Fire Control in

OREGON FLAX MILLS

Walter G. Cadmus, Jr.

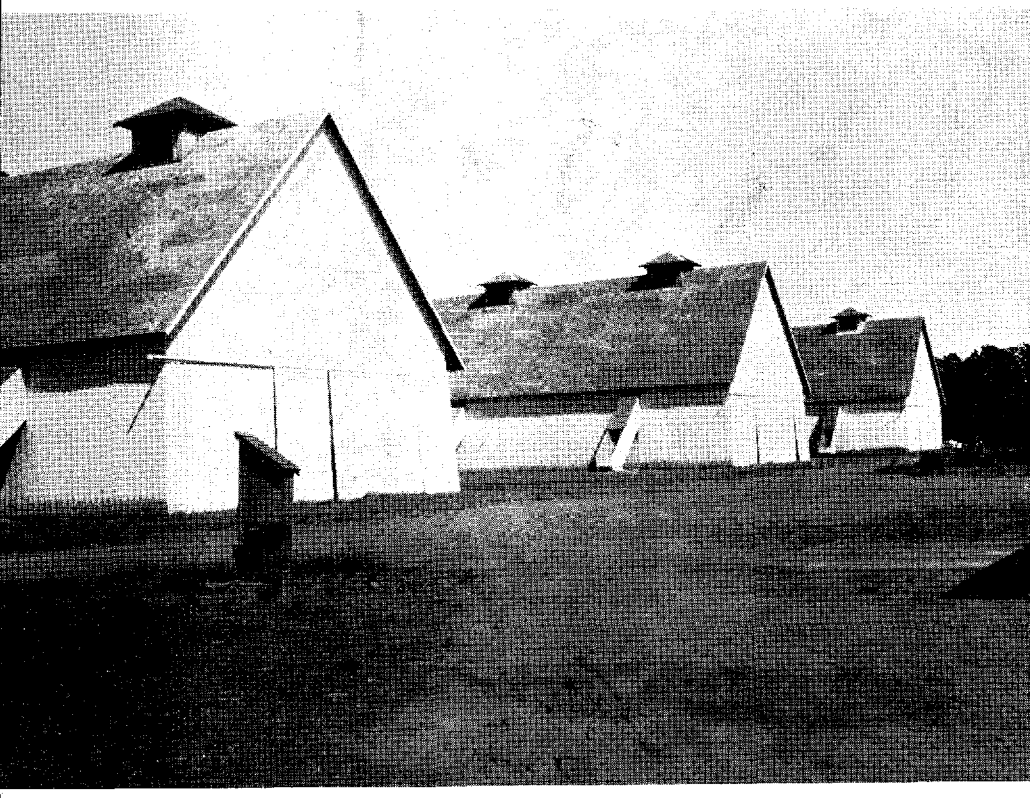

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Illustration on cover—

Flax straw storage sheds with built-in elevators. Note the fire hydrant in the foreground.

Fire Control in Oregon Flax Mills*

by

WALTER G. CADMUS, JR.†

INTRODUCTION

FIRES in fiber flax retting and scutching mills in Oregon caused property damage in the five years 1938-43 of more than a quarter million dollars. As flax milling is still a small industry, with 12 mills built and 2 building, this loss represents perhaps a higher rate on capital investment than is suffered by any other industry in the state. As a result, insurance companies are becoming increasingly reluctant to carry the risks. Because of this situation engineers of the Bureau of Plant Industry, Soils, and Agricultural Engineering and the Oregon Agricultural Experiment Station made a survey of the industry to determine causes of the fires and to recommend ways of preventing them.

PRODUCTION SEASON OF FLAX FOR FIBER

The growth and maturing season of flax for fiber is comparatively short, usually about five months—April through August. The flax crop is usually delivered to the mills by the growers during August and early September. Since only a small percentage of the crop can be processed during the delivery period or before fall rains, the rest must be stored. Storage is in sheds or in stacks with protective covering, each shed or stack holding between 500 and 1,000 tons. The storage of a large part of the crop has the advantage that mills can operate on a year-around basis, but as the straw is dry when it comes from the field, the storage of great quantities creates a serious fire hazard.

