THE TELLTALE PLUMMET IN THE WASHINGTON MONUMENT.

BY C. FRANCIS JENKINS, C.E.

Doubtless the longest plumb line in existence is that suspended in the Washington Monument, which has a free swing of more than 510 feet. It is of hard drawn copper wire, $\frac{3}{64}$ inch in diameter, and is suspended, for protection, in a galvanized iron pipe. The wire is located in a plane cutting the center of gravity of the monument, which is 174 feet 10½ inches above the door sill. The plummet was set June 12, 1887, with the top end of the wire fastened to an adjustable brass screw in an I beam about 10 feet from the west wall.

In the plummet house (which is riveted to the vertical protecting pipe), at the base, is a hollow iron pedestal, one side of which is fitted with a door for access to the interior, where stands a bucket of water in which the "bob," a 25 pound brass spheroid, swings. On top of the pedestal are two telescopes, one on the north side facing south and one on the east side facing west. Both are moved by micrometer screws with a travel along scales graduated to inches and twentieths, which, with the screws, give readings to thousandths of an inch.

These readings are taken daily, the maximum deflection ever observed being 0·14 inch, which by calculation shows that the top of the monument moves about three times as far as the center of gravity.

As carefully taken data would prove of great value to engineers who undertake the erection or custody of very tall shafts, it is proposed to make the readings automatic and continuous by means of a kind of improved pantograph enlarging one thousand times. These, with the heat records taken at the top and at the bottom, both inside and out, would constitute a record of great value, showing what scientists call the "breathing" of this 81,120 ton mass of stone.

No less interesting was the location of the shaft, or what is recorded thereof. The bench mark, known as the Jefferson pier, was built on the first meridian line of the United States, in 1793. It is at the intersection of a line drawn N.-S. through the center of the Executive Mansion and another E.-W. through the Capitol. No considerable record exists of the establishment of these lines, although it is tradition that President and Mrs. Jefferson were present at the time, and that Mrs. Jefferson gave her thimble to be set in the top of the wooden monument to receive the cratched cross. From this monument, and another located 90° therefrom, levels were taken, with which subsequent levels were compared to determine whether the monument settled evenly. All the levels taken show that the foundation has remained horizontal, although subject to a gradual diminishing settling, which, in the centennial year (1876), was 8·82 inches.

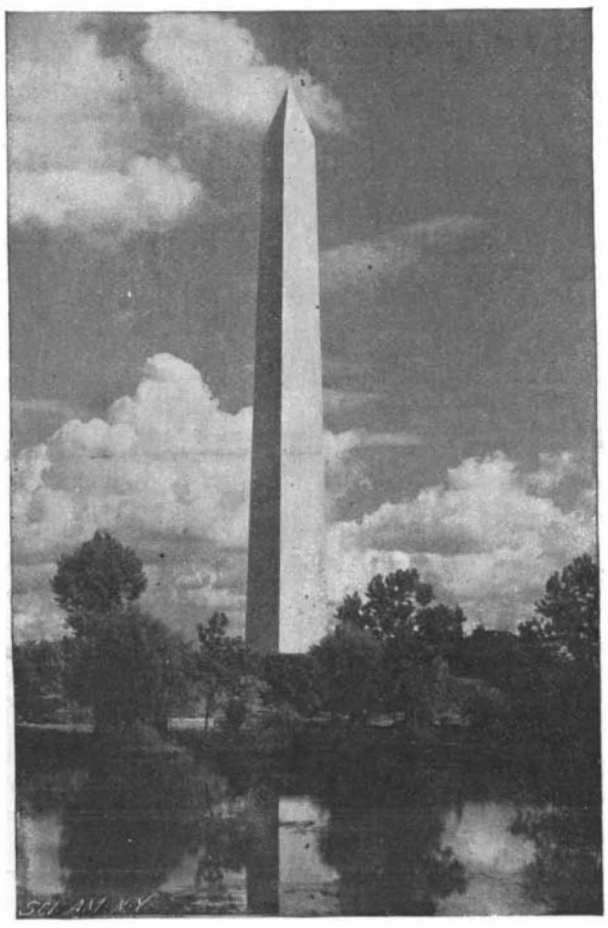
Starting a New Steam Plant.

