JIG-FILE FOR FINISHING DIES.

The accompanying sketch was made by our artist during a recent visit to the works of the American Waltham watch factory. It represents one of the thousand-and-one handy and ingenious machines with which the factory is crowded. Everyone who has handled a file at the bench knows how difficult it is to file a surface that shall be perfectly plane or exactly normal to some other surface. No hand is so steady or eye so true but inequalities or variation will occur. In the jig-file herewith shown the operator is finishing up some of the fine dies which are used in the factory. The file is carried in a vertically sliding head, operated by a crank and connecting rod below. It projects above a plane cast iron table, upon which the die is

JIG-FILE FOR FINISHING DIES.

firmly held down, and at the same time brought up with suitable pressure against the file. The machine is driven by belt and pulley and requires no manipulation after it is once started, the workman being able to direct his whole attention to bringing the die to the required shape. The table is capable of being set and clamped at any desired angle according as the edges of the die are to be square or at an angle with its face.

A LARGE OCTOPUS.

BY PROF. C. F. HOLDER.

One of the most disagreeable animals of the sea to handle or contemplate is the octopus. The tangle of arms, the snakelike movements, the strange flashes of color, the green glittering eyes, are all features that arouse a strong feeling of aversion on the part of the observer. I have had under observation several octopi at the Santa Catalina Aquarium and it has been interesting to note the characteristic features of the various individuals. In a small tank were confined three individuals having a radial spread of perhaps 18 inches. One affected a light yellow hue and was timid, sulking behind a rock. Another, of a dark reddish cast, was continually flourishing its tentacles, rising and falling on the side of the glass until an observer nicknamed it the "skirt dancer." A third was almost black, and was a vindictive fellow, ready at any time to make an attack. When I introduced my hand into the tank, this octopus would as quick as a flash send out one long attenuated tentacle and coil about it, then if an advance was made it would suddenly release its hold upon the rock and quickly encompass my hand with its eight arms, pressing the round serrated disks into the flesh while a tremulous motion would be felt.

At the first attack of this kind the sensation was one of horror. The hideous creature flattened out, assimilating the color of the flesh to a marked degree and evidently endeavoring to smother the hand with its folds, as the tentacles were distended to their utmost limit. To hold the hand firm under such circumstances required some effort, and I confess when it was first attempted, with a Florida specimen, I beat a rapid and decided retreat; but in the latter case I waited to see if the animal's object was to bite, knowing that the bill of so small a specimen could not make a serious wound. But the octopus merely pressed its mouth on the back of my hand, apparently trying to intimidate the supposed enemy. While fastened to the hand, it still held to the rock, and it was with difficulty released. When I remained quiet, the animal began to creep along like a huge spider, but at the first movement of my fingers it pounced upon my hand again, enveloping it in the eight snakelike arms. I finally twisted out of its grasp and seized it firmly by the body, when its rage became intense. Flushes of color passed over it in rapid succession; now red, black, yellow, and when at the height of its anger it was mottled and splashed with black—a frightful creature. It made a desperate effort to escape, but when released ejected a cloud of ink, darting off rapidly under its cover.

