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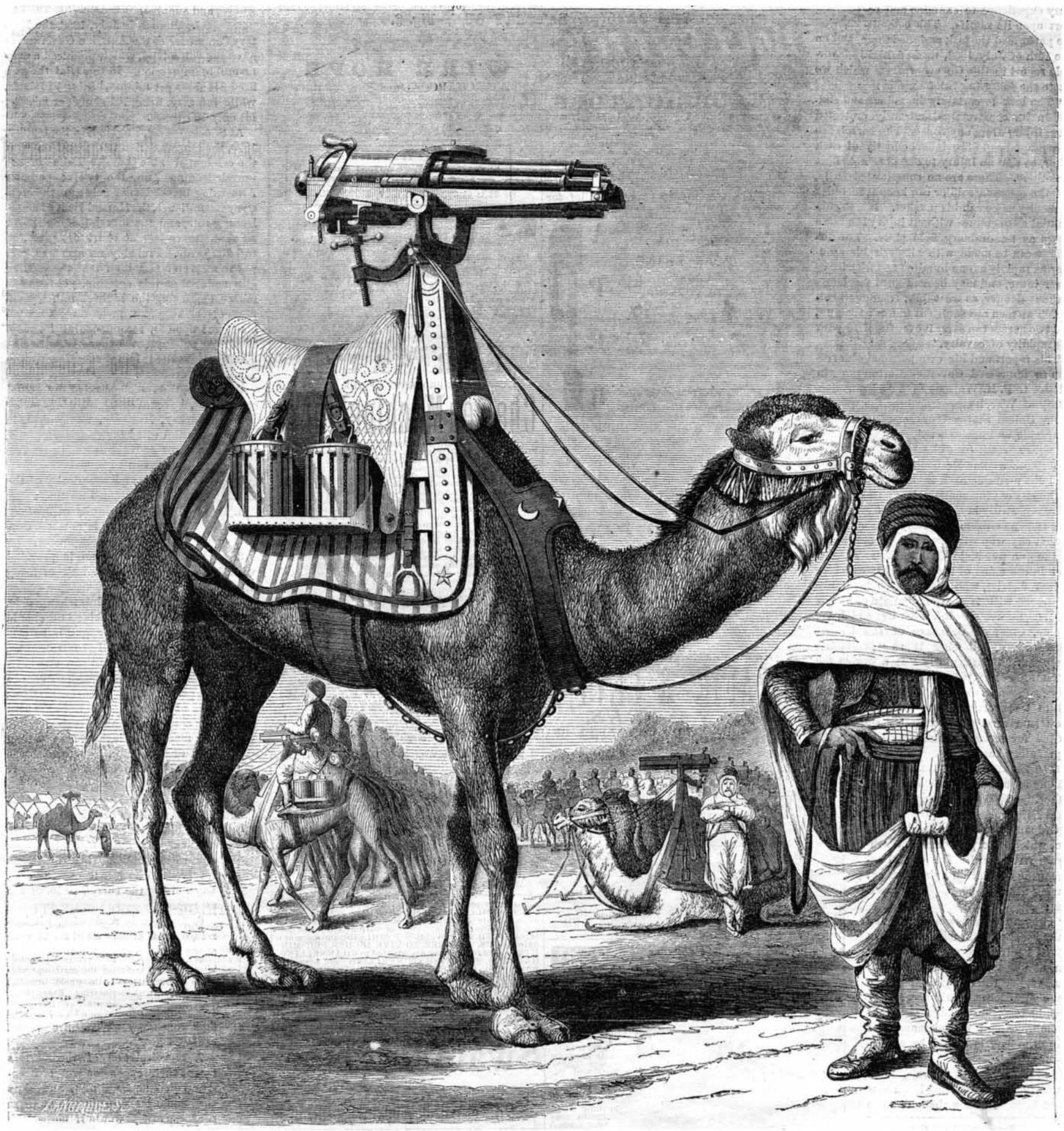
THE GATLING SYSTEM OF FIREARMS.

