A NOVEL CLOCK.

We take pleasure in presenting to our readers the following description of a differential clock, invented and designed by Mr. H. Conant, of Pawtucket, R. I., and built for him by Messrs. Tiffany & Co., of this city, in their best manner. Fig. 1 is a perspective view of the clock; Fig. 2 is an enlarged view of the dials; Fig. 3 is a front elevation of the works with the dials removed; and Fig. 4 is a side view of the diagonal shafts, *a* and *b*, and the differential motion; similar letters refer to the same parts in the different engravings.

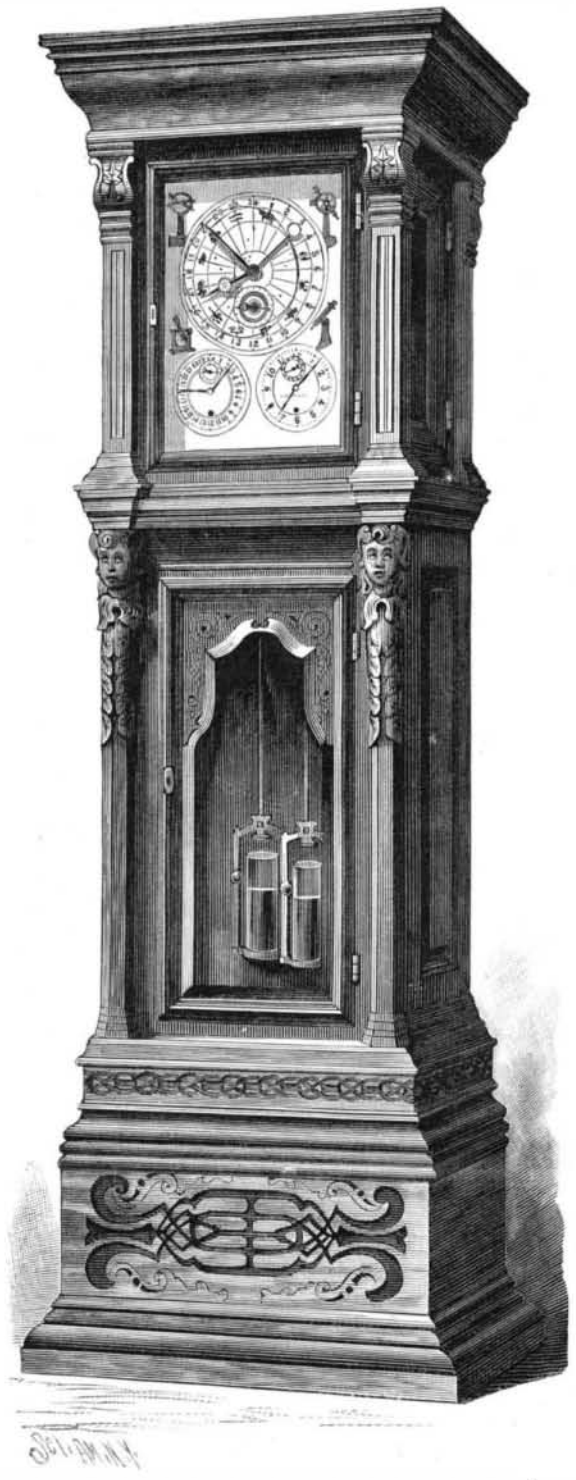


Fig. 1.—THE CONANT DIFFERENTIAL CLOCK.

There are two principal motions that belong to our planet—one of rotation upon its axis, called its diurnal motion, producing succession of day and night, and another, that of its orbit, or revolution round the sun, called its annual motion, which causes the four seasons of the year. The exact time occupied by its first, the diurnal, rotation is 23 hours 56 minutes and 4·09 seconds, this being a sidereal day, so called, because in that time the stars appear to complete one revolution round the earth. But as, while the earth is rotating on its own axis, it is also traveling forward in its orbit around the sun, it therefore has to turn a little more each day—about one three hundred and sixty-fifth part of its circumference, which amounts to 3 minutes 56 seconds of time—before a given meridian is again under the sun; in other words, it will require 24 hours on an average through the year for the sun to pass from one meridian of a place to the same meridian again. If this difference in time of the two revolutions be multiplied by 365, which is the number of times a meridian has been brought to the sun during the year, the result would be one sidereal day; consequently, the earth in reality turns on its axis 366 times each year.

