Above: The Lewis gun in the Egyptian campaign
Below: Extemporized mount for anti-aircraft work

Colonel I. N. Lewis, U.S.A.

Above: Lewis gun practice on board a battleship
Below: Stripped and mounted on a bombing plane

The Romance of Invention—VIII

The One-Man Machine Gun and Its Inventor

By C. H. Claudy

"If I can invent something which the Government wants and sell it in quantities, I can get rich on royalties."

There is nothing inherently wrong with such an attitude of mind. The Government must buy what it needs and expects to buy it at a profit. But there are some men who think that the devices they invent, which their government needs either in war or for purposes of war, should belong to it without thought of money or of price. There has been more than one example of such an attitude during the present war, but none more inspiring than that of the inventor of the Lewis gun, who refused to accept from his government royalties on the manufacture of this arm, and insisted upon a business arrangement by which more than one million dollars which was legally, rightfully and properly his share in royalties, was turned back to the treasury of the United States.

This is not to be a controversial article, nor to rake up the dead ashes of the fire which has blazed about the Lewis machine gun and the Ordnance Department since the memory of man runneth not to the contrary. The controversy has lost its point since the war, anyway, since other governments demonstrated what this one did not . . . that the Lewis machine gun is a practical, serviceable, German-killing mechanism, and, for its purposes, better, simpler, more easy to manufacture and operate than any other which saw service.

It must be a great satisfaction to Col. I. N. Lewis, U. S. A., retired, to know that his arm was responsible for killing more Germans than any other individual death-dealing device used on the battlefields of Europe. At the time of the armistice, more than a quarter of a million Lewis guns were functioning in France and Flanders. There were so many more Lewis guns in the British army than any other kind that British machine gunners were known as "Lewis gunners" regardless of the make of machine gun which they handled.

They were not only used on the ground, both as an offensive and a defensive weapon, but in the air; the Lewis gun was the first machine gun ever to be fired from an airplane, when Captain (now Colonel) Chandler of the Signal Corps took up a Lewis gun in a Wright machine and made fourteen hits out of fifty shots, at College Park, Md., in 1912.

The Lewis machine gun is undoubtedly the greatest contribution which Col. Lewis's inventive genius has given to the world, but it is by no means the only one.

He has been prolific of inventions, many of which are in use in the army today.

The list is a long one but among the many things he has conceived and wrought to a state of practical use are the first successful replottting and relocating system for coast batteries, a time-interval clock-and-bell system of signals, quick reading mechanical verniers used in coast defenses, the depression range finder (which determines range from coast gun stations by measuring the angle between object at sea and position elevated above the sea level, and which is more accurate in such determination than the gun is in hitting the object), a horizontal range and position finder, an automatic sight, a speed indicator for locomotives, a photographic time recorder, a self-regulating differential dynamo which puts out a steady current at varying speeds and loads, an automatic electric

even yet no chance for a final German win, with such statistics being rapidly translated into facts.

The Lewis gun—which is a development of the first "one man" gun of automatic firing mechanism ever conceived—is not, and should not be considered as, a competitor of other makes of guns with which it is frequently contrasted. One does not consider an infantryman's rifle as a "competitor" of a French .75, nor the pistol an officer carries as "competing" with a trench mortar.

There are three classes of automatic machine guns in general use. These are, the heavy, fired from a substantial tripod and used mainly for defensive purposes, belt fed and water cooled; the light automatic rifle, without any cooling system, gas operated and magazine fed, and similar in weight and portability to any other shoulder arm; and finally the intermediate type, which has more mobility than the heavy type, but possesses also a greater degree of durability and of accuracy than the light arm, and which can sustain continuous rapid fire for a considerable period.

The Lewis gun is of the intermediate type. It weighs twenty-six pounds and can thus go wherever infantry can go, carried by one man. In service two men are required, the second to carry and handle the magazines with the ammunition, but the gun is carried and operated by a single man. It is made of sixty-two separate parts, which can be assembled or dis-assembled with no other tool than the nose of one of its own bullets. It is, of course, built to interchangeability precision so that half a dozen guns can be dis-assembled, their parts piled in a heap and mixed, and six guns reassembled therefrom, each of which is a different gun from any which were taken down, yet each of which is as perfect and as good as any other Lewis gun.