Probably the most destructive field weapons, ever yet devised by man, are those illustrated in the accompanying engravings. In saying this, we are perfectly aware that we make a very strong statement. No class of invention has absorbed more thought and study than that of military engineering. "How to kill" most effectively has been a problem, to the solution of which the finest mechanical genius, aided by all the discoveries of science, has been applied for ages. It is indeed sad to reflect upon the apparent necessity for improvements in the means by which wholesale slaughter is to be perpetrated; but one consolation may be drawn from the consideration that the more destructive weapons can be made the less is the probability that nations will seek to settle their controversies by the stern arbitrament of blood, and the sooner will come the happy era when a better and wiser method for the adjustment of differences will be adopted.

A peculiar merit of Mr. Gatling's invention is the facility with which it may be adapted to the exigencies of field warfare in various parts of the world. The engravings illustrate several such applications, the largest exhibiting the way in which it may be used on the backs of camels, in India or other oriental regions where the absence of good roads and the peculiar features of the country render these animals most serviceable both for attack and defence.

We think it safe to say that one of these guns, mounted upon the back of a camel, as shown in our engraving, or carried by an elephant would be, in some situations, an efficient substitute for a regiment of men armed and equipped in the best modern style of infantry practice. Figs. 2, 3, and 4 represent respectively the battery gun mounted on a horse with ammunition, etc., the gun as it appears mounted on a tripod ready for service, and, lastly, the gun with its tripod folded and carried on the shoulders of two men, whileothers carry the supply of ammunition.



THE GATLING BATTERY GUN.—Fig. 1.

For a description of this gun, we avail ourselves of an excellent and exhaustive essay upon the subject, which we find in the "Science Record," for 1872*, from which we shall make such extracts as suit our present purposes.

HISTORY OF THE GUN.

The inventor of this wonderful arm is Dr. Richard J. Gatling, at the time of its discovery a resident of the city of Indianapolis, in the State of Indiana, but now of Hartford, Conn. He first conceived the idea of a machine gun in 1861, and is justly entitled to the proud distinction of being the originator of the first successful weapon of the kind ever invented. His first "battery" or gun was completed in that city in the early part of the year 1862, and his first American patent bears date November 4th of the same year. The gun was fired repeatedly during that year in Indianapolis, in the presence of hundreds and thousands of persons, over two hundred times a minute, and its performance was regarded by military men as so satisfactory that the Governor of that State, Hon. N. P. Morton—now United States Senator—appointed a committee of gentlemen of high standing and military experience to examine and report upon its merits. The committee performed the task assigned them, and on the 14th of July, 1862, made a highly favorable report to the Governor, from which we quote the following brief extract:

"The lock is certainly ingenious and simple in its construction, and fully protected from injury from any cause. The barrels are so arranged as to fire independently of each other, so that an injury to one does not affect the others. There are no complicated parts, and the common soldier can keep it in order as readily as he can his musket. It is so substantial as to endure without injury the same usage as an ordinary field piece. The discharge can be made with all desirable accuracy as rapidly as one hundred and fifty times per minute, and may be continued for hours without danger, as we think, from overheating. Two men are sufficient to work the gun, and two horses can carry it over the field with the rapidity of cavalry."

This report and his own personal observation so impressed Governor Morton that, in a letter to P. H. Watson, Esq., Assistant Secretary of War, he recommended the weapon to the United States War Department as a "valuable and useful arm."

MANUFACTURE OF GUNS IN CINCINNATI.

In the meantime Dr. Gatling had twelve of his guns manufactured in an establishment in the city of Cincinnati, Ohio, and fired them there repeatedly in the presence of army officers and the citizens generally. Among those in that city who witnessed the performances of the gun was Major-General H. G. Wright, then in command of the United States forces in that district, who also was so favorably impressed with it that, under date of March 11, 1863, he wrote to Brigadier-General J. W. Ripley, Chief of Ordnance of the United States army, indorsing it as "possessing much merit," particularly "as a device for obtaining a heavy fire of small arms with very few men; it seems to me admirably adapted to transport steamers plying upon the Western rivers, where infantry squads are needed for security against guerilla and other predatory bands.

