lower end, inserting the plug in the upper, and giving a quick, strong inspiration, the bullets may be easily thrown fifty feet. But out of compliment to the burgomaster, and in order to see the experiment in its perfection, the vacuum method should be adhered to.

NEW ISOCHRONAL CLOCK.

There is some doubt as to when the first clock was made, but historically we find mention of the production of a clock in 1232. All of the early clocks subsequent to this show a great inventive skill and wonderful constructive ability; but until the discovery of the isochronal property of the pendulum by Galileo, the mathematical investigation of the pendulum by Huygens, and the adaptation of the pendulum to the regulation of the motion of the clock by Harris, about 200 years ago, nothing like a perfect time-keeping clock was known.

Probably no single machine was ever made in so many forms or in so great numbers, nor at so small cost, considering the great number of parts, the accuracy with which the parts are made, and the care with which they are assembled. Of course the great majority of clocks only approximate accuracy. A few are reasonably accurate, but even these have errors which must be compensated.

Recognizing the fact that an absolutely perfect clock did not exist, Mr. H. Conant, of Pawtucket, R. I., has devised and patented a clock in which an average of time as kept by a number of pendulums and escapements of the most perfect construction is indicated by the main hands and dial. This clock is shown in the annexed engraving. It is a fine piece of mechanism, made by Tiffany & Co., of this city.

This clock is provided with four pendulums and four escapements arranged in pairs, as shown in Fig. 2. Each pair of scape wheel arbors carry pinions, which engage in the large spur wheels, which are placed loosely on their supporting shafts, and act as intermediates to transmit power from the main train to these several escapements. Fig. 3 shows in detail the arrangement of these wheels. Power is received by the middle wheel, B, and it is transmitted to the wheels on each side of it by means of the little planetary bevel wheel, C, which is fixed with its axis radially to the supporting shaft, and is carried around as the wheel, B, revolves. This arrangement will allow one of the pinions being stopped, or to move at a speed different from the wheel, B, or its mate on the opposite side of B, and is known to mechanics as a compound or differential gearing. In this case it acts to average the motions of the side wheels, A A, into the middle wheel, B, for it will be seen that if another pinion wheel be acted upon by the wheel, B, that this pinion would move at the average speed of the pinions driven by A A, which is the half of the speed of each added together. Then calling the assemblage of wheels in Fig. 3 an intermediate mechanism, it will simplify the description to say that the second pair of pendulums and their escape wheels receive their impulse by a duplicate mechanism, and that these two pair of pendulums are impelled by a third mechanism, whose central wheel is impelled by the pinion on the shaft of the sweep seconds shaft on the main dial, said pinion being a part of the main train, which is made correspondingly heavier and stronger, and is driven by a heavier weight than ordinary, inasmuch as the four escapements require four times the weight to give them proportionate effect. Thus it will be seen that the seconds hand of the main dial moves at an average of that of the four pendulums, and responds to the ticks of each.

To show fully the action of the clock, we will suppose that it is all ready to run, and the seconds hands, both of the pendulums, and the main dial are all set at 60 or zero, and the pendulums are at rest. We will now start pendulum No. 1. The pendulum ticks seconds, and the second hand of that escapement will revolve once in exactly one minute. But the seconds hand of the main dial, although it responds to the ticks of that pendulum, only moves forward one-fourth of a second, and will not complete a revolution until the first has made four revolutions. This shows that the value of the ticks of each pendulum is but a quarter of a second to the main seconds hand. Now, in corroboration, starting another pendulum will increase the speed of the main hand by another equal factor, and three pendulums moving will give three-fourths speed, while the four will impart a speed equal to one-fourth of each added together, consequently an average of the speed of all.