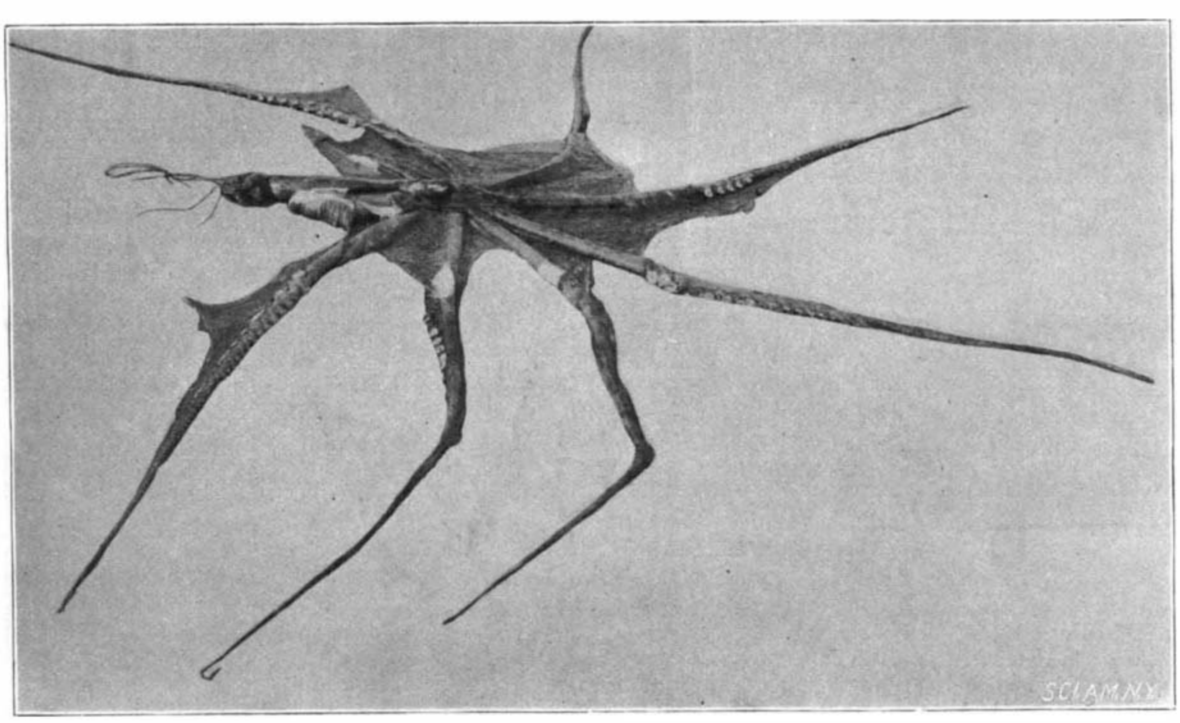
This octopus resented any intrusion and advanced to the attack at once. When a strange octopus was placed in the tank, although much larger, it came out of its corner without hesitation, eyed the newcomer a moment, then in some incomprehensible way literally hurled itself at the enemy, and in a second the two were rolling over and over in a contest that was amazing to witness. The sixteen tentacles wound about each other with the rapidity of light, and both animals ejected the inky fluid from their siphons. They resembled a ball of snakes rolling along and striking at each other more than anything else. A close examination of the writhing mass showed that the object apparently was to smother the opponent. Finally, the newcomer beat a retreat; it was badly wounded, and succumbed a few hours later.

The octopus is a favorite subject with popular writers on natural history, and many accounts have been written of its ferocity, which are almost invariably denied by naturalists; yet I am inclined to think that in some instances certain individuals are more or less pugnacious. I have handled scores of them from the Gulf of Mexico and California, and observed only one instance—the one cited—where the animal deliberately rushed to the attack, though I know of two others. One was observed by Mr. Ralph Arnold, a geologist, of Pasadena. He was wading among the pools at low tide at Point San Pedro when suddenly he heard a cry and turning saw some children in a pool, wading, and moving toward them a large octopus, its long arms raised above the water. Whether the animal would have attempted to attack them is a question, as it was interrupted in a more or less violent manner. A resident of Washington told me that once when visiting the shore he was advised by the fisherman with him to avoid the pools, and when it became necessary to cross them to pass over as quickly as possible, as large octopi frequented them. He considered this the exaggeration of a fisherman, and paid but little attention to it; but once in crossing a pool, stepping from stone to stone, suddenly a long livid arm shot out of the water and reached insinuatingly for his legs, the entire animal moving rapidly toward him. He, however, reached the rocks safely and bombarded the animal with stones. He estimated its size at twenty-five feet across, judging the tentacles to have been twelve feet in length. Again, it cannot be determined from this whether the animal would have seized him; though the observer was confident that it would, and that it was large enough to have held him under water had he been pulled in.

The specimen shown in the accompanying illustration was taken near Avalon, Santa Catalina Island. Its arms were over 10 feet in length, giving the animal a radial spread of at least 20 feet. The strength of these large octopi was shown in this instance, it being almost impossible to hold the animal until a large rope had been thrown about it. In Alaska the octopus attains even a larger size, individuals having been reported with a spread from tip to tip of tentacles of 25 or 30 feet. Such an animal is represented in the Yale Museum by a cast, and gives an excellent idea of how the living animal looks. At Santa Catalina Island small specimens are very common, and one has been taken in deep water—500 or 600 feet—having a radial spread of 15 feet, an uncanny monster, which, when it came up, threw its arms over the side of the boat and made a powerful resistance. Indeed, it was almost impossible to bring it in without tearing and cutting the large sucker-lined arms.