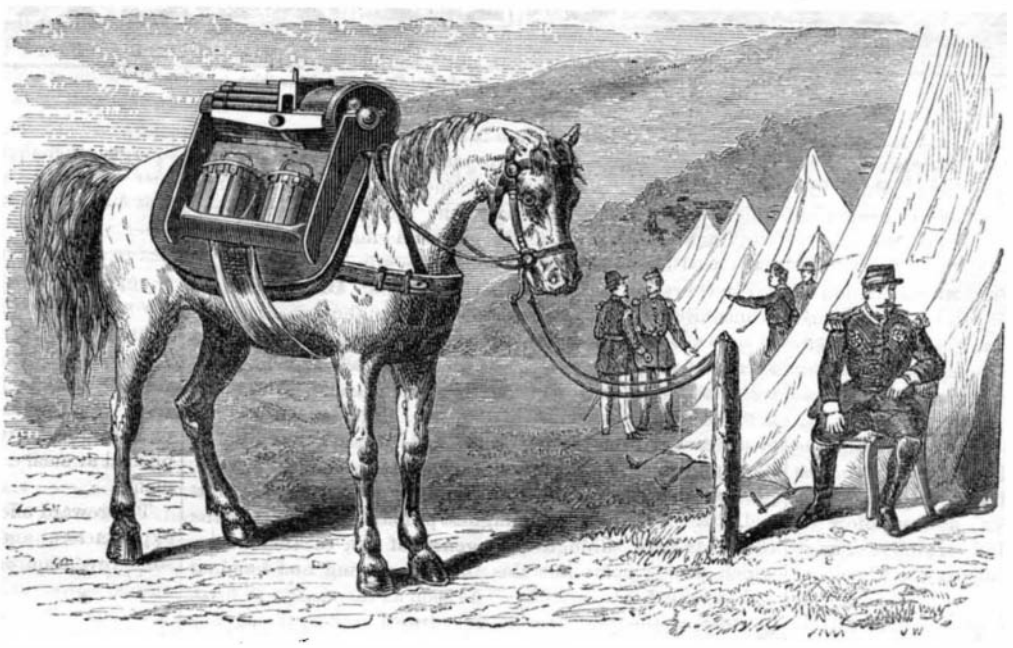
TRIALS BY THE U. S. GOVERNMENT.

Thus brought to the notice of the authorities in Washington, Rear Admiral Dahlgren, Chief of the Bureau of Ordnance, ordered a trial of the gun, which took place in the Washington navy yard. The official report made to him on this occasion, bearing date May 20, 1863, concluded thus:

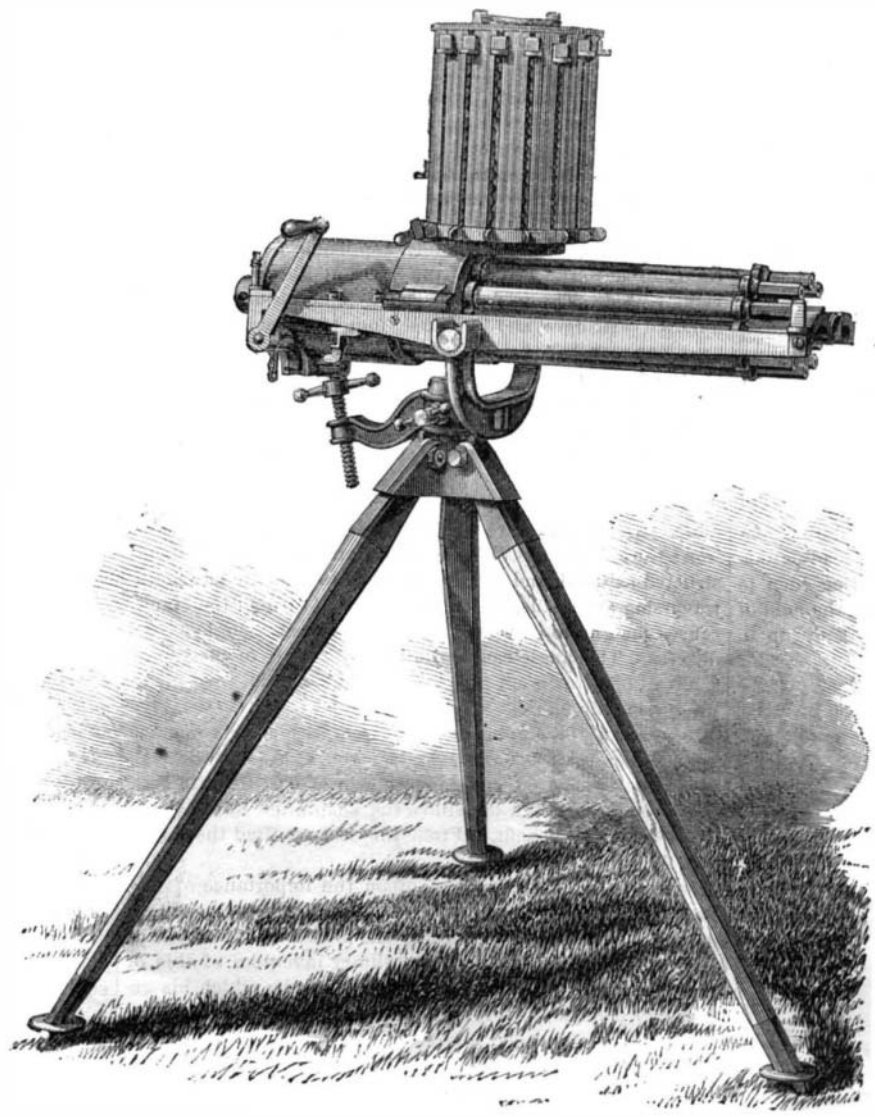
"The gun or battery has stood the limited test given it admirably; has proved itself to be a very effective arm at short range; is well constructed, and calculated to stand the usage to which it would necessarily be subjected. It is suggested that an improvement in the manner of rifling the barrels would be advantageous."

In accordance with the suggestion of this report, Dr. Gatling had a new set of barrels, with a change in the rifling, made and put in the gun; and it was on the 17th of July, 1863, again fired at the Washington navy yard, in the presence of a number of officers. The official report of this trial states that "the penetration of the Gatling battery was equal to that of the Springfield musket;" that the gun in its "mechanical construction is very simple, the workmanship well executed, and we are of the opinion that it is not liable to get out of working order."

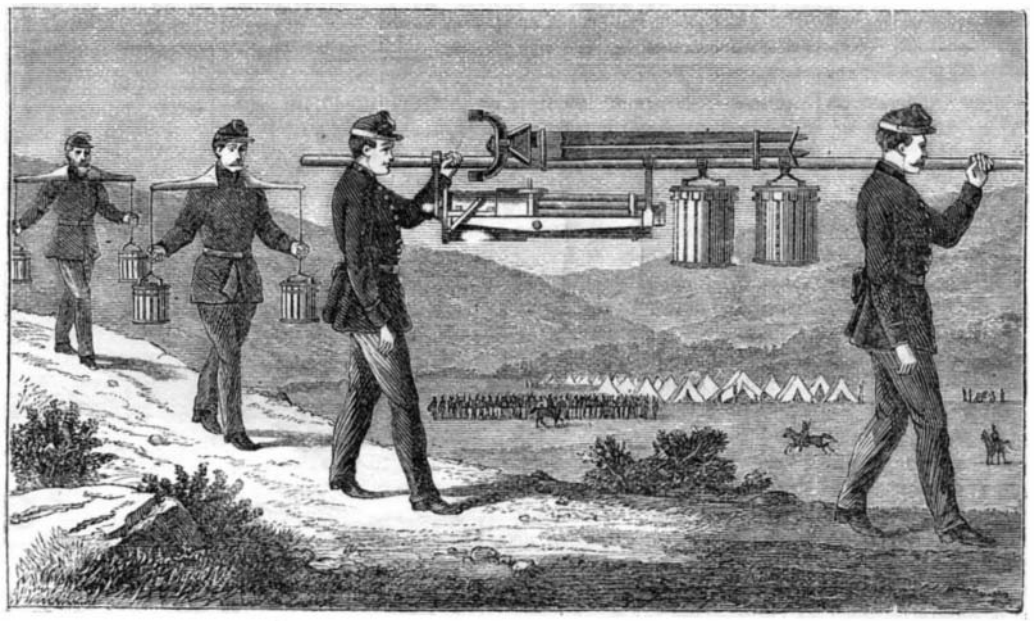
These trials were so satisfactory to Admiral Dahlgren that he gave permission to commanders of fleets and squadrons to order what guns they might think proper for the service: but few guns were then furnished, however, owing to Dr Gatling's inability to make them in quantities, and want of time to see naval officers and impress upon them their value and true character. But some of them did get into service before the close of the American war, and were used effectively in repelling rebel attacks upon the Union forces under command of General Butler, near Richmond, Va.



