The Rule of Contrariety in Inventions.

There is apt to be a fine irreverence about the inventor which leads him to suspect that any old way of doing a thing is for that very reason not the best way. Often he observes some time-honored plan of working, audaciously makes up his mind to do the exact opposite, and hits upon success. Guns were loaded at the muzzle for ages, until one day a man of originality thought of loading them at the other end, the preferable end on many accounts besides that of manifest convenience. The same path was trodden by the Frenchman who first put the eye of a needle near its point instead of away from its point. He little knew that he was doing a great deal to make the sewing machine a possibility. One of the notions of the pioneer railway engineers in England was that their rails must be flanged so that the wheels of locomotives and carriages should not get off the track. But some one of skeptical mind inquired: Why not leave the top of the rail flat, or nearly flat, and put the flange on the wheel, an easier thing to do? Accordingly the flange was taken from the rail to the wheel and remains there to this day, to remind the traveler that an Eastern philosopher said long ago: "To him that is well shod it is as if the whole earth were covered with leather."

It is a good many years now since steam was first used for heating buildings, and as air when warmed ascends, what more natural than that steam coils should hug the floors just as the stoves before them had done? But in some of the largest factories in this country the coils are fastened, not to the floor, but to the ceiling, which proves to be a better place for them. As everybody knows who ever sat before an open fire, radiation is a pleasanter means of warmth than convection, than heat carried along by currents of air; floor space is incidentally saved, and the risk of gathering combustible rubbish about the coils is avoided. In the ages of simplicity which came down to Watt's time and the invention of the steam engine, when a kettle was to be heated the proper place for the fire was thought to be outside. But when big boilers came in, with pressing need that their contents be heated in the shortest time possible, it was found gainful to put the fire inside. Stephenson's locomotive, the Rocket, derived no small part of its efficiency from his knowledge to which side of the boiler to apply flame.

On somewhat the same principle Lord Dundonald, one of the early improvers of the steam engine, forced the hot-air currents under his boiler from above downward, against their natural tendency to move from below upward. In this way he made available much heat that otherwise would have been wasted. The steam engine, whether mounted on wheels or not, always keeps its fuel outside; furnace and cylinder are distinct. To-day the steam engine's primacy is challenged by a motor which uses its fuel inside, the furnace being no other than the cylinder, precisely as in the barrel of a gun. So much more work does a gas engine yield than a steam engine, in comparison with the heat applied, that only the dearness of heat as supplied by gas prevents the speedy sup rsedure of steam for motive power. As gas engines grow steadily larger, their margin of economy becomes so decided that it begins to pay to make gas on purpose to burn in them.

In the reduction of bauxite, the refractory ore of aluminum, it is necessary to maintain an extreme temperature. The melting point of the mineral is high, and only so much of the heat as ranges above that temperature does work. In the Mining Department of the World's Fair is an exhibit showing how the modern metallurgist reduces aluminum with new economy. Instead of employing the old crucible method, and applying the fire from without, he incloses the ore in a non-conducting bed, and by means of a powerful electric current applies the heat from within. Electric furnaces of this type now produce bronze and other alloys at prices which steadily fall as their market enlarges.

Not far from the mining exhibit at Chicago stands Machinery Hall. When its visitors see one of the largest steam engines driving machinery with a slack belt, they are wont to express surprise. Ordinary folks to-day think just what machinists thought a few years ago: that tightness is the effective and, indeed, the only feasible condition for belts. But in this case, as in a good many others, the rule of contraries has come, and with profit.

Architects, as well as engineers and metallurgists, have found it profitable to go into opposition where some ancient practices have been concerned. In latitudes of much fall of rain or snow, the form of roof which most obviously suggests itself is the common pitched roof, resembling an A, more or less broadened. Vexed by bursting rain conductors, by impromptu object lessons as to the force of avalanches, Northern architects take not A, but V, duly widened, for their roof type. In winter, ice and snow, caught as in a basin, cannot fall to the street. Icicles are banished, and in conductors carried through the heart of the building, and kept warm by the building, ice is gradually melted without a chance to do damage.—*N. Y. Sun.*

A Gigantic Irrigation Project.

