the sheathing on the side of the ship exposed to the direct rays of the sun was to reduce the temperature from 20 to 35 degrees Fahrenheit.

After various trials, the following method of fitting has been adopted as the most satisfactory, and will be readily understood by reference to Plate 80, which shows adjacent frame spaces in successive stages of completion. Between the ship's frames, or bulkhead stiffeners, and 1½ inches from their inner edges, is fitted a framework of 1 inch by 1 inch by $^3/_{16}$ inch steel angle bar horizontally, and 1 inch by $^3/_{16}$ inch flat bar vertically, so spaced as to provide the necessary stiffness, and to carry bolts which extend to secure the finishing mouldings. Over this framework is drawn No. 19 galvanized iron wire cloth, ½-inch mesh. Over the wire cloth, asbestos fire felt (a very light porous asbestos) in sheets 1½ inches thick, is secured by galvanized sheet iron or wire cloth washers and copper wire. This fire felt is flush with the surfaces of frames, or edges of angle bars. Asbestos millboard, ⅜ inch thick, is placed over the fire felt to secure a smooth, hard finish, and is held in position by galvanized iron mouldings, ⅛ inch thick and 1½ inches wide, set up by countersunk nuts on the bolts carried by the inner frame. At the proper height is also a galvanized sheet iron chair rail, 4½ inches wide. All interstices around air ports and elsewhere are filled in with asbestos cement. The millboard is coated with sizing to prevent absorption, and then painted with white enamel and gold striped, resulting in a pleasing and symmetrical panel effect. The finishing mouldings come over the seams of sheets, and the size of panels must therefore be considered in connection with the commercial sizes of asbestos fire felt and millboard sheets.

This asbestos sheathing has been fitted around the engine-room trunk in junior officers' quarters on the New York; in the ward-room of the Indiana, as shown by Plate 81, where it was fittted in portable sections; in the ward-room and certain staterooms on the Massachusetts, Plate 82; and in officers' quarters on the Atlanta and the Cincinnati, where the method of fitting is as above described. In the Atlanta's cabin, the outboard side and the

under side of the turtle-back deck over the cabin have been sheathed as explained, while for the other bulkheads asbestos millboard only has been used. The result is shown by Plate 79.

METAL FOLDING BERTH.

The comfort and habitability of officers' rooms have been largely increased by the use of a metal folding berth, designed by Naval Constructor Bowles in 1895, but first fitted on the Massachusetts and the Chicago in 1898. When folded, the berth over the supporting brackets, its widest parts, extends into the stateroom but fourteen inches, thereby largely increasing the available floor space. This metal berth is also a great aid to cleanliness, being at all times as accessible and well ventilated as an ordinary brass bedstead. The installation of folding berths involves a change in the outfit of furniture. Below the folding berth is fitted a shoe locker, and over the berth a cabinet. Plate 83 shows the berth folded and covering curtain drawn, also shoe locker and cabinet; while Plate 84 shows the opened berth ready for occupancy. The stowage space lost by the removal of the drawers and lockers beneath the built-in berth is more than compensated for by the addition of a chiffonier, and a locker or transom, against the outboard side of the room. Every room is also furnished with a secretary-bureau, metal toilet rings, metal fittings for toilet articles, and the usual china crockery. The net result of the installation of metal folding berths is a largely increased available floor space, increased cleanliness, and increased stowage capacity, all of which is conducive to increased comfort and habitability of living quarters.

The bed frame is built up of tubing; the sides of the frame are fitted with castings to carry light wooden rolling battens at the proper height; the ends of the frame are fitted with bell crank castings, through the center of which fittings the bed is supported and hinged by means of bulkhead supporting brackets, and by the one or the other of the lever arms the bed is secured either in its opened or folded position. The spring mattress is secured by stretching between the head and foot of the bed frame, by means of steel spiral springs, a fabric in squares of about four by four inches, formed of steel wire links; both springs and links are heavily tinned. Slipping of the hair mattress when folding the berth is prevented by means of two elastic clothes straps which are hooked before the berth is folded, one around the mattress, and the other around the mattress and pillow. At the head of the bed there is fitted a built-up folding pillow rest which is opened out for carry-

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ing the pillow, and folded on the mattress before folding the berth. So as not to throw undue strain upon the light divisional bulkheads, two T stiffeners are run vertically between decks with webs out, to carry the cabinet and the folding berth. The stiffeners are spaced sufficiently far apart that the two berth-supporting brackets come just outside the ends of berth frame. The supporting brackets carry the weight of the berth by means of hinge bolts which pass through the bell crank levers already referred to, and the berth is secured to the supporting brackets, in either open or folded position, by means of locking pins which pass through the brackets and engage either one or the other of the bell crank lever arms.

METAL SKYLIGHT.

On battleships, where the space allotted to officers' quarters is limited by more important considerations, a large number of staterooms are inboard rooms, receiving light and natural ventilation by means of skylights only. On other vessels, skylights are required over mess-rooms and cabins to ensure natural light. Such skylights in the past have been of wood, and have proven thoroughly unsatisfactory, failing to be water-tight in service, and thereby causing great discomfort by leakage over berths or mess-tables. This unsatisfactory condition is due to the sudden and extreme changes of climate to which naval vessels by reason of their service are subject; also, in the case of raised skylights, to the frequent handling in drill when clearing ship for action; or, in the case of sunken skylights, to the jar in target practice. For such an unsatisfactory wooden skylight on the Cincinnati there has been substituted a skylight of sheet copper, which possesses all the essential features of a wooden skylight, with a larger clear area for the passage of light, and which is, in addition, thoroughly water-tight under all circumstances, even the water of condensation being provided for. This skylight is further splinter-proof and non-combustible, and is not affected by changes in temperature. It is about the same weight as the wooden skylight it replaces; and in appearance it is neat and ornamental. (This is shown by Plates 85 and 86.) By the use of the metal skylight one of the greatest annoyances and sources of discomfort of life on board ship will be removed.

DISCUSSION.

THE CHAIRMAN:—Gentlemen, this is a very interesting paper, and I am sure that there must be a number of members here prepared to discuss it.

MR. W. A. DOBSON, *Member*:—I simply wish to bear testimony to the wisdom of the policy pursued by the construction department in the Brooklyn Navy Yard in fitting United States vessels with these incombustible fittings. In corroboration of this policy I might state that in the vessels now being built for the Russian Government by the Cramp Company the asbestos sheathing is used entirely next to the ship's side, and also asbestos millboard is used as the dividing bulkhead between staterooms with great success. All the furniture in those ships, except chairs, is built of metal, and the decks—that is, the interior below the spar deck—are all sheathed with aluminum, so that the only woodwork on the ships is a deck plank on the upper deck. Thus we have an example of ships in a foreign navy which are fitted throughout with fittings which are in no danger at all of catching fire in time of action.

THE CHAIRMAN:—I believe Mr. McKay, of the Sprague Electric Company, is here. Perhaps he has something to say about the electric features of handling water-tight doors.

MR. C. R. MCKAY, *Visitor*:—There is just one point that I thought might be well raised in regard to that. Within the past two or three weeks I have been interviewing a number of shipbuilders, naval architects and naval constructors in regard to the use of water-tight doors. The point which has been raised in a number of cases is that in case of the closing from the emergency station of a large number of these doors there might be an excessive demand on the generating plant. In the construction of the controlling mechanisms for these doors we have been giving some attention to that, and we have found that there are a number of considerations which enter which will bring the maximum demands for any reasonable number of doors within the working capacity on board any ship. Among those considerations are, first, the ability to group any number of the doors of the total installation, so that only the number of doors in that group shall close simultaneously. In other words, when a man in an emergency station on board ship should push the emergency button to close these doors, he would simply push the button for one group of these doors, which would close practically simultaneously, even assuming that five or six doors were grouped in such a way as to be operated from a single button. Another consideration would enter in, which in all probability would prevent those doors from seating precisely at the same moment. The fact is that it is an extremely difficult matter, almost an impossible thing, to build two electric motors which will run at exactly the same speed, which would have to

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be the case if those doors were to seat exactly at the same instant. Now, the final amount of current taken to seat one of these after the entire clearway is shut but the door has not yet been wedged water-tight—the amount of current taken at the instant that the door is wedging is considerably in excess of the normal current taken to close the door. But the excess current taken at the time of seating is only for the fraction of a second, so that if we started to close the doors in any group which were intended to operate simultaneously, the probabilities are that with the number of doors in a group there would not be more than one or two of them seated at exactly the same instant. Mr. Hill, who has been working a great deal on this problem and making experiments upon it, has found that, in any event, the maximum power capacity which is required in a generating plant to operate any number of these doors will never exceed about 1 kilowatt per door and that for an installation of twelve doors on board ship, for example, there would not be required, so far as all the experiments have indicated, more than a maximum of about 9 kilowatts. It is not conceivable, I think, that in any vessel of such a large size as to require an installation of ten of those electric water-tight doors, even assuming that all those doors were operated from a single emergency button, the electric plant of that ship would be of such small capacity or be so entirely loaded up at the moment the doors were put into operation that it could not stand a maximum addition to its load at that time of 9 kilowatts; and I think also, in view of the fact that the whole tendency at the present time on board ships, so far as I am able to find out, seems to be toward the extension and general adoption of electricity for operating all auxiliaries, save possibly the main boiler feed pumps and a few other large ones, that the logical conclusion in such a case as that is to operate by electricity water-tight doors which may require to be closed from an outside point. I think we can fairly assume that in any installation on board ship, say, of twelve doors or less, even if those doors are not subdivided into groups but are so joined as to all be closed simultaneously, it would not be found necessary to add anything to the electric generating plant already installed in the vessel. There is another consideration that leads me to that conclusion, and that is this:—all generators now built for the Navy, and all other electric apparatus, are built and designed under the most rigid kind of specifications, not only with regard to their normal working loads, but with regard to their overload capacities; and it is also true that in any vessel where an electric plant is installed, any war vessel we will say,—where she is operating a considerable number of auxiliaries from the main generating plant, the normal maximum load under which that generating plant operates is considerably below its full capacity. I think another consideration is this:—that outside of the capacity, aside from the overload rating of ship generators as they are now built, the large reserve plant which is nearly always installed on naval vessels warrants the introduction of a very considerable number of electrically operated water-tight doors without paying any regard whatsoever to the total load that is going to be put on the generator plant.

