PUBLICATIONS OF THE
BRITISH FIRE PREVENTION COMMITTEE.—No. 8 (a)
Edited by the Executive.

FIRE SERVICE

IN

FACTORIES, WORKS, &c.

BEING

SUGGESTIONS

BY

HAROLD SUMNER

TWO ILLUSTRATIONS

Re-issue

LONDON, 1911.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE.
Founded 1897—*Incorporated* 1899.
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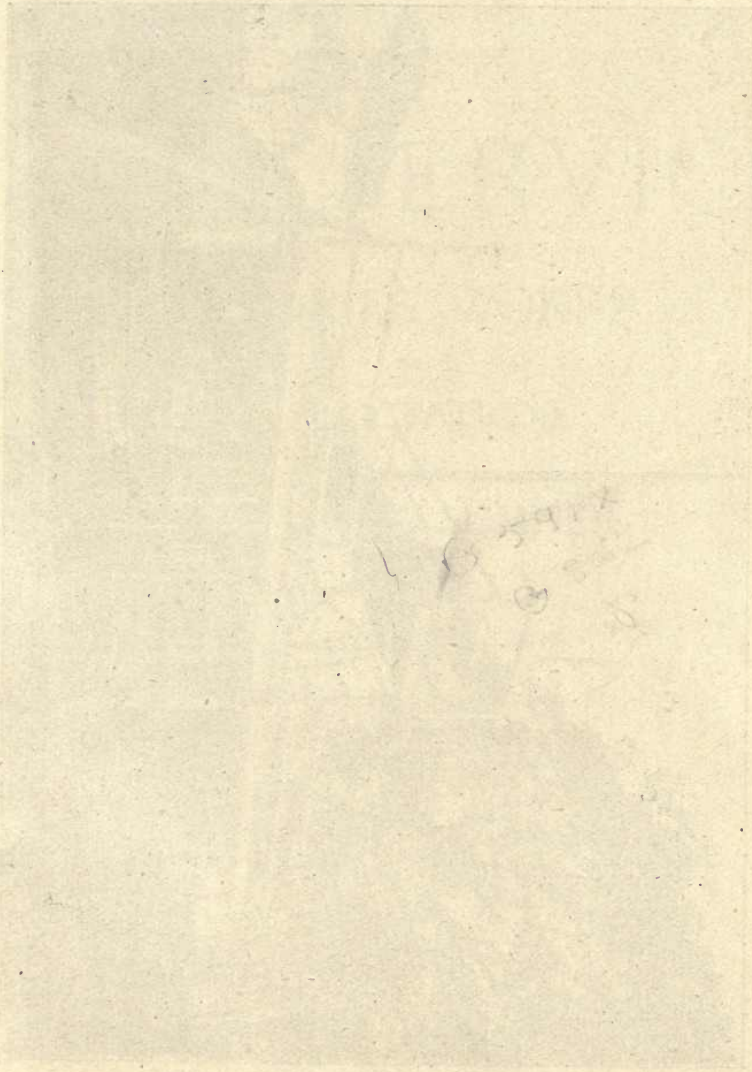

