

TERRIFIC BOILER EXPLOSION IN MILWAUKEE.

The scene of absolute destruction depicted in the two accompanying engravings might well be supposed to represent the effects of the detonation of a large amount of high explosive, so complete is the demolition of the building, and so thoroughly have its contents been disrupted and scattered. As a matter of fact the damage was entirely due to the explosion of a single boiler.

At first sight it would seem impossible that the amount of steam contained in a boiler at the instant of explosion should be sufficient to work the seemingly disproportionate amount of damage that generally ensues—disproportionate, that is to say, in the wide extent and violent effects produced as compared with

The boiler which exploded was one of four which were erected in one of the boiler houses at the Pabst Works, Milwaukee, Wis. The most sensational result—the one which gives a vivid idea of the energy of the expanding steam—was the fact that a big malt elevator, 60 feet high, adjacent to the boiler plant was moved four feet from its foundation. This effect will be noticed by examining one of the accompanying engravings, in which it can be seen that the remaining portions of the wall, although they are strictly parallel with each other, are out of line by about the four feet which it is estimated that the building was moved.

The wall of a machine shop, lying to the north, was blown in. Every window in this machine shop and most of the glass in the buildings surrounding the

brick chimney over two hundred feet high, which formed a part of the plant and stood over the rear portion of the boiler room, received not the slightest damage.

SOME PRINCIPLES OF BALL-BEARING DESIGN.

BY J. F. SPRINGER.

The old but constantly recurring question as to whether the top of a wagon wheel actually moves faster than the bottom is really involved in the ball-bearing problem. There is one fundamental fact implied in all questions of rolling which when once thoroughly mastered will have great effect in clearing up dark places. In rolling there is a progressive contact of one body with another of such character that there is

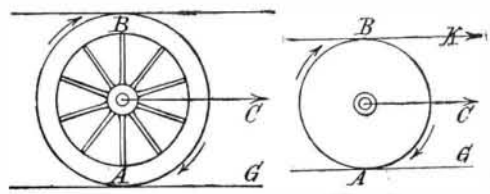


Fig. 1.

Fig. 2.

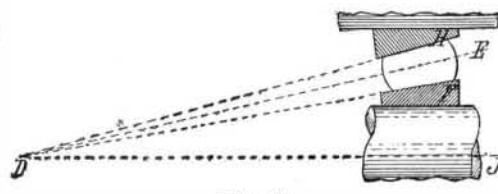


Fig. 3.

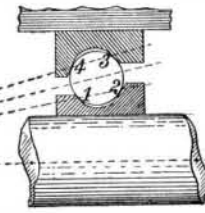


Fig. 4.



Fig. 5.

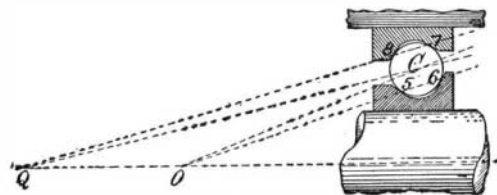


Fig. 6.

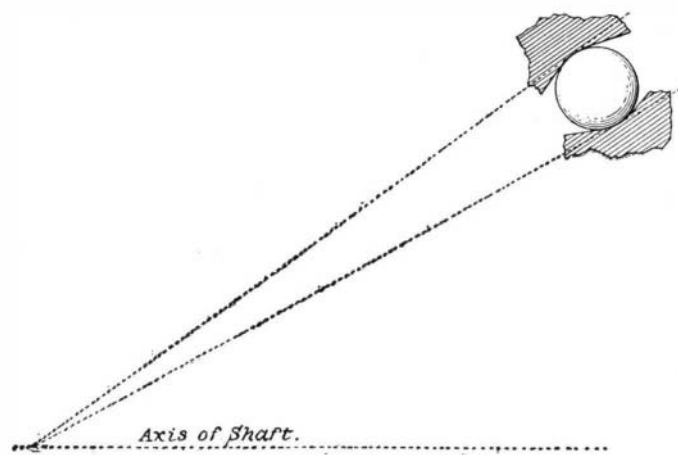


Fig. 7.

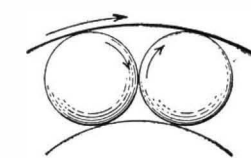


Fig. 8.

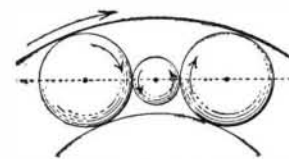
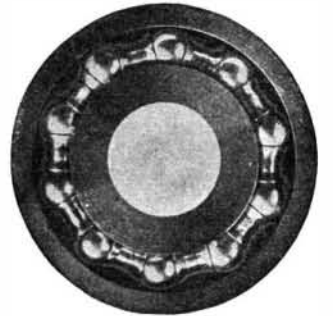


Fig. 9.



Fig. 10.

