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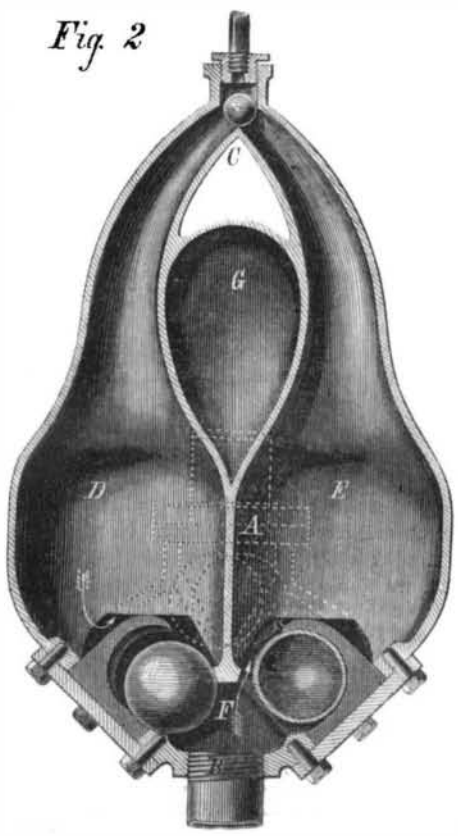
## THE PULSOMETER.

A steam pump with no cylinder, no piston, no piston rod, no stuffing boxes, glands, cams, or eccentrics, no slide valves, cranks, or fly wheels, and consequently requiring none of the repairs or renewals incident to the above mechanism, is the negative definition of the invention, the distinctive name of which heads the present article. Positively speaking, the invention is a device in which steam and water are brought in direct contact in suitably arranged chambers, where, by the alternate vacuum and pressure of the former, the fluid is first lifted and then forced out, in other words, moved by direct acting pulsation: a utilization, in fact, of the simplest principles of hydro-dynamics by means of one of the simplest forms of machine.

*Fig. 2*




From the sectional view, Fig. 2, the interior arrangement of the apparatus will be easily understood. Two long necked chambers, D and E, are joined together at their upper extremities, forming a common passage into which a metal ball, C, is fitted so as to oscillate freely between seats formed at the junction, thereby closing the orifice of either chamber, toward which it may fall. Steam enters from above, and hence the position of the ball, C, governs its entrance into one or the other vessel. Water, on the other hand, comes into the apparatus by the pipe, B, from below to the induction passage, F, which connects the lower portion of the two receptacles through circular orifices. In the latter, two spherical shells are arranged and seated so as to act as induction valves to the chambers respectively.

A is the delivery passage (shown in dotted lines), common to both chambers, and is also provided with a spherical shell, oscillating from side to side between seatings formed in the entrance to the conduits leading into the two chambers, which acts as a delivery valve to each alternately. G is a vacuum chamber, connected with the induction passage through a downward extension (not shown) on the side opposite the delivery opening, A. Suitable flanges and covers are arranged at the bottom of the chambers to allow of the removal of the shell valves when necessary.

