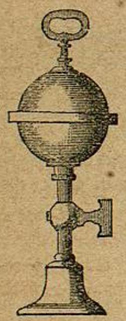
Great improvements have been made on the rude air-pump employed by Guericke; yet, imperfect as his instrument was, it produced results of deep interest to the learned men of that day. His most famous experiment was performed before the Emperor of Germany and his court. Two hollow metallic hemispheres of great size were prepared, fitting each other so closely as to form an air-tight globe. From this globe the air was removed with the pump, and a stop-cock prevented any new air from entering. Fifteen horses were then harnessed to each hemisphere; but their united strength was unable to effect a separation, so tightly were the two parts held together by atmospheric pressure. On turning the stop-cock and reädmitting the air, they fell asunder by their own weight.

Fig. 186.

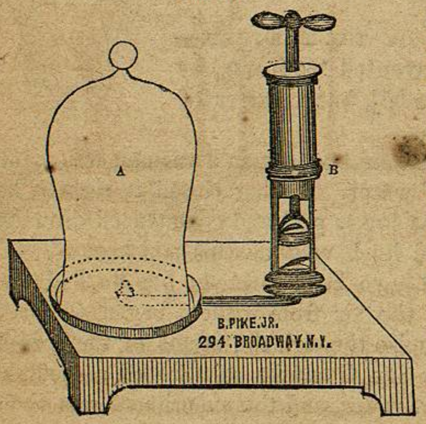


MAGDEBURG HEMISPHERES.

425. This experiment is often repeated at the present day, on a small scale. The Magdeburg hemispheres, as they are called from Guericke's native city, are represented in Fig. 186. They are fixed to the plate of an air-pump, instead of a receiver; and on exhausting the air they are pressed together so tightly that two men can not pull them apart.

426. Single-barrelled Air-pump.—A single-barrelled air-pump is represented in Fig. 187. A is a receiver with its edge carefully ground, resting on a plate near the centre of the stand. In this plate there is a hole leading into a pipe beneath, which connects the receiver with the barrel B. The lower part of the barrel is represented as cut away in the figure, in order to show the interior. A piston is tightly fitted to it, containing a valve opening upward, and connected with a

Fig. 187.



THE SINGLE-BARRELLED AIR-PUMP.

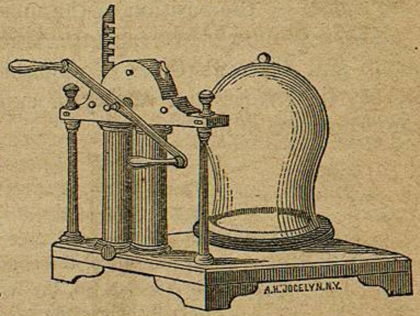
ricke's famous experiment before the Emperor of Germany. 425. Describe the experiment with the Magdeburg hemispheres. 426. Describe the single-barrelled air-

handle, by which it may be worked up and down. At the base of the barrel there is another valve, also opening upward.

427. *Operation.*—The plate having been carefully dusted and rubbed with a little oil, the receiver is placed on it, and the piston is drawn up. A vacuum is thus formed in the lower part of the cylinder, and the air in the receiver, by reason of its elasticity, pushes up the lower valve and enters the barrel. The piston is now in turn driven down; the pressure at once closes the lower valve, while the resistance of the air in the barrel opens the valve in the piston. Through the latter the air passes out, and by the time the piston has reached the bottom, it has all escaped. The piston is then again raised, and the whole operation is repeated,—a barrel-full of air being drawn out from the receiver as often as the piston ascends, and expelled from the barrel as it descends. At last the air in the receiver becomes so rare that it has not sufficient elasticity to open the valve at the base of the barrel. After this the exhaustion can not be carried any further. A perfect vacuum, therefore, is not produced; but the air is rarefied to such a degree that we speak of it as such.

428. Double-barrelled Air-pump.—The double-barrelled air-pump (see Fig. 188) acts on the same principle as the above, but exhausts the air more quickly in consequence of having two barrels and pistons. A section of the instrument is represented in Fig. 189, from which its working will be readily understood.

