that was what evidently took place. When they considered the efficient method of injection of the fuel into the Diesel engine, they had in conjunction with the use of oxygen and the high temperature due to compression all the factors for getting intensely rapid combustion, and it seemed to him that that was solely the cause of the accident, and pointed to the warning that oxygen should not be used. What surprised him was that engineers should ever have suggested the use of oxygen. Anyone having the slightest knowledge of combustion should have said it was the last thing to use. Under these conditions his object had been to give a warning, and if that had been successful he was highly gratified.

NOTES ON PILE DRIVING.

The President said that while inviting discussion on Mr. M. E. Kernot's paper he thought it was hardly a matter which permitted of discussion in the ordinary sense. It was a very complete, illuminating, and interesting record of pile driving experience, and except for the fact that one might, on a close scrutiny, have a different opinion as to the methods employed in reaching those results, there was no room for discussion, and personally he thought that the whole design of the experiment and the systematic manner in which it was carried out were so admirable that the author had left no room for comment. He should like to add that the question of pile driving was still a very open one, and one in which engineering practice was highly empirical. It afforded scope for research, and they awaited a good deal of data whereby the engineer could determine with confidence the static loads to be carried by piles under varying conditions.

The discussion was closed subject to the author's right of reply.

Mr. M. E. Kernot writes that as there was no discussion he has nothing further to add except that he hopes that he will be able to submit, during the next session, the results of some further investigations into pile-driving in difficult ground.

LECTURE.

The President introduced Mr. J. T. Wilkins, Deputy Chief Officer of the Metropolitan Fire Brigade, who was to bring before them a subject, of which he was a master. He was pleased to
see some of their architectural friends present, as it was a matter that affected that profession as well as themselves as constructors.

Mr. J. T. Wilkins said when Mr. Smith asked him to fix up a paper that would be suitable to be read at the meeting he had some feelings of trepidation. He did not think that Fire Brigade work could be considered altogether from an engineering point of view. But he must say that during the past few years so many new sciences had been developed to enable the firemen to deal with big fires, small fires, and incipient fires, that fire-brigading must now be looked upon as a profession.

FIRE PREVENTION AND EXTINCTION.

By J. T. Wilkins.

INTRODUCTION:

My object in writing this paper is not to enter into Engineering in detail, but to give a general idea of the methods and tactics adopted by a modern fire department.

Some statistics pertaining to the Melbourne Metropolitan Brigade are given on the last page of this paper.

Owing to the rapidly increasing height and area of modern buildings, it is becoming of consequent importance that fire appliances should be constructed to deal with an outbreak which might occur at a height of well over one hundred feet above the street level. Not only must the appliance be of an appropriate description, but the firemen of to-day must also be a highly trained and educated unit, if full advantage is to be taken of the apparatus at his disposal. A few years back a knowledge of seamanship, rope-splicing, etc., was a necessary qualification before admittance could be gained to the ranks of the London Fire Brigade, and this custom was followed by the various Chiefs of Colonial Brigades, nearly all of whom have gained their experience in the London Brigade. The recruits of the fire service to-day are, as a rule, drawn from the ranks of tradesmen, young, able-bodied and intelligent men only being selected. Every recruit is confined to the drill class for from three to four months, or until such time as he has shown the necessary proficiency, or has demonstrated his unfitness for brigade work.

The first essential in fire brigade learning is a knowledge of fire prevention. The very great majority of the present day fires
could have been prevented, or the damage considerably minimised by taking a few well-known and ordinary precautions.

To guard against attack, it is well to know the nature of the danger by which we are threatened, and the best means to adopt to carry out a counter attack. Thus, the origin and cause of fire outbreaks must be taught the young fireman, who, in turn, will advise those members of the public with whom he may be associated. The earliest theory of fire or combustion was formulated by a philosopher named Stahl, in the seventeenth century, and termed the phlogistic theory.

