A GIGANTIC CLOCK.

BY DR. ALFRED GRADENWITZ.

Few mechanisms exert the same fascination on the human mind as a clock. This instrument, measuring the most important factor of modern life, time, is in fact the most indispensable utensil of our activity. This explains why from the very earliest times of the watchmaking art some especially skilled constructors should have devoted so much attention and energy to the production of real marvel clocks. These endeavors to outdo one another by the construction of ever more complicated clocks have been continued to modern times. An interesting example is afforded by the clock that has been recently installed in the bell tower of the St. Gervais basilica at Avranches (France) and of which a short description is given in the following. The clock was constructed by Mr. Gourdin at Mayet (Sarthe) and claims to be the largest in France.

It comprises five works, viz., a regulating works and four striking works. The former, which is provided with a remontoir escapement, regulates and disengages the striking works; by means of hollow steel rods 38 m. (124 ft.) in total length, and 6 gear trains it actuates 7 dials, viz., 4 external dials 1.4 m. (4.6 ft.) in diameter, and 3 internal dials of smaller dimensions. The regulating works at the same time operate a large bronze wheel upward of 1 meter in diameter, carrying 96 pins, each of which corresponds to a quarter of an hour, and by the aid of which the various ringing effects are produced automatically.

These ringing effects are obtained by means of four clockworks, one of which serves for the hours, one for the quarters, and the two remaining for the several chimes, which are the following: The quarters ringing works will play the hymn "Inviolata," the first 5 notes being produced at the first quarter, further 8 notes with the second, and 11 notes with the third quarter, while with the fourth quarter, before the hour is rung, the whole phrase, "Inviolata, integra et casta es Maria," is heard.

At noon and at 7 o'clock in the evening the "Inviolata" is automatically replaced by some tune varying according to the season.

The hours are rung by means of a hammer 100 kgs. (220 lbs.) in weight on a bell weighing 6,454 kgs. (14,228 lbs.), the working weight of this clockwork being only 300 kgs. (661 lbs.) Another 22 bells representing a chromatical scale and varying from 33 to 2,230 kgs. (4,916 lbs.) in weight, has been provided for ringing the quarters and operating the chimes. The most remarkable feature of the latter is that the number of tunes is increased at will, the cylinders on which the cams of the hammers are located being readily exchanged, like those of a phonograph, provided the tunes in question fit into the series of notes represented by the 23 bells. The large cylinder visible in Fig. 1 to the right carries the cams, gearing with the ends of the bell hammers by means of the levers lifted by their aid. Each bell has been provided with two hammers, the weights of which, according to their size, vary from 6 to 20 kgs. (13 to 44 lbs.).

The dials of the clock are of ordinary dimensions, only the power and automatic operation of the ringing mechanisms as well as the weight of the hour's hammer (100 kgs.) being remarkable.

The aggregate weight of the whole clockwork is 2,000 kgs. (4,409 lbs.), its length being 4.15 m. (13.6 ft.), its breadth 1.90 m. (6.2 ft.), and its height 2.40 m. (7.8 ft.). The wheels of the ringing works are 0.60 m. (23.6 in.) in diameter.

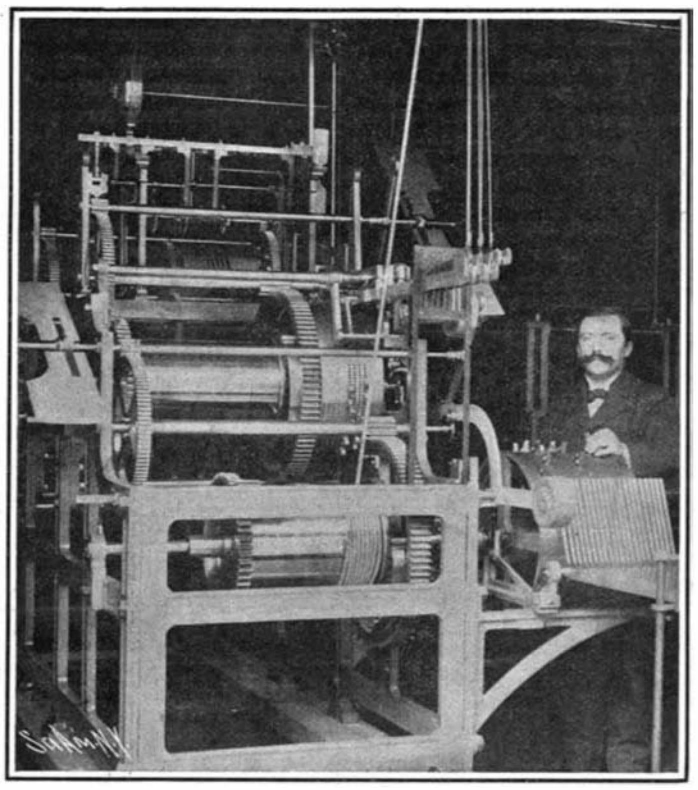

Fig. 1.—End View of Mechanism.