Fig. 188.

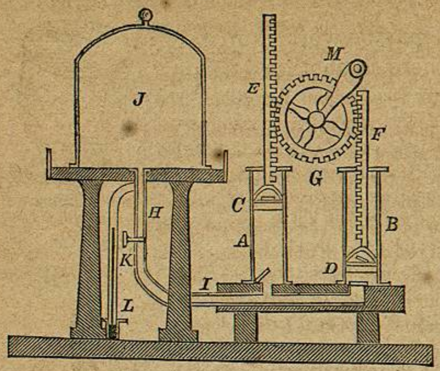


THE DOUBLE-BARRELLED AIR-PUMP.

A and B are the barrels, in which the pistons, C, D, work up and down. Each piston is connected with a rack, E, F, the teeth of which work in the cog-wheel G, turned by the handle M. When C is raised, D is lowered; and when C is lowered, D is raised. H I is the passage which

pump, as represented in Fig. 187. Describe the interior of the barrel. 427. How does the single-barrelled air-pump operate? 428. How does the double-barrelled air-pump differ from the single-barrelled? Describe the operation of the double-bar-

Fig. 189.



connects the barrels with the receiver J. K is a stop-cock by which the connection may be cut off. L is a tube resting at one end in a small vessel of mercury, and at the other connected with the receiver. This tube is called *a barometer gauge.* As the air in the receiver is rarefied, the external atmospheric pressure on the mercury in the vessel causes it to rise in the tube; the degree of rarefaction is therefore shown by the position of the mercury.

429. Experiments with the Air-pump.—With the air-pump and different pieces of apparatus which accompany it, may be performed a variety of experiments, illustrating the properties of air.

Fig. 190.

THE HAND-GLASS.

430. *The Hand-glass.*—The Hand-glass (Fig. 190) is a receiver open at both ends. Set the large end on the plate of the air-pump, and place the hand flat upon the top. As soon as the pump is worked, the pressure of the atmosphere is felt. When the air is exhausted, the hand can hardly be removed from the glass; on reädmitting the air through a stop-cock, it is raised without difficulty. The expansion of the air in the palm of the hand is shown by the redness of the flesh, and its puffing out while over the exhausted glass.

431. *The Apple-cutter.*—The Apple-cutter (Fig. 191) is a metallic cylinder with a sharp upper edge. An apple that fits it closely having been placed on its top, the air is exhausted. The pressure of the atmosphere forces the apple down on the sharp edge; the middle part is cut out and falls inside of the vessel.

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refied air-pump, with the aid of Fig. 189. What is the use of the barometer gauge? 430. What is the Hand-glass? Describe the experiment with the hand-glass. What causes the redness of the hand? 431. What is the Apple-cutter? Describe the ex-

Fig. 191.

THE APPLE-CUTTER.

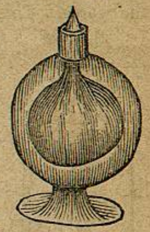
Fig. 192.

THE BLADDER-GLASS.

432. *The Bladder-glass.*—Over the large end of the hand-glass tie a wet bladder, as shown in Fig. 192. When the bladder has become dry, place the open end on the plate, and exhaust the air from the glass. The pressure of the atmosphere, unsupported from within, soon bursts the bladder with a loud noise. If a piece of thin india rubber be substituted for the bladder, it will be drawn in and distended, till it covers nearly the whole inside of the glass.

433. *The Lungs-glass.*—The Lungs-glass (Fig. 193) illustrates the elasticity of air. It is a small glass globe with a metallic stopper. Through this stopper passes a tube, to the lower part of which a bladder is tied. The whole is placed under a receiver, and the air exhausted. The air in the bladder, communicating through the tube with the receiver, is gradually rarefied. The air around it in the glass, having no communication with the receiver, remains of the same density. Owing to its pressure, the bladder becomes shrivelled when the receiver is exhausted; but, on the reädmission of the air, it resumes its former dimensions. This movement, regularly repeated, resembles the action of the lungs in breathing, and hence the name given to the apparatus.

Fig. 193.