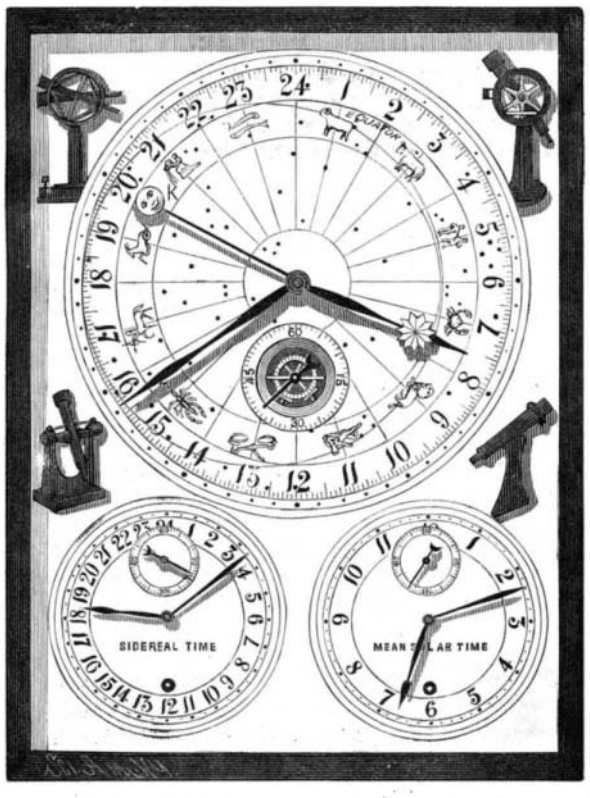


Fig. 2.—ENLARGED VIEW OF THE DIALS.

Now, if a clock were constructed with two works or movements, and, of course, each movement with its own pendulum and weight, one regulated to mark mean solar time and the other to mark sidereal time, it is evident that, as the one would continually gain at the rate of about 3 minutes 56 seconds a day on the other, the time indicated on the two dials would correspond but once in a year; and if this difference in time of the two dials could be automatically recorded on a third dial, it would mark the space which, in consequence of the earth's motion, the sun appears to describe among the stars. This great circle of the sun's apparent yearly motion is divided into twenty-four meridians, and is called right ascension, that measure in the heavens which is the same to the astronomer as longitude is to the navigator. These meridians are not reckoned in degrees, but in hours, minutes, and seconds of time; thus 15 deg. would answer to 1 hour, 1 deg. to 4 minutes, ½ deg. to 2 minutes, and ¼ deg. to 1 minute.

The clock herewith illustrated accomplishes this object by a most simple and ingenious arrangement of the parts.

