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DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

FIRES IN SHIPS IN PORT

by

S. H. Clarke

Summary

After several fires in large ships in recent years, the comments of the Joint Fire Research Organization have been sought from various quarters. It seemed appropriate to review some of the major problems of ship fires, and to describe them in a form suitable for further discussion. No mention is made of what may be called accepted good-practice in ship fire protection; the paper deals mainly with what may be expected in future trends.

It is noted that all the large fires in recent years have occurred in ships in port. The recommendations of the Convention for the Safety of Life at Sea are intended primarily to apply under sea-going conditions. They are not necessarily adequate when a ship is in port.

The following are among the suggestions made:

i) Careful attention should be given to the Report of the Working Party of the Ministry of Transport which recommends measures to ensure early detection and attack, with a well-defined chain of authority.

ii) Wherever possible automatic alarm systems, or preferably sprinklers, should be installed.

iii) Any steps that can be taken towards ensuring the integrity of fire compartments, which should be as small as possible, should be taken; where openings in fire division walls are necessary for normal operation of the ship, the utmost care should be taken to ensure that they are closed when not actually in use.

iv) It seems probable that water will remain the principle fire-fighting medium. The chief directions in which improvements may be expected are in the greater use of water sprays, and possibly in their indirect application.

v) The permanent installation of deep-lift pumps to prevent dangerous accumulations of water should be considered.

vi) It may be possible in future ship design to take into account the desirability of controlled ventilation in the event of fire.

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The disastrous fire in the Empress of Canada, followed by a small fire in the Queen Elizabeth, and then by the destruction of the Danish Steamer Kronprins Frederik, led to many articles and letters in the press, and to requests for information from the Joint Fire Research Organization. Some writers were optimistic about what might be expected as a result of fire research. Some made valuable suggestions for reducing the risk, but it was apparent from many letters that the magnitude of the problem is not readily comprehended. It may, therefore, be appropriate to review briefly the salient features of ship fires, and to consider in fair perspective what improvements are immediately practicable, and what might be expected as a result of fire research. The writer has discussed the subject with many colleagues, including officers of fire brigades with expert knowledge of ship fires. It is a pleasure to acknowledge that some of the ideas expressed in this note arose in, or developed from, these conversations. The note, which is intended as a basis for discussion, takes for granted what may be described as accepted good practice in ship fire protection, for instance, existing regulations and recommendations of the Ministry of Transport; it deals only with the broadest issues and with possible future developments.

Characteristics of ship fires

In the reports of the recent large fires, two points stand out prominently: firstly, that they occurred in port and not at sea; and secondly, that many of them were discovered at a time when they were within the capacity of an efficient fire protection system, and disasters followed through lack of appropriate attack in the early stages. The first of these is not surprising. When a ship is at sea there are always members of the crew on the alert and there is little chance of a fire developing to an appreciable size before it is detected and attacked. In port, on the other hand, no passengers are aboard, and there are times when most of the crew are on shore. Frequently, there are workmen aboard who are not familiar with the geography of the ship and with the normal fire protection system.

The first point to be grasped is that a large ship is an elaborate structure, carefully designed for a special purpose. It is comparable to a hotel, with the broad difference that whereas a fire in a hotel can usually be attacked from many points and usually at any level, a ship is virtually a gigantic basement with a complicated ventilation system, in which approach to the fire is strictly limited so that it has often to be fought against the stream of hot gases. As these usually have no adequate venting they tend to accumulate within the ship and to produce conditions under which fire-fighting is hardly feasible. Moreover, the proportions and dimensions of stairs and corridors are quite different, and the provisions of means of escape are on a totally different scale in a ship from that in a hotel.

The requirements of the International Convention for the Safety of Life at Sea [1] include the provision of fire resistant bulkheads, and a measure of fire grading comparable to, but on a much smaller scale than, that in a modern, large building. The requirements are primarily intended to ensure safety while the ship is at sea and while human life is at hazard. The indications are that they are adequate for these conditions, but that they are not equally effective when the ship is in port.

