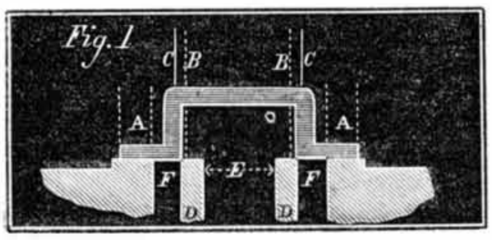
SLIDE VALVES.

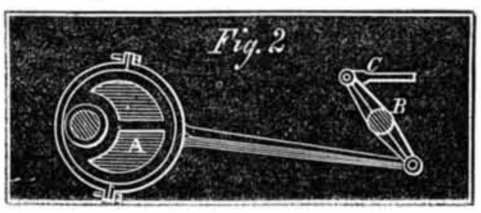
LAP AND LEAD.

A correspondent states that he has derived such great benefit from the use of the following diagrams published in the *English Mechanic*, in 1866, that he asks their reproduction in the pages of the SCIENTIFIC AMERICAN.

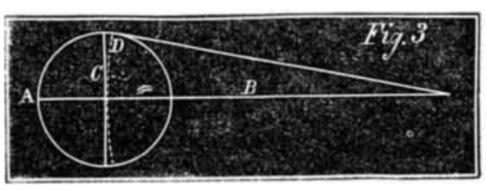
As most of the remarks seem to us to be sound, we reproduce them in our columns, and, as the matter is an important one, we have appended to the notice an addition which will prove serviceable, in a *practical* point of view, to a large number of mechanics. These remarks of ours on the slide valve, will make the subject comprehensible to those who seem to regard its study as too abstruse for ordinary comprehensions, while in reality nothing can be more simple than the working of this most indispensable portion of the modern steam engine:



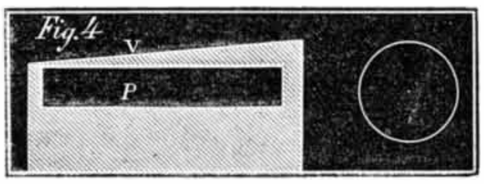
"First, as to the terms 'lap' and 'lead.' On looking at Fig. 1, it will be seen that the valve overlaps the ports at each end. Now, from the outside edge of the ports to the end of the valve, is the outside lap. By the lead of a valve is meant that the port is opened a little in advance of the piston, or the port is open for one stroke before the piston has quite finished the preceding one. This valve, Fig. 1, has neither inside lap nor clearance, and if the inside space was shortened up to the dotted lines, B B, it would have inside lap because it would lap on the bars, D D, and on the other hand if the dark parts were cut away, it would have inside clearance.



"This valve has a lap equal to the port. Therefore if it is set without lead at the beginning of the stroke, the exhaust port will be full open as it ought to be, or very nearly so, more especially when the ports are small. It does not seem to be generally known among drivers, that in a common valve, worked by an ordinary eccentric motion, it is impossible to cut off equal at both ends of the cylinder. This is caused by the angularity of the connecting rod, more or less, as the rod is longer or shorter in proportion to the crank. When the piston is at its half stroke, the crank is short of the vertical line, as shown by the dotted line D in Fig. 3.



"The piston is always before its middle position for the front stroke and behind it for the back stroke; consequently there is always the most steam for the front stroke, which will make the engine 'exhaust fullest at its out center,' as remarked lately by a correspondent. (The front stroke is that made towards the crank.) Some engineers attempt to find a remedy for this by giving the valve more lead for the front stroke, which will allow the valve to reach the end of its travel sooner, thereby shortening the front admission of steam. But this is a very poor remedy; in fact, it is the worst evil of the two, although it may not be told by the beating of the engine. The better way is to have unequal laps or an intermediate lever reversed in action, as shown in Fig. 2. By employing this and fixing it in its proper place, we can get equal admissions for both strokes.