Firmly secured on a solid base of metal are two regulators, each having a one-second mercurial pendulum. One of the pendulums is regulated to mean solar time and the other to sidereal time, the dial of the latter being divided into 24 hours and that of the former into 12 hours. The escape wheel shaft of each clock is long enough to reach out through the dial plate, and on the outer part is fitted, with a slight friction, a sleeve. On the inner ends of these sleeves are the beveled wheels, *c d*, of 90 teeth each, and their outer ends carry pointers indicating seconds on the dial plates. Engaging with these wheels are beveled pinions, of 30 teeth each, mounted on the lower ends of the long shafts, *a b*, which are carried up at an angle of about 45 deg. and connected with a differential motion (Fig. 4) controlling the works and hands of a larger dial placed above the two others. This peculiar motion is constructed of a light and accurately turned arbor or shaft, *h*, on which is fastened at right angles a crosspiece, on one end of which is mounted the wheel, *g*. On the shaft, *h*, and engaging with the wheel, *g*, are two larger wheels, *e f*, of 90 teeth each; these wheels are cut on both sides, as clearly shown in Fig. 4. Engaging with these wheels are wheels of 60 teeth each, fastened on the upper ends of the shafts, *a b*. It will be seen that both clocks are directly connected with the differential motion, and also that as long as the wheels, *e f*, which turn in opposite directions, are driven at the same speed, the wheel, *g*, will simply roll on its pivot without altering its position or that of the shaft, *h*. But assuming that the wheel, *f*, revolves twice around while the wheel, *e*, revolves once, then the wheel, *g*, will necessarily follow *f*, and in proportion to the speed of the two wheels, *e f;* but as these wheels move in opposite directions, it consequently follows that one-half the difference in the rates is lost, or instead of making a complete revolution—the difference between 1 and 2—it has only recorded half a revolution.

Now, to compensate for this error—in other words, to regain the half revolution lost—the wheels on the upper ends of the shafts, *a b*, have 60 teeth each, and the pinions at the lower ends have 30 teeth each; and as the driving wheels, *c d*, having 90 teeth each, are connected through the pinions, shafts *a b*, and upper wheels with the wheels, *e f*, also of 90 teeth,

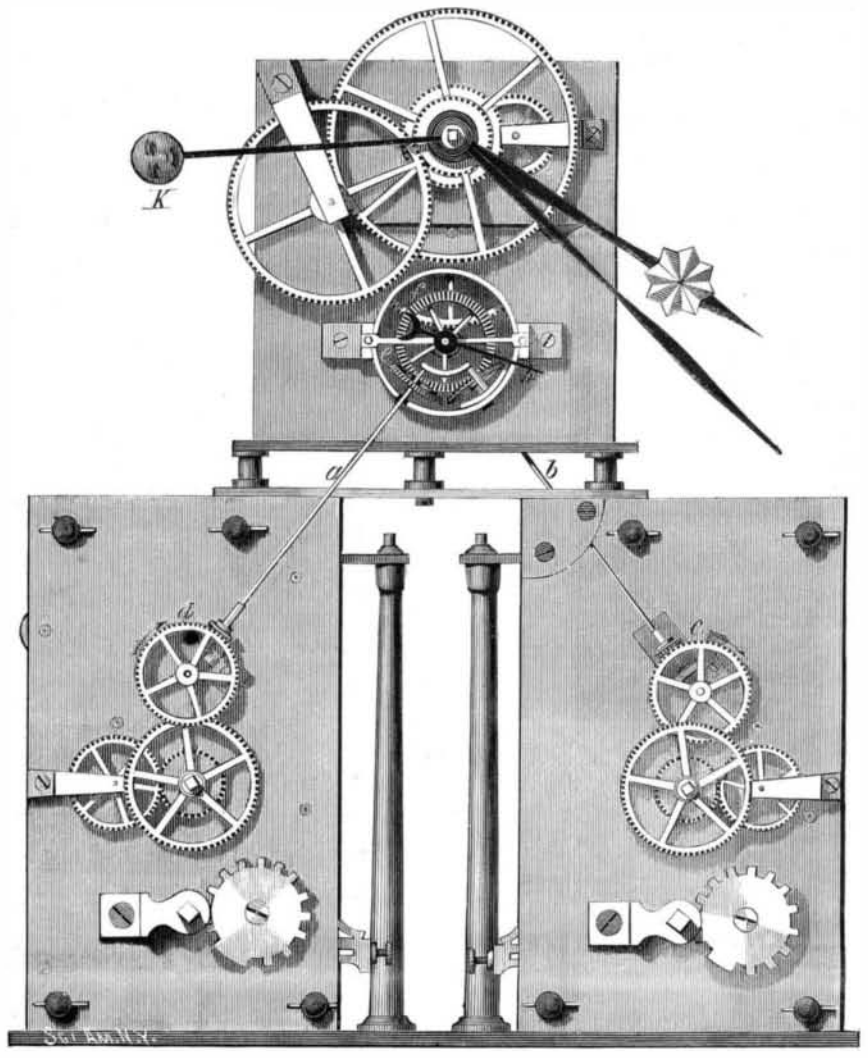


Fig. 3.—VIEW OF WORKS WITH DIALS REMOVED.

