whole range of labor-saving machinery there is perhaps no series of contrivances which so forcibly address themselves to the senses ; and yet, with all its intricate and wonderful operations, there is nothing mysterious in it, as the spectator can see and comprehend its workings from the beginning to the end. At one extremity of the machine is a large chest which is kept full of pulp, and through which a wooden cylinder with fan-shaped projections attached, is kept revolving to keep the fibers of rags, which resemble pure snow flakes, perpetually moving, and consequently equally suspended in the the water which contains them. At the bottom of the chest is a cock through which a continuous stream of pulp flows into a vat placed below it, which is always kept filled to a certain hight. This pulp flows through a narrow wire sieve, situated in the upper part of the vat, and is also kept in motion to make the sifting process the more complete. Having passed through the sieve the pulp flows through a pipe in the vat still onward to a ledge, over which it falls in a regular stream, like a sheet of water over a smooth dam ; here it is caught upon a plane which presents an uninterrupted surface of five or six feet, upon which it is evenly spread. This plane is constanly moving onwards with a gradual pace, and has also a shaking motion from side to side. This plane is composed of an endless web of the finest wire very closely woven together. The pulp does not flow over the sides of the plane because of a strap on each side, which is kept moving and passing upon its edges, and which regulates the width of the paper. After passing the wheels where these straps terminate, the paper is sufficiently formed not to require any further boundary to define its size. The pulp at this stage has ceased to be a fluid though the paper is still tender and wet. When it quits the plane of wire the paper passes over a large cylinder covered with felt, upon another plane also covered with felt, which moves onward the same as the wire plane. This felt surface is also endless, being united at the extremities like a towel upon rollers. It now travels up an inclined plane of felt, which gradually absorbs its moisture, when it is seized between two rollers which powerfully squeeze it. From thence it travels up another plane of felt and through a second pair of pressing rollers. The paper up to this point is quite formed but it is fragile and still damp ; from these it is received upon a small roller, and is guided by this over the polished surface of a large heated cylinder. The soft tissue now begins to smoke and the paper commences to harden. From this cylinder or drum, it is received upon a second, considerably larger and much hotter than the first ; as it rolls over the polished surface of the drum all the roughness of its appearance when in the cloth region gradually vanishes. At length having passed over a third cylinder, still hotter than the second, and having been subjected to the pressure of a blanket which confines it on one side, while the cylinder smoothes it on the other, it is caught upon the last cylinder, which passes it over to the reel, upon which it is wound in a finished state but in an endless roll. It has now to be cut into required lengths so as to form the size of the sheet. This is done in a supplementary machine which receives it off of the reel, and by means of a circular knife it is cut into the requisite lengths. The paper is counted into quires and reams, folded double, and subjected to a certain pressure, so that it may pack close for marketable purposes.

From the commencement of the process, when the pulp first flows into the wire web until the paper into which it is formed is received upon the reel, a little less than two minutes is occupied. The web of wire travels at a rate which produces twenty-five superficial feet of paper per minute.

In a machine the thickness of the paper is regulated by the quantity of stuff which is allowed to flow out of the chest ; and all that is required to render the thickness invariable is an invariable speed in the motion of the machine. If the web of wire travels at a rate that will form twenty-five feet of paper per minute, and the chest discharges five gallons of pulp in the same period, there can be no change in the thickness of the sheet ; but let the machine move at greater speed, say at the rate of twenty-five per minute, while the discharges are but five gallons, and the paper will be thinner by one fifth. Again, let the pace of the wire plane be unaltered, and the chest discharge ten instead of five gallons per minute, and the sheet will be just double the thickness.

In conclusion it should be remarked that the process of converting rags into pulp is the same with machine-made as with hand-made paper, except that in the former it is conducted on a more extensive scale. A hundred years ago rags were made into pulp, first by washing them by hand and then by placing them in close vessels until they became half rotten, and after the fiber was nearly destroyed they were reduced to pulp either by hammering in a mortar or by a cylinder grinding against the sides of a circular wooden bowl. These operations were slow, expensive, and very destructive to material ; and yet, crude as the method was, it existed for centuries, and so continued up to the period when science stepped in to enlighten mankind with its manifold wonders.

