SESSION 1891-92.

THIRTY-FOURTH PAPER

(OF TRANSACTIONS)

ON

WATER TIGHT

BULKHEAD DOORS

BY

MR. S. C. SAGE

(MEMBER OF COUNCIL).

Read Tuesday, December 8th, 1891

IN

GRESHAM COLLEGE, BASINGHALL STREET, LONDON, E.C.

PREFACE.

BROADWAY,
STRATFORD,
December 8th, 1891.

A Meeting of the Institute of Marine Engineers was held this evening in Gresham College, Basinghall Street, E.C., when a Paper on "WATER-TIGHT BULKHEAD DOORS," by Mr. S. C. SAGE (Member of Council) was read.

The Meeting was presided over by Mr. T. F. AUKLAND (Hon. Member).

Several full size Drawings and Tracings, also a Model, were exhibited to illustrate the various kinds of Doors and Gears referred to; of these reduced illustrations are shown, embodied with the Paper which follows. The Editor of the *Marine Engineer* has kindly presented to the Institute the blocks from which the illustrations are printed.

We are indebted to the kindness and courtesy of the Honorary Secretary and Committee of Management of Gresham College for granting us the use of the Hall for this and other meetings. A cordial vote of thanks was passed at the close of the meeting to the Committee for placing the Hall at our disposal.

JAS. ADAMSON,
Honorary Secretary.

WATER-TIGHT
BULKHEAD DOORS.

The subject I have chosen to address you upon this evening is, to my mind, of very great importance to us as marine engineers. I dare say there is not one of our members who has not at one time or another given the question considerable thought.

A great many laws have, at different times, been introduced by the Legislature of this and other countries for the better preservation of life and property at sea. Freeboards have been made compulsory. The capacity, number and equipment, the lowering and stowage of lifeboats, have become the subjects of a recent Act of our own Parliament, and there is a Committee appointed, which at the present time has not, I believe, completed its sittings, in connection with the position, construction and fittings of water-tight bulkheads; but I am not aware if the functions of this Committee include in its programme the very important feature of water-tight bulkheads, through which it is required to have passage from one compartment to another, viz: water-tight doors, their fittings, and the means of lifting and lowering such doors.

It is not my intention to occupy much of your time to-night by extending this paper to any great length, as I am hopeful that the discussion, which I am sure such an important feature of a sea-going vessel as water-tight doors will give rise to, will be much more useful and interesting as coming from many members,

each with probably a different and larger experience of the matter than my own.

Water-tight doors (as at present fitted to the bulkheads of the royal and merchant ships of the present day) are divided into two kinds, viz: those opening upon hinges, or swinging doors, and sliding doors, both horizontal and vertical, the vertical sliding doors being the kind most usually found in the vessels of the mercantile marine of this country.

Hinged water-tight doors are open to the objection that they occupy too much space, are more costly to construct, more difficult to make tight, take much longer and require more force to close, and can only be fixed in such places as will allow of the space required for their manipulation being kept clear. I have mentioned horizontal and vertical sliding doors, and have seen some fixed in a diagonal position, but the principle is similar in all.

With respect to sliding doors that open and close horizontally, I must say that I do not like this kind, as they must of necessity be more difficult to manœuvre than vertical ones, and there are also other disadvantages which I am sure are patent to most here to-night, and which prevent them from being so generally used as those of the vertical type. The only advantage I can see in horizontal doors is, that they can be closed quicker (with equal gear) having only the width instead of the height to travel, but this advantage is more than counter-balanced by the liability of the bottom slide to get choked with coals or other matter, and unless they be very well guided, they have a tendency to "cant" and thus obstruct the closing.

In horizontal doors their weight is no assistance to the operation of closing. A remarkable example of the relative efficiency of horizontal and vertical sliding doors is illustrated by the inquiry into the loss of the mail steamer *Oregon*, when it was elicited that out of all the vertical doors only one refused to work, but that one did close so soon as it was "let go by

the run;" while one door on the horizontal principle could not be closed, and no doubt was the cause of the vessel foundering. The effect of this casualty was to increase the prejudice which already existed in practical minds against the use of horizontal water-tight doors, and I do not purpose making any more remarks upon this kind of door, but will pass on to consider doors of the vertical type.

The frame-work of these doors should be sufficiently stiff to resist a slight deformation of the bulkhead in its immediate vicinity, and so arranged that the possibility of its getting clogged up is reduced to a minimum.

The door itself should be strong and as far as possible, self cleaning, by its upper and low ends acting as a scraper when in motion.

The gear for lifting and lowering (especially lowering) should be quick in its action, always accessible, easily worked by one man, under no circumstances allowed to be put out of gear, and the gear should be situated well above the deep water line.

Bearing in mind the above qualifications, which I consider a good door and gear should possess, I will now come to a description of the doors and lifting gear of same, that are usually fitted to the ordinary merchant steamer having only just sufficient of a crew (when all are well and able to work), to do the required and necessary work of the vessel both at sea and in port.

The keen competition of the present day to secure orders for ships has resulted in a saving spirit, and I very lately had a case under my notice where the two doors, from the stoke-hold into the thwart-ship bunker, were lifted at Cardiff to use the coals contained therein for the outward passage, and when the vessel arrived at New York and it was necessary to lower these doors to put the cargo of grain into the compartment forward of the stoke-hold, they could not be worked, as the nuts in the tops of the doors, being of cast iron, (!!) were rusted fast on the screws and could not be moved, and to get them closed the engineer had to take the brackets off the bulk-

heads at the tops of the screwed spindles and lower them down with blocks and falls.

Doors, as fitted to ordinary merchant vessels, are fairly well-made and fitted to their places, but the means of lifting and lowering them, in my opinion, leave much to be desired. These means, as generally fitted, consist of a long rod with a square thread at one end which passes through a nut in the upper part of the door. The rod is supported at its upper end by a bracket fastened to the bulkhead above the load line, and is there actuated by a hand wheel, a plain T lever or a ratchet. Sometimes the rod is made fast to the upper end of the door and the screw is at the bracket above, in which case the nut is in the hand-wheel or lever.

Some doors are made with a rack of the ordinary spur-tooth pattern cast upon its back, and are lifted with a countershaft having a pinion upon it gearing into the rack, and worked from above with suitable gearing.

Other doors are lifted and lowered by an endless screw at the end of the rod, which gears into a set of teeth on back of the door, cast obliquely to suit pitch of screw. Some of these latter kind of doors are fitted with an eccentric block at the bottom fitted with a lever, by turning which, the worm is thrown out of gear and the door falls by its own weight, but in this case it must always fall to the same level for the screw to re-engage in the rack to force down the door should its gravity not carry it down low enough to be tight, and also to be ready to lift it again.

It is plain to all of us that most of the gears here described are subject to grave defects, principally slowness of motion. The rods are generally placed so close to the bulkheads that a large handwheel at the top cannot be used, though I have seen the bulkhead cut to give clearance for a larger wheel than could otherwise be placed there, and a cupped plate fitted at the other side of the bulkhead to preserve its tightness.—The wheel in this case was 14-in. diameter.

As many of these doors are fitted with lifting

screws, having a pitch of not more than one-quarter-of-an-inch, the amount of labour and time required to lift or lower a heavy door through the space of 2½ feet will be obvious, especially as one operator has generally not power enough to keep the wheel going, but must work it intermittently.

I trust I am not saying too much when I here state that while a man, or for the matter of that, two men, were lowering a door of this description, the water (in the case of a collision or casualty causing a moderate-sized hole to be made in the ship) might reach the fires and extinguish them, and in some cases the water might carry with it some obstacle, which, by getting into the doorway, would prevent the closing altogether.

When the ordinary tunnel door is open, it has about one inch, or one inch and one half of play between the edges at bottom and the top of the side groove of the frame, and as the door is only suspended at the top of the rod so many feet above it, the result is that it falls to and fro when in a seaway, causing a most unpleasant clattering, which is very frequently stopped by jamming a wedge or other piece of wood behind it, and should this wood be forgotten in the hurry and excitement of a collision cr other casualty, it might then be found impossible to lower the door by any means from the top, and the water, by the time the obstructing wedge or block was remembered, might be above the door, and render it impossible to reach the obstruction.

I will now place before you, particulars of several doors and their gears which have come under my notice, and I have no doubt that many of my fellow members of the Institute of Marine Engineers have also had the same under their observation.

One gear was fitted with a split nut, very similar to a screw-cutting lathe, but opened and closed with a small spindle, having right and left-handed screws cut upon it, but to my mind this principle does not fulfil all the necessary requirements, as the door is released

from the suspending rod, and if it does not then entirely close, the nut must be re-engaged before the door could be screwed down tight. In this instance the nut was fixed on the door, and it would be necessary for a man to be at the bottom—possibly in a position of some danger—to connect the nut on the screw, and another man at the top to move the screw spindle, if necessary, to the proper position for the nut to close; though I do not see why the nut and screw with this gear should not be fixed at the top.

I consider the rack and worm system to be a much better plan than the screw and nut, and with a bevel wheel and pinion at the top could be worked much faster, and for lowering quickly, the eccentric block at bottom, previously mentioned, might be utilized by connecting a tube to the same, through which the screw spindle could pass, and with an eccentric block on top of the tube; also with a lever for throwing it out of gear from the top instead of from the bottom, and the same operator could, with one hand, work the eccentric blocks, while, with the other, he could slowly turn the screw round until it came to the proper position for re-engaging.

