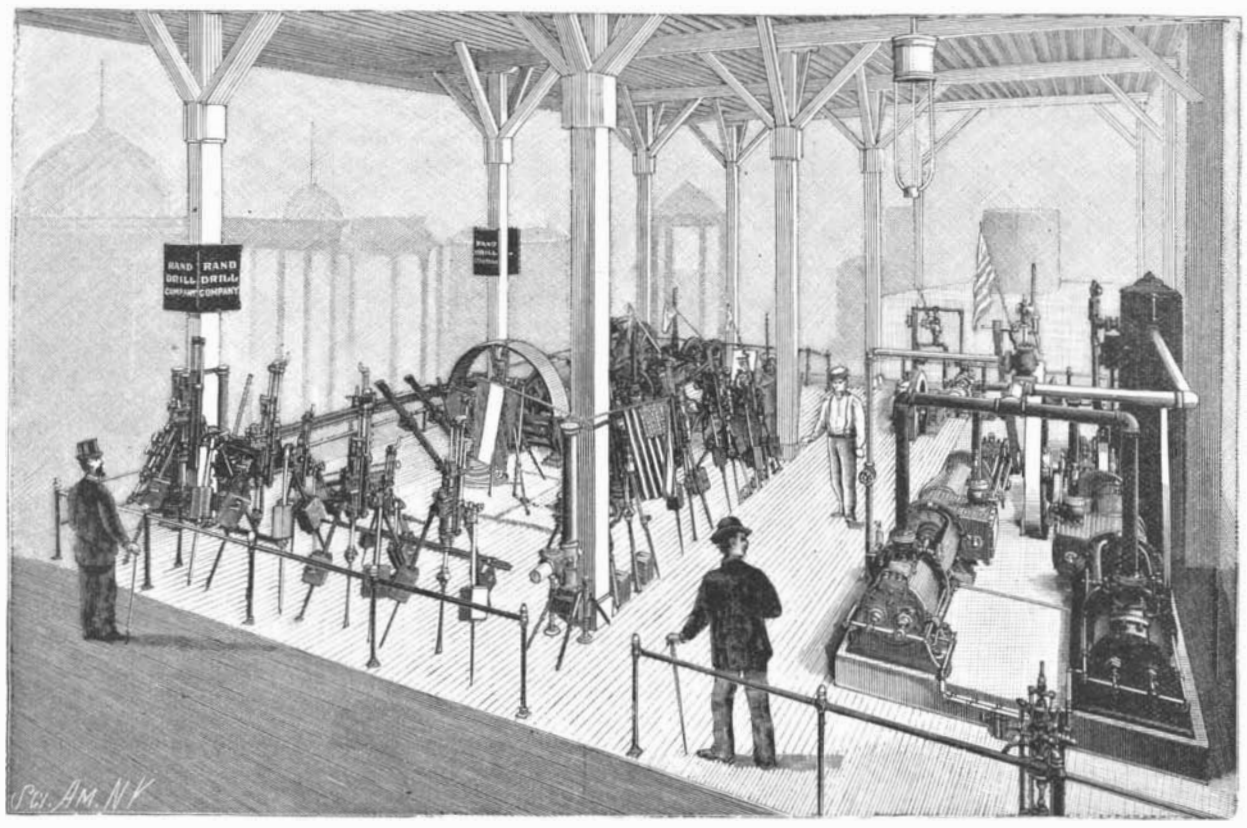
metal, with their outer edges serrated. Near the forward end of the sleigh, on each opposite side, is a curved rudder held normally out of the snow by a spring, but by pulling on a rearwardly extending cord a downward swinging motion is given to one of the rudders to move its rear curved end into contact with the snow or ice, to steer the sleigh to the right or left as desired. To conveniently pass the sleigh over ground a pair of front wheels is provided, their axles journaled in pivoted side arms and locked in place by a pin, the arms being swung downward when it is desired to wheel the sleigh over the ground, the paddle wheels being at the same time locked in their lowermost position, whereby the sleigh is lifted entirely off the ground. When the snow or ice is again reached, the arms carrying the front wheels are swung into their upper position and the paddle wheels are raised to the height best adapted to effectively engage the surface of the ice and snow. The invention also provides for the convenient and ready attachment to the main runners of different forms of auxiliary runners specially adapted for running over ice or hard frozen ground or loose or wet snow.