The octopus is a most interesting creature; its eight sucker-lined arms, like snakes, that creep into every nook, corner, and crevice; its power of changing color, blushing and paling at the slightest alarm, being features that appeal to the fancy and imagination. The octopus has a small mouth with jaws which call to mind those of a parrot and powerful enough to enable them to sever the vertebræ of good-sized fishes which they may capture. Each sucker is a factor, and when it is remembered that there are scores of them, with sharp cutting edges, one can imagine the reserve force and power of the animal. When closely pressed, they resort to the ink bag and force a stream of ink out which permeates the water and in the shadow of which they escape. I have seen a squid hurl its ink a foot or more into the face of a boatman in Florida, who was peering into the water in search of them.

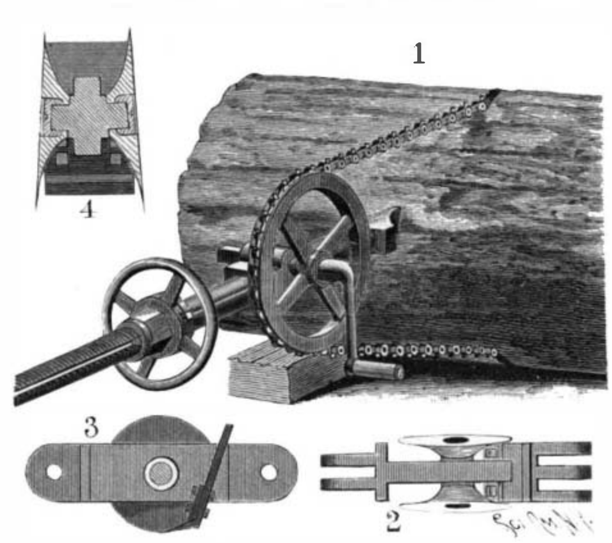
The octopi in confinement, previously referred to, eat fish or crab meat, and upon securing it, spread out their webs, covering as much surface as possible, and when eating, the tentacles are nearly always in motion, "wriggling" being the only term to describe their peculiar motion.



OCTOPUS TAKEN NEAR AVALON, SANTA CATALINA ISLAND, CALIFORNIA.

A MECHANICALLY-OPERATED CROSS-CUT SAW.

A novel cross-cut band or chain saw which is designed to saw logs far more rapidly and effectively than an ordinary saw has been patented by Matthew

