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CIVIL ENGINEERING.

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On the Cause of the Frequency of Fire occurring on board of Steam Vessels of all Descriptions. By CHAS. H. HASWELL, C. E.

To the Mechanics' Club of the American Institute, New York.

NEW YORK, January 31st, 1857.

In consequence of the frequency of fire occurring on board of steam vessels of all descriptions, I deem it proper to address you upon the subject, for the purpose of inviting your attention thereto, and at the same time submit to your consideration the following recital of the principal causes therefor, and also some observations regarding the proper measures which, in my opinion, should be resorted to, to arrest or remove them.

NEGLECT OF SECURITY AND PROVISIONS AGAINST FIRE ON THE PART OF
THE CONSTRUCTORS AND OWNERS OF STEAM VESSELS.

BOILERS.

1. *Boilers with external furnaces*, alike to the ordinary cylindrical boiler of the Western and Southern waters, are supported by iron standards; the sides of the furnaces and the bottoms of the lower flues, being constructed with brick work and mortar beds, and in the construction of this work, care is given more to the general confinement of the fire and flame for the economy of fuel, than it is to guard the vessel from being fired. When boilers of this description are used, even on land, it is impracticable to keep the brick work and bedding permanently free from fissures, whereby fire or sparks may pass out and ignite any inflammable material they may come in contact with; how much more difficult then,

must it be to keep brick work free from fissures, when it is subjected to the workings and concussions of a steam vessel.

2. *Boilers with internal furnaces*, alike to the ordinary marine boilers, are frequently constructed without water bottoms, hence, when the fittings of the legs to the bed of the boiler is imperfect, either by neglect in the workmanship, or may become so by the effects of rust, an opening is exposed, whereby fire or sparks may pass out, as in the case just recited.

3. *Boilers, the furnaces of which are fitted with blowers, to afford an artificial draft*.—In this case the pressure of air within the furnace, flues, and pipe, being superior to the external atmosphere, any fissure or hole in any part of the external face of the furnace, the fitting of the legs of the boiler to its bed, (when there is no water-bottom,) the fitting of the man-hole doors or flue-stoppers, and the fitting of the smoke pipe to the chimney, becomes a ready vent to fire or sparks which are driven out with great velocity, when the blast is high, and which falling upon, or adhering to, any inflammable material they may come in contact with, the risk of igniting it, is incurred thereby.

Coverings and protection to boilers.—It is very rare to find that the boilers of any of the Lake, River, or Sound steam vessels, are covered with felt (of hair), for the double purpose of protecting the wood work around them from fire, and for the economy of fuel. This very effective precaution against fire, is scarcely known amongst the class of steamers referred to, whilst its use in the sea-going service is almost universal, the utility of it being recognised, in restricting radiation of heat, from the boiler to the engine room and cabins of the vessel, and in its economy of fuel: although at this time there are many owners of steamships, who pertinaciously refuse to resort to this means of effecting economy of fuel, comfort to the passengers and crew, and of reducing the risk by fire, merely because it involves an immediate expenditure of money, and because the engineers of the vessel, in common with a large majority of the profession, always oppose any means calculated to save life, property, and fuel; consequently they do not urge upon the owners of their vessel, the propriety and necessity of this provision.

As a security against fire from being communicated by an over-heated boiler, a covering of felt is of the first importance—for the reason, that immediately upon its being burned, the peculiar odor of its combustion is readily recognised, the engineer and firemen upon duty at once know that the felt around the boiler is being burned; their attention is forthwith drawn to the circumstance, and if it has arisen from an over-heated boiler, or from fire being communicated through a hole or fissure, it is readily discovered, and remedial measures resorted to.

Covering and protection to wood work around boilers.—In our Lake, River, and Sound steamers, it is very rare to meet with any covering as a protection from heat or fire to the wood work contiguous to a boiler; the neglect of this essential point is so general, as almost to be deserving of being classed as universal, and as the occurrence of fire, originating around a boiler, is not restricted to one cause, but may arise from so great a number, it is difficult to account for the continual neglect of proper precautions upon this point.

The cases in which the wood work around a boiler is exposed to being fired are,

1. When the water in a boiler has been allowed to fall below the flues, the shell and steam drum or chimney, as the case may be, become sufficiently heated by radiation from the superheated steam within, to effect ignition of wood work immediately exposed to it.