THE RAND DRILL COMPANY'S EXHIBIT AT THE COLUMBIAN EXPOSITION.

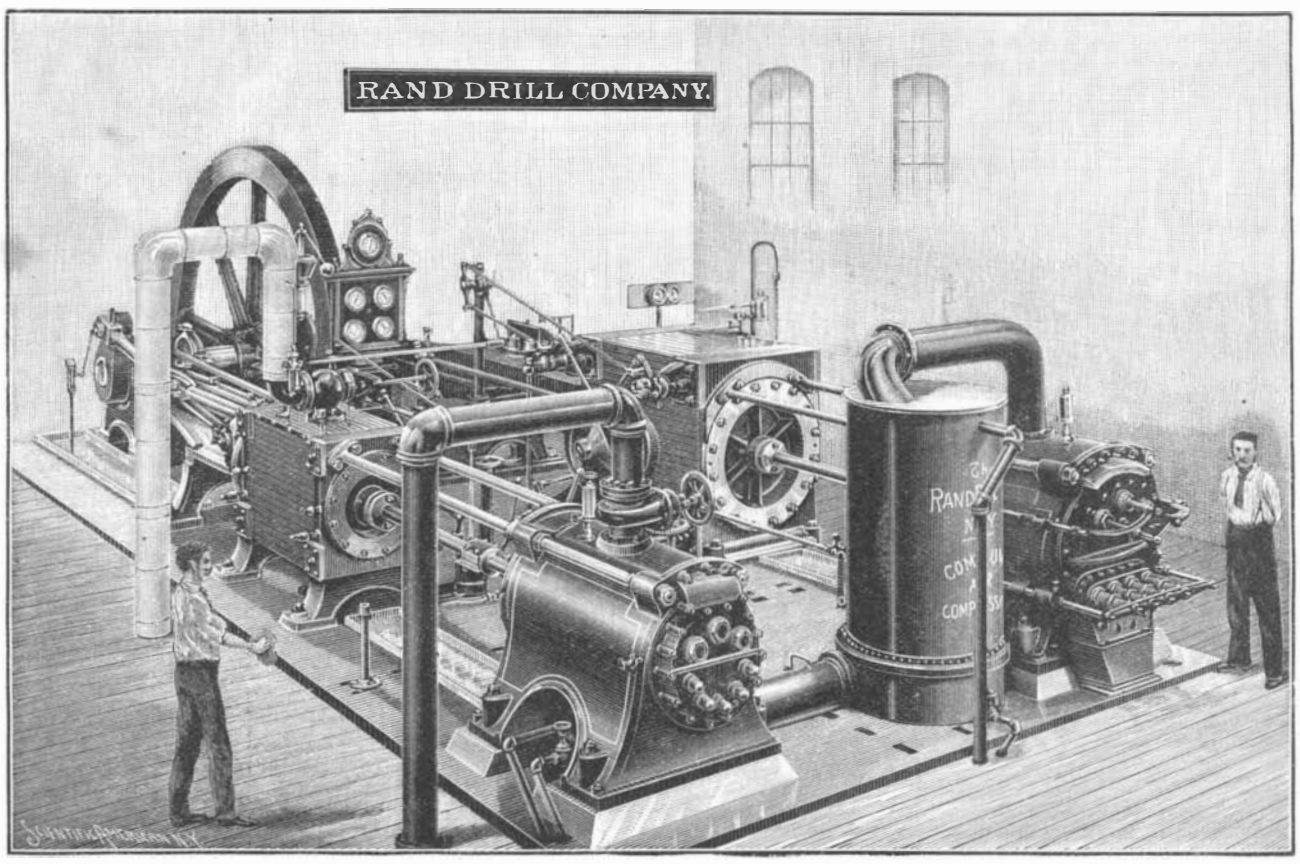
THE RAND DRILL COMPANY'S COMPOUND DUPLEX AIR COMPRESSOR AND ROCK DRILLS AT THE COLUMBIAN EXPOSITION.

