RAPID-FIRE GUNS AND AMMUNITION SUPPLY IN THE UNITED STATES NAVY.

In a recent article we promised to take up the question of rapid-fire guns and ammunition supply and show the present status of our navy in regard to these most important elements of the modern warship.

At the outset of the late war there was a mistaken impression among foreign critics that the United States Navy was severely handicapped by the lack of rapid-fire guns on its warships, and it was supposed that even on such vessels as possessed rapid-fire batteries the arrangements for the supply of ammunition were too faulty and slow to permit the guns being fired at their maximum speed. Neither of these assumptions was correct, and, indeed, so far from the navy being behindhand in the development of the rapid-firing principle, it is a fact that we were one of the first to experiment in this field and were only anticipated in the production of the 6-inch rapid-fire gun by the inability of our manufacturers to produce a satisfactory cartridge for the same.

Our greatest advance in the matter of armor and rapid-fire guns was made when Commander Folger, now of the U. S. S. "New Orleans," was the Chief of Bureau of Ordnance. It was his ambition to make every gun, including the 8-inch, rapid-fire in character, and that he did not accomplish all of his anticipations in this respect is owing to the fact that the private manufacturers, upon whom the government must depend for its supply of cartridge cases, were unable to manufacture cases of the size called for. The result was that, when Commander Folger resigned from the bureau in the winter of 1893, the 4-inch and 5-inch guns were the only calibers fully and satisfactorily developed, although the plans were already on foot for rapid-fire guns of calibers above the 4-inch and 5-inch, and for the manufacture and development of smokeless powder—that "open sesame" of the dreams of the rapid-fire gun inventor.

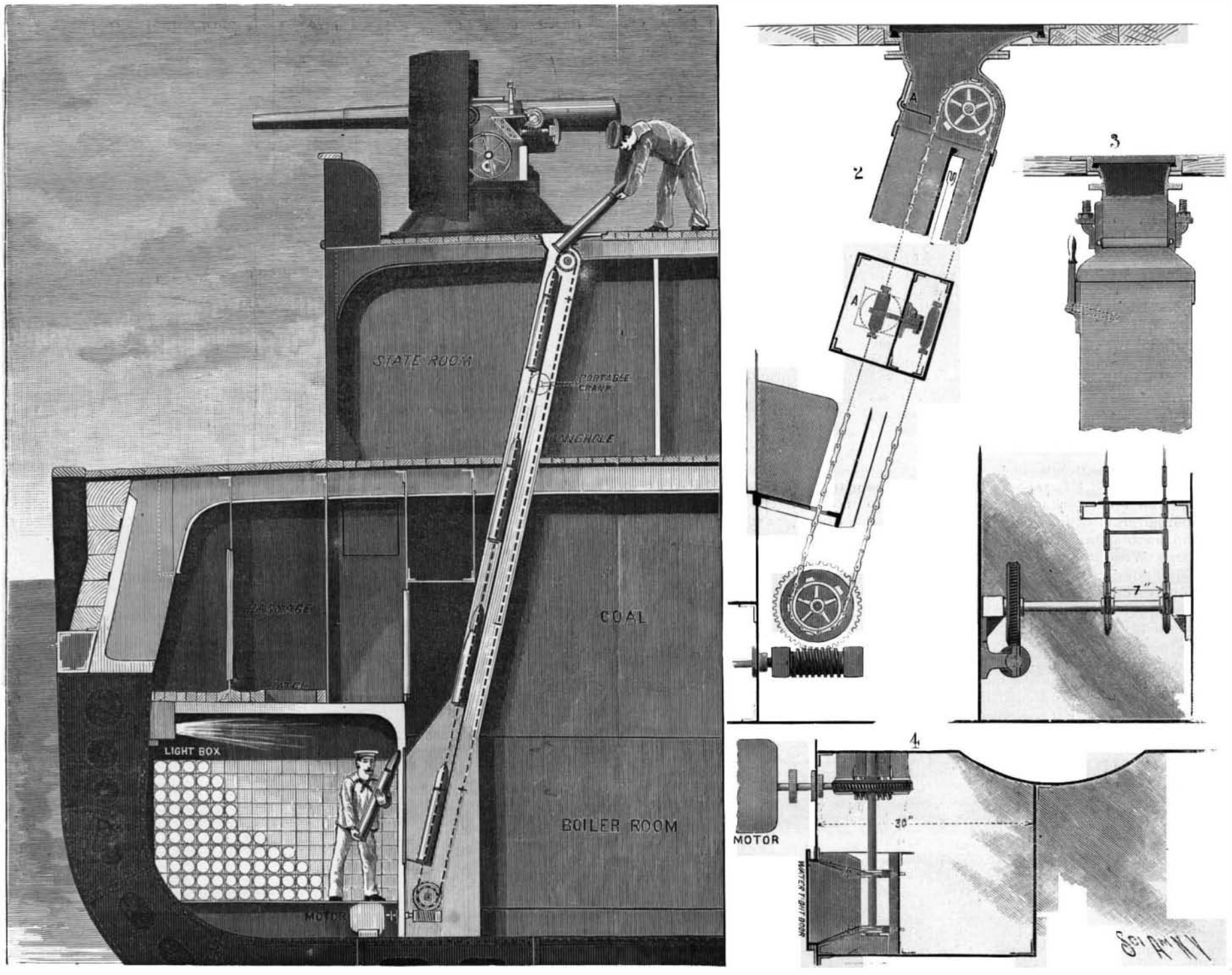
The early history of the development of the large caliber, rapid-fire gun in this country is also intimately associated with the name of Lieutenant R. B. Dashiell, Assistant Naval Constructor, United States Navy, who is the inventor of the excellent breech mechanism which bears his name, and of the mounts which carry all the 4 and 5-inch rapid-fire guns in our navy. Regarding these mounts, which are illustrated on pages 13 and 15 of the ARMY AND COAST DEFENCE SUPPLEMENT, we take this opportunity of correcting an error in the titles of these cuts, which was occasioned by an ambiguity in the official publications from which the cuts were made. The mounts are there credited to Lieutenant Fletcher, whereas they were actually designed by Lieutenant Dashiell. Lieutenant Fletcher has been conspicuously associated with the later development of rapid-fire mechanism, and due reference to his work will be made later in the present article.