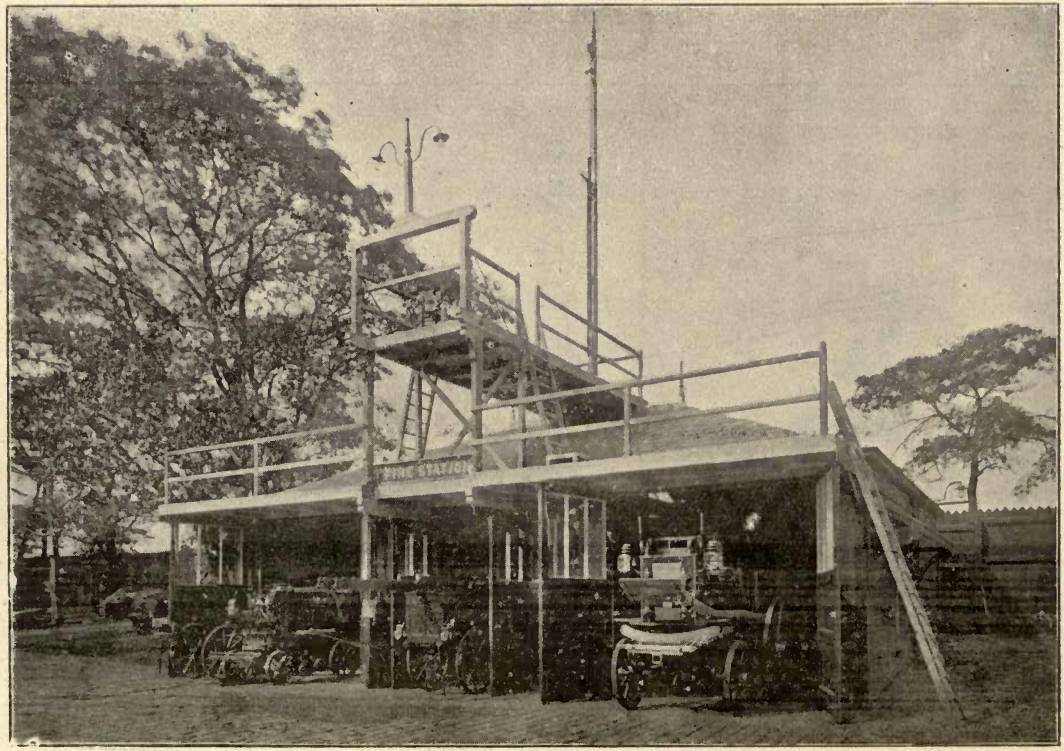

FIRE STATION AT THE STANDISH COMPANY'S WORKS.

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Two Shillings and Sixpence

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are:

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimizing the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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NOTE TO RE-ISSUE 1911

The Red Book containing Mr Harold Sumner's paper was first issued in 1898 soon after the formation of the British Fire Prevention Committee. It was much appreciated at the time and has since served as the standard paper on the subject not only at home but throughout the Empire.

To the Committee's founders the paper is well known, but it has undoubtedly escaped the notice of many of the members and subscribers who only became associated with the Committee's work since say 1900. Thus the Executive have decided to reissue the paper, and what more, to reissue it unaltered, for there is but little contained in the following pages that does not apply to-day precisely as when originally published some thirteen years back.

Like with other truly standard papers, the one here again presented has not lost by lapse of a full decade, for although a number of the fire appliances have been improved and motor-traction is rapidly coming to the fore in fire service work the principles and general arrangements advocated have the same bearing to-day as in 1898.

EDWIN O. SACHS.

8 *Waterloo Place,*
London, S. W.
1911

NOTE.

QUESTIONS relating to the fire service of a factory, a mill, or a similar establishment, as the case may be, receive as yet but scant attention. There is, however, at the moment, some feeling that more importance should be attached to the subject, and that there are considerable advantages to be obtained by avoiding that constant neglect of precautionary measures which has been so common.

It would, perhaps, only have been natural when dealing with the fire service of a factory, to see the words of advice from some prominent fire brigade officer, or from some expert closely associated with the technical aspect of the subject. But after due consideration, and well recollecting the prejudice with which expert advice is so frequently met, one could not fail to acknowledge that if the words of advice came from one actively engaged in the management of an establishment of this description, the manufacturer or mill owner, as the case may be, would perhaps be more prone to recognise that there exist concerns in which the question of fire protection is not only kept well in mind, but where some one member of the firm in question gives the matter sufficient attention to be able to control the precautionary measures with a considerable knowledge of what is actually required.

Mr. Sumner has very courteously taken upon himself this *rôle* of an adviser to his *confrères* in factory management. He writes as one who full well knows that no insurance money can make good the inconvenience and loss of trade generally occasioned by a fire.

He has been at pains to see that the establishment with which he is associated does not suffer from neglect, and at the same time he has so far made himself conversant with the points at issue that he is now able to lay down certain facts which should be particularly useful to others placed in similar positions to himself.

Much that Mr. Sumner says is of the most elementary description, but it is the elementary fact that is so essential where the constant neglect of questions of fire protection has also involved the complete ignorance of modern requirements. However elementary some of Mr. Sumner's words may sound to the reader who has some knowledge of the subject, such a reader may be assured that, for many, the entire contents of this paper are practically a new field.

Coming, as they do, not from an expert, I trust Mr. Sumner's words may be of use to those to whom they are primarily directed, *i.e.*, to those who have charge of going concerns. We have before us words of advice from one who has adopted precautionary measures with the conviction that these measures are in the interests of his business. They should be read as such.

EDWIN O. SACHS.

LONDON,
May 26th, 1898.

Fire Service

IN

Factories, Works, &c.

IT is difficult to generalise on a subject of this description. No two factories have the same requirements in the matter of fire service. And yet most factories have so much in common that I will attempt to show what is necessary for an establishment worked under normal conditions and of an average extent.

For the purpose of this paper I assume that the factory or works under consideration covers several acres; that the water supply is ample, either from reservoirs, river, or canal; that there is no fire brigade within reasonable distance; that there is no public water supply, and that the "risk" is an average hazard. It is assumed that the buildings are of fairly substantial type, mostly only one storey in height, but not constructed with particular regard to avoiding damage by fire or with any special attempt to separate the various hazards.

Now, the first consideration is the description of the plant to be adopted, and before entering further into this matter it is desirable to point out that quite as much care should be taken in choosing the best apparatus as if the selection of some additional machinery for the process of manufacture were in question. Only apparatus by first-class and reliable makers should be chosen.