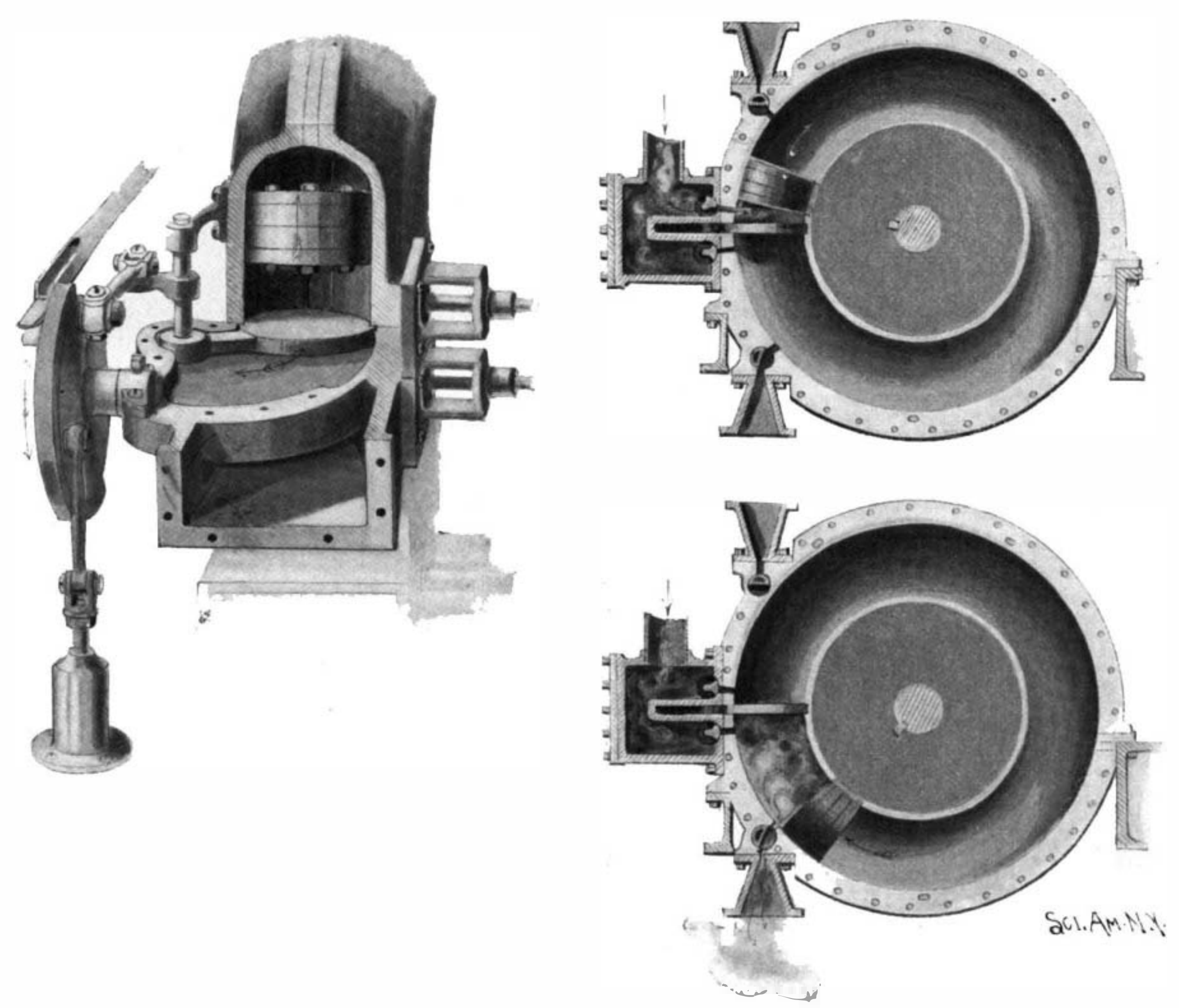


CLARK'S CHAIN CROSS-CUT SAW.

J. Clark, of Chaparal, Arizona Territory. Of the accompanying illustrations, Fig. 1 is a perspective view of the saw in operation; Fig. 2 is a plan view of a link of the saw; and Fig. 3 is a side elevation of a link, with the one cutter removed. Fig. 4 is a section of a link. The apparatus comprises a bar having at one end a head adapted to engage the log. At the other end the bar is threaded and formed with longitudinal grooves. A box is mounted to slide upon the plain portion of the bar and has arms with opposite flanges extending within the grooves. A two-part nut, operated by a handwheel, is mounted to turn on the threaded end of the bar, between the flanges of the arms. In the box a shaft is journaled carrying a sprocket-wheel around which passes the chain-saw. The links of the chain, as shown in Figs. 2, 3 and 4, are provided at each side with cutting-wheels inclined to each other so that only the edges will engage the wood, thus preventing the clogging of the wheels by the kerf. Chisels are connected with the links and extend between the inner faces of the wheels. The chisels are designed to detach a layer of wood cut by the wheels. In operation, the head of the bar is driven into the log, the chainsaw is passed around the log and sprocket, and the box carrying the sprocket is shifted along the bar by turning the nut until the chain is taut. As the sawing progresses, the handwheel is turned so as to screw the nut outwardly in order to force the sprocket-wheel toward the outer end of the bar. When the nut reaches the end of the threaded portion of the bar, a segment of the chain is removed; and the nut is returned to its initial position.

IMPROVEMENTS IN ROTARY ENGINES.

The many failures which have attended the efforts to produce a successful rotary engine and the fact that the direct acting crank and rod reciprocating engine remains in full possession of the field have led many people into the erroneous belief that there is something inherently wrong in the principle of the rotary engine—that, like perpetual motion or the supposed self-multiplying powers of liquid air, its theory is based upon a misconception or absolute ignorance of natural physical laws. As a matter of fact, however, the objects aimed at in the rotary engine are perfectly legitimate, and the principles upon which inventors have been working ever since Ramelli, in 1588, designed his rotary pump, of which the rotary engine is actually a reversal, are perfectly sound.