Rapid Combustion:

It was supposed that the phenomenon of combustion was due to the escape of something which he called phlogiston. This theory held its own for nearly a hundred years, when a renowned French chemist, Antoine Lavoisier, following on experiments by others clearly demonstrated what combustion really is, and that the presence of air was necessary to its support, as by the exclusion of air combustion failed entirely. He further proved that the products of combustion were heavier than the original matter. A simple demonstration of this fact may be made by burning a piece of magnesium wire, then on carefully weighing the ash it will be found to be heavier than the original metal. The products from a burning candle, if properly collected and weighed, will be found to exceed the weight of the candle. In the year 1775, it was discovered by the same scientist that the atmosphere consisted of distinct gases, oxygen and nitrogen, and that without the presence of oxygen it is impossible to support combustion. Any substance which will burn in air will burn with very much increased brilliancy in oxygen, but if an excess of nitrogen be present combustion is considerably retarded, or in other words, should the oxygen be entirely displaced by nitrogen, then no combustion can take place. The product of most burning substances or all substances containing carbon is mainly carbon di-oxide. This is a heavy and non-inflammable gas, and is used extensively in combination with water for displacing the oxygen supply, and thus preventing combustion.

Many attempts have been made to utilise C.O₂ in its gaseous state as a fire extinguisher, and failure, in almost every case, has been the result, the fact having been overlooked that, if a fire
should break out in an enclosed space, both the product of combustion C.O\textsubscript{2}, and the stoppage of the necessary supply of oxygen to support combustion tend to extinguish the fire. On the other hand an open fire soon assumes such magnitude that any attempts to encompass it with C.O\textsubscript{2} would be dwarfed into insignificance as the fire itself would be manufacturing the same gas in such quantities as to be incalculable. It therefore follows that, could the products of a fire be confined to the vicinity of combustion they must of necessity extinguish the fire to which they owe their origin.

The use of the word combustion demands some analysis of its meaning. Science teaches us that slow combustion is taking place in almost all known substances. The piece of dry timber in the forest is slowly converted into its constituent parts by the action of the elements. The same piece of wood used as fuel in the ordinary manner would undergo an exactly similar process of disintegration, but the time required to bring about this state in a natural manner may extend over years as compared with minutes in the latter case. This somewhat explains the difference between slow and rapid combustion. At the ordinary solar temperatures a slow chemical action is taking place, but should the temperature be raised by artificial means to something between 500 and 600 deg. the ignition point is reached, and violent chemical action is produced. That portion of the wood which has been heated until turned into gaseous matter burns with a hot flame, while the heavier carbon is in a state of incandescence. To maintain this violent chemical action, it is necessary that the temperature must not fall below the ignition point, and that a free supply of oxygen be available.

As in nearly every case of fire it is not possible to cut off the supply of oxygen by the substitution of a heavy non-inflammable gas, it becomes necessary to reduce the temperature by pouring copious quantities of water on the burning material, which also, under any but very extreme conditions, creates gases of a non-inflammable nature, and thus tends to exclude oxygen.

**Fire Prevention.**

Having briefly touched on the matter of ignition and combustion, I should like now to deal with fire prevention methods. With the wonders of electricity at the command of the fireman, it is practicable to not only obtain early notification of an outbreak of fire, but to receive warning actually before the incipient fire has reached
the ignition stage. The fact of a dangerous temperature being in
existence in any premises fitted with an approved thermostat can
be automatically signalled to the fire station, when an investigation
will surely point out the danger spot.