The first 4-inch rapid-fire guns to be built in this country were the Driggs-Schroeder and the Dashiell. As the Navy Department favored the slotted-screw system for its large guns, the Dashiell was adopted as soon as the gun passed a satisfactory test, which was in June, 1891. As far as mere rapidity of fire was concerned, the results obtained with this gun were superior to anything that had been accomplished abroad, as it was found to be capable of a sustained unaimed fire at the rate of 17 shots per minute. Work on the 4-inch guns was at once rushed at the Washington Navy Yard; and from that time on only the rapid-fire 4-inch was made, the old-fashioned 4-inch at once becoming obsolete. In the following fall the first 5-inch rapid-fire Dashiell gun was finished and tested. It gave results as much ahead of the foreign caliber as the 4-inch had done. It was at once adopted, and its manufacture was hurried as much as possible in order to arm ships of the "Detroit" and "Cincinnati" class. The "Olympia," flagship of Admiral Dewey at the battle of Manila, was also fitted with ten of these guns, and in that memorable fight there were no less than twenty 5-inch rapid-fire guns engaged. All of our vessels of the new navy carrying 4 and 5-inch guns have their batteries of the rapid-fire type and are fully up to date in every feature, except that of smokeless powder, and this indispensable element of rapid-fire efficiency has now been adopted as standard and will soon be in exclusive use throughout the navy.

As showing the excellent results obtained at an early day of the development of rapid-fire guns we direct attention to the report of the Chief of Bureau of Ordnance for 1892, which says:

"The recently adopted breech-mechanism for rapid-fire guns of 4, 5, and 6-inch calibers has been put to a most thorough test with both good and defective ammunition. Four-inch gun No. 11 was fired 248 times. The breech-mechanism was worked about 8,000 times with tight-fitting cartridge cases. These cases had to be hammered into the gun, and were selected for the purpose of testing the extractor. There has been no failure in the action of any part. A test of rapidity of fire was made before the Chief of Bureau and bureau officers. Five rounds were fired in seventeen seconds, using experimental cases. Since then on two occasions five rounds have been fired in fourteen seconds. On the second trial the gun was laid at 10° elevation and all five projectiles were in the air together. Similar exhaustive trials have been held with the 5-inch rapid-fire mechanism. Five rounds have been fired in two instances in twenty-four seconds and twenty-two seconds respectively, without preliminary drill."