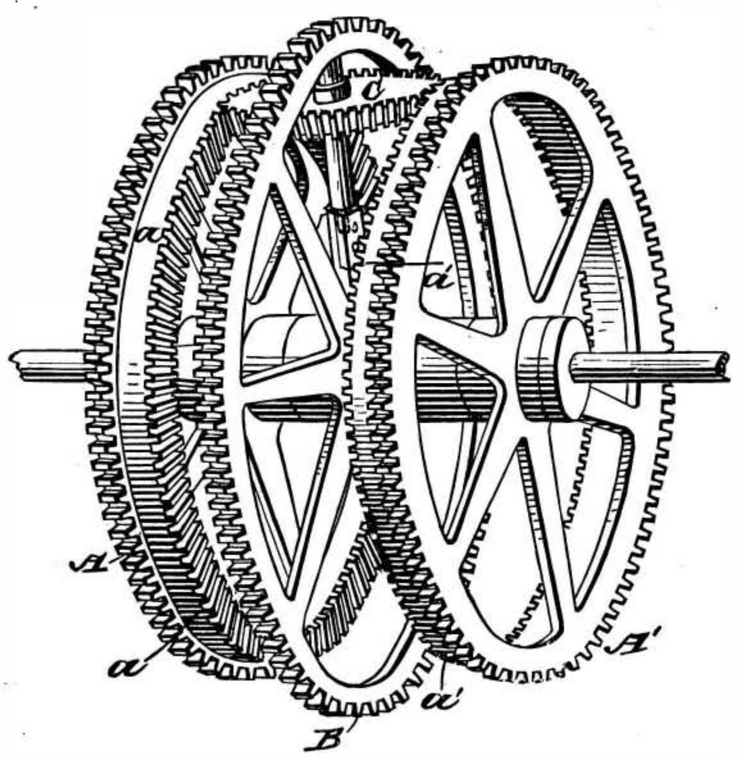

Fig. 3.—THE AVERAGING WHEELS.

To give room, the clock is made rather wider in its case than ordinary, and two pendulums are in front and two are in back. A plate of thick glass is put between the front and back pendulums, and is intended to cut off any sympathy caused by the motion of the air.

This clock is much easier of regulation than the ordinary clock, for the reason that it is not necessary that each pendulum should keep correct time, but that it should have a steady rate, and if it is too fast, it is corrected by another going correspondingly too slow; and the inventor believes that pendulums will have a steadier rate when thus associated than when isolated, quality and other circumstances being equal.

It will be readily understood from this description that these instruments can be made with two, four, eight, or even sixteen pendulums, or marine escapements, as desired for accuracy. This one here described was made for the purpose of exemplifying the invention and testing the workings of different compensating pendulums.

