PRACTICAL MECHANISM.

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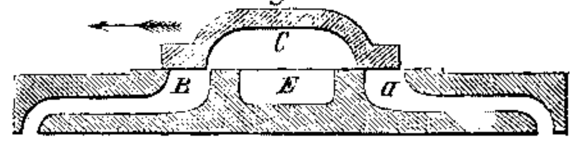
THE SLIDE VALVE.

The common slide valve is a simple device for regulating the ingress and egress of steam to and from the cylinder, as illustrated in Fig. 47. It is here shown in the position in

Fig. 47.



which it would be when the piston of the engine had moved to the end of one stroke and was prepared to commence the next, *a* being the port through which the steam is passing into the cylinder, and B, the port through which the steam which propelled the piston on the previous stroke must now find egress.

The valve, C, is moving in the direction of the arrow, so that the port, *a*, is left open for the steam to enter as the valve recedes from it, and a free communication is at the same time being established between the port, B, and the exhaust port, E, of the cylinder, thus permitting the steam to escape through E.

When the piston has arrived at the other end of the cylinder, the valve, C, will have moved back, so that these conditions will be exactly reversed, B being the port through which the steam will then enter, and *a*, that through which the exhaust steam will escape from the cylinder.

The lead of a valve is the width of opening which the valve permits (by reason of the position to the crank in which the eccentric is set) to the steam port when the piston is at the end of the stroke, as shown in Fig. 47, at the port, *a*.

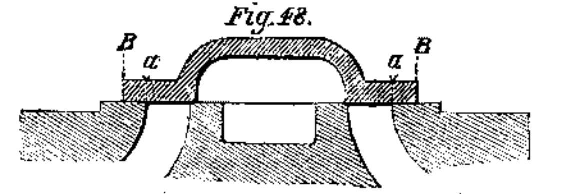
If the valve were set so that it had no lead, both the ports, *a* and B, would be closed by the valve, so that the steam could neither enter nor leave the cylinder until the momentum of the fly wheel had caused the crank to pass the dead center, and therefore the valve to open.

Lead is given to a valve to enable the steam to act as a cushion upon the piston, by admitting the steam to it before it has arrived at the end of its stroke, thus causing it to reverse its motion easily and without noise.

If the working parts of an engine have much play or lost motion in them, the steam admitted by lead will, by opposing a gradual force in a direction opposite to that in which those parts are moving, take up such play before the piston has reversed its motion, and therefore more gradually and less violently than would be the case if the force of the steam came upon the piston at the instant at which it reversed its motion. In the latter case the piston, after reversing its motion, would have no load against it until the play of the working parts was taken up, so that it would travel very fast during the instant of time in which such play was being taken up; and the check, given to it on meeting its load again, would cause a thump or pound to the piston. But if the working parts are a reasonably good fit, and the valve has lap on it to give a free exhaust, there appears no necessity for giving the valve more lead than is sufficient to about fill the steam passage and the clearance (that is, the space between the cylinder cover and the piston when the latter is at the end of its stroke) with steam at full pressure, by the time the piston arrives at the end of the stroke: the object of lead to this amount being to supply steam at full pressure to the piston from the instant the crank has passed its dead center and the piston has commenced its stroke, and at the same time to prevent any unnecessary amount of back pressure, for the steam admitted by lead acts at all times as a back pressure upon the piston; so that, if the valve has too much lead, not only is there a consequent loss of power from back pressure, but the piston receives a sudden and violent shock, which is sure in the end to result in damage to some part of the engine, such for instance as loosening the piston upon the rod, or either loosening or breaking the crosshead pin or the crank pin. It must be borne in mind that, as the steam admitted by lead commences to enter the cylinder before the piston has arrived at the end of its stroke, if the amount of lead is so great as to admit sufficient steam to the steam passages and cylinder, and to fill them at full pressure before the piston has arrived at the extreme end of its stroke, the advancing piston will have to force or pump part of such steam back again into the steam chest. At the moment at which this forcing back will take place, the center line of the crank will be nearly parallel with the center line of the bore of the cylinder, so that the effect will be that the whole momentum of the fly wheel, which is traveling fast, is concentrated upon the piston, which is then moving very slowly, to force it ahead against the full head of steam (admitted by the lead); and the whole strain of these opposing forces is accumulated upon the pillar block holding the crank shaft, bearing the crank pin and the crosshead pin in a direction the most favorable for bursting them apart, resulting in a serious loss of power, and (as before stated) in ultimate damage to the engine. In the case of a locomotive, where the piston speed and the wear and tear of the working parts is very great, an extreme amount of lead is admissable to take up such wear and prevent pounding at each end of the stroke; the lightness of locomotive frames (as compared to the heavy frames of stationary engines) enables them to spring from the strain created by any excess of lead, and hence the crank and crosshead pins do not encounter so severe a strain as would be the case if the same amount of lead were given to a stationary engine. One eighth of an inch of lead is sufficient for an ordinary freight and $\frac{3}{16}$ of an inch is sufficient for passenger or express locomotive, the difference being in consequence of the greater running speed of the latter. Engines whose cylinders are vertical and above the shaft are given more lead on the bottom than on the top of the cylinder, because the wear of the various moving parts of the engine is mostly downwards and away from the cylinder, so that the lead becomes more on the top and less on the bottom as the engine wears. If, however, the cylinder is vertical and below the shaft, these conditions are exactly reversed.