METHODS OF PROCESSING FLAX FOR FIBER AND THEIR HAZARDS

There are six distinct operations in getting out the fiber from the straw: (1) deseeding, (2) retting, (3) drying, (4) scutching, (5) hackling, and (6) tow cleaning. All these operations, except

* This report is based on studies made under cooperative investigations by the Oregon Agricultural Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture. Credit is due the State Fire Marshal of Oregon and the Oregon Insurance Rating Bureau for assistance in preparing this report; to the Oregon flax mills and to W. M. Hurst, Senior Agricultural Engineer, Bureau of Plant Industry, Soils, and Agricultural Engineering, for information on flax processing operations.

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retting and field drying, are mechanized and involve numerous fire hazards.

Deseeding is commonly done in a separate building, but in some instances all the machine operations are performed in the same building. The deseeder raises much dust that settles on the building framing, machines, and floors, creating a flashfire hazard. The dry straw itself, moving through the machines, is subject to flashfire hazard, in the event some foreign substances in it strike sparks from the rotating combs or if an electric spark results from static electricity generated by the machine.

The deseeded straw is tied into bundles and taken to the retting tanks or is stored in sheds. Seeds and bolls are carried on a conveyor belt to a thresher where they are separated, the bolls drawn off for fuel, and the seeds sacked for shipment to an oil mill or stored for planting.

Breaking up and scutching the dried and brittle retted flax straw to obtain the fiber also raises much dust. The hackling, or combing, of the long fibers creates lint. Cleaning the residue, or tow, with breakers and shakers is likewise a dusty and linty process. These processes often festoon the framing of the mill with lint and dust and create a flashfire hazard.

The bolls from the deseeder and thresher and the broken straw or shives from the scutching machine are usually drawn off by suction and conveyed pneumatically to a fuel building where they are stored and used as fuel under the boiler. This material is highly combustible and contains a great quantity of inflammable dust. Excess shives that cannot be used as fuel are carried by the exhaust ducts to refuse piles, which at a few mills are enclosed or partly enclosed with metal. The piles, usually close to the buildings, constitute a hazard because of flying sparks or grass fires.

MILL FIRES AND THEIR CAUSES

Seven of the privately owned or farmer's cooperative flax fiber mills and two tow cleaning establishments in Oregon have had fires, ranging from those of a minor nature to fires that have destroyed practically the entire plant. Fires in deseeder buildings in one or two instances have stopped processing for an entire season. There have been several disastrous fires in the flax mill at the state penitentiary, but as these fires were of a nature different from the fires in the remainder of the industry, they have not been included in the report of this survey.

The causes of these flax mill fires are almost as numerous as the fires. The causes fall into many categories as shown in Table 1.

Table 1. OREGON FLAX PLANT FIRES—1938-43

Cause of fire	Number of fires	Per cent of total loss
1. Faulty electrical equipment	3	5.35
2. Matches dropped near plant	1	10.26
3. Sparks from combustion	1	0.55
4. Dust on electric light globes	2	1.71
5. Exhaust from truck	1	0.35
6. Short circuit in panel board	1	0.11
7. Overheated oil burner in drier	1	36.93
8. Overheated drier	1	0.88
9. Undetermined	5	43.86

Table 2. FIRE LOSSES AT NINE FIBER FLAX MILLS*

Mill number	Loss from faulty equipment		Loss from other known causes		Loss from undetermined causes		Total loss from all causes	
	Amount	Per cent	Amount	Per cent	Amount	Per cent	Amount	Per cent
1	$ 346.54	.14	$25,683.03	10.26	$ 9,597.30	3.83	$35,626.87	14.23
2	1,675.00	.67	1,381.22	.55	....	....	3,056.22	1.22
3	....	....	....	....	76,280.90	30.48	76,280.90	30.48
4	....	....	....	....	11,754.08	4.69	11,754.08	4.69
5	271.46	.11	880.00	.35	....	....	1,151.46	.46
6	92,422.59	36.93	....	....	12,171.00	4.86	104,593.59	41.79
7	12,473.00	5.00	....	....	....	....	12,473.00	5.00
8	3,133.85	1.25	....	....	....	....	3,133.85	1.25
9	2,211.50	.88	....	....	....	....	2,211.50	.88
Total	$112,533.94	44.98	$27,944.25	11.16	$109,803.28	43.86	$250,281.47	100.00

* Based on figures furnished by State of Oregon Department of Insurance, Office of the Fire Marshal.