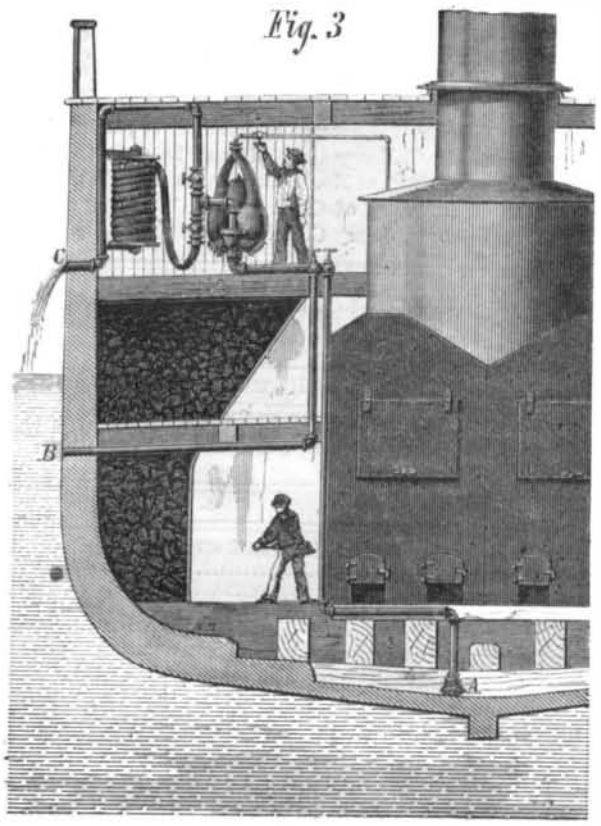
This entire apparatus, with all its chambers and passages, is cast in one piece, and at the same time with the induction shell valves in their proper positions, thereby forming their respective seatings, while chills of suitable form are placed so as to mold the seating of the steam and discharge valves also. Stud bolts are similarly cast in their proper positions upon all the flanged passages, ready for the screwing on of the flanges. As soon, therefore, as the core sand is removed, the flanges bolted on, and the steam and discharge valves put in their places, the pump, after the necessary connections are made, is ready for immediate operation.

Such is the simple arrangement of mechanical details, the working of which is equally uncomplicated. Referring again to Fig. 2, it will be observed that the ball, C, is on its right hand seat. Consequently steam has free entrance to chamber, D, the latter, with the suction pipes and other chambers, being supposed to be filled with water. The fluid in the left hand receptacle is therefore subjected to a pressure directly from above and the steam is thus applied in a manner to secure the least amount of condensation. The result is that the water line is gradually depressed, and the liquid forced out past the ball in the lower part of the chamber, which naturally takes the position indicated in the engraving, and thence out through the discharge opening, the shell in the latter yielding to the pressure and falling toward the right. It will be noticed that the shape of the chamber allows the steam to expand gradually as the fluid surface is depressed, so that the water is not agitated until the discharging outlet is reached. At precisely that moment agitation commences, the steam mingles and condenses, and, as the inventor expresses it, if a vacuum gage were applied to the chamber, "the needle would fly round from 0 to 28 like a streak of lightning."

The result of this sudden collapse is evident; the ball, C, is instantly drawn over to close the opposite orifice, the shell on the delivery conduit falls also back to the left, preventing the reflux of the water, and the induction valve ball is forced back against its guard, leaving a clear port for the column of water in B. To cushion the ramming action of the fluid thus drawn violently in, the vacuum chamber, G, comes in play. This, as before remarked, is connected with the induction chamber, F, and contains air in its upper portion. A small air check valve is screwed into this vacuum chamber, which lifts, when a partial vacuum is produced therein, allowing the entrance of a small quantity of air, but closing against its return. The valve opens at each pulsation and its lift, and thus the amount of air permitted to enter, may be regulated by a suitable screw.