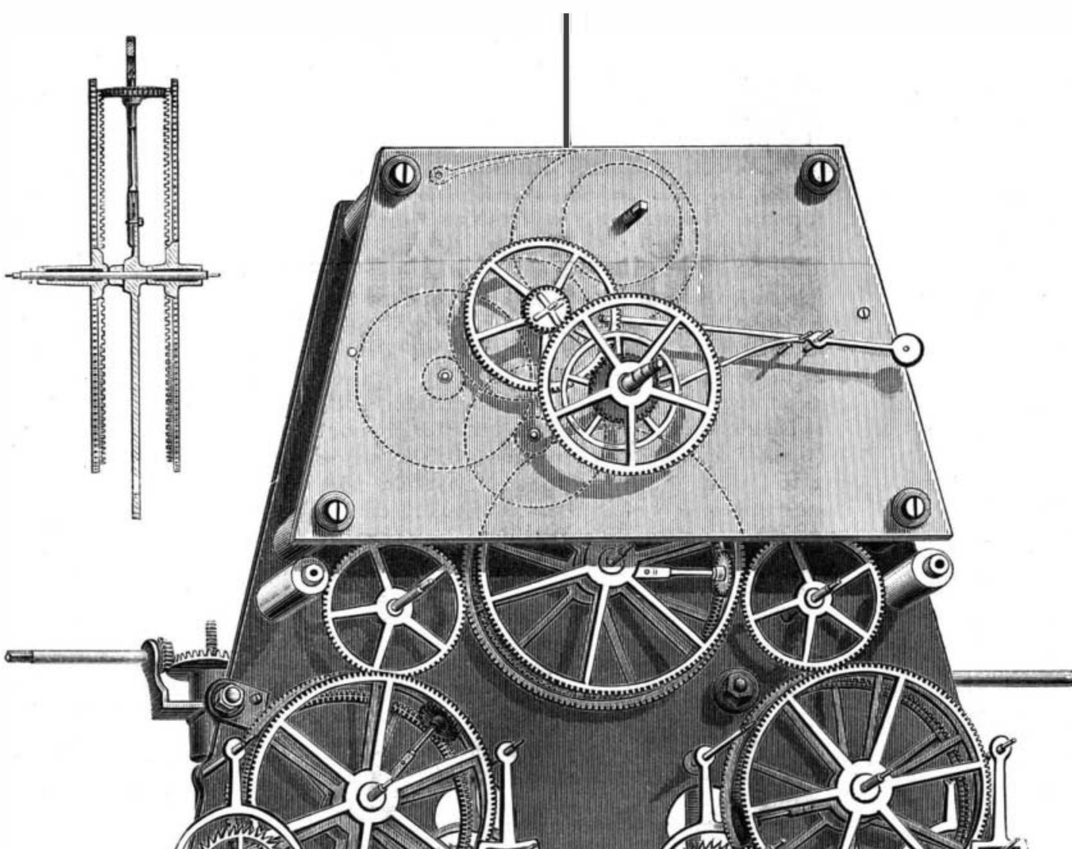

Fig. 2.—TIME AVERAGING MECHANISM OF CONANT'S CLOCK.

New Secondary Battery.

A new type of secondary battery was employed on the electric launch recently tested by the French naval authorities at Havre. The inventor is a M. Desmazures, and the cell is constructed as follows: A cylinder of tin plate forms at once the containing vessel and a portion of the negative electrode, which is a sheet of the same material. The positive electrode is made from a plate of porous copper, obtained by subjecting the metal in a state of powder to a pressure amounting to several tons on the square inch. This plate is separated from the negative element by a partition of parchment paper supported on glass rods, the object being to prevent copper oxide reaching the negative element and causing a film of metallic copper to be there deposited. The cell is filled with a mixed solution of zincate of soda and sodium chlorate, and is then hermetically sealed. The charging is effected in the usual way, the result being a deposition of metallic zinc on the negative electrode, which is redissolved on discharging. The number of cells used at Havre was 132, which furnished a current of from 87 to 89 amperes under a difference of potential of 100 to 104 volts, and the weight per horse power per hour was about 73 pounds.

Wild Geese in Dakota.

A traveling correspondent now in central Dakota says they had a cold snap there in the latter part of October, when the temperature quickly fell to 12° F. below zero. One curious effect of the cold was to bring down immense flocks of wild geese. Seen from the car windows, when they alighted on the stubble fields they looked like great snow banks, covering many acres of ground. Mr. Goose unlike Mr. Buffalo seems to augment in numbers. They are exceedingly shy and difficult to shoot. The best way to capture them is to dig a pit near where they feed, stick up two or three dozen decoys made of sheet iron painted up, and when a flock flies over they come down out of curiosity. If a man is sunk in the ground up to his shoulders, they don't recognize him. Another way is to approach a feeding flock with a team of horses, of which they are not shy. They don't seem to see a man if he remains in a wagon. Skirt the flock as close as possible, then suddenly turn and run the horses straight for them at top of speed. They rise slow, and one can get directly under, oftentimes, and bang away with results.

Two men brought fifty-seven in half a day. They are fine, large game, about the size of domestic geese, and nice eating.

Artesian wells are growing quite fashionable in this central part of Dakota. I meet them quite often. Any town that makes any pretense to be a town must now have its artesian well. They all seem to be about 900 to 1,100 ft. deep, and cost from about $3,500 to $4,000 each, with a pressure of 180 to 200 lb. to the square inch. W. Y. B.

Ostriches.

A correspondent at Cape Colony, South Africa, writes us as follows: A curious habit of these birds was witnessed on the farm Guilford, in the Queenstown district, by the proprietor and some of his family and servants during the late rains.

The nest, which is merely a large, flat, saucer-like hole in the ground, became flooded; and when the water did not directly drain off, the two parent birds began to drink it up till the nest was drained dry.