it is evident that the wheels, *e f*, revolve twice while the wheels, *c d*, revolve once. By thus proportioning the gears, the exact difference in the speeds of the wheels *c d*, is transmitted to the shaft, *h*, and is recorded by the pointer or hand.

Now, as the clock marking sidereal time gains at the rate of about 4 minutes in 24 hours, or 10 seconds in 1 hour, and as 10 seconds is one-sixth of a minute, it will take 6 hours to complete one revolution of the hand on the differential motion, which is the period of 1 minute in right ascension; 15 days 6 hours is 1 hour, and 1 year is 24 hours in the same measure. The hour hand on the large dial therefore represents the sun's apparent yearly motion among the stars.

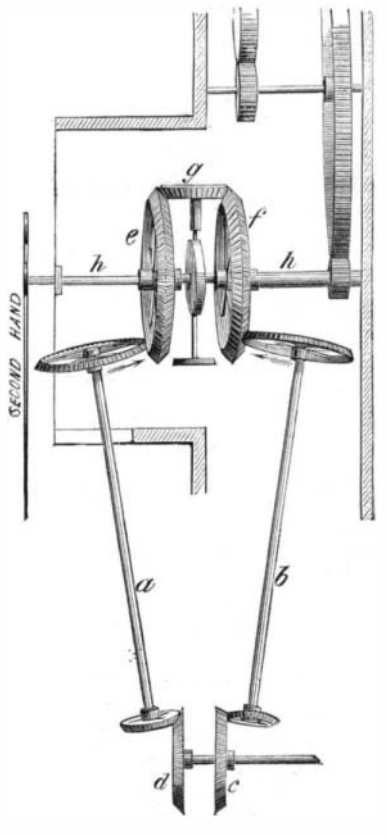


Fig. 4.—SIDE VIEW OF THE DIFFERENTIAL MOTION.

Another hand, *k*, representing the moon, and making exactly one revolution from one new moon to the next following, has been added.

The hour and minute hands of the different dials are independent of each other, so that one set of hands may be set, if necessary, without affecting the others; but, as has been already said in describing the differential motion, the second hands are connected, so that if either of the clocks should vary one way or the other, the seconds of right ascension would also be affected. In that case it is simply necessary to correct the second hand of that particular clock, when the seconds of right ascension are thereby also corrected.

The shaft, *h*, carries the second hand of the large dial, and from it an ordinary train of wheels gives minutes and hours; when the hour hand passes entirely around the dial, it indicates that the sun has passed through all the hours of right ascension, and a year of time has been exactly measured off. The hand representing approximately the moon's mean right ascension revolves 254 times in 19 years, or a lunar cycle, and passes the sun 235 times in the same period, making that number of lunations. The large dial also represents that portion of the heavens traversed by the sun and all north of the same, the center being the north pole. A number of the most useful and best known fixed stars are engraved thereon, with their names affixed. The eccentric circle represents the ecliptic; the equator and northern and southern Arctic circles are concentric, the latter being the outer one. The sun touches the outer circle on the 21st of December (the winter solstice) and the inner or northern circle on the 21st of June (the summer solstice). It passes the 24th hour of right ascension and crosses the equator on March 21, or vernal equinox, and at the 12th hour of right ascension it again crosses the equator, on September 21, the autumnal equinox. The signs of the zodiac are also engraved on the dial in their proper positions, as shown in Fig. 2.