2. When water has been allowed to fall below the flues as just referred to, and the occurrence is discovered, it is customary, immediately to haul the fires from out of the furnaces, into the fire room, and when the wood work immediately over and around the fire room is not properly protected, fire is likely to communicate to it, and fires from this cause have frequently occurred.

3. When blowers are used, the fire or sparks that may be blown out through fissures in the furnace doors, ash pits, flue holes, chimney connexions, &c., will readily ignite wood already at a high temperature and quite charred, from having been before exposed to such temperature.

Chimney Jackets and Rooms.—In single decked steamers, when the boiler is below, and the steam chimney is above the main deck, or when the boiler is on the main deck or upon the wheel guards, it is customary in many cases, to cover the chimney or chimneys, as the case may be, with a wooden casing, set off from it but a few inches, and in others to cover it with a sheet iron jacket, in most cases imperfectly made, and in all, insufficiently fitted. In steam vessels with two or more decks, the boiler or boilers being in the hold, the steam chimney and the base of the smoke pipe are commonly enclosed in wood work alone, which is in some cases set at a proper distance from the chimney, to avoid the risk of it being fired by sparks or the continued radiation of heat from it, but the purpose of this space is very frequently negatived, by its being used for the storage of swabs, buckets, brooms, &c., &c.

This wood work, however, is very seldom properly protected, in many cases no protection at all is attempted; in some a coat of whitewash is laid on, and in others a lining of tin, zinc, or iron, in which the laps of the sheets are laid downwards, as if they were there placed to shed rain or water falling from above, instead of fire arising from below. The tin, and even the zinc, unless well nailed, are too light, and their expansion at high temperatures too great for this purpose: the consequence is, that when subjected to the heat of the smoke pipe, they wrinkle and spring to such a degree, as not only to admit any sparks that may arise up from below, to pass between their laps and under them to the wood, but the sparks are liable to be arrested there by the inequalities of the surfaces, where they are exposed to a draft of air which readily effects an ignition of the wood, and when this is discovered, the presence of these sheets prevents the immediate application of water to the fire underneath them, and before they can be removed, the flame has passed through the joints or crevices of the light wood work around the chimney and boiler, and the whole is in full combustion.

In other cases this wood work around the steam chimney or drum, is placed close to it, precluding the proper circulation of air, and not affording the necessary room wherewith to cover the wood with any material, or even to whitewash it, and when fire is communicated to this work,

fitted by its character and position for ready combustion, it is in the most favorable condition therefor, and when ignited it requires but an instant for it to be developed, beyond the control of the means usually found in steam vessels.

Deck loads.—It is a common occurrence for the main deck of our Coast, Lake, Sound and River steamers to be so encumbered with freight, that not only is a great risk incurred from fire being communicated to the freight when combustible, but in the occurrence of fire, the presence of this freight is an obstruction to the means necessary to be resorted to, to extinguish it.

Store and Tool rooms.—These are other and prolific sources of fire on board of steam vessels, rendered so by their being appropriated to the storing of oils, paints, turpentine, (the latter frequently in packages of glass,) wiping stuff, either of loose hemp or cotton waste, packing yarn, cotton wick, matches, &c., &c., which in a large majority of cases are not properly stowed, but from the carelessness of those who visit these rooms, articles alike to the above recited, are scattered about and constantly exposed to be ignited by the upsetting or falling down of a lamp or candle. In steamers with two decks, the boiler or boilers being below, it is by no means unusual to find a part of the space immediately over the boilers allotted to a store room for the engineers' department, for the reason that being unsuited by its high temperature for ordinary purposes it is not objectionable on that account as an engineers' store room, added to which, it is declared to be very convenient to the engine room, and the propriety of the location is thus confirmed; the result of which practice is, that upon the upsetting of an oil can, or the breaking of a glass vessel containing spirits of turpentine or paint oil, the top and sides of the boiler beneath are flooded with an element of combustion, which rarely if ever fails to cause the destruction of the vessel.

Pumps.—In the construction of an engine for a steam vessel, it is usual to attach an ordinary lifting pump, of a capacity calculated to free the vessel from the drips and vents of water from the engine and boiler, and from the ordinary leaks of the hull. This is also arranged so as to be worked by hand when the engine to which it is attached is not in operation, and it is usual also, to connect to the feed pumps of the boiler, an air vessel by which it may be made to project water, and thus be used as a fire engine, and until the introduction of the independent steam fire engine and bilge pump of H. R. Worthington, within the last ten years, no other means were depended upon to free a steam vessel from water, or furnished it to arrest a fire.