"Fig 4 is a good shape for a valve. The end is beveled about a ½-inch in a length of 6 inches. This would give the crank a chance to pass the center before the full pressure is applied. I think an eccentric of varying travel would be a good thing for an engine where the loads are more some days than others, so that the steam may be cut off earlier by giving the valve a shorter travel. It might be made like Fig. 5. The conclusions that I come to on the subject are these:

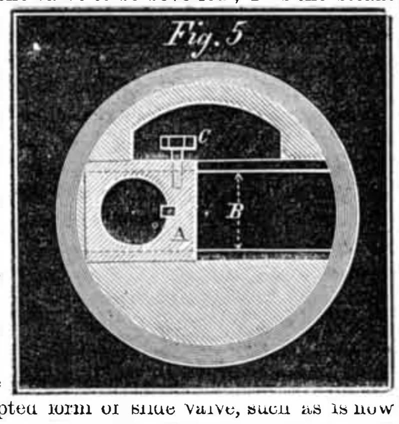
"1. The valve should have a lap equal to the width of port at least.

"2. No lead is required at speeds of less than 400 feet of piston per minute. The back pressure caused by compression is an ample 'cushion' for the piston, and the piston ought to get the pressure gradually after the crank has passed the center by beveling the edge of the valve or other means.

"3. The connecting rod should be as long as possible, never less than five times the length of crank, but seven or eight times the length would be better.

"4. The valve should be a lead for exhaust, in some cases a fully open port.

"In Fig. 1, A A are the outside laps; F F, the ports; E, the exhaust port; D D, the bars. Fig. 2, A, the eccentric; B, a lever with arms of equal length; C is the valve rod. Fig. 3, A, is the center line of cylinder; C is a line at right angles to it; D is the point where the crank pin reaches to when the piston is in the middle of the cylinder. Fig. 4, the dark shaded part V, shows the end of the valve to be bevelled; P is the steam port. Fig. 5, A, is a boss keyed to the crank shaft; the eccentric has a slot cut across it, as seen at B, which allows it to slide on the boss, and is fixed for its proper throw by the screw, C."



We shall limit ourselves, in the following supplementary dissertation, to the description of the most generally accepted form of slide valve, such as is now in daily use in the great majority of our best constructed engines, reserving for some other occasion an account of the many modifications and varieties of such valves, or *cut-off's*, as have at different times been recommended by various engineers.

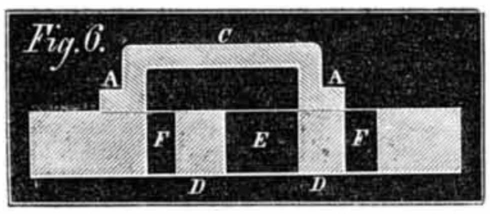


Fig. 6 is a section through such a slide valve, in which C is the slide, A A, the outside laps; F F, the steam ports; E the exhaust port, and D D, the bars.

The slide is best made with an inside lap of $\frac{1}{12}$ of an inch on either side.

The exhaust port must be from 2 to $2\frac{1}{2}$ times as high as the steam ports.

The section of the steam ports must be from $\frac{1}{15}$ to $\frac{1}{20}$ of the area of the piston head for high speed engines, such as locomotives, rolling-mill engines, etc., and from $\frac{1}{20}$ to $\frac{1}{30}$ of the area of the piston for slow speed engines.

The ratio between the width of the steam ports and their hight, ought to be approximately as follows:

4 to 1 for small engines.
5 to 1 for medium sized engines.
6 to 1 for large engines.
7 to 1 for still larger engines.

From what we have just said, it will be seen that the proportions, in inches, of all the parts of a slide valve can be computed when its hight has been determined relatively to the area of the piston, as we have shown above. For this purpose proceed as follows:

1. To find the *hight* of the *exhaust* port, multiply the hight of the steam port by $2\frac{1}{2}$.

2. To find the *thickness* of metal in the *bars*, add $\frac{2}{12}$ of an inch to the hight of the steam ports.

3. To find the clearance of the inner edge of the steam ports, multiply the hight of the steam ports by $4\frac{1}{2}$ and add $\frac{4}{12}$ of an inch.

4. To find the clearance of the inner laps, multiply the hight of the steam ports by $4\frac{1}{2}$ and add $\frac{2}{12}$ of an inch.