Portable Boilers.

At the Steam Users' Association monthly meeting, held at Manchester—Mr. W. Fairbairn, President, in the chair—Mr. L. E. Fletcher, chief engineer, said that the increasing number of boilers used for steam crane and other similar purposes, renders it important that any dangerous defects to which these boilers are liable should be generally known. The explosion of these boilers has become by no means unfrequent, and as they are now constantly used in the erection of public buildings, and sometimes in close proximity to crowded thoroughfares, the subject becomes of increasing importance. The boiler in question was of the internally-fired vertical class, cylindrical in the external casing, as well as in the internal fire-box, and domed on the top, while the flames from the fire-box pass off to the chimney through a single central uptake tube, which formed a most important tie between the crown of the fire-box and that of the external casing. Boilers of this type are very simple in construction, and well calculated when new to resist a high pressure, so that they are very generally adopted. The dimensions of the one under consideration were : Height, 8 ft. 9 in. ; diameter, 3 ft. 6 in. in the external shell, and 2 ft. 9 in, in the fire-box ; while the thickness of the plates was $\frac{5}{16}$th in., and the load on the safety-valve, per square inch, 70 lb. The defect to which it is now wished to call attention, was a deep groove or furrow running entirely round the inner casing of the fire-box at the bottom of the water space, and eating into the metal to a depth varying from $\frac{1}{8}$ to $\frac{3}{16}$th in., so that more than half the strength of the plate was gone. This is not a peculiar case ; others very similar havd been met with, and especial danger arises from the fact that these grooves are very difficult to detect. They take place so low in the water space as to be very nearly, if not entirely, concealed by the blocking ring at the bottom, while the only opportunity of examining them is through one or two small sight holes cut through the outer casing. It is frequently supposed that because boilers are small therefore they are safe, whereas the fact of their being small makes them dangerous. Small boilers cannot be inspected as larger ones can, since they do not admit of access for a man, and, therefore, they are to a greater or less extent apt to be worked on at a risk. The internal examination, and thus the safety, of portable boilers is a question which hitherto has not received that consideration which it deserves, but the subject should no longer be neglected. It is well worthy of the attention of engineers to endeavor to construct such portable boilers as are too small to admit of a man's getting inside, so that they may be taken to pieces for examination ; and it becomes imperative either that arrangements should be made for doing this, or that these boilers should not be allowed to work on for more than three or five years without being cut open for examination, whatever the inconvenience might be. No doubt if the attention of engineers were directed to this subject, inventive talent would soon construct boilers that could without much difficulty be taken to pieces so as to be examined internally, and thus their safety ensured.

PULEX IRRITANS IN HARNESS.

What is a " Pulex Irritans?" This formidable name, dear reader, is the scientific cognomen of that formidable little monster, the flea. These minute pests have been made to do, what by nature they are ill calculated for, namely, to administer to the amusement of mankind, showing an amount of docility truly surprising when brought under the subjection of skilled trainers. Novices they are generally adroit enough to elude. The following humorous description of the performances of a troupe of these little comedians we copy from the " Naturalist's Note Book :"

" If any inquiring reader wishes to know whether that little tormentor, scientifically known as " Pulex irritans," and vulgarly as the flea, has ever been found of any use in the economy ot nature's realm, we are happy to inform him that we can answer his question in the affirmative. It must not be imagined that we are going to discuss the question whether it is desirable that the human form divine should be subject to sundry little aggravating bites, which are liable to make one's angry passions rise, or whether the ordinary avocations of fleaish life are at all beneficial to humanity at large. Our object is to place him before our readers as we have seen him, in a new light, earning an honest livelihood (*mirabile dictu !*) by the sweat of his brow, and affording a subsistence to the individual whose philanthropic ingenuity helped him to such a desirable end.

