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FIRE PROTECTION HISTORY-PART 206: 1905 (FIRE EXTINGUISHING AGENTS-STEAM)

By Richard Schulte

The ninth Annual Meeting of the National Fire Protection Association (NFPA) was held in New York in late May 1905. Among the committee reports presented at this meeting was the Committee Report on "Steam Jet". The following is the transcript of this report:

"***The President.*** *The report of the Committee on Investigation of the Value of the Steam Jet as an Extinguishing Agent, will be read by title. Mr. McFadden, the Chairman, will read the conclusions.*

INVESTIGATION OF THE VALUE OF THE STEAM JET AS AN EXTINGUISHING AGENT.

F. McFadden, Chairman.

E. F. Chapman,	*F. O. Hawkins,*	*P. D. C. Steward,*
W. I. Fisher,	*R. M. Kelley,*	*H. M. Tanner.*
	J. W. Minor, Jr..	

Your Committee feel that this Report, as here submitted, should be considered as recording only the result of a partial investigation of the subject.

It might well be considered within the scope of Committee work to determine, as far as possible by actual test, the volume and pressure of steam that would be required to extinguish certain fires.

Suitable apparatus and a proper site could not be obtained; so the plan for conducting a series of tests was abandoned.

We have endeavored to secure a record of all fires, that have been controlled or extinguished by the "Steam Jet," in buildings under surveillance. For this purpose special fire report blanks were furnished [to] *all members. The blanks for reporting "Steam Jet Fires " have been in the hands of members for period of fifteen months; and it is assumed that we have received all the available data, from those interested in the labors of this Committee.*

The investigation of your Committee has been restricted to the following plan:

1. To record the extent of "Steam Jet" service for fire extinguishing purposes, as regulated by practice, or by the recommendations of Inspectors and Rating and Inspecting Organizations, comprising the membership of this Association.

2. To secure information concerning the type of apparatus used to direct the "Steam Jet " for fire extinguishing purposes.

3. To gather from the records of members and others, all available information concerning the actual fire service of the "Steam Jet."

In presenting this Report for your consideration the Committee believe it pertinent, and in order, to first cite briefly several established facts relating to combustion and fire extinction:

FIRE EXTINGUISHING.–The rapid chemical union of any substance with oxygen is always accompanied by heat, and frequently by flame, in which case the substance is said to burn–to be in a state of combustion. Combustible substances do not burn until they are heated up to their point of ignition–that temperature at which the substance will unite with oxygen.

The atmosphere contains about 23 parts of oxygen by weight; sufficient to support ordinary combustion, such as the burning of any substance composed largely of carbonaceous material.

As heat and oxygen are necessary for the continuance of fire, or combustion, it naturally follows that ordinary combustion will cease, if the supply of oxygen be excluded; or if the temperature of the air, surrounding a burning substance, be reduced below the point of ignition. So then in theory–fire extinction is reduced to the problem: (1) Cutting off the supply of oxygen; or (2) Lowering the temperature of the burning substance below the point of ignition.

In practice fire extinction in the open, is only accomplished by a combination of both methods; except in the case of a small fire, like the burning match, one snuffs out between the fingers,– the fire of the burning match dies as the result of excluding the air containing the supply of oxygen.

Water, the common agent, employed for the extinction of fire, by reason of the quenching effect as well as its power of absorbing very large quantities of heat from burning substances, is unquestionably the most efficient fire extinguishing agent available for general service.

Steam, the vapor of water, produced by the application of heat, has not the cooling properties of water; but, by virtue of its inherent energy, it will quickly displace all atmospheric oxygen, when delivered in sufficient volume, under pressure, at or near, a burning substance, in a room or enclosure.

Air, at or under atmospheric pressure, will not unite with steam of higher pressure; hence, by its power of expanding a proper volume of steam, at even a moderate pressure above the atmosphere, will drive away the air and thus extinguish a fire; or arrest combustion by excluding the oxygen.

***"STEAM JET" SERVICE FOR FIRE EXTINGUISHING.**–Whilst steam has long been recognized as a valuable agent for fire extinction, under certain conditions; there is not in service, so far as your Committee have discovered, any complete apparatus installed solely for the purpose of extinguishing fires by steam. As a matter of fact, it would not be practical or profitable to provide a steam generating equipment for "Steam Jet" service alone. Indeed, there is no crying need for such an expensive apparatus; the well designed, installed and maintained automatic sprinkler equipment, with proper water supply, is considered to be, for general service, the most economical and complete fire extinguishing appliance, devised by man, for the interior protection of buildings.*

So the "Steam Jet" has very properly been relegated to the field of special service: (1.) For the protection of such small rooms, and enclosures–Lumber Drying Kilns, etc., which, owing to their peculiar construction, or to the arrangement of the stock in process, will not permit of complete protection by the regular water distributing automatic sprinklers. (2) For the protection of special hazardous features, of steam power plants, having inadequate water supply. (3.) The "Steam Jet" has also been used successfully for the extinction of fires in the cargo space of the modern compartment marine vessel.

Practically the entire fire underwriting interests of the United States, and Canada–in so far as relates to the standards promulgated for fire prevention and private fire extinguishing apparatus–is delegated to the Associations and Organizations, comprising 90 per cent of the active membership of this Association. Therefore, it may be assumed that the extent of "Steam Jet" service is further regulated by the standards prescribed by our active members; and by the recommendations of their Inspectors.