**Automatic Thermostat:**

The automatic thermostat has now passed the experimental
stage, and, if properly installed and maintained, is absolutely re-
liable and certain in its action, and to be recommended for any but
the most inflammable risks. The latest class of thermostat is
provided with a compensating device, that in the May-Oatway
type being composed of a channel steel bar about 6 ft. in length,
with a thin copper wire stretched from end to end. From the centre
of this copper wire a weight is suspended, just hanging clear of 2
flat contact springs. A slow rise in temperature causes the steel and
copper to expand at practically the same ratio, but a quick rise of,
say, 20 per cent. in one minute causes the smaller mass (viz., cop-
per wire) to expand more rapidly than the more massive part, thus
allowing the weight to drop between the contact springs, and close
the electric circuit. This operates the sending instrument, and
transmits a pre-arranged code to the fire station. A thermostat
invented by E. H. Kirkby is fitted with two bi-metallic coils. Each
of these coils is composed of a strip of two metals soldered to-
gether, and afterwards rolled into shape. The two metals se-
lected must have a different ratio of expansion, thus on the appli-
cation of heat and consequent expansion, the outer metal being
more readily affected causes the bi-metal combination to extend,
keeping its spiral form. A similar coil is shrouded in a solid
cast iron base, therefore one coil only being affected by a sudden
rise of temperature, a contact is made between the two, but a
slow rise permeates the whole of the metal, causing the shrouded
coil to recede, thus keeping the contacts apart. An ingenious
form of thermostat has been designed by Reichel of New Zealand.
This is actuated by a generator of electricity known as the thermo-
pile. It consists of sticks of metal (antimony and bismuth) linked
together in pairs, and arranged in series until sufficient voltage has
been attained. Half of each of these sticks is covered by the porce-
lain base, being thus protected from any sudden heat. A thermal
rise of 2 deg. or over in one minute causes a current to generate,
but a slow rise in temperature affects the whole mass, and no
appreciable current is generated.
**Water Sprinklers:**

Should the risk be exceptionally dangerous from a fire point of view the best protection will be afforded by the automatic water sprinklers, which are operated by the heat, about 150 deg. fusing the metal which holds the water in check, thus providing for extinguishing the fire, and at the same time electrically calling the brigade to the scene of action, either to turn the water off, or complete the subjugation of the outbreak.

**Facilities for Summoning the Brigade**

The most important factor in preventing heavy fire losses, and what may be termed the first line of defence, is the public fire alarm service, provided by the brigade. This is so simply arranged that almost any individual can readily send in a fire call. The system designed and perfected by this brigade is one calculated to meet existing requirements, and also overcome the great difficulties of keeping up a continuous and reliable service under most unsuitable conditions as to outside line wires. The adoption of a closed circuit system under these circumstances was most imperative, as by that means, the failure of any line would be instantly recorded at the fire station, and the fault rectified. The method of running circuits radially from a fire station, terminating generally at a distance of from one to two miles, is such that to reach the most distant call-box on a circuit each of the closer points must be passed in turn. This ensures the attendance of the brigade even should an incorrect call be sent in. As a rule not more than six call boxes are fitted to any one circuit.

The call box contains an instrument with a coiled spring turning a disc fitted with pins according to the circuit number of the box. Each pin on passing a certain point depresses a contact trigger, which opens the circuit, thus sending in the pre-arranged signal by automatic telegraphy. The call is received on a dial at the fire station. This is operated by an indication line relay of special construction. On the construction of this relay depends the success of the whole system. Many experiments were made to determine the best and most reliable type to adopt. The ordinary telegraph relay was found to be quite unsuitable. Finally an electro-magnetic relay with special split cores made of finest charcoal iron, and wound to a resistance of about 100 ohms, was adopted. The energy required for the operation of this relay is derived generally from the public supply mains, the character
and pressure of the current being transformed, and rectified, or re-generated, so as to be utilised economically for charging a secondary battery of from three to five cells, a working pressure of from 6 to 10 volts being necessary for efficiency, each circuit taking from 25 to 30 milliamperes.

A telephone, on the common battery principle, is fitted to each box. This is only for the use of the brigade, being locked up in the box. All the public is asked to do, in the event of a fire occurring, is “to break the glass and press the button.”

First Aid Appliances:

It is well to bear in mind that all fires are the same size at one time during the outbreak, and that nearly all fires can be subdued at that time, i.e., at their inception, therefore it is advisable always to have appliances at hand to act promptly. The best known appliance for dealing with an outbreak at a very early stage is the ordinary bucket of water. This bucket should not be too large, and should be painted red on the outside with some indication as to its use. This form of fire extinguisher is very unreliable in most cases, as it has a nasty habit of drying up or wandering round looking for other jobs. It also makes an excellent receptacle for rubbish or dirt. Apparently so simple a matter as throwing a bucket of water on a fire is unworthy of mention, but the fact remains that the contents of the pail rarely reach the fire. Certainly the thrower will receive a liberal share himself.