THE GATLING BATTERY GUN.—Fig. 2.



THE GATLING BATTERY GUN.—Fig, 3.



THE GATLING BATTERY GUN.—Fig. 4.

VARIOUS OTHER TRIALS AND REPORTS.

Trials in France, in 1867, proved the superiority of the gun over the famous mitrailleuse, but the Emperor claiming the latter as his own, refused to recognize the merits of the American arm so far as to supersede the mitrailleuse by it.

The gun was thoroughly tried by the United States Ordnance Bureau, in 1865, favorably reported upon, and adopted.

In Vienna, in July, 1868, the Military Committee of the Austrian Government gave the gun a trial, which produced a very favorable impression. In this trial the gun fired 246 shots per minute, hitting 216 times, while infantry, firing 721 shots per minute, hit only 196 times.

At Shoeburyness, England, in September, 1870, the gun was tried in comparison with the celebrated nine pounder India bronze muzzle-loading gun, the twelve pounder Armstrong breech-loader field gun, the Montigny mitrailleuse, the Martini-Henry breech-loading rifle, and the breech-loading Snider rifle; the three last at short distances, up to 1,200 yards. Probably no arm was ever put to a severer test than that the Gatling gun endured on this occasion, yet the committee, embracing the highest military experts of the kingdom, made a most favorable report upon it, recommending its adoption. A subsequent exhaustive trial at Woolwich resulted in its adoption by the British Government.

Its merits, thus demonstrated by actual experiment, have secured its adoption by Russia, Turkey, Hungary, and Egypt, in addition to the United States and England.

MAIN FEATURES AND SUPERIORITY OF THE GATLING GUN.

The main features and superiority of the Gatling gun may be summed up thus:

1. Its rapidity and continuity of fire.

2. Its simplicity—there is nothing complex about the gun.

3. Each barrel in the gun is provided with its own independent lock or firing mechanism.

4. These locks are made interchangeable, and are strong and durable; but should they get out of order, the gun is so constructed that any one or all of them can be, in a few moments, taken out and others inserted in their places, and so the gun can be kept in perfect working order at all times on the field of battle. It will not be denied that this is a feature of the greatest value, s the lock mechanism is the most essential part of a machine gun, and is the only part liable to get out of order from use.

5. All the locks revolve simultaneously with the barrels, carrier, and inner breech, when the gun is in operation. The locks also have a reciprocating motion when the gun is revolved. The gun cannot be fired when either the barrels or locks are at rest.

6. The gun is made of single barrels, open at muzzle and breech, with space between them for the free circulation of air and radiation of heat, thus preventing to a great extent that heating and fouling of the barrels which, otherwise, the rapidity and continuity of its fire would cause.

7. The isolation of the barrels makes their expansion and contraction equal and uniform, and thus they suffer no distortion from these causes, as they would if massed together.

8. The barrels are open from end

*Science Record for 1872. A Compendium of Scientific Progress and Discovery during the Past Year. New York. Munn & Co.: Office of the Scientific American, 37 Park Row.

to end, and can easily be kept clean by the use of a swab or wiper.

9. The cartridges are loaded directly into the rear ends of the barrels; thus all leakage of gas at the breech is prevented.

10. The gun fires a shot at a time in rapid succession, and thus, by dividing the time used in rapid firing into equal parts between the discharges, and preventing an accumulation of recoil, it admits of larger charges, heavier balls, and consequently greater range.