THE CHAIRMAN:—I think we should all be interested to hear from Mr. Erhard, of the H. W. Johns Company, something about the asbestos side of this question for making the accommodations on board ship more comfortable.

MR. GEO. P. ERHARD, *Visitor*:—Mr. Chairman and Gentlemen:—It is about four years ago that we first took up this asbestos bulkhead in a very tentative way, the idea being as much as possible to furnish a fibrous, felt-like material which would have all the non-conducting properties, be absolutely fire-proof, of course, and splinter proof, and at the same time be susceptible of being handled to fit the various shapes and conditions without losing any of its tensile strength or causing any fractures. We took it to the Navy Yard, and our first experiments were made, I think, about two years ago, on the engine hatch bulkhead of the New York. The results were so satisfactory that we went further. The next ship fitted was the Indiana. There we had the idea of making it in panels, each panel being attached to join the frames so that at any time, if any accident occurred, each panel could be taken out bodily. We found that construction was a little thing, and that the repairs, if any should be necessary, could be so easily made by removing parts of the non-conducting covering, that we dispensed with that form of structure, and in the Massachusetts and the other ships that we have fitted since, we dispensed with that entirely and carried out exactly the plan in the paper read by Mr. Watt. The results, I must say, have been exceedingly satisfactory. I should like to mention here that the assistance we have received from the Department has been almost—I might say, entirely—the cause of the success, and in my last interview I had with Admiral Hichborn, about two weeks ago, I was very glad to see that it was to be adopted generally on all constructions. Of course, we are ready to take improvements and suggestions of all kinds, and the assistance we have received from all the different yards has been so encouraging that we feel that we have finally struck very nearly the right thing.

MR. W. B. COWLES, *Member*:—Mr. Chairman and Gentlemen:—It is a pleasure to see the new era—the attention to details—but it has always seemed to me that attention to details, in naval matters especially, means in war, victory, and in peace, safety and comfort. I am also glad to observe that some of my own individual missionary work in regard to some of the details of ships is bearing fruit and receiving the commendation which comes to successful devices by followers in the same line. I am glad to be endorsed in the axioms which I attempted to lay down for the existence and operation of water-tight doors on board ships. I see that the proposed water-tight door illustrated in this paper has for its keynote the distant operation of the door not interfering with the safe control and operation of the door at the door itself. I regard that as a most commendable feature, which is absolutely necessary in any power installation for the operation of doors or hatches on board ship. You cannot put doors and hatches on a ship and close them from a distance and

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damage or endanger Jack. If you attempt to do anything of that kind Jack will spoil your scheme very easily. Human nature comes into the design, and you have got to take it into consideration. Look out for him, make him safe, and then he will help you and make the ship safe. I shall not attempt to discuss the features of the door itself in this connection, because I assume that it would be unfair, the door itself being the old, well-known, vertical, sliding door, with its well-known and conceded objections. The merits or demerits of the door itself, as shown here, do not seem to me to have anything to do with the proposed power operation of the door. Electricity can be used, as proposed here, on any door. The better the door, the better the scheme, because the door is part of it. If the door is not good, there will be trouble. I will only say one thing about this door, which does not reflect on this door in this position at all, but upon all doors of that type, and that is, the tightening of the door at the side by a long wedge, of a taper in this case of 1 to 96, I believe, is a thing which will make the door jam when the bulkhead warps, and if there is any possible way of preventing bulkheads warping on a ship during her service while afloat and in dock, and afloat in different conditions in a seaway, and from the different strains that come on a ship—if there is any possible way of stopping that warping, I have not yet had it called to my attention. So that a door which does not take into account the inevitable warping of a bulkhead does not seem to me to be a door which is suitable for power operation.

Now, as to the electric operation of doors. Several years ago, while delving into this specialty, I very naturally thought that it could be done by electricity—saw that it could be done by electricity,—investigated and carried out some schemes for operating a door or set of doors by electricity. The disadvantages at that time coming to my view led me to leave the electric operation of doors for the operation by fluid pressure, because that seemed to me to lend itself more directly to the work in hand, the conditions of work. I have noticed that there is, I might almost say, a stampede, or an endeavor to stampede, the constructing engineer towards electricity. Now it does not do for a constructing engineer to be stampeded. He should simply hold himself ready to use the best agent obtainable for doing the particular work on which he is engaged, and I myself hold that electricity in this particular case is not as available as, for instance, compressed air, especially in plants of doors and hatches where the number exceeds five to eight, or I will stop at five, for the reason—perhaps the principal reason—that the power is drawn, and must necessarily be drawn, direct from the generator to operate these doors all together, involving, apparently, a large increase in generator capacity. I have listened with much attention to the remarks on that subject which have just been made by another speaker, and I am rather disposed to leave that point to the issue of test and experience. I believe that in large installations electricity cannot be used directly on the doors with anywhere near the advantage that air can be used for the same purpose, because the electricity can be used to store the air with far greater economy and with no draught, at the time of emergency, on the generator capacity, and because air is fully as flexible for

this purpose, and as innocuous in all respects to the surrounding conditions, as electricity is. It can be led to the doors with less expense, I believe, and with no more interference with all surrounding things to be considered. It lends itself as a fluid to a direct push and pull, which is the work to be performed. I am sorry that the present installation of these doors on the Atlanta is not to include more doors, for the reason that it would be very interesting to see a full test of this system. It is to be regretted that the Atlanta was not considered to have the generator capacity necessary to run the full installation of doors. Whatever may be the outcome, it is gratifying to know that this matter is being worked out, and the best door gear for different conditions will be attained, and so the engineering world, and the Navy in particular, will be benefited.

Naval Constructor Francis T. Bowles, *Member:*—Mr. Chairman, having reached quite a mature age without having been guilty of an invention, I was led into committing that indiscretion during the past year, and the electric water-tight door is the result. I should not like to endanger the good opinion of any one of you by recommending it for a moment; but, with the usual fatuity of inventors, I consider it a very good thing. (Laughter.) I refrain from going into any discussion of the door, and I merely wish to point out to you the difficulties that perhaps a good many of you have incurred in storing air. (Laughter and applause.)

Asst. Naval Constructor R. M. Watt, *Member:*—Mr. Chairman, there is *no* question but that the power door has come to stay. The men welcome it, because it relieves them of manual labor, and for that reason they exercise every care to keep it in working condition. Realizing the necessity of lessening the increasing complications of ships (a subject so ably presented yesterday by Mr. Dickie), this form of power door was devised. It is simple in its mechanical features, and simple in its electrical features. It makes use of electricity, the power which those present connected with shipbuilding apparently believe the best adapted, and therefore the one form of power which should be in general use everywhere, outside the engine and boiler compartments of ships.

Relative to points raised by Mr. Cowles, the mechanical features of the door contain certain novel features apparently overlooked. These features overcome many of the objections that have been urged against the old form of water-tight doors. Briefly, the main points of difference are, the open frame at the bottom of the door, and the wedges at the top, which complete the uniform tightening of the door all around the frame, at sides, top, and bottom. This is the first time that wedging of a door has been arranged for in this manner.

The question of the warping of the bulkhead has been met by the use of a rigid frame of apparently great weight. If this frame is not sufficiently rigid to prevent warping of the bulkhead, it is proposed, and will be a very easy matter, to increase the scantlings to positively accomplish this.