THE LUNGS-GLASS.

Fig. 194.

VACUUM FOUNTAIN.

434. *Vacuum Fountain.*—Fig. 194 represents a tall glass receiver, terminating at the bottom in a metallic cap, through which a tube passes. This tube is furnished with a stop-cock, and a screw, by means of which it may be fastened to the plate of an air-pump. A jet communicating with the tube rises into the receiver. Screw this apparatus to the plate of the pump, exhaust the air, and close the stop-cock. Then unscrew the whole, place the lower end of the tube in a vessel of water, and open the stop-cock. The pressure of the atmosphere will force the water up through the tube and jet into the vacuum, forming a beautiful miniature fountain.

Another mode of producing a vacuum fountain is with the apparatus shown in Fig. 195. It consists of

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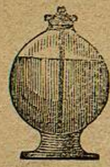
periment with the apple-cutter. 432. How is the experiment with the bladder-glass performed? 433. What does the Lungs-glass illustrate? What does it consist of? Describe the experiment. Why is the lungs-glass so called? 434. What does Fig. 194 represent? How is the vacuum fountain produced? Describe another mode of producing

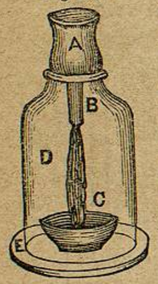
Fig. 195.



a glass vessel with an air-tight stopper, through which a tube extends almost to the bottom. The vessel, nearly filled with water, is placed under a tall receiver, and the air exhausted. The elasticity of the air within the vessel, not being counterbalanced by any pressure from without, forces the water through the tube in the form of a fountain.

435. *Bottle Imps.*—The bottle imps, described in § 397, may be made to dance up and down in a jar of water in an exhausted receiver. These figures are hollow and contain air. When the receiver is exhausted, the pressure on the surface of the water being removed, the air in the figures expands and drives out some of the water. This diminishes their specific gravity, and causes them to rise. When the air is readmitted, the pressure is restored, the air in the figures is compressed, water enters, their specific gravity is increased, and they sink.

Fig. 196.



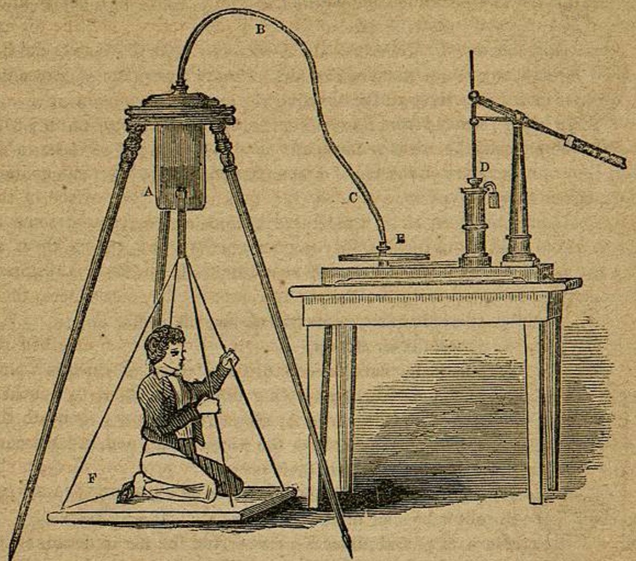
436. *The Mercury Shower.*—On an open-mouthed receiver, D, place the cup A, in the bottom of which is a plug of oak wood, B, projecting downward about two inches. Put some mercury in A, and set the saucer C beneath the oaken plug. Exhaust the air from D, and the mercury will soon be forced by atmospheric pressure through the pores of the oak, and fall into the saucer in a silvery shower.

437. *The Weight-lifter.*—This is an apparatus with which the pressure of the atmosphere is made to lift a heavy weight (see Fig. 197). A is a cylinder attached to a frame, firmly supported by three legs. On the bottom of the cylinder rests a closely fitting piston, to which the platform F is attached. A tube, B C, connects the interior of the cylinder with the plate E of the pump D. When the air is exhausted from A, the pressure of the atmosphere raises the piston, together with the platform and its contents, the whole length of the cylinder. Atmospheric pressure being 15 pounds to the square inch, the number of pounds that can be lifted by a given cylinder may be found by multiplying its area expressed in inches by 15.