The classification "undetermined" may, of course, include fires resulting from any of the other enumerated causes. In one or two instances the cause was thought to have been spontaneous combustion, but at this time too few facts are known regarding the chemistry of combustion in flax straw or dust and the evidence was too uncertain to warrant a definite conclusion. "Undetermined" may also cover incendiarism, arson, or sabotage, but there has been no proof of such crimes at these flax mills. Static electricity is another possible cause of some of the fires. Other possibilities under this classification are unscreened chimneys and careless smoking by employees.

FIRE PROTECTION

Flax mills are in rural communities and are seldom closer than a mile to urban fire stations. The mills have been forced, therefore, to provide their own fire-fighting equipment, pay high-rate insurance, and bear unusually heavy losses.

SURVEY FINDINGS

The salient points in flax mill fire control, as brought out by the investigation, come under ten principal classifications:

1. General layout and construction of buildings.
2. Electrical installations.
3. Ventilation of the buildings.
4. Mill "housekeeping."
5. Fire protection equipment.
6. Night watchman and alarm systems.
7. Fire drills and instructions.
8. Smoking facilities for employees.
9. Screening of smokestack.
10. Miscellaneous.

General layout and construction

In the first mills built, deseeding, scutching, and tow cleaning were done in the same building. Experience gained in the operation of these original mills and as a result of several disastrous fires demonstrated that processing units should be separated. When some of the newer mills were organized during 1941-42 the sites were studied and buildings constructed according to plans prepared by engineers of the Bureau of Plant Industry, Soils, and Agricultural Engineering, using spacing as suggested by the Oregon Insurance Rating Bureau and the office of the State Fire Marshal. The typical building layout consists of a combined office, warehouse, and scale shed, a deseeder building, a scutcher and tow-cleaning building, a boiler house, a fuel shed, a pump house, straw storage sheds, and retting tanks with no building closer to another than approximately 100 feet.

All buildings inspected were of frame construction. The earlier buildings were generally metal covered, especially the mill building, but on account of war restrictions, recent construction has been limited to any materials available. Wall and roof coverings of corrugated iron, other sheet metal, wood shingles, or patent asphalt materials, used in a great variety of combinations, were observed. It has been the general practice to leave storage sheds open at one side and one end for ventilation and easy handling of materials. This is a great hazard, however, if a fire occurs in an adjacent building, if sparks fly from distant buildings, or if there are grass fires. Some mills, however, have storage sheds completely closed.

Mechanical elevators and conveyors

The straw storage sheds of several mills had built-in elevators; portable elevators were used in the sheds of some other mills. Most mills had elevators at the deseeders for loading wagons and some used drag lines for conveying shives to the fuel building. Fire hazards in connection with elevators and conveyors may arise from improper electric wiring, switches, overload protection and motors, from sparks from the conveyor chain as it meshes with the sprocket wheel, and from static charges generated by the fast-moving belt. Other hazards might result from bundles of straw clogging the conveyor, and from loose straw catching in the sprockets or wrapping around axles.

Portable elevators in sheds are essentially the same as the built-in elevators, except that the conveyor belts or chains are exposed and current is brought to the motor through long flexible cords. Hazards here may be caused by closeness of the motor to the stacked straw and the plug-in connections at the outlet boxes. Also there is the added hazard from the exhausts of trucks unloading within the shed. The built-in elevators are fed from outside the shed. (See Cover engraving.)

Retted straw driers

Two or three mills used forced-drying on the retted straw. The artificial drying systems in use were not entirely perfected and in two instances overheated driers have resulted in costly fires. All other mills dried by wigwamming the straw in the open field.

Electrical installations

The electrical installations were generally in conformity with the National Electrical Code, with wiring in cables or conduits, switches boxed, and electric bulbs dustproofed or vaporproofed, but there were some flagrant violations of the Code. Power panel boards and switches were generally in special dustproof rooms. Motors were not all dustproof because this type was difficult to obtain. The motors were, however, grounded in most cases. The machinery was all electrically operated, fast moving, and had many belts and pulleys, sprocket chains, and other friction parts. Most of the control switches were of approved types. None of the processing machines observed were grounded.