11. This peculiarity of no recoil is of special value in the defenses of bridges, fords, mountain passes, etc., which are frequently attempted during darkness, fog, or storm, as also in the smoke of battle, when the movement of the enemy cannot be accurately observed.

12. Firing a shot at a time also allows a lateral motion of the gun to be kept up during the time of firing, which result is attained in the Broadwell carriage upon which it is mounted, or by the Kinne attachment to the carriage manufactured at Colt's armory, Hartford, Conn., by which the gun is traversed automatically.

13. No resighting and relaying are necessary between the discharges. When the gun is once sighted, its carriage does not move but at the will of the operator, and the gun can be moved laterally when firing is going on, as heretofore remarked, so as to sweep the sector of a circle of twelve or more degrees without moving the trail or changing the wheels of the carriage.

14. The continuous firing, a shot at a time, avoids all deflections of the balls.

15. As musketry fire, the small Gatling can be trained with far more accuracy and delicacy than small arms from the shoulders, and has no nerves to be disturbed in the din, confusion, and carnage of the battle field, nor will the smoke of battle prevent its precision.

16. It requires fewer horses and men to serve it. The weight of the small Gatling is only three hundredweight, of the medium, five hundredweight, and of the largest sized, six hundredweight. Two men serve the first, and from five to seven men the last two. A still smaller sized gun, weighing only one hundred and twenty-five pounds, has recently been constructed at Colt's armory under the supervision of Dr. Gatling, a full description of which is given hereafter.

17. Its great economy, not only in men and horses, but in ammunition.

18. The great safety in the transportation of this ammunition. The cartridge cases or shells for the larger Gatling guns are constructed of sheet metal which is $\frac{15}{100}$ of an inch thick; the heads are made solid, and solder is used in their bases. These shells can be reloaded and fired from fifty to one hundred times. They are also waterproof, strong enough to stand all usage incident to the service, and are safer in transportation, are of less weight, and occupy less space, thus requiring fewer men and horses, for their transportation and service, than artillery ammunition. By carrying loading machines, with extra balls and powder, and detailing men to reload the shells after they have been fired on the field of battle, a supply of ammunition can always be kept up in time of action.

19. The operation of loading is greatly simplified. There is no need of sponging, capping, priming, adjusting of fuses, cocking, etc. All that is required is to supply the hopper with the cartridges and to turn the crank, when a continuous stream of balls can be discharged.

20. The flanges of the cartridges have square faces in front, which enable the shells to be easily extracted from the chambers of the barrels, after they have been fired, by the improved extractors with which the locks are now made.

21. The great range of the large gun, equal for all practical purposes to that of the field gun, and greater, in accuracy and precision, given to it from the use of the elongated leaden bullet, which has great specific gravity and small air resistance.

22. The projectiles of the large gun may be either solid shot, shell, or canister, like those of field artillery.

23. The balls of the Gatling gun ricochet for a greater distance than the shells or missiles of the field piece.

24. The feeding drums and feed cases of the gun can all be used with any gun of the same calibre.

25. The working parts of the guns are encased in the breech covering so as to be entirely protected from dust and bad weather.

26. The largest sized gun, with a range of from two thousand to three thousand yards, can be taken apart, packed on mules, carried across mountains, and on its arrival at its destination can be reassembled in a few minutes.

DESCRIPTION OF THE GATLING GUN.

The gun consists of a series of barrels in combination with a grooved carrier and lock cylinder. All these several parts are rigidly secured upon a main shaft. There are as many grooves in the carrier and as many holes in the lock cylinder as there are barrels. Each barrel is furnished with one lock, so that a gun with ten barrels has ten locks. The locks work in the slots formed in the lock cylinder, parallel to the axes of the barrels. The lock cylinder, which contains the locks, is surrounded by a casing which is fastened to a frame, to which trunnions are attached. There is a partition in the casing, through which there is an opening, and into which the main shaft, which carries the lock cylinder, carrier, and barrels, is journaled. The main shaft is also, at its front end, journaled in the front part of the frame.