Another form popular some years back, was known as the hand grenade, and consisted of a glass flask containing ammonia chloride solution. This was to be thrown into the fire, breaking the glass and liberating the contents. There was also the dry-powder extinguisher packed in a small tin tube. This wonderful powder was composed of soda bi-carbonate, a small amount of colouring matter, and some clay or powdered starch to prevent caking.

Both these latter forms of so-called fire extinguisher have proved a delusion and a snare, in fact the burning of the Iroquois Theatre was in a great measure due to the fireman on duty attempting to extinguish the flames with two tins of this dry powder instead of using some more efficacious means.

The hand chemical extinguisher has come to stay. It would not be exaggerating to state that millions of these little extinguishers are now in use. The ordinary type contains about 2½
gallons of water, with \( \frac{1}{3} \) lbs. of bi-carbonate of soda in solution. A bottle containing 4 fluid ounces of sulphuric acid, and closed only with a loose weighted stopper, is placed in the upper part of the cylinder with the stopper above the solution. On inverting the cylinder the stopper falls back, allowing the acid to come in contact with the soda solution, thus liberating the carbon dioxide from the soda. A pressure of about 100 lbs. per square inch is generated, which is sufficient to eject the solution to a distance of about 40 ft. In every well organized brigade a big majority of the fires attended are extinguished by means of these small extinguishers.

**WATER SUPPLY.**

**Necessity for Fire Pumps:**

Notwithstanding the fact that almost any class of building with its contents can be made reasonably safe from destruction by fire, there is always the conflagration hazard to be kept in mind. Given the right weather conditions and the proper chain of circumstances, a disastrous fire is always possible.

To deal with these conditions a copious water supply is absolutely necessary, and even with this available a conflagration at times may assume such tremendous proportions as to be almost unquenchable. The violence of the chemical action taking place in the heart of a great fire is quite beyond description, and possibly beyond imagination. We know that the most powerful streams of water at our command make not the slightest impression on the material, and it is quite within the bounds of reason to suppose that the water is converted instantly into an inflammable gas, which adds its quota to the violence of the conflagration.

In New York and other American cities a special fire main is provided, and water is pumped through these mains at a minimum pressure of 150 lbs. to the square inch; and although no time is lost in bringing dozens of large streams to bear on a fire, it frequently happens that the bare walls of a large warehouse bear eloquent testimony of the failure to check the fire. In such a case the only thing to be done is to take every precaution to prevent the fire from spreading.

Unfortunately the water service of this city is far from satisfactory from a fire-extinguishing point of view. The total pumping capacity of the fire engines of this brigade amounts to 6,100 gallons per minute, and there are but few places in the city where
Plate 1.

Melbourne and Metropolitan Central Fire Station.

Melbourne City West Fire Station: 40 H.P. Hatfield Motor Reciprocating Pump.
Plate II.

Typical Inner Suburban Station (Collingwood):
Shand & Mason 250 gal. Steam Pump.

Typical Outer Suburban Fire Station (Hawthorn):
Petrol Engine.
PETROL MOTOR PUMPING ENGINE, HORSE DRAWN, ROTARY PUMP; CAPACITY 200 GALS. PER MINUTE.

WATER MAIN PRESSURE RECORD, CENTRAL STATION.
sufficient water could be obtained to allow these pumps to be worked at their full capacity.

Capacity and Type of Fire Pumps:

The static water pressure in this city is about 140 lbs. per square inch at the lower levels. This is a useful pressure for fire work, but owing to the small capacity of our water mains that pressure soon drops below an efficient working margin. Advantage must then be taken of the fire pump. Canvas dams are erected close to the hydrants on the mains, and the water allowed to flow into them without restriction through 2 ½ inch canvas hose. This draws off practically all the water the mains are capable of delivering. The end of the suction pipe of the fire pump is placed in the canvas dam, and the water passing through the pump is raised to a pressure ranging from 100 to 150 lbs. per square inch as required.