Formerly, when the applications of compressed air were more or less tentative, and the whole system was little more than experimental, engines of a comparatively cheap type were naturally employed for driving the compressors, at the expense of course of economy of fuel. With the rapid development of recent years in the various uses of compressed air, the point was reached where users began to inquire carefully into the cost of production and a demand arose for compressors embodying the highest and most advanced construction, both as regards the compressors themselves and the engines for driving them.

The Rand Drill Company, of 23 Park Place, New York City, have been pioneers in meeting this demand for machinery of the most advanced type. An example of their latest construction was shown in their conspicuous exhibit in Machinery Hall at the Columbian Exposition. This machine, which is here illustrated, is the largest and most highly organized of any exhibited at the Fair. It has, in consequence, attracted a great deal of attention. It was driven by a Corliss engine of the cross compound condensing type. The air cylinders are compounded, in order to make the compression in two stages, and between the two cylinders is an intercooler through which the air must pass in its progress from the low pressure to the high pressure cylinder. This intercooler has a function analogous to the intermediate receiver of compound steam engines, but in addition to that, it has a more important function, which is the chief reason for the compound system as a whole, viz., the cooling of the air at the middle of its compression. As is well known, the compression of air develops a large amount of heat, which by expanding the air consumes a portion of the power which is subsequently lost, in consequence of the air becoming cooled before use. The purpose of the compound system is to diminish this loss by taking the air from the first cylinder when partly compressed, and hence heated to a moderate degree only, and cooling the same down to its original temperature by means of a water jacket, after which it is discharged into the second cylinder and the compression completed. There are thus two stages of compression, the second of which is begun with cold air, whereas in the usual single cylinder system the compression is continuous, the latter half being done on air already heated during the first half.

If the indicator cards from the two cylinders be combined in the manner common with compound steam engines, the result would be to show a break in the compression line, that portion which represents the completion of the compression being set back nearer the end of the card, the results indicating a considerable saving in power.

The air end of this machine is fitted with the Rand Drill Company's well known mechanically moved air valves, which constitute a marked advance on the regulation spring valves heretofore almost exclusively used. The mechanical attachment to these valves operates upon the springs with which the valves are fitted. The ordinary style of compressor valve is in principle the same as the valves of pumps, being opened by the pressure of the air and closed by springs which constantly press upon their backs. In use, such valves, as is well known, have a chattering action due to the constant conflict between the air which is trying to open them and the springs which try to close them. The action of the mechanical gear is to retract the pressure of the springs from the valves, during the period when the valves are required to be open, thus leaving the valves under the influence of the air only and doing away with the chattering. The final result, however, is much more far reaching than this description would at first indicate. The chattering of the valves necessitates a small lift, in order to limit the violence of the action, and this, by reason of the accompanying small opening, necessitates a large number of valves to give the required total opening. With large compressors this multiplicity of valves becomes formidable and complicated. The action of the mechanical gear stops the chattering, as before mentioned, and the necessity for a small lift no longer remains. Consequently, the valves are given a high lift, so as to give a free and unobstructed opening, and the total number of valves is, consequently, very largely reduced. The machine is also fitted with the Rand Drill Company's differential pressure regulator, the operation of which attracts the attention of the mechanical eye. This regulator operates upon the knock-off blocks of the Corliss gear, much after the manner of the usual ball governor, with which the compressor is also supplied, and it is the combination of these two governors acting upon the same set of knock-off blocks which forms the interesting feature referred to. When the machine is started without pressure in the air pipes, the throttle valve is thrown wide open, and the machine runs up to the highest limit of its speed until checked and controlled by the ball governor, after the manner of ordinary Corliss engines for motive power. As the pressure rises, it soon reaches a point to which the plunger of the regulator is loaded; this plunger then rising shortens the cut-off and slackens the speed, when the ball governor drops, and the compressor remains under the control of the pressure regulator, which shortens or lengthens the cut-off as may be necessary to give the speed which shall maintain the air pressure, any drop of pressure being accompanied by an increase of speed and any rise of pressure with a diminution of speed. Should, however, the demand for air exceed the capacity of the machine, the pressure will drop below that to which the regulator is set, when it will go out of action, and the speed will increase until the ball governor acts as at the start. At times, when the demand for air approximates the capacity of the machine, this interchange of action between the two regulators is constantly taking place.