The 6-inch rapid-fire gun, with cartridge case, passed the development stage in the winter of 1894-95, since which time the 6-inch rapid-fire gun has become the standard of its caliber, and no more guns of the ordinary type are manufactured. Before the appearance of the 6-inch cartridge case as an article of commercial manufacture, Lieut. Dashiell endeavored to obtain rapid-fire results from a 6-inch gun by using a quick-acting mechanism with the De Bange gas check. By this means the gun-breech could be handled rapidly and considerable time saved in the service of the gun. As an example of what was done with a gun so fitted, attention is drawn to the same report of the Chief of Bureau of Ordnance for 1892, which says, in speaking of the experiments made that year with smokeless powder, "Besides the advantages of smokelessness and high velocities, the quality of leaving no dirt or fouling in the gun places at once the 6-inch gun with quick-acting mechanism among rapid-firing guns, even if using the service cartridge bag and the De Bange check and priming for each shot. As an example, before the Howell board, ten rounds were fired in two minutes and fifty-six seconds, sponging the chamber and wiping ou gast-checks after each round. The time for sponging was five seconds, for wiping out slope two seconds, or a loss of seven seconds due to the use of a



AMMUNITION HOISTS FOR SUPPLYING 4-INCH RAPID-FIRE GUNS ON THE MONITOR "PURITAN."

powder with a residue. There being nine intervals in the ten rounds, one minute and three seconds would have been saved had smokeless powder been used, or the ten shots would have been fired in one minute and fifty-three seconds, which is as good if not better than the record of any foreign 6-inch gun with projectile of 100 pounds weight." At the time of these tests a test was also made of a gun fitted with the slow-fire mechanism, the conditions of firing being precisely similar for each gun. The gun with the ordinary slow-fire service mechanism took five minutes and two seconds for the ten rounds.

These experiments are of great interest in that they show that the ordinary delivery of a 6-inch gun was more than doubled by application of quick-acting mechanism, even without the use of smokeless powder, and that this result was obtained as far back as 1892. In 1897, five years later, the Vickers Sons & Maxim Company, of England, produced a gun on the same principle—a quick-acting mechanism with the De Bange gas check and no cartridge cases—with which gun they obtained a rate of fire of from seven to eight rounds per minute. This shows that so far from our Naval Ordnance Bureau being behind in the development of rapid-fire ordnance, it was, so far as the principle is concerned, five years ahead of what may be considered the highest development of the 6-inch gun in Europe. As the Vickers gun uses smokeless powder, the results obtained were considerably ahead of those which we achieved at our proving ground in 1892, for the reasons which we have already quoted from the report of that year.

The good work of Lieut. Dashiell has been supplemented by the excellent designs of later date by Lieut. F. F. Fletcher, whose rapid-fire mechanism is illustrated on pages 13 and 15 of the Coast Defence number of the SCIENTIFIC AMERICAN SUPPLEMENT. In this mechanism the breech is unlocked, withdrawn, and traversed clear of the breech by a single sweep of the lever acting on a very compact worm and rack device. To the same gentleman the navy is indebted for the quick-acting breech mechanism applied to its heavy 12 and 13-inch guns. This is a modification of a worm and rack device invented by a Frenchman named Farcot in 1880. His invention was not successful, as it could never be operated by hand power, and it was the modification introduced by Fletcher that made it a success. With this device the 13-inch breech has been opened in 8¾ seconds, and the time between rounds has been reduced to 1 minute and 47 seconds.

In connection with Dashiell's early experiments with a 6-inch rapid fire mechanism, it is interesting to note that our government has lately purchased the rights to use and manufacture the Vickers breech mechanism for $200,000. With this improvement and the use of smokeless powder added, our rapid-fire guns will stand in the very front rank for speed and efficiency.