The following table will serve to indicate the recommendations, or practice, governing "Steam Jet" service, by our active members who represent the Fire Underwriters:

Organization.	*Steam Jet Service Recommended for the Protection of.*
Associated Factory Mutual Fire Insurance Company's Inspection Bureau.	*Do not recognize but concede the value for concealed spaces that cannot be covered by Sprinklers.*
Association of Fire Underwriters of Baltimore City.	*Shavings Vaults.*
Board of Fire Underwriters of Allegheny County.	*Do not recognize.*
Boston Board Fire Underwriters.	*Certain Dry Rooms and Enamel-Baking Rooms.*
Buffalo Assn. Fire Underwriters.	*Shavings Vaults.*
Canadian Fire Und. Association.	*Dry Rooms, Japan Ovens, Shavings Vaults, Picker Rooms.*
Chicago Und. Association.	*Shavings Vaults, small enclosu. res, ,Dry Rooms, etc.*
Cincinnati Insp. and Rating Bu.	*Shavings Vaults, small enclosures, Dry Rooms, etc.*
Cleveland Inspection Bureau.	*Shavings Vaults.*
Factory Insurance Association.	*Have recommended for certain special service.*
Fire Und. Inspection Bureau.	*Have recommended for certain special service.*
Insurance Assn. of Providence.	*Do not recognize.*
Insurance Survey Bureau.	*Favor for small enclosures, Vaults or Dry Rooms.*
Kansas Fire Ins. Insp. Bureau.	*Smoke Houses, Shavings Vaults.*
K. & T. Board Fire Underwriters.	*Shavings Vaults, Tobacco Dryers.*
La. Fire Prevention Bureau.	*Shavings Vaults, Dry Kilns and small enclosures.*
Louisville Board of Fire Und.	*Shavings Vaults, Tobacco Drying Machines and small enclosures.*
Manitoba & N. W. Fire In. A'ssn.	*Shavings Vaults, small enclosures and Dry Kilns.*
Michigan Inspection Bureau.	*Dry Kilns for Saw Mills.*
Middle States Insp. Bureau.	*Favor for small enclosures.*

Milwaukee Board of Fire Und.	*Shavings Vaults and small enclosures.*
Missouri Insp. & Survey Bureau.	*Shavings Vaults and Dry Kilns.*
Newark Fire Ins. Exchange.	*Leather Japannery Ovens.*
New Brunswick Board Fire Und.	*Picker Rooms, Shavings Vaults and Dry Houses (Kilns).*
New England Bu. United Insp.	*Small enclosures, heaters in Rubber Factories, Gauze Rooms.*
New England Ins. Exchange.	*Shavings Vaults.*
New Hampshire Board Fire Und.	*Do not recognize.*
Nova Scotia Board of Fire Und.	*No standard, would approve for Drying Rooms.*
New York Board of Fire Und.	*Malt Mills.*
New York Fire Ins. Exchange.	*Malt Mills.*
Ohio Inspection Bureau.	*Shavings Vaults, Dry Kilns, Picker Rooms.*
Philadelphia Fire Und. Assn.	*Dry Rooms, Malt Houses, Shavings Vaults, also Laundrys, Dry Rooms, drying wood, cotton, jute, or other vegetable fibre, Picker Boxes, Napping Rooms.*
Philadelphia Suburban Un. Assn.	*Shavings Vaults in Planing Mills, only.*
St. Louis Fire Prev. Bureau.	*Dry Rooms for varnished goods.*
South-Eastern Tariff Assn.	*Shavings Vaults, Dry Kilns, Gin Flues, small enclosures, Drying Machines, etc.*
Texas Fire Prevention Assn.	*Shavings Vaults, Dry Kilns.*
The Union.	*Shavings Vaults and small encl.*
Und. Bu. of Middle & South Sts.	*Dry Kilns and Shavings Vaults.*
Und. Assn. of Middle Dept.	*Shavings Vaults in Planing Mills, only.*
Und. Assn. of New York State.	*Shavings Vaults.*
Und. Bureau of New England.	*Favor for certain small encl.*
Western Factory Ins. Assn.	*Certain Dry Kilns & small encl.*

It will be noted in the above table, that it is the general practice to recommend the "Steam Jet," only for the protection of small enclosures–except for the Lumber Drying Kiln, which at many plants is found to enclose a space of 30,000 cubic feet in a single compartment.

The limited extent of the special "Steam Jet" service, would seem to indicate that comparatively few classes of manufacturing plants have sufficient steam generating apparatus to supply a proper quantity of steam for fire extinguishing; and further, that only a small number of the manufacturing plants, generating large quantities of steam, maintain the steam, under pressure, at all times.

Probably the most satisfactory "Steam Jet" service is afforded in protecting the lint flues of the gin, at the Cotton Ginnery. During the operating season, practically all fires occurring in the Upland Cotton Ginnery, originate in the gin: generally from matches, nails, or other foreign matter coming in contact with the rapidly revolving gin saws. The "system" gin which delivers the lint taken from the seed cotton by the gin saws, to a metal flue discharging into a condenser over the baling press, is the most modern type of machinery used in preparing the staple for market. A fire in any one of the gin stands, is almost instantly transmitted to the flue and thence to the condenser over baling press. Gin fires are of frequent occurrence and require prompt action on the part of attendants to prevent the total destruction of the plant. The "Steam Jet" is conceded, by all conversant with the situation, to be the best and most complete fire extinguisher, for gin fires. (Plate No. 1 shows a ginnery flue, condenser, baling press, and the arrangement of "Steam Jet.")

When we consider that all of the 61,000 private and public gin houses, located in the cotton growing States, may be operated at various times during the cotton picking season; and that three and four fires per day is not an unusual occurrence at the gin house; and when we consider further that the majority of these gin houses are isolated, and not protected by public or private hydrants, we must admit the value and possibilities of "Steam Jet" protection for this class of property.