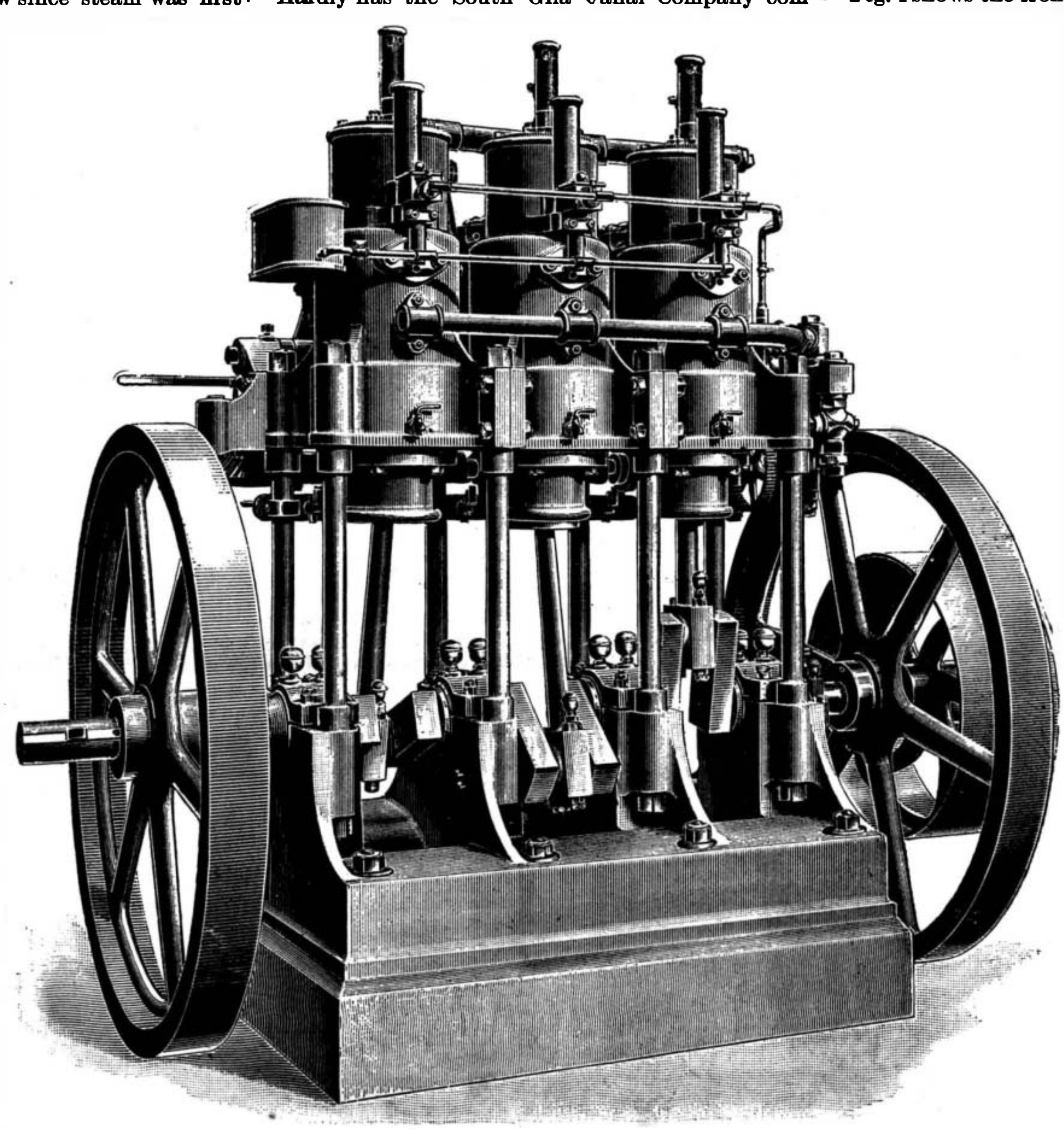
Hardly has the South Gila Canal Company commenced the great work of damming the Gila River and building a canal 125 miles in length, through one of the best portions of Arizona, and before the Sonora Canal Company has completed the survey for its canal in California, when another project of the utmost importance to Yuma and the great area of arable land lying to the south and east of Yuma, in Arizona and the Mexican State of Sonora, is inaugurated. The plan is to dam the Gila River at the gorge, twelve miles east of Yuma, and create a reservoir thirty miles in length and eight miles in width. The dam, which will be of solid masonry, is to be 4,500 feet in length and 110 feet high. It will extend from the mountains on one side of the Gila to the opposite bank on a reef of bed rock, where three small islands rise out of the bed of the stream. These islands will form abutments to the dam, which will be built with such a slope as will carry the water away from the dam without cutting or wearing away the rock at its base. The flume, or canal, which will conduct the water away from this reservoir to the lands to be irrigated, will not be over a mile in length.