The principal part of the fire-extinguishing apparatus is the pump, be it a stationary one or a portable steam fire engine. This pump we will call the fire pump, and remark that it should be preferably a stationary one. Its position should be carefully chosen, both as regards the distance from the main water supply and the boilers which are to supply it with steam. It is advisable that the fire pump be exclusively bought and used as such, and beyond occasional employment as an auxiliary or stand-by to the general pumping plant of the works, it should not be brought into daily and regular use, but be solely retained for its specific purpose. It must not be understood by this that it is to have no attention paid to it, and stand idle month after month ; on the contrary, it should be worked regularly at stated intervals, tried for lengthy and short spells under the conditions it would be required for, and occasionally be thoroughly overhauled.

The reasons for having a pump stationed for fire purposes only are, firstly, that it would probably be found to be an uneconomical pump for general purposes ; and, secondly, that, provided it has proper attention bestowed on it, it is always ready for immediate use without time being lost in changing from some other work it may be performing. The type of pump I consider best adapted for this work is one of the duplex type, *i.e.*, having two steam cylinders and two water cylinders, steam and water cylinders being on the same rods. This type has the advantage of starting immediately and dispensing with a fly-wheel. The water-way should be large and so arranged that the water, when passing through the pump, has no devious paths to follow. It should be brass-lined throughout the water end, and of strong construction. Large suction and delivery air vessels should be provided, and also a bye-pass between the delivery and suction chambers, so as to enable the pump to work with small or large jets. For deep lifts the suction pipes should be provided with a foot valve,

and where possible with a charging pipe and valve. Hose valves can also be conveniently provided so as to permit of two or more jets being directly obtained from the pump.

In ordering such a pump it should be carefully specified that the pump shall be able to work efficiently and well with a low, as well as a high, steam pressure. This is essential, since the steam pressure is often low at night time or during any stoppage of the works. It must also be taken into consideration that the quantity of water stated to be delivered by the makers is generally the maximum possible under the most favourable conditions.

The fire pump should be housed in a building of its own, preferably detached from any other, but as near its steam supply as possible. In factories, where steam is not kept up during the night or during holidays, it is advisable to have an auxiliary boiler placed near the fire pump. This boiler should then be of a quick steaming type, similar to those used with steam fire engines, and it should be possible to raise steam to 100 lbs. pressure in eight minutes. In such cases, of course, the fire pump should be connected with the main boilers as well as with the auxiliary boiler, so that the steam supply from the former, if available, can be primarily utilised.

The fire pump should be directly connected with the principal system of fire mains. Where it is possible the delivery into the mains should be effected through a T-piece delivering into two mains, each running in different directions from the fire pump, but joining at the most distant point, thereby forming a complete circuit round the premises. Each main should have a controlling shut-off valve in the pump house, so that it can be used independently of the other.

Valves should be placed at various convenient points on the mains to permit the speedy cutting off of any section that may be rendered inoperative through a

burst, without the whole system of mains being necessarily thereby affected. The mains should be large, and should be laid at least two feet six inches below the surface. Cast iron spigot and socket pipes, coated internally and externally with Angus-Smith's solution, should be used in preference to flanged pipes, though the latter are useful when any alteration to the mains may be expected to frequently occur. All the pipes should be carefully tested before being laid. Easy bends in the directions of the flow of the water should be provided, and every precaution taken to minimise loss of pressure through friction in the pipes. Branch circuits can be taken off the principal system for special sections of the works or for circuits of secondary mains, such as the internal ones, and dead-ends should be avoided. A flush-out pipe controlled by a valve should be provided for flushing out the mains periodically, or for emptying them in cases of severe frost. The latter valve, of course, would be placed at the lowest point of the mains, so that the mains could be quickly and efficiently emptied.

An automatic water-relief valve should be placed on the main close by the fire pump, and, further, one or more valves of this description should be placed on the mains. This precaution will obviate any damage to the mains or fire pump from shocks occasioned by the simultaneous or sudden shutting-down of the hydrants in use.

The course of the mains should not be laid too close to the buildings, but some few feet away, without being so placed as to be liable to be damaged by heavy traffic passing over the hydrant boxes.

The position of each hydrant or standpost off the main system should be clearly indicated by a plate on the wall immediately over the hydrant. The hydrants should be placed in near proximity to or opposite the entrances to different parts of the works, and should be so arranged that at least four jets are easily capable of

being brought to bear on any given point. The hydrant boxes should be lined with cement and drained. Special precautions should be taken against frost either by the adoption of "frost-proof" hydrants, by keeping the fire mains empty during the cold weather, as indicated above, or by ensuring in some way a gentle and constant flow of water throughout the system. It should be strictly prohibited to deposit anything on or in close proximity to a hydrant.