"STEAM JET" APPARATUS.–It is the established practice of the underwriter and the fire protectionist, to apply the general term: "Steam Jet," to the volume of steam used for fire extinguishing as well as to the apparatus provided for directing the steam.

The two general types of apparatus in service are classed:

1. *Hand operating "Steam Jets."*
2. *Automatic "Steam Jets."*

THE HAND OPERATING APPARATUS usually consists of a pipe and controlling valve, connected to and with the Boiler, or main steam pipe, and the enclosure or room to be protected. No special skill is required to design or install this type of apparatus,–the connection is made to Boiler or main steam pipe at the nearest point and controlling valve properly placed, the pipe is then extended and the free end inserted, at any convenient place, through the wall of room or enclosure to be protected.

This simple apparatus may be maintained at trifling cost, and require only the labor of opening a single valve to liberate the steam, which, if of sufficient volume and pressure, will seek out and speedily extinguish any fire of ordinary combustion, in the enclosure, as effectually as water distributed by the costliest or most complicated appliance.

There is apparently no well established rule as to the proper size of "Steam Jet" piping,–the 1-inch diameter or smaller pipe is commonly provided for the small enclosure and the Shavings Vault; for the large enclosure, it is generally planned to have a 2 or 3-inch diameter pipe or even larger if such can be safely served by the Boilers with steam under pressure for several minutes.

The size of pipe, as well as the whole scheme of proper "Steam Jet" protection must be regulated by the capacity of the Boiler or Boilers available.

The unit of measurement, the "Horse Power," as commonly applied to steam Boilers, is based on the evaporation of 30 pounds of water per hour, from a feed water temperature of 100 degrees "F.", into steam at 70 pounds gauge pressure; on this basis of capacity–a 100 H. P. Boiler would convert 50 pounds of water per minute into steam at 70 pounds gauge pressure. Such a volume of steam, when delivered into a room or enclosure at atmospheric pressure, would occupy about 1,646 times as much space as the water from which it was converted. In other words: an 100 H. P. Boiler could furnish, each minute , a volume of steam sufficient to fill an enclosed space of approximately 1,300 cubic feet. Steam at 70 pounds gauge pressure will flow into the atmosphere with a velocity of about 1,454 feet (expanded) per second. Theoretically, a 1-inch pipe, not exceeding 100 feet in length, would be ample to carry off into the atmosphere, or into an enclosed space, all the steam that could be generated by the continuous operation of a 100 H. P. Boiler. In practice a larger pipe would be required, to prevent excessive friction and loss of pressure.

Inasmuch as it is not necessary to long continue the application of the "Steam Jet," to extinguish a fire in a room or enclosure, of small area; and in view of the further fact that all Boilers in operation have available a considerable volume of steam, it is possible to secure good "Steam Jet" service from a 50 H. P. Boiler for the limited time (estimated) required, to extinguish fires in the average Shavings Vault, and the small Drying Room.

In the Southern States, the process of drying the resenous pine woods is considered to be one of the most hazardous features found at the Saw Mill plant. The common type of Drying Kiln–as well as the most desirable from the Underwriters' standpoint–is the natural draft Kiln, heated by direct radiation from a series of suspended or supported steam pipes. The "fat" yellow pine woods of the South may be dried in less time than it is possible to dry, without injury, a similar bulk of hard wood; hence temperatures as high as 230 degrees "F." frequently prevail in the Dry Kilns in that section. The large number of steam heated pipes required, for such drying, must necessarily be served by large capacity steam Boilers. As many as 15 Kilns, each enclosing a space of approximately 30,000 cubic feet, will be found at the large plant; which plants invariably have a sufficient number of Boilers in service capable of furnishing, at all times, a comparatively abundant supply of steam at good pressure . These Kilns are operated night and day continuously, the lumber to be dried is, generally, stacked high on the trucks or cars, in such a manner, that very little clear space exists between the top of lumber and ceiling of Kiln (See Plate No. 2). The regular equipment of water distributing automatic sprinklers, when provided, cannot afford complete protection for such a Kiln,–the almost solid pipes [piles] *of lumber occupying practically all the upper portion, and fully 60 per cent of the entire Kiln space, forms a serious obstruction and would unquestionably prevent the proper distribution of water from the sprinklers. As steam cannot be so obstructed, it naturally follows that the Drying Kiln at the Saw Mill plant, having always, during the hazardous process of drying, a sufficient supply of steam, is a special feature that may be afforded good protection by the "Steam Jet."*

[**Illustrations (Plates No. 1, 2, 3, 4, 5, 6 and 7) Omitted**]

The Rating and Inspection Organizations of the Southern States made special effort to encourage the introduction of the "Steam Jet" for Drying Kiln service at such plants. The practical Saw Mill operators who have been questioned, appear to be unanimous in the belief that the "Steam Jet" is the best form of protection for the Drying Kiln. The newly erected Drying Kiln in the South is now, generally, equipped with the "Steam Jet" apparatus– even though there be provided the regular water distributing automatic sprinkler system.

During the past year one of our members furnished Saw Mill owners or operators, detailed plans and "Steam Jet" specifications for the protection of Drying Kilns at 112 plants.

The several "Steam Jet" specifications issued by the South-Eastern Tariff Association are illustrated by Plate Nos. 1, 2, 3, 4 and 5.