The capacity of the various pumps in use by the brigade is:

1. Steam pump of 1,000 gals. per minute ....... 1,000
   1 " , " 600 " , " ............... 600
   2 " , " 450 " , " each ................ 900
   5 " , " 350 " , " .................... 1,750
   1 " , " 200 " , " .................... 200
   2 Petrol motor pumps, 450 gals. per minute each .. 900
   5 " , " pumps 150 " , " ............. 750

Total .. ................. 6,100

To enter into a detailed description of the various types of pump used by this brigade would entail a very considerable amount of time and labour, but a short description of each machine may be of interest.

The ordinary type of steam fire pump is directly connected to the piston of the steam cylinder by means of two piston rods, one on each side of the crank shaft. The crank shaft and fly wheel are used only to regulate the stroke of the engine and operate the steam slide valve and feed pump for boiler. The ratio of area between the steam piston and bucket plunger of pump is such that with a steam pressure of 125 lbs. per square inch a working pressure on the pump of 140-150 lbs. per square inch may be maintained. The steam cylinder and attachment of the engine are of the ordinary description, but the pump is of a class peculiar
to fire engines. It is double-action pump on the delivery, and single action only on the suction side. This result is obtained by the arrangement of a perforated bucket with soft rubber valves fitted to the end of the plunger piston. On the down stroke of the pump the piston displaces one-half of the contents of the pump barrel, the other half being lifted by the bucket on the up-stroke as the rubber valves close at the commencement of the upward movement. The barrel of the pump is also sucked full on the upward, or suction-delivery stroke.

A large air cushion is provided so as to maintain a continuous and steady stream, and on the suction side a vacuum chamber is fitted to take up the oscillation in the water column in the suction hose. Although a foot-valve is provided with most fire pumps it is practically never used, as the pumps are so accurately constructed that a lift of 28 feet is easily accomplished.

A later type of pump is of the complete double action type fitted with hard composition valves and metal springs. The valve boxes are so arranged and placed as to be quickly accessible should any fault occur.

Typical Fire Engine Boiler:

The great success of the steam fire engine depends almost entirely on the very fine type of boiler, or rather steam generator, which was originally invented and manufactured for that purpose.

These boilers are of the water-tube type with 120 or more tubes of \( \frac{3}{4} \) in. \( \times \) 14 G. muntz metal. They vary in length, being at right angles to cylindrical portion of the upright boiler, in which they are fitted. A boiler of this description, weighing little over half a ton, is capable of generating and maintaining 35 H.P. of energy, providing that suitable coal fuel is used.

Although these generators are marvels of energy production considering their small weight and measurements, their capacity for devouring the very best quality of coal is somewhat astonishing. The water space between the tubes and above the crown is very limited, and a boiler such as described, when up to high water level, does not contain more than 14 gallons of water. This necessitates the utmost vigilance of the man in attendance. Practically all the steam brigade pumps are horse drawn, but successful attempts are now being made to attach or combine petrol motor traction. Naturally steam traction would be most suitable
were it not that the time necessary for raising a working pressure makes this almost impracticable.

Some fire engine builders provide for keeping the boiler constantly under steam, and this is an excellent arrangement for the said builders, as the constant circulation of hot water soon necessitates the purchase of a new boiler.

Some enterprising South Melbourne firms have been making the boilers for us for years, and they have not only been much cheaper than those we had to import from England previously, but there is no doubt the quality is more than equal.

**Motor Pumps:**

On account of these drawbacks the petrol motor is rapidly displacing the steamer, as the motor is not only capable of performing rapid traction work, but the same engine provides the motive power for operating the pumps when the scene of operations is reached.

The action of the internal combustion engine is now so well known that I shall not attempt any detailed description. There are no unusual features in the engine dedicated to the motor fire engine, but the pump is distinctly of a "fire" type. That in use in this brigade is known as a "Hathfield," and may be shortly described as three plunger pumps arranged inside a hollow ring, all being operated by the one crank. The "ring" casting is separated by an inside web throughout its whole internal circumference. One half of this hollow ring is connected to the suction, the other to the delivery side of the pump, with the necessary soft rubber valves between.

Another pump much in use is the centrifugal type, arranged in two or three stages, with special provision for obtaining an initial vacuum. Both types are eminently suitable for quick and effective fire work, and very considerable rivalry exists at present between the builders and users, both sides proving distinctly that each is superior to the other.