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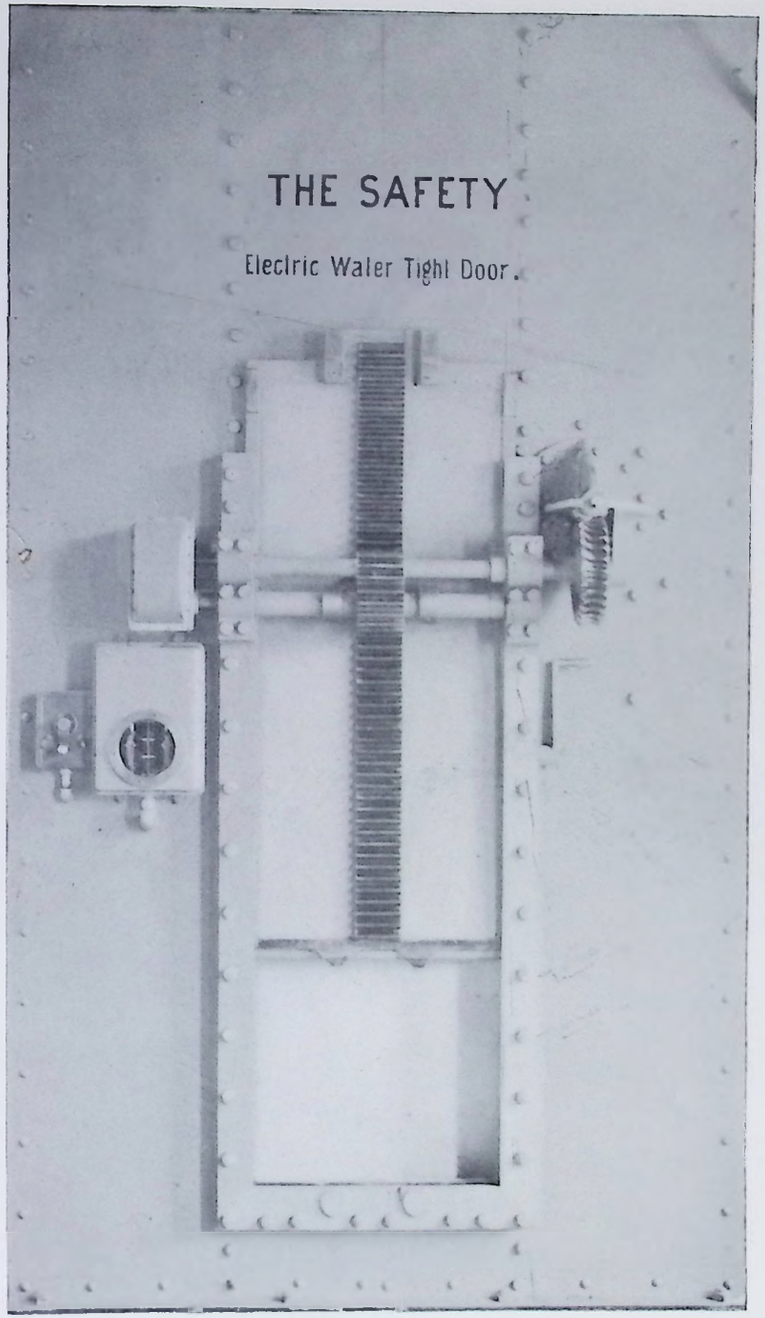
The availability of electric power has been very fully discussed by Mr. McKay.

Mr. Cowles' claim that air can be led to the doors with less expense than electricity is open to argument. The use of air requires the use of special tight-joint fittings and pipe of great strength, the expense of which, I contend, will exceed the cost of bringing electric power to the doors.

THE CHAIRMAN:—We will now pass on to the next paper, by Professor C. H. Peabody,—"Progressive Speed Trials of the U. S. S. Manning."

Professor Peabody read the paper.

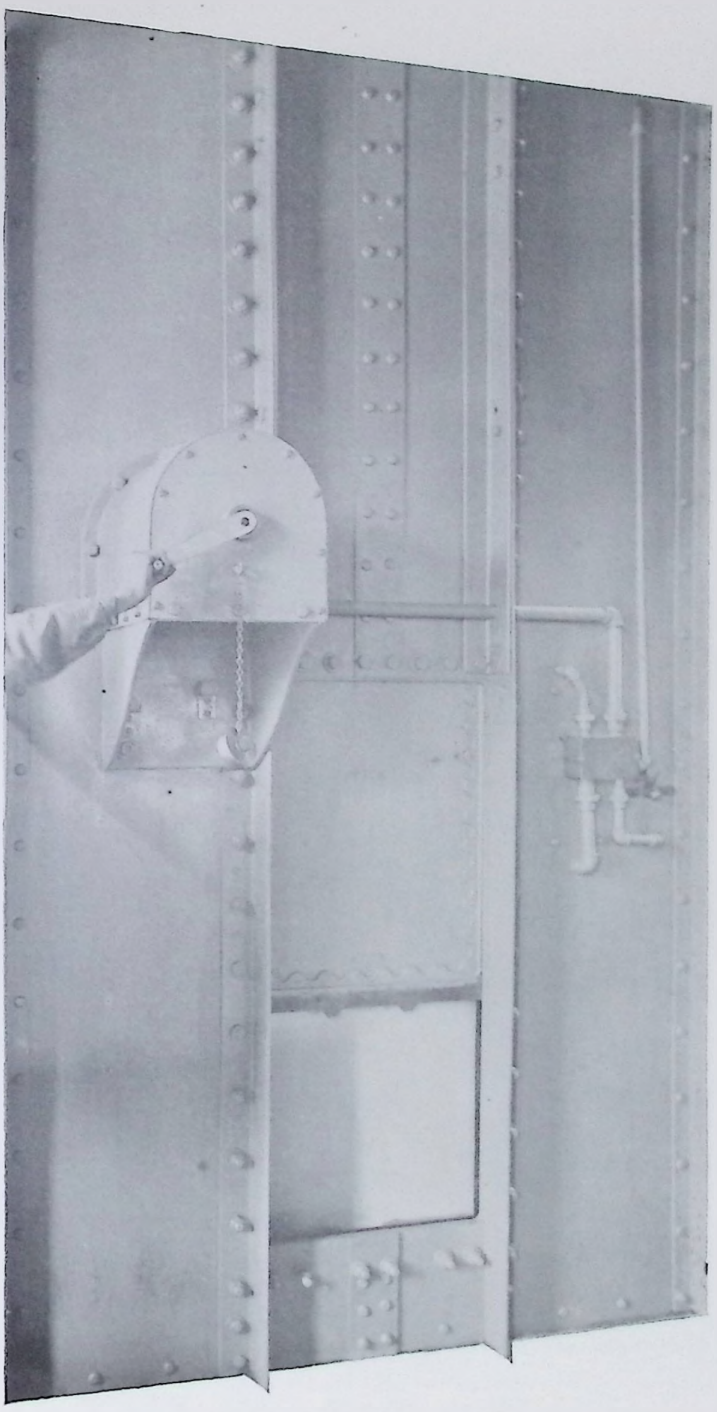
To illustrate paper on "Novelties in Ship Fittings,"
by Assistant Naval Constructor R. M. Watt, U. S. N., Member.



SAFETY ELECTRIC WATER-TIGHT DOOR PARTLY OPEN. FRONT VIEW, SHOWING HAND CRANK STOWED.

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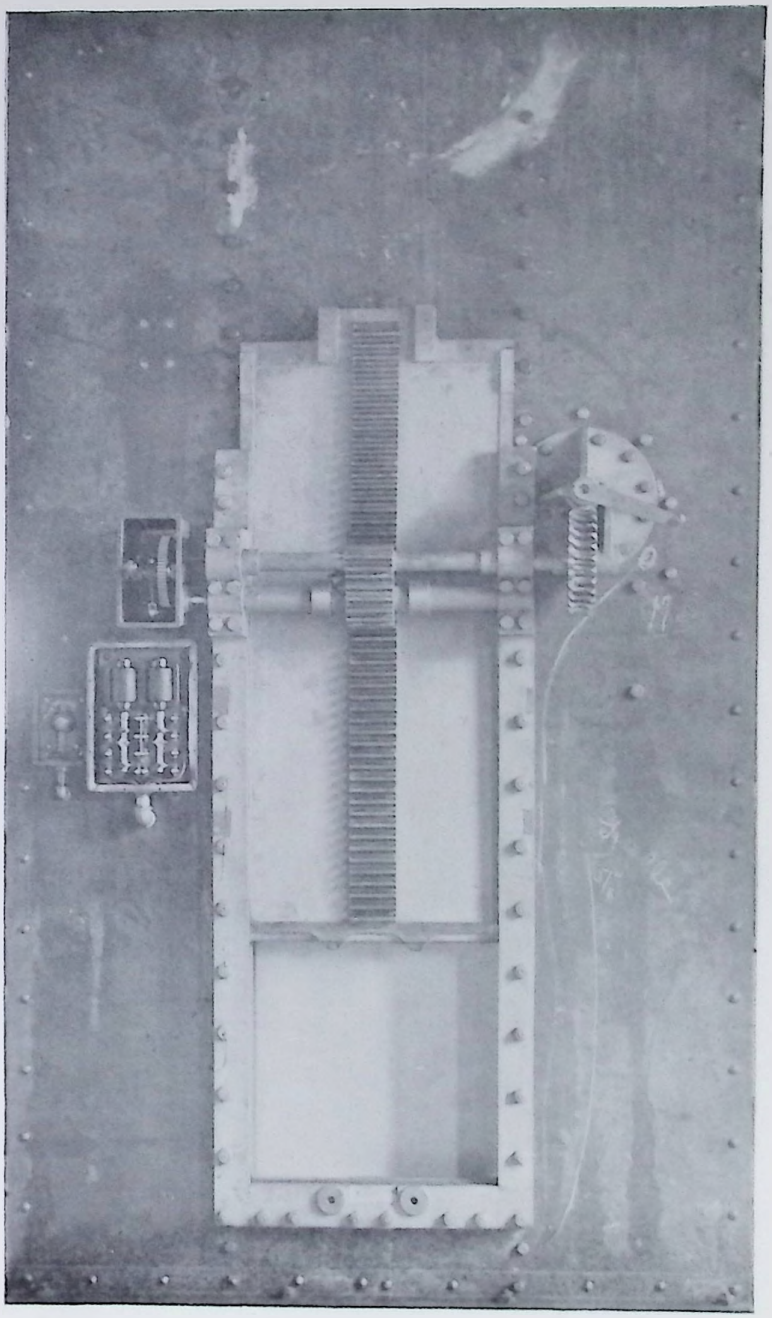
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Safety Electric Water-Tight Door Partly Open. Rear View, Showing Hand Crank Shipped.