The name differential is applied to this clock because the hands of the large dial are indebted for their motion to the difference of speed in the two separate clock movements, the mean right ascension of the sun being always the difference between mean solar and sidereal time; and the inventor's theory is that, starting the hands at zero or 24 o'clock, regulating one to sidereal and one to solar time, they will come together again at the end of the year, that is, the hands of the large dial will have made a complete revolution, and the solar clock will give the exact time to a second when the year is completed, or any portion of the year.

This clock is intended for the Observatory at Dudley, Mass., connected with Nichols Academy, where it will probably be placed the coming season.

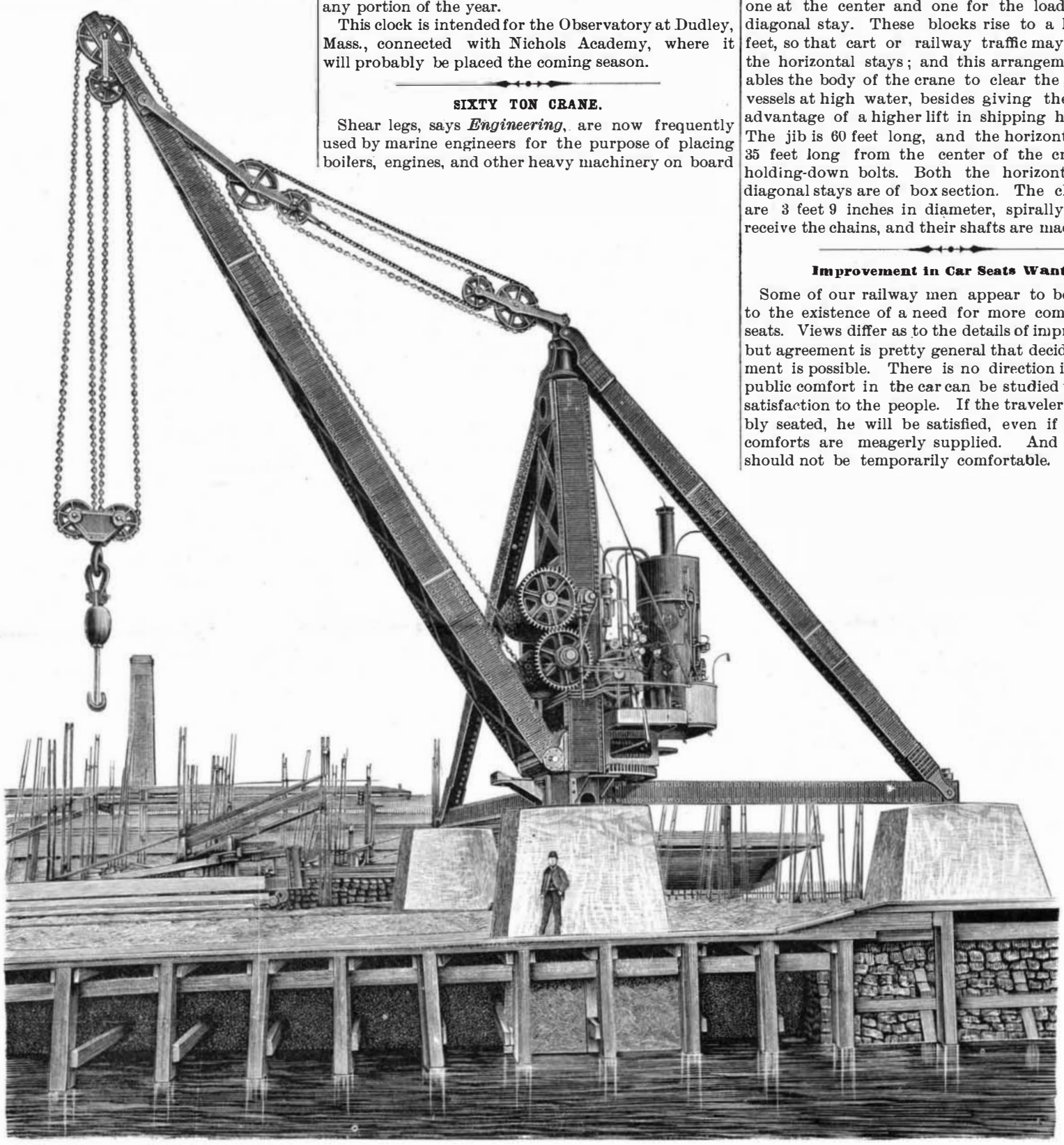
SIXTY TON CRANE.