In regard to the ammunition supply, there is no question but what the United States navy ranks ahead of any other navy in the world in the success obtained in delivering ammunition to the battery, at least so far as the rapid-fire guns are concerned. There is, of course, much yet to be desired in the delivery of ammunition in turrets, but the recent invention of Lieut. Haeseler, U. S. N., and its application to the "Texas" has shown what can be done in this line; for the delivery of ammunition to the "Texas" guns has been increased about six times by the adoption of plans prepared by this officer. The delivery of rapid-fire ammunition to all calibers of rapid-fire guns out of turrets has been developed along the lines tending to simplicity and immunity from disaster from the enemy's fire, and it has now reached such a stage that ammunition can be delivered at the gun as rapidly as the gun can fire it. As a matter of fact, the ammunition supply may be said to be excessive, because the maximum rapidity of aimed gun fire is attained only in volleys for intervals of not greater than three minutes at a time; whereas the ammunition hoist runs steadily as long as it is fed from the bottom.

All the hoists are of the endless chain pattern shown in the accompanying illustrations of the hoists to the 4-inch rapid-fire guns on the monitor "Puritan." The hoists consist principally of a trunk (see Figs. 2 and 3), about 18 inches square for 6-inch ammunition and less for the smaller calibers, in which runs a pair of sprocket chains with cross bars between them at intervals. The arrangement is practically an endless ladder with rungs about seven feet apart. The bottom of the trunk opens into the magazine, and the chains travel over sprockets at the bottom of the hoist and at the top just below the deck. The chains are driven by an electric motor through a worm and worm-wheel. The ascending half of the hoist passes in front of the magazine door, and here the men in the magazine take the cartridges from the racks and place them, one at a time, on the rungs or steps, by which they are carried up to the gun. The speed of the chains varies from one to two feet per second, and the delivery of the charges is from six to eight per minute for the larger rapid-fire guns. In the 6-pounder hoists of the "Indiana," boxes containing eleven rounds of ammunition have been delivered at the rate of seventeen boxes per minute. The trunks are made of such a width that they can be traversed by a shot, and, unless the chain itself be cut, the burrs thrown up by such a shot will not interfere with the passage of the round of ammunition, The upper end of the hoist is made flush with the deck and is closed with a flush scuttle plate, thus making no obstruction whatever on the deck above. The trunk is also closed with a watertight door in the magazine (see Fig. 4). A number of pawls (A, A, Fig. 2) distributed along the central guide plate in the trunk prevent the ammunition from falling in case the chain be shot away.

So effective is the system that, by a judicious arrangement of ammunition hoists throughout a ship, her whole ammunition can be delivered on deck in thirty minutes. It is needless to say that the battery could not deliver it at the enemy in thirty minutes, as no gun could stand the ordeal of continued firing for this period.

The accompanying table shows the relative number of 4, 5, and 6-inch rapid and slow-fire guns on the ships that are built or approaching completion in our navy.

The table shows we have a total of 318 rapid-fire guns against 68 of the slow-fire type. The 6-inch slow-firers are to be found on gunboats, such as the "Yorktown,"

	Rapid-fire.			Slow-fire.
	6-inch.	5-inch.	4-inch.	6-inch.
Battleships	60	28	6	....
Monitors	....	....	10	....
Armored cruisers	....	12	12	....
Unarmored cruisers	18	74	16	46
Gunboats	....	....	82	22
	78	114	126	68

and cruisers, such as the "Philadelphia" and "Baltimore," that were built before the era of heavy rapid-fire weapon, and have some of them been continuously in commission for several years. The policy of the department is to replace these weapons with rapid-firers the first time that the exigencies of the service permits the ships to return to the navy yards. The 6-inch slow-firers on the "Texas" and on the three battleships of the "Indiana" type are now being replaced with rapid-firers, and it is probable that within the next twelve months the last slow-fire gun will have disappeared from the United States Navy.

The Current Supplement.