Before proceeding to consider possible improvements in ship construction it is well to remember that for many years emphasis will have to be placed on methods of dealing with fires in ships as they are at present. This view was accepted by a Working Party of the Ministry of Transport [2] which made recommendations for mitigating damage by fires in ships in port. Bearing in mind that they had to make suggestions that could be implemented at once, the Working Party focussed attention on the importance of a clearly-defined chain of authority together with a well-organized, and disciplined fire watch, so that immediate detection of fires would be ensured and would be followed by rapid extinction. The chain of authority is visualised as beginning with those responsible for observing outbreaks of fire in their early stages, including those responsible for seeing that there is always a clear approach available for the Fire Brigade, and extending to the Officer responsible for deciding that fire fighting should cease or that a ship should be sunk.

The report of the Working Party has been criticised as nebulous, but there can be no doubt that it competently directs attention to the critical weakness of current practice. Its recommendations are feasible, and they would provide in port a degree of safety comparable to that enjoyed at sea. The apparent simplicity of the advice is deceptive, however, and it is likely that legislation would be necessary to ensure that it would be carried out.

Construction of ships

Reference has already been made to the peculiarities of ship design which almost inevitably result in the accumulation of hot gases in which fire fighting is impossible. It is often said that in fire on land the greatest difficulty encountered is that of smoke; in ships, to this is added that of heat. Even to a fireman wearing breathing apparatus and protective clothing, the heat is such that approach to the fire is often beyond human endurance. It follows that the direct application of water to the seat of the fire is often impossible.

It is difficult to see how a ship could be designed so as to permit its normal functions, and at the same time to eliminate these hazards if a fire develops beyond a certain stage. Every consideration emphasizes the importance of preventing outbreaks of fire, or at least of ensuring that any outbreaks are detected and extinguished at once. It should not be necessary here to elaborate the obvious precautions of automatic fire alarms or, better still, automatic sprinkler protection. The record of efficiency of sprinklers is too well known to require discussion at this stage.

The International Convention [1] recommended that the hull, superstructure, and deckhouses of ships should be sub-divided at distances not exceeding 40 metres (131 ft) by division bulkheads having a fire-resistance of one hour. Within the divisions provided by these bulkheads three alternative methods of limiting the development of fire in its early stages are contemplated:

"Method I - The construction of internal divisional bulkheading "of "B" class divisions (as defined later) generally without the "installation of a detection or sprinkler system in the "accommodation and service space; or

"Method II - The fitting of an automatic sprinkler and fire alarm "system for the detection and extinction of fire in all spaces "in which a fire might be expected to originate generally with "no restriction on the type of internal divisional bulkheading "in spaces so protected; or

"Method III - A system of subdivision within each main vertical "zone using "A" and "B" class divisions distributed according "to the importance, size, and nature of the various compartments, "with an automatic fire detection system in all spaces in which "a fire might be expected to originate, and with restricted use "of combustible and highly flammable materials and furnishings; "but generally without the installation of a sprinkler system."

While, as already mentioned, these measures may be effective at sea, in many instances the main fire divisions have proved ineffective when seriously menaced by a large fire while the ship was in port. One obvious reason is that the bulkheads were not imperforate, and some of the doors were open. There are various well-known ways of dealing with this situation on land, some of which would be applicable in ships.

There has been a steady trend towards insistence on the use of non-combustible structural materials in ships. This is an obvious precaution and will doubtless continue. It should not be overlooked, however, that, as in buildings, the main danger may arise from the contents and not the structural materials.

In looking to future designs it may be mentioned that the basic principle of fire grading of buildings is the division of the whole building into separate fire compartments each of which is structurally capable of maintaining its integrity. It should hardly be necessary to stress the necessity for ensuring that the integrity of these divisions is not impaired by ducts, and that there are no continuous dead spaces behind panelling. This principle is intended to be embraced by Method III above.

In theory a ship could be constructed as a series of fire compartments of varying sizes, the air supply to which could be controlled through the normal ventilating system. In so far as this is practicable, some benefit could be derived from the unusual form of construction which has appeared in the foregoing to present nothing but difficulties. This point is raised again below.