438. It has been proposed to transmit mails between distant points, by atmospheric pressure, on the principle of the weight-lifter. A strong metallic tube, perfectly smooth on the inside, would have to be laid between the places, and a piston tightly fitted to it. Large air-pumps, worked by steam, would be placed at both ends of the tube. The mail being attached to the piston at one end of the line, the pumps at the other would be set in motion. A partial vacuum would be produced, and atmospheric pressure would drive the piston through the tube at a rate estimated at 500 miles an

a vacuum fountain. 435. How may bottle imps be made to dance up and down in a jar of water? Explain the principle. 436. How is the mercury shower produced? 437. What is the Weight-lifter? Describe it, and its mode of operating. How many pounds will a given cylinder lift? 438. To what has it been proposed to apply this

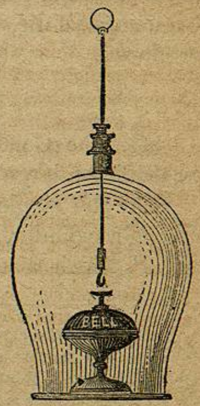
Fig. 197.



hour. Such is the theory; whether it can be practically applied, remains to be proved.

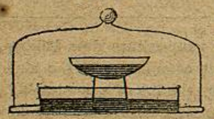
439. *Vacuum Bell.*—This apparatus is intended to show that air is essential to the production of sound. A bell is so fixed under a receiver that it can be rung by pushing down a sliding-rod which passes through the top. When rung before the receiver is exhausted, the bell is distinctly heard; but, when the air is withdrawn, it is almost inaudible. If a perfect vacuum could be produced, it would not be heard at all.

Fig. 198.



440. *Freezing Apparatus.*—Water may be frozen in a vacuum, with the apparatus shown in Fig. 199. Having placed the liquid in a shallow vessel over a basin containing strong sulphuric acid, set the whole under a receiver and exhaust the air. Under the diminished pres-

Fig. 199.



principle? Give the theory of the process. 439. What is the apparatus known as the vacuum bell intended to show? Describe the experiment. 440. Describe the freezsure, the water is rapidly converted into vapor, which is as rapidly absorbed by the acid. The continued evaporation cools the water to such a degree that it is finally covered with ice.

441. *Miscellaneous Experiments.*—In a vacuum, boiling commences at a much lower temperature than in the air. This is shown by placing some hot water under a receiver and exhausting the air. The pressure of the atmosphere being removed from its surface, the water soon boils; but it comes to rest the moment that air is reädmitted. For the same reason, water boils at a lower temperature on the top of a mountain than at its base, as has often been observed by travellers.

442. If beer is placed under a receiver and the air exhausted, it begins to foam. This is owing to the elasticity of the carbonic acid in the liquid, rushing out to fill the vacuum. If the air is reädmitted, the beer resumes its usual appearance.

443. A shrivelled apple in an exhausted receiver is puffed out to its full size by the expansion of the air within.

444. If a vessel of water containing a piece of wood, a vegetable, or almost any solid substance, is placed under a receiver, and the air is exhausted, minute globules of air can be seen forming on the surface of the solid, and sometimes even bubbling up through the water. This proves the porosity of solids and the presence of air in their pores.

445. A lighted candle in an exhausted receiver is extinguished, and the smoke falls because it is heavier than the rarefied air. If a mouse, rabbit, or other living creature, is placed under a receiver and the air is drawn off, it immediately shows signs of distress, and soon dies.

446. These experiments show that air is everywhere present, and is essential to life and combustion. In a vacuum, animals die, vegetation ceases, and sound can not be produced.

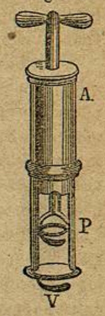
The Condenser.