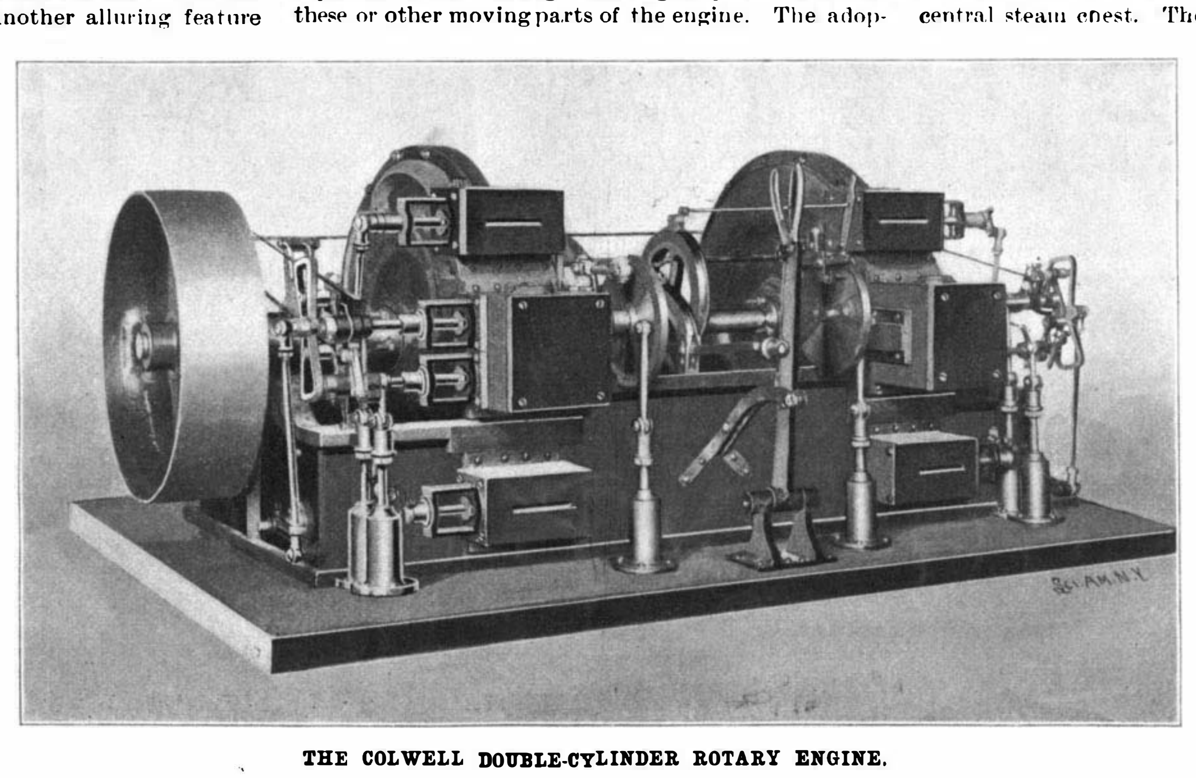


ABUTMENT AND VALVE GEAR—COLWELL ROTARY ENGINE.

The stumbling blocks which have brought rotary engine builders to grief have been entirely of a mechanical or structural nature.

Undoubtedly the feature that has proved most attractive in the rotary engine is the fact that the pressure on the piston is at all points of the stroke applied tangentially to the circle described by the crank, and so avoids the "dead centers" of the reciprocating engine. The turning moment of any given amount of pressure at the crank pin upon the crank shaft is the product of this pressure by the vertical distance between the direction in which it is exerted and the axis of the crank shaft. In a reciprocating engine this vertical distance varies from zero on the dead centers to a maximum just before the half stroke, when the crank and connecting rod are at right angles. Consequently, a constant and even turning moment can only be secured in the reciprocating engine by connecting two cylinders to a common shaft and placing the cranks at ninety degrees. The piston pressure of a rotary engine, on the contrary, is always exerted tangentially to the circle described by the crank, and, consequently, its turning moment is at a maximum throughout the whole revolution.

There is, moreover, a loss of power in the reciprocating engine due to the change of direction of pressure at the cross-head, a certain component of the piston pressure being exerted against the guide bars. This loss is greatest when the crank is near the half stroke and the turning moment is largest. Another alluring feature of the rotary engine is the fact that the heavier reciprocating parts of the standard type of engine are dispensed with, and it is not necessary to provide the customary massive flywheel or heavy counterbalance weights. Lastly, there is the attractive feature of the economy of space that is realized by doing away with piston rods, cross-heads, guides, and connecting rods, and the economy in material and labor which is consequently realized in manufacture.