" 'From information received' (to use police parlance) we went to an exhibition opened by Mr. Kitchingman, in order to view the performances of his stud of trained fleas, or, as worded in his announcements, 'of trained apterous insects, the only specimens of the articulata in the world ever taught to perform.' These apterous laborers were harnessed by means of an extremely fine hair or fiber of silk, which was tied round their bodies, having the two ends rising perpendicularly above their backs and fastened to a split in a tiny straw, which formed the pole of the carriage they were engaged in drawing. We must confess that at first we entered the room with some feelings of alarm, suggested by the thought that some of the menagerie might escape, but this was soon dissipated at the sight of their burdens, which at once set our minds at rest.

" The performances were highly interesting and considerably varied. One flea was engaged in a swing, his motion being caused by his kicking violently against one side of a well in which he was placed, which exertion bumped him against the other side and made him indignantly jump away again, so that the unfortunate creature was in a perpetual state of kicking. Another hauled up a little ivory bucket from a well, while a third drew a ship along a tight rope, walking upside down. A fourth was occupied in turning a cardboard cylinder after the manner of a treadmill, but two others, still more unhappy, were occupied in a compulsory see-saw worked by each in turn giving a vigorous spring into the air, thus bringing the other at the opposite end of the balance to the ground. The largest, and consequently, we presume, the laziest, declined to jump at all, but remained sitting quietly down, leaving his comrade miserably suspended from the beam, and frantically clutching at the air in the vain attempt to reach the ground. A military pulex was engaged in firing off a miniature cannon, but on a former occasion the shock was too much for his nervous system, so that when we were present he was unable to perform. The exhibitor kindly gave us a good deal of information about his collection which was very interesting. The fleas are generally imported from Russia and Belgium as being larger and more docile than the English ones, and are set to work immediately, the training beginning with a starvation of two days. At first they are very refractory, persisting in progressing by a series of violent jumps instead of a proper jog trot ; but after a week or so they sober down and draw their burdens steadily unless stirred up to violent exertion, when they will gallop vigorously for a few inches, but sit down to rest and regain their breath directly afterwards. After they once learn to walk steadily, we are told, it is difficult to persuade them to leap again. At night all the performers are unharnessed and fed on the back of the employer's hand, after which repast they repose in a box enveloped in cotton wool. If at night any performer does not feed heartily, and with a good appetite, his progress is proportionately languid and slow the next day; but when any member of the establishment declines to eat for three or four days, his end is expected in a short time. About a hundred others are usually kept in stock and training, as they are comparatively short lived, three or four months being supposed to be the allotted period of their days. Perhaps confinement and hard labor affect their spirits. The workman engaged in drawing up the bucket had, however, reached the hoary age of nine months, and his demise therefore will not be unexpected. The immense muscular power possessed by these creatures is here fully demonstrated. No doubt many of our readers have experienced the difficulty of holding a wild pulex for a minute or two, before consigning it to perdition. The flea Hercules draws a model of a ship estimated to be five hundred times his own weight in a very easy manner. It seems that the English fleas are the most stubborn and difficult to train, but when once properly subdued they work better and last longer than the others ; but the Englishman we saw was anything but steady, tugging and straining at his collar in a frantic manner.

"One of the most interesting features of the exhibition is the beautiful form of the models employed for the work. They are carved in ivory and exquisitely finished, and, of course, of the minutest size possible, being adapted to the fleas in a most ingenious manner, and manufactured by the exhibitor himself. The delicacy of touch and sight attainable after practice is surprising, as each performer is harnessed without the aid of a glass, merely being taken between the operator's finger and thumb. Mr. Kitchingman told us also that he knows every individual performer by sight, so that he has no difficulty in selecting each member of his troupe for his own work."