447. The Condenser (Fig. 200) is an instrument used for forcing a large quantity of air into a given vessel.

Like the single-barrelled air-pump, the condenser consists of a cylinder, A, with a valve at its base, V, and a piston, P, which also contains a valve, tightly fitted to it.

ing apparatus, and the experiment with it. 441. At what temperature does boiling commence in a vacuum, compared with that at which it commences in the air? How is this shown? What is said of the boiling of water on the top of a mountain? 442. What phenomenon is presented when beer is placed under a receiver and the air exhausted? 443. When a shrivelled apple is so placed? 444. How is the presence of air in the pores of solids proved with the air-pump? 445. How is it shown with the air-pump that air is necessary to combustion and animal life? 447. What is the

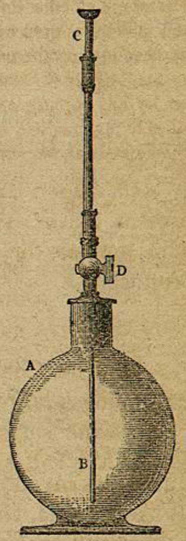
Fig. 200.



Instead of opening upward, however, as in the air-pump, these valves open downward.

448. *Operation.*—The condenser having been screwed to any strong vessel in which it is desired to condense air, the handle is worked up and down. A vacuum being produced below the piston, as it ascends, its valve is opened and air rushes in; while the valve in the cylinder is closed by the pressure of the air in the vessel. When the piston descends, its valve is closed by the pressure of the air in the cylinder, while the other valve opens and allows this air to be driven into the vessel. With every ascent of the piston, therefore, the cylinder is filled with air, and with every descent this cylinder-full of air is forced into the vessel.

Fig. 201.



Air is condensed in the chamber of the air-gun (described in § 399) by the use of this instrument.

449. *Experiment.*—An interesting experiment may be performed with the condenser and the apparatus represented in Fig. 201. A is a globe half full of water, with a tube, B, reaching nearly to the bottom, and extending upward through an air-tight cap till it terminates in a screw just above the stop-cock D. The condenser, having been screwed on, is worked till a large quantity of air is forced into A. The stop-cock is then closed, the condenser is unscrewed, and a jet-pipe, C, is put on in its place. The stop-cock is now opened, when the pressure of the condensed air, being greater than that of the atmosphere, forces the water in A up through the jet, making a beautiful fountain.—This experiment shows that the elasticity of air is increased by condensing it.

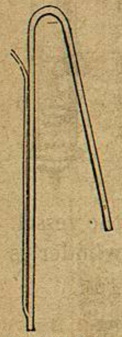
Pneumatic and Hydraulic Machines.

450. The Siphon.—The Siphon, represented in Fig.

Condenser? Describe it. 448. How does the condenser operate? 449. Describe an experiment with the condenser and the apparatus represented in Fig. 201. 450. What

202, is a simple instrument for drawing off liquids from a higher to a lower level. It is nothing more than a bent tube, with one leg longer than the other.

Fig. 202.



THE SIPHON.

To use the siphon, fill it with some liquid and then invert it, stopping the long end with the finger, and setting the short one in the liquid to be drawn off. Remove the finger, and the liquid will commence flowing from the long end. The upward pressure of the atmosphere is counterbalanced by its downward pressure on the surface of the liquid to be drawn off, and the liquid in the tube will therefore flow in the direction of its greatest weight. As it flows, a vacuum is formed in the tube, and fresh liquid is constantly forced up into the short leg. The flow continues till the liquid falls below the extremity of the short leg.

451. Some siphons, like that in the figure, have an additional tube, open at the upper end and at the lower communicating with the long leg. This saves the trouble of turning the siphon, every time it is used, to fill it with liquid; for, the long leg being stopped with the finger and the mouth applied to this additional tube, the liquid may by suction readily be made to fill both legs.

452. Tantalus's Cup.—Fig. 203 represents Tantalus's Cup, which is simply a goblet containing a siphon, the short leg of which reaches nearly to the bottom, while its long leg passes through the bottom and extends below. The siphon is concealed by a figure, which seems to be trying to drink. Water is poured in; but, the moment it reaches the lips of the figure, it recedes, because just then it passes the turn of the siphon and begins to be discharged below.