In connection with the main system generally, simply known as the external fire main, a series of internal mains, each forming its own circuit, can be arranged. A shut-down valve should be placed at the points of connection between the external and internal mains, so that the latter can be easily cut off from the external mains should they be damaged or rendered useless during the progress of a fire. The position of these valves should also be clearly indicated. This system of inside mains should run through every part of the factory. Each room or section of the works should have one or two fire valves off these internal mains, the hydrants being situated near the entrance to the room or section.

Quite apart from the water supply and pressure obtainable through the fire pump, it is advisable that the whole of the mains (internal and external) be connected either with an overhead tank, situated on a roof and holding at least 6,000 gallons, or to a public supply main.

This tank, or public supply, will always keep the mains, external and internal, charged with water under a slight head, and be found useful for a rapid first attack on any outbreak discovered in its early stages. This slight head may suffice to extinguish a small fire or keep the flames in check till the main pump can be got to work. A valve should be placed in a convenient position on the rising pipe to the tank; this valve is to be closed when the fire

pump is at work, so as to avoid any loss of pressure or water on the system of mains.

It is important that a large-sized tank should be employed when a constant steam supply is not available, and this tank should be of sufficient capacity to ensure a plentiful water supply till steam is raised in the quick-steaming boiler mentioned before. Automatic starting valves can be placed on the steam supply pipe of the pump, in order to start the pump directly any water is drawn from the mains, but this device, of course, can only be adopted when a constant steam pressure is obtainable. Where the reservoir or other source of water supply furnishes sufficient head to keep all the mains under a moderate pressure at the highest point of the system the tank can be dispensed with.

Neither the external or internal fire mains should be used for the ordinary supply purposes of the factory, if it can be avoided; and, where it is necessary, all connections must be securely made, so as to stand the pressure necessary for an efficient fire service.

As to the hydrants and valves, these should be of the best make, of gun metal throughout, and of such construction that they are not liable to leak and are easily and quickly opened. Near each fire valve or cock a cupboard or box, containing sufficient hose to reach to any point of the protective area of the fire valve, a branch pipe, and a proper sized nozzle should be provided. This cupboard should be damp-proof and provided with glass doors, so that it can at once be seen if the proper appliances are in good condition. Instead of the cupboard, the hose and branch pipe can be flaked on a swivel bracket, or attached to the wall, but in damp places the cupboard is preferable. If the hose is kept directly attached to the valve, a small tap or cock should be placed between the seating of the valve and the hose coupling. This tap should be kept partially open, so that any water leaking past the valve will be

drained away, preventing any deterioration of the hose and calling attention to the faulty state of the valve. A tap can be placed on the main itself for the purpose of filling the fire buckets, etc. It is advisable to provide an air vessel of large size, or a water-relief valve, to each circuit of internal mains, and also a few cut-off valves in a similar way and for reasons similar to those mentioned when speaking of the external mains.

As the internal mains are of undoubted utility in preventing the spread of a fire or checking it in its inception, it is advisable that the fire valves and mains should be as numerous as possible. The size of the internal mains generally depends on the size of the room or part to be protected, but the greater proportion of the internal mains should not be less than four inches in diameter. But with all due regard to the value of the internal main or circuit, the external main should always have precedence, owing to possibility of working from it in more than one direction, or, in other words, owing to its greater elasticity. It should also not be forgotten that internal mains are liable to damage during a fire, and may thus cause the outside mains to be inefficient until the necessary stoppages have been effected.

For this reason, too, should the question ever arise of protecting a factory by external *or* internal mains solely, and not by a combination of the two, then the external main should be chosen without hesitation, and any internal protection must be supplied by means of hand-pumps, and so forth.

Roof hydrants are of undoubted utility where access to the roof is easy. These hydrants can be furnished either by the prolongation of an internal rising main or by an exterior rising pipe in connection with the external main. Where iron fire escape landings are provided for the escape of employés in two or more storied buildings, fire valves can also be placed off such

roof mains at different levels in proximity to these landings.

In choosing positions for the roof hydrants, their accessibility and range of working utility should be carefully considered. Shut-off valves and drain taps should be placed in convenient positions so as to prevent damage by frost.

Where it is necessary or desirable to have two fire pumps, each with a separate system of mains, a connection between the two systems of mains should be made, in case either of the fire pumps break down or be otherwise out of service.

All underground valves should be placed in cement-lined, well-drained, brick chambers, with easily removable covers, and have a specially lettered plate fixed to a wall in close proximity.

It is also advisable so to arrange the piping that one or more of the pumps in the factory can, if required, pump into the fire mains to afford auxiliary aid.

Smaller appliances, such as buckets, hand pumps or chemical "extincteurs," can be judiciously distributed about the works. The buckets should be painted red, or some distinctive colour, and should always be kept three-quarters full of water. A few drops of glycerine spread over the surface of the water in a thin film, will materially prevent evaporation. Workpeople should be distinctly forbidden to use these buckets for any other purpose than extinguishing of fire.