BY EGBERT P. WATSON.

It not unfrequently happens that new steam plants are put in use with the greatest possible dispatch. Owing to a rush of business or delay in getting the new engines and boilers, so soon as they can be set up in place the boilers are fired and steam turned on the piping at full pressure at once. Then there is hurrying to and fro with wrenches and calking tools and all the appliances of the trade to stop leaks that would not have appeared had a proper course been pursued. A steam plant is a complex structure, and until the strains caused by changes of form, from expansion and contraction have been adjusted or taken up gradually, there will always be trouble, and lasting derangement if too great haste is made to start. The course that long experience has shown to be the safest in the end is indicated in the advice here given.

Take the case of the tubes and tube sheets of a fire-box boiler. So soon as a fire is started, the tubes, tube sheets, and side plates are exposed to great heat, if the fire is urged, in a short time, and while the rest of the boiler is cold, or at the temperature of the air and contained water, whatever that may be. In boilers of defective circulation or none at all, this variable temperature may be maintained for hours, and it requires no imagination to see that the effect upon the boiler is injurious, to say the least. The tubes are stretched tightly between two rigidly fastened sheets of greater or less thickness, with the result that something must give or buckle, when they are heated, to the extent of the expansion at least. This applies to the side sheets and stay bolts as well, and from this brief citation it follows that, when a new boiler is started for the first time, discretion is certainly the better part of valor. Not unfrequently boilers which have been well constructed in the first instance, a good job in all parts, have been practically ruined, or, if that is a little too strong an expression, very much injured by haste in putting them into action. More harm has been done by the "hurry-up" plan of starting a new steam plant than persons without experience can conceive. Not only the boiler suffers, but the brickwork and front also, if the boiler is an externally fired one.

When a new boiler is fired for the first time, a boy's bonfire on the grates for ten or twelve hours is ample heat. The water should not be allowed to get over blood heat, or about 100 degrees, and this temperature should be steadily maintained all day. Upon no account should any steam be formed, the boiler being allowed to cool slowly at night. For the second day the heat should be increased to 200 degrees and maintained at that stage for ten hours, the heat and vapor being permitted to circulate through the whole of the pipe system. On the third day steam should be raised to ten pounds and kept at that all day. If this plan is followed, the changes of form which take place will occur slowly instead of violently when a contrary course is exhibited, and all the expansion strains absorbed or redistributed without bad results. On the contrary, if fires are forced from the start, there may or may not be visible local leaks, but the probabilities are that in the near future various disturbances will appear which might have been avoided by less violent measures upon the start. On the third day also the boiler should be thoroughly cleaned by feeding and blowing at frequent intervals. During the process of construction much dirt of all kinds accumulates; since black oil is used in quantity for drilling and tapping holes, a greasy sludge will be formed and settle on the cooler parts of the boiler, unless it is removed before it has time to settle. Not only upon the cooler parts, but upon other parts as well. If the circulation is active, this sludge is carried around until it happens to hit some place that it sticks to. When that occurs, no water can get beneath it, but heat from the other side of the plate can; when that occurs, the plate is



THE TELLTALE PLUMMET IN THE WASHINGTON MONUMENT.

overheated and the steam pressure forces the sheet down, making a bag, or pocket, that has to be cut out promptly and the sheet patched. This danger is supposed to be imminent in old boilers only, but it is by no means unknown in new boilers but a few weeks old.

It not unfrequently happens that new boilers are started with no water supply aside from the contents of the boiler, but it seems needless to say that this is a dangerous proceeding. If from any cause leaks of importance should start, or many small leaks, the only course possible would be to haul the fire or fires at once. This might or might not be feasible, according to circumstances, but an ample water service should be assured before the fires are started, and at least two sources of feeding the boiler when at work—an injector and a steam or power pump. Injectors are fickle things, especially new ones. If a slight air leak is present in the suction, they promptly quit work, although the leak is not apparent to the eye. All new boilers are liable to foam from the grease in them, and an injector will not work then, because it needs dry steam, not hot water, to act properly. The writer was much bothered by a high pressure injector refusing duty recently (225 pounds steam pressure), and only got it to act at last by binding all suction joints externally with red lead putty. After this was done there was no further trouble. The joints were not practically air tight, although they seemed to be.