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Safety Electric Water-Tight Door. Covers Removed from Spring-Lever Switch, Limit Switch, and Sprague Gravity-Controller Boxes.

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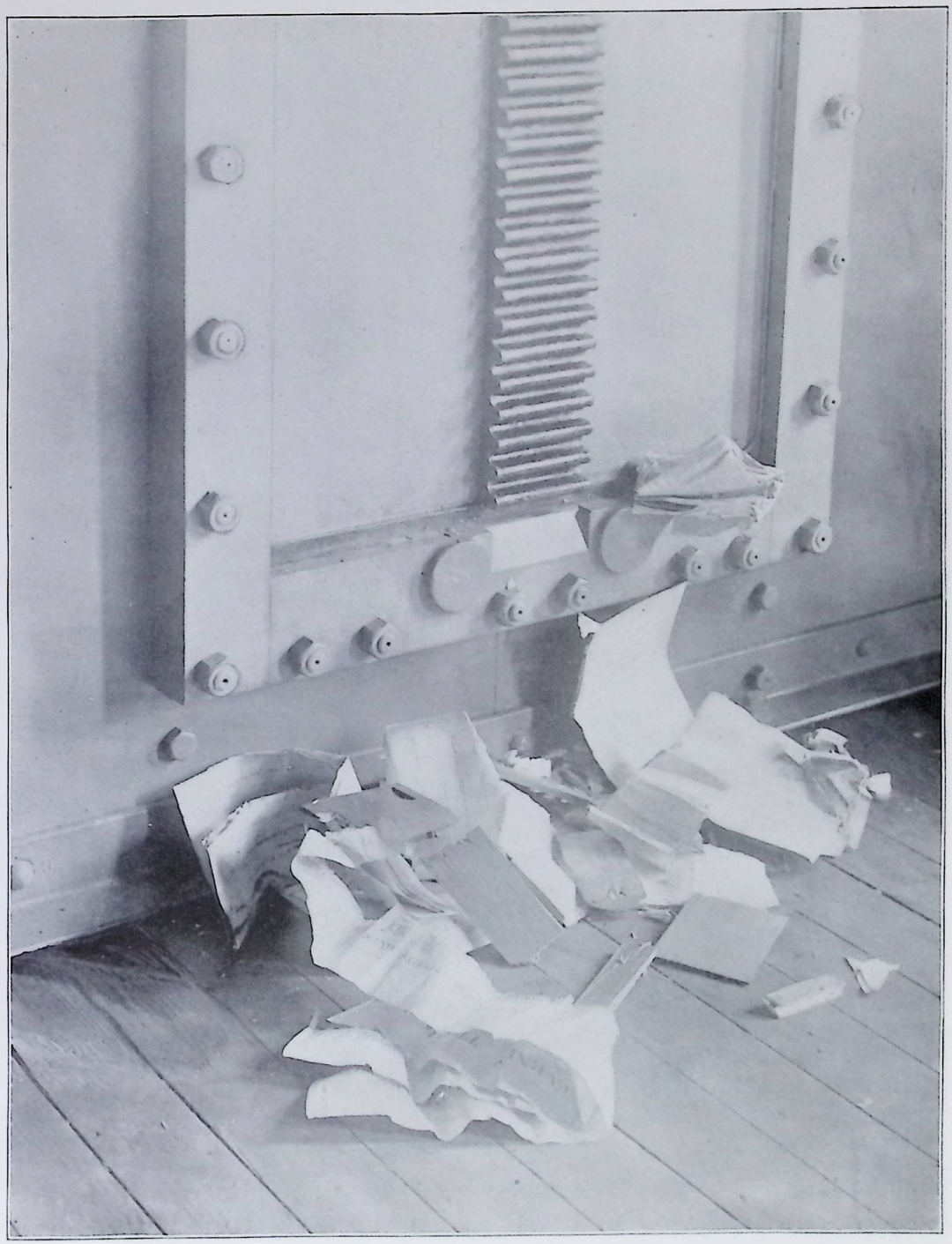
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Safety Electric Water-Tight Door. Cover Removed from Motor Case. Hand Crank Stowed.

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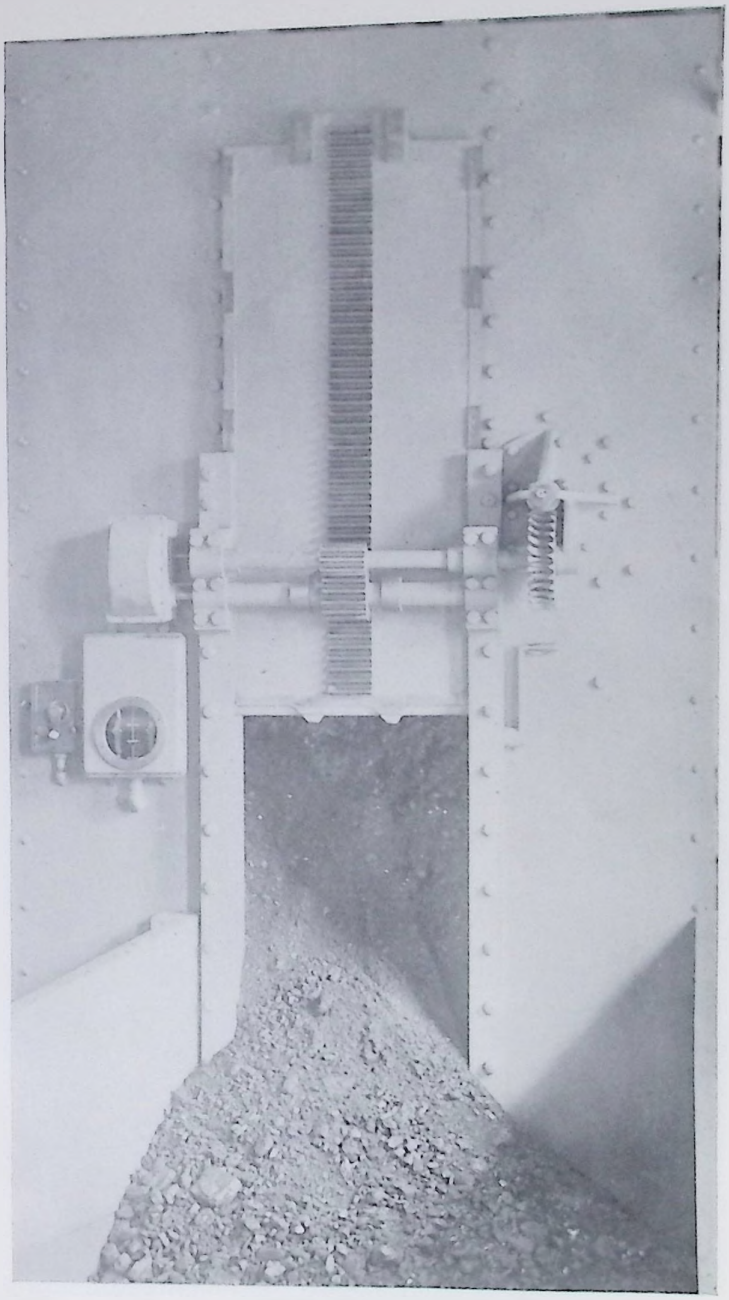
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Safety Electric Water-Tight Door after Closing, Having Cut through Wooden Box and Folded Newspaper on the Sill.

