only necessary to turn the wheel so as to slack the tie-bar, when the chain at the end or tail of the stirrup comes into play and lifts the hook in a way that will be easily understood. The couplings can be tightened up as much as need be by turning the chain-wheel and screw nut in the opposite direction This invention has already been tested on one of the English railways with marked success.

THE TIDES

Sir William Thomson recently delivered a very important and instructive lecture on this subject in the City Hall, Glasgow. There could not have been less than two thousand persons present on the occasion. We do not propose to give our readers a *resume* of the lecture, but it may be interesting to note in passing that Sir William has somewhat upset the popular notion about the fluidity or liquid state of the centre of the earth. He maintains that unless the material of the supposed shell of the earth were preternaturally rigid—say scores of times more rigid than steel—the shell would yield so freely to the tide-generating force, that it would take the figure of equilibrium almost as freely as water would, and there would be no rise or fall of the water relatively to the solid land left to show to us the phenomenon of the tides. The greater the mass the more it was disposed to yield, and a careful calculation of force showed that in virtue of the greatness of the mass, it would require enormously increased rigidity in order that the earth might keep in shape. The earth had on the whole a rigidity greater than that of a globe of glass of great dimensions, perhaps greater than that of a globe of steel of the same dimensions. The earth must be exceedingly rigid; and whatever view geologists might take as to the underground temperature, and the past history of the earth's conformation, they had no right to assume interior fluidity. After a most interesting series of experiments assisted by elaborate diagrams, explanatory of solar and lunar tides he remarked that the phenomena of diurnal tides were altogether overlooked in the Admiralty tide tables for the whole earth, although there were places where the diurnal tides were greater than the ordinary tides; and he was surprised at the supineness of the Hydrographic Department of the Amiralty on the point, considering that their attention had been called to the facts.

Sir William then passed on to explain his self-registering tide gauge, which would show the height of the water at every moment during the whole time the intrument was in action. it was not yet in use, but would be tested soon at the island of Madeira. In connection with this instrument there was a tide calculating gauge, which by an ingenious arrangement of pulleys calculated of itself the condition of the tides at Liverpool. We reserve any notice of this latter instrument at present, as it is undergoing some important modifications.

The self-registering tide gauge is shown in the engraving on page 116 and consists of a timepiece or pendulum clock A, secured on the top of a supporting frame B and brackets B. This clock, in addition to keeping time, actuates the large drum or cylinder C, at a slow uniform speed, by a bevel pinion and wheel at the upper end of the drum spindle, which is carried in journal and footstep bearings in the frame B. The continuous web of paper, upon which the figure of the rise and fall of the tides is registered, is first wound on to the small cylinder D, which revolves loose in its journal and footstep bearings in the same frame, and has a slight frictional piece or spring, so that when the front end of the paper is fixed in a slot or clip on the cylinder C, it is gradually wound thereon close down to the guiding rim on the lower end of both cylinders, so that the point of the lateral tubular pen projecting from the lower part of a small ink vessel attached to the weight *d*, describes the figure on the paper, as indicated at *a'*, up and down in an acute-angled zigzag manner, every rise and fall of the tide, as the weight *d* with its float rises and falls with the parallel guiding frame d', which is set on pivots so as to be tilted slightly every hour by a motion taken from a notch in a disc on the hour shaft of the clock; an arrangement of levers and spring at *e* bringing back the frame *d'* and pen *a* to their normal position. The small lateral marks or projections on the up-and-down angled lines of the figure on the paper indicate the height of tide at every hour and the extreme points of the angled lines indicate the extent of rise and fall of the spring and neap tides to a proportionally reduced scale through the reducing gearing EE'. A cord of fine wire is attached to and wound round the large rim pulley E, and has its free hanging end attached to the weight F, which has the actual tidal float attached to it working or floating in calm water, or within an open pipe or tube immersed therein, so as to insure that the water and float, wherever the instrument may be placed, may be as little as possible affected by local or shore influences, or by the winds or waves. A pinion on the end of the shaft of the drum E works into a large wheel on the second shaft E', so as to drive it at such slow or reduced speed that the cord or wire carrying the weight and ink bottle *d*, and which is wound round and attached to the small pulley or E'', will cause the pen *a* to traverse up and down proportionally to the rise and fall of the float F and of the tides where it is at work. The weights E and *d* are made to exactly counterbalance each other, and the paper may be ruled in divisions either from the top or bottom edges, or from a centre line of the tidal figure, corresponding to feet and inches of the actual rise and fall of the tide, or of the float F, or other measurements desired.

We understand that Sir William Thompson is making some improvements upon this instrument with the view of making its action and application even more perfect, particularly in reference to the feeding and unwinding of the web of paper, which improvements we may describe and refer to in a future number.

WIER'S HYDRO-GYROMETER.

The object of the speed indicator, or "Hydro-gyrometer," of which we annex a plan and elevation, is to enable those in charge of an engine to ascertain by mere inspection the number of revolutions which it is making at any moment. In many cases this becomes a matter of considerable practical importance. In a steamer or upon a locomotive for example, the number of revolutions per minute gives a tolerably accurate measurement under ordinary conditions, of the speed at which the vessel or engine is moving. In many factories it is of great importance that a uniform speed of engine shaft should be maintained under continuously varying loads, and wherever very much steam power is employed it certainly becomes more than a matter of mere curiosity to know to what extent, if at all, the engine is deviating from the speed which has previously been determined as the most convenient and economical.

To obtain the rate of revolution from a counter, or by counting with a watch, is obviously both troublesome and inaccurate, what is wanted is an apparatus by which the speed is absolutely indicated continuously, just as the total number of revolutions run is indicated by the ordinary counter. The hydro-gyrometer is the invention of Mr. M. A. Wier, Junr (of Messrs. M. A. Wier & Co., telegraph engineers, Abchurch-lane). In its simplest form the hydro-gyrometer consists of a vertical cylinder partly filled with a suitable liquid, in which a screw is caused by the engine to rotate continually. The bottom of the cylinder communicates with a vertical glass gauge tube fixed upon a properly graduated dial board. When the engine is at rest the liquid stands at the same level in both cylinder and tube, and the corresponding point on the dial is marked zero. When the engine is in motion the action of the screw either forces the liquid up in the glass tube or draws it down (according to whether the engine is running ahead or astern), and the graduation upon the dial is so arranged that the number which is level with the surface of the liquid always corresponds with the number of revolutions made by the engine, ahead or astern as the case may be.

The type of instrument we illustrate is the same in principle as the one just described, but is rendered more complete by the addition of a counter and a self-registering apparatus. A in this case is the cylinder and B the screw, the latter being driven by the engine shaft by suitable means through the spindle N and the screw wheel and worm P. The screw therefore revolves with a speed definitely proportioned to the speed of the engine. The cylinder A is in free communication through very small holes in the nozzles at its lower end with two smaller brass cylinders C and D placed beside it, which take the place of the glass tube in the simpler instrument. A float in the cylinder D is connected by a fine cord passing over a system of pulleys K, with a pointer placed upon the circular dial L, which is graduated so that the pointer shall at each instant indicate the number of revolutions (astern or ahead)