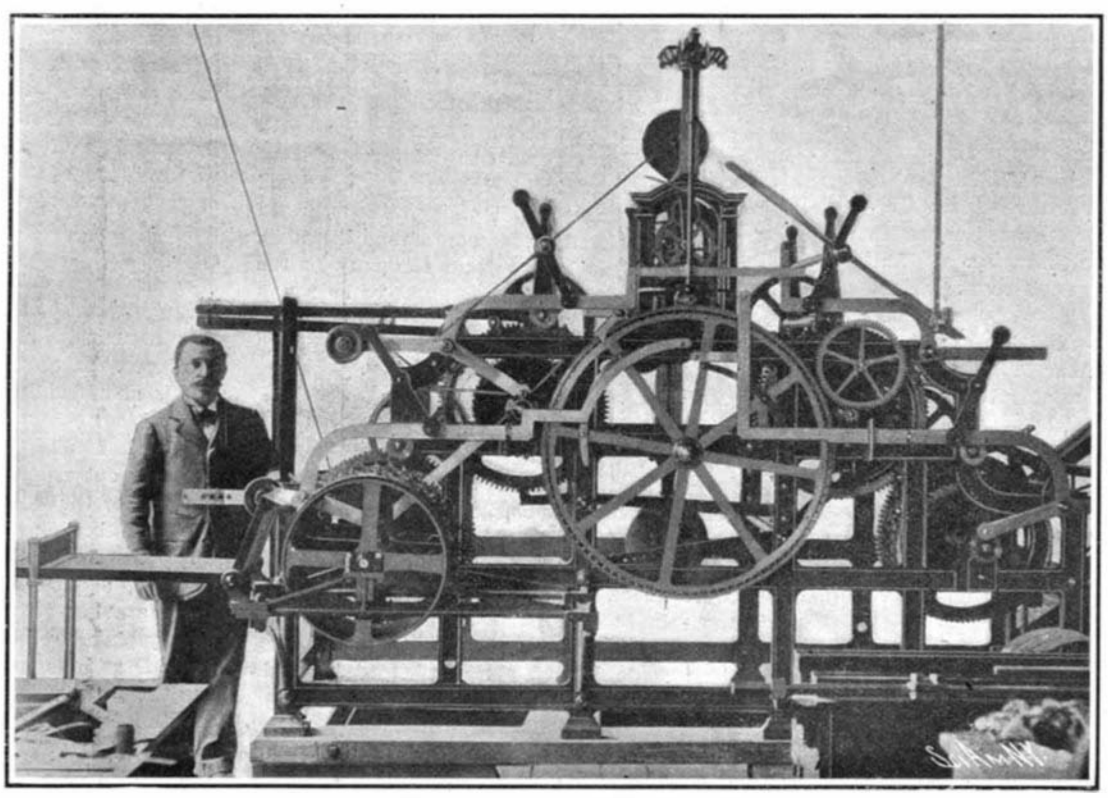

Fig. 2.—Front View of the Mechanism.

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A professor at Lehigh University has made a calculation to show that if a tiny vessel of one cu. cm. (0.061 cu. in.) capacity is filled with hydrogen corpuscles there can be placed therein, in round numbers, five hundred and twenty-five octillions—525,000,000,000,000,000,000,000,000—of them. If these corpuscles are allowed to run out of the vessel at the rate of one thousand per second it will require seventeen quintillions—17,000,000,000,000,000,000—of years to empty it. We leave it to our readers to calculate how long the filling process will require.

Vanadium Steel in Automobile Manufacture.

Automobile construction has put steel makers to a severe test. To obtain strength, durability, and elasticity and yet to reduce weight are problems of no mean order. Many experiments and tests are necessary to get the best results.