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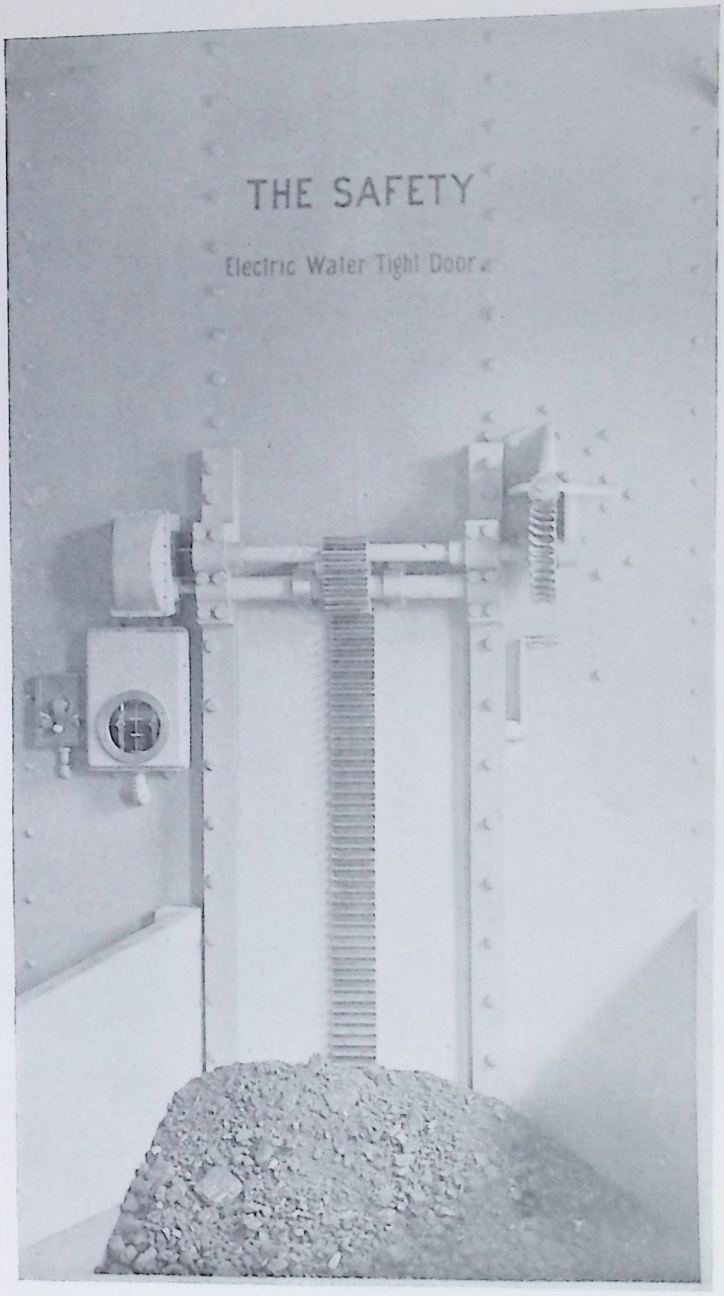
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SAFETY ELECTRIC WATER-TIGHT DOOR AFTER OPENING AGAINST COAL STORED BEHIND THE DOOR.

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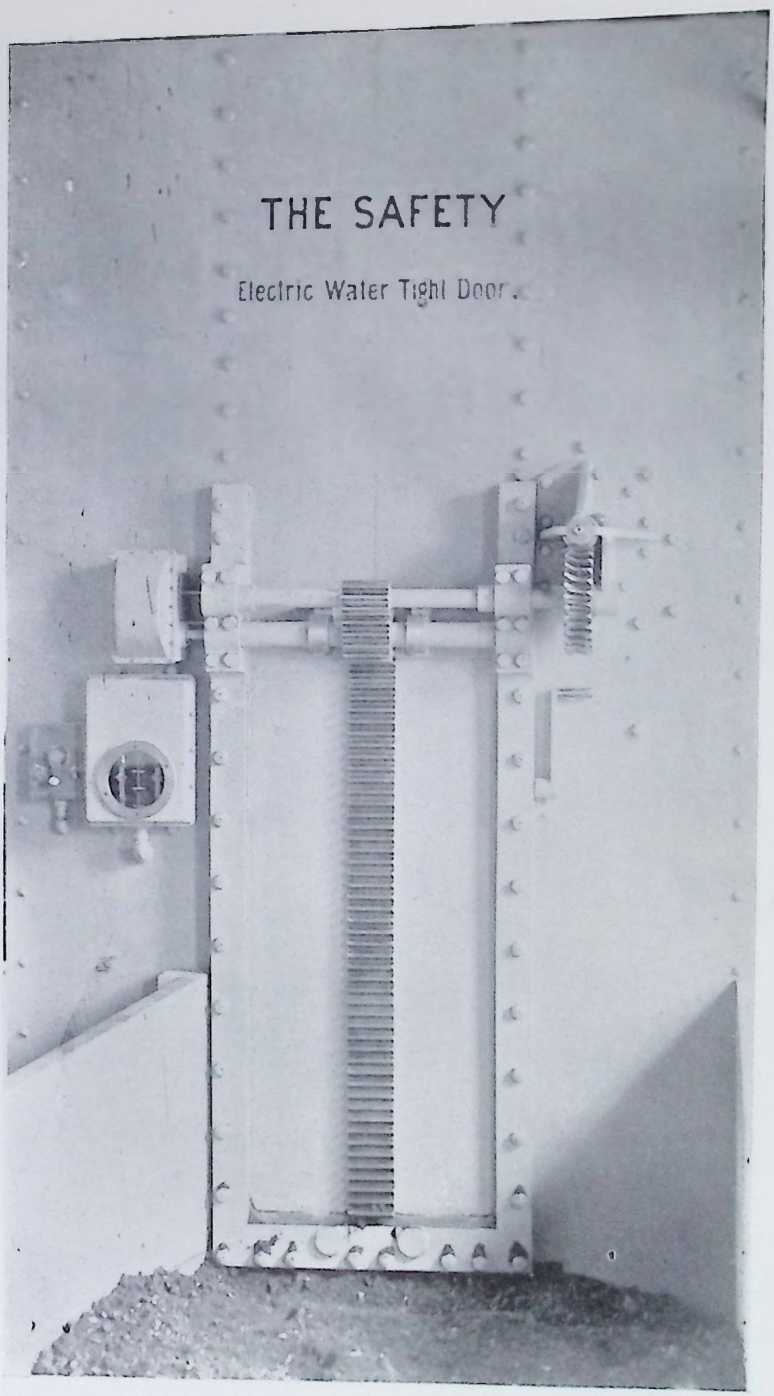
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SAFETY ELECTRIC WATER-TIGHT DOOR AFTER CLOSING THROUGH COAL ON DOOR-SILL.

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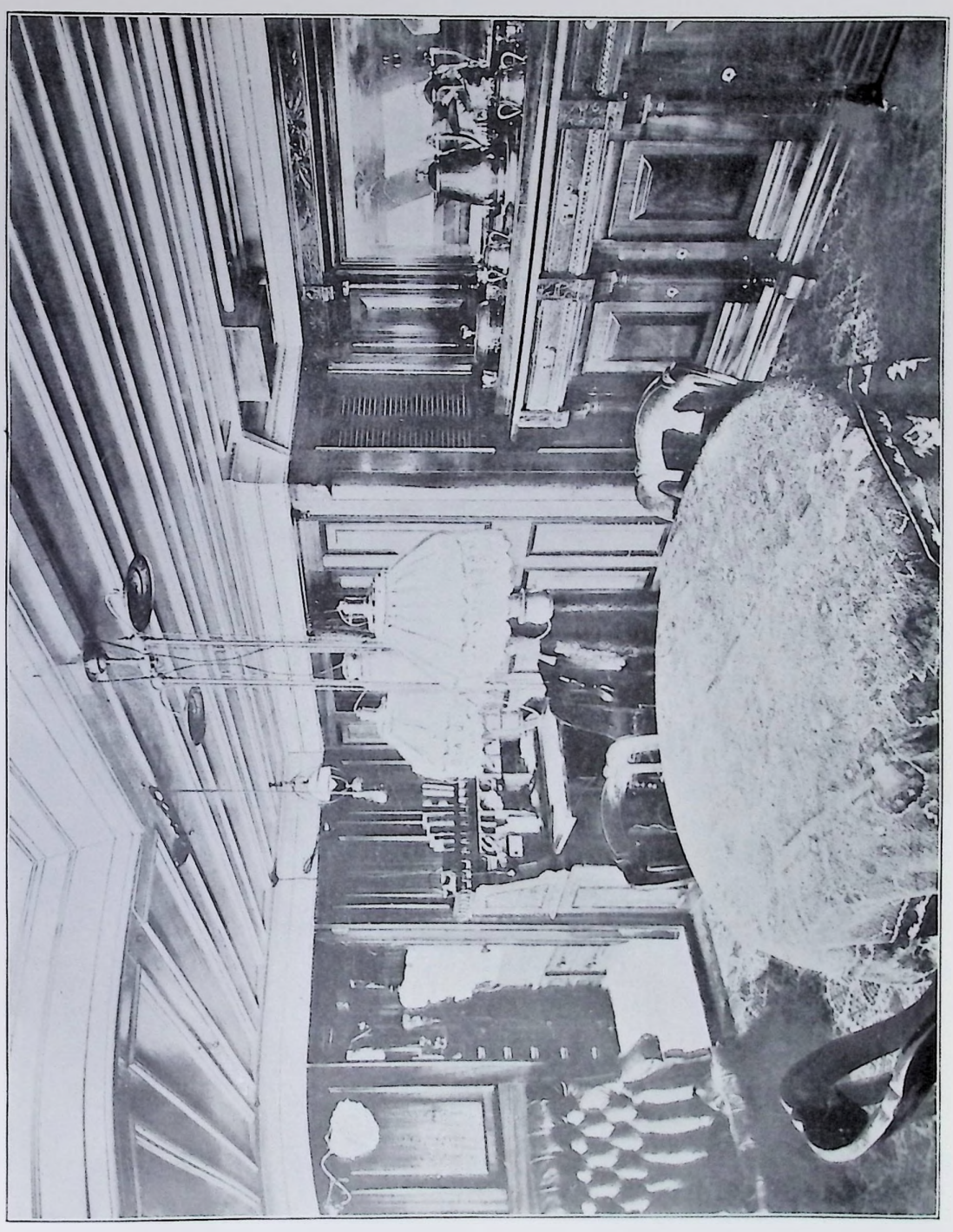
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SAFETY ELECTRIC WATER-TIGHT DOOR. COAL CLEARED AWAY SHOWING DOOR AS SEATED THROUGH COAL.