SOME PRINCIPLES OF BALL-BEARING DESIGN

the cause. Everyone who is familiar with boiler firing knows how quickly the reserve of steam in the boiler is used up in the cylinders of the engine, if the firing be not faithfully attended to.

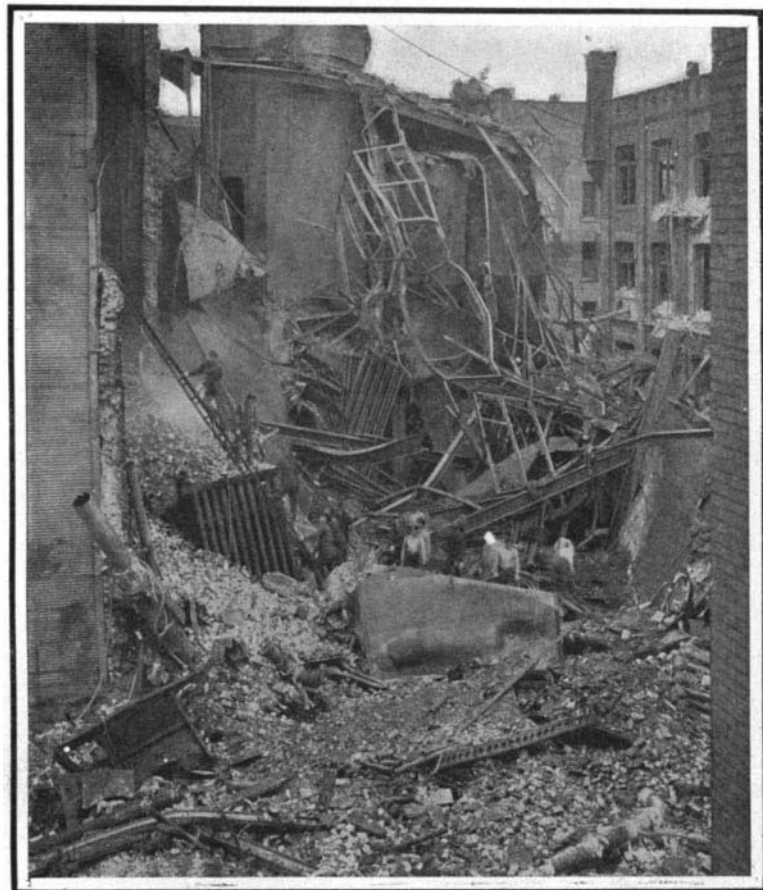
The explanation of the great damage resulting from an explosion is to be found in the fact that the boiling point of water varies with the temperature and the pressure to which it is subjected. If the pressure be suddenly reduced, a rapid ebullition of the water ensues with the emission of great volumes of steam. Consequently, when the whole of the pressure upon the highly heated water in a boiler is suddenly removed by the rupture of the boiler shell, the whole mass flashes at once into steam with a practically explosive effect, which shows itself in the lifting of roofs, the blowing out of walls, and the hurling, as is frequently the case, of the shell of the boiler to distances of several hundred yards.

plant were broken, as was most of the glass in stores and houses within a radius of two blocks of the explosion. Tenth Street, adjoining the building, was buried under tons of debris, which in some places was piled to a height of from six to eight feet. Flues, boiler pipes, and various fragments of the boiler were scattered over the street and some of them were curled up into fantastic forms.

It frequently happens in a boiler explosion, particularly if one end be torn off and the main body of the boiler be left intact, that the water, flashing suddenly into steam and rushing out through the unclosed end, reacts against the air with a violent rocket-like effect, and the mass of the boiler is driven to great distances. In the present case, a large section of the boiler went hurtling through the air across Tenth Street and fell upon the roof of a storehouse sixty feet in height, where it remained imbedded. Strange to say, a lofty

no sliding. That is to say, at the point of contact there is absolutely no movement of the one body past the other. In Fig. 1, the wheel is rolling upon the ground *G* in the direction *C*. At the present moment, the point of contact is *A*. If the motion is a rolling one, then at the point *A* there is no slip or slide. This means that the point of the wheel touching the ground at *A* has absolutely no motion. But this point on the tire of the wheel enjoys this absolute rest for the instant only. The next infinitesimal portion of time there is a different particle absolutely at rest. And so on, as the wheel rolls along, every point of the circumference in succession becomes for one instant only an absolutely quiescent point. What is moving is the position of the point of rest.

This is true whether the rolling body rolls along a straight line or not. If the line rolled upon, however, has any motion of its own, then the contacting



To the left is seen the wall of the building 60 feet high which was moved bodily a distance of 4 feet.



The debris covered this street to a depth of several feet. A large portion of the boiler was thrown across the street and landed on a roof of a 60-foot building.

EFFECTS OF A TERRIFIC BOILER EXPLOSION AT MILWAUKEE.