From the end of the flume to the south and west, canals will be constructed over the mesa and valley lands in different directions when the lands, which all belong to the United States government, are settled. The reservoir, it is estimated, will hold water enough to irrigate the 3,500,000 acres of land lying to the east and south of Yuma, which extends into the Mexican State of Sonora, and will also furnish water for 100,000 acres of the Sonora Land Company, lying between the dam and Colorado River, in the valley of the Gila. It is estimated that the dam alone will cost $5,000,000, and that it will take two years to complete it.

OIL ENGINES AT THE GREAT EXPOSITION.

The engravings herewith represent an English three-cylinder 20-horse power "Trusty" oil engine, exhibited, the *Engineer* says, in the Chicago Exhibition. The three cylinders are connected to a three-throw crank shaft, with cranks set at 120 deg., so that the work of the three cylinders is well distributed throughout the period of each revolution. The valve gear is worked from one cam shaft, driven by silent worm gearing. The engine is fitted and controlled with one governor of the rotative type, but either of the cylinders may be cut out at will, the valve gear for each being worked by separate cams. With the exception of the changes in form necessary to the vertical construction, the engine is composed of working parts which operate in the same way as those of the horizontal engine which was described in our impression of the 4th December, 1891.

Fig. 1 shows the front of the engine, and Fig. 2 shows the arrangement of the valve gear arms centered upon a fixed shaft and operated by cams, one of each set of which is controlled as to position by the governor, as in the horizontal engine. Fig. 3 shows the end of the engine, and thereby the valve levers and the double pump for supplying air to the ignition tube lamps, and for circulating water round the jackets. The engine is supported on a strong bed-plate of good form, carrying the cylinders on eight turned columns fixed by tight fit in holes on the sides of each bearing, and fastened by nuts which are accessible. The crank is carried in four large bearings and fitted with two fly-wheels. The engine is of good design, and works with ordinary petroleum lamp oils or with the heavier Broxbourne oil. It is made by Messrs. Weyman & Hitchcock, Limited, Guildford, and is exhibited in the Chicago Exhibition by Messrs. Baker & Co.



THE WORLD'S COLUMBIAN EXPOSITION—TWENTY HORSE POWER OIL ENGINE.
Fig. 1.—FRONT VIEW.

Enormous Enterprises.

The advancing years seem to produce an increase rather than a diminution in the number of gigantic schemes. We have all heard of the scheme for expending $40,000,000 in the construction of a monster dam in the vicinity of Newfoundland that would turn the Gulf Stream back on itself and give New England a tropical climate, so that the Granite State boys could climb palm trees to shake off the succulent cocoanut on their own bleak hillsides, while the Rhode Islanders would offer scant encouragement to the peripatetic Italian banana vender, as each and all of them would have a banana tree in close proximity to his own back porch.

A more recent scheme is the bridging of the English Channel between Dover and Calais. It is said that this scheme has gone so far that a company has been formed to secure the necessary concessions from the British and French governments. The cost of this bridge is something like $240,000,000.

The latest scheme is one for roofing London and other large cities, and thus doing away with the umbrella trust. The projector has not yet considered any such vulgar and insignificant detail as the matter of cost, and hence has not enlightened the public on this point.

Such schemes are, adds the *American Artisan*, of course, largely visionary; but they indicate a tendency to grapple with the most stupendous undertakings that is in a manner characteristic of the nervous and progressive age in which we live.

A FRENCHMAN declares that vegetation can be aided by electricity. Potatoes planted in the path of the electric current grew enormously, and electrified tomatoes became ripe eight days before the others.