The steam lap of a valve is the amount by which it exceeds the extreme width of the cylinder ports, as illustrated in Fig.

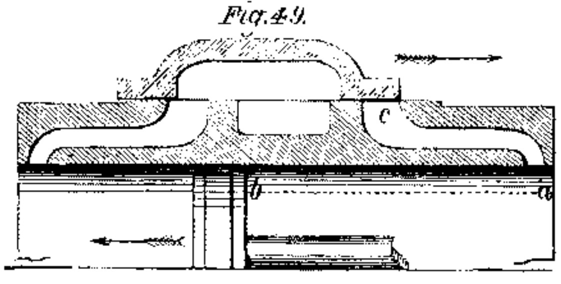
Fig. 48.



48, from *a* to B being, in each case, the lap.

By means of giving steam lap to the valve, the engine is enabled to use its steam expansively, that is, the valve cuts off the supply of steam to the piston before the latter has traveled to the end of the stroke, as shown in Fig. 49, in which the valve is shown as having just closed the port, C, the direction in which the piston and valve are respectively moving being denoted by the arrows.

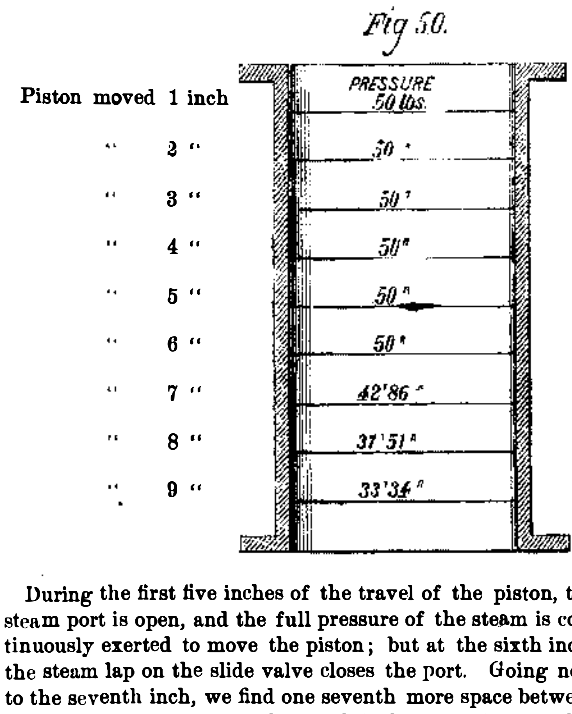
Fig. 49.



Lap on the exhaust side of a valve is a subject to be hereafter treated upon. The advantage derived by using steam expansively may be perceived by supposing the stroke of a piston to be 9 inches, and the steam supply to be cut off by reason of the lap on the valve when the piston has traveled 6 inches; it will then have to travel the remaining 3 inches of stroke, receiving only such pressure as the steam already in the cylinder will impart. The pressure of steam increases or diminishes in exact ratio to the space it occupies, the temperature being maintained equal; that is to say, if the steam occupying one cubic foot at a pressure of 50 pounds is permitted to expand its volume so that it occupies two cubic feet, its pressure will decrease to 25 pounds; but if it were compressed so as to occupy one half of a cubic foot, its pressure would rise to 100 pounds.

In Fig. 49 the steam would occupy that portion of the cylinder from *a* to *b* (that is, 6 inches of its length, supposing the whole length to be 9 inches), at a pressure of, say, 50 pounds per inch. When, therefore, the piston has moved another inch, the steam will occupy $\frac{1}{7}$ more space (that is, 7 inches instead of 6 inches of the length of the cylinder), thus reducing its pressure by $\frac{1}{7}$, bringing it down from 50 to 42·86 pounds per inch, and so on, as illustrated in Fig. 50, in which *a a* represents a section of a cylinder.

Fig. 50.



During the first five inches of the travel of the piston, the steam port is open, and the full pressure of the steam is continuously exerted to move the piston; but at the sixth inch, the steam lap on the slide valve closes the port. Going now to the seventh inch, we find one seventh more space between the piston and the cylinder head, while there is only six inches of steam at normal pressure; and so we have one seventh less pressure, or 42·86 pounds. At the eighth inch, the space and the steam are still more disproportionate, there being one fourth more space and of course one fourth less pressure; and at the ninth inch, the end of the stroke, there is, similarly, one third more space and one third less pressure.