Plate No. 1 shows the plan recommended for the ginnery flue: A 1-inch diameter pipe is connected with the Boilers and then extended into the flue near the condenser over the baling press, a quick opening lever valve, for controlling the steam supply, is placed in the piping near the baling press–at a point most convenient for the attendant, who is always at the baling press when the gins are being operated. Plate No. 2 illustrates a type of the single compartment, brick, Lumber Drying Kiln, showing the arrangement of steam heating coils, the lumber on trucks, and the "Steam Jet" pipe. Plate No. 3 is a plan of the Kiln showing the piping and valve controlling the steam supply for the hand operating "Steam Jet." It is the general practice to provide a stop cock, fitted with a stout operating lever–in lieu of the regular globe valve–for controlling the steam supply. The piping from Boiler is placed under ground, with the stop cock in a covered pit about 35 feet from Kiln,–the stop cock is so arranged that it can be opened by pressing down on the lever–thus a powerful force may be exerted by the foot of the operator, who can throw the entire weight of his body on the lever to overcome any tendency of the stop cock to "stick."

Plate No. 4 illustrates the arrangement of "Steam Jet" provided for the Shavings Vault.

Pipes with numerous small perforations are sometimes used, as a substitute for the single open pipe, in the room or enclosure to be protected. The perforated pipes are objectionable in that the small perforations are easily closed by dirt or rust; the larger single pipe will afford better service.

For extinguishing fires in the coal bunkers and in the cargo space of the modern ocean steamship, the "Steam Jet" apparatus is frequently provided. Each compartment to be protected is fitted with a separate steam pipe, all of which pipes terminate at a convenient place near the steam supply main; each pipe is provided with a connecting union–but no valve. When the steam is needed for fire extinguishing, in any compartment, the required amount is furnished through a valve and flexible hose connection, kept attached to the steam supply main for that purpose.

THE AUTOMATIC "STEAM, JET" APPARATUS as a general rule differs from the hand operating device in the method of controlling the steam supply; and also in the arrangement of piping. The hand operating "Steam Jet" piping may be placed in the enclosure at any convenient point–the automatic device in order to secure the best service must be placed near the top of the enclosure.

The Automatic "Steam Jet" is operated by the heat of the fire it is intended to extinguish; acting on a solder releasing device which either liberates a weight that in falling fractures a thin cast iron cap closing the end of pipe; or, permits a weighted lever to fall and open the valve; or, the solder releasing device may be part of the valve–like the regular automatic sprinkler.

The approved arrangement would seem to be the plan of closing the open end of "Steam Jet" pipe–by the regular, hard solder, 1/2-inch orifice, water distributing, automatic sprinkler when the small enclosure is to be protected; for the larger enclosure the "Jumbo" (1-inch or 1[-]*1/4-inch orifice) automatic sprinkler is used.*

Plate No. 5 illustrates the automatic "Steam Jet" arrangement recommended by the South-Eastern Tariff Association for the protection of a Lumber Drying Kiln: The two "Jumbo" automatic sprinklers are placed close to the ceiling, one each, about 25 feet from the loading and discharging ends of the standard length Kiln. The 1[-]*1/4-inch pipes supplying the sprinklers are connected to a 2-inch pipe placed about the center of Kiln; the piping is trapped, in the manner shown, to prevent objectionable circulation and for the purpose of keeping the "water of condensation" in the piping nearest sprinklers. A stop cock or valve is provided in the supply pipe– at a safe and convenient point–this valve is kept open, except when necessary to shut off steam for repairs.*

Several of our active members favor the plan of connecting the steam supply to the regular water distributing automatic sprinklers (this in addition to the regular water supply), for the special protection of Drying Rooms or other hazardous enclosures of small area; the steam supply alone is also approved.

A number of "Steam Jet" devices and appliances, for fire extinguishing purposes, have been patented in the United States. But few of these devices are now in service in the plants regularly visited by the Inspectors of our active members. One of the patented "Steam Fire Extinguishers" designed for the protection of Lumber Drying Kilns consists of a fragile cast iron cone, which is attached to, and closes, the end of steam jet pipe–on a guide rod attached to the cone is suspended a heavy weight which is held in position by several "non-corrosive" levers, in turn supported by a copper or brass chain having fusible links inserted every 8 feet of its length. The chain and links being secured throughout the ceiling of Kiln. When one of the links is severed, as by fire, the weight fails and breaks the fragile cone and thus automatically permits the steam to enter Dry Kiln.

One other type of "Automatic Alarm and Steam Fire Extinguisher" found in service for the protection of a Lumber Drying Kiln is an arrangement consisting of perforated pipes secured to the ceiling of Kiln; the steam supply, for this apparatus, is held back by a spring lever valve, kept closed by a chain held in position by fusible links placed near the ceiling of Kiln. The fusing of any one of the links releases the lever and permits the spring and steam pressure to open valve and enter the Kiln by way of the perforated pipes.

These Automatic devices generally have a small branch pipe extending outside the Kiln, to which is attached a steam whistle, provided for the purpose of sounding an alarm upon the opening of valve controlling the steam supply. The need of such alarm is questioned when it is considered that a large volume of steam may be wasted in sounding the whistle–the attendant at Boilers should quickly note the drop in steam pressure by a reading of the steam pressure gauge and the steam required for whistle reserved for fire extinguishing.

Special Drying Rooms, or enclosures, having a separate steam engine to operate the "blowers" or fan systems, used in hastening the drying process; or for stock or refuse conveying, have been provided with automatic "Steam Jet" apparatus, so arranged, that the one movement of a lever would accomplish the two-fold purpose of stopping the engine and at the same time permitting the steam supply to serve the "Steam Jet" pipe.

Several years ago the Chairman of your Committee suggested such a plan for the protection of Tobacco Drying Machines and other Drying Rooms using the "Hot Blast" system for drying stock. Plates Nos. 6 and 7 illustrate the plan suggested.