A hand pump in conjunction with the buckets will be found of more utility than the small chemical "extincteurs." The "extincteurs" have the advantage that they can be called into instant use, but, even then, present in this respect no real advantage over a hand pump and two or three buckets full of water. On the other hand, "extincteurs" require a certain amount of special knowledge as to their use, and necessitate frequent examination. Moreover, as the charges are comparatively expensive, frequent trials or use for

instruction purposes are seldom thought of, and, further, they present the great disadvantage of being quickly exhausted and requiring considerable time for recharging. "Hand grenades," it should be added, are generally useless unless in the hands of specially-trained men fully conversant with grenade throwing.

In chemical laboratories, a box of slightly moist sand should be kept handy for dealing with outbreaks of fire where water cannot be successfully employed.

The other accessories, such as branch pipes, stand pipes, and so forth, should be of the best type and sufficient in number. The couplings should be preferably the same as those of the nearest fire brigade, and all accessories should be of the same size and type throughout the place. A certain number of ladders should be stored at a given place, and be of such a size that access to the roofs can easily be obtained.

In addition to the stationary fire pump and system of fire mains, or in place of them, it may be found desirable to have either a manual or a steam fire engine, or both. Either of these appliances will be found useful in case of a break down of the fire pump, or steam and water main, and especially in those establishments where steam is not always kept up day and night throughout the year. The initial expense of these appliances will probably be found less costly than a thoroughly efficient system of mains and a fire pump, though the latter have many advantages, the most obvious of which is the fact that the water can be supplied by hydrants at any convenient point required —irrespective of the distance from the main water supply, and under a better head than could be obtained by pumping through long lines of hose from either a manual or steamer.

Provided that a fairly good public water main supply is obtainable, a steamer or manual, in conjunction with a reservoir or river, is a useful addition to a fire protective plant.

These engines should be placed in a well-ventilated room or station of their own, conveniently situated for quick "turning-out," and for easy access to the different parts of the buildings. They should be kept scrupulously clean, in thorough working order, and provided with the necessary gear. They should be so arranged that they can be taken by hand or horse draught to any desired spot.

A steam fire engine is to be preferred to a manual owing to its greater power and ease of working.

A supply of boiling water should be constantly kept for the boiler of the steamer either by means of a gas jet or heater. With some instruction it will be found that any intelligent mechanic can efficiently take charge of the steam fire engine.

In order, however, to work the fire appliances efficiently—no matter if they take the form of mains and hydrants, fire engines, or both—it is advisable to form a body of trained men who have a thorough acquaintance with the fire protective measures and appliances at the disposal of the works or factory in question. This body of men should be known as the Works Fire Brigade, and its members should be picked men residing in the near vicinity of the works.

It is advisable that the Brigade be a relatively large one, so that the services of a certain number of them can be relied upon during the stoppages of the works. The officers should be chosen from amongst those having authority in the works, and the whole placed under the direction of one of the superior officials or heads of the firm.

The men should have the proper clothing and helmets supplied to them, and every effort made to make the members feel that the Brigade is one of the valued institutions of the establishment.

It is perhaps more satisfactory that the men be remunerated for drills than that their services be voluntary. The remuneration is a useful lever for the

maintenance of proper discipline, and is in many ways a more efficient system than a voluntary one combined with some special benefit such as an annual dinner or excursion. The paid system, further, need not, and should not, exclude any such special benefit as a dinner or outing for the men of the Brigade.

The Brigade can be divided into companies or sections, each in charge of a foreman. Each company should have its special duties in case of an outbreak of fire, one company having charge of the stationary fire pumps and the maintenance of the steam and water supply, whilst another has charge of a steam fire engine. The whole organisation should, however, be under the command of one chief officer, who would be responsible to his employers.

The Brigade should be drilled regularly, and every member should be made acquainted with the working of *all* the different appliances, hydrants, water sources, and so forth, no matter what special section he may be attached to. The drills should have special reference to the buildings they are primarily expected to protect.

A certain number or all the men may also be conveniently instructed in ambulance work. An ambulance corps is of great utility in any works for dealing with the accidents which unfortunately take place from time to time, but for fire brigade work the possibility of obtaining "first aid" on the spot is essential.

The fire appliances throughout the works should be inspected weekly by some responsible officer of the brigade and a report made to the chief, who would have to verify these reports from time to time. This weekly inspection should not be of a perfunctory nature, but a thorough examination of all pumps, hydrants, valves, etc., about the place, and any defect should be promptly repaired. A special report book with the necessary headings should be kept and signed by the officer charged with this inspection. In this report book a record of all tests should also be kept and it should

shew when the appliances were last thoroughly overhauled. All appliances should be cleaned and every hydrant flushed out once every week under the supervision of the inspecting officer. To avoid friction with the heads of departments, etc., the internal appliances can be put under the charge of the respective foremen of rooms or shops, but these foremen should be made responsible for their being kept clean and in good order, and the appliances should, nevertheless, be regularly inspected.