Unsolved Problems that Edison is Studying.*

Thomas A. Edison, when he was congratulated upon his forty-sixth birthday, declared that he did not measure his life by years, but by achievements or by campaigns; and he then confessed that he had planned ahead many campaigns, and that he looks forward to no period of rest, believing that for him, at least, the happiest life is a life of work. In speaking of his campaigns, Mr. Edison said:

"I do not regard myself as a pure scientist, as so many persons have insisted that I am. I do not search for the laws of nature, and have made no great discoveries of such laws. I do not study science as Newton and Kepler and Faraday and Henry studied it, simply for the purpose of learning truth. I am only a professional inventor. My studies and experiments have been conducted entirely with the object of inventing that which will have commercial utility. I suppose I might be called a scientific inventor, as distinguished from a mechanical inventor, although really there is no distinction."

When Mr. Edison was asked about his campaigns and those achievements by which he measured his life, he said that in the past there had been first the stock-ticker and the telephone, upon the latter of which he worked very hard. But he regarded the greatest of his achievements, in the early part of his career, as the invention of the phonograph. "That," said he, "was an invention pure and simple. No suggestion of it, so far as I know, had ever been made; and it was a discovery made by accident, while experimenting upon another invention, that led to the development of the phonograph.

"My second campaign was that which resulted in the invention of the incandescent lamp. Of course an incandescent lamp had been suggested before. There had been abortive attempts to make them, even before I knew anything about telegraphing. The work which I did was to make an incandescent lamp which was commercially valuable, and the courts have recently sustained my claim to priority of invention of this lamp. I worked about three years upon that. Some of the experiments were very delicate and very difficult. Some of them needed help which was very costly. That so far has been, I suppose, my chief achievement. It certainly was the first one which made me independent, and left me free to begin other campaigns without the necessity of calling for outside capital, or of finding my invention subjected to the mysteries of Wall Street manipulation."

The hint contained in Mr. Edison's reference to Wall Street, and the mysteries of financiering which prevail there, led naturally enough to a question as to Mr. Edison's future purpose with regard to capitalists, and he said:

"In my future campaigns I expect myself to control absolutely such inventions as I make. I am now fortunate enough to have capital of my own, and that I shall use in these campaigns. The most important of the campaigns I have in mind is one in which I have now been engaged for several years. I have long been satisfied that it was possible to invent an ore concentrator which would vastly simplify the prevailing methods of extracting iron from earth and rock, and which would do it so much cheaper than those processes as to command the market. Of course I refer to magnetic iron ore. Some of the New Jersey mountains contain practically inexhaustible stores of this magnetic ore, but it has been expensive to mine. I was able to secure mining options upon nearly all these properties, and then I began the campaign of developing an ore concentrator which would make these deposits profitably available. This iron is unlike any other iron ore. It takes four tons of the ore to produce one ton of pure iron, and yet I saw, some years ago, that if some method of extracting this ore could be devised, and the mines controlled, an enormously profitable business would be developed, and yet a cheaper iron ore—cheaper in its first cost—would be put upon the market. I worked very hard upon this problem, and in one sense successfully, for I have been able, by my methods, to extract this magnetic ore at comparatively small cost, and deliver from my mills pure iron bricklets. Yet I have not been satisfied with the methods; and some months ago I decided to abandon the old methods, and to undertake to do this work by an entirely new system. I had some ten important details to master before I could get a perfect machine, and I have already mastered eight of them. Only two re-

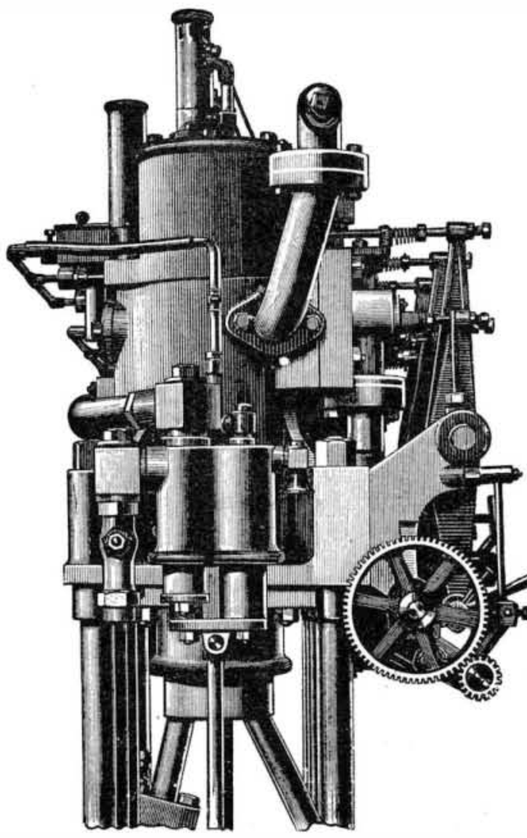


Fig. 3.—END VIEW.