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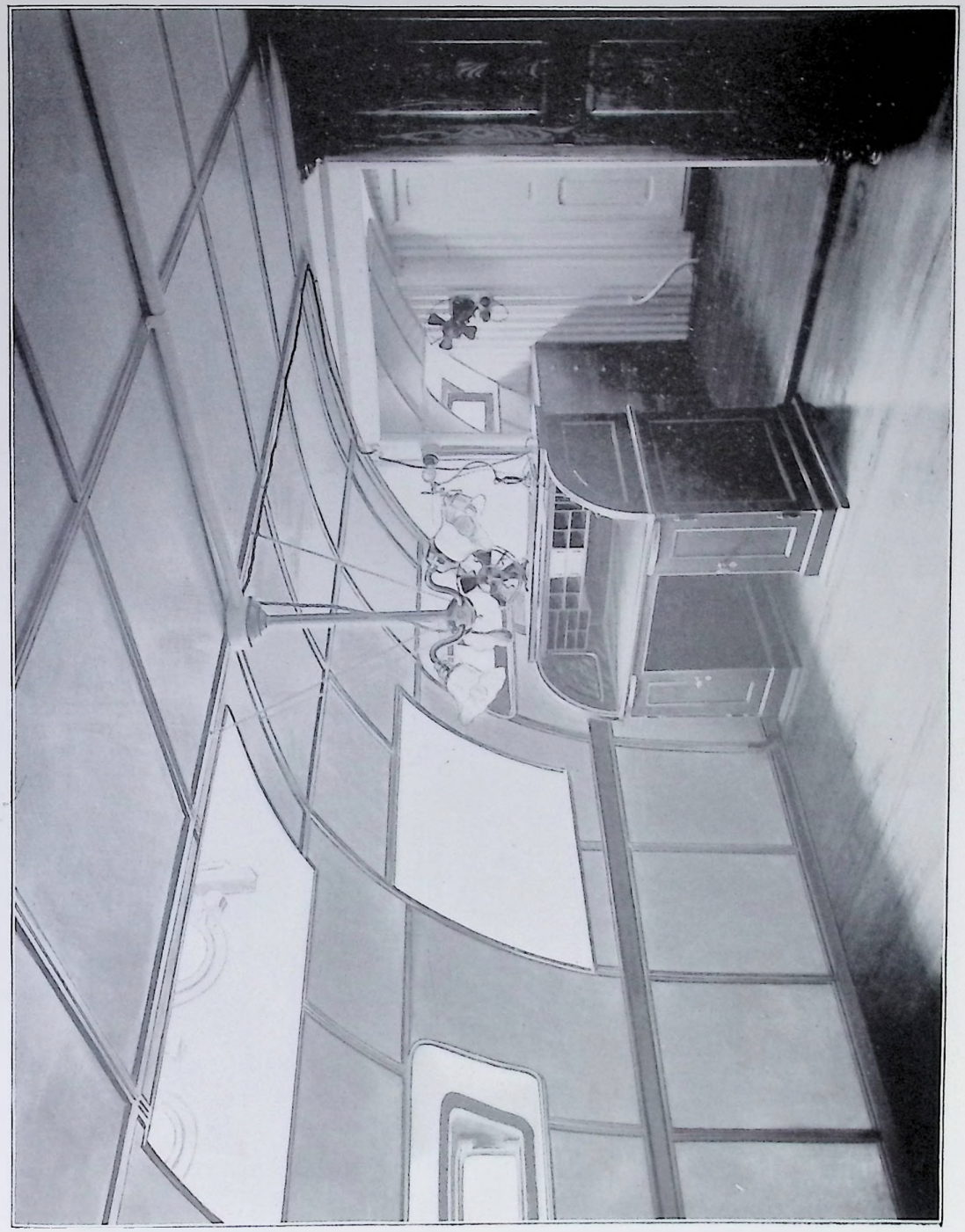
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U. S. S. Atlanta. Showing Woodwork in Cabin before Refitting.

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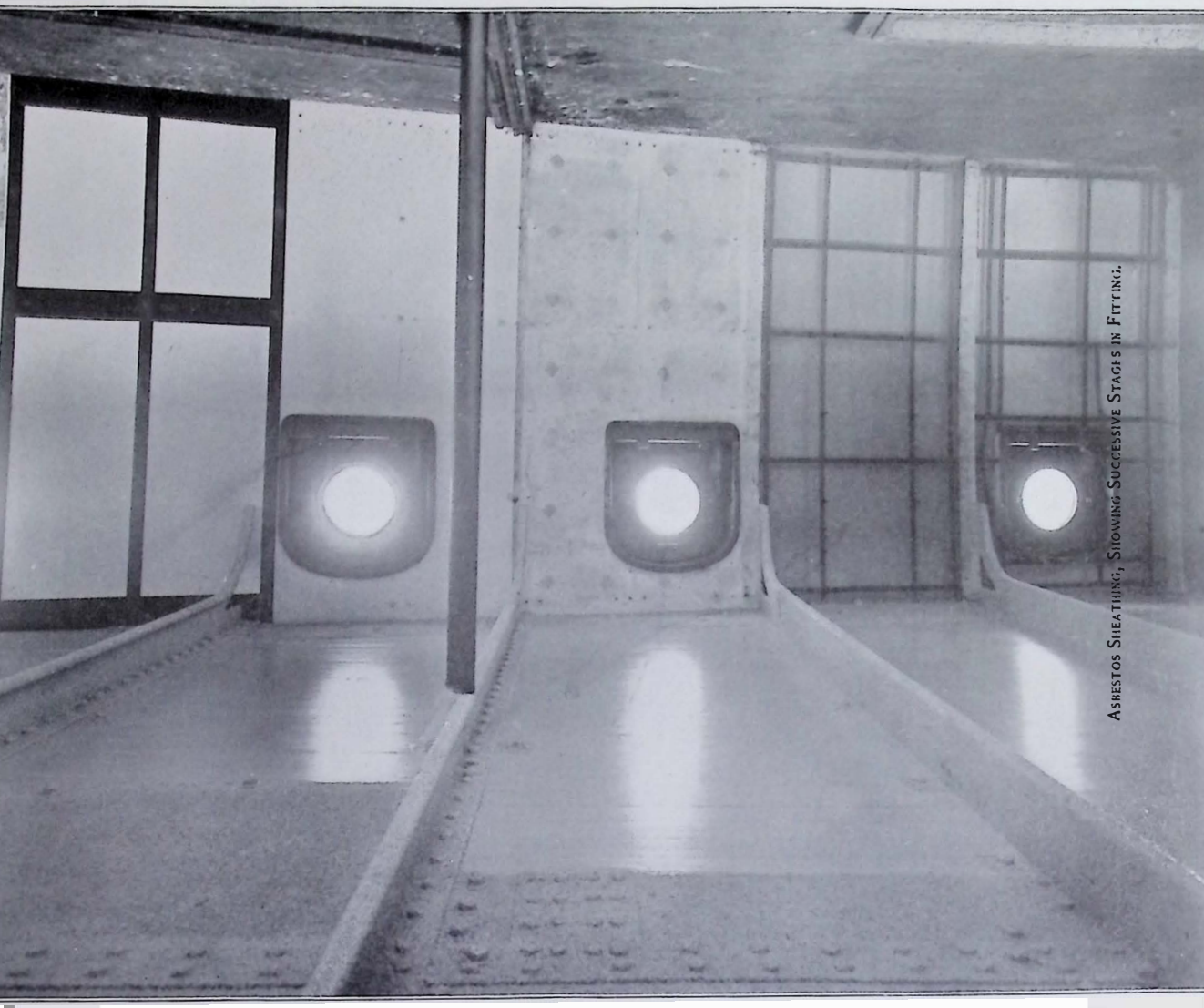
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U. S. S. Atlanta, Showing Cabin after Refitting.