The device is non-patentable, all parts–except possibly the lever–being regular stock articles of trade. Several Drying Rooms and "Blower" Engines have been equipped in accordance with this plan, but to date no actual fire service tests have been reported.

The "Three-Way Cock" could also be used to advantage as a hand operating device in the Boiler House, for the purpose of diverting the entire steam supply to the "Steam Jet" apparatus.

Harris' Technological Dictionary of Insurance Chemistry contains a description of the "Steam Jet" apparatus provided for the protection of the steamships "Britannic" and "Germanic"– the apparatus was designed to protect the compartments between decks by steam alone, or by carbonic acid gas and steam, in which case the steam became the vehicle to carry the carbonic acid gas to the fire. Mention is also made, in same book, of a "Patent Fire Extinguishing Apparatus," the essential features being a cooling apparatus and a "Steam Jet," by which means waste gases, incapable of supporting combustion, were to be secured from the smoke stacks or funnels of the vessel and conveyed to the fire– the hot gases being cooled in transit by the apparatus.

A SUMMARY OF "STEAM JET" FIRES REPORTED TO COMMITTEE

A number of "Steam Jet" fire reports have been received from members and others. Each complete Report on file has a distinctive value in the general sense, that it is evidence tending to prove or disprove the worth of the "Steam Jet." The value of the "Steam Jet" as a fire extinguishing agent for lint flues and condensers at Ginneries, may rightly be considered as established, if the question is to be determined solely by the fire reports: which state in substance that the 100 odd, reported, fires were extinguished by the "Steam Jets." On the other hand, the several reported failures of the "Steam Jet" to control or extinguish fires in the Lumber Drying Kiln, or other enclosures, should not be accepted as conclusive evidence that the "Steam Jet" is unable to cope with such fires. The reports denoting failure are of value only when complete. The incomplete report – that which fails to give the steam pressure, or capacity of Boilers, or the size of "Jet," and how supplied, as well as the method of control, does not prove or disprove the value of the "Steam Jet."

GIN FIRES:

One hundred and four is the number of fires reported–for a period of about 15 months–as occurring in Cotton Ginneries, that have been extinguished by the "Steam Jets." In all such fires reported the "Steam Jets" promptly extinguished the fire at small loss.

No. 124.– GINNERY, FAIRBURN, GA. Fire supposed to have been caused by a spark dropped from pipe of driver of wagon containing seed cotton; the spark being conveyed by the pneumatic system into one of the gins, was quickly fanned into a blaze and extended into the condenser by way of the lint flue. The lint flue was equipped with a 1-inch hand operating "Steam Jet," supplied by two 100 H. P. (each) Boilers through about 90 feet of 2½-inch diameter pipe. The fire was discovered by the attendant at baling press, who promptly opened the valve controlling "Steam Jet." Fire was extinguished in about two minutes, with a loss of about $3.00 on cotton. No claim made. Sixty pounds steam by gauge pressure registered; during the fire there was no perceptible drop in steam pressure. The Ginnery resumed operations in about 10 minutes after fire was discovered.

No. 115.– GINNERY, BAMBERG, S. C. Fire originated in gin, by foreign matter in cotton striking gin saws.; the fire immediately extended into flue and thence into condenser. The attendant at baling press, who first noticed fire, turned on the "Steam Jet," which extinguished the fire with a loss of only a few pounds of cotton. No claim made. The "Steam Jet" was served by a 3/4-inch diameter pipe, supplied by a 100-foot length of 2½-inch diameter pipe, connected to 120 H. P. Boilers; steam pressure 50 pounds gauge; no noticeable drop in pressure during the time (about 10 minutes) "Steam Jet" was in operation.

This fire occurred during the visit of Inspector Mauldin, of the South-Eastern Tariff Association, who requested that the "Steam Jet" be kept in service for at least 10 minutes.

No. 26.– GINNERY, MILLEN, GA. Gin fire, caused by friction from cotton adhering to "breast"; fire extended to condenser and was extinguished by the 1-inch "Steam Jet," supplied by a 2-inch diameter pipe from 100 H. P. Boiler, 50 feet distant; 60 pounds steam pressure; no drop in pressure during the three minutes "Steam Jet" was in operation. Loss only 5 pounds of cotton. No claim made.

No. 116.– GINNERY, OORDELE, GA. Gin fire, caused by match entering with seed cotton. Fire extended through flue to condenser. Gins were shut down and "Steam Jet" operated for about five minutes, completely extinguishing fire. Loss about $60.00, mainly on frame and metal parts of condenser. "Steam Jet" consisted of a 3/4-inch diameter pipe (110 ft. long) direct from two 60 H. P. (each) Boilers; 80 lbs. steam pressure by gauge. The Ginnery Building was protected by the regular, water distributing automatic sprinklers; sprinklers, however, were not provided inside of condenser– it appears that the "Steam Jet" was not immediately turned on, as the heat escaping from burning condenser opened two sprinklers in room near by. The sprinklers would undoubtedly have held the fire, which as stated above, was extinguished by the "Steam Jet." No claim made.

There is a noticeable sameness about all reported Ginnery fires, that have been extinguished by the "Steam Jet"– the only variation being the information relating to the origin of the fire and the extent of damage. To recount the other recorded fires of this class would be practically a repetition of the four fires here-in-before cited. Many of the reports sent in are lacking in essential details–the capacity of Boilers not being furnished in all cases; the length of time the "Steam Jet" required to extinguish the fire has not been given, as also the details concerning the loss of steam pressure. All reports, however, state clearly that the "Steam Jet" extinguished the fire– the losses vary from 50 cents to $100.00; the latter sum would be sufficient to rebuild a condenser and pay for considerable burned cotton.