Static electricity

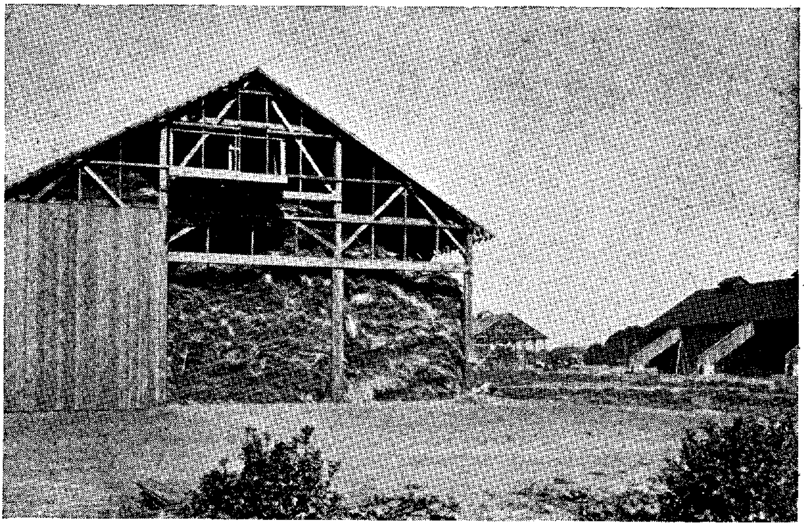
The air is hot and dry during the peak of the processing season, a condition that favors the generation of static electricity by the fast-moving machine parts, belts, pulleys, and conveyors. During most of the year, however, when the air has high humidity there is not much danger from this source. Static electricity may be generated also in the sheds as the straw is stacked. The metal roofs and walls of most straw storage sheds had not been grounded.

Lightning

There is practically no danger from lightning in the fiber flax region, so lightning rods have not been installed.

Ventilation

The dustiest operations are in the deseeding and scutching buildings and here are the greatest dust flashfire hazards. Of the



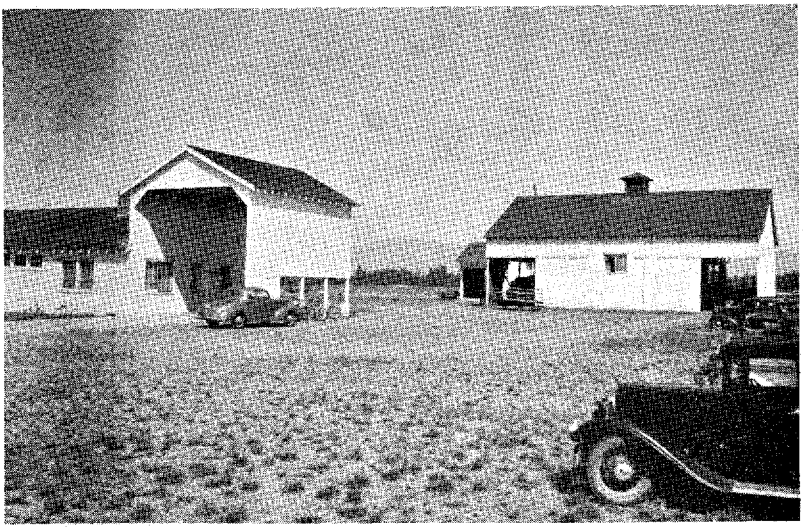
A flax straw storage shed partly filled before construction was completed. Other straw storage sheds appear in the background.

eleven deseeding buildings observed only two had cupola vents, and one had gable vents. One mill had hoods over the deseeder machine attached to the suction installation, and two others were contemplating installing hoods. The storage sheds only at the mills where built-in elevators had been installed had cupola vents, one for each elevator. Boiler rooms and fuel rooms had been vented in only one instance. Most of the scutching buildings had windows at both sides that, when open, give cross ventilation, but in winter this is objectionable unless supplemental heat is provided.

Mill housekeeping

Housekeeping was good at some mills, but there was nowhere evidence of rigid clean-up standards. In many cases the truss framing and walls were heavy with dust and hanging lint. One mill had a compressed air installation for cleaning machinery, but as the building was not vented the clouds of dust blown off the machines settle elsewhere. At three plants the walls and ceilings of the scutching and tow-cleaning buildings were ceiled with plywood, which is a great improvement.