THE RAND COMPOUND DUPLEX AIR COMPRESSOR AT THE COLUMBIAN EXPOSITION.

The diameters of the air cylinders of this machine are 22 inches and 34 inches, and the diameters of the steam cylinders 22 and 40 inches, while the stroke of 48 inches is common to all.

The Rand rock drills formed a noticeable feature at the Exhibition. There were shown drills for every variety of work, including mining, quarrying, sub-

marine work. A long experience has enabled the Rand Drill Company to bring these drills to such a state of perfection as to perfectly adapt them to the wide range of uses to which they are applied and to give them the qualities of durability and efficiency which are so essential to machines subjected to rough usage and trying conditions.

Enlarged Stereoscopic Pictures.

The following description of Mr. John Anderton's system for obtaining stereoscopic effect on the lantern screen is given in the *British Journal of Photography:*

"In adapting the stereoscope to the optical lantern, the problem to be solved is, to place upon the screen a pair of ordinary stereoscopic pictures in such a manner that, while the right eye can only see the right hand picture and the left eye the left hand picture, yet the two are combined and conveyed to the brain as one.

"In the invention this problem is solved in an exceedingly simple manner. The pictures on the screen are in full perspective, the various objects forming them standing out as if possessed of three dimensions, and appearing in their correct relative planes. A pair of ordinary stereoscopic transparencies are superposed on the screen as nearly as possible; the pictures not being identical, a perfect registration cannot be obtained. The light from each picture is polarized, one vertically, the other horizontally, and the combined picture is viewed through an analyzer similar to a small opera-glass. This analyzer is so constructed that, while the right eye can only see the image portrayed in horizontally polarized light, the left eye can only see that in vertically polarized light. An important part of the invention is the screen. It is a well known fact that polarized light is apt to be broken up on reflection. The screen employed is faced with dull or matt silver, a long series of experiments having proved this to be the best material."

To this descriptive outline, which is in the nature of a "popular" one, it is only necessary to add that the superposition of the stereoscopic picture is effected by halving the transparency and projecting the halves by means of an ordinary biunial lantern. The polarizers are placed before each objective.

We may at once say that for our own part we consider stereoscopic projection, as worked out by Mr. Anderton, and shown recently, as perfectly successful. Indeed, our expectations never went within measurable distance of what we then realized.

The two pictures, when superposed, show a duplication of outline, due, of course, to the fact that absolute registration of the two dissimilar halves cannot be got. When looked at through the analyzer, however, the blur disappears, the image coalesces in the brain just as when a binocular slide is examined in the stereoscope, and the screen picture becomes at once well defined and truly stereoscopic, objects standing out in apparent relief and solidity with all the charm of reality.

It should be said that, while all the pictures shown yielded stereoscopic effect when viewed through the analyzer, some were less successful than others. Interiors, flowers, landscapes, animals, were shown, perhaps the most realistic being the picture of a tiger in a cage, the paws of the animal reaching, as it were, out of the picture, the bars of the cage separating from the animal beyond them, and the whole effect being remarkably good.

It is claimed that any subject taken with a binocular camera would be suitable for stereoscopic projection, but we are disposed to think that successful effects, not only to a popular audience, but to those not unfamiliar with stereoscopic photography, would be best obtainable by suiting the treatment of the subject to the conditions of the case. Thus, it appeared to us that the most successful pictures shown were those which had been taken with short focus lenses separated rather above the distance which strict theory demands, so as to obtain some little exaggeration of relief. This, however, is only a reflection in passing.

On the whole, Mr. Anderton is to be congratulated upon the undoubted success of his adaptation of certain optical principles to stereoscopic projection. The lantern stereoscope should be widely popular.

The Cost of Carelessness.