SHAVINGS VAULT FIRES:

No. 25.–SAW MILL, MARBURY, ALA. Frame Shavings Vault, adjoining Boiler House. Fire caused by spark from furnace doors. Shavings Vault was equipped with 1½-inch "Steam Jet"; pipe about 50 feet long from 200 H. P. Boilers; 60 pounds gauge pressure. Fire promptly extinguished with no noticeable drop in steam pressure. No claim made.

No. 66.–PLANING MILL, CHICAGO, ILL. Brick Shavings Vault, dimensions 15x 10x20 feet. Fire, which occurred from fire box of Boiler, extended into Shavings Vault and had been burning for some time when discovered by fireman. "Steam Jet" through a 2½-inch diameter perforated (numerous 1/4-inch holes) pipe, with 3/4-inch opening, at end, having controlling valve in Boiler Room and connected to two 60 H. P. (each) Boilers; 80 pounds gauge pressure, was turned on for about 10 minutes and extinguished the fire; drop in steam pressure not noted–probably not exceeding 5 or 10 pounds. This was rather a large Shavings Vault, and the fire had made considerable headway when discovered.

No. 48.–PLANNING MILL, COLUMBIA, S. C. Brick Shavings Vault (large size), 15x35x18 feet, adjoining Boilers. Fire caught from shavings in front of Boilers and extended into Shavings Vault and was quickly extinguished by the "Steam Jet." The "Steam Jet" apparatus, consisting of a 1[-]*½ inch diameter pipe, connected by 2-inch diameter pipe, to Boilers at top, and also to the "blow-off pipe" at bottom (a very bad practice). About 75 pounds pressure of steam maintained during the short time "Steam Jet" was in service. Very little damage done to roof of Shavings Vault. No claim made.*

LUMBER DRYING KILN FIRES:

No. 119–SAW MILL, DOVER, N. C. A battery of 7 adjoining frame Drying Kilns, each enclosing a space of approximately 20,000 cubic feet. Kilns of the natural draft, steam heated, type having double walls, filled with saw dust and frame doors at ends. The "Steam Jet" equipment consisted of a 2½-inch hand operating Jet, in each compartment, controlled by a separate globe valve, all being supplied by one 4-inch diameter pipe, served by a 500 H. P. battery of Boilers, 150 feet distant; about 80 pounds steam pressure maintained. This fire occurred during the day, in one of the older Kiln compartments, presumably caused by spark from Boiler stack being drawn into Kiln at bottom. The "Steam Jet" was called into service and maintained for nearly 30 minutes (loss in steam pressure not given); when Kiln was opened, it was found that the fire had been practically extinguished by the "Steam Jet." Very little loss on contents, but the walls and ceilings were damaged to the extent of $170.00.

This is a brief record of one of the few successful "Steam Jet" fires for a Kiln of this class. The Kilns had each a large open ventilator on apex of roof, extending about 70 feet in length, through these ventilators a considerable volume of steam escaped, which accounts for the somewhat lengthy (30 minutes) period of "Steam Jet" service. Assistance was also rendered by applying hose streams of water to the outside of Kiln.

No. 29.–SAW MILL, BADHAM, S. C. Three frame Drying Kilns, each enclosing a space of about 27,000 cubic feet. Fire, which occurred during day, was caused by spark, from a small portable Boiler near by, getting into the ventilators then in use. The Kilns were not provided with the regular "Steam Jet" apparatus, but the main steam pipe, with valves outside, had been extended, into Kiln for the purpose of connecting to steam heating pipes. The open steam main served the purpose as well as the regular "Steam Jet." The fire was extinguished with little loss and no claim resulting. The steam generating plant consisted of a battery of Boilers rated about 500 H. P.; steam pressure 80 pounds. Size of pipe supplying steam heating pipes not given (assumed to be 4-inch diameter pipe). Time of "Steam Jet" service, or loss of pressure not noted.

No. 23.–SAW MILL, DUNHAM, ALA. Fire (origin not reported occurred about 6:40 P. M. in a five-compartment frame, natural draft, steam heated, battery of Lumber Drying Kilns; each compartment enclosed a space of about 28,500 cubic feet. Kilns had hollow sheathed walls and ceilings, forming concealed spaces. The open ends of each compartment were closed by canvas curtains. The hand operating "Steam Jet" apparatus consisted of one 2-inch diameter pipe, inserted in end of each compartment, all being supplied by one 3-inch pipe connected to the 5-inch steam main, served by Boilers having a combined capacity of 450 H. P.; 90 pounds gauge pressure registered at time of fire. The fire was discovered by owner of Plant, who saw that all "Steam Jets " were put in service at once. Owner claims fire, which early burned out the canvas ends of Kilns, was held in check by the "Steam Jets." The "Steam Jets" did not prove effective, mainly owing to the fact that the full volume of steam was not concentrated on the Kiln compartment in which the fire originated. [It was a serious blunder to dissipate the steam pressure through fine "Steam Jets" in all five Kilns.] The available steam supply was further impaired by the loss of canvas curtains at ends, which, as before stated, had been quickly burned out, thus permitting the steam to escape from Kilns.

No other form of fire extinguishing apparatus had been provided for the Kilns–or for any other part of the Plant. Ordinarily a fire in this type of Kiln would not require more than 40 minutes time to entirely consume the building and contents . The "Steam Jets," though badly handicapped, and not properly arranged, prevented the fire from extending rapidly to the other compartments; more than 2½ hours elapsed before the Kilns and contents were destroyed. It is believed that if "Steam Jets " had been assisted by two serviceable hose streams, the fire would been confined to one Kiln compartment. Property loss, $15,300; insurance loss, $8,000. It was reported that a good volume of steam was maintained for at least two hours. The loss in steam pressure was not noted.