Shear legs, says *Engineering*, are now frequently used by marine engineers for the purpose of placing boilers, engines, and other heavy machinery on board large steamers; but inasmuch as their motions are restricted to two, their usefulness is also limited. The motions referred to are hoisting or lowering and traveling outward or inward in a straight line at right angles to the wharf on which the shear legs are erected. When a boiler or piece of machinery is to be shipped, it must be brought under the lifting block. It is then raised and projected outward until it hangs directly over the vessel, which is itself then moved forward or aft, so that the object that is being dealt with may be lowered into its exact position. It will thus be seen that shear legs of themselves only cover a line, though by moving the vessel they can be made to cover an area.

Cranes having a fixed radius of jib are sometimes used for similar purposes, and such cranes have a slight advantage over shear legs, as the boilers and pieces of machinery may be deposited upon the quay or wharf under the range of the jib, ready to be lifted on board; but in this case also a line only is covered—the only difference being that it is circular instead of straight, and the vessel must be moved forward or aft when the loads are being lowered to their respective places, just in the same way as when shear legs are being used.

A crane such as we illustrate herewith is free from these defects. The jib rises and falls by power, and thus secures the covering of a large area. Boilers or other loads may be stored all round the wharf, and, by adjusting the jib radius, may be placed exactly in position on board the vessel, which remains moored, or may even be aground.

The crane now illustrated was constructed by Messrs. George Russell & Co., and has been placed on the wharf in the works of Messrs. D. J. Dunlop & Co., engineers and shipbuilders, Port Glasgow. Its working load is 60 tons, lifted at a radius of 35 feet. The foundation consists of three concrete blocks—one at the center and one for the loading of each diagonal stay. These blocks rise to a height of 14 feet, so that cart or railway traffic may pass under the horizontal stays; and this arrangement also enables the body of the crane to clear the gunwales of vessels at high water, besides giving the additional advantage of a higher lift in shipping heavy masts. The jib is 60 feet long, and the horizontal stays are 35 feet long from the center of the crane to the holding-down bolts. Both the horizontal and the diagonal stays are of box section. The chain barrels are 3 feet 9 inches in diameter, spirally grooved to receive the chains, and their shafts are made of steel.



IMPROVED SIXTY TON STEAM DERRICK CRANE.

Improvement in Car Seats Wanted.

Some of our railway men appear to be awakening to the existence of a need for more comfortable car seats. Views differ as to the details of improved forms, but agreement is pretty general that decided improvement is possible. There is no direction in which the public comfort in the car can be studied with greater satisfaction to the people. If the traveler is comfortably seated, he will be satisfied, even if some other comforts are meagerly supplied. And the seating should not be temporarily comfortable. A seat may be so constructed as to look inviting and luxuriously easy, and so as to be really easy for a while, but its lines may yet be such as make it very wearying when it is occupied for any length of time. The limitations in the way of the designer are not to be lightly dismissed. He must make his seat reversible, which fact bothers him not a little. He must be economical of space, and must study conditions of cleanliness in both the seat and the car. Cheapness of construction and strength must also not be lost sight of. But with all these it is yet not an insurmountable task to design a seat that will be very much more comfortable than the majority of those now in use, and we are glad to see that efforts are being made to obtain such a seat.—*The Railway Review.*

ONE of our contemporaries reports that Isabella, ex-Queen of Spain, is not only an owner of considerable real estate in Philadelphia, but is a shareholder in the Keely motor. From the same source we learn that the Motor Keely promises positively to mote very soon, but it begins to be believed that his mote is the much-quoted one which is all in his eye.