With these details, then, of the numerous causes of fire on board of steam vessels, and of the imperfect means to prevent or arrest them, I now proceed to recapitulate the several causes here referred to, and to suggest such measures as, in my opinion, should be resorted to, by the owners of steam vessels at this time, and builders of them hereafter, by which this class of disasters may, to a great extent, be averted.

NEGLECT OF SECURITY AGAINST FIRE.

1. *Boilers with external furnaces* should be supported by iron standards alone. The sheet or plate iron, as the case may be, which encloses

the masonry should be accurately fitted in its joints, and under no circumstances should the wood work around the boilers be allowed to be within one foot of them, their upper surfaces being well covered with felting of hair, and the under side of the wood work immediately over them sheathed with zinc or sheet iron; the nails securing which to be in squares not more than one and a half inches apart, and the laps of the sheets to be secured at every half inch.

2. *Boilers with internal furnaces*, should have water bottoms in order to guard fire from being communicated to their beds through openings therein, and when a natural draft is used for combustion, the exhaustion within the furnaces, flues, and pipe, is such as to cause a current of air to lead into and through any apertures opening to them, and hence fire or sparks are prevented from being emitted through any of the ordinary openings or joints about a boiler; but where a blower is used, the conditions are entirely different. The pressure of air within the furnaces, flues, &c., is so great, that fire, sparks, and even small pieces of ignited coal will be forced through any openings that may exist, and as it is impracticable to construct a boiler without a number of insecure openings, such as those of the furnaces, ash pits, and flue doors, smoke pipe joints, &c., fire is constantly being forced out through them, and a great number of steamers have been destroyed from this cause, added to which, the momentary firing of them from this cause is a matter of so very frequent occurrence, that if the public at large were fully aware of the risk of life they incurred in traveling in steamers where blowers are used, the abandonment of all such vessels would be so universal, that the owners of them would be compelled to remove this risk forthwith; their interest in this inducing their attention thereto more effectually than any law that might be enacted to reach them. So opposed to all propriety is the use of blowers, and so essentially necessary to the requirements of personal safety is the abandonment of them, that I question if a jury, composed of intelligent persons, with the facts fully before them, could be found throughout the entire country, that would not decide that a vessel in which they were used was unsuited to carry passengers, even on a river or sound, and unseaworthy on a lake or the ocean.

3. *Covering and protection to boilers*.—All boilers should be covered with a hair felting, both for the purpose of indicating when they are unduly heated, and as a means of preventing the radiation of heat from the boiler to the wood work around it. So well established are the advantages of felting boilers, both for the economy of fuel, security against fire, and comfort to a crew, with all engineers—and I wish to be understood as not using this term to include mere drivers of engines—that in some of the Atlantic, and in all Naval steamers, the felting of twice and thrice the ordinary thickness is used, added to which are fitted over it coverings of canvass and sheet lead.

NEGLECT OF PROTECTION TO WOOD WORK AROUND BOILERS, THEIR CHIMNEYS AND SMOKE PIPES.

1. *Protection to wood work around boilers*.—The wood work immediately around a boiler, its steam chimney or drum, should be set off

from it as far as it may be practicable, consistent with the capacity of the vessel; thus, when a boiler is in the hold of a single decked vessel, it is not practicable to afford much space between its top and the under side of the deck beams above it without making a break in the deck, a measure not always consistent with the requirements of the vessel; neither is it desirable when the boilers are upon the guards of a steamer to construct a covering to them of a sufficient height to secure it from being fired by radiation of heat from the boiler. Neither is it imperatively necessary that there should be any great distance between a boiler and its surrounding wood work; one foot is a desirable distance, and even more would be preferable, but when blowers are not used, and a boiler is properly covered, the wood work around it if properly protected may be set within six inches of it with safety, and all wood work about a boiler, as well as the top and sides of the fire rooms, should be covered with sheet iron or zinc, secured in the manner already detailed, with the further precaution of placing the laps of the sheets upwards. When a metal covering is not used, several coats of thick whitewash, stiffened with a little glue, will answer a good purpose; in fact, I think this preferable to coverings of tin or zinc as they are usually put on.

