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**EXTENSION SERVICE**  
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**Prevention of and Protection From  
Smut Dust Explosions and Fires  
in Grain Separators**

By

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**The State College of Washington**  
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# PREVENTION OF AND PROTECTION FROM SMUT DUST EXPLOSIONS AND FIRES IN GRAIN SEPARATORS

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## SMUT DUST EXPLOSIONS AND FIRES

### Fire Protection

In order to protect the machine and threshed grain from destruction by fire a set of rules similar to the following should be made and strictly enforced:

1. Do not smoke around separator, straw stack or threshed grain.
2. Keep all litter and straw cleaned up around the machine.
3. Pile the sacks of threshed grain far enough from the machine and straw stack so that they will not be destroyed in case of fire.
4. Plow a strip around the setting and around the sack pile to protect the shocked grain and the sacked grain.
5. Provide your machine with a reliable sprinkler system, preferably automatic. Inspect it each day and be sure that it is in working order before starting up.
6. Have your machine wired to carry away accumulations of static electricity.
7. Install a dust collecting apparatus on your machine:  
It lessens the danger of explosions and fires.  
The threshed grain sells higher on the market.  
It provides better working conditions for men.
8. Fasten a half-inch steel cable to the front of the separator and the front of the engine so that the separator may be pulled away from the straw stack in case of fire. When a steam hose is used in connection with the sprinkler system it should be long enough so that it will not be pulled in two when the engine is backed up. Be sure that this cable is in place before starting up.
9. See that spark hood on engine stack is in good order and is in place at each setting.
10. Instruct your men what to do in case of fire. Frequent fire drills are recommended.

### Prevention of and Protection from Fires

For the past four years the question of smut dust explosions and fires as applied to threshing machines in the wheat belt of the Northwest has been studied by members of the experiment station staff and engineers of the State College of Washington, the United States Department of Agriculture at Washington, D. C., co-operating.

A study of such fires and explosions convinced the investigators that the explosions, with their subsequent fires, were caused by the ignition of a mixture of smut dust and air within the threshing machine, which explosion and fires might result from any one of the following causes, to-wit:

1. Incendiarism.
2. Spark or live coal from engine.
3. A hot bearing.
4. Striking of cylinder teeth upon concaves. Gravel or small stones passing through cylinder.
5. Static electricity.

Threshing machine operators report having found matches in the grain shocks and in the separator after a fire. In tests made with a machine in Whitman County, Washington, matches tied up in the grain were fed into the machine and in each case a fire resulted.

2. In some tests made by Mr. G. A. Olson, chemist at the State College of Washington, in 1914, upon the inflammability of a mixture of smut dust and air it was determined that the liability of explosions from a spark or live coal were very remote. He found it impossible to ignite such a mixture by inserting into it a red hot piece of charcoal. A spark from the engine or a live coal alighting in the straw or chaff about a machine might, however, cause an outside fire.

3. Fires caused by hot bearings are due to gross neglect on the part of the separator tender and need not be discussed here.

4. If the teeth in the cylinder and concaves get loose or get out of alignment and strike against each other they may possibly cause a spark of sufficient intensity to ignite the dust mixture within the machine.

During the cleanup if small stones or gravel are allowed to pass through the cylinder they also may strike against the teeth and cause a spark. Some operators spread canvas about the separator and thereby, in cleaning up, avoid danger from such rubbish.

The cylinder teeth should be frequently examined to see that they are in the correct position and, if possible, a place should be chosen for a set up which is free from rock and gravel.

5. Experimentation has established the fact that smut dust may be fired by static electricity.

Static electricity is generated in a separator by the movement of grain and straw across the various parts of the machine and by the moving belts. This electricity accumulates until a sufficient potential is available to cause it to jump to some other part of the machine which is at a lower potential. If this discharge takes place in the proper mixture of smut and air, an explosion will occur. In igniting the smut and dust particles within the separator its action is the same as that of a spark within the cylinder of a gas engine.

The only practical method of dealing with this discharge is to provide an easy path by which the potentials within the machine are equalized and the whole of the metal parts effectively grounded. This is most easily accomplished by carefully connecting all of the metal parts to a common collecting point which is, in turn, connected to the ground.

### Prevention of Fires

Since no practical means have been developed for the elimination of all the smut, the danger from fires is ever present and every possible means should be used to prevent the explosions within the separator and the fires outside of the machines.