I have here a sketch of the patented arrangement of Messrs. Donkin and Nichol, which is more rapid in its action than those previously noticed. As you will see, a pulley is mounted above the door, and a chain, starting from a short-screwed spindle at top of the door passes over this pulley, the other end of the chain being attached to a weight sliding between guides fixed upon the bulkhead. The balance-weight, when in position, is heavy enough to keep the door open, or it may be arranged the reverse way. In either case the action would be nearly the same. You will see by the sketch that there is a short length of chain depending from the bottom of the balance-weight with a long link at the end, which, when the door is open, is passed over a stud in a convenient position. In the case of the door being the heaviest, on releasing the chain from the hook or stud, the door would close quickly or slowly, as required, being under the control of the operator. In the event of the weight being the heaviest, it would be necessary,

after the securing chain was let go, to assist the door in its downward course by hand. In case the door should require to be forced down to become perfectly tight, a hinged nut is fixed, which closes around the short screwed spindle, between the door and the chain previously alluded to, and also serves to start the door in opening.

The disadvantages of this balanced or partially balanced door are, in my opinion, first, its extra weight; second, the additional space occupied; third, the liability of the guides of the balance-weight to become corroded or painted up so as to stick, or partially annul the benefit of the balance weight; fourth, if the ship has a strong list, the door may only go halfway down, or not far enough to engage the nut on the screw; and, fifth, the manipulation of the whole has to be effected below.

There is a very ingenious door, patented by Mr. McElroy. This door is very quick in its lowering motion, which I consider to be of the first importance in connection with these doors, as there is plenty of time, generally, for the opening part of the process. I have two tracings which will show the arrangement of the quick lowering, and it will at once be seen that they can be closed with this gear very quickly. This would probably be a very good gear to fit to vessels of the mail and passenger lines, and has already, I understand, been fitted to the R.M.S. *Scot*, built by the firm of which the President of this Institute is the head.

The drawbacks of this gear in my opinion are: first, the question of cost, as it is obvious that it would be much more expensive to make and fit than the ordinary door with the simple screw, nut, or rack; second, its extra liability to get out of order by reason of its extra working parts getting corroded or stuck fast by neglect, &c.; and third, that the system cannot very well be adapted to existing doors of the ordinary type.

An automatic arrangement for closing McElroy's patent doors has been invented and patented by Mr.

Niccol, by which arrangement the door is released when the water reaches a certain height in the ship's bilges.

The specification of this patent is now on the table and may be inspected by anyone present.

It consists of a tank being formed in the bottom of the vessel to within a certain height of the floor platform. In this tank is a float with a guide spindle through the centre. Attached to the side of the tank is a lever which is connected with suitable bell cranks, rods, levers, pinion, and rack, to the disconnecting rod of the door. When the water rises to a certain level in the ship it enters the tank and lifts the float, and by the arrangement of rods, &c., releases the friction bands around the two worm wheels which form the nut, and allows the door to drop. My objections to this automatic gear are, its cost, the probability that with so many pins, joints, bearings &c., it will become so stiff from corrosion, non-use, neglect &c., that the float would not have power to perform its function of disengaging the suspending machinery of the door.

Then there is the possibility of the "limber" of the vessel in which the tank is situated, becoming isolated from its neighbours by the limber holes being choked up, and through water from the platform coming into it might become individually full, lift the float, create a false alarm and, probably, imprison some poor fellow in the tunnel until "eight bells."

It is not clear to me from the specification of the patent where the water enters the float tank, and I may be wrong in assuming that it enters near the top, in which case, after it has performed its function, the water which caused it to act must be let out to allow it to be ready for action again.

For my part I do not see the necessity of enclosing the float in a tank at all, so that it is enclosed between plates that will prevent it from damage and from being lifted by the "sallying" of the water when the ship is rolling. If the float were properly protected from these injuries, but capable of being influenced im-

mediately the water in the bilge increases above its normal height, and the disconnecting rod from the float marked conspicuously, and the bulkhead also utilised as a kind of index and register, the attention of those on duty would probably be called to the smallest increase, and means taken in time perhaps to discover and overcome its in-rush.

Having given you a few particulars of different doors and the means of working them, I will now endeavour to point out what I consider a good water-tight door should be, but I must leave it to more competent minds than my own to evolve the perfect machine that is so much to be desired. The framework should be of strong construction and have a section at the side bars that will not allow of clattering, jamming, or holding obstacles that would prevent its action.

I have here a sketch shewing a section of the door and frame, also a model which will enable you to judge of its merits. There should be no groove or ledge at the bottom or side, and the wedge shape necessary for the tight closing of the door should be formed by the distance between the guide bars and facing strips of the frame. You will see that the guide bars are of V section, and the tooled parts of guides and facing strips are clear of all obstructions that would prevent them being cleaned, if required, by simply passing a scraper over them, and there being no groove or sill at the bottom, whatever dirt may fall, passes freely away. The top and bottom bearing surfaces of door and frame are made diagonally, or, more properly speaking, obliquely to its axis, and act like a pair of shear-blades and would clear off any incrustation that may have formed upon the bearing surfaces and so it may almost be called a self-cleaning door, and one that, from the formation of the guide bars, cannot clatter.

The bolting and packing of all door frames should be carefully done so as to avoid distorting the shape, and the bolts pitched close enough to withstand the considerable pressure there would be upon it should a compartment become full of water. Horizontal

angles of good section and length should be fitted across the top and bottom of the aperture to compensate for the plate cut out, and bulkhead stiffeners should never be cut for the clearance of the door or its gear without adequate compensation, as the bulkhead in the vicinity of doors should be, if anything, stiffer here than in any part, as a distortion at this point may cause the best door and gear to be rendered inoperative. It should be avoided as far as possible to have gear for working bulkhead doors fitted below in the engine or boiler rooms, as it is there they are more liable to become damaged and difficult to work when there is water in the ship.

Having given you some particulars of what I consider a good door should be, I will now endeavour to explain to you what I also consider to be the best gear for manipulating the same; but here I must ask your indulgence whilst I explain that I have no interest in any of the doors or gears that I here make mention of, but am only giving you the results of my observations of the different kinds of doors, etc., that I have encountered in the course of my business. The best gear that I have observed for the elevating or lowering of water-tight doors is the one patented by Mr. Van Ollefen, and made by a celebrated firm in Sheffield, who are also the manufacturers of several other patented specialities much used in connection with the profession to which I am proud to belong. The specialties I refer to being the Purves ribbed boiler flues, Servè boiler tubes, &c.

I have the honour to exhibit to you now a large drawing of the Van Ollefen gear, which will, I trust, enable you to see its points at a glance, but I will endeavour to explain to those who cannot see so plainly as those seated nearest to it, the system upon which it works.

You will see on the elevation behind the frame a series of three wheels mounted upon one spindle or shaft. The first one is a pinion wheel which gears into the teeth of a rack at the end of the rod to which the

door is suspended; the second one is a ratchet wheel, into the teeth of which a pawl engages; and the third and largest one is a brake pulley or wheel. The pinion wheel and ratchet wheel are keyed on the shaft, or cast in steel or malleable iron in one piece, as may be preferred. The brake wheel, however, is loose upon the shaft and is fitted with a brass bush to prevent sticking by rust, &c. The pawl is fitted to the brake wheel, hence when the brake wheel is revolved, the pawl is carried round with it. A spring is placed on the pawl to cause it to gear in the teeth of the ratchet wheel, no matter what position the wheel may be in. It is thus evident that when the shaft is turned, the pinion and ratchet wheels have to move with it, but the brake wheel, being loose, stands still, the shaft turning within it.

You will further observe to the right a small wheel placed at an angle. This wheel is fixed to a screwed delta metal spindle which passes through a bracket and serves to press upon or release the brake block or band as the case may be. These are all the working parts of the machine, and I will now give a short explanation of the mode of working.

We will suppose the door is down and has to be lifted. Screw the brake block reasonably tight against the brake wheel to prevent it from turning. An ordinary ratchet lever which is supplied with the machine, is placed upon the square end of the shaft and turned in a right handed direction. The rack and the door are thus raised, the ratchet wheel, as it passes the pawl, receiving it in each tooth by the force of the spring, and keeps the door at the height to which it is raised by each movement of the lever. Two or three strokes of this lever are all that is necessary to lift the door. The weight of the door being held by the friction of the brake band or block upon the brake wheel, has a tendency to rotate the machine in a left handed direction, but the pawl being in gear with the ratchet wheel holds it fast by reason of the brake band being screwed tight.

If the brake be now released the ratchet wheel pushes the pawl and the brake wheel before it and the door will close. By these means it is not necessary to disengage the pawl before the door will close, hence the machine is always ready for use. All that is required to be done to lower the door is to ease the brake, and screw up the brake when the door is down, so as to be ready for lifting again. With this gear the door can be lowered at any speed or stopped at any point of its downward motion, and it is always ready to force the door down or lift it up again.

To avoid mishaps which might occur, should anyone tamper with the brake spindle while the door is up, a safety pin is provided, as shewn on the left at the upper part of the drawing. This is simply a straight pin with an eye at one end to allow of it being pulled out, and is secured from loss by a small chain. It is applied to one of a series of holes in the brake wheel, one of which holes is sure to be near the top of the machine, and the pin, which has a length of about two inches, is placed in the hole which happens to be uppermost, its own length and position preventing it from falling out.