The engines and appliances at the fire station should be in the charge of one or more firemen especially told off for this duty, and would also be subject to regular inspection.

The fire alarm can be given by means of a steam whistle when steam is always kept up, or by means of a bell. The whistle should be of a distinctive sound, and not the same one which calls or dismisses the workpeople. The fire whistle should occasionally—once or twice a week—be blown at pre-arranged times, preferably at the middle of the day and simultaneously with the works whistle, in order to keep it in thorough working order. It can be placed either on the watchman's room, the central office, the fire station, boiler house, or other recognised building. In large establishments it is, however, better to have a supplementary system of electrical fire-calls communicating from the different buildings to wherever the whistle may be placed. Where an establishment covers a very large area, there can be more than one whistle.

The watching service or patrolling of the works as a precautionary measure against outbreaks of fire, is a most important feature of any system of fire protection. This precaution of watching is now practically always undertaken at every factory of any size, and it often constitutes the sole fire preventative measure. The system can be elaborated according to the size and the risk of the premises in which it is employed. In other

than very large establishments, it is generally performed by the night watchman, who must be a trustworthy, active, and resourceful man, and have a thorough knowledge of every part of the premises under his care, of the position of the fire appliances, their nature, and the resources generally at his command. It is of paramount importance that the patrolling is systematically carried out, and that every part of the works or factory, however insignificant, receives a regular visit from those appointed to this duty. It is therefore necessary that some means be adopted to ensure that this duty is satisfactorily carried out. Surprise visits are of value, but some mechanical or electrical system of recording the visits of the watchman to the various points of his rounds, are very desirable. The use of peg clocks or control watches will be found to meet this desideratum The control watch is carried by the watchman, and its distinctive feature consists of a strip of paper round the inside of the watch ; the strip is graduated or subdivided into hours, half hours and quarter hours. Each room or determined point is provided with a case affixed to the wall containing a special key attached to the case by a chain. Each key makes a separate and distinctive mark on the strip of paper, showing the time the watchman inserted the same into the watch. The strip on its removal in the morning gives a faithful record of the various points visited, the route taken, and the time of each visit to the different parts of the works. By a judicious distribution of the keys and a determination of the route to be taken so that every part of the works must be patrolled by the watchman, satisfactory results are obtainable.

Where more than one watchman is employed on night service, one should make his rounds while the other remains in the watchman's office ready to attend to any emergency. The system of electric fire calls from various points of the works or factory, and communicating to the watchman's office or fire station, can be

usefully adopted in this case. The watchman not on patrol can receive the call and immediately give the alarm.

The number of men employed, and the system adopted for night watching, must of course depend on the size of the establishment. In very large works it may be found desirable to have one or two members of the fire brigade sleeping at the fire station, and in addition it may be necessary in day time to have one or more men ready for any emergency, and solely employed as watchmen or firemen. The close proximity or otherwise of the members of the Works Fire Brigade should be taken into consideration when determining the question of night or day watching service. Part of the Fire Brigade can keep their uniforms at the station, and part at home, so that no time is lost either by day or night in securing a number of properly equipped men. The day men and night men should be changed every month.

In a factory the risk of fire is always present to a certain degree, quite apart from any special risk in the process of manufacture, on account of the carelessness of those employed on the premises. It is, therefore, essential that this factor be taken into due consideration.

Smoking is generally severely prohibited, but the necessary attention to the use of matches, where gas is used as an illuminant, is mostly overlooked.

The lighting of the gas jets should be solely in the hands of those especially appointed to this duty.

Electric gas igniters, or special gas lighting lamps, should be employed, and both the ignition and the extinction of all gas lights should be performed by the same men.

Wire guards should be adapted to all unenclosed gas jets, and the supply pipes made of galvanized iron.

Similar precautions apply to electric light fittings, only those who are duly authorised should be allowed to switch the light off or on at the main switchboard or

distributing boards. Any tampering with the fittings; should be strictly prohibited.

The accumulation of oily rags or waste must be guarded against. A special receptacle should be supplied for these, which should be emptied periodically. Proper oil-catching tins should be provided on all engines, shafting, and the like, and the reprehensible practice of putting down sawdust to catch the oil drippings absolutely forbidden. Not only is the oil-soaked sawdust highly dangerous, but this method of catching oil dripping is wasteful in the extreme.

By the use of suitable tins, the waste oil can be collected, filtered, and used again.

Accumulations of dust or lint on the steam pipes or boilers is to be avoided.

Where a steam pipe passes through a wooden partition, the hole through which it runs should be of considerably larger diameter than really necessary, so as to permit a current of air passing between the pipe and the woodwork. Should this not be admissible, asbestos packing should be placed between the pipe and the timber. On no account should steam pipes be placed on, or in close proximity to woodwork without some special precaution being taken to prevent any ignition of the latter. The covering of steam pipes to prevent condensation, as universally carried out, greatly minimises the risk of fire.