The whole pressure of steam on the piston during the last 3 inches of the stroke has been obtained without any supply of steam to the cylinder from the steam chest, and constitutes the gain due to using the steam expansively.

It must be borne in mind that, when the piston commenced its seventh inch of stroke and first inch of expansion, the pressure of steam upon it was 50 pounds, and that not until it had reached its seventh inch of stroke and completed its first inch under expansion had the pressure fallen to 42·86, so that 42·86 is less than the average pressure the piston received during that inch of its stroke, but is as near as we can arrive at it unless we take the movements of the piston and pressures of steam at a greater number of points, as, for instance, at every half inch of piston movement.

It would appear that this saving of steam had been obtained at some sacrifice of the power of the engine, since the piston performed the last 3 inches of its stroke under a reduced pressure of steam; but such is not the case, for if the valve has no steam lap on it, the exhaust port is not sufficiently open when the piston is at the end of the stroke to permit the steam to escape freely; hence it puts a back pressure on the piston, which is a greater loss to the engine than is caused by the reduced pressure due to working expansively: so that an engine whose valve has no lap will not only use less steam, but will become more powerful if lap be added to the valve.

An experiment made two years ago by the author clearly demonstrated this fact. A new engine, fitted with a common slide valve which had no lap upon it, was attached directly to a pump, which drew water 4 feet and forced it through a $1\frac{1}{4}$ inch nozzle, a pressure gage being attached to the air chamber of the pump. Steam at 60 pounds to the square inch was supplied to the engine, whose performance then was to maintain an even pressure of 17 pounds per inch in the air chamber, the engine making 120 revolutions per minute. After running a few days, the slide valve of the engine was taken out and $\frac{5}{16}$ of steam lap was added on each side, a new and larger eccentric being fitted to the engine in order to give the slide valve the necessary increase of stroke. No other part of the engine or pump was altered or removed; but upon turning on the steam, the engine ran up to 175 revolutions, and maintained an even pressure in the air chamber of 34 pounds to the inch.

The Common Hammer.

Few people, says Mr. J. Richards, in witnessing the use of a hammer, or in using one themselves, ever think of it as an engine giving out tuns of force, concentrating and applying power by functions which, if performed by other mechanism, would involve trains of gearing, levers, or screws; and that such mechanism, if employed instead of hammers, must lack that important function of applying force in any direction that the will may direct.

A simple hand hammer is, in the abstract, one of the most intricate of mechanical agents, that is, its action is more difficult to analyze than that of many complex machines involving trains of mechanism; but our familiarity with hammers makes us overlook this fact, and the hammer has even been denied a place among those mechanical contrivances to which there has been applied the mistaken name of mechanical powers.

Let the reader compare a hammer with a wheel and axle, inclined plane, screw, or lever, as an agent for concentrating and applying power, noting the principles of its action first, and then considering its universal use, and he will conclude that if there is a mechanical device that comprehends distinct principles, that device is the common hammer; it seems, indeed, to be one of those things provided to meet a human necessity, and without which mechanical industry could not be carried on. In the manipulation of nearly every kind of material, the hammer is continually necessary in order to exert a force beyond what the hands may do, unaided by mechanism to multiply their force. A carpenter in driving a spike requires a force of from one to two tuns, a blacksmith requires a force of from five pounds to five tuns to meet the requirements of his work, a stonemason applies a force of from one hundred to one thousand pounds in driving the edge of his tools; chipping, calking, in fact nearly all mechanical operations consist more or less in blows, and blows are but the application of an accumulated force expended throughout a limited distance.

Considered as a mechanical agent, the hammer concentrates the power of the arms and applies it in a manner that meets the requirements of the work. If great force is needed, a long swing and slow blows accomplish tuns; if but little force is required, a short swing and rapid blows will serve, the degree of force being not only continually at control, but the direction at which it is applied also. Other mechanism, if used instead of hammers to perform the same duty, would from its nature require to be a complicated machine, and act but in one direction or in one plane.

Tin-Canned Butter.

The president of the New York Butter and Cheese Exchange lately received a package of Danish butter, which, although it had been packed in tin for more than seventeen months, was in excellent condition. It came from Bolivia, where it had been sent from London, and was accompanied by a note addressed to the New York butter and cheese merchants, asking if as good a quality of butter could be produced here. If as good butter could be made here, New York would soon have control of the trade of the South American markets, as the cost was too great to get their butter direct from London. It was decided that butter of as good quality could be made in this country. Arrangements will be made to secure the South American trade, and tin will be used for packing purposes instead of wood.

MR. I. LOWTHIAN BELL, President of the Iron and Steel Institute of Great Britain, and one of the most eminent iron masters of England, is now in this country. He is visiting our principal iron works and mining regions.

CHIANG-QUAN-WA, an intelligent Chinaman of San Francisco, has applied for a patent for an improved overall.