2. *Protection to wood work around steam chimneys and smoke pipes.*—Chimney rooms should be afforded a space sufficient to admit of the passage of a man around the chimney, and should be without any floor, so as to furnish a free communication for the escape upwards of the heated air from around a boiler, and also to admit of the introduction of a hose pipe in the event of the wood work around it being ignited. Whenever a smoke pipe passes through a deck, however light its character, there should be an open space around it to admit of a current of air to pass through it, and between this space and the wood work there should be a metallic boxing containing water to guard the wood from ignition.

WANT OF PROVISIONS AGAINST FIRE.

Pumps.—Where security from fire is imperfect a greater regard to the provisions against it should be had; this requirement, however, is not observed, and the disregard to the safety of human life, and the interests of the underwriters, which so generally exists, is observable in the want of provisions against fire, as in the other points referred to.

All steam vessels should be provided with an independent steam fire engine and pump combined, and all sea-going steamers of magnitude should be provided with two, and an independent boiler to work them; fitted to these pumps there should be a sufficiency of hose (in good order) to lead to any part of the decks or hold; added to which there should be the proper number of hand fire pumps upon the upper deck of the vessel, with hose sufficient in length to reach to any part of the vessel forward or aft, according as the pumps may be located forward or aft, and which hose should be so fitted as to be capable of being attached to the hose of the engine pumps. Further, the provisions of the U. S. Law of 1852, regarding the carrying of fire buckets and axes should be rigidly enforced, and a non-compliance therewith should be held to be a forfeiture on the part of the owners of a vessel that was burned to any claim for loss on the Underwriters.

As many owners of steam vessels will think this suggestion of even one independent steam pump and a boiler, a requirement altogether unnecessary, and imposing too great a burthen upon them; they will be surprised to learn that I can support my views by a reference to the fact that most of the sea steamers belonging to this port are fitted with pumps of this character, and that many have two of them, and an independent boiler to operate them; further, that rarely does a month pass without the occurrence of a steam vessel upon the coast or ocean being saved from burning or sinking, solely by the use of these pumps, and under circumstances, too, when the ordinary engine and ship's pumps prove totally inadequate to meet the requirements of the case.

If the provisions against fire on board of steam vessels—both as to the means of subduing it, and the proper organization of the officers and crew in the event of fire—were such as to give confidence to the public, there would not, upon its occurrence, exist that want of reliance in the ability to arrest it which is so fatal to the chance of subduing it. When the officers of a vessel are aware of their insufficient means to arrest a fire, and the crew are without that observance of obedience and restraint which is due to discipline and a reliance in their officers, there can be little combination of efforts, and when the inflammable character of a steam vessel is considered, it will be admitted that it is not from the labors of one or a few individuals that success is to be anticipated. It requires a high order of even compulsory discipline for a crew to continue at their posts, with the knowledge that passengers are not only cutting off their means of safety by the occupation of the boats, but terror-stricken and frenzied, they are probably destroying that very means by their confused and ill-directed labors.

So long as the captains of steam vessels do not exhibit to the public that the provisions for personal safety and discipline on board of their vessels is generally adequate to the demand upon them, so long will their labors and that of their officers be rendered impotent, for the crew and passengers, judging of the present by the occurrences of the past, will look for such safety as that which their selfishness will direct, and their own resources will effect for them.

STORE ROOMS.

Engineers' Store rooms—Should be located away from the fire room or boilers; all inflammable and combustible materials like turpentine, paints, oil, and tallow, should be kept in metal tanks, securely fastened to the deck, and both they and wiping-stuff, spun-yarn, &c., should be stored in a room other than a tool room or work shop, the location of which should be such that it not only could be readily reached in the event of its being on fire; but it should be so located as to receive sufficient light into it to set aside the use of artificial light, except at night, and then it should be lighted by a fixed light without the room, but shedding its rays into it, alike to the manner in which the magazines on board of vessels of war are lighted.

Lights.—Instead of the universal neglect to give to engine and fire rooms a sufficient light whereby the operations thereof may be conducted without the use of hand lamps; there should be fixed lights

of a construction and character suited to give full light to all parts of these rooms; thus setting aside the risk of firing a vessel by the upsetting of a lamp, &c.

IMPROVIDENCE OF CAPTAINS AND ENGINEERS.