A minute gained in the early part of a fire is worth an hour at a later period. With this object in view we have adopted the practice of building light but commodious bodies to fit a high-powered touring chassis fitted with pneumatic tyres. Each of these appliances carries 1,000 feet of 2½ inch canvas hose, jump-
ing sheet, standpipes, and all the numerous small appliances, including electric torches, rubber gloves, hand chemical extinguishers, a small "first aid to the injured" outfit, and last, but not least, a first-rate house-breaking kit. The ordinary time taken to get away from the station with one of these first turn out machines is from 10 to 15 seconds, and the average speed is 30 miles per hour. The success of these fast machines has been conclusively proved in this brigade, and we learn from copies of fire press that American brigades have adopted the same tactics. Melbourne may fairly claim to be one of the first brigades to recognise the practicability and value of this type of appliance.

The Passing of the Horse:

The advent of the motor-propelled vehicle is looked upon by firemen and others with mingled feelings of satisfaction and regret. Satisfaction that very much better work can be performed by the motor, and regret that the friend and companion of all firemen, the horse, will in a very short period of time be a thing of the past.

A horse-drawn, but very useful, American pump ("Gasoline") is employed in some of the more distant suburbs. It consists of a single-cylinder petrol engine of large diameter and stroke direct-coupled to a rotary pump. This pump is fitted internally with two cogged rotors geared deeply with each other. The ends of the teeth of the rotors are fitted with brass slip pieces kept up to the face of the inside of pump barrel by springs. This ensures a perfect fit, and enables a vacuum of 26 inches or over to be obtained. The action of the cogged rotors is to pass the water from the suction to the delivery side in the same manner that a piece of paper would be run through; no valves being required on either side. A pressure of 120 lbs. per square inch can be easily maintained.

Extension Ladder:

No fire brigade is complete without a good supply of extension ladders. There are several in this brigade, varying in height from 35 feet to 87 feet. This latter is practically the longest ladder built, and unfortunately requires the services of two strong horses to draw it to a fire, although it is, in other respects, up to date.

The bunch of ladders are elevated to the required angle manually, and extended by means of a small engine, the motive power
being obtained from compressed carbonic acid gas. Three cylinders, each containing 14 lbs. of gas, are carried, and each cylinder is capable of extending the ladder twice to its full height. The engine is of the ordinary high-pressure steam construction.

The safe working of this ladder depends on the observation of the figures supplied on a quadrant fixed to the movable frame. A plumb-bob points to the set of figures to be regarded, according to the angle of elevation, and determines the height to which it is safe to extend. For instance, the desired angle being 50 degrees, it is safe to extend to 70 feet, the vertical height then being 58 feet, and the projection 34 feet over centre of turntable.

FIRE PRECAUTIONS NECESSARY IN HIGH BUILDINGS.

The predominating class of city buildings naturally determines the class of fire appliances to be selected, and also demands that structures of such a height as to be inaccessible by means of fire brigade appliances must be specially constructed and equipped.

Without entering into the merits or demerits of present-day fire-resisting building construction, it is only reasonable to expect that as the buildings increase in height and area much greater attention should be given to the matter of fire-resisting construction, and the provision of fixed fire extinguishing appliances.

There appears to me to be no reason against a properly constructed building being carried to any reasonable height providing that the areas between the various floors are sufficiently subdivided. Automatic fire detectors should be installed in every portion of the building, and fire appliances of the best type be available at any point with a special fire pump and fire mains. It is imperative that stairways and elevator shafts should not be left open at the various floors, but cut off by fire-resisting partitions and doors, and provision made for an isolated staircase of a thoroughly fire-resisting character to be used in case of fire. The exit by this means should be the easiest way of leaving the building, not as in many present instances, practically a forlorn hope.

I think quite as much might be urged from a health point of view against very tall buildings on account of the exclusion of sunlight from the streets adjoining.

It must not be deduced from the foregoing that I favour the erection of tall buildings, but should such be allowed, there is no
reason why, with proper regulations and supervision, they should not be rendered reasonably safe from a fire protection point of view.

With regard to prevention of the spread of fire, too much stress cannot be laid on the value of wired glass. If properly fixed in steel frames, a polished wired glass window is a splendid fire resister, and will admit nearly as much light as an ordinary unwired window.