Warning devices

So great is the importance to be attached to early warning of outbreaks of fire that this aspect warrants a special heading. It is evident that under existing circumstances it is not sufficient to rely on the human element, and automatic apparatus should be installed in all large ships. It would be helpful if figures could be made available which would indicate the amount of money that could profitably be allocated to automatic fire protection even in existing ships. The International Convention for the Safety of Life at Sea mentions the use of sprinklers under Method II, and fire alarm systems under Method III. The writer suggests that wherever possible sprinklers are preferable and should be provided.

Fire-fighting

Despite the hopes sometimes entertained, it is unlikely that any material will be found to improve on water as the main fire-fighting medium in ships. Foam will continue to be needed for oil fires, and there may be a use for dry-powder extinguishers on certain special risks, but these can only be regarded as minor contributions.

The reasons for this general statement are that water is cheap; it is readily available in large quantities, and it is well suited for dealing with fires in the materials commonly found in ships. The chief difficulty is to find a method of applying it at the seat of the fire and as soon as possible after the moment of outbreak. It is here that the emphasis must be laid, and this difficulty would apply equally to any other medium.

The impossibility of reaching the seat of the fire has led all too frequently to the application of large quantities of water which have accumulated in the hull and endangered the stability of the ship. The general principles of stability are well understood and are beyond the scope of this note. It is only necessary to consider whether the application of so much water is economic, and what alternatives can be suggested. The question of economy is debatable; it could only be answered satisfactorily if complete salvage statistics were available, including the extent to which salvage has been affected by fire-fighting in the major disasters. It seems likely that the application of large quantities of water is only likely to be effective where reliance can be placed on fire division walls that are not too widely separated (e.g. as in holds).

It should be possible to employ deep-lift pumps to prevent undue accumulation of water. This idea is not new in principle, but for successful application a sufficient number of pumps would have to be permanently installed in strategic places, and with inlets and outlets also strategically placed. Such installations would offer difficulties, but they would not be insuperable.

Improved equipment and methods of application of water will undoubtedly be forthcoming. For instance, it is possible that there will be increased use of water sprays. It would be foolish, however, to encourage hope that the most efficient equipment in the hands of the most skilful fire-fighter could be effective against a fire that has been allowed to pass beyond a certain stage before the Fire Brigade is able to attack.

The only really novel idea that has been produced in recent years is that of the indirect application of water spray by introducing it into a controlled ventilation stream so that it automatically finds its way to the seat of the fire. American experiments (3) on a limited scale showed promise, but the extent to which it can be practiced in really large ships is open to doubt. The idea should, however, be fully examined.

Discussions and conclusions

From the foregoing brief review it is clear that although a fire in a large ship presents one of the most difficult situations that have to be faced by Fire Brigades, much can be done by the application of existing knowledge to make the probability extremely remote. It would appear that the standard of fire protection on British ships at sea is high, but the indication is that its level depends to a large extent on the human factor in the shape of the alert watch that is constantly kept. In considering what steps can be taken to lessen the hazard with ships in port it would be impossible to over-emphasize the importance of looking first to means of detecting outbreaks and ensuring immediate attack.

To recapitulate:

i) Careful attention should be given to the Report of the Working Party of the Ministry of Transport which recommends measures to ensure early detection and attack, with a well defined chain of authority.

ii) Wherever possible automatic alarm systems, or preferably sprinklers, should be installed.

iii) Any steps that can be taken towards ensuring the integrity of fire compartments, which should be as small as possible, should be taken; where openings in fire division walls are necessary for normal operation of the ship, the utmost care should be taken to ensure that they are closed when not actually in use.

iv) It seems probable that water will remain the principle fire fighting medium. The chief directions in which improvements may be expected are in the greater use of water sprays, and possibly in their indirect application.

v) The permanent installation of deep-lift pumps to prevent dangerous accumulations of water should be considered.

vi) It may be possible in future ship design to take into account the desirability of controlled ventilation in the event of fire.

References

1. International Convention for the Safety of Life at Sea 1948. Treaty Series No. 1 (1953). H.M.S.O. 1953.

2. Report of the Working Party on Fire Prevention and Fire Fighting in Ships in Port. H.M.S.O. 1950.

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