No. 20.–SAW MILL, ARRINGDALE, VA. A battery of six-compartment, adjoining, frame, natural draft, steam heated Kilns; each compartment enclosed a space of about 29,000 square feet. The usual platforms, Assorter and Unloading Sheds were attached at either end. The ceilings and part of the walls were sheathed with 1-inch dressed boards, forming concealed spaces, part of which had been filled with saw dust. The ends were closed by frame doors of two thicknesses of 1-inch boards.

The hand operated "Steam Jet" equipment consisted of two 2½-inch diameter open pipes (one at each end), for each compartment. The twelve 2½-inch outlets were supplied by one 3-inch pipe, 200 feet long and served by 8 Boilers, having a combined capacity of 800 H. P.; steam pressure about 70 pounds gauge. This "Steam Jet" apparatus was not properly arranged, as only one valve had been provided, which upon being opened permitted the steam pressure to be dissipated through all of the 12 outlets–two in each of the six Kilns.

The fire, which occurred at noon, is assumed to have been caused by a spark from the Saw Mill Boilers, 200 feet distant. Fire was first discovered at the loading end of the outside Kiln compartment nearest Saw Mill. The "Steam Jets " were turned on promptly, but failed to extinguish the fire. The superintendent of plant stated that "Steam Jets" seemed to intensify the fire, which rapidly extended to the other parts. The roof was burned and collapsed in about 20 minutes after fire was discovered–the steam supply was then cut off. The Kilns and contents, which were valued at $17,000, with $13,000 insurance, were practically destroyed. The failure of the "Steam Jet" in this fire is readily explained–indeed, it would be most surprising if the "Steam Jets" as arranged, and served, had not hastened, rather than delayed the destruction of the buildings. Assuming that the volume of steam was sufficient at the Boilers, the failure of the "Steam Jet" may be attributed to the loss of steam pressure, due partly to the long run (200 feet) of piping, and mainly to the very important fact that 12 open 2½-inch Jets (area aggregating 58.8 square inches), were all served at one and the same time by only one 3-inch pipe (area 7.06 square inches). Under such conditions, the expansive force of steam was undoubtedly spent and the pressure practically nil, by the time steam reached the scene of fire. A single 2-inch "Steam Jet," served by the Boilers, should have promptly smothered the fire in short order if the ventilators had been closed.

No. 28.–FURNITURE FACTORY, GRAND RAPIDS, MICH. Brick Dry Kiln (blower system), six compartments, each 16 feet wide, separated by frame partitions, all under one roof, total area about 100x110 feet. Height of kiln not given. Estimated to enclose a space of 163,600 cubic feet.

The "Steam Jet" equipment consisted of one line of pipe (2-inch to 1-inch), suspended from ceiling in each compartment, to which was attached, 20 feet apart, a Grinnell, ordinary (½-inch orifice) automatic sprinkler– 40 sprinkler heads in all. The equipment was supplied solely by steam from Boilers (size not given) through a 3½-inch diameter pipe about 100 feet long. Steam pressure 70 to 100 pounds by gauge.

The fire, which occurred (origin not stated) about 4:10 P. M., was first discovered in center of brick hot air duct and speedily extended to lumber piled on trucks standing in Kiln. Report states that all sprinklers promptly opened, but the steam failed to extinguish the fire. A number of the essential details are not given in this Report, the Inspector who rendered Report evidently has little faith in the "Steam Jet." We quote from the Report: " * * Live steam, as has been fully demonstrated before, increases the heat, retards the work of the firemen, hides the fire, but does not extinguish it. The city fire department worked hard and long; at one time had 22 streams on the fire, and at last were able to confine the loss to the Dry Kiln, and its contents only." Property and insurance loss $13,800. This "Steam Jet" equipment was not considered to be properly arranged and owing to the lack of essential details it would be unfair to class this failure as evidence tending to disprove the value of the "Steam Jet."*

No. 42.– DRYING KILN, VANCOUVER, B. C. Only a brief Report of this fire was rendered–the size and type of building not given. The point of interest being that the Kiln was located over water, and that the "Steam Jet" failed to extinguish fire, for the reason that the flooring was burned and allowed full draft from below. The opening in floor also undoubtedly permitted the steam to escape.

MISCELLANEOUS FIRES:

No. 101.– DRYING MACHINE, TOBACCO FACTORY, RICHMOND, VA. Frame, steam heated by coils, "hot blast" type, similar to a "Hurricane" Textile Stock Dryer, consisting of 12 compartments, all enclosing a space of about 13,500 cubic feet. The machine was provided with twenty-four 60-inch fans (two each compartment), making 240 revolutions per minute and maintaining a temperature of about 200 degrees "F." in the drying compartments. The '"Steam Jet" apparatus of two 1-inch outlets in each compartment, supplied by a 2-inch diameter steam main, served by three Boilers (180 H. P.), located about 100 feet from drying machine. About 75 pounds of steam by gauge pressure maintained. The fire occurred during the process of drying leaf tobacco, which was being carried slowly through the machine, on an endless wire apron. The cause of fire was not *discovered. Steam from "'Jets" was promptly admitted for about 10 minutes and practically extinguished the fire, the public fire department aiding at the last moment with several small chemical extinguishers. Damage small, no claim made. The drop in steam pressure was not noted. It was stated that considerable steam escaped through the ventilators and*

through the open top of cooling compartment before machine was stopped; notwithstanding this, the small "Steam Jets" proved effective and extinguished the fire, with less loss than would have resulted from the use of hose streams of water. The machine was located on upper floor of an ordinary brick building, having thin (not tight) boards on joists for flooring. Approximately $50,000 in stock was stored on lower floors, directly under drying machine–this stock was not damaged.