The time to pack all valves, joints, and stuffing boxes is before the start; not after it. Much confusion has been caused by neglecting this apparently minor detail, if there is any such thing as a minor detail about a steam plant. Above all things, keep the man with the handy screw wrench from tightening up leaky joints under pressure. Upon no account should this be allowed, even with so low pressure as ten pounds. A bolt that leaks may be a bolt that is broken, and the least twist upon it sets it free. After that anything may happen. The writer once saw a bolt blow out under 200 pounds pressure, and as it left a considerable area undefended, one bolt after another ripped off until the pressure was reduced by the area opened. If a man had been trying to tighten that leaky bolt, he would have been killed. Again, a blow cock of only half inch diameter leaked so badly that a man undertook (contrary to advice) to tighten it. As soon as he touched it with the wrench it promptly blew out and he had a badly scalded hand as the result. Fittings are sometimes caught by two or three threads only, the man at work on them having heard the whistle blow before he got through, and forgotten to screw them up afterward. The best time to make all changes and adjustments is when the boiler is cold. It cannot do any harm then.

Look out, too, for the man who supposes things about a steam plant. Suppositions in lieu of personal knowledge are dangerous and cannot be tolerated. With all the precaution which can be exercised, accidents may occur; they are quite likely to happen when only lukewarm vigilance is observed, instead of absolute personal inspection of every detail under pressure.

Clocks in the White House.

"The clocks in the White House," remarked an official clock winder to a Washington Star reporter, "are by no means the least interesting things about the house, though but little has ever appeared about them in the newspapers. Strange as it may appear, but one of the old clocks there is of American manufacture, though all that have been purchased of late years are. The one clock referred to was made in New York and was purchased when James Monroe was President. It is one of the permanent fixtures in the green room, and has been there ever since it was purchased. As a timepiece it compares favorably with any of the foreign-made clocks, though it was made at a time when America was not as famous for its timepieces as it is now. The most interesting clock there, of course, from its history, is the clock in the blue parlor, which was once the property of Napoleon Bonaparte, who presented it to General Lafayette, and the latter presented it to General Washington. The frame of it is made of alabaster and French gilt bronze. It has to be wound but once in a month. It keeps time to-day as accurately as when first made. What is known as the Lincoln clock, purchased when President Lincoln was in the White House, is an object of interest in the red room, and is of ebony and gold. It strikes the quarters, halves and hours. In Mrs. McKinley's room is a clock which has been running without the slightest intermission for nearly thirty years. The clock at the foot of the stairs leading up to the President's office is the one that the public generally sees. It is rather modern in construction, of the 'regulator' pattern, and is very reliable. The clock in Private Secretary Porter's room is admired for its cathedral gong rather than anything else, but it is a good clock, and has proved itself such for the ten or fifteen years it has been there."

The Corner Stone of Health.

"Exercise," said a physician the other day to the editor of a contemporary, "is the corner stone of health. It differs essentially from work, in which the fundamental idea is that of labor. On the contrary, the idea of exercise is based upon activities undertaken for the benefit of the body or mind, some form of exertion intended to promote health or furnish amusement. Work is essentially toil, even though it be congenial. Exercise, on the other hand, is purely recreation. If exercise be taken only from a sense of duty, it loses the distinguishing feature of exercise and becomes work. A course of exercise, say cycling, should be carried on by easy stages. Exercise is a tonic and therefore benefit is not to be derived from a single dose. If active exercise is necessary as a hygienic measure, what form is best? You cannot persuade your patients to run, it is so undignified; or to saw wood, it is too laborious. But if you can persuade them to ride a wheel, you have cured them, if it is exercise they need." The wheel was then discussed from the therapeutic point of view in this way: "Active exercise may be divided into three classes, those requiring strength, speed, and stamina, and they all increase in common the circulation of the blood. Exercises requiring the exertion of strength are more fatiguing than those of speed. Cycling can be adapted to the requirements of the enfeebled invalid."

THE last determination of the speed of sound has been made by Mr. A. Leduc, who finds that the rapidity of propagation of sound waves through dry air at 0° C. (=22° F.) is 1098·58 feet per second.—Comptes Rendus, December 26, 1898.