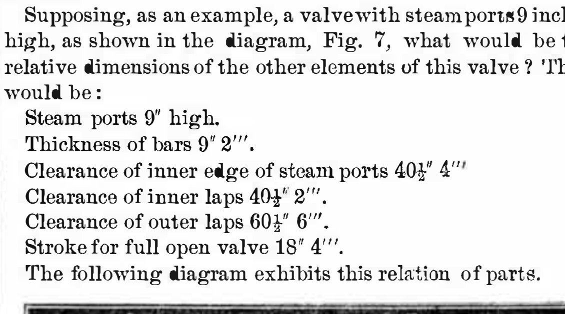
5. To find the extreme clearance of the outside laps, multiply the hight of the steam ports by $6\frac{1}{2}$ and add $\frac{6}{12}$ of an inch.

6. To find the length of valve stroke, for a full open port, multiply the hight of the steam port by 2 and add $\frac{4}{12}$ of an inch.

Supposing, as an example, a valve with steam ports 9 inches high, as shown in the diagram, Fig. 7, what would be the relative dimensions of the other elements of this valve? They would be:

Steam ports 9" high.
Thickness of bars 9" 2'''.
Clearance of inner edge of steam ports $40\frac{1}{2}$" 4'''
Clearance of inner laps $40\frac{1}{2}$" 2'''.
Clearance of outer laps $60\frac{1}{2}$" 6'''.
Stroke for full open valve 18" 4'''.

The following diagram exhibits this relation of parts.



English builders give an average inside lap of $\frac{1}{10}$ of an inch on either side. For low-pressure engines, working with from $2\frac{1}{2}$ to 3 lbs. over pressure, $\frac{5}{8}$ of an inch is given, while for marine engines, working with from $4\frac{1}{2}$ to 5 lbs. over-pressure, the lap is from 1 to $1\frac{3}{4}$ inches.

The rule given for lead (relative advance of the slide) is as follows:

Multiply the square of the area of the piston in inches by 0·002, and divide the product by the length of the valve orifice in inches. The quotient gives the width of the open steam ports when the piston has reached either end of its stroke, *i. e.*, is full up or full down. In a 30-inch cylinder, for instance, with 12 inch length of valve orifice, it would be 0·15 inch. The eccentric for communicating motion to the slide must always work at an acute angle to the direction of the slide, and this lead angle must be greatest the greater the degree of expansion used.

Figs. 8 and 9, will make this matter clearer by showing the relative working of slides and piston in an engine where the lap is made to bring on expansion, and which cuts off at $\frac{3}{4}$ stroke.

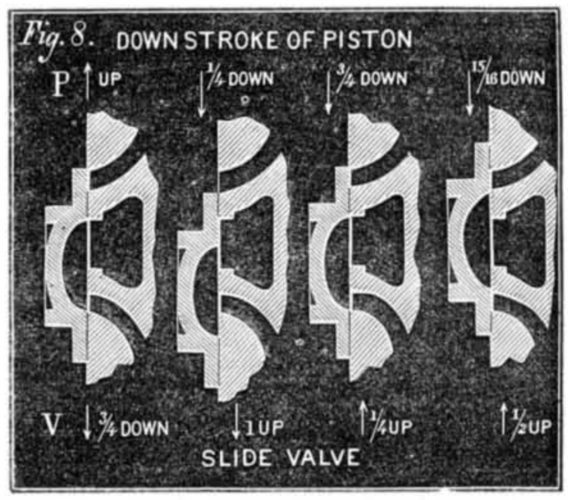
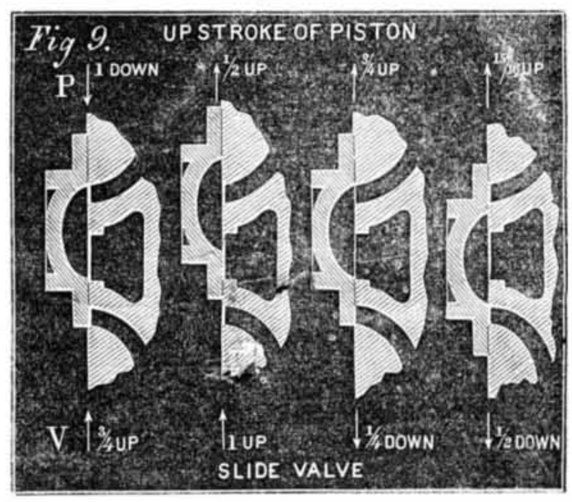


