one horse power, nor could he find any one who could inform him where such an engine could be had.

If some person would make such an engine and boiler, that could be sold at a reasonable price, I am confident large numbers could be sold. As they would be used by amateurs in or about residences, they should be as simple as possible. No money should be expended on them merely for show, such as planing or polishing parts which can be painted; but they should be strongly built, and special care should be taken to furnish ample boiler capacity, with strength sufficient to prevent accidents.

Thinking persons are now convinced that much of our domestic labor can and should be done by power. It is a disgrace to our civilization that a woman should be compelled to break her back over a wash tub and board. Very few men would be willing to do the same work all day; and there is no reason, why this operation, which is a combined chemical and mechanical process, should not be done by machinery, and so of many other domestic labors.

Some fifteen years ago I had great difficulty to find a small foot lathe, as no manufacturer appeared to make one for sale; and after writing far and wide, I only succeeded in getting one from a man who built it for his own use. Today they are regular articles of trade, made by several concerns, all of whom find ready sale for them. The same would undoubtedly prove true of small engines. Who will do it?

Washington, D. C. W. C. DODGE.

An Appeal to Inventors.---A New Invention Greatly Needed.

To the Editor of the Scientific American:

This part of the country is infested with fleas and sand flies, and so far I have been unable to find anything that will either drive them away or kill them. We have tried rock camphor, carbolic soap, and kerosene oil, and have so far failed. The fleas infest our houses and barns, and almost every animal that walks. Some people say that the sand breeds them, some attribute them to the hogs, but there have been no hogs running round here since the war. Some people say that the fleas are not as bad as they were just after the war, but both pests are terrible. We keep our bedrooms dark, and undress outside; and keeping camphor in the beds, we have better nights, but in the morning they go for us, as hungry as ever and by the score.

The sand flies go for both man and beast, especially on still, moist mornings and evenings, and all day when it is still. Some people smoke to drive them away from the face, and the negroes substitute a stick in the mouth with a bunch of burning rags on the end; but the little persistent pests will bite the ears, hands, and neck, in spite of everything. Kerosene oil will keep them off for 5 or 10 minutes; but it evaporates, and they bite as badly as ever. If there is anything known to the scientific world, that will either kill or drive them off, you will confer a great boon on a large suffering community by letting us know of it.

Borel Plantation, St. Mary's, Ga. WILLIAM STEELE.

PRACTICAL MECHANISM.

NUMBER XX.

BY JOSHUA ROSE.

PUMPS.

Pumps are commonly divided into three classes, the suction pumps, the force pumps, and the suction and force pumps.

SUCTION PUMPS.

A suction pump causes water to raise itself, by relieving its surface of the pressure of the column of air resting upon it. The principle upon which it acts may be explained as follows:

The surface of all water exposed to the air has the pressure of the air or atmosphere resting upon it; if, therefore, one end of a pipe or tube be lowered into water, and the other end be closed by means of a valve or other device, and the air contained in the pipe be drawn out, it is evident that the surface of the water within the pipe will be relieved of the pressure of the atmosphere; and there will be no resistance offered to the water to prevent its ascending the pipe. The water outside of the pipe, still having the pressure of the atmosphere upon its surface, therefore forces water up into the pipe, supplying the place of the excluded air. The water inside the pipe will rise above the level of that outside of the same in exact proportion to the amount to which it is relieved of the pressure of the air, so that, if the first stroke of a pump reduce the pressure of the air contained in the pipe from 15 lbs. on the square inch (which is its normal pressure) to 14 lbs. per inch, the water will be forced up the pipe to the distance of about 2¼ feet, because a column of water an inch square and 2¼ feet high is equal to about 1 lb. in weight.

It is evident that, upon the reduction of the pressure of the air contained in the pipe from 15 to 14 lbs. per square inch, there would be (unless the water ascended the pipe) an unequal pressure upon its surface inside as compared to that outside of the pipe; but in consequence of the water rising 2¼ feet in the pipe, the pressure on the surface of the water, both inside and outside, is evenly balanced (taking the level of the outside water to be the natural level of the water inside), for the pressure upon the water exposed to the full atmosphere will be 15 lbs. upon each square inch of its surface; while that upon the same plane, but within the pipe, will sustain a column of water 2¼ feet high (weighing 1 lb.) and 14 lbs. pressure of air, making a total of 15 lbs., which is, therefore, an equilibrium of pressure over the whole surface of the water at its natural level.