main to be solved; and when this work is complete, I shall have, I think, a plant and mining privileges which will outrank the incandescent lamp as a commercial venture, certainly so far as I am myself concerned. Whatever the profits are, I shall myself control them, as I have taken no capitalist in with me in this scheme."

Mr. Edison was asked if he was willing to be more explicit respecting this invention, but he declined to be, further than to say: "When the machinery is done as I expect to develop it, it will be capable of handling twenty thousand tons of ore a day with two shifts of men, five in a shift. That is to say, ten workmen, working twenty hours a day in the aggregate, will be able to take this ore, crush it, reduce the iron to cement-like proportions, extract it from the rock and earth, and make it into bricklets of pure iron, and do it so cheaply that it will command the market for magnetic iron."

Mr. Edison, in speaking of this campaign, referred to it as though it was practically finished; and it was evident in the conversation that already his mind turns to a new campaign, which he will take up as soon as his iron-ore concentrator is complete and its work can be left to competent subordinates.

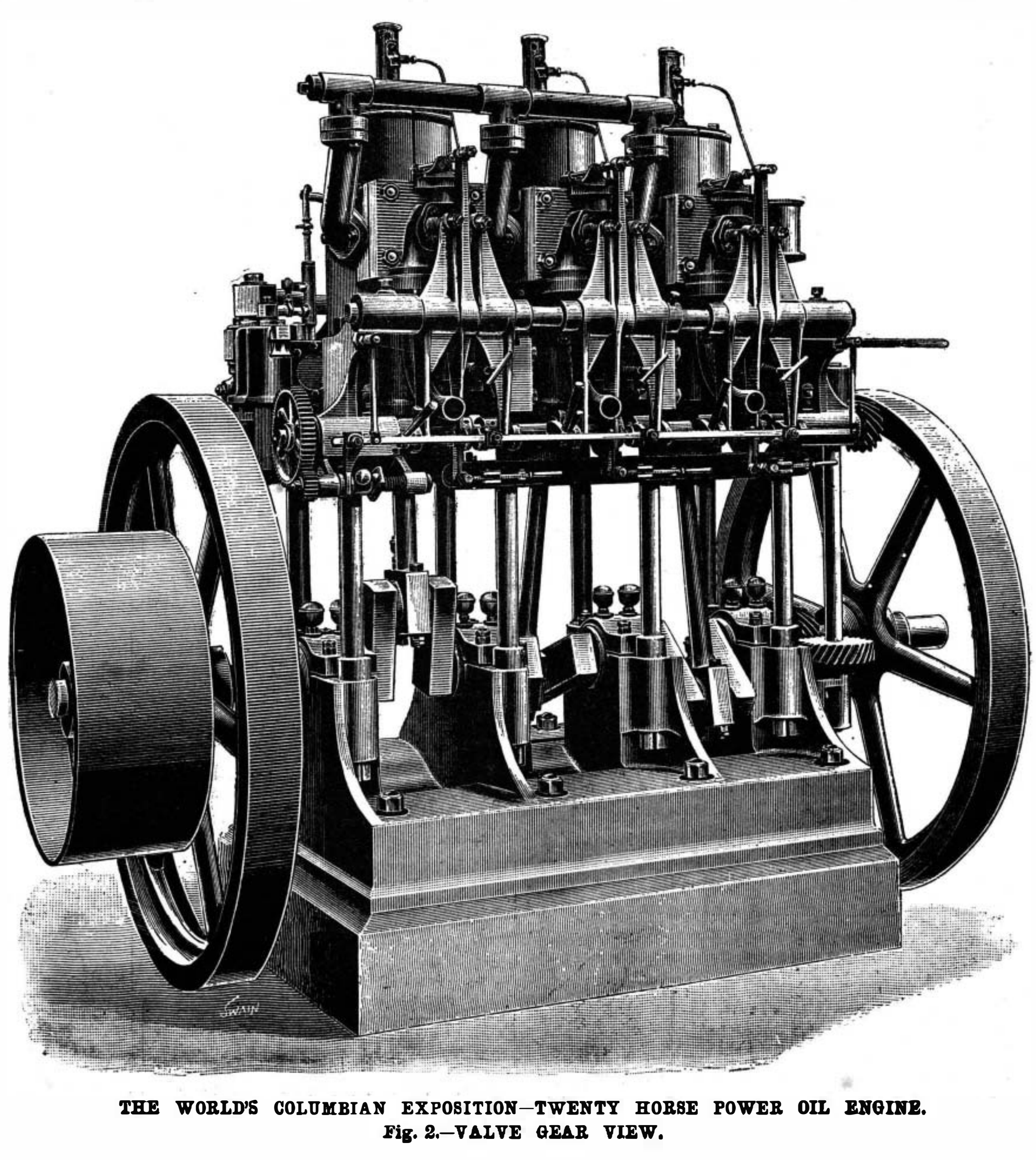
He was asked if he would be willing to say what he had in his mind for the next campaign, and he replied: "Well, I think as soon as the ore-concentrating business is developed and can take care of itself, I shall turn my attention to one of the greatest problems that I have ever thought of solving, and that is, the direct control of the energy which is stored up in coal, so that it may be employed without waste and at a very small margin of cost. Ninety per cent of the energy that exists in coal is now lost in converting it into power. It goes off in heat through the chimneys of boiler rooms. You perceive it when you step into a room where there is a furnace and boiler. It is also greatly wasted in the development of the latent heat which is created by the change from water to steam. Now that is an awful waste, and even a child can see that if this wastage can be saved, it will result in vastly cheapening the cost of everything which is manufactured by electric or steam power. In fact, it will vastly cheapen the cost of all the necessaries and luxuries of life, and I suppose the results would be of mightier influence upon civilization than the development of the steam engine and electricity have been. It will, in fact, do away with steam engines and boilers, and make the use of steam power as much of a tradition as the stage coach now is.