The following points should be observed in regard to the condition and care of the separator:

1. The litter which collects around the outside of the machine should be cleaned up frequently.

2. The bearings should be inspected often and should be kept well oiled so that heating will be prevented.

3. Accumulations of dust collecting on the framework and top of the separator should be swept down frequently.

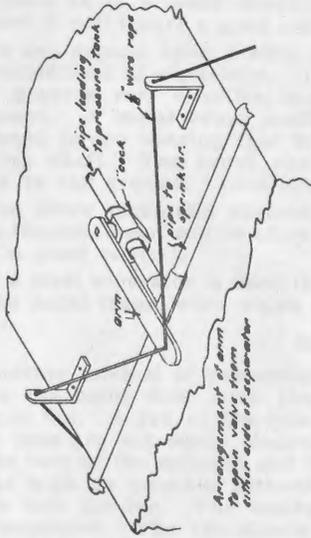
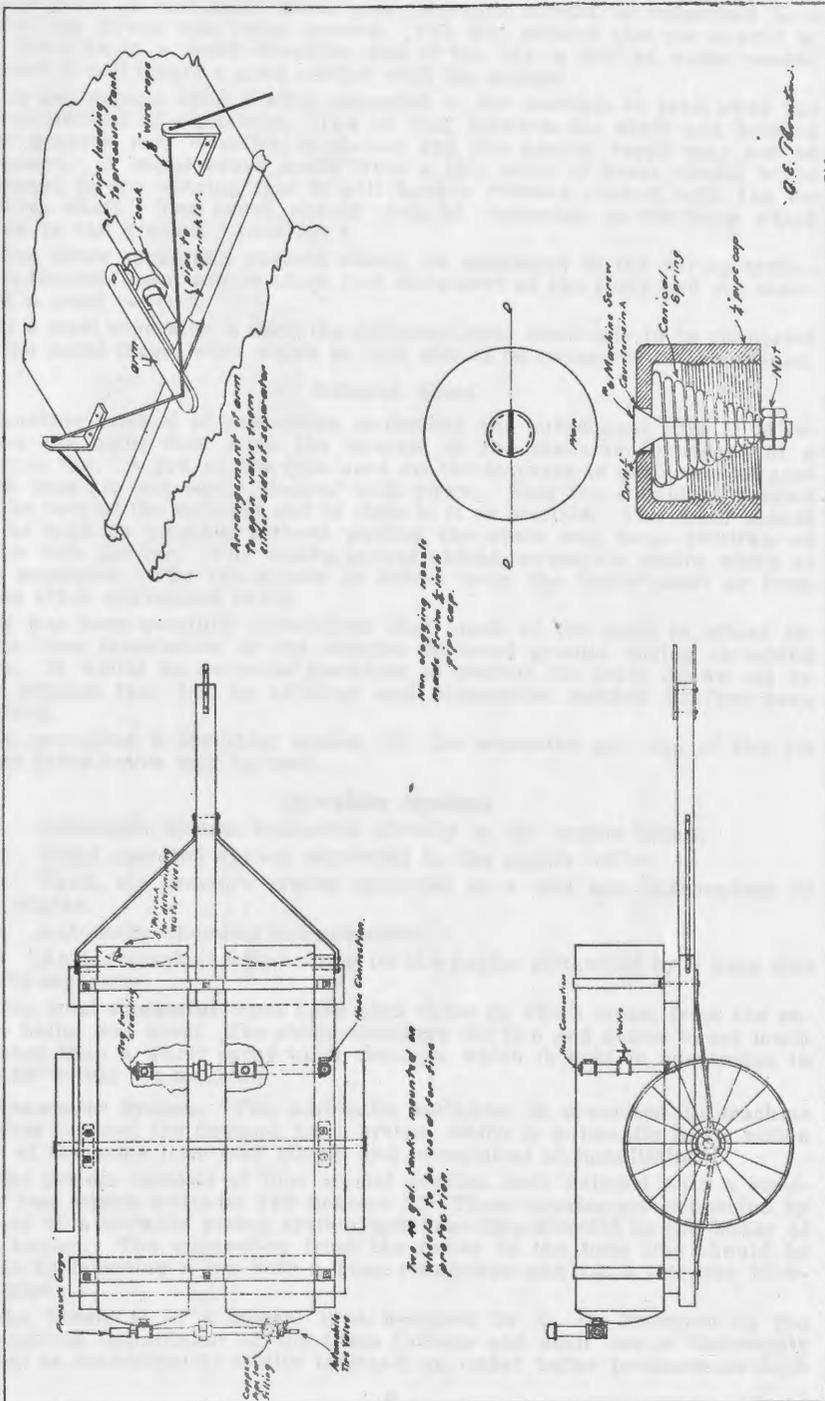
4. If possible, pockets or ledges anywhere about the machine in which there is a liability of dust collecting should be eliminated. Such dust thrown about by an explosion provides fuel for the fire that follows.

5. A conspicuous—NO SMOKING—sign should be displayed on either side of the machine, which should be ENFORCED by the machine owners.