Wooden partitions should be avoided as far as possible.

Stacks of wood or timber yards should be placed at a safe distance from any building. Special precautions must be taken in the storing of easily inflammable substances such as oils, paints, etc.

Fire-resisting doors should be placed at all openings in party walls or other dangerous positions. Iron doors are not to be recommended, they are heavy and unreliable, owing to their tendency to warp or buckle when exposed to great heat. Doors made of two or three thicknesses

of timber, covered with lap-jointed sheets of tinned steel, are in every way preferable to the solid iron door.

"Fireproof" shutters can be usefully employed in certain cases, but care must be taken that the entire window framing is fire-resisting.

The sprinkler system, though of comparatively recent growth, is now extensively employed in factories, and particularly in cotton spinning and weaving mills. The sprinkler consists of a valve with a half-inch opening, which is kept closed by means of a strut or other mechanism. A fusible solder is employed in one or more parts of the sprinkler. This solder melts at a given degree of heat and opens the valve, which allows the water to fall on a serrated plate, thereby distributing a fine spray or rain over a comparatively large area. The sprinkler is thus automatic, the heat resulting from an outbreak of fire bringing it into immediate action. The pipes to which the sprinkler are attached and from whence they obtain their water supply, are fed either by an overhead cistern which must be at least 15 feet higher than the roof of the buildings the sprinklers protect, or by an automatic self-starting pump. Two distinct water supplies are required for a sprinkler installation, viz., a combination of tank and pump, or a public supply main and pump or tank. Sprinklers, however, have now been brought to a state of great perfection, and are generally considered reliable fire extinguishers.

A modification of the ordinary sprinkler is the "drencher" sprinkler. This is an open sprinkler or valve placed on an empty pipe, the water supply being controlled by a valve which is opened on an outbreak of fire. The object of this type of sprinkler is to form a sheet or wall of water to prevent the flames passing from one building to another either through a door or windows, and can be used to protect the whole frontage of any building in danger from a fire raging in its neighbourhood.

The Factory Acts require that special provision be

made for the escape of work-people in case of fire, and, further, reasonable provision has to be made for the escape of all persons on storeys above the ground floor.

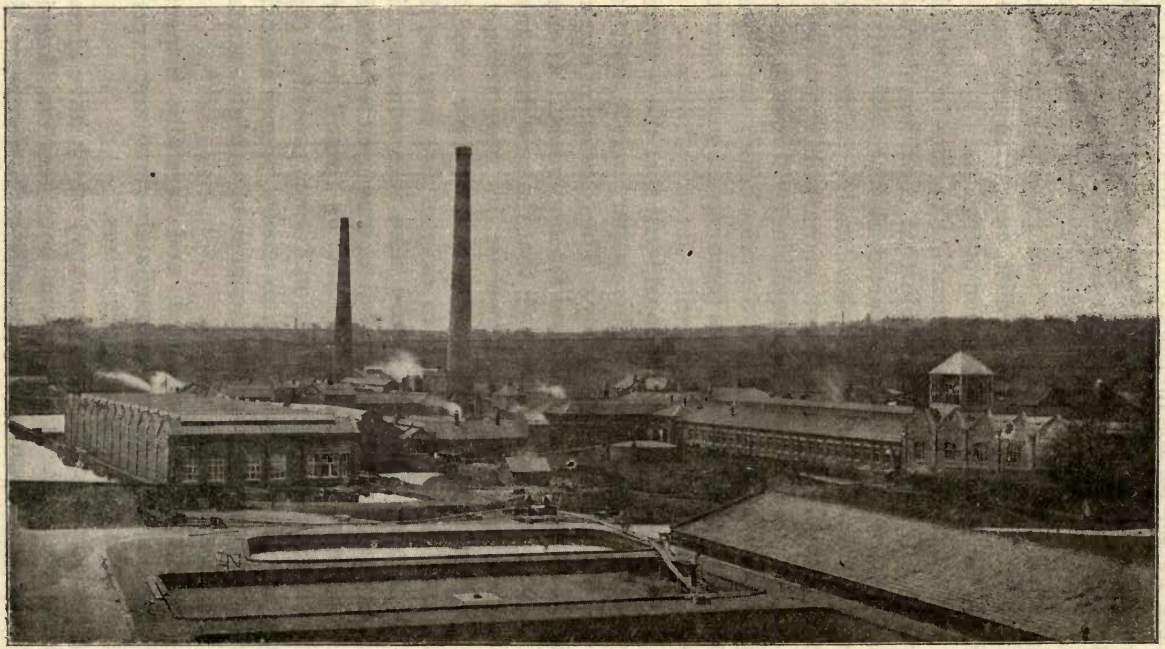
In every factory or workshop erected after January 1st, 1896, the doors of each room in which more than ten persons are employed must, except in the case of sliding doors, be made to open outwards.