Should the brake become eased through any unforeseen circumstances, the pin will only go so far as to catch upon the horizontal bar of the frame and thus keep the door from falling more than two inches or so, and the door then being noticed to be not so far open as usual, will indicate that the gear requires to be seen to. The safety pin of course has to be removed before the door can be closed.

If a door is fitted with this gear and the slides or faces should become clogged and the door fall only a part of its required travel, to close it completely, the operator at top simply reverses the lever on the shaft and works it two or three short strokes and the door is thereby forced down, and as you can see by the drawing that this gear is capable of very powerful work in either direction, any ordinary obstruction would be overcome, and there is no danger that the person

manipulating the gear would be injured if the door should go down with a rush, as the brake wheel only would revolve upon the shaft while the ratchet in the hand remained stationary.

The space occupied by this gear upon the bulkhead is twenty inches in breadth and the distance from the bulkhead to the extreme end of the shaft is ten-and-one-half inches. This gear can be made to operate on doors situated at a distance from it, at an angle from it, or where the door is situated in a recess, but all these require a modification of the gear from what I have already described. In these instances the rack has to be cast upon the back of the door and bevel gear has to be resorted to.

All gears, however, where it is possible, should be arranged to always have a straight pull and all complications be avoided. With all gears that I have seen, doors in out of the way positions must always be fitted with a complication of gearing, rods, levers, or other arrangements, and of the different gears which have come under my notice, the one now before you is the one that, in my opinion, can be best adapted to any kind of sliding door of the vertical type.

During a visit to Rotterdam on business I saw a set of Van Ollefen's gear fitted to the tunnel door of ordinary construction such as is usually fitted to cargo steamers. The screw had been cut from the lower end of the rod, the brass nut removed from the door and the rod made fast in the hole that the screw had previously passed through, by a nut above and below. A rack was welded to the upper end of the rod and the gear bolted to the bulkhead just above the tops of the cylinders, where it could be easily reached and worked by one man without any great exertion. The chief engineer of the steamer stood by the gear while I went below to the door and watched operations. The door was at first let down with a rush and closed completely, then lifted up and lowered slowly, being perfectly under the control of the brake band, I then went to the top and worked it up and down myself and found it to work admirably.

What I consider to be one of the best features of Van Ollefen's gear, and second only to its quick and easy lifting and lowering of the door, is that its cost (although I do not know what it actually costs) should be much less than other quick gears that I have seen, and not the least advantage is that it can be fitted to any existing door of the ordinary pattern without any alteration to the door itself, and can be fixed (having the gear supplied by the makers) by any ordinary blacksmith in a few hours.

The drawbacks to this gear, that I can see, are:— First, that it is possible—by the safety pin being omitted to be inserted, and some person slackening the brake band—that the door may be let down with a possibility of injury to life or limb, should anyone, by some extraordinary coincidence, happen to be in the aperture at that precise time. Second, That it is possible for the shaft, through neglect, to become rusted and set fast in its bearings through the frame, though this could be obviated to a great extent by the use of brass bushes, as in the brake wheel. The third objection is the sordid one of cost, which I am afraid will frequently prevail in commercial transactions, but, as I am convinced of the importance of *quick action* in times of emergency, when not only property, but human life also, may be at stake, I trust that no consideration of cost will interfere with the adoption of what is so much to be desired, namely, the quick and effectual closing of water-tight doors on bulkheads of ships.

Before concluding, I may say that I have been at sea in vessels that had no tunnel to put a door upon, in vessels where there was no entrance into the tunnel from the engine room, it being necessary to go down a trunk-way alongside the mainmast, and the visit to the bearings and stern gland had to be performed at the change of watch, so that the engineer relieving could be at the engines while the other went into the tunnel, and even then the tunnel did not extend to the stern gland, which could only be reached by going through a trap door in the cabin floor.

DETAILS OF VAN OLLEFEN'S GEAR.

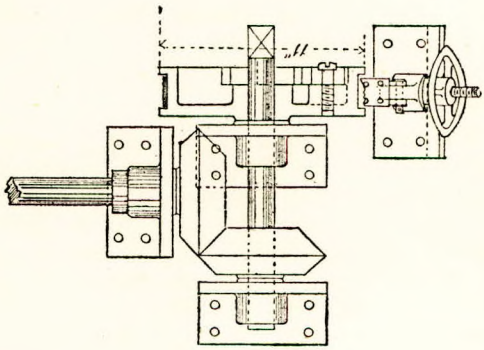

Fig. 1.

(Van Ollefen.)

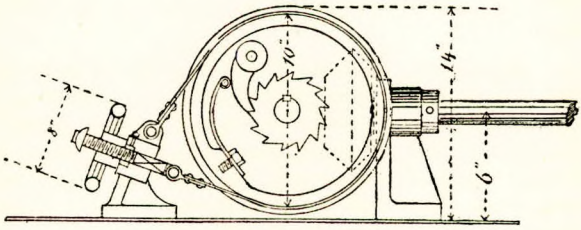

Fig. 1a.

(Van Ollefen.)

ARRANGEMENT OF VAN OLLEFEN'S GEAR.

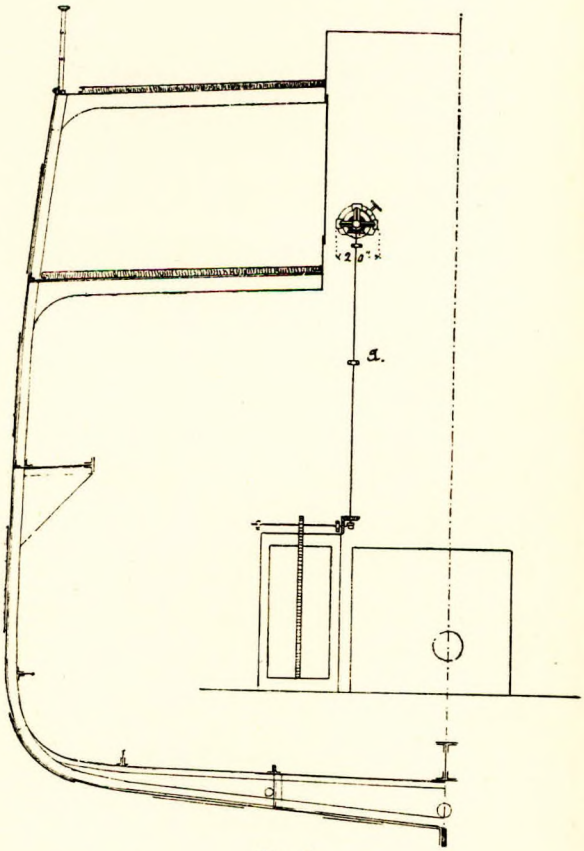

Fig. 2.

CROSS SECTION OF VAN OLLEFEN'S DOOR.

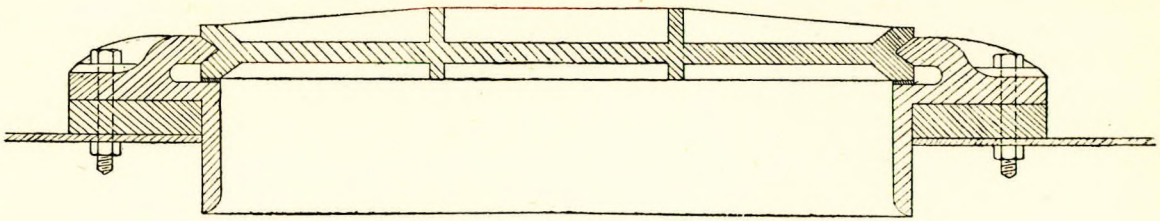

Fig. 2A.

(VAN OLLEFEN.)

ARRANGEMENT OF VAN OLLEFEN'S GEAR.

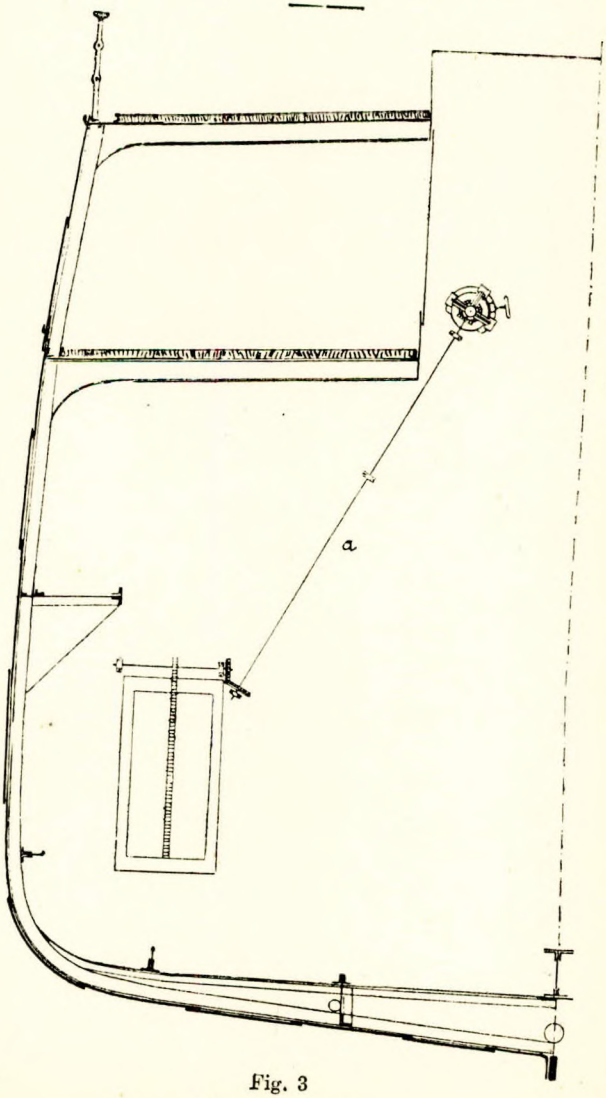

Fig. 3

VAN OLLEFEN.