Preparing metals for automobile construction requires entirely different methods from those for other engineering specifications. Steels that under ordinary circumstances would stand the usual static tests, would prove unavailable if tried under the severe dynamic strains to which they would be exposed. J. Kent Smith, the English metallurgist and exponent of vanadium, in an address to the Mechanical Branch of the Association of Licensed Automobile Manufacturers, stated that from 80 to 90 per cent of the breakages were caused by dynamic strains to the metal, leaving only 10 or 15 per cent as the result of the static. It has been the aim of each engineer to discover the best grades of steel for each specific part of an automobile, which would withstand the particular dynamic strain to which it would be subjected.

In vanadium there seem to be found all the elements to give the desired requirements. Vanadium is peculiar in that unlike many other metals it has no value in itself, but when alloyed with steel has infinite capabilities. Vanadium has long been known. It is found in small quantities in Swedish ore, but in such small quantities that its use was prohibitive.

The addition of vanadium to various steels has overcome in many ways the difficulties that have presented themselves in dynamic forms to the specific duties of certain grades of metals. It is a most elusive element, and its presence is not always known. If there is any oxide left in steel, it will be cleaned out by the vanadium. To use it as an agent for this work, however, is very expensive. An analysis of a steel known to contain vanadium will not always result in the finding of a percentage that has been put in, although tests will show its presence in certain degrees. For example, it may be known that 15 per cent has been put in an open-hearth casting, whereas the analysis will show but 4 per cent. This is because its introduction is improper. It is quite useless to introduce vanadium in oxidized steel because you cannot find any vanadium in the steel. It naturally did its easiest work first, seizing the oxygen, so that the steel did not receive the dynamic qualities of the element. Its work was confined to cleansing.

Unlike many other elements, vanadium, to get the best results, must be used in extremely small quantities. A little goes a great way, too much being as useless as not enough. For casehardened steel from 1½ to 2 per cent remaining in the steel will give better results than a less amount, although even if properly introduced 10 per cent of the amount put in, that is, 10 per cent of the 2 per cent, must be counted as a loss.

In some instances steel makers have directed their efforts to attaining a satisfactory tensile strength, which is of course necessary, but in many cases the tensile strength has been increased to the detriment of the dynamic qualities of the metal, and this often without needing the maximum tensile strength for some specific duty of the steel. With the addition of vanadium the same tensile strength may be maintained or even lowered with the dynamic qualities increased, but for certain conditions the dynamic qualities would not be necessary. This would apply to the parts of an automobile where a steady and consistent strain is maintained.

Bending tests by Prof. Arnold have shown that vanadium steel will stand a much higher alternating stress test than steels containing any of the other alloys. A high carbon may break at 100 alternations. Steels of the best acid or open-hearth casting will run as high as 290. An excellent quality of nickel steel ran to 270, while vanadium steel has attained as high as 570, or nearly 100 per cent better than a good nickel compound.

The life of steels, pure carbon steels, is materially lengthened by the addition of this alloy. A pure carbon steel on test ran to 280; the same after the addition of vanadium ran to 480. The simple addition of vanadium to a low-carbon steel raises its tensile strength or the elastic limit of the steel. In regard to nickel steel, vanadium does not increase the life of the steel when tested beyond its elastic limit. Where the dynamic qualities enter into the duties of a metal, it has been found that the intensifying of chrome by vanadium has given the most satisfactory results. Where the requirements are more static than dynamic, or an equal proportion of both, vanadium nickel has proven to be the better.

The principal parts of an automobile that are constantly receiving the sudden or unexpected shock or strain will be most benefited by vanadium steel or vanadium chrome. Axles, springs, frames, crankshafts, and gears should be specifically adapted to the dynamic conditions imposed upon them. In casehardened gears, tests have proven that vanadium chrome has been used to great advantage.

Vanadium has proven a most satisfactory alloy because it works so generally. It works in more than one direction, but these directions can be directed to get the maximum results if properly handled. It has an advantage in that it machines nicely. Vanadium chrome machines almost like a carbon steel. There is no apparent difference in machining a carbon axle and a chrome-nickel axle. A vanadium chrome shaft is a little stiffer to machine than an ordinary carbon crankshaft, but it is no more difficult than an ordinary nickel crankshaft, and not as hard to machine as a nickel-chrome would be. In forging it is the same way, not being more troublesome than a plain nickel steel. On the whole, the introduction of vanadium steels for particular parts of automobile construction has been accompanied by the most satisfactory results. It has been conceded that chrome vanadium steel is the finest steel ever used for building moving machinery.