If, in consequence of a second stroke of the pump, the air pressure in the pipe is reduced to 13 lbs. per inch, the water will rise up it another 2¼ feet, and so on until such time as the rise of the column of water within the pipe is sufficient to be equal in weight to the pressure of the air upon the surface of the water without; hence we have only to determine the hight of a column of water necessary to weigh 15 lbs. per square inch of area at the base of the column to ascertain how far a suction pump will cause water to rise, and this is found by calculation or measurement to be a column nearly 34 feet high. It becomes apparent then that, however high the pipe may reach above the water level, the water cannot rise more than 34 feet up the pipe, even though all the air be excluded within the pipe, because the propelling force, that is, the atmospheric pressure, can only raise a column of water equal in weight to itself. It is found, however, in practice, to be an excellent suction pump which will raise water thirty feet.

From this it will be perceived that the terms "drawing water" and "suction pump" do not accurately represent the principles upon which this pump performs its duty; and it would be much more proper to call it a "displacement pump," since its action is simply to enable the water to rise by displacing the air from its surface.

The duty of this pump is, therefore, in the first place, to extract the air from the suction pipe, and, in the second place, to discharge the water from its barrel through the medium of valves in such a manner that the column of water in the suction pipe is at all times entirely excluded from the pressure of the atmosphere.

FORCE PUMPS.

A force pump is one by means of which the water is expelled from the pump barrel and through the delivery pipe by means of the mechanical force applied to the pump piston or plunger; the amount of power required to drive such a pump will, therefore, depend at all times upon the hight to which the water is required to be forced. When a pump is arranged to draw the water, and force it after it has left the pump barrel, it is termed a suction and force pump; but if the water merely flows into it in consequence of the level of the water supply being equal to or above that of the top of the pump barrel, it is termed simply a force pump. Hence a suction pump performs its duty in causing the water to rise to the pump, a force pump is one which performs its duty in expelling water from its barrel, and a suction and force pump is one which performs both duties alternately.

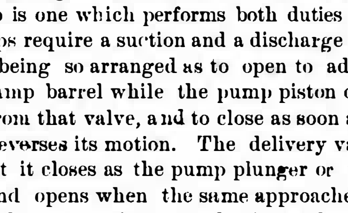
All pumps require a suction and a discharge valve, the suction valve being so arranged as to open to admit the water into the pump barrel while the pump piston or plunger is receding from that valve, and to close as soon as the plunger stops or reverses its motion. The delivery valve is so arranged that it closes as the pump plunger or piston recedes from it, and opens when the same approaches it. When, therefore, the pump piston recedes from the suction valve, the latter opens and admits the water; and when the piston reverses its motion, the suction valve closes, and the descent of the pump piston forces the water through the delivery valve, that being its only possible mode of egress from the barrel of the pump.

The arrangement of the valves may be the same for a force as for a suction pump (although it is advisable, in some cases, to place an additional valve to a force pump to prevent the pump piston from receiving the force of the water in the delivery pipe), the only difference being that the water is permitted to flow freely away from a suction pump, whereas it is confined to the delivery chamber or pipe in a force pump, so as to force it to the required hight or pressure, as the case may be.

PISTON PUMPS

A piston pump is one in which the water is drawn or forced by means of the piston fitting the barrel of the pump airtight, which is most commonly done by providing the piston with two cupped leathers, formed by being pressed in a die made for the purpose. The leather is soaked in water before being placed in the die, and is allowed to remain in the die until it is dry, when it will be sufficiently hard to admit of being turned in the lathe. Fig. 57 represents such a piston in section, A A being the leather, B the piston, C C

Fig. 57.



a piece of metal, placed between the leathers to fit their rounded corners, so that the sides of the leathers shall not move when the piston reverses its motion, and D the follower, which clamps the whole together by means of the pressure received from the nut behind it.

The capacity of a piston pump is its area multiplied by the length of its stroke; but it must be remembered that all pumps throw less water than their capacity, the deficiency ranging from 20 to 40 per cent according to the quality of the pump. This loss arises from the lift and fall of the valves, from inaccuracy of fit or leakage, and in many cases from there being too much space between the valves and piston or plunger.