Fig. 8 shows the relative directions and positions of the piston and slide during the whole down stroke of the piston. Starting from the moment the piston has reached its full extent of upward course, we have successively:

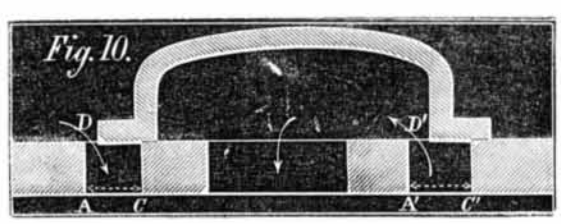
1. Piston up in full. Valve $\frac{3}{4}$ down.
2. Piston $\frac{1}{4}$ down. Valve quite down.
3. Piston $\frac{3}{4}$ down. Valve $\frac{1}{4}$ up.
4. Piston $\frac{15}{16}$ down. Valve $\frac{1}{2}$ up.

Fig. 9, exhibits the relative directions and positions during the whole *up* stroke of the piston.



1. Piston, down in full. Valve, $\frac{3}{4}$ up.
2. Piston, $\frac{1}{4}$ up. Valve, quite up.
3. Piston $\frac{3}{4}$ up. Valve, $\frac{1}{4}$ down.
4. Piston, $\frac{15}{16}$ up. Valve, $\frac{1}{2}$ down.

In order to obtain this motion the eccentric must in thi case have an "advance" of 30 degrees. As the reader wil notice, the exhaust steam is cut off at $\frac{15}{16}$ of the piston stroke But this is of little moment, as the back pressure of this smal quantity of exhaust steam, as proved by the indicator, is in significant, beside which, it is again utilized to a certain extent on the next following stroke.



The lead at any period of time is obtained:

1. For the entrance steam port, by dividing the hight o the aperture at the entrance port (D, Fig. 10) by the tota l hight of the port (A C, Fig. 10.)

2. For the exit steam port, by dividing the hight of the aperture at the exit port (D' Fig. 10) by the total hight of the port (A' C' Fig. 10).

Black Walnut Polish.

Take asphaltum, pulverize it, place it in a jar or bottle, pour over it about twice its bulk of turpentine or benzole, put it in a warm place, and shake it from time to time. When dissolved, strain it, and apply it to the wood with a cloth or stiff brush. If it should make too dark a stain, thin it with turpentine or benzole. This will dry in a few hours.

If it is desired to bring out the grain still more, apply a mixture of boiled oil and turpentine; this is better than oil alone. Put no oil with the asphaltum mixture, as it will dry very slowly. When the oil is dry, the wood can be polished with the following: Shellac varnish, of the usual consistency two parts; boiled oil, one part. Shake it well before using. Apply it to the wood by putting a few drops on a cloth and rubbing briskly on the wood for a few moments. This polish works well on old varnished furniture.—*Chem. News*

Improvement in Springs for Vehicles.

This improvement consists first, in the substitution of taper longitudinal ribs, A, (see engraving) for the ribs and slots in common use, which prevent lateral slipping of the leaves of carriage springs, and second in the application of India-rubber bearings—one of which is represented at B—to the cast metal seat of the spring, C, whereby much of the jar and concussion, when vehicles are in motion, is prevented from transmission to the spring, and greater play and elasticity also secured.