The outstanding features of the gun which have made it recognized on the field as the preëminent light machine gun are its simplicity, its accuracy, its reliability and the fact that it is air-cooled. The heavy types of machine guns are, and must be, water cooled, but water is not only heavy to carry but not infrequently difficult if not impossible to obtain on the battle front. Guns without cooling systems get too hot to fire after a few minutes of rapid use. The air-cooled gun can fire two thousand rounds if necessary and still be in condition to be picked up in the hand.

This air cooling feature is accomplished by an outer

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It is certain that no one weapon did such signal execution in the war as the machine gun. Certainly, none so greatly dominated military tactics. Hence, particular interest attaches to the man after whom some 250,000 of these weapons on the fields of France and Flanders were named. As Maxim is the father of the machine gun, so Lewis is the father of the light machine gun. The story of his unsuccessful fight to introduce his great invention into the Army has well earned for him the title of "the stormy petrel of the Ordnance Bureau." Reluctantly, he carried his invention abroad, where he made good. He made good again when his own country, in the stress of the great war, called for his weapon; and he made lastingly good when he filled the orders and refused the one million dollars of royalties which was his due.—THE EDITOR.

cut-out switch, an automatic pole changer for dynamos, etc., etc.

Many of these devices are of sufficient interest to the public to deserve more extended mention, but none of them makes that popular appeal which is found in the light machine gun—the device which captured Jerusalem and which makes two men so armed the equal in killing power of twenty-five infantrymen. Had the war continued, the United States would have been able to put in the field some three hundred thousand machine guns a year . . . a third of these would have been Lewis guns and the other two-thirds Browning, Marlin, Vickers, Maxim, Schwarzlose, etc. Three hundred thousand guns, six hundred thousand gunners, would easily equal fifteen million infantry equipped with rifles, as far as killing power is concerned. Had everything else gone wrong, there was

future transportation problem of this important area of our country, but it would tend to relieve the congestion of the railways of the entire United States." This is not a fanciful assumption, because the figures show that the Mississippi basin contains 70 per cent of our farms, produces 76 per cent of our wheat, 72 per cent of our livestock, 85 per cent of our corn, 55 per cent of our wool, 70 per cent of our cotton, 4 per cent of our iron ore, 47 per cent of our lumber, 69 per cent of our petroleum, and 60 per cent of our bituminous coal.

The Romance of Invention—VIII

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jacket or casing inside of which is a radiator of aluminum fins. The barrel mouth-piece is so shaped that the gases of explosion, as they pass out of the gun barrel, exert a sucking action upon the air and cause a current of air (continuous in the case of continuous or automatic firing) to flow through the radiator, thus cooling off the gun. It is interesting to note in passing that the cooling system "pays for itself" not only in permitting sustained fire by carrying off the great heat developed, but by actually adding to the power of the gun. It has been found by test that bullets propelled through the barrel of a Lewis gun have a greater velocity than those projected by the same charge through the barrel of an uncooled gun of the same length, the reason being found in the fact that the draft of air prolongs the pressure of the gases upon the projectile. The gain is greater than the loss caused by diverting a small portion of the gases through a port in the barrel for the operation of the gun.

The Lewis gun is fed from magazines, not from belts. These are of steel and hold forty-seven rounds each, and can be changed with lightning-like rapidity. The gun itself has but nine moving parts. These are operated (in automatic firing) by diverting a small amount of the gases of explosion through a gas port four inches from the muzzle. This diverted gas-stream is led into a "regulator" where any sediment is deposited and finally into a cylinder where it impinges upon a piston, driving it back, winding up a spring. This spring operates the mechanism of the gun, revolving and stopping the magazine, moving the cartridge into firing position, ejecting the spent cartridge and firing the new one. It is the diverted gas from the second shot which winds up the spring ready to operate the gun for the third shot, and so on.

In passing it may be of interest to say a word about "jamming." Particularly in airplanes is the "jamming" of a machine gun dangerous, because there is so little time to rectify the trouble. Asked as to this matter Col. Lewis gave a very illuminating answer.