Where shives were used as fuel, boiler rooms were generally dirty and dusty. In some mills with boilers not enclosed or lagged, accumulated dust on the hot metal has ignited. The floor of the



A modern flax plant showing covered drive over scales adjacent to office building and the deseeding building in the background.

boiler house in some plants was littered with shives, which were so fine that it was difficult to keep the floor swept clean. Danger was always present when the fire door in the Dutch oven was opened to add more fuel.

The supply rooms of but one or two mills were found in orderly condition. In most of the mills supplies were piled on the floor and packing boxes and packing debris scattered about or in piles.

Warehouses were for the most part clean and well organized with baled fiber and tow neatly and safely arranged.

Many of the mill yards were badly kept. Grass and weeds had been allowed to grow up in almost all areas not actually under use. When green, this growth is no hazard but when dry it becomes a serious hazard. At some of the mills still under construction materials were scattered about without thought as to orderliness.

Fire Protection

Equipment and other provisions for fire fighting were more or less haphazard in many of the mills but tend to become more uniform and adequate in the newer mills. Protections so far developed consist in mill installations of fire pumps, hydrants and hose, barrels of water and buckets, and various types of chemical extinguishers. Other protection factors were the availability of fire-fighting equipment and volunteer brigades in nearby communities.

Most of the mills had an ample water supply for fighting fire. Six of them had already installed or were at the time installing systems of pumps, fire lines, and hydrants. Pumps were of various sizes, but most of them had a capacity of 500 gallons a minute, and the mains were of 5- or 6-inch pipe. There were usually seven to nine hydrants, most of them with two outlets. Each hydrant was equipped with from 100 to 250 feet of 1½- to 2½-inch hose. In some systems the feeder mains were valved in such a way that if any part of the system fails the remainder could be kept in use. Generally, barrels and buckets were inadequate in number and were not kept filled with water. There were not enough chemical extinguishers. In three instances a garden hose had been hooked up to water supply lines inside the buildings for immediate use against flashfires. One mill had installed sprinkler heads in the scutcher building.

Night watchman

Most of the plants maintained a night watchman. Only two of these, however, were clocked. Eight of the plants also hired a night fireman for the boiler. In case of fire these men spread the alarm by telephone. Three plants had fire sirens or whistles.

Fire drills

None of the plants had instituted regular fire drills as the fire control systems were only recently installed. In all cases, however, key men had been appointed to operate the pumps, valves, hydrants, etc., and the other employees could probably do much to prevent a serious catastrophe before arrival of adequate fire fighting personnel and equipment. There had been no general instructions on the use and location of chemical extinguishers.

Smoking facilities

Special quarters where the employees are permitted to smoke had been provided at only a few mills. Smoking is permitted in the vicinity of the office in all other cases. "No Smoking" signs were conspicuous inside and outside all processing buildings and the sheds.

Trespassing

Strangers were generally not permitted to go about the premises of any of the mills without permission or unaccompanied. "No Trespassing" signs were posted at some mills and others had the signs for posting as operational activities warrant.

Smokestacks

Six mills had screened stacks to keep sparks from flying from the burning shives, which are used for fuel at all mills except one, which burned oil.

Spontaneous combustion

When very dry pulled flax, deseeded straw, or retted straw is stored in sheds or stacks there is small likelihood of spontaneous combustion. A few bundles of damp straw, however, buried in a stack or in a pile in a shed might provide the conditions for spontaneous combustion. A pile of hulls and trash from the deseeder has been known to catch fire from spontaneous combustion.

Exhaust from trucks

All straw is transported about the premises of the mills on trailer racks drawn by gasoline tractors, and growers bring their straw from the field to the mill by motor truck. The exhausts from all these conveyances are hazardous, and one serious fire is known to have resulted from backfiring.

RECOMMENDATIONS

The survey has shown that there are many flax mill fire hazards and it is recommended that steps be taken to eliminate or reduce these hazards along the following lines.

Buildings

As previously stated, flax mill buildings are of frame construction. At present deseeding is done for the most part in a separate building, but often scutching and tow cleaning are done in the same building. Usually the scutching machinery is on the second floor and the tow shaker or cleaner directly below. Since hazardous operations should be carried on as far as possible in separate buildings, it has been suggested that a building should be provided for tow cleaning. It has also been suggested that one fireproof structure might be designed suitable for deseeding, scutching, and tow cleaning.