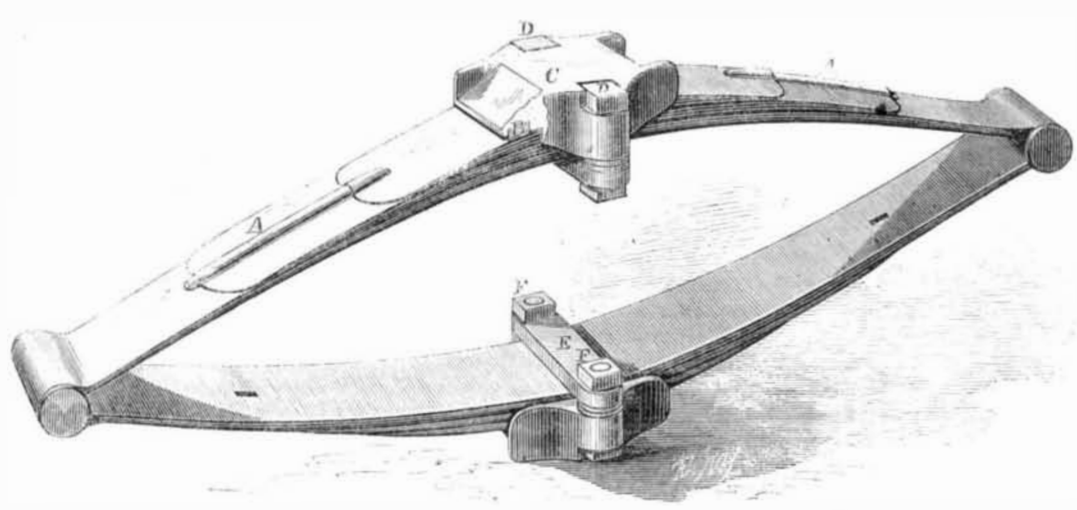
The ribs, A, are formed in the leaves by swaging, and are so made that the convex side of any leaf exactly fits the concave side of the leaf exterior to it, when the leaves are put together.

The cast metal seat, C, is fastened by bolts, D, passing through the bar, E, and held firmly by the nuts, F. The seat is so constructed that the rubber bearing, B, separates the leaf next it slightly from the seat, so as to admit of compression and expansion, corresponding to the motion of the spring. By this means considerable elasticity is gained over that attained by the ordinary method, and the force of violent shocks much weakened.

Beside the gain in elasticity this method is claimed to possess the following advantages over the old method. The form of the ribs gives greater strength to the leaves. Their tapering form limits the amount of the depression when heavily loaded, in consequence of the binding or wedging of the convex surface of each rib in the concave surface of the one lying upon it.

The spring can be made as light and graceful in appearance as those of the old style, and the number of leaves is entirely unessential to the application of the improvement, which is adapted to all springs from those of the heaviest locomotive to springs for the lightest buggy.

This improvement has been made the subject of two patents—the first bearing date, May 26, 1868, and the second June 2, 1868—both of which were obtained through the Scientific American Patent Agency, by George Douglass, whom address for further information, Bridgeport, Conn.



DOUGLASS' IMPROVED CARRIAGE AND CAR SPRING.

UTILIZATION OF BONES.

Not much more than fifty years ago old bones went to the refuse or dirt heap, being thrown away as a valueless substance, with the exception of a very small amount of them which was employed in the manufacture of glue.

In our day, however, the trade in bones has acquired a vast importance. From them are manufactured soap, glue, phosphorus, bone black, and valuable manures.

Many ships sail to distant parts of the world in order to obtain cargoes of bone. The battle-fields of Europe have even, in some instances, been dug up, and their long pent treasures sent to the bone mills to be converted into "superphosphate," which, applied to the wheat and fodder crops, has helped in the shape of bread and meat to support the present generation.

Men have thus actually been made to feed upon the remains of their ancestors through the speculative genius of the manufacturer of artificial fertilizers!

Bones are collected along with old rags in every country in the world, but the largest supplies are obtained from South America, where an immense number of cattle are annually slaughtered for the sake of their hides and fat.

The city of Hull, in England, is the principal depot for bone for the European market, and possesses many large and powerful crushing mills, where they are reduced into fragments of the desired size.

We shall limit ourselves to-day to the manufacture of soap and glue from bones; reserving for a future article the method of utilizing them in the production of phosphorus and of superphosphates.

Practical information being what is needed in this matter, we shall sum up the whole subject as concisely as possible for the benefit of our readers.

1. Place the bones in large baskets, or nets, in running water so as to wash off the adherent dirt.

2. Hang the baskets to dry and drip, or spread the bones on an incline so as to allow the water to run off from them.

3. Carry the bones to a crushing mill or to a stamp mill, and reduce them to the size of a hickory nut. If this be done between revolving, horizontal cylinders, these must have sharp-edged ridges about three-quarters of an inch broad on their outer surfaces.

4. Receive the crushed bones on a bottom formed of parallel rods which will allow fat and marrow to ooze through, without giving passage to the bone.