Familiarity with danger seems to breed, if not a contempt for it, an utter carelessness. We have seen, says the Chattanooga *Tradesman*, the "Mohawk Dutchman," the celebrated expert with a band scroll saw, rub the ball of his thumb in dirty grease and then cut the grease off with the rapidly running saw as clean as could be done with soap and water. We have seen a man put his finger under a powerful trip hammer in motion just to show how well he could manage the machine. Many other foolish things are done just to "show off." But most of the accidents happen through a carelessness resulting from familiarity. As long as an operator is afraid of his machine, he is not apt to get hurt. Many human minds are so constituted that they cannot bear a sustained effort in one direction; that is, cannot be always equally on the alert in regard to a certain contingency. A train dispatcher or switch tender may hold a place for years without ever making a mistake, and at last make a terrible one, from some cause he could not explain. The only way to lessen the number of casualties—they cannot be avoided entirely—is to take all precautions. This is required of the owners if they wish to escape costly damage suits, but when all possible precautions have been taken, one can then only trust to luck.

THE SCIENTIFIC AMERICAN MATCH SAFE.

The readers of the SCIENTIFIC AMERICAN will be interested in the accompanying cut, which represents,

THE SCIENTIFIC AMERICAN MATCH SAFE.

not a copy of the paper, but a silver match safe, which is manufactured in facsimile of the SCIENTIFIC AMERICAN, and represents it as folded in a wrapper and as having passed through the mail. The familiar blue one cent stamp is in one corner and canceled by the New York postmark. The name of the owner may be enameled upon the wrapper and the autograph accurately reproduced. The manufacturers, Messrs. Enos Richardson & Co., of 23 Maiden Lane, New York, have paid us the compliment of selecting the SCIENTIFIC AMERICAN as the most representative and available paper for this purpose, and we take pleasure in acknowledging their courtesy and discrimination.

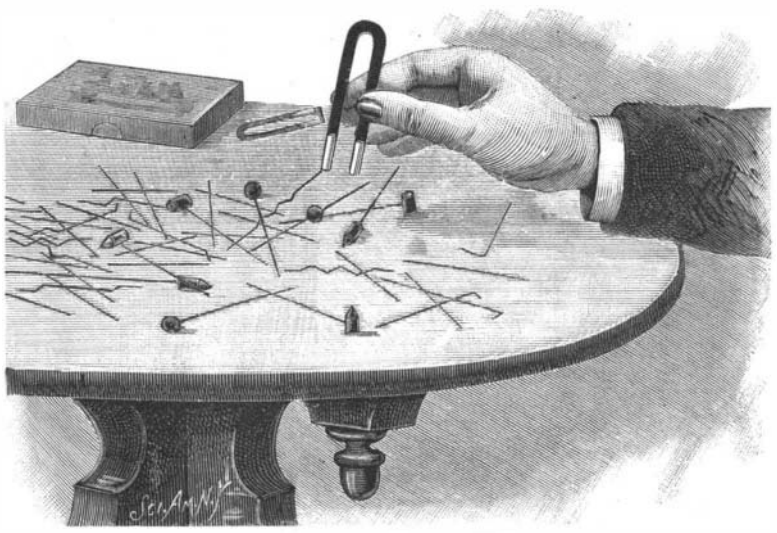
MAGNETIC JACK STRAWS.

The illustration below shows one of the most ingenious devices for the amusement of children to be found this season among the various toy stores and elsewhere.

It is a game that will not only amuse children, but affords an endless source of amusement to adults as well, and can be played by any number of persons.

The game is put up in a neat little box, and contains a large number of metal straws of various colors, crooked, and angled, and crimped, and some of them having little heads of colored wood in various forms, together with two magnets.

The object of the game is to withdraw a single straw from the bunch by means of a magnet and without touching or disturbing the other straws. The game is manufactured by E. I. Horsman, of 341 Broadway, N. Y.



MAGNETIC JACK STRAWS.

The Simplon Tunnel.