The poor hen bird was so full that she seemed quite sick; the cock, however, drank his full share as in duty bound, being the most assiduous in all matters pertaining to the incubator, always sitting on the eggs himself by night.

The Isolation of Fluorine.

This recent scientific achievement of M. Moissan has been made the subject of a report to the Chemical Section of the French Academy, which, according to *Engineering*, sets forth the work of preceding chemists leading up to the late discovery. From this it appears that Scheele and others taught us how to prepare fluoric acid, and Davy attempted to isolate fluor, or fluorine, as he called it. Since Davy's attempt several others have tried it by electrolysis, some of these injuring their health in the process. M. Moissan succeeded by the electrolytic method, and came to the conclusion that the gas which is disengaged at the positive pole by electrolysis of anhydrous fluorhydric acid is fluor. This conclusion has been justified by the report of the above mentioned committee. This gas was found to have the following properties: It is completely absorbed by mercury, with the production of protofluoride of mercury; it decomposes cold water, disengaging ozone; phosphorus burns in it, producing fluoride of phosphorus; sulphur warms, melts, and even flames in it; iodine is transformed in it to a colorless gaseous product; antimony and arsenic in powder burn in it; crystalline silicium takes fire and burns in contact with it, producing fluoride of silicium. Adamantine boron burns in it with greater difficulty. Carbon seems unaffected, but iron and manganese in powder burn in it with sparks. It attacks most organic bodies with violence; alcohol, ether, benzine, turpentine, and petroleum take fire in contact with it; and fused chloride of potassium is attacked, cold, by it, with disengagement of heat.

Edison's Improved Phonograph.

We recently gave some account of this, but the following report of an interview with Edison by a *World* reporter contains additional particulars which are both curious and interesting. In answer to about two hundred questions, more or less, Mr. Edison said:

"Perhaps I am wrong in telling you anything about my phonograph, because what I claim for it is so extraordinary that I get only ridicule in return. I am so confident that when the apparatus appears it will dispel all doubts as to its practicability and working value that I can afford for the present to ignore all kinds of criticism and keep at my work regardless of the storm which I have been raising by telling a few people that there was such a thing as a perfected phonograph in existence. I am sure that while scientific men may doubt that I have succeeded as well as I say I have, they will admit that there is nothing at all impossible in what I claim, and that the germ of the perfected phonograph, should such a thing appear, is very clear in my old toy of ten years ago, which was exhibited all over the country, and was then acknowledged to be one of the wonders of the century. Just consider for a second what my old phonograph is, and think how little needed to be done to bring it to a working instrument. With my roughly constructed instrument of 1877 I reproduced all sorts of sounds, getting back from the phonograph something like the original sound. Of course, you had to yell into the thing, and the reproduction of conversation was often something of a caricature of the original. Nevertheless, to obtain a result that could be understood was doing wonders, and most people who remember my exhibitions will admit that while I did not produce a commercial machine, I made a very interesting and creditable attempt, and my whistling and singing phonograph was a wonder.

"There were all sorts of objections in detail to my first instrument. It weighed about one hundred pounds; it cost a mint of money to make; no one but an expert could get anything intelligible back from it. The record made by the little steel point upon a sheet of tin foil lasted only a few times after it had been put through the phonograph. I myself doubted whether I should ever see a perfect phonograph, ready to record any kind of ordinary speech and to give it out again intelligibly. But I was perfectly sure that if we did not accomplish this, the next generation would. And I dropped the phonograph and went to work upon the electric light, certain that I had sown seed which would come to something. For ten years the phonograph has come up in my brain automatically and almost periodically. I would turn it over and over mentally when I had nothing else to think about. When I couldn't sleep at night, when traveling, when worried about business affairs, I would think the phonograph over and jot down any new ideas for future experiments. Eight months ago I began laboratory work upon it again, and a month ago I stopped because I could see no further improvement to be made. It is a finished machine—simple, cheap, effective, not liable to get out of order, and it does everything that I ever hoped the perfected phonograph might do.

