Service Expected from Various Machine and Structural Parts.—We do not know with certainty whether any material can resist an infinite number of repetitions of any stress however small. The safest view for an engineer to take seems to be that under repeated stress materials of construction have a limited "life." The exponential formula for repeated stress gives results in accordance with this view. If this view is held, the number of repetitions which any structural or machine member will have to withstand in normal service becomes of importance. The following list gives the numbers of repetitions of stress which may be expected to be applied to various machine and structural members. The list is intended to be suggestive rather than to serve as an exact guide.

The members of a railway bridge carrying 100 trains per day for a period of 50 years would sustain about 1,826,000 repetitions of stress. The stress would vary from the dead-load stress to a live-load stress averaging somewhat below that caused by the passage of the heaviest locomotives.

A railroad rail over which 250,000,000 tons of traffic passes would sustain something like 500,000 repetitions of locomotive wheel loads, the stress being slightly more severe than a repetition from zero to a maximum. The rail would have to stand, in addition to the locomotive wheel loads, something like 15,000,000 repetitions of stress caused by car wheel loads. The stresses set up by car wheel loads would be about half as great as the stresses set up by the locomotive wheel loads.

A mine hoisting rope bent over three sheave wheels and operating a hoist 100 times a day, in a term of service of five years would sustain 550,000 repetitions of stress. If the sheave wheels are so placed that they reverse the direction of the bending of the rope the range of stress would be nearly a complete reversal; if bending takes place in one direction only the range of stress is from nearly zero to a maximum.

The piston rod and the connecting rod of a steam engine running at 300 r.p.m. for 10 hours per day, 300 days per year for 10 years, sustains 540,000,000 repetitions of stress, and the range of stress involves almost complete reversal.

A band saw in hard service for two months sustains about 10,000,000 repetitions of stress varying from nearly zero to a maximum.

A line shaft running at 250 r.p.m. for 10 hours a day, 300 days per year, sustains during a service of 20 years 900,000,000 repetitions of bending stress due to force transmitted by belts, gears, and driving chains. The stress is almost completely reversed. It should be noted that for the line shaft the torsional stress is not repeated nearly so often as is the bending stress.

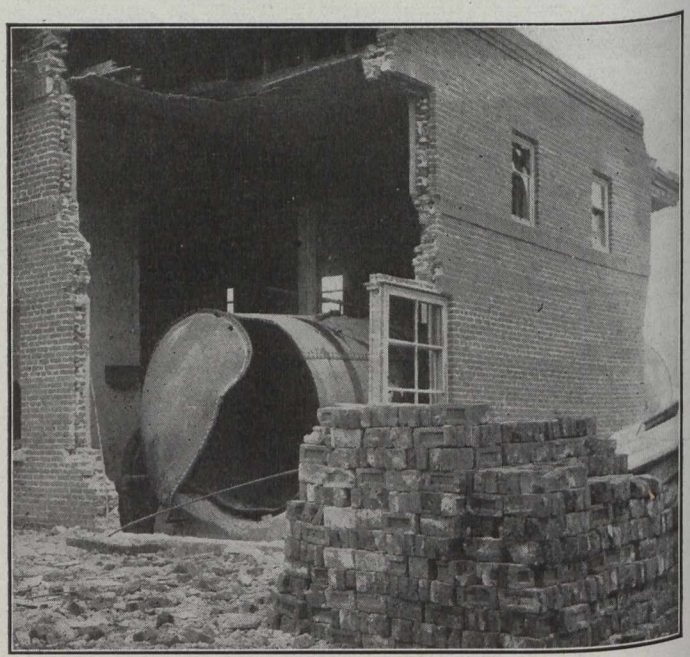
The shaft of a steam turbine running at 3,000 r.p.m. for 24 hours per day, 365 days in a year during 10 years' service sustains 15,768,000,000 reversals of bending stress caused by the weight of rotating parts and the tangential force of the inrushing steam.

In the United States Geological Survey Press Bulletin No. 233, Sept., 1915, it is stated that a ton of absolutely pure limestone would burn to a little over half its weight of lime, or about 1,120 pounds, which, counting 80 pounds to a bushel, would give 14 bushels of lime to a ton. The weight of the burned product, however, generally averages more than this, owing to impurities in the limestone, and also because in ordinary kilns the combustion is not complete enough to drive off all the carbon dioxide. A cubic foot of limestone averages in weight from 145 to 175 pounds, which would make a ton of limestone contain from 11 to 14 cubic feet.

BURSTING OF WATER TANK AT CANORA, SASKATCHEWAN.

The corporation of the town of Canora, Sask., suffered a loss on September 23rd, which crippled their fire protection and did considerable damage to their town hall and power station. The water storage tank which was located in that portion of the municipal building occupied by the electric light plant, burst while being filled with water, the unfilled portion containing air under pressure. The extent of the damage to the building and the tank itself is shown in the accompanying view. The tank was raised from its foundation and forced back about four feet. While half a dozen rivets pulled through the metal of the shell, the remainder held, thus tearing a strip from the end of the shell along the centre line of the rivet holes.

The cause of the accident was found to be due to the relief valve being badly corroded and the tension spring



Results of Explosion of Water Storage Tank at Canora, Saskatchewan.

filled with rust. This valve was so placed that the waste or overflow from other pipes discharged over the top of it, thus causing the heavy corrosion. The pressure gauge, too, shows heavy corrosion and is reported to have registered but 40 lbs. per sq. in. The relief valve was set at 100 lbs. per sq. in.

This tank, which is 9 feet in diameter and 38 feet long, formed a part of the Hoosier high-pressure system which was installed in 1912 for fire protection only. Similar systems have been installed for fire and domestic supply by the corporations of Yorkton, Wilkie, Melfort* and Old Battleford.

The town of Canora has now under construction a more complete system of waterworks which was designed by Messrs. Chipman and Power and which will be ready for initial test about October 15th of this year. The steel stand pipe which is being constructed for the new system is shown in the background of the photograph.

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*See *The Canadian Engineer*, January 29, 1914.