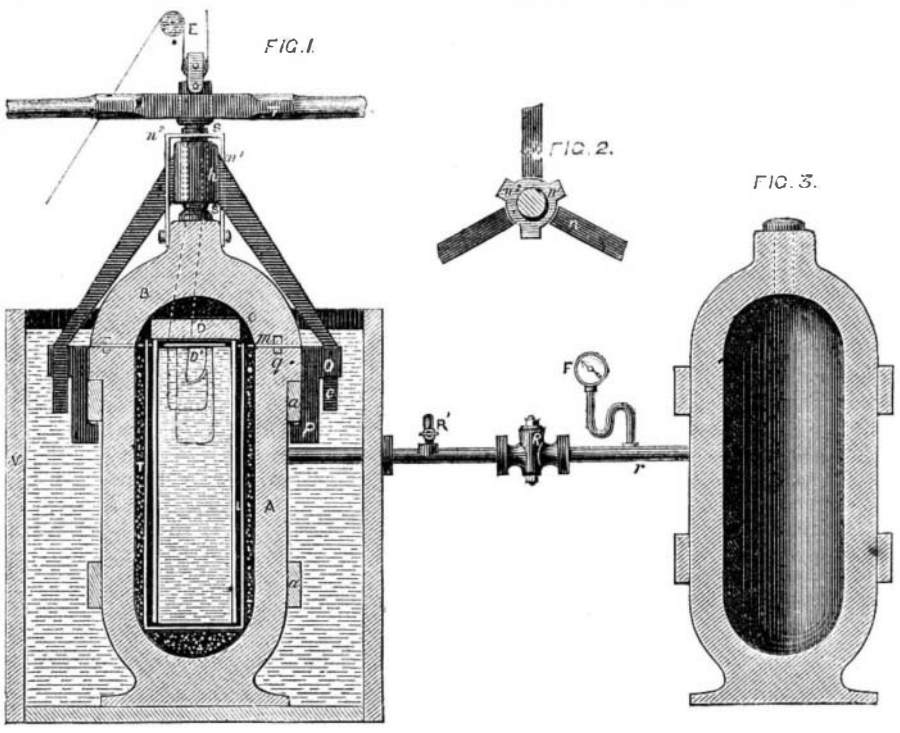
Revival of Interest in Sorghum.

The quantity of cane planted this year, says the *Sorgo Journal*, and the interest manifested in sorghum, is greater than in any year since 1866. The value of sorghum as a farm crop is beginning to be appreciated, and those now engaged in the business are devoting more attention to its cultivation, and are providing better facilities for its manufacture than ever before. This is wise, and all the enterprise which may be devoted to the crop will be well rewarded. Sweets of all kinds are and must be high for the present, and proba bly for many years. Last year's crop of sorghum is about exhausted. New Orleans and tropical molasses are scarce, and sugars are almost at famine prices. This state of things is, of course, aggravated by the disturbances in Cuba, and by the fact that Louisiana has not produced all the sugar and molasses that could be consumed, as many predicted she would. But there is an underlying cause of high prices greater in importance and greater in permanence than these accidents of the time, and which would be felt even it peace prevailed in Cuba, and a half million hogsheads of sugar were being made in Louisiana. We refer to the natural increase in the consumption of sugar, and to the growing disproportion between the demand and the supply. This will prevent sugar and molasses from declining to the old prices, until some new and much more productive source of sugar shall be developed. We make this remark to remove a notion which prevails, that, if Cuba were restored to peace, and Louisiana to her former productive capacity, sugar and molasses would be furnished at their old prices, and then sorghum would be no longer profitable. Reasoning thus, many have refrained from engaging in sorghum, and many who are in the business, regarding it as a temporary or short-lived enterprise, fail to make adequate and permanent preparation for the business. This is a mistaken policy, we think, and we advise those who are making preparation for work to consider well, and see if they are not warranted in regarding sorghum as a business likely to be permanently profitable, and worthy of a permanent and a substantial outfit in buildings and apparatus. But all the probabilities are that Cuba will not for many years, if ever again, produce her former supply of sugar, and that Louisiana will not for five, and, perhaps, ten years, produce as much sugar as she did before the war. So that the producer of sorghum may calculate upon a good substantial and a continuous profit from the business, and also upon the chances amounting almost to a certainty that the profits will be for some years, at least, extraordinary. Under these circumstances the "revival of interest in sorghum," must, we think, become a permanent and a growing revival.

In a recently published paper on the gases given off by fruit it is stated that various kinds of fruit after having been plucked from the trees—for instance, apples, cherries, gooseberries, and currants—begin to absorb oxygen and give off carbonic acid.

Casting Metals, Glass, etc.