"All machine guns break, at times, and all machine guns jam," he said. "There was never a machine gun made of which some part would not break sometime if you used it long enough. The best machine gun, other things being equal, is that one which has its breaking point reached after the wear on the gun barrel has become so great that it is no longer of service. But a break, while it will cause a jam, is not by any means the only cause of a jam. A jam is the result of any cause within the gun which stops fire. In the vast majority of cases it comes from faulty ammunition, faulty either from error in manufacture or from damage done it before it went into the gun. If ammunition is too large or too small or bent or dented it may cause a jam, exactly as a faulty cartridge may jam in a single shot rifle. When you consider the extreme rapidity with which an automatic rifle may be fired, the wonder is not that it jams sometimes but that it doesn't jam more often than it does. It is never possible to jam a Lewis gun by a mistake in assembly because it is not possible to put a Lewis gun together wrong.

Machine gunners are taught to assemble a Lewis gun blindfolded, by the sense of touch, and no two parts are so alike that they can be mistaken the one for the other."

During his long career in the army, Col. Lewis demonstrated that it is possible to be an officer and an individual at the same time. On numberless occasions he has been summoned before Congress and interrogated as to conditions affecting the service, and his straight-from-the-shoulder answers, if they frequently shed needed light on the matters which required illumination, and eventually brought reforms, were frequently so vigorous and outspoken as to earn for him considerable animosity from those responsible for the conditions of which he spoke.

Born in 1858, graduated from West Point in 1884, and serving continuously as an officer of artillery until he retired in 1913, Col. Lewis has seen this country grow up, in a military sense, and has the satisfaction of knowing that "the stormy petrel of the Ordnance Bureau" as he has been called, has not beaten his wings against the bars of red tape and officialdom in vain. Many of his inventions (all presented to the government absolutely and without any question of any payment or any royalties) are in use today. It was his official report on the obsolete and inefficient ordnance equipment supplied the army in the Philippines, which drew the Secretary of War's attention to needed reforms there during the war with Spain. Col. Lewis must look with satisfaction on subsequent history, for it records the fact that when Root later brought the matter to the attention of Congress he turned to Col. Lewis for a plan for a modern corps organization of artillery, which plan with but few minor changes was adopted and became law.

It was because of a confidential report of an investigation Col. Lewis made abroad that a complete rearmament of the field artillery of the United States was effected, modern quick firing guns on long recoil cartridge being adopted.

In addition to his many honors, this inventor has received the Elliot Cresson gold medal for his contributions to small arm manufacture.

Col. Lewis has at times been a target for criticism because he took his gun abroad, and there established factories for it. There is no other answer needed than the following facts, which are indisputable and undisputed:

1. When he invented and perfected his gun, still in the service of the United States, he made repeated efforts to give it to the government, which would have none of it.

2. He took it abroad and demonstrated its efficiency and practicability only after his retirement from the army and only after he had given up hope of getting it adopted by the United States.

3. He never did wish it adopted by the United States because he desired to make money out of it . . . his many inventions, always given, never sold, to the government should be sufficient proof of this. But if not, the fact that, when the United States entered the war and began to order machine guns of all types, regardless of their previous adoption by the War Department, he turned back to the Treasury over a million dollars in royalties on his gun sold to the nation, certainly does prove it.

4. The use of hundreds of thousands of the Lewis gun on the battlefields of Europe, where it competed with the best guns of both American and European manufacture is sufficient proof of the value of the arm.

Col. Lewis's experience, which is by no means unique, may well be a sufficient groundwork for the question asked by many inventors, as to why the United States has no more encouragement to give to those Americans who evolve the new and useful improvements of pro-

RECENTLY PATENTED INVENTIONS

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longitudinally extending slot which gradually decreases in size towards the point, yet is of sufficient size to permit the thread to be passed through upon longitudinal movement into the bore of the needle.

DOOR BOLT.—E. BRADSHAW, 881 Ashby St., San Francisco, Cal. The invention has for its object to provide a device of the character specified for positively locking the door from the inside in such manner that it cannot be opened from the outside by boring or cutting the door, which is normally spring-held in operative position and which may be locked in operative position.

PIVOT HINGE.—J. Z. HANSON, 237 W. 13th St., Fort Worth, Texas. The invention relates to pivot hinges and associate parts used with lids and containers. The object is to provide a pivot hinge which may be easily operated for normally holding the lid of a can in place and permitting the easy movement thereof to one side so as to uncover the can. Another object is to provide a hinge which will, when operated, first raise the lid and then turn the same to an open position.