*Fire Break Doors:*

The fallacy of using solid iron in the construction of so-called fire-resisting doors has been so frequently demonstrated that it would appear unnecessary that I should again raise a word of warning as to their utter unreliability. An ordinary door of 1 inch flooring boards is a much better fire-resister, but a wooden door of several layers of wood, the grain of each layer running diagonally to the others, and properly sheathed with sheet steel, is a splendid fire-resister. On numerous occasions the latter type has proved its great utility, notably in a fire which occurred at Briscoe and Co.'s hardware four-storey warehouse in Little Collins Street. The back portion of these premises was totally destroyed, the heat being very intense, causing the solid brick dividing wall to crack and warp considerably. Notwithstanding this fact the composite fire-resisting doors remained practically intact. Another instance occurred at Stone's timber yard, Fitzroy, when, although the mills were totally destroyed, the fire door guarding the boiler house proved its absolute reliability. This door was opened by the writer immediately after the fire, and worked well, and with the exception of a little bulging of the sheathing on the exposed side, appeared little the worse for its severe roasting.

On the other hand the plain sheet iron doors buckle, and leave their moorings on the first rise in temperature. They not only convey the fire by induction and radiation to the protected portion of the premises, but owing to their buckling are almost sure to resist any attempt to force them open to allow of the brigade gaining access thereby to the actual fire.

*Smoke Appliances:*

For the purpose of enabling a fireman to enter places where there is an insufficiency of air to support life, or where the atmo-
sphere may be charged with poisonous gases, several types of smoke helmets are used. The apparatus giving the most satisfaction, and filling most requirements is known as the "Draeger."

It consists of a face mask rendered air-tight by a pneumatic cushion fitting round the outer part of the face, and inflated according to the size and shape of the wearer. An oxygen supply is compressed into a cylinder, and carried on the back, there being sufficient to last for two hours. A breathing bag is connected by tubes to the face-mask and oxygen cylinders and potash trays are arranged to take up the carbon dioxide given off by the lungs. It is calculated that an individual performing heavy work continuously for two hours exhales about $3\frac{1}{2}$ cubic feet, or 7 ounces of carbon dioxide.

**SPECIAL SERVICES.**

A special service staff of an officer and 27 men is employed on various duties, such as firemen at theatres and places of entertainment. The brigade also contracts to keep private fire appliances clean and in good order, making a small annual charge for such services.

All this work is carried out by the special service men. These 28 men are engaged almost exclusively on fire prevention duties, it being on but rare occasions that they are called on to perform any active fire duties.

**Chrono-Electric Watchman's Detector:**

As the price of safety from fire is continual vigilance, a word or two may be said regarding night watchmen. It is against human nature to continuously remain awake at night and sleep by day, therefore, no matter how conscientiously a watchman may strive to perform his undoubtedly arduous duties, he is sure to fail on occasions. This fact has been repeatedly demonstrated by the chrono-electric device manufactured and installed by this brigade. The system consists of an electrical recording clock of the dry-ink marking cylinder type. In addition to the usual mechanism for producing the local record, there is a time limit attached to the wheel train, whereby the brigade is instantly warned should the watchman exceed the time limit between the periods of his patrol. The operation of this is as follows:
Should the pre-arranged interval of time elapse without the watchman operating a clock switch, a contact is made by the clock mechanism, which closes a local service through an alarm relay which, on attracting its armature, opens a fire alarm line, and gives a signal distinct from the fire code. On receipt of this signal the brigade takes immediate steps to again restore the watching. There is also a time switch connected to the above mechanism, which is set to automatically cut out the warning device during the daytime, when no watchman is on duty.

APPENDIX:

*Items Relating to the Melbourne Metropolitan Fire Service.*

Area of Melbourne Metropolitan Fire District, about 280 square miles.

