

quently of the meal, through elevators, spouts and conveyors is in itself a source of danger, owing to the inflammable nature of the dust created.

To obviate this danger we would suggest the following arrangement viz.: Place the malt bins in the lowest story (the grain can be distributed from the weighing hopper to the bins by horizontal conveyor) have one set of elevator cups to convey the malt to the top story directly into the mill, or, better still, into a small supply hopper above the mill. When ground the meal can be carried by a small elevator to a meal bin on the same floor with the mill, and from there distributed to the mash tubs through spouts. In such an arrangement we have but one set of elevators passing through the entire building to act as a flue in case of fire. The rollers of the mill are placed horizontally, and so close to each other that a common business card can be easily passed between them. In most mills the motion from the general driving system is imparted to one roller only, the friction of the passing grain causing the second roller to revolve. It can be easily seen that a foreign particle, such as a nail or a piece of stone, coming between these rollers would, through its tendency to spread the rollers, cause considerable friction at the point of contact, which in most cases would result in a fire or an explosion of the finely-divided meal dust or both.

Where the motion of the one roller is transmitted to the second by means of cog wheels outside of the mill box, this source of danger is partly eliminated, since then the rollers have sufficient power to crush a stone or flatten a nail and to pass them through without causing much friction. Recently malt mills have been constructed in such a manner that the bearings of the second roller were moveable, and held in place by a spring, sufficiently powerful to keep the rollers together when grain only is passing, and spreading the rollers when a harder substance is encountered. In this last described mill the motion is transmitted to each roller by a separate belt. Usually the ground malt falls from the rollers directly into the elevator cups to be carried to the meal bin. If the rollers strike fire, the elevator box, acting as a flue, carries such a fire to the upper stories. To prevent this a trap hopper should be provided under the mill to receive the meal, and the elevator be connected with this hopper in such a manner that the hopper can be always kept full while elevating. This arrangement is similar to a water trap in a sewer pipe. Care must be taken to prevent the hopper from running empty. This might be done by closing the opening between the hopper and the elevator automatically. To relieve the strain on the sides of the mill and hopper in case of an explosion, a vent pipe has been provided. Such a pipe must be of a good diameter and must pass laterally through the walls of the building. The trap hopper, the lower part of the elevator box, and the vent pipe should be of iron or iron-lined.

In a recent malt mill explosion, two distinct detonations were noticed; the dust in the mill exploded, and the flames being carried to the upper story through the elevator, the dust in the meal bin exploded with terrific force, doing great damage to the building and causing a fire, which was, however, extinguished before much additional damage was done.

The grain should be most thoroughly cleaned before passing through the rollers. This rule is general, and covers all places where grain of any kind is ground. In most malt mills in the larger breweries a powerful magnet has been placed directly above the rollers, in such a position that the grain passes over it before reaching the rollers. This magnet takes up all the iron particles, such as nails, pieces of elevator cups, small bolts and nuts, wires from self-binding reapers, etc., and prevents them from reaching the rolls. This simple contrivance, independent of relieving the fire hazard materially, increases the life of the rollers from one month to six months. It is incredible what an amount of iron the malt contains. We have been shown a large cigar box full of nails, etc., taken from the magnet in one week. Copper, brass or stones are not removed by the magnet, and the danger is therefore not entirely removed by it. Grain cleaners and bolting sieves are used in many breweries to clean the malt before passing it through the mill. In our estimation the additional hazard of the grain blowers, or even of a smut machine, when properly located and properly watched, is counterbalanced by the reduced hazards at the mill, owing to clean grain passing through the rollers.

The malt mill should be in a light position, and all parts of the mill should be of easy access. We have seen malt mills in such dark corners of the brewery building that artificial light was necessary throughout the day, and as the lights used were open lights, it will be easily seen that the hazard of the mill was considerably increased.

In the usual arrangement of smaller breweries we find the grain storage and the milling done in the same building with the brewing proper. Where space can be had, it is better to erect a separate and detached building for the milling. A malt mill carelessly put up and carelessly operated is as great a source of danger to a brewery as is a picker to a woollen mill, and as great care should be taken to separate the mill house from the brewery proper as should be taken in separating the picker house from the main mill. The separation is more easily done in our case, owing to the easy passage of malt or meal through spouts, even across intervening yard space. It took years to remove the picker from the main mill, and it will be years before the malt mill will be removed from the brewery building.

The ground malt or meal is now run from the bins where it has been stored to the mash tub. There are two different methods of mashing, namely, by the infusion method and by the decoction method. The former is more generally used in this country, and we will therefore describe it.

In the mash tub, water at a certain temperature (about 120° to 130°) is added to the meal until it has the consistency of a thin paste. This paste must be kept at a temperature below the boiling point of water, and constantly stirred, this being done by mechanical means, so that the sugar contained in the meal may be dissolved and any remaining starch may be changed into sugar. After the proper time has elapsed the wort is strained, the spent grain remaining in the tub to be used as cattle feed, and the liquid run directly into the "copper" to be condensed by boiling. The "copper" is a large kettle of that metal enclosed at the top and heated by steam. This heating was formerly done by direct heat, and is even now being done in that manner in a number of breweries. When the wort has attained the proper state of condensation, and after the hops have been added to it, it is run into large tanks, where it is allowed to settle; from these it is run over cooling racks and then to the coolers proper. These are large, shallow iron tanks in the top story of the brewery, or in one of the adjoining refrigerating houses, where the wort can be cooled by air, which has free access through slatted windows and ventilators in the roof. After being cooled the wort is ready to be fermented; that is to say, to have the sugar it contains changed into alcohol, and to generate carbonic acid through the instrumentality of the yeast, which is either added to the wort or which is developed from the spores of the yeast plant always present in the fermenting rooms. The fermentation of the beer takes from three to five days. The scum which has formed on the top is removed. This scum in rising clarifies the beer, which is now ready to be run into vats, where the necessary after-fermentation can take place. This fermentation must take place very slowly, and to accomplish this the temperature of the vat or fermenting rooms is artificially reduced. For this purpose the refrigerating houses have been erected. These refrigerating houses are nothing but large ice boxes, where the air is cooled by large quantities of ice, provision being made for a free circulation of this cooled air. The refrigerating houses are more recently being cooled artificially by cold produced through the evaporation and condensation of ammonia vapors. These so-called ice machines are very expensive, and are being adopted by the larger breweries only. The bungs of the vats in the refrigerating house are left open, so that the excess of carbonic acid generated during the fermentation can pass off. Eight or nine days before drawing the beer for use the bungs are closed in order to confine the carbonic acid in the beer, which, when the beer is drawn from the keg, causes the froth so pleasant to the eye and so profitable to the saloon keeper. The fermenting vats must be varnished at least once a year, so that the beer they contain does not assume a woody taste. This varnishing is generally done in the buildings, since it causes considerable trouble to remove the vats to the yard to be varnished. The varnish used is usually a resin varnish, thinned with naphtha or some equally volatile solvent. Such a varnish necessarily gives off a very inflammable and explosive vapor. Only a few years ago a large refrigerating house in Philadelphia was destroyed by fire.