Fig. 203.

TANTALUS'S CUP.

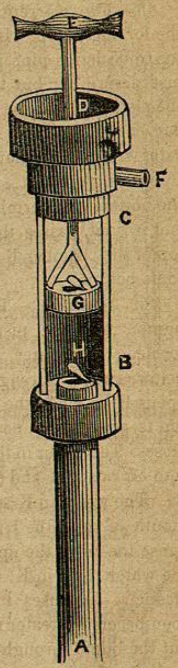
453. The Lifting-pump.—The Lifting-pump was invented by Ctesibius [*te-sib'-e-us*], who flourished at Alexandria, in Egypt, 250 B.C. Though the son of a barber and brought up to his father's calling, he attained distinction by his mechanical abilities. Several ingenious

is the Siphon? How is it used? Explain the principle on which it works. 451. What improvement is attached to some siphons? 452. Describe Tantalus's Cup, and the principle on which it works. 453. Who invented the Lifting-pump? What is said of Ctesibius? 454. Of what does the lifting-pump consist? 455. Describe its mode

contrivances for raising water are attributed to this philosopher, besides the clepsydra already described.

454. The common Lifting-pump is represented in Fig. 204. It consists of a cylinder, B C, to which is fitted the air-tight piston G, containing a valve opening upward. A is called the suction-pipe; it must be long enough to reach the water that is to be raised. In the top of the suction-pipe is the valve H, opening upward into the cylinder. E is a handle, by which the piston may be worked. F is a spout, from which the water is discharged.

Fig. 204.



THE LIFTING-PUMP.

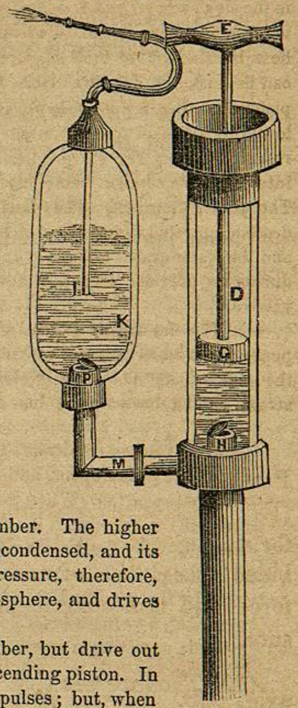
455. *Operation.*—To work the pump, raise the piston. As it ascends, it leaves a vacuum behind it, and the water under the pressure of the atmosphere rushes up through A, opens H, and fills the cylinder B C. The piston, having reached the top, is now forced back. Its downward pressure at once closes the valve H, so that the water can not return into the suction-pipe; but the valve in the piston opens, and through it the water rushes above the piston. When the piston has reached the bottom of the cylinder, it is again raised; its valve being now closed by the downward pressure, the water is lifted by the piston into the reservoir D, whence it is discharged by the spout. Meanwhile, the second time the piston rises, a vacuum is formed below it as before, and the whole operation is repeated.

456. Thus we see that water is raised in pumps by atmospheric pressure. The air will support a column of water from 32 to 34 feet high. To this elevation, therefore, water can be raised with the lifting-pump; for greater distances, the forcing-pump must be used.

457. The Forcing-pump.—The Forcing-pump, after raising a liquid through its suction-pipe, does not discharge it from a spout above, but by the pressure of the returning piston drives it through an opening in the side below. The

of operation. 456. By what agency is water raised in pumps? How high a column will atmospheric pressure support? To raise water to a greater height, what must liquid is thus forced, either directly or by means of the pressure of condensed air, to a greater height than it could otherwise attain.

Fig. 205.



THE FORCING PUMP.

458. Fig. 205 represents one form of the forcing-pump. It has a cylinder, piston, and suction-pipe, like the lifting-pump just described; but there is no valve in the piston. Near the bottom of the cylinder enters the pipe M, which communicates with the air-chamber K, by the valve P, opening upward. The tube I, open at the bottom and terminating at the upper end in a jet, passes through the air-tight top of the chamber K, and extends nearly to its bottom.