A plunger pump is one in which a plunger is used in place of a piston, the gland through which the plunger moves serving as its guide and also keeping it air and water tight. The plunger is made smaller in diameter than the bore of the pump barrel, so that the capacity of such a pump is the area of the end face of its plunger multiplied by the length of its stroke, because the pump acts by reason of the displacement caused by the plunger entering the barrel. Pump plungers should always be draw-filed lengthways to prevent them from wearing away the packing so rapidly. It is always advisable in this kind of pump to allow as small an amount of space between the plunger and barrel as possible, for the following reason: When the plunger becomes worn, it is necessary to turn it up again in the lathe, thus reducing its diameter. The result is that there is so much air in the pump, between its barrel and the plunger, that it expands as the plunger leaves the barrel and is merely compressed by the plunger returning, so that the pump becomes very ineffective, and finally ceases to pump at all. If the pump, in such a case, be primed with water each time it is started, it may draw water, but not to its full capacity, as the air will remain in the pump barrel until such time as it may become absorbed by the water.

Suction valves for all pumps should be made as large in area as it is possible to get in, so that they will not require to lift much to admit the water to the pump: since it is evident that, when the piston or plunger commences to descend and the suction valve to close, the water passes back through the suction valve until it is closed, thus diminishing the effectiveness of the pump, and, further, causing the valve to close with a blow which proves very destructive to the valves, especially of fast running pumps.

The area of the opening of a suction valve must be at least equal to the area of the suction pipe, whose area is determined by the following principles: Water will not flow through a suction pipe in a solid stream at a greater speed than that of 300 feet per minute. It follows, then, that, the quantity of water the pump is required to throw being determined, the suction pipe must be of such a size that 300 feet of it will hold such quantity.

If the suction pipe be any smaller than that size, the pump will not be fully supplied with water; and the piston or plunger traveling faster than the supply of water follows it, there is, when it arrives at the end of its suction stroke, a partial vacuum in the pump barrel, which keeps the suction valve open. When the piston or plunger has descended until it strikes the water again (the suction valve not having yet closed), the water, descending with the piston, strikes the suction valve with a blow, which, as before stated, gives a backward impetus to the water in the suction pipe, and closes the valve with a blow very destructive to it; especially is this the case in a force pump or a fast running steam pump, in which latter case the steam piston accelerates in speed (when the pump piston has the partial vacuum, referred to, in it) because not only is the steam piston relieved from performing any duty, but it is assisted by the vacuum; so that it accelerates its speed greatly until the piston strikes the water in the pump barrel, which it will do with such force as to very probably break some weak part of the engine or pump, or cause the crossheads or piston to become loose. If the working parts of any pump are accurately fitted, it will deliver more nearly its full capacity of water when running slowly.

An air chamber placed in the suction side of any pump causes a better supply of water to the pump by holding a body of water near to it, and by making the supply of water, up the suction pipe, more uniform and continuous. Air chambers should be made as long in the neck as possible or convenient, so that the water, in passing from the pump barrel to the delivery pipe, shall not be forced up into the chamber at each stroke of the pump; for the air in the chamber becomes gradually absorbed by the water. If fresh water is continually passing into and out of the chamber, the air in it will soon become absorbed, and water will supply its place; but if the air chamber has a long neck, the water at its highest level in the chamber will remain there unchanged by the action of the pump, and will become impregnated with air, thus diminishing its propensity to absorb any more; and although the air will finally become all absorbed out of the air chamber, the process is a very much slower one, the air chamber being so much the more effective, and its elasticity, imparting a steady flow of water from the delivery pipe, being unimpaired.

Pumps whose pistons revolve are subject to the same defects from inequality of wear as are rotative engines, but the results are not so keenly experienced, because water will not leak through so rapidly nor to so serious an extent as steam, and, further, because the leakiness of the pump may be compensated for by an increase of the rotative speed of the piston.

Water will not, however, as before stated, flow through the suction pipe at a greater velocity than 300 feet per minute; so that, if the pump performs more revolutions that are requisite (according to its capacity) to carry off more than the quantity of water contained in 300 feet of its suction pipe, the power used in running those extra revolutions is lost, inasmuch as they are superfluous except for the purpose of compensating for the defects in the construction or leakiness of the pump, in which case the excess of speed becomes a necessary evil.

HAIR can be turned blonde, or, in other words, killed, by washing in a very weak solution of soda twice a day. We happen to know that two of the leading belles of New York society owe their much-admired golden tresses to this simple recipe. A piece of soda about as big as a small hickory nut to a quart or so of water is the right proportion. Less soda gives the hair a reddish tone. We do not advocate, however, any such interference with Nature.