No. of calls received during 1912 .................. 2,082
Cost of service, 1912 .............................. £67,151
Principal Officers ................................. 3
District Officers ................................. 10
Chief Electrician ................................. 1
Inspector ......................................... 1
Officer in charge of workshops ................. 1
Station Officers ................................. 23
Firemen ......................................... 188
Auxiliaries ...................................... 6

Total ........................................... 233

Special Service Staff—
Senior Fireman .................................. 1
Firemen ......................................... 27

Total ........................................... 28

Workshop Hands .................................. 10
Fire Stations ................................... 48
Horsed Escapes ................................. 8
Motor Escapes .................................. 1
Motor Pumps ................................... 2
Horsed Petrol Pumps ......................... 5
Motor Chemical Engine .................... 1
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horsed Chemical Engine</td>
<td>1</td>
</tr>
<tr>
<td>Motor Salvage Van</td>
<td>1</td>
</tr>
<tr>
<td>Motor Hose Waggons</td>
<td>2</td>
</tr>
<tr>
<td>Horsed Hose Reels</td>
<td>40</td>
</tr>
<tr>
<td>Hand Hose Reels</td>
<td>41</td>
</tr>
<tr>
<td>Extension Ladders</td>
<td>8</td>
</tr>
<tr>
<td>Horses</td>
<td>76</td>
</tr>
<tr>
<td>Hose, in miles</td>
<td>22</td>
</tr>
<tr>
<td>Hand Pumps</td>
<td>46</td>
</tr>
<tr>
<td>Smoke Helmets and Jackets</td>
<td>7</td>
</tr>
<tr>
<td>(Including two Draeger)</td>
<td></td>
</tr>
<tr>
<td>220 Fire Alarm circuits</td>
<td></td>
</tr>
<tr>
<td>776 Street Call points</td>
<td></td>
</tr>
<tr>
<td>290 Auxiliary points and 13 automatic systems in public buildings.</td>
<td></td>
</tr>
<tr>
<td>23 Circuits to sprinkler installations, and 45 sprinkler call transmitting instruments.</td>
<td></td>
</tr>
</tbody>
</table>

**DISCUSSION.**

The President, in moving the vote of thanks recorded in the Proceedings, said although the hour was late they did not regret being kept a little longer than usual in listening to the interesting exposition of the subject matter in which they were all interested, not only as citizens, but as professional men. He felt he was echoing the views of the meeting when he said that they were indebted to Mr. Wilkins for the trouble he had taken in bringing the matter forward. Not only were they indebted to him for the whole of the subject, but they were more especially interested in those matters which appealed to their professional instincts. These were the machinery and plant, and also the question of fireproof construction. Both these matters seemed to indicate a fruitful field for an interesting discussion when the paper had been printed and circulated.

Mr. Anketell Henderson (President of the Royal Victorian Institute of Architects) had pleasure in supporting. Mr. Wilkins and the Architects were old friends. He had described what they always called the Architect’s enemy—the car that carried those cylinders which despoiled them of so much work. He had often heard Architects who confessed that they thought such and such a building really ought to be burned down. But all joking aside,
it was very interesting to hear a description of the machinery, and more especially the men with the machinery, and he would like Mr. Wilkins to give a little more information about the gas cylinders. He thanked the Institute of Engineers on behalf of his own Institute for the invitation to be present.

Mr. J. A. Smith also supported. He was with the President very thoroughly when he said that the paper would open up a large field for discussion. Mr. Wilkins had brought forward matters, especially in regard to construction, that appealed to them as Engineers very strongly. The illustrations Mr. Wilkins had shown them, and also some of the descriptive matter, brought before them, if that were needed, the necessity for greater fire protection in Melbourne's more congested neighbourhoods. And might he, without anticipating the discussion, ask Mr. Wilkins what his views were upon the present mode of constructing buildings six, eight, or more storeys in height on the narrow streets and more valuable places of intensest business in Melbourne, largely glass-walled and entirely without fire protection?

The President said the usual hour for separating was passed, and he proposed to close the meeting, and allow the further discussion of the matter to await the publication and circulation of the Proceedings.

Discussion adjourned.
Library Digitised Collections

Author/s:
Wilkins, John Thomas

Title:
Fire prevention and extinction (Lecture & Discussion)

Date:
1914

Persistent Link:
http://hdl.handle.net/11343/24572

File Description:
Fire prevention and extinction (Lecture & Discussion)