"My phonograph will occupy about as much space on the merchant's desk, or at the side of the desk, as a typewriter does. It will work automatically by a small electric motor, which runs at a perfectly regular rate of speed, is noiseless, and starts or stops at the touch of a spring. Suppose the merchant wishes to write a letter; he pulls the mouthpiece of the phonograph to him, starts the motor with a touch, and says what he has to say in an ordinary tone of voice. When he is done, he pulls out a little sheet and rolls it up for the mail. The recipient places this sheet in a similar phonograph, touches the motor spring, and the instrument will at once read out the letter in a tone more distinct, clearer, more characteristic of the voice of the writer than any telephone you or I ever heard. The phonograph voice is not a loud voice, perhaps not more than twice as loud as the sound you get from a good telephone, and an earphone will be necessary. This, however, may not be an objection, inasmuch as people do not always want to have their letters heard all over the office. In aiming for loudness in the phonograph, I went astray in my first experiment. I should have tried for clearness. The present apparatus will satisfy any one who is half satisfied with the telephone. Of course, there are no disturbances in the phonographic message such as those made by induction along a telephone wire; and as the apparatus will repeat the letter over and over again, it is possible to understand every syllable, even in a noisy office. I was so overcome with the success of my first instrument, finished about six weeks ago, that I doubted whether I could make another equally good, and I went to work at once to do so. My second instrument works as well as the first, and I have forty workmen employed in making the tools for the manufacture of the first lot of 500 phonographs. They will cost $60 apiece.

"Now for some speculation as to what people may do with the phonograph. I am confident that it will be found in the office of every busy man. I am confident that the editor and the reporter of the future will never think of losing time by writing with a pen or dictating to a stenographer when the printer can set type better from the dictation of the phonograph than he can from copy. I have already perfected an apparatus which allows the phonographic message to be given out in pieces of ten words each. The printer touches a pedal with his foot, and the phonograph says ten words. If he sets the ten correctly, he touches the pedal again and gets ten words more. If he is in doubt he tries another pedal, which makes the phonograph repeat. In the future some method may be found of combining the phonograph and the telephone—that is to say, the phonograph may be made so delicate as to take down the sound from a telephone and give it out again when wanted. As yet I have not attempted any such thing. The vibrations of the telephone diaphragm are too delicate for use in the phonograph. In business I think that the phono raph will be used everywhere. Outside of business it is hard to say exactly to what uses it may be put. As it will record and repeat any kind of musical sound, and as the process of duplicating the phonogram, as I call my sheet of metal which has passed through the phonograph and become impressed with certain sounds, is very cheap, the phonogram copy of a lecture, a book, a play, or an opera need cost but a trifle.

"For music I know that you will simply laugh when I tell you what I have done with the two instruments that I have finished. I have got the playing of an orchestra so perfectly that each instrument can be heard distinct from the rest. You can even tell the difference between two pianos of different makes; you can tell the voice of one singer from another; you can get a reproduction of an operatic scene in which the orchestra, the choruses, and the soloists will be as distinct and as satisfactory as opera in this sort of miniature can ever be made. Opera by telephone has been done in Paris and London more or less successfully, but the phonograph will eclipse the telephone for this purpose beyond all comparison, and phonographic opera will cost nothing, because the phonogram can be passed through the phonograph, if necessary, a thousand times in succession, and once the machine is bought there is no other cost beyond the trifle for phonograms. For books the phonogram will come in the shape of a long roll wound upon a roller. To make the first phonographic copy of a book some good reader must of course read it out to the instrument; once that is done, duplication to any number of thousand or million copies is a simple mechanical work, easy and cheap. Now, just think a moment what that means.

"Suppose you are sick, or blind, or poor, or cannot sleep. You have a phonograph, and the whole world of literature and music is open to you. The perfected phonograph is going to do more for the poor man than the printing press. No matter where he is, the poor man can hear all the great lecturers of the world, can have all the great books read to him by trained readers, can hear as much of a play or an opera as if he was in the next room to the theater, and all this at a cost scarcely worth mentioning. I remember that when the telephone was first announced it was said that now people in the wilds of Africa or America might assist nightly at the performances of the Paris Opera House. The wires from that favored spot might run to all parts of the world. Well, we have not yet got to that, though it is a scientific possibility for the future to perfect in detail. But the phonograph will make such a thing perfectly easy. The phonographic record of a performance at the Paris Opera House can be duplicated by the thousand and mailed to all parts of the world. I don't know but that the newspaper of the future will be in the shape of a phonogram, and the critic will give his readers specimens of the performance and let them hear just how the future Patti did her work, well or otherwise. This sounds like the wildest absurdity, and yet, when you come to think of it, why not? Have I told you enough to make you believe that I am joking? Well, I am nothing of a joker, and this is all the most sober kind of statement. Within two months from now the first phonographs will be in the market."