ARRANGEMENT OF DONKIN AND NICHOL'S GEAR.

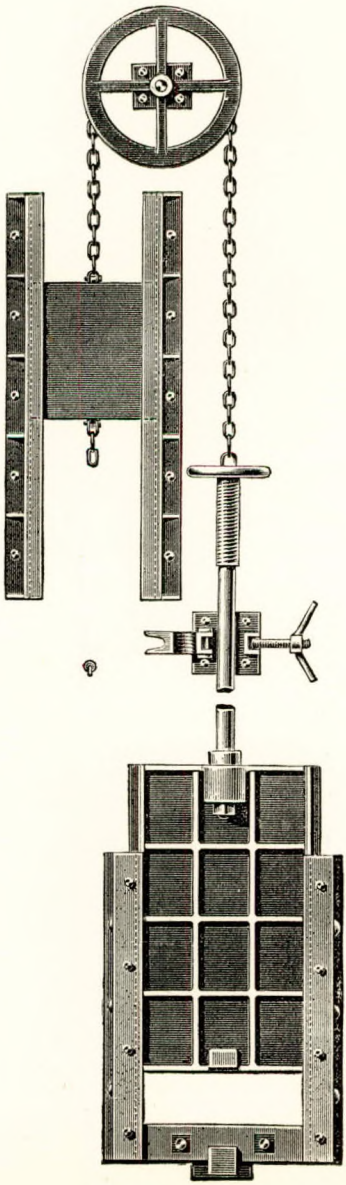

Fig. 4

(Donkin and Nichol.)

CROSS SECTION OF McELROY'S DOOR.

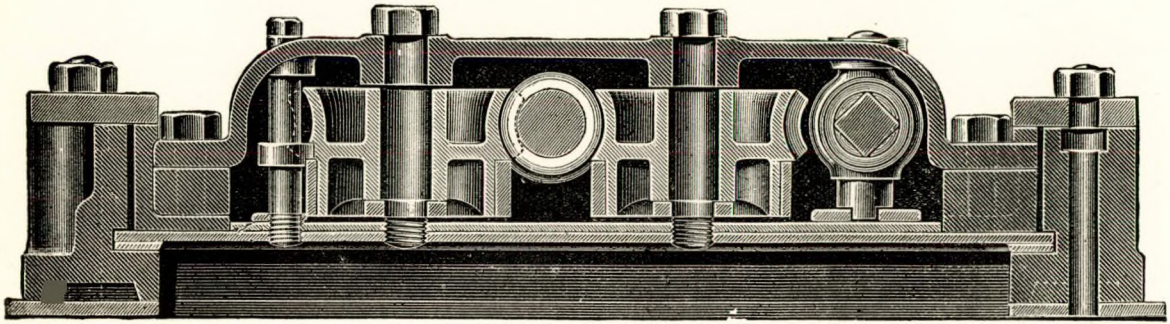

Fig 5.

CROSS SECTION OF McELROY'S GEAR.

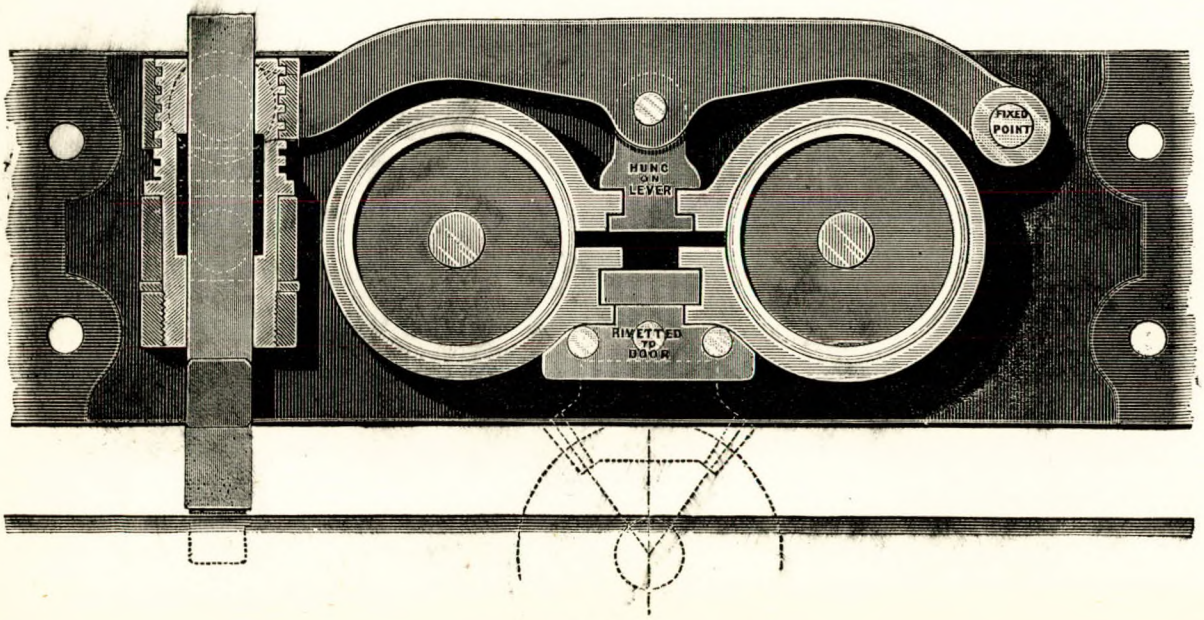

Fig. 6.

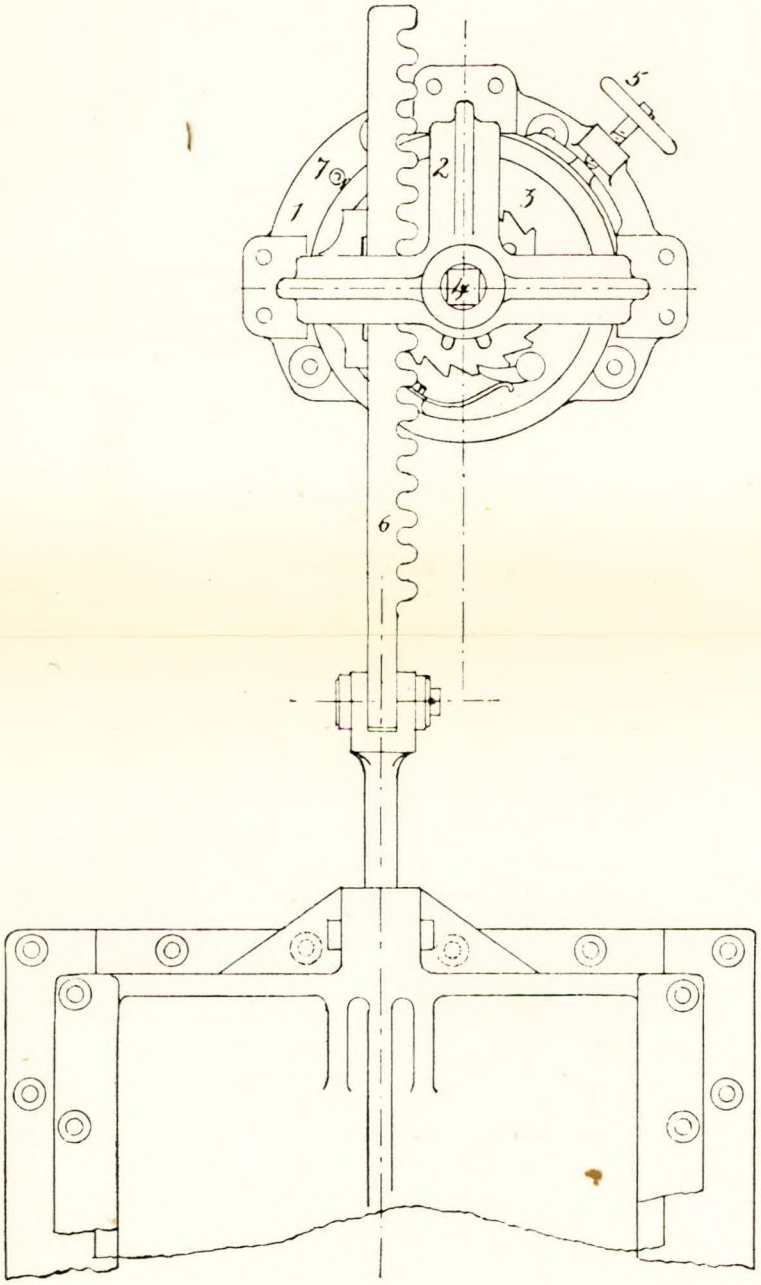

Fig. 7.
(Van Ollefen.)