The interior walls of the scutching and tow-cleaning buildings of the present type should be lined with plywood or other smooth material and painted to facilitate cleaning.

All buildings should be metal covered, both on walls and roofs, whenever conditions again permit. If sheds are entirely enclosed the danger of sparks from smokestack, grass fires, or burning buildings setting the stored straw on fire is greatly reduced. A fire within a walled shed is more easily confined and adjacent sheds are not as liable to catch fire. By keeping walls of adjacent sheds wet, the sheds and the content of straw can often be saved. Pouring water on the straw may save it from fire but may ruin it, even causing spontaneous combustion later.

Plans for new flax mills should include spacing in accordance with regulations approved by the Oregon Insurance Rating Bureau, April 15, 1943, which specify that for future construction, buildings should have the following minimum spacing with reference to other structures:

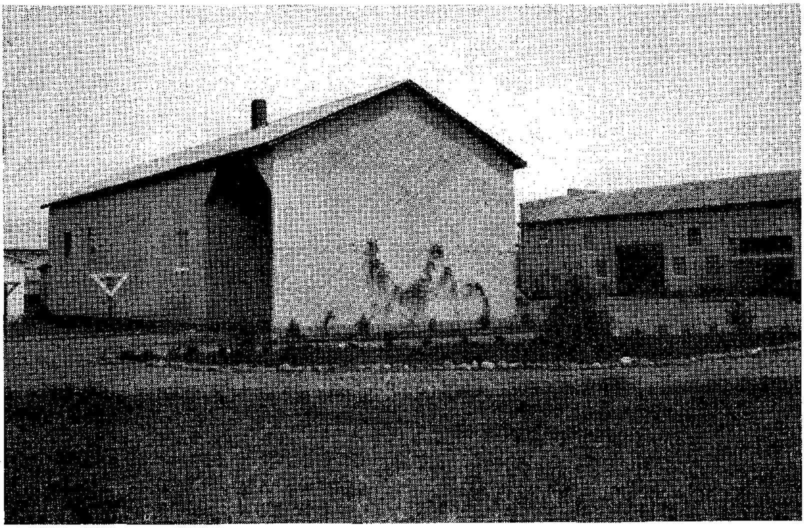
		Spacing between buildings	
Size	*Floor area*	*Closed sides*	*Open one side*
Abnormal	Over 8,000 square feet	150 feet	200 feet
Large	1,501 to 8,000 square feet	120 feet	160 feet
Ordinary	201 to 1,500 square feet	100 feet	133 feet
Small	Up to 200 square feet	32 feet	43 feet

Any straw storage shed holding in excess of 500 tons is considered to be of abnormal size.

Cupola ventilators are desirable on fuel sheds to carry off dust blown in with the shives. Automatic sliding metal-covered fire doors between fuel shed and boiler room passageway reduce the hazard of fire spread. A similar door between the passageway and the boiler room still further reduces the danger.

Electrical installations

It is necessary that electric wiring be brought up to the requirements of the National Electrical Code if it does not already meet these standards. Dust-tight electric lamps, motors, and switches add to safety in dusty and linty spaces. Cabinets of approved type should be used for all switches or conductors and short circuit protection provided for all magnetic switches. It is necessary to inspect all switch boxes periodically and clean out dust. Broken dust-proof protectors over light fixtures call for immediate replacement from spares kept on hand. Drop lights are dangerous except where they are in accordance with the National Electrical Code. Portable lamps should have wire guards. All motors should be grounded and all wiring to motors should be run in conduit and until appropriate motors can be obtained extra inspection and maintenance care should be given these items.



A flax plant showing the driveway over the scales. The corrugated iron roofing and siding aid in fire control.

Static electricity

In summer, tests for static electricity should be made and all machines that show any indication of it should be grounded.

Not only should each machine be grounded as a unit, but its individual parts should be wired so that a complete system of electrical connections from all moving parts will center in a common grounded wire. This applies to the thresher machine used in connection with the deseeder, as well as to all other machines.