5. Place the crushed bones in wicker baskets in large vats or tanks, and cover them with water, the temperature of which must be from 120° to 140° Fah., *and no more.*

6. Skim the fat as it forms from the top of the warm water, and it is then ready, after mixing with alkalies, to be boiled, into soap. *If the bones had been boiled*, the soap obtained would contain glue, be of inferior quality, dark-colored, and bad scented.

7. Take the baskets and their contained bones from the grease vats, and let them drip, after which suspend them in wooden vessels, into which pour muriatic acid, diluted with water, until it marks 7 degrees of Baumé's areometer (spec. grav. 1·05.)

7. Leave the bones in this mixture until the upper ones are soft and pliable; this generally takes places is about six or seven days if the proportion of bone and acid has been well regulated.

9. Sink the baskets in a second set of wooden vessels, filled to half their hight with muriatic acid, diluted with water, till it marks 3° on Baumé's areometer, and leave them in this solution until they are transformed into a soft, malleable, semi-transparent substance, out of which all the lime has disappeared.

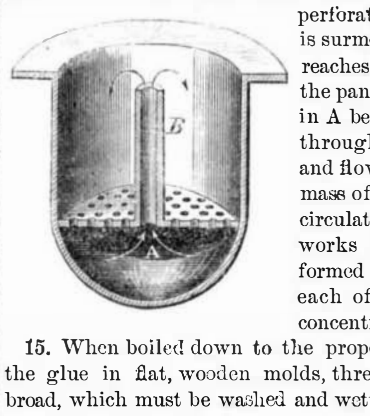
10. Wash the bones by running a stream of cold water over them for one-quarter of an hour.

11. Place the bones in a tank containing lime water to neutralize the acid, and after this, wash them again several successive times with cold water. The lime must be slaked in the water used, and 1 part of lime by weight employed to every 200 parts of water. The whole must be well stirred, covered, and allowed to rest for some hours.

12. The bones, after these last washings are completed, are now in a suitable state for the manufacture of the best quality of glue.

13. The acid, at 3° Baumé, used for the second operation, is suitable for conversion into that of 6° Baumé for the next first maceration.

14. Boil the bones in pans constructed as shown in the following cut. The bottom plate which supports the bones is perforated by small holes, and is surmounted by a pipe which reaches above their surface in the pan, so that when the water in A begins to boil it runs out through the top of the pipe, B, and flows over and through the mass of bones in a perpetually circulating stream. In large works the operation is performed in successive boilers, in each of which the degree of concentration is increased.



15. When boiled down to the proper consistency, run out the glue in flat, wooden molds, three feet long by one foot broad, which must be washed and wetted before the introduction of the glue.

16. Take up the glue sheets from the molds with a knife slipped under them, and cut it crosswise into six or seven lengths by means of a "special" glue cutter.

17. Dry your glue on twine netting, the strands of which must be $\frac{1}{12}$ inch in diameter. The netting is stretched on frames 6 feet long and $1\frac{1}{2}$ feet broad. The temperature of the drying rooms must be maintained at from 59° to 77° Fah. When the outer air has this temperature, it is allowed to freely circulate among the layers of frames, through lattices situated all round the building, and which can be closed or opened at will. When dry it is ready for market.

18. The muriatic acid solutions are separately treated, in a manner we shall describe in a future article, in order to save the valuable phosphoric acid they contain.

Hydropathic Treatment of Railroad Stocks.

The *Merchant's Magazine* publishes the somewhat startling fact that twenty-eight of the leading railroads of the country have, within the short space of two years, increased their combined capital from 287 millions to 400 millions of dollars, showing an average inflation of 40 per cent. The editor argues, what is undoubtedly true, that it is impossible to adduce any really sound justification of the "watering" policy. It is, in most cases, simply a deceptive game played by speculative directors, who, after the inflation has been consummated, will be the first to forsake the bubble, and quietly wait to profit from the ultimate violent revulsion in values; while the attempt to draw out of the consumers of the country high charges for freight, so as to pay dividends on the increased stock, is a direct check to our material progress.

The Game of Croquet.