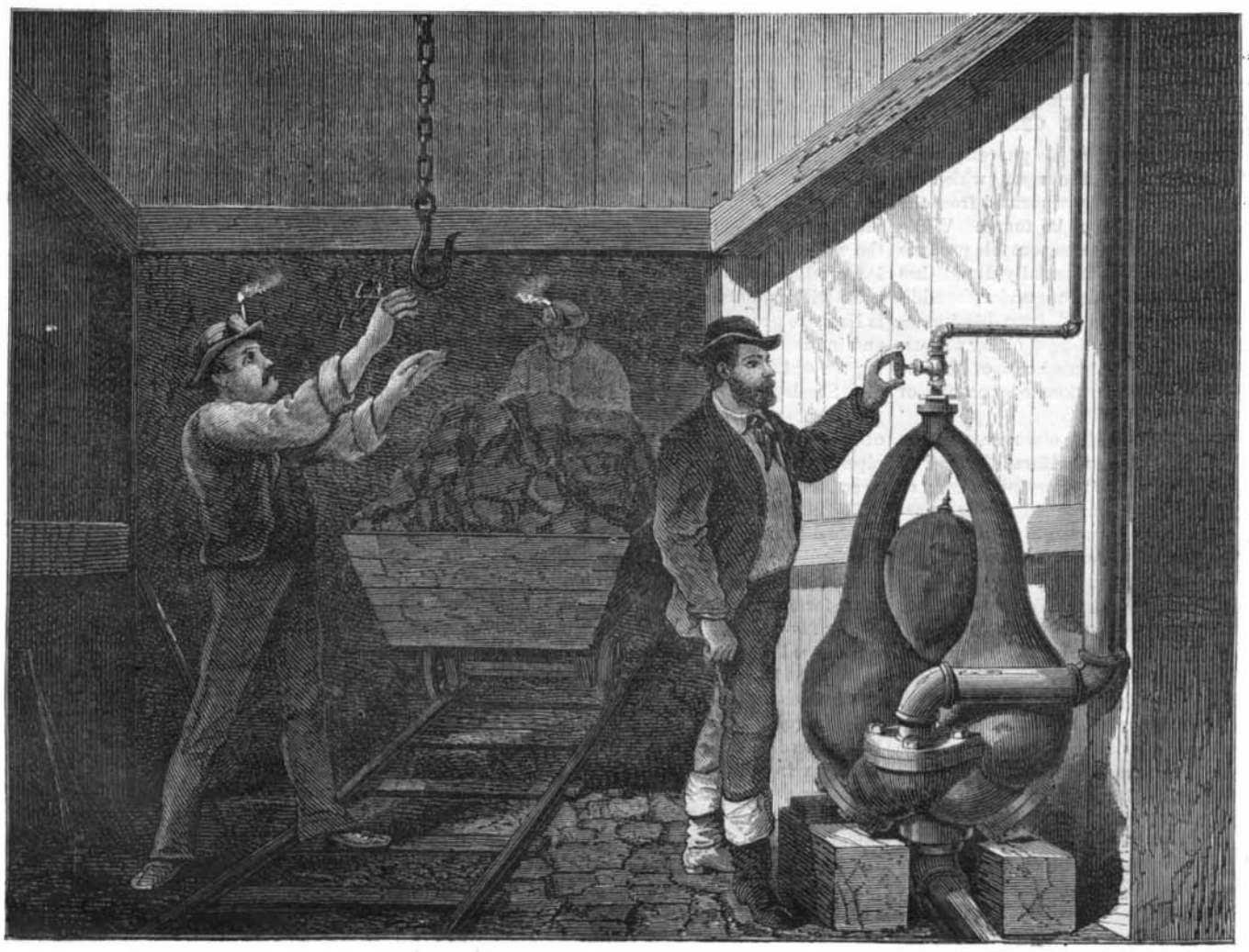
The operation described as going on in chamber, D, is in-

*Fig. 3*




stantly repeated in chamber, E, the moment the ball, C, flies over. Consequently the receptacles filling and emptying alternately give, it is stated, all the elements of a double acting pump, drawing and forcing a constant stream at the same time.

Sufficient of the working of the apparatus has, we think, now been described to insure clear comprehension of the general operation. The functions of the various moving parts in detail, the reader interested can readily determine for himself. It remains, therefore, to note the advantages claimed and the various uses to which the pump may be profitably applied.



HALL'S PULSOMETER OR STEAM PUMP.—Fig. 1.

Our larger engraving (Fig. 1) represents the pulsometer as arranged in a mine. In such localities, as many are aware, the pump is very liable to get out of order, work irregularly, and, in fact, form a troublesome part of mining economy. The present device, according to the inventor, is free from the difficulties inherent to ordinary apparatus. We are told that it works constantly as long as supplied with steam, requires no attention, shows no perceptible wear of parts, and does not become choked by sand, wood, or mud. The patentee also states that he has successfully applied the pump at a distance of 800 feet from the water to be raised, where 150 feet was clear lift. He adds that economy of

steam is one of the principal advantages of the invention, in addition to the saving effected in repair and care.