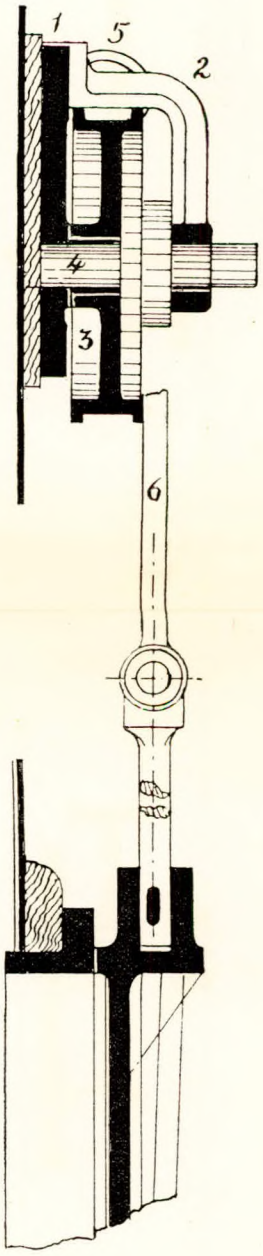

Fig. 7a.
(Van Ollefen.)

DETAILS OF VAN OLLEFEN'S GEAR.

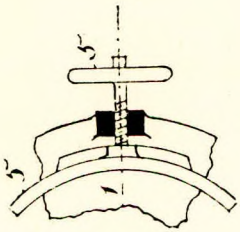

Fig. 7.
(Van Ollefen.

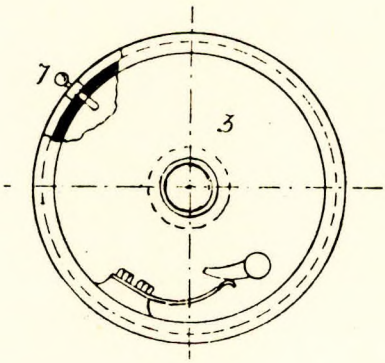

Fig. 7a.
(Van Ollefen.)

ARRANGEMENT OF McELROY'S DOOR AND GEAR.

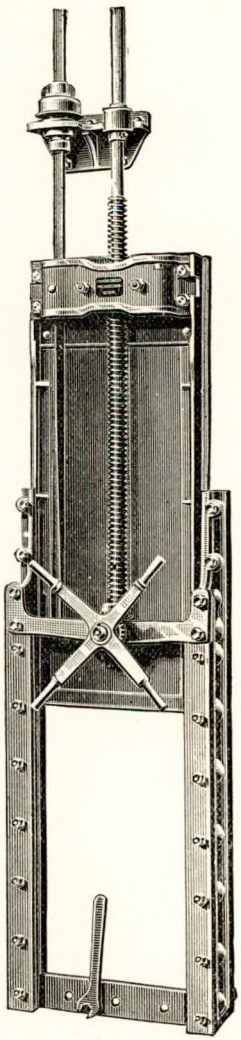

Fig. 8.

(T. Niccol and McElroy.

INSTITUTE OF MARINE ENGINEERS.

SESSION 1891-2.

REMARKS

ON THE

THIRTY-FOURTH PAPER

(OF TRANSACTIONS)

ENTITLED:

WATER-TIGHT

BULKHEAD DOORS

BY

MR. S. C. SAGE

(MEMBER OF COUNCIL),

READ AT GRESHAM COLLEGE, E.C.,

On TUESDAY, DECEMBER 8th, 1891.

Discussion continued at the Town Hall, Stratford, on Tuesday, December 22nd, 1891.

WATER-TIGHT DOORS.

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DISCUSSION
AT
GRESHAM COLLEGE, E.C.
ON
TUESDAY, 8th DECEMBER, 1891

THE CHAIRMAN
(MR. T. F. AUKLAND).

I have listened with great pleasure to the paper read by Mr. SAGE, and among others, one thing that strikes me is the necessity of having the fittings made of the very best material, *i.e.*, something that is anti-corrosive. And as on certain days in the week they have drill on board ship for lowering gear, &c., so they should have practice with water-tight doors; if that were done, when the occasion arose for the use of those doors, they would be readily closed, for unless they are properly attended to, as in the case of the main engines, they cannot be depended on.

The Act that produced limited liability companies has been the cause of the tramp, the limited liability company only wishes to get as cheap a steamer as possible and make it pay as much money as possible, turning it into a mere money making machine; she is well insured and so long as she goes well and pays, that is right, and if she does not go all right, well, the loss is not great.

Recently when passing through one of the steamers in the dock I saw two or three horizontal doors which had to be shut, not lowered down. I prefer, I must say, the vertical system where the door can be lowered down by its own weight, as supposing water to be in the hold it would be difficult to shut the hinged doors.

Captain FROUDE

(Ship-Masters' Society).

This paper describes various kinds of water-tight doors and the methods in use for working them. The little I have to say is rather in connection with the position in which they are too often fitted—and perhaps is outside the objects in view. Mr. Sage has mentioned his recent experiences in a steamer; two doors in the stokehold bulkhead of her reserve bunker were opened on leaving Cardiff to get at coal during the passage; at New York it was necessary to close the doors for the purpose of stowing grain in the reserve, the screw appliances were found to be rusted fast, the brackets had to be taken off the bulkhead and the doors to be lowered by tackles.

I venture to protest against any kind of arrangement in main bulkheads by which such a state may become possible. Usually, the hold forward of the stokehold bulkhead is the largest in the steamer, and the reserve bunker is a portion of it—divided from the fore part by a wooden bulkhead. The engine and boiler department is another large hold; together, the two holds are more than half the vessel. Suppose a hole made by collision below water, and during the currency of coal consumption, in either of those holds the water-tight doors would be open of course, the inrush of water would make the chances of closing them infinitesimal—the consequences may be imagined.

The head of coal at an angle of 45° by itself, through doors, say four feet by two and a half feet, would make the shutting very difficult. I

might challenge any engineer to do it in less than a quarter of an hour, even if he were assisted by a fireman.

The coal bunkers, and engine and boiler rooms of steamers should be self-contained.

I complain of those in control who build steamers on plans in which faulty arrangements of this kind obtain. If steamships go to sea so constructed, and if bulkheads are a needful safeguard, then in my opinion the owners and underwriters interested, and all on board are simply hiding their heads in the sand — ostrich like, sooner or later they will suffer.

I think the meeting will agree with me in what was said just now, namely, that it is a bad practice to depend on water-tight doors situated where they cannot be closed very quickly at any moment.

It is quite easy and, in many respects, preferable to arrange reserve bunkers so as to avoid the necessity.

The state of matters complained of is inexcusable and indefensible, it exists in steamers of all sorts, and is almost universal in tramps. I have lately seen the system in use on board a new one belonging to a first class line. Gentlemen I thank you for giving me this opportunity to speak on the subject.

Mr. J. H. THOMSON

(Member of Council).

I am very glad that Mr. Sage has brought in the human element, that is, as regards care required. No door or appliance will answer on board unless it is cared for. I think that the old arrangement in many ships, of appointing Saturday "oil-can day" a very good one and it ought to be kept up, the carpenter going round with the oil can and trying all sluices, doors, valves, &c. I think that engineers ought to carry out the same principle. In many ships it is carried out, as there is a day for

doors, bilge pumps, cocks, valves, &c. There was an instance that occurred twenty-five years ago of a vessel, now lying somewhere about the Irish Channel, fitted with all the modern appliances of the age as regards water-tight bulkheads and other things. At the investigation as to the cause of the loss of the vessel, the question of water-tight doors came up; they were closed, and the time that they were closed was noted—and here comes in the human element—she had been some time on service and there had been a good many alterations made, as one thing was put upon the bulkhead and another one taken off, fresh holes were drilled each time, which were omitted to be plugged up when the gear was discarded. When the water got into the after compartment, the engine room bulkhead was like a sieve. In my own experience I have seen several cases of that kind, and at one time put in as many as a dozen bolts into a bulkhead. This shows that the human element must be taken into consideration, and it is well that engineers should bear that in mind; whenever one thing is moved, in the way of spare gear, &c., the holes should be filled up and the bulkhead made water-tight again. I think we have listened to a very good paper on a very interesting subject, and we are much indebted to Mr. SAGE for it.

The CHAIRMAN made a remark about being on board a steamer where he saw some doors fitted horizontally. I presume they were the doors of the main deck, but underneath in the regular bulkhead there is a water-tight door independent of the one above. In this case it is the only way the doors can be fitted because there is no head room, as the bulkhead goes right up to the spar deck, but before these doors would require to be closed it would be necessary, in the vessel referred to, for the water to be up at least six inches above the load line. The doors in question are hinged, and fitted with adjustable bolts, so that, in the event of part of the space being wanted for coals or other purpose while the remainder was being used for cargo, these doors can be jointed up close and bolted, so as to isolate the one portion from the other.

Mr. F. W. SHOREY

(Member of Council).

It was not my intention to say anything concerning this paper to-night. It is a subject I have not given much attention to, I am sorry to say, but am convinced by the remarks made to-night that it is a very important one, and one that should occupy the minds of every marine engineer. I have been highly pleased with the paper, and think it should be beneficial to all of us. Of the various types exhibited by the drawings and described in the paper I certainly prefer the Van Ollefen. I should like to ask one question; does the door fall by its own weight? It does, I understand, and that if found necessary to jam it down afterwards, you simply reverse the ratchet. I would like to remark here, is there not a danger in respect to the pin being sheared through? Now what is to prevent this door jamming, similarly to the other types, should anything get in, which is so often the case; you well know that when water is washing about in the bilges various things float and wash about and find their way to the bulkhead doors; again this door is subject to the same danger as all others, viz., corrosion. We well know bulkhead doors seldom receive the attention they should, and I must say that, considering the many defects in most doors, the one mentioned is the best I have seen, and let me say in conclusion that Mr. Sage deserves great credit for bringing before us such a paper.