6. The spark hood on the engine should always be in place and should be inspected to see that there are no rust holes in the screen.

All metal parts of the machine should be connected to the ground by means of a suitable wiring system. Wires should be run from the shak-





Non-slagging results  
made in 1/2 inch  
pipe cap.

Two 40 gal. tanks mounted on  
wheels to be used for fire  
protection.

O. E. Thornton.



ers, strawracks, sieves, fan shafts, cylinder and beater shafts, and metal frame work to one main wire, which in turn should be connected to a metal pin driven into moist ground. The dirt around this pin should at all times be in a moist condition and if too dry, a pail of water poured around it will insure a good contact with the ground.

Do not depend upon a wire connected to the bearings to take away the accumulations of electricity. The oil film between the shaft and bearing may prove a very effective insulation and the desired result may not be obtained. A metal brush made from a thin strip of brass should be so fastened to the bearing that it will have a rubbing contact with the revolving shaft. The brush should then be connected to the wire which leads to the ground. (See cut.)

The straw racks and shakers should be connected to the wiring system by a flexible metal coil to allow free movement of the parts and yet maintain a good contact.

If a steel separator is used the different parts need only to be connected to the metal frame work which in turn should be connected to the ground.

### **Exhaust Fans**

Another method of preventing explosions and subsequent fires is to remove the smut dust from the interior of the machine by means of a suction fan. A fan of the type used on the stackers is preferred because such fans are not easily clogged with straw. This fan should be located to the rear of the cylinder and as close to it as possible. The speed should be as high as possible without pulling the grain and large particles of straw into the fan. The intake should extend across the entire width of the separator. The fan should be driven from the beater shaft or from some other convenient shaft.

It has been carefully determined that much of the smut in wheat results from inoculation of the summer fallowed ground during threshing time. It would be desirable therefore to destroy the smut drawn off by the exhaust fan; but no efficient and economical method has yet been devised.

In providing a sprinkler system for the separator any one of the six types given below may be used.

### **Sprinkler Systems**

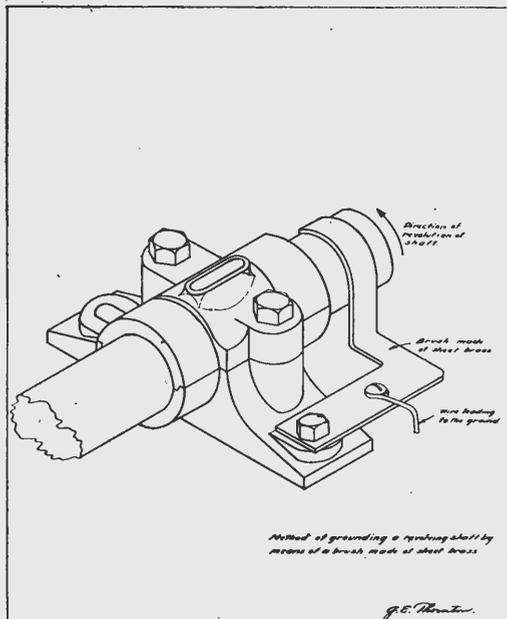
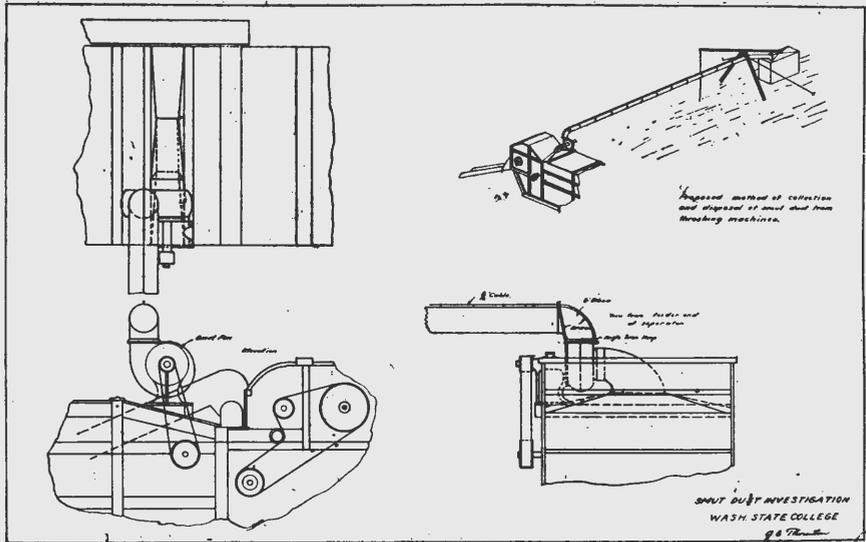
1. Automatic system connected directly to the engine boiler.
2. Hand operated system connected to the engine boiler.
3. Tank, air pressure system mounted on a cart and independent of the engine.
5. Automatic chemical extinguishers.
6. An independent water pump on the engine connected by a hose line to the separator.