The current SUPPLEMENT, 1186, contains a number of papers of remarkable interest. "The Congo Railroad" is an illustrated article accompanied by a map which gives a detailed account of this great engineering work in the heart of Africa. "High Explosives and Smokeless Powder," by Hudson Maxim, is a very important paper by the great explosive expert. It is a paper which will be read with interest by all who are in any way interested in the ordnance of both the army and navy. The attention of our readers is called to the short notes which are given each week and which are also scattered through the paper. In the present number there are twenty-seven notes on a large variety of subjects. "Bull Fighting" is an article illustrated by engravings made from actual photographs in the bull-fighting ring. "Drinking Water at Camp Thomas" is a report of a sanitary engineer on the condition of Camp Thomas, Chickamauga, Ga. "The Significance of the Garment," by Alice C. Fletcher, is a paper read before the last meeting of the Association for the Advancement of Science. "Liquid Air" is a lecture delivered by Prof. G. F. Barker, of the University of Pennsylvania. This lecture has been revised by the author. The first installment is published in this week's issue of the SUPPLEMENT.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Mechanical Devices.

MOTOR CARRIAGE.—VICTOR ETIENNE PRETOT, Paris, France, has patented a motor carriage which he calls a fore-carriage. It is designed to be used in connection with any ordinary carriage in the same manner as horses. It consists of a very compact motor, operated by petroleum, and connected with the axle by an ingenious arrangement of differential gearing by which any desired speed and power may be applied. The mechanism for stopping, starting, and backing is simple and convenient.

TREAD-SANDING MACHINE.—GEORGE A. ENSIGN, Defiance, O. This invention relates to machines for truing and smoothing the treads of wooden vehicle wheels, and it is the object to provide a simple and durable machine for this purpose, which will enable the operator to perfectly smooth the tread of a wheel and render its peripheral surface square to the plane of the wheel. It consists principally of oppositely arranged abrading surfaces between which the tread to be acted upon is adapted to pass, and a revoluble standard for supporting and carrying the vehicle wheel and holding it between the two abrading surfaces.

JACK.—JOHN S. SCHLOSSER, Wadsworth, Ill. This jack is simple and durable in construction, easily applied, and conveniently manipulated. It is more especially designed for raising the felly from the spoke of the wheel to permit the insertion of a washer on the tenon of the spoke to insure a firm joint and to prevent the wheel from rattling. It is provided with a support adapted to be clamped to the spoke of the wheel. The support comprises a U-shaped member formed with sets of steps, the clamping member having a cam surface and pivot pins for engaging the steps. The jack is so simple in construction that it is not liable to get out of order and can be readily applied to any sized wheel for the purpose mentioned.

HAND DRILL.—JAMES MCSWEENY, Pittsfield, Mass. This invention is an appliance for regulating the feed of drilling apparatus, and is designed especially for hand drills. The drill spindle is threaded and carries a nut provided with a head by which the nut may be manually turned to hand feed the drill. Supported rigidly on the framing of the drill is a clamping device, by which the nut may be rendered fast with the frame, and, consequently, stationary with reference to the drill spindle. Then, as the spindle turns, the drill is fed with mechanical regularity by the action of the nut on the threads of the spindle. The several parts have such peculiar construction and are so combined that the device may be manipulated with ease and certainty.

VEHICLE-WHEEL.—JOSEPH BLAIS, Sherbrooke, Can. This invention relates to a vehicle-wheel, and has for its object means for tightening the tires on the rims of wheels. For this purpose a wheel with a double set of converging spokes is employed, by a novel mechanism. The inner ends of the spokes are moved toward and from each other, thereby increasing the diameter of the wheel at the rim.

AUTOMATIC FIRE-EXTINGUISHER FOR PASSENGER COACHES.—MAHLON MONROE WILLIAMS, Rico, Col. This invention provides a new fire extinguishing apparatus especially designed for use on passenger coaches. It is so arranged as to automatically extinguish the fire in the heaters, blow out the light in the lamps, or shut off the gas in the gas burners in case of a wreck or other accident, in order to prevent the coach from being set on fire. It includes a reservoir for compressed air for use in blowing out the lights and for forcing water into the fire boxes of the heaters, or shuts off the gas supply in case gas is used for illuminating purposes. Various means are provided for the automatic operation of the device in an emergency.