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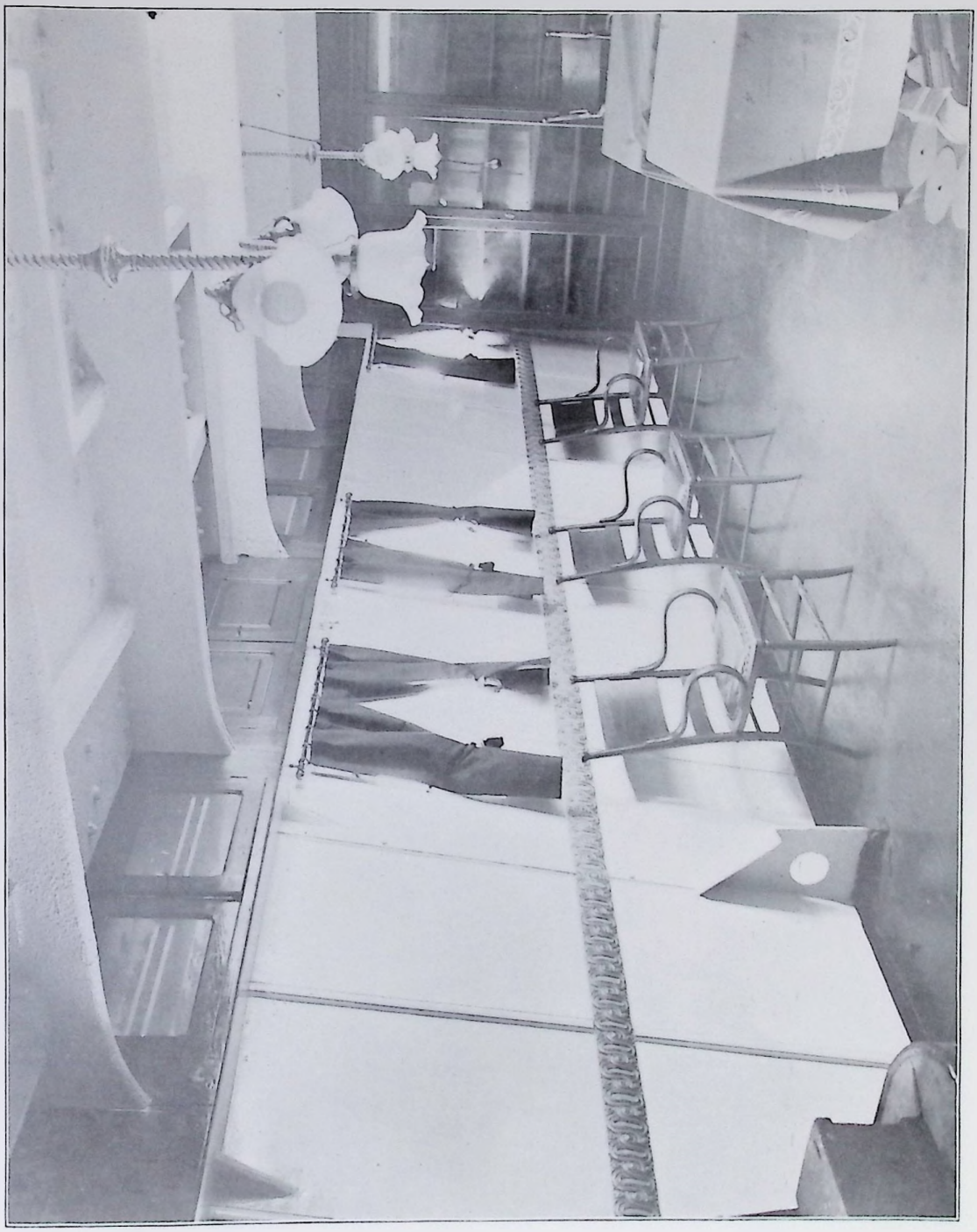
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ASBESTOS SHEATHING, SHOWING SUCCESSIVE STAGES IN FITTING.

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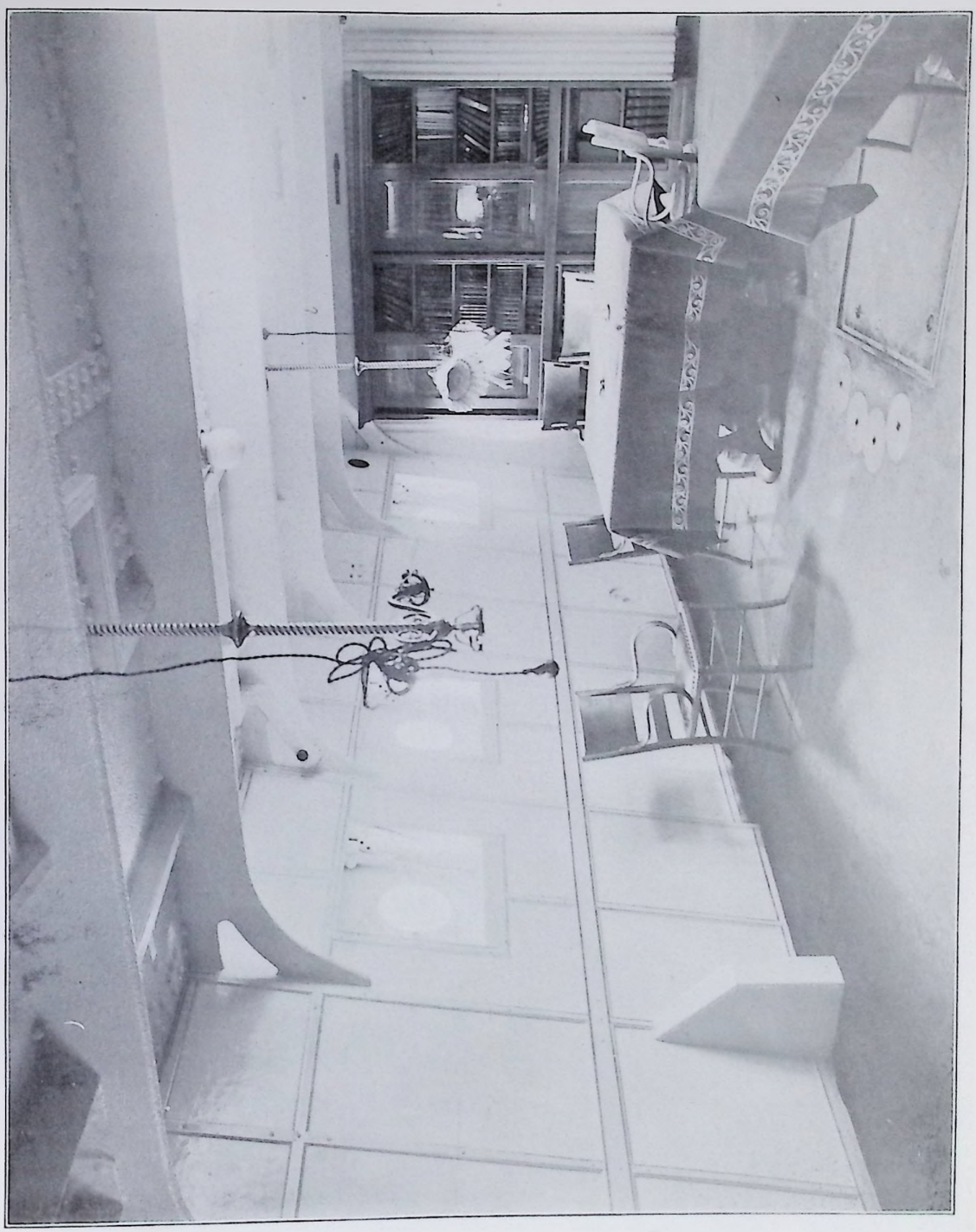
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Asbestos Sheathing as Fitted in Wardroom of the U. S. S. Indiana.

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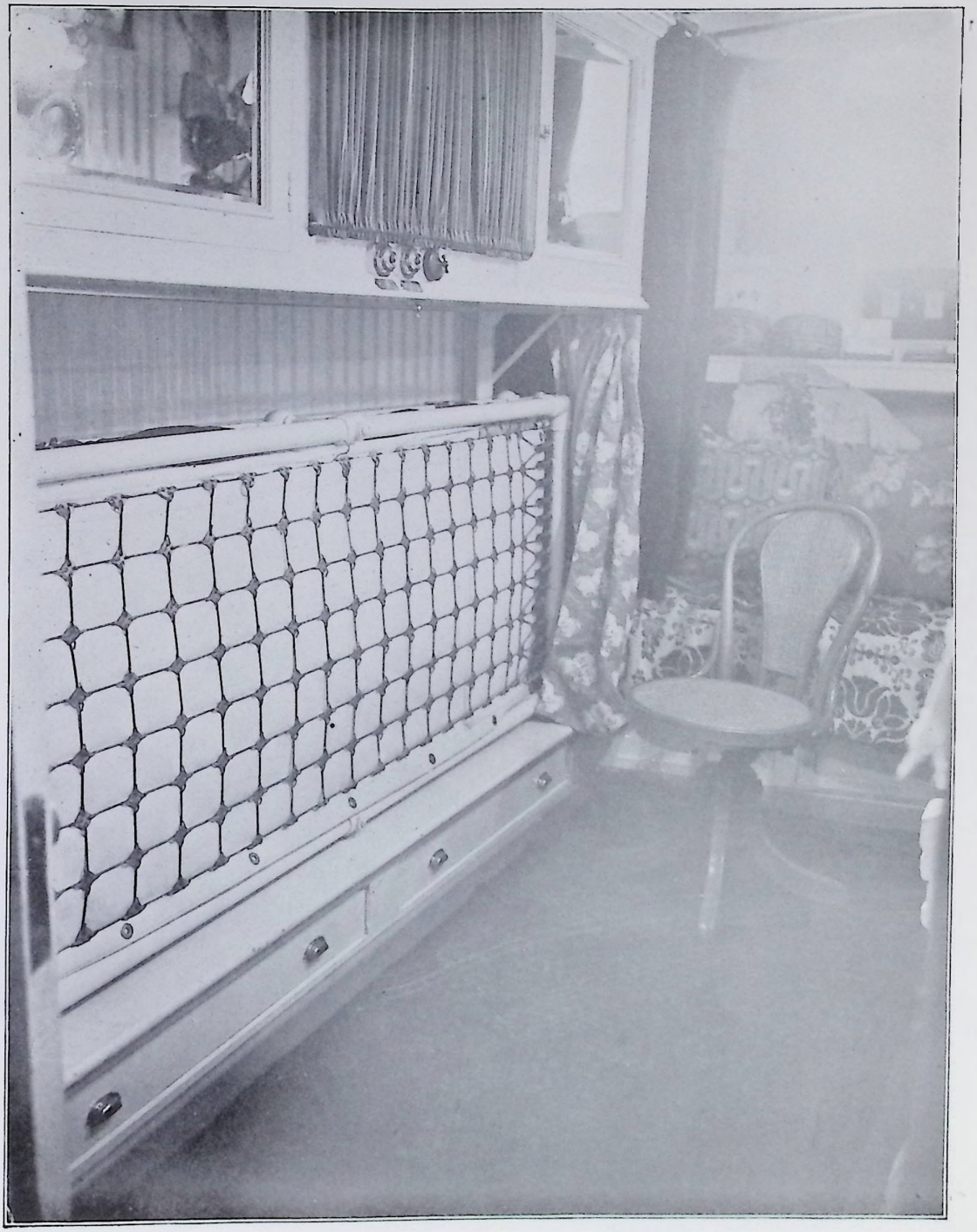
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ASBESTOS SHEATHING AS FITTED IN WARDROOM OF THE U. S. S. MASSACHUSETTS