The reporter to whom Mr. Edison told all this in his usual earnest and quiet manner asked several expert scientists what they thought of it. Not one was found who was willing to say that there was anything impossible or even improbable in what Edison claims to have done. The points of detail mentioned as difficulties about which Edison had said little or nothing were, first, the scarcity of good small electric motors, perfectly regular and perfectly noiseless; secondly, the difficulty of making a recording sheet for the phonograph which would not wear out when passed through the instrument a great many times. This was one of the old troubles of the first phonograph. Edison says that he has made a perfect motor and also a perfect material for his phonograms, but as yet he will not show either to outsiders.

How to Copy Photographic Magic Lantern Slides.

A correspondent in the *English Mechanic* suggests the following mode for making magic lantern slides. We submitted the article to an experienced photographer, who expresses some doubt as to its working satisfactorily, but at the same time he recommends amateur photographers to try the receipt, and if not found satisfactory, that they experiment with other ingredients or the same substances in other quantities until they discover a better process.

The process is known as the "blacklead" process, and the principle of it is that gum arabic becomes insoluble when placed in contact with white light. The following ingredients must be mixed carefully, and allowed to remain 24 hours before using:

Gum arabic	60 grains.
Glucose	45 grains.
Glycerine	10 minims or drops.
Water	2 ounces.

When well melted add (in a dark room) 30 grains of potassium bichromate.

A glass plate, the size of the slide about to be copied, is well cleaned and coated (in the dark room) with the above solution. When quite dry, it must be well heated previous to exposure in the printing frame. The exposure of this sort of plate, like any other, can only be found by experience; for, of course, a great deal depends on the density of the photograph and the brightness of the light. This process differs from ordinary photography in this way: In photography a positive will give a negative, and *vice versa*. In this process a positive gives a positive and a negative a negative.

Having exposed the plate for a sufficient length of time, you now develop by brushing over it with a large camel's hair brush the finest blacklead. It will now be observed that that part of the plate which saw most of the light will be insoluble, and the blacklead will not stick there; but on that part of the plate which saw no light the gum arabic will be soluble and the blacklead will adhere. To get the photograph dense enough, you will have to keep rubbing in the blacklead for a considerable time. Having developed it sufficiently, you now pour on some thin collodion, so that every part will be covered, and then tilt the plate up on one side to drain. When well drained dry well, and then wash in clean cold water for two hours. Remember that without the collodion the picture will fade away when put in water, and that the plate must be washed until the collodion is perfectly dry.

The reason that you wash the plate after collodionizing is that all the potassium may be removed. When completely finished, it is a good plan to cover the side with the photograph on it with a piece of clear glass to protect it, binding the two together with an edge of black paper—needle paper is the best.

Destruction of the Phylloxera.

Dr. Clemm has patented the following process in most civilized countries:

He incorporates with the soil sulphides and carbonates which easily undergo decomposition, preferably those of potassium. Peat which has been made to absorb sulphuric, nitric, or phosphoric acid is then also introduced. The acid gradually acts upon the sulphide and the carbonate, liberating sulphureted hydrogen and carbonic acid in the soil. These two gases, according to the experiments of Dr. Eyrich, of Mannheim, are rapidly and uniformly distributed, and prove fatal to the *Phylloxera* in its underground stage, as well as to Colorado beetles, field mice, moles, etc. The potash remains in the soil as a sulphate, nitrate, or phosphate. The question is whether useful animals, such as earthworms, humble bees, carnivorous ground beetles, etc., will not be destroyed also.