Letters patent have been taken out in France for improvements in casting metals, glass, and other materials. We give an illustrated description of the apparatus employed. An air-tight vessel is formed of a hollow cylindrical vessel of cast iron, closed at its lower end, and strengthened on the exterior by rings of wrought iron shrunk upon it. The vessel is closed air-tight at its upper end by a hemispherical cover, between which and a flange around the upper edge of the vessel is placed a washer of soft metal; the lid when closed is pressed firmly down upon the washer by a screw working through a head or nut which is held down to the vessel by three descending arms, formed at their lower ends with lugs to hook on to other lugs which pass below the flange on the top of the vessel. When the head or nut is thus held the lid can be forced down by turning the screw which works through the nut. In case where it is desirable to apply the heat to the material during the time it is solidifying, as, for example, when casting ingots of steel, the mold into which the steel is to be cast is surrounded with a casting of thin metal, and placed within the air-tight vessel. Between the thin metal case and the sides of the vessel, pieces of charcoal are roughly broken up, and are so placed that air may penetrate readily through the charcoal; when the melted metal is poured into the mold the charcoal is thereby brought to a red heat and ignited, and by this means the metal is kept heated. As soon as the metal has been poured into the mold, a thin plate is placed upon the top of the metal in fusion, and a thick plate of fire-clay is placed over the top of the mold; the lid of the outer vessel is then put on, and the joint is made air tight by forcing it down by a screw, as above described. Compressed air is afterwards admitted into the vessel from a suitable reservoir; the communication between the reservoir and vessel can then be closed by a cock, so that the pressure in the vessel may be increased by the expansion of the air as it becomes heated.



APPARATUS FOR CASTING METALS, GLASS, Etc.

Fig. 1 of our illustration shows a vertical section of an apparatus constructed as described, the apparatus is more especially suitable for making castings of steel, but similar means may be employed when making castings of glass or other fluid substances.

A is a strong vessel of cast iron, strenghtened exteriorly with wrought-iron rings, *a*, shrunk upon it; B, a lid for closing the vessel air tight; S, the screw for pressing down the lid or cover on top of the vessel, A; the screw works through the nut, *n*, which, when the lid is to be closed, is held down to the vessel, A, by three arms formed at their lower ends with lugs, *c*, which are passed under other lugs, *o*, the stems, P, of which are fixed to the upper strengthening ring, *a*, of the vessel, A.

The screw and nut are connected to the top of the lid, B, by three other arms *n*1, descending from a ring, *n*2, through which the screw passes freely. The construction of these parts is clearly seen in the cross section shown at Fig. 2. At the top of the screw is carried a pulley, over which is passed a cord, E, by which the screw and with it the lid, B, can be raised or lowered when the lid is disconnected from the vessel. *q*, *q* are steady pins to keep the lid concentric with the top of the vessel, A, and *m*, is a soft-metal washer for making the joint between the vessel, A, and lid, B, air tight. In the interior of the vessel, A, is placed an iron ingot mold, L, into which the melted metal is to be pored; the lower end of the mold is closed by an iron bottom, as shown, and the top of the mold is covered over with a slab of fire tile, marked D, the ingot mold is surrounded by a casing, T, of thin sheet iron, and between this casing and the sides of the vessel, A, is placed charcoal broken into small pieces so that the air may pass freely amongst it. At Fig. 3 is represented a reservoir of compressed air communicating with the vessel, A, by a pipe, *r*, on to which is fitted a pressure gage, F, to indicate the pressure of air in the reservoir. The passage of air through the pipe, *r*, from the reservoir to the vessel, A, is controlled by a cock, R, the pipe, *r*, also carries a tap, R1, by opening which the pressure of air may be reduced when desired.