In Fig. 3, our artist has depicted the application of the pulsometer on shipboard, showing a double arrangement whereby it may be used for freeing the ship from bilge, or for drawing sea water, in case of fire or to wash decks. A shows the bottom of the suction pipe near the keelson, fitted with a suitable rose nozzle. This, provided with proper valves, connects with the pump and thence overboard at C. At B water is drawn in through suitable adjustment of the valves and carried to the coil of hose represented. The arrangement is simple and, doubtless, very convenient and effective.

Another application is to the locomotive; the small space required by the machine rendering it easily located and thus convenient for filling the tender from roadside streams, in cases of necessity. In addition to these instances, the pulsometer, it is claimed, may be employed for pumping deep wells, being suspended by a chain or rope, and lowered as the work progresses; for removing water from foundations, as we are informed that it will raise fluid containing fifty per cent of sand or mud; as a working meter, as, by knowing the exact capacity of the working chamber and counting the pulsations, the quantity of liquid moved at any time may be determined; and in fine, through its absence of complicated parts, freedom from requirements of oiling, packing, and constant supervision, for a multiplicity of other uses which circumstances will suggest.

The device, which is covered by some thirty patents, is the invention of Mr. C. Henry Hall. It may be seen, and other information obtained, at No. 20 Cortlandt street, in this city, or at the manufactory of C. H. Hall & Co., corner Hudson and Sussex streets, Jersey City, N. J.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## THE "GRANGES" AND THEIR OBJECT.

The agriculturist is, from the nature of his pursuit, necessarily isolated; and the greater the scale upon which his operations are conducted, the wider is he separated from the communities in which his market must be found. While thus compelled not only to raise but transport his produce to the consumer, at an expense which materially diminishes his profits, he, on the other hand, also labors under the additional disadvantage of being far removed from his immediate sources of supply; hence he is obliged either to purchase his necessaries of life at an augmented cost of importation, or else submit to the often extortionate exactions of agents and middle men.

It was a fact, evident to every thinking observer, that the state of affairs which existed in the agricultural districts of the west during last fall, resulting in the burning of corn as fuel rather than pay the high rates demanded for its transportation to eastern markets, was such as to necessitate speedy means of relief; while it lead many to the thought that, if reform could not be effected through individual effort, it might be gained by aggregation. To these causes may be attributed the very rapid spread of an organization, the object of which is—setting aside all political construction, w ich is beyond our province—to bring the farmer into direct relations with the manufacturer and capitalist; and at the same time, by the agency of association, to improve his intellectual and social, as well as financial, condition. The system of granges, as they are termed, originated in 1867; but on being broached to farmers, it was regarded at the time with suspicion and virtually discountenanced. Up to the beginning of 1871, but 125 societies had been formed; but from the autumn of 1872, the plan has grown in popularity to such an extent that there are now over five thousand granges, aggregating 300,000 members; while it is estimated that fully 8,000 will have been organized before the close of the present year. The order of so-called Patrons of Husbandry is modeled something on the Masonic principle, so far as secresy and the observance of a ritual is concerned, the object of ceremonial restriction being principally, however, to excite an interest and engender a more fraternal feeling among individuals. The National Grange in Washington grants dispensations to form other lodges, and the masters of the latter, when a certain number are organized in a State, constitute a State Grange. The last body elects its own master, who is a member of the National Grange or governing authority. Both sexes are eligible to membership, and a certain amount of internal discipline is maintained.

These societies deal directly with producers, buying their supplies in quantities and paying cash. Contracts are made by agents with manufacturers to furnish various articles at the lowest price attainable. A list of parties thus agreeing is sent to every grange. If a farmer requires, for example, a reaper, a sewing machine, or a piano, instead of buying it from a middleman, he notifies the master of his grange, to whom he pays a stipulated price. An order from the official to the maker procures the desired article, and the same process is gone through with for anything else that a member may need. Necessarily, manufacturers are willing to sell to the granges; and in some cases, we learn, are satisfied to do an exclusive business with them. On their part, they save agents' commissions and send their wares direct from factory to depot for a certain cash profit. There are no vexatious delays, time sales, nor bad debts to distribute, perhaps, among the bills of other customers.