Mr. R. LESLIE

(Honorary Treasurer).

In the first place we are very much indebted to Mr. Sage for his very valuable paper. With regard to water-tight doors, the first thing we have to do is to have them well looked after; if properly looked after the ordinary door with the ordinary rack will do very well, for, as the Chairman remarked, if we do not look after the engines they will not work. The great

thing desired is to have as little gear as possible, and to have that little as good as possible. I certainly think that in a great many cases water-tight doors are thrown together, and do not have the same workmanship and attention as the main engines, and I am of opinion that a little more care in construction should be given. I may mention that I have seen frames of doors pulled a quarter of an inch out of their place; when this happens the door will neither shut nor open easily. The great thing to aim at is good workmanship, and afterwards attention. I do not believe in doors having screws with a quarter of an inch pitch, as they take too long to open any door, and, in a case of collision, not many minutes are given for shutting doors (this I have had experience of), and I am of opinion that a screw with say $\frac{1}{2}$ or $\frac{3}{4}$ inch pitch, if fitted with a proper brake to stop the door from running down, would be the best. The weight of the door could easily be counterbalanced by a chain from top of door over a pulley, and with a weight at the end equal nearly to the weight of the door.

Mr. CHURCHILL

(Member of Council).

I am sorry I did not hear the commencement of the paper, and have not had an opportunity of considering the question sufficiently to make suggestions or to ask any questions. Bulkhead doors appear to me to be like other machines in a ship; it is useless to trust to Providence to keep them in order. They must be properly looked after just as the main engines are looked after. With regard to the question of corrosion, the faces and slides of the doors might be Barffed, and this would prevent anything like oxidation. It is not expensive, and would last for years. Messrs. Hopkinson are making valves with Barffed iron plugs instead of gun metal, as they come very much cheaper, and I do not see why this method should not be used for parts where it is necessary to prevent rusting, and which have a comparatively small amount of wear and tear.

THE HONORARY SECRETARY.

Most of the points I have noted down have been taken up already, but I dare say they will bear repetition. I agree with Mr. SAGE in reference to the automatic door, a photograph of which we have had in our rooms for some time, showing the arrangement of the automatic gear patented by Mr. Niccol in connection with McElroy's door. I also incline to think that the wash of water coming over the tank might fill it and raise the lever, causing the door to suddenly fall, while some one was entering, or in the tunnel. Of course that is the drawback to the automatic arrangement. Capt. FROUDE has referred to the bunker bulkhead doors. That subject has been put forward recently at the meetings of some of the kindred societies. I have seen one or two doors fitted as described. In one of them I saw an arrangement by which the door could only be closed from below; it had simply a rack and ratchet lever for closing the door from the stokehold. Of course, had the water got into the ship through the bunker it would have been impossible to work the door. Mr. SHOREY referred to the door which Mr. SAGE has so far described; it will probably be explained in his reply as to the action of the door and the guiding bars. The door itself, and the bottom of the frames are arranged like a shearing machine blade, so that as much as possible the door will clear away any obstruction that lies between the knife edges. Mr. THOMSON has referred to the gear being worked, and I think the rule is in most companies that the water-tight doors shall be regularly tried throughout the voyage, and in the case Mr SAGE referred to I think it was not done, otherwise the door would have been kept in working order. Of course we cannot but agree with Mr. CHURCHILL in strongly condemning the use of cast iron for nuts and fittings in connection with this and every other gear of a similar character; the difference in cost is so little one would hardly think parsimony would reach so far as to substitute the one metal for the other in details of machinery, which are of more than passing importance, and it is manifest that water-tight doors are of vital

importance, in that their value is in proportion to the perfection of all the connections being proved in cases of emergency. The lowering of the door is the important factor, in the raising of it, time is not the first element to consider. I have read the paper with much interest, and think Mr. SAGE deserves our hearty thanks for bringing the subject before us.

MR. SAGE'S REPLY.

As regards Mr. THOMSON'S remarks, I do not think they require any answer, except that I cordially approve of his opinion that all gear should be as faithfully looked after as the main engines. In regard to Mr. WHITE'S remarks as to non sea-going vessels that do not go beyond Dover, I may say there is water deep enough round Dover for a vessel to sink in without giving its crew a chance, and he seems in his ships to have so arranged the door as to prevent scalding, not drowning, although I perfectly understand the reason. Now, with regard to Van Ollefen's gear I have seen a door fitted with it cut through a 2in. square piece of wood, the small model and large drawing show that there is over the weight of door, power enough to cut through any ordinary obstruction with the ratchet lever. With regard to Captain FROUDE'S remarks, as we have to deal with ships as they are offered to us, they would have been better addressed to Lloyd's or a committee of shipowners. There is no doubt that every practical man will agree with him in saying that all bunkers should be divided by a water-tight bulkhead from the cargo space, but the Institute of Marine Engineers cannot attempt such a radical change. With regard to shutting the door, with ordinary coals such as you would find running from the bunkers, and provided the gear is powerful enough and the doors properly constructed, it would be a very great rush of coal that would prevent the door closing. It would force through the coal, the surplus on one side going into the open stokehold. The gear is constructed as a detaching and impelling downward gear. It has been remarked that in some places the surfaces of iron should be replaced by brass. I notice the doors

of H.M. ships of war are composed of wrought iron or steel, faced with brass straps. We all know there is a considerable degree of moisture in saline air, and with such an arrangement unless the slips were securely fastened, galvanic action might be set up, and scale form between the surfaces. I heard that Mr. CHURCHILL suggests that the surface of iron doors should be Barffed to preserve them from corrosion. I agree with Mr. LESLIE'S remarks and am much obliged to Mr. THOMSON for his. I quite concur with the remarks that lowering is the most important thing in connection with these doors, and we can do this with the gear described here, which opens or closes equally quickly, except, of course, that it closes a little quicker by letting it go. Three turns will either lift it up or force it down.

In reply to Mr. SHOREY.—If the pin were caught in the wheel it might shear it, but it would not break it, and would not bend it so as to prevent its being drawn out. Even supposing the brake were entirely released maliciously, it might shear it, but I do not think so, as it is made of delta metal and the holes in the periphery of the wheel are so close that it could not have a long drop. I quite agree that the small screw is a poor arrangement, as with a $\frac{1}{4}$ inch pitch it takes a long time to close; besides, the doors are frequently fitted in a loose and unworkmanlike manner. When the door is shut there is the danger of something being below it, and when it is open it shakes about and makes an annoying clatter.

ADJOURNED DISCUSSION.

HELD IN THE

TOWN HALL, STRATFORD,

TUESDAY, 22nd DECEMBER, 1891.

THE CHAIRMAN

(Mr. Thomson).

In opening the meeting this evening for the purpose of discussing further the subject of water-tight doors, it will be better to ask our Honorary Secretary to refer to some remarks which he has received regarding special doors, &c., which were remarked upon in the paper.

THE HONORARY SECRETARY.

The paper read by Mr. Sage is on a subject of interest and moment to all, and the discussion should be a fruitful one. Our thanks are due to the author of the paper for what he has laid before us, both letter-press and diagrams. With respect to a choice between vertical and horizontal doors for water-tight bulkheads, I do not see any very great objection to the horizontal doors for certain places, as on the bulkhead between the engine-room and the tunnel, where the danger of the way being blocked by *débris* is not so great as it is between the stokehold and bunker, or the engine-room. In the horizontal door the space to be covered before the door is closed is less, but it is certainly an advantage to have the force of gravity acting in the direction of the closing, and this is in favour of the vertical doors; while along with these, are other advantages which require to be considered both in favour of the vertical and horizontal doors. As there seems to be a disposition in favour of vertical and condemnatory of horizontal doors, it is well to place on record the arguments on both sides. Probably, therefore, this will be done as the discussion proceeds, so as to make the whole as complete as possible.

Reference has been made by Captain FROUDE to the fact that water-tight doors are frequently fitted where the difficulty of closing them smartly is, from the nature of things, almost impossible. There is a large number of steamers where there is no water-tight door between the after bulkhead of the engine-room and the forward bulkhead of the stokehold. In these cases the water-tight door is among the coals, and I am inclined to think that the case of a steamer having the water-tight bulkhead forming the coal bunker bulkhead is far from being an exceptional one. In many cases there is a water-tight door on the bulkhead between engine-room and stokehold, but I should say there are more the other way.

As to the gear for manipulating the door, whether horizontal or vertical in action, in the more recently built steamers by Messrs. Denny & Co., fitted with hydraulic gear for working cargo or steering, a very simple and effective arrangement is designed by which the doors are opened and closed by hydraulic power, applied by means of rods and pinions. The cases I refer to are fitted with Messrs. Brown's hydraulic engine and machinery.

There is no doubt that water-tight doors and gear require regular practical attention and exercise at sea, and overhaul when necessary in port Nothing is gained and much might be lost by delaying a slight renewal or overhaul on the score of economy, and here the fine distinction between true and false economy, which has already been referred to, comes into play. Water-tight bulkheads have been receiving a good deal of attention of late at the hands of a special committee, and it is probable that water-tight doors and sluices will also receive attention.