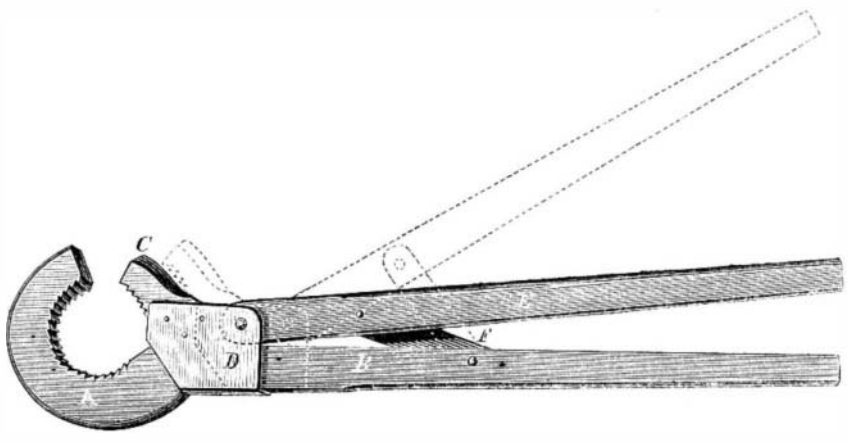
The apparatus is used in the following manner: Supposing the air reservoir to be filled with air at a pressure of about 10 atmospheres and that the melted steel is ready to be run into the ingot mold, the metal is poured into the ingot mold, L, the small disk of sheet metal, D1 is placed on the top of the fluid metal, and the whole is covered over with the disk of fire tile, D, as shown in the illustration, the fire tile having been previously heated to a white heat.

As the ingot mold becomes heated by the metal poured into it the heat is radiated from it across the small air space between the mold and the thin metal case by which it is surrounded, heats this casing to a red heat, and ignites the charcoal by which it is surrounded. The lid, B, is closed and fixed securely on the top of the apparatus, the lower end of the screw being forced down on the circular washer, *u*, on the top of the lid, B, by turning the screw of the lever arms, T1, upon it; the apparatus being closed, the tap, R, is opened, the compressed air passes into the apparatus, so making the pressure in the vessel, A, equal to the pressure in the air reservoir, the air becoming quickly heated, in the vessel, A, the pressure rises, and if the tap, R, is then closed, the pressure in the vessel, A, will rise above that in the air reservoir.

It will thus be seen that the pressure in the vessel, A, can readily be regulated by means of the taps in the pipe, *r*. We must here remark that the quantity of air which passes from the air reservoir into the vessel, A, is relatively very small, as the vessel, A, is almost entirely filled with the ingot mold, the casing, and the charcoal with which it is surrounded. This is very advantageous for economizing the compressed air employed, but more especially for concentrating the heat in a small space, so that the metal in the ingot mold may cool slowly and as regularly as posible, the exterior of the vessel, A, is surrounded by water contained in a bath or vessel, V, so as to keep it cool, as shown by our illustration. Steel thus cast into molds and subjected to pressure, is under the most favorable conditions for solidifying into a homogeneous mass, for as regards pressure it is compressed with a force which is considerable, as a pressure of ten atmospheres corresponds to a column of melted metal of about forty-five feet high; if this is compared with the hight of the head or get of metal usually employed by founders it will be seen how greatly superior is the process of casting above described to that usually employed. A pressure of ten atmospheres has been taken as an example, but there is nothing to prevent a pressure of twenty thirty or forty atmospheres being employed, as this may be done without danger. By the process above described a dense and homogeneous ingot is obtained, as the metal is not only subject to pressure while in a fluid state, but also as it passes through the pasty into the solid state. By the combined use of a concentrated heat and great pressure a highly malleable steel is obtained, and also a steel which when tempered becomes extremely hard, these being the two most valuable qualities in steel.

Improvement in Pipe Tongs.

This is an implement which is of great importance in gas fitting and plumbing, and presents decided advantages over the old style of pipe tongs. By its use the pipe may be more firmly grasped with less liability to injury, while it is equally convenient in use. In the engraving, A, is a curved jaw comprising about, or a little less than three fourths of a circle,



CRAIN'S PATENT PIPE TONGS.

and is forged with the handle, B, in one continuous piece. C is also a curved jaw about, or a little less than one fourth of a circle in extent, and is riveted to a bent plate, D, passing over the back of B. The other handle, E, is pivoted to D, and the two handles are connected by a link, F, so that when the handle E, is opened to the position shown by the dotted outline, the jaw, C, is withdrawn to the position shown by its dotted outline. This allows the pipe to enter between the jaws.