The most successful types have been those in which steam from the engine boiler was used. The steam smothers the fire and seems to act much quicker than a water spray upon the dust which is held in suspension in the air within the machine.

**Automatic System.** The automatic sprinkler is presented to machine owners to meet the demand for a system which is automatic in its action and at the same time very simple and economical of installation.

The system consists of four special nozzles, each equipped with a sensitive fuse which melts at 160 degrees F. These nozzles are connected by means of a suitable piping system and hose line directly to the boiler of the engine. The connection from the boiler to the hose line should be made by inserting a tee with a hose connection and valve into the blow-off pipe.

The nozzle is of a special type designed by G. E. Thornton of the Mechanical Department of the State College and each one is thoroughly tested to determine its ability to stand up under boiler pressures as high



as are used on traction engines. The fuse with which the nozzle is equipped has a sufficient strength in tension to stand a pull of 350 pounds and still has a fusing temperature of 160 degrees F. When this temperature is reached the fuse is melted and the water is released.

The nozzles should be screwed into a pipe line which runs outside along the center of the top of the machine and when in place they could come just a little below the inside of the top boards or metal top of the separator. The nozzle should be turned so that the fuse will be toward the front of the machine. In this position the straw will keep



the fuse bright and free from dust and thus permit a quick action of the heat upon it. Since the whipping of the straw will wear the fuse it should be inspected every three or four days and if the wear is excessive the fuse should be replaced by a new one. To make a replacement, loosen the machine screw in the lower bar of the nozzle two turns, slip on a new fuse, tighten the screw and the nozzle is ready for use.

If the automatic system is used a tee with hose connection should be inserted into the pipe line on the separator for the purpose of fighting outside fires.

The advantage of this equipment is readily seen. Its action is instantaneous. It is simple and economical of installation. The piping being outside the machine and nozzles projecting inside, there is nothing to collect straw or interfere with the passage of the straw over the straw racks.

The entire system can be assembled on the ground and fastened in place on the top of the machine by means of four pipe straps. (For description of Automatic Sprinkler and method of installation see Plate 1, at back of bulletin.)

**Hand Operated Sprinkler System.** The hand operated system is nearly the same as the automatic sprinkler. The difference is in the nozzles and method of working the valve at the engine for admission of steam to the line leading to the separator.

**Tank Air Pressure System Mounted on a Cart.** Provide a two-wheeled cart upon which can be mounted two forty-gallon tanks such as are used on hot water systems in the home. This cart should be trailed behind the separator during the threshing season, and afterward should be stored in an outbuilding ready for any emergency about the farm.

These tanks should be filled two-thirds full of clear water and then pumped up with air until a pressure of 100 to 125 pounds is reached. An automobile tire pump may be used for this purpose. A pressure gauge should be placed on the tanks for determining the amount of pressure.

The tanks should be connected to a sprinkler system on the separator by means of a  $\frac{3}{4}$ -inch hose. The system may be put into action by pulling a rope which opens a valve in the pipe line.

The nozzles used on such a system should be of a type which are not easily clogged by dust from the outside of the pipe line or by sediment on the inside. A very cheap and efficient nozzle may be made from a  $\frac{1}{4}$ -inch pipe cap, as shown by the print at the back of this bulletin.

Another non-clogging nozzle may be made from a cast iron pipe plug, as described in Bulletin No. 379 of the United States Department of Agriculture, Washington, D. C.

### **Smut Fans**

The fire hazard may be greatly reduced by installing a suction fan on the separator to remove the smut dust from the interior of the machine. The removal of the smut dust from the machine dilutes the mixture and reduces the danger of an explosion. The fan should be of the exhaustor type and should be designed for the removal of dust and fine particles of straw.

For a 32-inch cylinder or smaller, a 12-inch fan is recommended. Over that size, a 15-inch fan is recommended. The speed of such fans range from 1200 to 1500 revolutions per minute.

The speed at which the fan should run can be determined by watching its action. If it picks up large particles of straw and some of the lighter kernels of grain, the speed is too high. If it is not convenient to change the size of the drive pulley, a damper should be provided in the suction pipe for throttling the intake. Although the latter method reduces the efficiency of the fan, it is the more convenient and provides a ready means of adjustment to suit the conditions under which the machine is operating.

The elbow opening from the fan to the pipe carrying the smut away should be made so that it will swing to either side of the machine.

Such fans are built and put on the market by the Sturtevant Fan Company of Seattle, Washington, and also by the American Blower Company of Seattle, Washington.