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(Illustrations are indicated by an asterisk.)

SOLID FLOATING ON MOLTEN IRON.

The facts and principles in regard to this matter are few and simple. Iron, like water, in changing from the liquid to the solid state expands. Solid iron floats on molten iron for the simple reason that a cubic foot of solid iron is lighter than a cubic foot of molten iron. The reason why a pattern must be made larger than the desired casting is, that the iron hardens while it is very hot, and then in cooling it shrinks. Careful experiments have shown that ice also contracts by reduction of temperature.

Iron and water are not the only substances that expand in changing from the liquid to the solid state; it may be a general law applicable to all substances. It has long been known that water, iron, and antimony have this property; and Dr. Rowell, of this city, has observed it in the case of at least six other substances, namely, lead, zinc, tin, resin, wax, and tallow. The expansion of some of these substances is much more than that of others; the expansion of zinc approaches that of iron, while lead expands so very little that unless the temperature of the solid portion is almost as high as that of the melted portion, the solid will sink in the molten mass. This condition may be obtained by filling an iron vessel with molten lead, and after the lead has hardened, placing the vessel over a fire; the lead will, of course, melt first on the outside, and the temperature of the central lump will be at the same time raised nearly as high as that of the melted portion; in these circumstances the solid will float just at the surface of the melted mass.

VELOCITY OF MECHANISM.

Fan blowers are frequently run with a velocity of 3,000 turns per minute, while the usual velocity of cotton spindles is between 6,000 and 7,000 turns per minute. These are the highest rotary velocities with which we are acquainted in ordinary mechanism, but M. Arago, in measuring the difference in the velocity of light while passing through air and through water, wished to give a revolving mirror a velocity of 8,000 rotations per second. This he was unable to do; with the most delicate and perfect arrangement of cog wheels he was able to impart only 1,000 revolutions per second to his mirror. M. Foucault, by substituting for cog wheels a delicate turbine acted on by a steam jet, raised the velocity to 1,500 turns per second. M. Arago by removing the mirror and turning the spindle alone, achieved a velocity even by means of cog wheels, of 8,000 turns per second—equal to 480,000 turns per minute.

That spindle, therefore, turned 80 times while an ordinary cotton spindle is turning once! This is the highest rotary velocity of which we have any account.

BOILER EXPLOSIONS ON WESTERN WATERS.

The boiler explosions on the Western waters seem to occur as frequently as ever, but public indignation is aroused only where tubular boilers are the cause.

The inspectors in New Orleans have given public notice that after certain dates they will condemn all boats having tubular boilers, and a recent paragraph in one of our exchanges, stated that a number of engineers in Louisville, Ky., had left the boats because the proprietors persisted in retaining tubular boilers; as if boilers could be taken out and set ashore like trunks.

If such foolish prejudices are allowed to rule, a new generation would seem to be required; not wise after its own conceit, but skilled in the management of modern steam engines and boilers.

Very little attention seems to have been directed to remedying the evils complained of except by the summary action alluded to, but a great deal of useless denunciation is indulged in. Occasionally, however, we find men with sensible ideas who think, not unreasonably, there are remedies for all diseases, and that tubular boilers can be as well run on Western rivers as in other parts of the world.

Mr. John Schaffer writes a long letter to a St. Louis paper, setting forth the fact that the boilers on Western steamboats are very badly designed. He says the steam room is so small and the point at which the steam pipe leaves the boiler so little above the water, that constant priming takes place, and that he has seen the water pass out of the exhaust pipe in a perfect flood.

We give his own words:—

From my own observation, corroborated by the experience of other engineers of opportunities, the recent explosions were caused by a want of water in the boilers, and that the water was in every instance drawn from the boilers without the knowledge of the engineer on watch at the time of the explosion. I have seen the water in boilers escape through the cylinder of the engine with such velocity as to have emptied the boilers in two or three minutes, if not checked, and this occurs frequently on our high pressure boats, and in my judgment the failure to detect the escape of water in that way, from the boilers through the engine and out at the escape pipe, has caused the late as well as disasters in former years.

The boilers upon our boats are set higher than the cylinder of the engine. The steampipe leading from the boilers to the cylinder is generally somewhat in the form of a siphon, sufficiently so, if once started to draw the water from the boilers, and that the water does frequently so start to flow, every engineer of experience knows to be the case. The main difficulty is to know the exact time and the cause of the water starting to flow out of the boiler through the cylinder and escape pipe. This generally happens when the water is high in the boiler, with a low pressure, or ordinary pressure, of steam The space for steam is occupied by water so as to leave small steam room, not sufficient to supply the cylinder which may be making from 12 to 15 revolutions per minute.