459. *Operation.*—To work the forcing-pump, raise the piston. A vacuum is formed; and water, from the reservoir below, rushes through the suction-pipe, opens H, and fills the cylinder. The piston is now pushed back, when H at once closes. The water in the cylinder is forced into M, raises P, and enters the chamber K. The water in K soon rises above the mouth of the tube I, and begins to condense the air in the upper part of the chamber. The higher the water rises in K, the more the air is condensed, and its elasticity increases in proportion. Its pressure, therefore, soon becomes greater than that of the atmosphere, and drives out the liquid through the jet.

Some forcing-pumps have no air-chamber, but drive out the liquid by the direct pressure of the descending piston. In that case, the discharge is by successive impulses; but, when made from an air-chamber, it is continuous.

460. THE FIRE-ENGINE.—The Fire-engine is a combination of two forcing pumps, with a common air-chamber and suction-pipe. Its operation will be understood from Fig. 206.

The pistons, C, D, are attached to a working-beam, A B, turning on the

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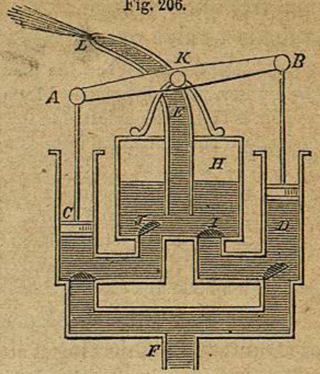
be used? 457. What is the principle on which the Forcing-pump acts? 458. Describe the form of forcing-pump represented in Fig. 205. 459. Explain its operation. When there is no air-chamber, how does the forcing-pump drive out the liquid? 460. Of what does the Fire-engine consist? Describe its operation with Fig. 206.

Fig. 206.

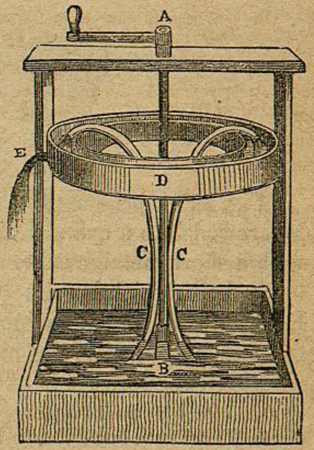


pivot K, so that one rises as the other descends. They are driven up and down by *brakes* attached to the beam and worked by a number of men on each side. F is the suction-pipe. H is the air-chamber, and E a pipe rising from it, to which a flexible leather hose is attached, so that the stream can be turned in any direction. The piston D in Fig. 206 is ascending, followed by a stream of water from the reservoir below, the valve I leading into the air-chamber being closed. The piston C, on the other hand, is descending; its lower valve is closed, and the water drawn into the cylinder during its previous ascent, is now being forced into H, through the open valve J.

461. The fire-engine is one of the most powerful forms of the forcing-pump, since water is being constantly forced into the air-chamber by one of the pistons, and the air is violently compressed. With a good engine, a stream can be thrown more than 100 feet high.

462. THE CENTRIFUGAL PUMP.—The Centrifugal Pump (Fig. 207) is an instrument for raising water by the combined effect of the centrifugal force and atmospheric pressure.

Fig. 207.



THE CENTRIFUGAL PUMP.

It consists of a vertical axle, A B, and one or more tubes, C, C, fastened to it, extending into a reservoir of water below, and branching off towards the top so as to bring their mouths over the circular trough D. E is a spout for discharging the wa-

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461. What is said of the power of the fire-engine? How high can a stream be thrown with a good engine? 462. What forces are brought to bear in the Centrifugal Pump?

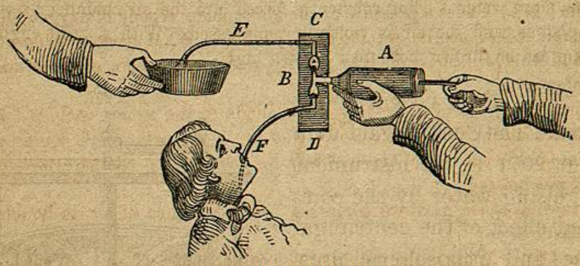
ter from the trough. Near the top and bottom of each tube is a valve opening upward.