When the question of extending or altering existing premises arises, it is advisable that considerable attention be given to any constructional features that may be dangerous from a fire preventative point of view, and above all that separation of hazards should not be forgotten. The employer should never forget to consult the officer in charge of his fire service before starting any constructional work and his opinions should have due consideration.

In conclusion, it may be considered that the protective measures mentioned in this paper may entail too considerable pecuniary outlay. The question of expense should not serve as an excuse for negligence. It must, of course, not be overlooked that the case here taken is that of a factory thrown on its own resources. It is, however, advisable, no matter how good or efficient the external help in case of fire may be, that every factory or works should take into consideration the necessity of being prepared for emergencies, whether the necessary installation adopted be a small or a large one. And where an installation is once provided, there should be every effort made to ensure proper attention being bestowed to the maintenance of a high standard of efficiency.

An effective, well-planned, and carefully inspected fire-protective plant will immediately repay any expense when the moment of urgency arises.

Those firms (and there are many) which have already given this matter their serious consideration, keeping efficient fire brigades and installing the necessary fire-extinguishing plant, have had no reason to regret their outlay on such precautionary measures.



VIEW OF THE STANDISH COMPANY'S WORKS.

APPENDIX.

Fire Protective Arrangements at the Works of the Standish Company, Ltd., Worthington, near Wigan.

The water supply for the works comprises two reservoirs containing 3,000,000 gallons and 400,000 gallons respectively, with daily supply of 750,000 gallons. There are also a river and some brooks, and a minor reservoir.

There is a double acting high speed stationary fire pump, duplex type, with steam cylinders 14 inches in diameter, water cylinders 7 inches, and 8-inch stroke. Capacity, 800 gallons per minute. This fire pump is housed in a separate building in close proximity to a range of boilers, and can take its water supply from either of the two main reservoirs. It feeds two 6-inch cast-iron mains forming a complete circuit round the works. It is fitted with byepass, relief valve, and hose couplings, and is kept ready for instant use.

The external 6-inch mains feed 26 hydrants, the position of which is denoted by wall plates. Each hydrant is placed in a cement-lined brick chamber which is drained. Each main is controlled by a valve in the fire pump house, sectional cut-off valves being also provided. The piping is so arranged that in case of breakdown of this pump, two boiler feed pumps can be utilised, giving a delivery of about 500 gallons a minute.

There are several internal mains connected with the external mains by means of valves which are controlled outside the buildings. The internal mains are 4-inch cast-iron flanged pipes and are connected with an overhead tank about 35 feet high, carried on four walls and containing 24,000 gallons of water. This tank is fed from a third and smaller reservoir by a direct-acting pump and supplies various parts of the works with water. The tank can be promptly cut off from the system of fire mains when the fire pump is in operation. The pump supplying this tank, which is situated in the centre of the works, can be used for fire purposes and fire valves are provided therefor. Fourteen internal fire valves are provided, each having a sufficient quantity of hose and branch pipe in close proximity. Buckets, chemical extincteurs, hand pumps, etc., are distributed throughout the works where necessary.

The fire station—36 feet long, 25 feet broad, and 15 feet high—contains one steam fire-engine of double-acting vertical type of

300 gallons capacity, kept in readiness for instant use; also a hose-cart, manual engine and ambulance-cart, 1,000 yards of hose, eight stand-pipes, twelve branch-pipes, scaling ladders, fire ladders, lamps, and a complete set of minor accessories, such as smoke-jacket, nozzles, etc. A constant supply of hot water is kept, and all engines are arranged for manual or horse draught.

The fire alarm consists of a steam whistle of the syren type, and is controlled from the outside of the fire station. At night time a red electric light is also displayed when the alarm is sounded.

A sub-station is situated at the opposite end of the works, and contains hose, stand-pipes, branch-pipes, hand-pump, buckets, ladders, etc. A coal supply for the steamer is also kept at the main fire station and near the sub-station.

The fire brigade consists of thirty members, inclusive of officers, and is divided into sections of five men, each in charge of a foreman. One section has the control of the pumps, water and steam supply, in case of fire. The brigade is uniformed, and all members live on the firm's property, or in close proximity to the works. All drills are remunerated and take place fortnightly.

Twelve members of the brigade keep their uniforms at the station, the remainder at home. Every month these twelve men are changed. The brigade also attends fires in the district when required.

The nearest available town brigade (volunteer) is five miles distant.

The Works ambulance corps is composed of members of the fire brigade.

All fire apparatus throughout the works is cleaned once a week. All fire valves and hydrants are inspected and tested weekly. Written weekly reports are made concerning the good maintenance and condition of all appliances connected with the fire protection of the works.

Steam is kept up day and night throughout the year.

Night watching is performed by a night watchman. Two firemen, an engine-man, and a night watchman are always on the premises during the night and on Sundays.

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