The presence of static electricity can be ascertained with any ordinary two-coil galvanometer that will show deflection and direction, if not magnitude. The simple procedure is to establish a good "ground" by driving an iron rod 3 to 4 feet into the earth, pouring water around it, connecting one lead from the galvanometer to this rod and using the other to touch in turn motors, shafts, frames, blowers, and all moving parts. If it is impractical to ground all parts, a strip of grounded ¼-inch mesh wire could be installed along the side of all motors, pulleys, etc., to catch and absorb static charges.

One or two bare wires installed the full length of sheds close to the ridge and out of the way of workers or stacked straw and connected to the grounding rod with insulated wire will carry off static. All metal roofs as well as all metal walls should be grounded. Wherever metal roofs are grounded, no bare wires are necessary within the building. It is necessary that grounding wires be frequently checked to insure against breakage or damage and that the earth around the grounding rods be kept thoroughly wet during dry weather.

For further information on static electricity, grounding tests, etc., reference is made to a pamphlet "Static Electricity," published by the National Fire Protection Association, International, 60 Batterymarch Street, Boston, Mass.

Ventilation

Deseeders, scutchers, and tow handling machines should be hooded and vented through cupolas with gravity or forced ventilation. Cupola vents on enclosed storage sheds are not desirable except above elevator shafts, as they tend to create an updraft during a fire. In these sheds all door openings and other openings should be kept closed, except when loading or unloading.

Mill housekeeping

"Housekeeping" or general building cleanliness about flax mills receives too little attention. Beams, electric fixtures and wiring, shafting, motors, machines, boilers, floors and steps should be cleaned of all accumulated dust and lint—and kept clean.

Cleaning of all buildings subject to dust, lint, and shives at the close of the day or at the changing of shifts will keep down fire hazards. They will be held down still more if grass and weeds about the premises are kept cut and raked up during the dry season. Another related safety factor is the use of metal refuse burners at least 100 feet from any building to burn all waste not needed for fuel.

Order in the supply storage rooms is a safety factor easier to attain if there are sufficient shelves and racks. Cardboard packing boxes, excelsior, or other packing material, should be burned in the refuse burners as soon as supplies have been unpacked.

Fire protection

Every plant needs a complete system of water mains, hydrants, and pumping plant large enough to provide adequate fire protection for the entire plant and storage sheds. The office of the State Fire Marshal will furnish all plants a layout of such a system. Whereas, in some instances, systems of mains and hydrants have been installed, they are not entirely adequate for full protection. They will serve only for localized fires. Too great reliance should not be placed on aid from volunteer organizations in rural areas.

A recommended system outlined by the State Fire Marshal has a pumping plant that will provide at least 1,000 gallons of water a minute under pressure while maintaining a flowing pressure of 65 pounds continuously at all hydrants with automatic pressure controlled starters and manual stop controls. It calls for hydrants located at vantage points around the buildings, sheds, and open stacks, each hydrant to be 6 inches with two 2½-inch hose ports and one 4-inch engine port. The system also provides for first-aid methods of fire control by locating a system of stand pipes and 1½-inch hose with nozzles in such a manner that 100 feet of 1½-inch hose will reach to within 20 feet of the interior of all buildings. Each mill needs an adequate supply of 2½-inch hose and nozzles housed for ready availability for fighting large fires. Standard inside standpipe and hose protection should be installed where possible.

In view of the fact that trained firemen will not always be immediately at hand to utilize the yard fire system, automatic sprinkler protection is desirable in the deseeder, scutching, and tow-cleaning buildings and in the boiler room and fuel storage. A wet system could not be maintained during the winter months at these buildings unless they are heated, but the system could be kept in service the entire year, by the installation of dry-pipe valves or other approved methods such as the seasonal use of nonfreezing solution in the piping. Advice from manufacturers of sprinkler systems should be obtained before any installations are begun.

In addition to the above equipment it is desirable to have chemical fire extinguishers handy to all machines. Barrels of water and buckets should be placed throughout all buildings and near all sheds, as outlined in the National Board of Fire Underwriters' Pamphlet No. 10, entitled "Standards of the National Board of Fire Underwriters for the Installation, Maintenance and Use of First Aid Fire Appliances as Recommended by the National Fire Protection Association." In general, one barrel of water with two buckets provides for each 2,500 square feet of floor area.