RIM TOOL.—H. RUSH, Chinook, Mont. The object of the invention is to provide a tool for straightening tire rims of automobiles which have become bent in use. The tool consists of a handle and a head, the head having a flat face to form a driving surface, and having in the face opposite the driving surface a slot forming upper and lower jaws, the lower jaw extending slightly beyond the upper to form a wedge to permit it to be driven beneath a bent rim edge.

JACK.—H. I. BENEDICT, 250 W. 55th St., New York, N. Y. A specific object of the invention is the provision of a jack in which the lifting element may be easily and quickly set to any desired position and then operated by a crank means for lifting the load, the lifting element being in the form of a rack with which meshes a worm wheel that is adapted to mesh with an operating worm, the worm wheel being shiftable into and out of engagement, so that the lifting element can be readily adjusted to any desired position.

INSERTIBLE SAW TOOTH.—A. M. CURRIER, 315 E. 3rd St., Aberdeen, Wash. The invention relates to a saw tooth adapted for circular saws, band saws, or shingle saws; its general object is to provide an insertible tooth and a holder therefor so formed and arranged relatively to each other and to the saw that the thrust exerted on the tooth when in operation is essentially absorbed by the blade, the holder is substantially relieved of the pressure on the tooth in sawing.

LINE CUTTING TOOL.—G. L. NICHOLS, Ravenswood, W. Va. The purpose of this invention is to provide a line cutting tool having cutting means which is operable automatically to cut a drill controlling line when the tool engages the drill, such means being normally inactive to prevent the accidental cutting of the line during manipulation of the tool to and from the drill.

Heating and Lighting

HEATER FOR OIL TANKS.—G. C. BOWEN, 901 W. 3rd St., Coffeyville, Kan. The invention has for its object to provide a simple, inexpensive, yet efficient device for heating oil tanks, consisting of a series of pipe sections connected with a heater, which will effectually

A SIDE VIEW OF THE DEVICE WITH PARTS BROKEN AWAY

and uniformly heat the oil and prevent freezing, and wherein the coils of pipe are rigidly supported, and wherein the heater will not interfere with the proper scrubbing of the tank.

GRATE.—T. PEARSON, 634 Midland Ave., Syracuse, N. Y. The object of the invention is to provide a grate arranged to permit of conveniently and quickly agitating burning fuel with a view to keep the same free from ashes and to insure complete combustion. Another object is to permit of readily crushing any clinkers without violently disturbing the burning fuel. Another object is to permit convenient dumping of the burning fuel whenever it is desired to do so.

HEATING FURNACE.—A. H. PARKER, 33 William St., Montclair, N. J. The invention

relates to a heating furnace in which gas is employed for the fuel. A specific object is the proviso of a heating furnace which embodies a plurality of heating units independently controlled which are supplied from a common cold air box and which have individual hot air ducts leading to different parts of the building, so that heating of the various rooms or floors can be regulated as required.

AUXILIARY STOVE LID.—E. S. GREEN, 36 Lafayette Ave., Trenton, N. J. An object of the invention is to provide an attachment for cook stoves and more particularly relates to an elongated lid adapted to be temporarily placed on the stove over the fire box, when the temporary lids and cross plate are removed, said auxiliary lid having means whereby it may be adjusted to variously position the hole either at the center or at either end of the fire box according to where the hot area in the fire box may be located.

Machines and Mechanical Devices

CENTRIFUGAL CASTING MACHINE.—P. L. GILL, 1133 Broadway, N. Y. The object of this invention is to provide a centrifugal casting machine especially designed for casting annular or cylindrical articles of considerable length and arranged to insure a quick delivery into and a proper distribution of the molten metal within the casting box to prevent undue chilling of the metal and the formation of flaws. Another object is to permit of making castings in which the cross sectional area is equal to or greater than the area of the inside diameter of the casting.

AUTOMATIC FEEDER.—M. PORTZSCH, 72 Grove St., Passaic, N. J. The invention relates particularly to an automatic feeder for various kinds of machines as for instance drying, tentering, selva neutralizing and carbonizing machines. The object is to provide a feed which will cause an automatic adjustment of the various parts whereby the cloth as it enters the machine will properly engage the pins or other engaging members so that the cloth will be stretched, dried and otherwise operated upon without any action on the part of an operator.