The cost of buying being lessened, the organization has yet to reduce that of selling. At present, and indeed for some period past, the attitude of many of the Western railway corporations and the farmers has been open hostility. The former refuse to reduce their freight charges, and the latter, except where compelled by circumstances, decline to pay them. Of course, politics are brought in, which add to the asperity of the war. The farmers point to the goods of the manufacturer traveling from terminus to terminus at charges far below those demanded for the transportation of the crops, and ask an equalization of expense, decrying the carrying of the wares of one man at rates less than that required for the produce of another. The railroads, on the contrary, assert that it is cheaper for them to transport goods in unbroken bulk from one end of their main lines to the other, shipping and unloading at points where facilities exist for the purpose, than to gather single individual crops from sparsely scattered intermediate stations.

Although no particular compromise has been suggested, the policy of the granges is toward negotiation and diplomacy rather than a continuation of the difficulty, toward securing as advantageous terms as possible from opposing capital rather than undergoing the losses of open rupture. The system, so far as its fundamental principles are concerned, is of material benefit to the farmer; but how far it will stand the test to which time will subject it, it is hardly possible to predict. It is not coöperation, nor are its supplies derived from establishments in the nature of coöperative stores. Briefly summed up, its object is to break away the barriers encompassing the farmer, which are the natural consequence of his isolation, and to bring him at least to a level, so far as the advantages of trade and social intercourse are concerned, with men of other callings.

## THE FLOWING OIL WELLS OF PENNSYLVANIA---GREAT DECLINE IN THE PRICE OF OIL.

Within the past few weeks, a new section of the Pennsylvania oil region has been tapped by enterprising well drillers, and their labors have been rewarded by the opening of flowing fountains of the unctuous commodity. So prodigious has been the flow of oil that the proprietors, so it is reported, have scarcely been able to provide barrels and tanks fast enough to catch the liquid as it spurts from the pipes, and considerable quantities have run to waste.

The result of these new petroleum supplies is the overstocking of the market and the decline in price to the insignificant sum of 75 cents per barrel, delivered on the cars near the wells. At this figure the oil is almost given away. This is a condition that, probably, cannot long continue, and the price will undoubtedly soon rise again. But the depression is likely to prove very disastrous to large numbers of honest and industrious oil pumpers, who, from their wells furnishing ten or twenty barrels of oil per day (working night and day, Sundays included), were just able to make a living, and give employment to their hardworking assistants. Hundreds of these oil dealers will, we fear, be made bankrupt, their pipes and engines sold for old iron, and their families brought to suffering.

The new flowing wells are in Butler county, Pa., a considerable distance south of Oil City. The new oil region is supposed to be quite extensive. The opening of every new section is the signal for the formation of a new city. The Starr farm, near Grease City, is at this moment the most highly favored by the caprices of petroleum fortune. One well, here located, has been flowing over a thousand barrels of oil *per diem* for more than a fortnight, and several others in the immediate vicinity are regularly delivering five and six hundred barrels daily. Large numbers of new wells are being bored. Already a new town is in existence on this farm, having its hotels, boarding houses, livery stables and rum shops. Seventeen of the latter were in full blast within ten days after the oil began to flow.

The principal use of petroleum at the present time is in the form of illuminating oil. Various attempts have been made to employ it as a substitute for bituminous coal in the manufacture of illuminating gas; and if this could be accomplished with economic advantage, the demand for crude petroleum would soon be equal to the supply, and steady, remunerative prices might always be expected. Some of the difficulties connected with the conversion of petroleum into illuminating gas are suggested on another page. The subject is well worthy of study, and we hope that some one will be able to solve the problem.

The discovery of new uses to which this abundant article can be put likewise presents itself as an excellent subject for research.