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METAL FOLDING BERTH IN FOLDED POSITION WITH CURTAIN DRAWN BACK.

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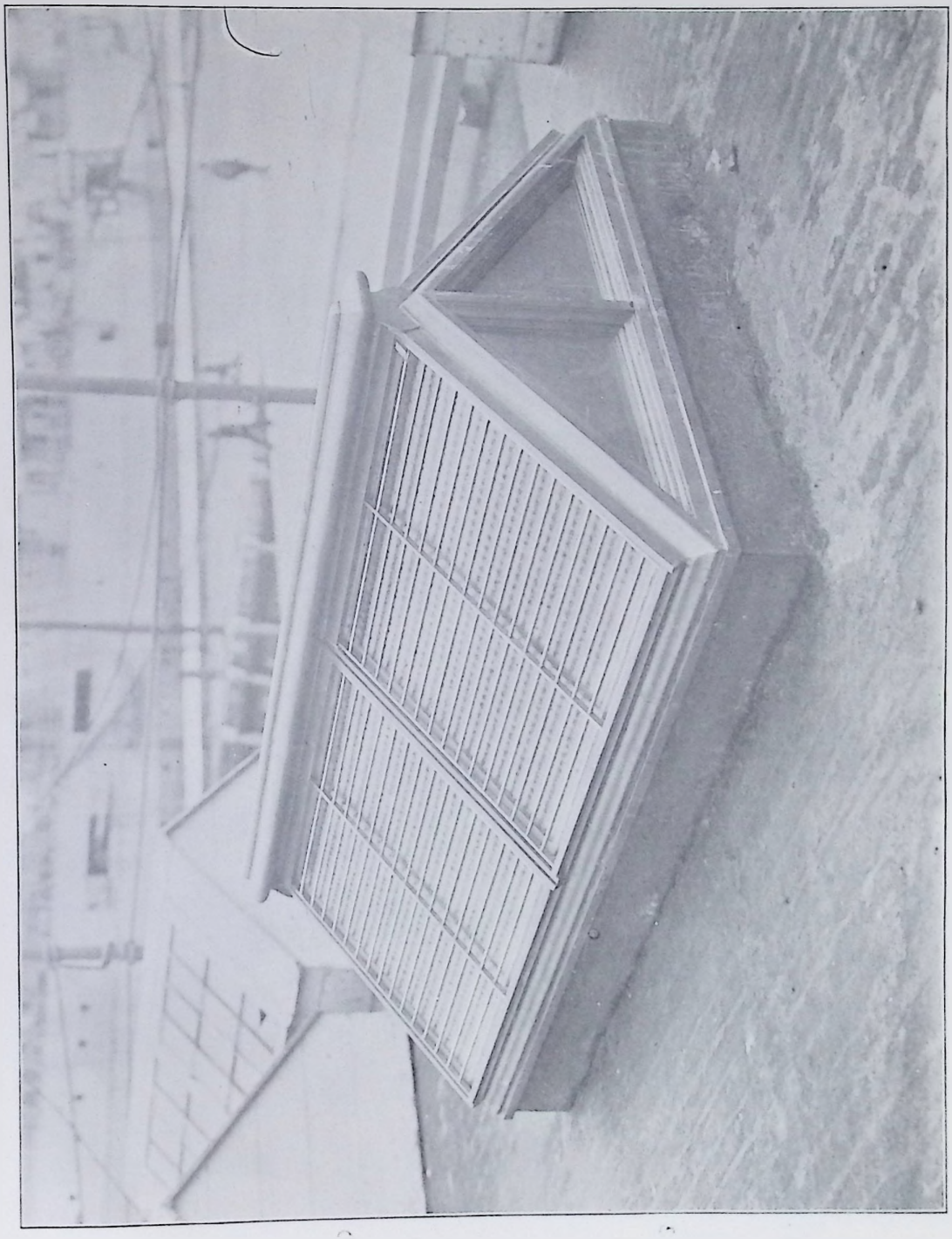
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METAL FOLDING BERTH OPENED READY FOR OCCUPANCY.

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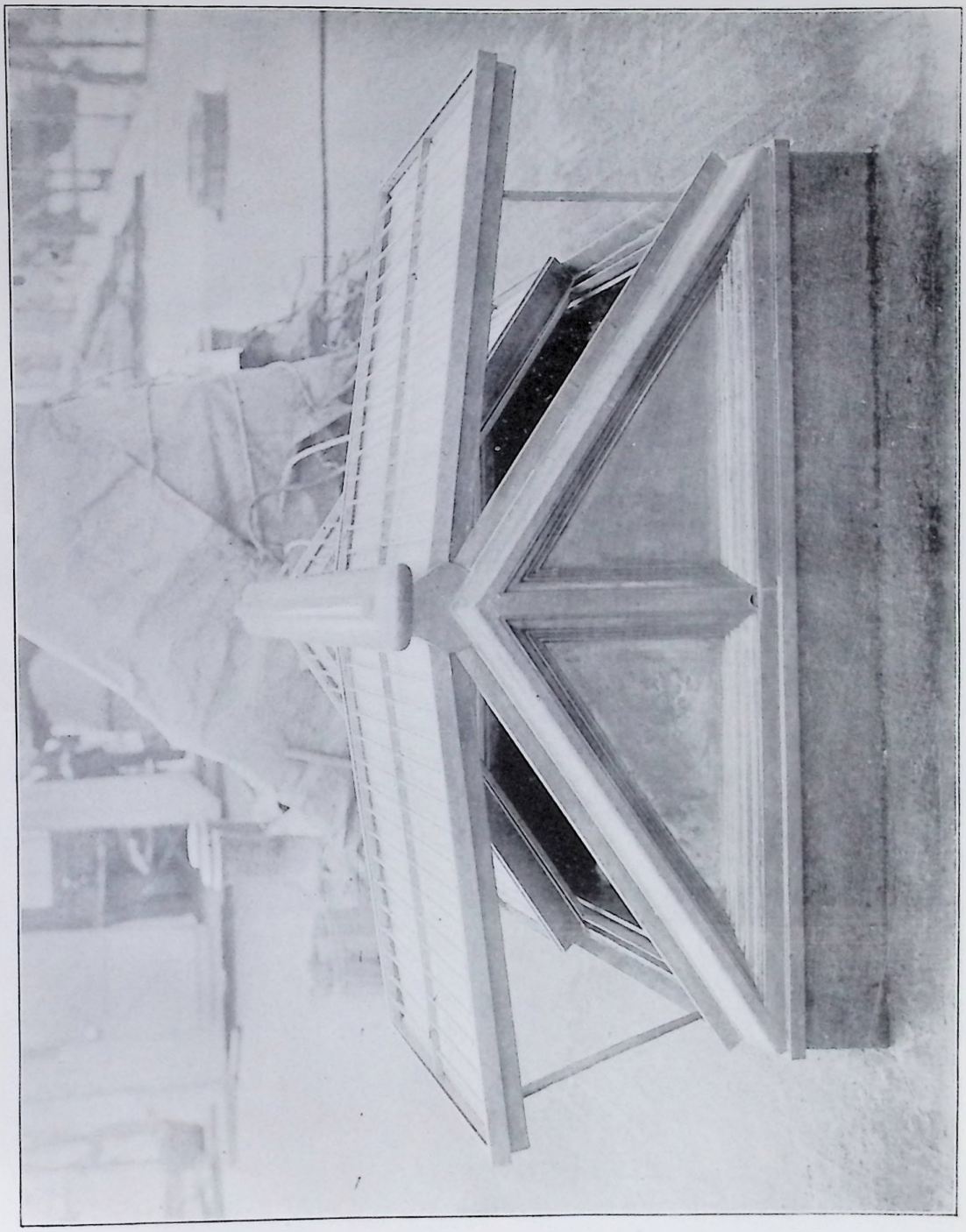
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METAL SKYLIGHT. SASH CLOSED.

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METAL SKYLIGHT. SASH OPENED FOR VENTILATION.

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