CIRCUIT-CLOSING DEVICE FOR LIQUID-LEVEL GAGES.—L. G. LE COMPTE, 2824 25th Ave., Oakland, Cal. In general this invention relates to liquid level gages, but more particularly to that portion directly actuated by the level of fluids, for completing a circuit upon either the rise or fall of the fluid in order to in turn actuate devices at a distant point whereby to register such rise and fall.

Musical Devices

SOUND RECORD.—J. ROBSON, 39 Main St., Moose Jaw, Saskatchewan, Can. The invention relates to phonographs and similar sound reproducing machines using records having sound grooves for engaging with the stylus of the sound box. The object is to provide a covering for such records arranged to protect the records against dust, injurious deposits and other extraneous matter, and to permit using the record in the machine without requiring removal of the covering. Another object is to return the tone arm and the stylus to starting position without requiring stopping of the phonograph.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—P. A. LAWRENCE, 421 E. 8th St., Benson, Neb. The object of the invention is to provide an engine which utilizes the principle of injection of oil under high pressure against air under high pressure, the air being provided by the engine itself during part of its compression stroke. The invention also contemplates the use of an auxiliary air tank supplied with compressed air by the engine during the period when the engine is being stopped.

Designs

DESIGN FOR A PLATE AND THE LIKE.—S. and J. BUTT, 982 Union Ave., Bronx, New York, N. Y.

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cesses and machinery which give this country the name of being the most inventive of them all. The question may well be asked whether this country is not as much in need of a Department of Invention as its existing departments are in need of a housecleaning directed against red tape?

The Exploring Rocket

(Continued from page 161)

rocket continues to get impulse from its exploding charge even in complete vacuo. He has made repeated and careful experiments to demonstrate this, and it stands demonstrated. Accordingly the impression which existed in some quarters that his rocket would fail as soon as it reached an atmosphere sufficiently rare is an erroneous one. It does not get reaction from the air, but from its own mass.

In conformance with the purposes which impelled him to make this investigation, Dr. Goddard has so designed his rocket that it can carry a camera or some other instrument of observation and record, together with a gyroscope to keep this instrument properly oriented, if this be necessary. In the SCIENTIFIC AMERICAN MONTHLY for February will be found a long article in which Dr. Goddard's experiments are set forth in considerable detail, and a number of his models are illustrated. In the present place we have space only for this brief presentation of the fundamental features of the undertaking. That this will be a successful one, and that by means of the parachute to be attached to his rocket Dr. Goddard, the first time he sends this little messenger aloft, will recover data of much meteorological value, seems hardly open to question. But he will not shoot at the moon—somebody else will have to do that for him.

From Coal Barge To Bunker

(Continued from page 163)

of the endless chain is effected by a drum at the top. This, in turn, is driven by gears so related that ten rotations of the driving shaft are required to effect a complete turn of the drum. The gear connections with the crank-shaft of the engine may have any ratio desired. About the time the "Herald" went into service, this ratio was eight to one and resulted in the bucket movement being carried on at the rate of 65 feet per minute. The engine was a small, direct-acting, double-cylinder steam engine, the cylinders having the size of 7 x 10 inches. It seems that but little power is actually required to drive the elevator and hoist the coal.

Some steamships of the London & North-Western Railway have bunkers arranged on the side. Such bunkers may often be served by the elevators by means of chutes arranged transversely on the coal barge. The elevator delivers to the chute and the coal slides down the chute into the bunker. But a different supplementary device will at times be desirable. A specially designed conveyor may be employed to receive coal from the endless chain of buckets and transfer it to the ship's bunker. Such a conveyor is of advantage when the coal is to be delivered through apertures in the vessel's deck. It is provided with a supporting carriage similar to the carriage used with the elevator. It is possible to elevate the conveyor until it attains an angle of 18 degrees with the horizontal or depress it to 30 degrees below the horizontal. Further, it may be revolved through a complete circle and may be shifted lengthwise of the barge.

The "Herald" has a speed of 5 knots (6 miles per hour). The crew required consists of seven men—master, engineer, assistant engineer, fireman, and three deck hands. This crew is sufficient to attend to all matters connected with navigating the barge and operating her handling equipment. The elevators have a capacity of 100 tons each per hour. Thus a barge might be provided with five elevators and have her hourly-discharge ca-

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