I have received a few communications on the subject before us to-night, which, as suggested, I will lay before you. Mr. AUKLAND has forwarded his views, and from his own standpoint these remarks are valuable. It is regretted that Mr. NICCOL (Glasgow) could not be

present, as he might have further explained the door and the automatic arrangement with which his name is associated.

Messrs. Nichol & Donkin (Newcastle) have also forwarded an explanation of their door, replying also to the remarks made by Mr. SAGE in the paper.

I may remark, *à propos* of sluice doors, that there is a recommendation to do away with sluices on water-tight bulkheads, and in many cases this recommendation has been carried into effect.

MR. T. F. AUKLAND
(HON. MEMBER).

This paper is a most interesting one, and I am quite sure we all feel very much indebted to Mr. SAGE for having brought it before the Institution for discussion. Water-tight doors in bulkheads are a most important factor in the means adopted for securing, as far as possible, a ship's safety at sea, and therefore is a subject which ranks foremost in desirability for securing that safety. The principal danger we have to face at sea now is the one of collision, but whether it be collision, or leakage, or going on shore, it stands us equally in good stead, whenever a casualty happens, because it is quite possible for a vessel to be damaged locally only, and if communication for the water is effectually cut off, then may we hope for time to be allowed for saving the vessel and her cargo, but if damaged even very seriously and it becomes ultimately impossible to save the vessel, at all events the most important thing of all, viz., the lives of those on board may be saved. It is very repugnant to the feelings of us all as Englishmen, and should be to those in particular who have to do with the construction of ships, that it should be possible for a ship to get suddenly into such a difficulty that she should sink in two or three minutes, giving no time even to save life. Now I think this would be almost impossible if a perfect system of "water-tight doors" were fixed in every ship. This precaution is adopted in most of the large liners; but why should it not be

equally necessary in cargo ships and steamers. I do not know what attention this subject lately received in the discussions before the late Royal Commission upon loss of life and property at sea, but it appears to me that it should have held a most distinguished place in their deliberations. Surely it is very much better to devise means for keeping a vessel that has met with accident afloat, than simply to provide means of flotation for those on board in case of a ship's sinking; prevention we are told is certainly better than cure, and, if you have a vessel retained by a perfect system of water-tight doors, firmly closed, whereby one half, or two thirds, or better still, three fourths of the vessel remain tight, it must be far more advantageous in the probability of saving life and property than all the other means put together, but, unfortunately, in many tramp or cargo steamers, it is difficult to go to the expense of providing all these important necessaries. Thoughts are too much occupied in making a good freight, and cramming every possible atom of cargo into a steamer, in order to show a good percentage of return upon the capital invested at the end of the year, and being made reasonably comfortable by insurance, there is not much concern shewn in providing, except, perhaps, in a cheap manner, the best possible means of saving a vessel in times of casualty. For instance, we have heard in the paper of doors with hinges or with sliding gear made of common material most certain to accumulate rust, and when wanted to be used found to be quite unworkable. Now this is perfectly useless, because the very resource upon which depends the safety of the ship is not attainable, and the ship is probably lost in consequence. I maintain that water-tight bulkhead doors should be worked by gear made of material which is non-corrosive, so that if seen to by competent and careful men at short intervals, so as to ensure their efficient movement at a critical moment, by this means many a good ship might be saved from destruction. Only the other day we had the case of a steamer loaded with grain, actually sitting upon her anchors in port. She got hulled and sank, spoiling all the cargo. Now if this vessel had had water-tight compartments formed

by the instant closing of water-tight doors, this, I believe, could not have taken place. I was interested in a steamer coming in from Manilla to London last June, with a cargo of hemp. Unfortunately when three miles off Dover, in a mist, about three or four o'clock in the morning, she came into collision with another steamer, coming across her bows, which steamer was sunk and about seventeen lives were lost. The steamer freighted with hemp had her stern carried away, her bow plates torn open, and twisted inwards, making a great gaping hole in her fore compartment, which of course filled with water, taking her down by the head; but, nevertheless, the fore bulkhead held its own and did not break away with the inrush of water into the fore peak, and consequently the steamer was most fortunately able to steam up the river to the London Docks, where she discharged and went into dry dock for repairs. Now had it not been for this good and efficient water-tight bulkhead the fate of that steamer would most probably have been the same as the one which collided with her. I must admit that the two cargoes were very different, the one which sank being railway iron, while the one that was saved consisted of hemp, and possibly formed a good backing for the fore bulkhead. I had another steamer of the same fleet which was run into astern by the French mail steamer *La Bourgoyne*, and this steamer was laid open by the Frenchman, so that in the photograph, which I possess of her, her saloon fittings and table were actually visible, still she was ultimately towed into port. I grant this steamer had a light cargo (esparto), but still it proves the great advantage of having compartments water-tight, which maintains in the steamer, in case of accident, a sufficient amount of surplus buoyancy to keep her afloat until assistance can be rendered. I beg again to express the pleasure I have had in listening to this admirable paper.

Mr. THOMAS NICCOL.

With reference to Mr. Sage's paper on water-tight doors, I agree with him on many points. I prefer the vertical to the horizontal door for the reasons mentioned,

and again I would never think of using a fine square threaded screw shaft in either an iron or brass nut, as the threads are likely to get filled or rusted up; neither do I approve of racks on doors, as the spaces between the teeth form convenient receptacles for dirt of all descriptions, the consequence of which might be the breaking of a portion of a tooth on either wheel or rack, the broken piece forming a most obstinate obstruction, and perhaps not easily got at to remove it.

With reference to Mr. SAGE's remarks on McElroy's patent door, there is no doubt, looked at and compared with some doors as fitted, it is expensive, but there are doors and doors; for instance, I have seen supposed water-tight doors fitted in a steamer, the cost of each door complete being £5, the efficiency of these doors in a case of collision I would consider nil, their cost dear at any price, but when the safety of the ship is taken into consideration the cost of a good and reliable door is a very small item, and looked at from this point of view, *the certainty of its action*, the McElroy door is not, in the usual sense of the term, expensive.

In the tracings and photos sent, you will notice that the screw shaft has a V thread, this thread is well rounded on its outer edge and has never less than $\frac{3}{4}$ inch pitch for a door about three feet by two feet; this form of thread presents no surface on which any obstructive obstacle could rest, it is also the strongest, and the form least liable to damage. You will observe that the worm wheels form the nut for this screw to action, when lifting or lowering the door by its ordinary method, but there is one very important part I would draw your attention to, and it is this, when the door is running down by the quick lowering motion you will observe that the motion of the worm wheels is *outward*, so that it would not matter what dirt may be lying on the top of this gear, as soon as the door started, the motion of the wheels would throw it all off, thus the action of the door is certain. These wheels do not revolve when the door is being lifted, moreover, although these doors can be shut down as quickly as any drop door, their action is con-

trollable by the operator, who can stop the door at any point in its descent and lift it again without throwing anything in or out of gear, and what is worthy of note is, that when these doors are run down there are no chain wheels revolving with chains swinging about them, simply the worm wheels allowed to travel down the screw at a desirable speed. One other point Mr. SAGE has omitted to notice, and that is that these doors, by extending the twisted rod (by a round rod) up to and through the upper deck, by means of a simple arrangement of deck plate, the indication *open* or *shut* is given, as the twisted rod turns as the door is in motion. There is also an arrangement of safety catch on these doors (this does not show on the photo) which may, if desired, be thrown into position so that the door will rest on the same, this is a preventative catch used only when the ship is rolling heavily, so that it is impossible for the door to come down without the engineer controlling it, this catch can be thrown out either from stokehold or deck.

With reference to my automatic arrangement, it is intended that the float tank be placed in a separate water-tight recess or compartment, and that the water enter this compartment near the top. As to the *height* of the compartment this is to be regulated according to the desire of the ship-owner. One may wish it to act as soon as the water reaches the stokehold floor, another may not wish it to act until it reaches the furnace bars, a point that will soon be reached in the event of a collision being so serious that quick action of closing doors is necessary, and when all have rushed for life, no one being near the doors, to shut them down. You will thus see that water from platforms can be easily kept out of this compartment by having the top of the compartment somewhat higher than the stokehold floor.

Mr. SAGE mentions that the pins, joints, bearings, &c., may become stiff from corrosion, non-use, neglect, &c.; Mr. SAGE forgets that every time the door is opened or closed, all these pins, joints, bearings, &c , are working, as the automatic gear is not a thing disconnected from the

ordinary working of the door, but is always connected and works with the door at all times, so that it is no more liable to rust up than any other working part of the door. It is quite true that after it has performed its work and probably saved the ship, that the water will have to be pumped out of the float tank compartment, if the water has only reached high enough to enter this compartment and caused the automatic gear to do its work. I should think it would be a matter to be thankful for that they had no more water to pump out. Mr. Sage says he does not see the necessity of enclosing the float in a tank at all, as I have already stated, it is to be kept entirely separate from all bilge water and not intended to be acted upon except by a pouring in of water caused by collision; another reason for putting the float in a tank is that no curious one should get at it to lift it by hand, all the rods connected therewith being cased in. I trust I have made my remarks thoroughly explicit and easily understood.

Mr. NICHOL

(Messrs. Donkin & Nichol).