"It would enable an ocean steamship of twenty thousand horse power to cross the ocean faster than any of the crack vessels now do, and require the burning of only two hundred and fifty tons of coal instead of three thousand, which are now required, so that, of course, the charges for freight and passenger fares would be greatly reduced. It would enormously lessen the cost of manufacturing and of traffic. It would develop the electric current directly from coal, so that the cost of steam engines and boilers would be eliminated. I have thought of this problem very much, and I have already my theory of the experiments, or some of them, which may be necessary to develop this direct use of all the power that is stored in coal. I can only say now, that the coal would be put into a receptacle, the agencies then applied which would develop its energy and save it all, and through this energy electric power of any degree desired could be furnished. Yes, it can be done; I am sure of that. Some of the details I have already mastered, I think; at least, I am sure that I know the way to go to work to master them. I believe that I shall make this my next campaign. It may be years before it is finished, and it may not be a very long time."

Mr. Edison looks farther ahead than this campaign, for he said: "I think it quite likely that I may try to develop a plan for marine signaling. I have the idea already pretty well formulated in my mind. I should use the well known principle that water is a more perfect medium for carrying vibrations than air, and should develop instruments which may be carried upon sea-going vessels, by which they can transmit or receive, through an international code of signals, reports within a radius of say ten miles.

Mr. Edison believes that Chicago is to become the London of America early in the next century, while New York will be its Liverpool, and he is of opinion that very likely a ship canal may connect Chicago with tide water, so that it will itself become a great seaport.

PARIS has 87,655 trees in its streets, and each tree represents a cost to the city of £7. This makes, in round numbers, £600,000 worth of trees in the streets.



THE WORLD'S COLUMBIAN EXPOSITION—TWENTY HORSE POWER OIL ENGINE.
Fig. 2.—VALVE GEAR VIEW.

*By E. J. Edwards, in *McClure's Magazine*, June, 1893.