MACHINE FOR MANUFACTURING WELDLESS CHAINS.—JOSEPH MAYERS DAVIS, Glasgow, Scotland. This invention relates to a machine for the manufacture of weldless chains having open or unstayed links, with or without thickened ends, from a bar of cruciform section by a consecutive series of cold punchings and other operations. The bar of cruciform section is transferred into a series of unchained unstayed links, by being passed once through a machine actuating three sets of punches arranged to act at consecutive points. After the punching operation, which constitutes the initial stage of the manufacture, means are provided for bringing the links to a round section by stamping between dies and being compressed laterally to the desired form and dimensions.

ROCK-BREAKER AND ORE-CRUSHER.—FRANCIS H. COOK, Spokane, Wash. This new rock-breaker belongs to the class of machines for crushing ores in which an oscillating jaw is aranged opposite to the fixed jaw, the same forming two sides of a hopper. The movable jaw is actuated by an eccentric shaft. Adjustable crushing rolls are also provided to reduce the rock or ore to a fine state of division. The simplicity of the construction permits of a ready examinetion and cleaning of the parts.

APPARATUS FOR MIXING TEA.—In the old form of machine for this purpose, it has been usual to discharge the contents of the mixer through the charging aperture in the side of the drum into a receptacle below. To cause the contents to run out entirely, the drum is turned backward and forward several times to completely empty it. Mr. C. H. BARTLETT, Bristol, England, has patented a mixer in which these difficulties are avoided, and in which the teas are more thoroughly mixed. The mixing drum has a central discharge aperture and a chute connected therewith. After the mixing is done, the mixed tea is carried upward by the rotation of the drum and discharged upon the chute, through which it flows out of the machine.

Railway Appliances.

CONDENSING LOCOMOTIVE.—Two patents have been recently issued to THOMAS J. MURRAY, of Butte, Mont., for a compound locomotive, which condenses the exhaust steam, heats the feed water, and in which the fuel is kept dry. This locomotive is capable of making a very long run, owing to the economy gained in both water and fuel. The entire locomotive is housed to prevent waste of heat and to protect it against snow, rain, and dust. The parts of the main frame which slide one upon the other are provided with ball bearings. The forward truck carries the cylinders. The boiler has a closed fire box, and the air for supporting the fire after being heated is drawn through the burning fuel by an exhaust fan in the smoke box. The exhaust steam is delivered to a surface condenser in which it is condensed and returned to the water tanks. The feed water is heated to a very high temperature and admitted to the boiler by gravity after the pressure in the heater has been equalized by the admission of steam from the boiler. The engine has many novel features, which need to be explained at length to be clearly understood.

NUT-LOCK.—JOHN R. HORN, Camden, Ark. This spring nut-lock device is intended to automatically take up the slack caused by wear of the angle or fish plates and bolts and at the same time positively lock the nut and absolutely prevent backward rotation of the nut when in use, while at the same time it can be easily applied and removed. The device consists of a steel bar or rod, having approximately the form of the numeral 8, with its ends both free and bent outward from the plane of the body portion of such device, one of the ends being beveled on its inner side.

Agricultural.

VINE-TRIMMER.—GEORGE NORMAN JEUNE, Deer Wood, Minn. This new vine-trimmer is a machine especially designed for conveniently trimming strawberry or other vines or plants running close to the ground. It is arranged in a very simple manner to permit the user to conveniently move it over a field to cut up rooted as well as exposed vines. It comprises a shear or blade having a beveled, chiseled edge on the inclined forward end. The revoluble cutter is secured on one face of the shear or blade, and is operated in conjunction with the cutting edge at the top of the blade. Motion is transmitted to it from a wheel which is adapted to travel on the ground. The chiseled edge cuts the rooted vines, while the other vines are cut by the revolving cutter.

Miscellaneous.

MUTE CLAVIER.—LOUIS ILLMER, Jr., Washington, D. C. This invention is an improvement in mute claviers for piano practice for use in studying the piano. It consists of an exercising apparatus provided with keys and with a rocking sounding device having a detent which moves into engagement with the key when the latter is depressed. Means are provided whereby if one key is depressed too far before the previously depressed key is released, the first key will be held by a detent, and if a key be depressed and then released before a second key is depressed, the action will, as the first key moves upward, strike a bell and indicate to the