Although this is the last cause to which I shall ask your attention, yet it is by no means the least worthy of reference; on the contrary, I consider that if a large majority of these officers better discharged their duties to their employers and to themselves, there would be but little occasion for me to have addressed you this communication.

Captains.—Captains of steam vessels in the superintendence of their construction and equipment, should pay that attention to the requirements of security and provisions against fire, which, if they are at all qualified for the position, their experience and observation will show them to be necessary. The interests of the owners of steam vessels require full attention to these points, their contract with the public, in a moral view, demands it.

Engineers.—As the security against fire on board of a steam vessel are more immediately under the supervision of the engineer than that of any other person, and as he is, or ought to be, better acquainted with the risks therefrom, a strict requirement should be demanded from him, both by the owner and commander of a steam vessel, as to the resort on his part to every practicable security against fire, and every available provision for it if it should occur.

Upon an engineer entering upon duty on board of a steam vessel, it is his first care to advise himself fully as to the security and provisions against fire, and the means to free the vessel from water in the case of her leaking or being bilged, and if she is not properly secured and provided, he should forthwith report this condition of affairs to the captain, and if he or her owner assumes the responsibility of not noticing this report, the engineer has discharged his duty, and he must abide events; if, however, it should happen that human life should be sacrificed by inattention to his report, and the case should come fairly before the public, I am of the opinion that like reports of engineers would receive better attention for the future. If engineers had adopted this course they not only would have effected a just attention to their representations, but they would have saved many lives, both of the public at large and of their own profession.

Unfortunately, however, engineers as a class are the last persons not only to assume this position, but to acknowledge its propriety; for instead of guarding against the dangers which they are best advised of, they appear to consider the exhibition of an indifference to them a point of honor. In corroboration of this, I could present many relations, clearly exhibiting that it is not through the providence of engineers, that the public and the underwriters are to look for safety.

Not only has it required ten years of labor and importunity to introduce the independent steam fire and bilge pump into a bare majority of steam vessels, even with the support and repeated exhibitions of it having saved both vessels and crew, but from the almost united resistance of engineers, it is likely to require a longer period than this to introduce

the practice of felting boilers, and protecting the wood work around them.

In fact, the disregard of the owners of steam vessels, and the neglect of the trust confided to the captains as well as engineers, in not directing and requiring the proper precautions against fire is almost universal, notwithstanding vessels and lives without number have been lost in consequence of this neglect, altogether inexcusable and without a justification upon any one point, or under any combination of circumstances.

With them the non-occurrence of a fire where the security is imperfect, is assumed to be conclusive as to the sufficiency of the security from its occurrence at any subsequent period, and if it has so occurred that a boat indifferently secured and provided against fire has run for a period without ever being fired, it would be found very difficult to induce either her owner, captain, or engineer, to adopt any change, having in view any improvement in her security against fire.

As the proportional loss of steam vessels by fire is greater with us than with any other nation, it is not amiss, as a measure of apology for us, that the cause of it should be referred to here, with the view of showing how this blot upon our fame has arisen.

Upon the first introduction of steam navigation in this country it was confined to rivers, bays, and the shores of Long Island Sound, and if a fire occurred, reliance for security of life was had more upon the facility with which the vessel could be run ashore, and the passengers and crew escape thereto, than the probability of subduing it by provisions for the purpose.

Had our first essays occurred at sea, and been restricted thereto like to those of the English, we would have commenced with a better observance of the requirements of security from fire, but unfortunately the burning of a steamer upon a river does not present itself to the feelings of the public, like to a similar occurrence at sea, where, from the losses and horrors that usually attend it, it is universally conceded to be the terror of the ocean.

My purpose in submitting these views to you, as has already been stated, is that of inviting your attention to this subject. If you should see fit to submit this letter to the public, it may be the means of arresting the attention of the owners and officers of steam vessels to the responsibilities of their positions, and should it cause them to reflect upon the nature of their duties both to the public and themselves, I cannot doubt but that some good may be effected thereby ; if so, the interests of all and my object will be well accomplished.

*American Railway Securities.**

It has often been asked why American railway securities and shares, usually excellent, rank so low in market price. The answer is because they have no English agency. Money is much dearer in America than in England. Left to American investors alone, American railways will

* From Herapath's Journal, Jan. 1857.