No. 22.–TOBACCO DRYING MACHINE, TOBACCO PRIZERY, DANVILLE, VA. Machine similar to that described above, but larger (19,000 cubic feet), was equipped with the regular water distributing automatic sprinklers covering all parts, and also with 3/4-inch diameter pipe hand operating "Steam Jets," placed 10 feet apart at bottom of machine; the "Steam Jets" were served through a 2-inch diameter pipe, by three Boilers (150 H. P.), located in adjoining building; steam pressure by gauge about 80 pounds. Fire occurred during the process of drying scrap tobacco; probably caused by a match or waste paper entering with scrap. Four automatic sprinklers promptly opened, and aided, by the "Steam Jets," extinguished the fire in about two minutes. This may very properly be classed as a sprinkler fire; the sprinklers unaided would have completely extinguished the fire– the service of the "Steam Jet" hastened the work and, unquestionably, served the good purpose of preventing a large water damage to stock on floors below. Loss $150.00.

No. 53.– SMOKE HOUSE AT PACKING PLANT, WICHITA, KAN. This Report as rendered is incomplete: the size of building, capacity of Boiler, steam pressure and many other details are lacking. Fire was caused by falling meat and grease running down wall into fire below. The Report states that "Steam Jet" was served by a 2-inch pipe and completely extinguished the fire in a short time at a loss of $60.00. Our correspondent writes: "The assured is very enthusiastic on the value of the "Steam Jet" since this fire."

Nos. 7, 8 and 9.–BARK MILL, TANNERY, NARROWS, VA. Three separate fires occurring in Bark Mill, all caused by foreign substance in bark, were promptly extinguished by the small "Steam Jet"; no claim made.

No. 21.– TEXTILE STOCK DRYING MACHINE, PHILADELPHIA, PA. This Report is a copy of the regular Fire Report issued by one of our active members, and does not contain the special data required for the complete "Steam Jet" Fire Report. The Report is interesting in that it contains opinion of Inspector as to the probable cause of failure; we quote from Report: "Employees working in room opened the doors of dryer and attempted to put out fire by use of chemical extinguishers, but were driven back by the heat and steam from the open steam sprinklers in dryer. The fire quickly spread to stock of the yarn (about 3,000 pounds) in room and to the woodwork, and opened all of the sprinklers in room, about 20, which were connected to steam line from Boilers.

*"Upon the arrival of the public fire department, a few minutes later, the steam was shut off sprinklers, and fire fought with hose streams, * * * Although all the steam sprinklers in the room opened, it is claimed, appearances would indicate that they were of little or no value. It is probable, however, that had the doors of the dryer been kept closed, the steam sprinklers inside might have confined the fire to the dryer."*

STEAM DATA AND TABLES.– The several well known Engineers' Reference Books, notably: "Kent's Mechanical Engineers' Pocket-Book," "Suplee's Mechanical Engineers' Reference Book" and "The Power Catechism," contain useful tables and practically all the information required concerning the properties of steam.

[**Tables Omitted**]

Tables 1 and 2, as arranged, should be of value in planning "'Steam Jet" protection.

Through the courtesy of Henry Harrison Suplee, B. Sc., M. E., and by permission of the Publishers, The J. B. Lippincott Co., of Philadelphia, we quote the following data and tables from pages 589 and 590 of "Suplee's Mechanical Engineers' Reference Book":

CONCLUSION.– As the result of our investigation:–

We find that it is the general practice of all but three of our active members, who represent the Organizations charged with the task of inspecting insured property, to recommend the "Steam Jet " as a fire extinguishing agent for the protection of Shavings Vaults, or certain other hazardous small enclosures, to be found at the various manufacturing establishments under surveillance.

We find the "Steam Jet " apparatus, when properly installed and served, to be a valuable extinguishing appliance for the protection of small rooms or enclosures.

We find that the "Steam Jet, " if of proper volume, may be classed as a valuable fire extinguishing agent for the protection of certain types of Lumber Drying Rooms or enclosures of moderate, or comparatively large area. This in view of the fact that fires rarely, if ever, occur in such rooms or enclosures, except during the process of drying, at which time fully 60 percent of the space may be occupied by a solid that would prevent complete protection by the regular water distributing automatic sprinklers . The Drying Room or enclosure containing lumber in process of drying would require a less volume of steam for fire extinguishing than the empty room or enclosure.

We find that proper "Steam Jet" protection cannot be afforded rooms or enclosures of large or moderate area, provided with large ventilator or outlets that would permit the larger part of steam to escape from room or enclosure.

We recommend that the "Steam Jet" be not accepted as satisfactory protection for rooms or enclosures in buildings that can be properly protected by the regular water distributing automatic sprinkler system.

We recommend that the introduction of "Steam Jet" apparatus be encouraged for the protection of gins and flues at the Cotton Ginnery, and for certain hazardous enclosures of small area, especially such that may be found at the isolated factory not provided with standard or sprinkler protection.

We direct attention to the necessity of properly arranging the "Steam Jet"; and also to the error of recommending this form of protection when a proper volume of steam, under good pressure, is not available.

Mr. Merrill. I move that the report be accepted and that it take the usual course. Adopted.

Although it appears that steam is a viable fire extinguishing agent, the use of steam to extinguish fires was never developed much beyond special hazard applications.

* * * * *

Source: "*Proceedings of the Ninth Annual* [NFPA] *Meeting*", New York, 1905.

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