When the handles are pressed together, the jaw, C, approaches the other with great force through the action of the toggle formed by the handle, E, and the link, F; but as the pipe is grasped on all sides there is no danger of crushing it. The jaws are toothed internally in the usual manner, and for the same purpose. Patented, through the Scientific American Patent Agency, Aug. 3, 1869, by R. Crain of Shaffer Farm Dennison Post Office, Pa., who may be addressed.

SOMETHING NEW IN MECHANICS.

Under this head the *Independent Democrat*, of Concord, N. H., gives us a long description of what the editor supposes to be a new way of transmitting power, specially useful in cities as a substitute for steam, the invention of Horace Call, of that city.

By means of water wheels and pumps, air is to be compressed at the river bank and conducted in pipes to the city shops. Here the air discharges into the bottom of a tank, and bubbles up like a boiling caldron. Within the tank is a bucketed wheel, so arranged that the buckets will receive the ascending current of air, the force of which will turn the wheel and drive the machinery of the shop.

"The philosophy of the power," says the *Democrat*, "is simple. The air displaces the water in an upward current, equal to the weight of water down. It is so simple that it is a wonder that it has never been applied before.

"The possibilities of this invention afford a wide field for speculation, and one which we will not enter upon to-day. When we consider that it probably costs $50,000 a year to operate the stationary engines in this city, while a river with 10,000-horse power runs through it, unused, the magnitude of an invention which proposes to make it available at a comparatively small expense, is one which challenges the attention of mechanics and scientific persons."

There appears to us nothing in the above invention which warrants the great expectations expressed by our New Hampshire cotemporary. The practice of driving machinery by compressed air is very old. Ordinarily it is wanting in economy as compared with the direct employment of water or steam. But in inaccessible locations, in mines, and tunnels, it is used to advantage, serving for ventilation as well as power. In the Hoosac and Mont Cenis tunnels the drilling machines are driven by air, which is compressed by water power and carried long distances in pipes to the drills.

The only novelty in Mr. Call's improvement lies in his tank and air wheel; but this form of air engine can hardly be as effective as the ordinary machines. The resistance of the wheel revolving in the water, and the friction of the rising air will about equal, we should think, the friction of a well-constructed piston engine.

The Ponsard Process of Smelting Iron Ore.

This is a French improvement, if indeed it shall prove to be in practice a real improvement. The chief feature of the Ponsard process, is that the ore is pulverized and mixed with pure coal or carbon, and then placed into tubular crucibles, heated from the outside. By thus protecting the ore from the direct action of the fuel employed for heating the crucibles, inferior combustible matter can be used and a certain economy thereby effected. By an arrangement of the furnace, gray or white iron, or even steel, can be produced at will. The furnaces can easily be converted into puddling furnaces into which the metal can enter at one side and run out at the other, prepared for being submitted to the rolling mill.

Suit for a Million.

Andrew Whiteley, who for a long time has been contending with the Commissioner of Patents for certain reissues, has finally entered suit against that official. In his declaration he sets forth that, in various patent cases in which he was assignee of Gage, Weeks, Haines, and others, for improvements in harvesters, etc., he obtained certain orders of Judge Fisher, of the Supreme Court of the District of Columbia, directing the Commissioner of Patents to take certain evidence as to novelty, to reissue certain patents, and to antedate others; that, in consequence of these proceedings, he has been compelled to lose time, opportunities of making money, and to employ counsel, by reason of which he is a large loser. He therefore brings suit, laying his damages at one million dollars.

If Mr. Whiteley should succeed in getting judgment for the amount of damages claimed, we imagine that it might go hard with Commissioner Fisher to raise the funds.

Carvalho's Painting of the Grand Canyon of the Colorado River.

Mr. S. N. Carvalho, patentee of a very excellent steam super-treating device and an artist of considerable merit, gave a private exhibition of a new painting of his, on Friday evening, September 3d, at his studio, 765 Broadway. The subject is a view of the Grand Canyon of the Colorado River, and is of interest from the fact that the sketches were taken by Mr. Carvalho on the spot and while attached to the Fremont expedition as photographic artist. The stern and impressive grandeur of its everlasting rocks made such an impression on Mr. Carvalho that he took sketches of them