Now the proof of this theory is to be found in the facts that most of the recent explosions as well as those in former years have happened to boats in about one to one and a half of an hour after they had started from some point where the fires had been cleaned out and the water was known to have been full in the boilers. The first boat in which my attention was called to this, as the cause of the explosion, was the steamer *Metropolis*, which exploded one of her boilers on the Ohio river about eleven years ago. The boat was new and on her first trip. The captain, who was on the upper deck, discovered the water going out through the escape pipe, so as to literally flood the deck. He called to the first engineer, who was in bed, to know what was the matter; stated that the water was coming out of the escape pipe. The engineer immediately discovered that water was flowing with the steam through the cylinder and escape pipe. He examined the state of steam and found 120 lbs. Before he could reach the boilers one of them blew up; two or three sheets had given way over the hottest part of the fire. The same happened to the steamer *John J. Roe*, in 1861. The boat had made a landing, and started out with full water in the boilers. Shortly before the accident the water was discovered by the pilot going out of the scape-pipe. The steamer *Princess* blew up in 1860. This boat had started from the landing at Baton Rouge with full water. The engineer stopped the doctor; the water began to fall on deck from the escape-pipe, and in a little time two boilers exploded. The engineer on duty was killed The *St. Nicholas* blew up near Helena about eight years ago. This boat had the water to escape through the engine before the accident, on several occasions, but the engineer had discovered it and shut down the valve at two or three different times! The steamer *Sultana*, which exploded three of her boilers in April last, had left the coal yard above Memphis about one hour before. The engineer lived long enough to state that all the machinery was working well, and that there was sufficient water in the boilers as indicated a few minutes before. The escapement was in the chimneys, and could not, of course, be detected by the escape pipe.

Numerous other instances are cited by Mr. Schaffer, but we have no room for them.

Of the gun boats built at St. Louis in 1861, seven of them had to be altered after they got to Cairo. It was found that owing to the construction of the steam drum and pipes, the water went out through the engines and escape pipes.

It seems incredible to us that such things could be and pass unnoticed, but Mr. Schaffer speaks from experience, and therefore knows.

The remedies are plain, and some very good common-sense alterations are recommended. It is not uncommon for boilers to prime. Even our marine boilers do it, especially those in ships which run in both salt and fresh water; but when we find that such a state of things exists we take means to stop it. We open the doors and close the throttle partially, and if we have a variable cut-off, run it down so as to follow short. We put on all the feed so as to lower the temperature in the boiler, but our engineers do not find it necessary to run away from the boat or the inspectors, to denounce the boilers as dangerous.

"Eternal vigilance is the price of liberty," and it is also the price of safety and economy in the use of steam power.

THE PROPER TEMPERATURE FOR CHURNING BUTTER.

For a few weeks past the Farmers' Club has devoted considerable time to the discussion of butter making, and much difference of opinion was elicited in regard to the proper temperature for churning butter.

It has long been known that the churning of butter is simply a mechanical operation, working no chemical change in the constituents of the cream. The butter exists in the milk, forming 4½ to 5½ per cent of its weight, but each little globule is inclosed in an exceedingly delicate membrane, which prevents the several globules from adhering together. By the process of churning these membranes are worn or broken, thus allowing the several globules to come together in a single mass. At a temperature below about 60° this union will not take place, while at a few degrees higher temperature the casein of the milk will mingle with the butter, giving the butter a white color and the flavor of cheese. The best butter is obtained at the lowest temperature at which the butter will come, and this is variously stated at from 55° to 66°. This difference of opinion may result from difference in the samples of milk tried by different observers, or it may be due to the fact that in some cases the temperature was observed before the churning commenced, and then the temperature was raised several degrees by the churning. It was stated in a recent number of the *Mechanics' Magazine*, that Mr. Rennie raised the temperature of water, by simply churning it, to the boiling point. While engaged in experimenting on the evolution of heat by the agitation of water, he put ten pounds of water into a churn which revolved at the rate of 232 revolutions per minute; the temperature of the water rose to the boiling point, and an egg was boiled hard in it in six minutes.

If the farmers throughout the country would buy thermometers for the purpose, and would always have their cream at 60° to 66° temperature when they churn it, the average quality of our butter would be very greatly improved, and an immense amount of labor in churning would be saved. Thermometers without cases are most suitable for measuring the temperature of liquids, as they may be easily cleaned after immersion.

Great Plan for a Steam Railroad Around New York.

At the last meeting of the Polytechnic Association, Mrs. Wilson read a paper prepared by her husband, Mr. H. B. Wilson, in which elaborate details were given of a plan for a railroad around Manhattan Island, to be sunk in a dry canal 40 feet wide, and deep enough to run the cars beneath bridges at the surface. It was proposed to build the road along the edge of the water, and to have a double track for freight, and another double track for passengers. Mr. Wilson's idea was to have this road in addition to a subterranean road beneath Broadway.

CARELESSNESS is half way between accident and intention.