A counterpart to the railway velocipede, illustrated on another page, for the amusement of young persons, is the game of croquet, one of the out-of-door entertainments which has become very popular within a few years. It has the advantage over the railway velocipede in the matter of expense—the price of a set of croquet implements costing but a fraction of that of the railway; but where parties can afford it we recommend the introduction of both. The game of croquet is healthful, graceful, and social, and for young persons of both sexes we know of no open-air amusement that combines so many beneficial qualities with that of pleasure. The introduction of the game into schools is becoming quite common.

The manufacture of croquet implements has grown into an extensive business at Springfield, Mass., and the firm of Milton Bradley & Co., of that city, has become identified with the manufacture of the finest qualities of these goods.

Explosion of a Gasometer.

The city of Cincinnati felt the rumble and roar of a great explosion on the 24th ult. The *Commercial* says: "A great mass of black smoke rose above the Gas Works, then came a concussion that shook the windows, and immediately the smoke was crowned with a big, red flame-burst that shot up to an amazing hight. The shock was felt all over the city, except in the extreme limits, and probably not less than a third of the population realized immediately that something extraordinary had occurred.

"The gasometer, or holder, which burst, was a mass of boiler-iron of a quarter of an inch thickness, 127 feet in diameter, and 35 feet in height. It was an immense, inverted, circular tank, that rose and fell slowly, according to the amount of gas confined between its top and the surface of the water. Sunk into the ground, with a depth of 35 feet, is the tank proper, circular, of course, of stone, brick, and mortar. There were 375,000 feet of gas in the holder when the explosion occurred. We find it impossible to state the cause of the explosion, and difficult to convey any idea of the appearance of it. It appeared as if the roof of the holder was rent in twain from north to south, that as it rose and fell back the overwhelming sound was heard, and then the great bursts of flame and smoke arose. For an instant, for a square around, the breath of a mighty heat played. The woodwork of doors and windows was blistered and blackened. Men a hundred feet away found their faces, arms, and hands scorched to the flesh, and for many squares around, the close, stifling heat was felt, and then it was all over.

"The explosion is not accounted for by even the best informed gas manufacturers. When it occurred there was no fire near the holder, and no gas had been let into it for six hours. One theory is that of great expansion of the gas by solar heat on the holder, the consequent bursting of the roof, and flame communicated to the escaping contents from the stack of the Globe Rolling Mill. The idea has quite generally prevailed that there is no danger of an explosion to a holder. Several instances refute this. In October, 1865, a gasometer of the London Gaslight Company's works, at Nine Elms, Battersea road, exploded, killing ten men. It was twice the size of this. Not long since, we are informed, there was a similar explosion at Chicago. Both these explosions, however, were accounted for, the fire communicating from the governor in the first instance. How this ever occurred no one seems to know. The officers and employés of the works are puzzled, and cannot solve the mystery. So far as we can learn the only sufferers as to property, by this affair, is the gas company, whose loss is about $100,000, on which there is no iusurance."

Correspondence.

The Editors are no responsible for the Opinions expressed by their Correspondents.

Large and Small Cart-Wheels.

MESSRS. EDITORS:—Your correspondent, "F. W. B.," in No. 22, current volume, page 342, in his comments upon my communication in No. 20, of same volume, makes an amusing misapplication of a well-known law of friction, to prove that the friction between the axle and the hubs of cart wheels, moving the same distance, in the same time, with a given load, will be the same, whether the wheels are large or small.

The law which he invokes in support of this paradoxical proposition is laid down in the books in these words:

"The friction is entirely independent of the velocity of continuous motion."

All that this law establishes, in relation to the friction between the axle and hub of a cart wheel, is this: In moving the same cart, with the same load, a given distance, you will have the same amount of friction to overcome, whether it moves at a greater or less velocity; because there is the same amount of rubbing between the axle and its "circumscribing box or bearing," in the one case as in the other; and it makes no difference whether that amount of rubbing is performed in a long or a short time.

It is precisely this law that proves the correctness of my proposition; viz., that "by doubling the size of the wheels, you reduce the friction one-half."

To illustrate: Suppose the axle, on which the wheel turns, is six inches in circumference. It is manifest, that at each revolution, every particle of matter in the hub or box, which comes in contact with the axle, must move around the latter a distance of six inches, and with the friction due to the