It is desirable to have chemical extinguishers suitable for various types of fires such as in combustible rubbish, wood, or straw; fires in inflammable liquids, oils and greases; and fires in electrical equipment. Information and advice upon the type for use in each case can be obtained from the State Fire Marshal or the Oregon Insurance Rating Bureau.

All boilers should be inclosed with brick or lagged, to prevent ignition of settling shives, dust, or lint.

Metal protection around burning shive piles is necessary unless the piles are at least 300 feet from the nearest building.

If some straw must be stored outside the sheds it is well to have the stacks carefully formed, not larger than 500 tons, and in well drained locations. If such stacks are 200 feet apart and 200 feet from any building or shed the fire hazard will not be too great.

Night watchman

Standard watchman clock service should be installed at every plant.

Fire alarm

Fire whistles or sirens are essential for effective fire fighting at every plant. This would serve to call all employees to their stations if a fire starts during the day, and at night would call the neighborhood to the assistance of the man on the premises.

Fire drills

Fire drills and instructions are necessary to teach the use of hose, extinguishers, first aid equipment, etc. There must be key men who know the workings of the entire protection system, how to start the fire pump, location and operation of valves, and handling hose and adjusting nozzles. Other workers should be instructed in giving any necessary assistance, removing trucks and other equipment out of range of the fire and watching for flying sparks. The office of the State Fire Marshal will supervise instruction in fire drills, if requested to do so by the plant managers.

Smoking facilities

It is desirable to provide smoking facilities for employees at all mills and to have regular smoking periods. Experience shows that these practices cut down "sneak smoking." If matches are allowed, they should be of the safety type that requires special chemical scratch pads for ignition. At some factories employees reporting for work are required to deposit all matches at the entrance gate.

Trespassing

To prevent trespassing, factories are frequently fenced. Flax mills, including the drying field, usually cover too large an area to make this practice feasible. A fence with a gate, however, can be constructed across the entrance to the mill at some locations that would help in discouraging people from wandering over the ground. In any event, "No Trespassing" signs should be posted at frequent intervals throughout the area.

Smokestacks

Screened smokestacks are necessary at plants where shives are used as fuel to keep the light burning particles from being carried into the air.

Exhaust from trucks

Exhaust pipes from motor trucks or tractors if damaged or not muffled are likely to throw out sparks and may be a cause of fire. It is therefore desirable to inspect trucks used for deliveries to the plants.

Gasoline and fuel storage

Gasoline and other inflammable fuels and oils are less of a hazard if storage tanks are under ground and if gasoline pumps, oil containers, and other dangerous quantities of such materials are kept in fireproof buildings on clean premises. Spots where oil has dripped from crankcase or chassis are less liable to start fires if immediately covered with dirt or gravel.

CONCLUSION

The survey of fire hazards in flax mills shows that constant vigilance is necessary to eliminate or reduce them. It is essential that each mill institute the best possible precautions so that the hazards may be reduced.

The precautions include: Definite housekeeping programs and clean-up duties for employees; careful and regular inspections of all electrical equipment, prompt replacement of faulty or broken parts, and care taken not to overload motors and wiring systems especially by adding equipment to already loaded lines; maintenance of adequate first-aid equipment and instruction of employees on its location and use; installation and maintenance of fire fighting facilities and systematic and frequent fire drills at all mills. It is desirable, furthermore, to have smoking facilities for employees, to screen smokestacks, prohibit trespassing, muffle exhaust of motor trucks, and isolate and protect gasoline and oil storages.

All of the enumerated precautions enter into the adjustment of insurance premiums, and proper attention to minimizing hazards will tend to lower rates. While it is true that at present insurance premiums are high, it must be borne in mind that the total net income from premiums for 1 year can be entirely consumed by one fire. It is because of this that insurance companies are reluctant to carry the risks at all. A serious fire at any one mill jeopardizes the protection of all the mills. Hence, every mill should work continuously to minimize hazards and increase protective measures.

Fire hazards must be greatly reduced and fire protection facilities must be increased to bring about lower insurance rates, to protect present plants and equipment that if burned are hard to replace, to save irreplaceable fiber, and to prevent delays in production schedules of fiber flax so badly needed in the present emergency.