It is announced from Berne that the contract for boring a tunnel through the Simplon has just been signed and has been given by the Jura-Simplon Railway Company to Messrs. Brand, Brandau & Co., of Hamburg, and Locher & Co., of Zurich. Both these firms have some experience in mountain railway work, the former having joined in the boring of the Arlberg tunnel and the latter having constructed the line up the Pilatus. The Mont Cenis tunnel, the first of the Alpine tunnels constructed, took 13 years in its completion; the first blast (at that time the only method known for boring tunnels) was made with gunpowder in 1857, and it was not till four years later that machine drilling was introduced, while the subsequent application of compressed air drills came almost too late for the engineers to profit fully by them. The average rate of advance during the thirteen years' work was 2·57 lineal yards per working day of 10 hours, each lineal yard costing £226. In boring the St. Gothard tunnel the engineers could profit by past experience; it was commenced in 1872, and, though two miles longer than the Mont Cenis tunnel, was finished in 1881. Turbines of 2,000 horse power compressed the air for working the Ferroux drills, and the rate of advance was 6·61 lineal yards per day, at a cost of £143 per yard. Further advance was made in the boring of the Arlberg tunnel, which is 6⅛ miles in length, and took only three years to construct. In this case the average rate of advance was 9·07 yards per day, at a cost of only £108 per yard. We have no doubt that a further advance will be made in the boring of the fourth of the Alpine tunnels, and we hope that this advance will be due to electrical methods. We have now at our command most efficient electrical drills and can work these drills by electromotors. Motive power in mountainous regions can easily be derived from some of the numerous waterfalls to be met with in these regions, and the locality of the central stations, thanks to the progress of electrical power transmission, can, within the prevailing limits, be pretty nearly chosen at will. We feel sure that the enormous advantages of an electric installation will not be overlooked by the contractors, and in this case the stipulated time for the completion of the work of 5½ years will prove more than ample. It is contemplated to construct at first only a single line of rails; a gallery, however, will be made at the same time, and will afterward be widened to enable a second line of rails to be constructed after four more years. The cost is estimated for the first enterprise at fifty-four and a half million francs (£2,180,000), and for the addition, fifteen million francs extra.—*Electricity.*

The Year's Progress in Naval Ordnance and Armor.

The annual report of the Chief of the Navy Bureau of Ordnance gives a good summary of the year's work in the bureau, as well as an estimate for the next fiscal year, which is $7,145,801, of which $6,500,000 is for arming vessels already authorized. Of 453 guns of calibers from four to thirteen inches which have been ordered, 298 are completed, including twenty-five 10 inch, eight 12 inch and five 13 inch; 188 are afloat; and forgings for 368 guns have been delivered. The 13 inch guns have not been tested as yet, owing to delays in mounting. Progress is being made on 8 inch nickel-steel guns and on the Hurst 8 inch guns. Cartridges will hereafter be supplied for the 6 inch guns. Of the small guns for the secondary batteries, 480 Hotchkiss and Driggs guns, 360 are finished. Two hundred and thirty-seven gun mounts have also been completed.

Smokeless powder is not yet suitable for regular use, but large quantities of brown powder are supplied by the California Powder Company, of Santa Cruz, and by Du Pont & Co., who have also supplied 50,000 pounds of gun cotton. The treatment of small caliber projectiles by the Harvey process has proved very satisfactory. Experiments are being conducted in firing shells from high-power guns charged with gun cotton and fulminate.

Contracts for 6,489 tons of armor have been made during the year and the plants have been enlarged to admit of delivering the armor more rapidly. By the new arrangements armor can be supplied as fast as needed to the vessels in the shipyards. The armor, both the nickel-steel and the Harveyized, continues excellent in quality. A number of new Howell and Whitehead torpedoes have been received. The difficulty with the main valve of the pneumatic guns of the Vesuvius has not been overcome and Commodore Sampson recommends that the $450,000 appropriated for a similar vessel be used to build four torpedo boats instead. The report shows that the Bureau of Ordnance is making substantial progress.

Edison on Flying Machines.

Once I placed an aerial motor on a pair of Fairbanks scales and set it going, says Thomas A. Edison. It lightened the scales, but it didn't fly. Another time I rigged up an umbrella-like disk of shutters and connected it with a rapid piston in a perpendicular cylinder. These shutters would open and shut. If I could have got sufficient speed, say a mile a second, the inertia or resistance of the air would have been as great as steel, and the quick operation of these shutters would have driven the machine, but I couldn't get the speed. I believe that before the air ship men succeed they will have to do away with the buoyancy chamber.

A ROCHESTER man has devised a plan by which a trolley street car can be stopped almost instantaneously, or within a space of three feet, while the car is going at full speed. As he omits, however, adds *The Railway Review*, to provide for stopping the passengers, it is only fair to presume they will object.