463. *Operation.*—When the pump is to be worked, the tubes are filled with water, which is prevented from escaping by the lower valves. A rotary motion is then communicated to the tubes by means of a handle attached to the axle. The centrifugal force at once acts on the water within, causing it to open the valves and rush forth from the mouths of the tubes. As it ascends, a vacuum is left behind it, into which water is driven by atmospheric pressure from the reservoir below. Streams are thus kept pouring into the trough as long as the rotary motion is continued.

A large centrifugal pump, worked by steam, has raised no less than 1,800 gallons a minute to a considerable height.

464. THE STOMACH PUMP.—The Stomach Pump is an instrument for injecting a liquid into the stomach of a poisoned person and withdrawing it, without removing the apparatus. The stomach is thus rinsed out, and life is often saved.

Fig. 208.



THE STOMACH PUMP.

Fig. 208 represents the stomach pump. A syringe, A, is screwed into a cylindrical box, B, where it communicates with a short metallic tube. This tube leads on either side into a bulb, which is connected with a tube of india rubber. Each bulb contains a movable circular valve of metal, which fits either extremity, and may be made to close either by raising the opposite side of the instrument.

Operation.—To work the pump, turn the syringe so as to depress C and elevate D; and then introduce the tube F into the patient's stomach, and E into a basin of warm water. The metallic valves fall to the lowest part of

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Of what does the centrifugal pump consist? 463. What is its mode of operation? What has been effected with a large centrifugal pump worked by steam? 464. For what is the Stomach Pump used? Describe its parts. How is it worked?

their respective bulbs, which brings them directly opposite where they are in the Figure. Now draw out the handle of the syringe. A vacuum is produced; and the warm water, under atmospheric pressure, rushes up to fill it, all communication with F being cut off by the valve. The syringe being thus charged, the handle is pressed back, and the water, prevented from returning into E by the valve, is forced through F into the stomach. Without removing the india rubber tube from the stomach, now turn the instrument, so as to raise the side C and depress D, as shown in the Figure. The metallic valves are thus thrown to the opposite extremities of their bulbs, and by working the syringe with them in this position, the contents of the stomach are drawn off and discharged into the basin. The syringe is thus always charged through the depressed tube and emptied through the elevated one.

465. The consideration of the steam-engine, the greatest of pneumatic machines, is deferred till we shall have treated of the mode of generating steam by heat, a subject which belongs to Pyronomics.

EXAMPLES FOR PRACTICE.

1. (*See* § 398.) Under a pressure of one atmosphere, a body of oxygen fills 24 cubic inches, and its specific gravity is 1.111. What space will it occupy, and what will be its specific gravity, under a pressure of three atmospheres?
2. Some hydrogen, by a pressure of 20 pounds to the square inch, is forced into a space of one cubic foot. How great a pressure will compress it into half a cubic foot, and how will its density then compare with what it was before?
3. Into what space must we compress 10 cubic inches of air, to double its elastic force?
4. (*See* § 401.) What is the weight of 600 cubic inches of air? What is the weight of the same bulk of water?
5. A vessel, full of air, weighs 1,061 grains; exhausted, it weighs but 1,000 grains. How many cubic inches does it contain?
6. (*See* § 414.) What is the downward atmospheric pressure on the roof of a house containing 115,200 square inches? What is the upward atmospheric pressure on the same roof?
7. What amount of atmospheric pressure is supported by a boy whose body contains 1,000 square inches of surface?
8. (*See* § 408.) When the mercury in the barometer stands at 29 inches, at what height will a column of water be supported by the atmosphere?
   [*Solution.—The specific gravity of water is* 1; *that of mercury,* 13.568. *A column of water will be supported at the height of* 29×13.568 *inches.*]
9. When the atmosphere supports a column of water 32 feet high, how high a column of mercury will it support?
10. (*See Fig.* 183.) How far above the earth's surface would the mercury stand only two inches high in the barometer?