Mr. Sage in his paper sets forth the qualifications of a vertical water-tight door, frame, and gear, which I cordially approve, and the whole of these qualifications I claim for my rapid-closing, water-tight door.

Replying to the supposed disadvantages alluded to by Mr. Sage, I have to say—

First, the only extra weight is the balance-weight, guides, and pulley, which I think abundantly compensated for by obtaining a door which can be almost instantaneously closed, and without risk of shattering the frame, by allowing it to drop the whole distance of its traverse without support.

Second, there is the additional height occupied by the balance-weight, pulley, and chain *above the packing platform* round the cylinders.

Third, the guides of the balance-weight are, as any practical engineer will readily understand, made so slack that there is not the slightest possibility of their being choked by paint, nor is there any reason why, being painted, they should corrode more than any other part of the engine-room or machinery.

Fourth, the angle to which the ship would have to tack, or list, in order to cause the door to stick halfway down, would be so great that the bulwarks at that side, and probably a considerable part of the deck, would be under water, and the ship in danger. At any rate, I have never heard this complaint made against any that I have fitted.

Fifth, the manipulation is *not* effected from below, but entirely above the packing platform round the cylinders, as in any ordinary screw door.

Sixth, I may point out that, as there is no bar along the bottom of the door, it is impossible to become choked up in any way, so as to prevent it being perfectly closed.

Finally, it is impossible that the door shall go down by the run, as in Van Ollefen's arrangement (so highly approved by the author), so that there is neither danger of injury to life or limb should anyone, by some extraordinary coincidence, happen to be in the aperture at the precise time, nor is there, as before stated, the danger of shattering the frame, and so endangering the ship and the lives of all on board in case of an in-flow of water, especially when the doors are large (say, 4 feet 6 inches deep) as in some supplied by me.

THE CHAIRMAN.

(Mr. Thomson).

Water-tight doors should be kept shut as much as possible, to avoid the necessity of running to shut them at the actual moment of danger. In ships which I have been in, all the small sluice-doors were kept shut

to confine any leakage to the one compartment; and if that principle applied to the small doors it should also apply to the large. The only places where there are large doors are on the engine-room and stokehold bulkheads, and the question is how are they to be manipulated. Messrs. Donkin & Nichol's seemed a very good arrangement, and also Van Ollefen's seems very good in many respects. Messrs. Brown Brothers, of hydraulic fame, have an arrangement for closing such doors by means of hydraulic pressure, which is always available when the ship is steered by hydraulic power, as referred to by the Honorary Secretary. A very convenient arrangement might be made by having a master cock and three branches from it so that the whole thing could be put into gear at once, supposing, of course, the other doors were shut. The cock, or small sluice in the collision bulkhead, should be kept shut always. Mr. SAGE has brought two or three ideas before us in regard to doors closing—some suddenly, some slowly, and others more slowly, and it is for those present to state objections to, or approval of the novelties introduced.

Referring to remarks made at the previous meeting, and in reply to Mr. AUKLAND'S remarks as to horizontal doors, it has occurred to me that the doors on the main deck referred to, were not so much for water as to localise a fire. With regard to Mr. MCLEAN'S remarks, the Board of Trade is not anxious to interfere unless the ship has a passenger certificate.

MR. W. W. WILSON

(MEMBER OF COUNCIL).

Not having had the pleasure of being present at the reading of this paper, and having only had a short time to hurriedly glance over the copy now provided, I am afraid I can say but very little on the subject. However, in the little I have seen of it, I observe that Mr. SAGE does not approve of horizontal sliding-doors. In this I am quite of the same opinion, and I think

they should not be used, especially in any part where the grooves in which they slide are likely to get clogged up with any dirt such as in coal-bunkers. I have invariably found that when placed in these positions they give no end of trouble both in opening and shutting, and being, as a rule, moved by means of an ordinary rack and pinion, the usual result is that the teeth of either the rack or pinion, and often both, get broken off, and some other means, such as levers or screw-jacks, have to be resorted to for moving them, which, of course, it would be impossible to accomplish were an accident to occur to prevent access to the immediate vicinity of the door.

I have seen this clogging of the grooves partly remedied by having the lower one perforated so that any dirt could fall through, but in coal-bunker doors even this is of but little use. Altogether, I certainly consider that the use of horizontal doors should not be encouraged.

With regard to water-tight doors of any kind as coal-bunker doors, I consider it ought to be one of the chief aims of the naval architect to avoid them as much as possible. In many instances this could be done where they are used, and without any serious detriment to the buoyancy of the ship; but I am quite aware that in large ships with heavy power, and a consequently large consumption of fuel, they must necessarily be used in some places. Still I think that even there, their number might in many cases be reduced.

Mr. Sage seems to think a good deal of the Van Ollefen door. I am sorry the drawings of this are not before us to-night, so that we who have not already seen them could have better understood the arrangement. However, from the description, I am also inclined to think it is a very good one; but, at the same time, I think that, be it ever so good, it would share the same fate as most other doors, in that if it were exposed to much dust and rubbish, it also would get clogged up and rusted unless very frequently

cleaned and overhauled, so that possibly, at the very moment when urgently required, it would be found wanting.

When the Guion s.s. *Oregon* was lost (which loss, if I remember rightly, was attributed to a horizontal door being unable to be shut at the critical time), I remember reading that Messrs. Elder & Co., her builders, were introducing a new door, which, by a special arrangement, was thrown out of gear, and thus allowed to drop; and the bottom being formed with a sort of knife edge, it was presumed to cut its way through any probable obstruction in the shape of coal or even light wood. I don't know whether either of the patent doors mentioned in the paper refers to this one or not, but it seems to me that in it there was a possibility of it falling just at the time it was not wanted.

My own opinion is that the door with the least and simplest gear attached, is what is required; and in that list I might include the usual door with the worm and rack on the back of the door, or that in which the rod for lifting is attached firmly to the top of the door, with the screw at the top, the nut lifting the rod as well as the door. Each is, of course, suitable for its own particular place; the one being applicable to a situation where the rod can be raised and the other where it cannot.

The trouble found in the first design—viz., that with the worm and rack—is, that as a rule both of them are rough castings, and there are, consequently, considerable inequalities in the teeth which cause them to work rather unevenly; but if these were trued up in the machine I consider they would make as effective a door as any.

One of the other class—viz., where the rod also rises—I have known to be lowered through a distance of about three feet, by means of a bevelled wheel and pinion, the wheel being the nut, in about a couple of minutes, although it took somewhat more than ten

minutes to raise it through the same space. No doubt, had it been balanced as in the Donkin and Nichol door, described in the paper, it could have been raised quicker, but at the same time it would not have been lowered quite so easily.

With regard to the small sluices on water-tight bulkheads, which have been incidentally mentioned as requiring to be worked every week at least, my opinion is that this should *not* be done unless under urgent circumstances, especially on those bulkheads next to the engine-room or stokehole, for it is my experience that on several occasions after working them the adjacent holds were often found with water in them, very much to the annoyance of all concerned. On arrival in port on these occasions, it was invariably found that, although to all appearance the sluices were properly shut, still there was a small chip of wood firmly jammed beneath the valve, thus causing it to be constantly leaking. I therefore say that, if necessary to retain these sluices on bulkheads at all, they ought to be put in good working order at the terminal ports, and if so attended to at these times when they could be got at and properly examined, there would be no need whatever to have the weekly working drill gone through, and they would still be ready for any emergency if required.

I think Mr. SAGE deserves the thanks of the Institute for bringing forward such a paper, and giving us an opportunity of discussing a subject of so much importance to the sea-going engineer.

MR. WM. BROCK

(MEMBER).

Formerly it was the custom in one company in which I have served, that we should work the sluices once a week. This is now altered, and the sluices are kept shut. The quantity of water in the hold, or well, should always be ascertained before opening the engine-

room sluice. When the after-sluice has not been properly closed, the water may thus get into the hold and damage the cargo — say, when the vessel's trim is altered, by cargo being worked out forward or in aft when in port, or even by the coal consumed lightening the ship forward, thus causing the bilge-water from the engine-room to flow into the after-hold.

Mr. SAGE'S REPLY.

I will take the remarks briefly and *seriatim*. With regard to Mr. Nichol's remarks (Messrs. Donkin & Nichol), the weights take up space, and this is a disadvantage; and if they are made with much clearance they make an unpleasant clattering when the ship is rolling. It is remarked that their operations could all be carried on above, but there is an operation to be performed below in screwing the door down to make it perfectly watertight, and as regards the bar across the bottom it is only remarked that a door should not have a ledge across the bottom. I have no interest in any speciality, but only pass opinion upon any gear that has come under my notice. With regard to sluices, I did not intend to make sluice-valves a part of the subject, but the question of their being kept shut is quite a matter of opinion. I consider that under normal circumstances they should be kept open to drain the ship into the engine-room, as it is well known that pumps work better from directly below them than through a range of pipes. The sluice-valves should be manipulated occasionally to keep them free. Regarding Mr. McLean's remarks, he agreed with me that automatic doors were rather complicated to trust to.

With regard to shutting off the supply of coal by shutting the bunker doors, ships generally have side bunkers, and these would be available. I think Mr. McLean's suggestion to memorialise the Board of Trade too Quixotic. The Board of Trade have a fatherly feeling towards ships, but it does not go so far as that. Mr. McLean agreed with Mr. Thomson that the sluices should be kept shut, and be opened