THE COLWELL DOUBLE-CYLINDER ROTARY ENGINE.

Now, the above well-known theoretical and practical advantages of the rotary engine cannot be disputed and they have served to attract an amount of mechanical thought and skill which has resulted in some extremely ingenious designs by such men as Cochrane, Napier, Fletcher and later inventors. While it is true that hitherto no rotary steam engine, except those of the turbine type, has been so successful as to establish itself in competition with the standard reciprocating engine, the rotary principle has been applied with marked success to various types of blowers, ventilators and pumps of which Roots' blower is the most notable example.

Chief among the difficulties which have hitherto stood in the way of the production of the successful rotary engine have been those of providing a satisfactory form of valve gear, steam ports, etc., for the admission and control of the steam and a suitable sliding abutment to support the reaction of the steam within the cylinder. The accompanying engravings of a two-cylinder rotary engine, which have been prepared from drawings furnished by Mr. T. M. Colwell, 704 Atwood Building, Chicago, Illinois, show an intelligent attempt on the part of the designer to overcome these difficulties, and it will be noticed that both in the details and general plan of the engine, there is a departure from previous types. In the first place the engine is in duplicate and consists of two annular cylinders, mounted upon a common shaft, each cylinder having its own independent valves and abutment gear, the only parts common to the two being the eccentrics, link motion and reversing mechanism. The annular cylinders are true circles in cross section, the pistons being segments of a true circular ring, with the faces radial to the center of the main shaft. They are packed with split piston rings, and it is stated that no difficulty has been experienced in securing steam-tight joints either in these or other moving parts of the engine. The adoption of the annular form of cylinder conduces to cheapness and accuracy of manufacture, and indeed in these respects it is perhaps the best form into which the rotary engine can be cast.

The vital feature of the engine is the abutment mechanism, shown in the accompanying detail drawings. A rotary engine to be efficient must be so constructed that the piston shall be under pressure substantially throughout its entire stroke, and it must be capable of expanding the steam to the extent that is attained in engines of the reciprocating type. To secure these results the steam must be admitted with a minimum amount of clearance between an abutment and a movable piston, and the supply must be capable of being cut off at any desired point of the revolution. Also it is evident that for the best results the arc of the circle through which the steam pressure is operative on the piston must be the greatest possible. This requires that the abutment be allowed to remain in place until the piston is about to complete the entire circle of movement, then very rapidly withdrawn to let the piston pass, and as rapidly re-inserted behind the piston so that the steam may be again admitted before the piston has had time to travel any appreciable distance without pressure.

Now, the difficulty has been to remove and insert the abutment with sufficient rapidity without destructive hammering or bruising of the mechanism. In some engines the abutment has been moved slowly, with a consequent increase in what might be called the "dead" space in the cylinder, and to compensate for this the circle of the piston space has been inconveniently enlarged. In the present case the dilemma has been avoided by reducing the weight of the abutment, to allow the use of a "swinging" mechanism that is exceedingly rapid in its movement. Intimately associated with the problem of the swinging abutment is that of the position and action of the steam ports, and the whole problem is met by using the regular Corliss valves and gear and placing the admission ports in close proximity to the abutment. There are separate valves for the admission and exhaust, and these are provided in duplicate (as shown in the illustration), so that by throwing over a single reversing lever both engines may be reversed. This is rendered possible by using double links for working the valve stems, so that one pair of eccentrics does duty for the whole eight valves. The arrangement is clearly shown in the general view of the engine, where the lower and upper steam chests contain the forward and reverse exhaust valves, while the forward and reverse admission valves and the recess which receives the abutment during its withdrawal are contained in the larger central steam chest. The operation of the valves and abutment is shown clearly in the detail views. In the upper view the piston has swept by the abutment which has just been swung back into place, and the inlet valve is admitting steam, the exhaust valve being at the same time open. In the lower view the steam has been cut off and the piston is about to sweep by the exhaust port. The abutment will be withdrawn only just in time to clear the front face of the piston as it passes forward in its path. When the engine is reversed, the lower admission valve and the upper exhaust valve are utilized. The right hand drawing shows the mechanism for swinging the abutment, which is made exceptionally light and is pivoted on a vertical shaft which is at-