The employment of petroleum as a fuel, in lieu of coal, especially for use on steam vessels, has been repeatedly attempted, but without economical success. Weight for weight, petroleum yields fifty per cent more heat than coal. In markets where coal is worth $6 a tun, petroleum must be supplied at 3½ cents a gallon or $1 a barrel in order to compete, as a fuel, with coal.

## THE STUDY OF MATHEMATICS.

We have frequently advised our readers who are deficient in a mathematical education to devote some time to the study of this science. It is scarcely necessary for us to advance any arguments in support of this advice. The statement that "knowledge is power" is always true, with certain limitations, and especially true with regard to the power which it puts into the mechanic's hands.

We have seen men who, in spite of strong efforts, had labored in vain from a lack of favoring circumstances. Not knowing how to study, and having no one to show them, all their time has been thrown away. Nothing can be equal in value to the efforts of a good teacher, in smoothing the path of the pupil; but perhaps a few general hints on how to study may do some good.

We suppose that our reader is thoroughly acquainted with arithmetic or the science of numbers, and that he is ready to commence the study of algebra, which may be called the generalization of arithmetic, operations being performed on general quantities, producing results that are general in their nature. If the student will fairly master this idea at the outset, it will be of great value to him in his future studies. Many a young man has gone entirely through a treatise on algebra without really understanding the purpose of his pursuit.

We say that the product of 4 multiplied by 6 is 24. Here we have two factors and a product. Now let us see if we can form a perfectly general expression of this nature. In this case, we would say that the product of two quantities is equal to a third quantity, and the next thing to do will be to represent this statement by an algebraic expression. To do this, let us represent the first quantity by $a$, the second by $b$, and the product by $c$. Then the algebraic expression of the statement given above will be $a \times b = c$, and the statement is called the translation of the algebraic expression. Simple as this may appear, we have seen many students who professed to be well acquainted with algebra, who were unable to translate the most elementary expressions. The reader will doubtless see at once the value of this kind of practice. Since algebra is a process of generalization, or, in other words, since the results obtained are perfectly general in their nature, it is necessary to be able to translate these expressions and interpret the results. How unmeaning an algebraic expression appears to those who are not familiar with the subject! But, on the contrary, how much is conveyed by a few symbols to those who hold the key to the translation! Let the young student, then, make himself expert in the translation of algebraic expressions at the commencement of his course of study.

A teacher of great experience once told us that a very common answer to his question to a student: "Why is this so?" is: "The book says so, in such a place." An answer of this kind shows an utter want of appreciation of the nature of the study. Algebra is eminently a rational science, and the reason why can be given for any one of its propositions. The student should exercise himself in finding out the reason why, in any particular case, and should receive no statement in the book on trust. To say that there is such a rule without being able to give the reason for the rule is evidence of learning merely by rote, a method applicable to some branches of study but wholly out of place in this pursuit. A rule is merely the translation of a general formula, which formula has been established by exact reasoning. All the arguments must rest on some basis; so the principles of mathematical science are based on a few simple propositions, or axioms, which cannot be demonstrated and can scarcely be denied. These axioms being admitted, various propositions are established, the axioms being used as a starting point. The student can then have a sure test, as to the truth or falsity of any statement made by the book, by tracing it back to its original source.

We frequently receive questions from correspondents who ask for rules that can be worked out by arithmetic, as they do not understand algebra. Frequently, as no data are sent, the question could not be answered without the use of algebra. But as the correspondent does not understand how to use a formula, the translation is sent, and he has only to apply the data. So, after all, we are using an algebraic formula in answering his question, merely putting it into a shape in which he can use it. This is quite sufficient to show the general nature of the science. We feel convinced, from the many communications we have received on the subject of a mathematical education, that our present remarks are timely, and we shall be amply repaid if they prove of any assistance to the young student. We do not mean for him to rest satisfied when he has finished the study of algebra; but our hints on this subject will apply with equal force to any other branch of mathematics.

It does not matter so much what text book the student uses as how he uses it; and as most mathematical works are