In front of the partition, in the casing, is placed a cam provided with screw surfaces. This cam is rigidly fastened to the casing, and is used to impart a reciprocating motion to the locks when the gun is revolved. There is also, in the front part of the casing, a cocking ring, which surrounds the lock cylinder, is attached to the casing, and has on its rear surface an inclined plane with an abrupt shoulder. This ring and its projection are used for cocking and firing the gun. This ring, the spiral cam, and the locks make up the loading and firing mechanism.

On the rear end of the main shaft, in the rear of the partition in the casing, is located a gear wheel, which works to a pinion on the crank shaft. The rear of the casing is closed by the cascable plate. There is hinged to the frame in front of the breech casing a curved plate, covering partially the grooved carrier, in which is formed an opening through which the cartridges are fed to the gun from feed drums. The frame which supports the gun is mounted upon the carriage used for the transportation of the gun.

The operation of the gun is very simple. One of the feed drums filled with cartridges is placed upon the gun, as shown in the engraving; a man then turns the crank, which, by the agency of the gearing, revolves the main shaft, carrying with it the lock cylinder, carrier, barrels, and locks. As the gun is revolved, the cartridges, one by one, drop into the grooves of the carrier from the feed cases, and instantly the lock, by its impingement on the spiral cam surfaces, moves forward, pushes the cartridge into the chamber, and, when the butt end of the lock gets on the highest projection of the cam, the charge is fired, through the agency of the cocking device which at this point liberates the lock, spring, and hammer and explodes the cartridge. As soon as the charge is fired, the lock, as the gun is revolved, is drawn back by the agency of the screw surface in the cam acting on a lug of the lock, bringing with it the shell of the cartridge after it has been fired, which is dropped on the ground. Thus, it will be seen, when the gun is revolved, the locks in rapid succession move forward to load and fire, and return to extract the cartridge shells. In other words, the whole operation of loading, closing the breech, discharging, and expelling the empty cartridge shells is conducted while the barrels are kept in continuous revolving movement. It must be borne in mind that while the locks revolve with the barrels, they have also, in their line of travel, a spiral reciprocating movement; that is, each lock revolves once and moves forward and back, at each revolution of the gun.

The feed drum has been lately applied to the gun by Mr. L. W. Broadwell. It takes the place of the feed cases previously used. The feed drum is a cylinder, containing four hundred cartridges, and by its use, four hundred shots can be fired, one man only being required to work the gun—that is, to attend to the feed and turn the crank—and all of these shots can be fired in one minute. The ammunition is carried in the drums, and as soon as one is emptied, it is removed and replaced by a full one, the change only requiring a few seconds.

The carriages for the gun which are represented in the plates are manufactured in Europe of wrought and cast iron; those made at Colt's armory, Hartford, Conn., are constructed of wood, and there is attached to them an automatic traversing apparatus, which, by the act of turning the crank, causes the gun to traverse through a maximum angle of six degrees. This angle can be diminished at will, or the apparatus can be thrown out of gear in an instant, and the gun be fired in one direction.

The use of these guns in connection with camels was, we believe, suggested by Col. H. H. Maxwell, R. A., Superintendent of the Cossipore Gun Foundery, whose experience in East India warfare led him to believe the adaptation would prove of the greatest benefit. From this has resulted the camel gun illustrated herewith.

It is needless for us to dwell upon the importance of this gun. All future warfare will be modified by it to an extent difficult to foretell. Mr. Gatling has placed his name on historic record with the greatest military inventors of this or any previous age, and has achieved a success which his genius and persistent effort well merit.

Mr. Gatling's present address is at Colt's Foundery, Hartford, Conn., where the guns are manufactured.

Steam on the New York Canals.

Last year the Legislature of the State of New York offered a reward of one hundred thousand dollars for the best plan for canal boat navigation by power. But as yet no person has produced the right sort of a plan, and the reward is still open for competitors.

The State Auditor, in a recent report, says:

The Legislature of 1871 passed an act entitled "An act to foster and develop the internal commerce of the State, by inviting and rewarding the practical and profitable introduction, upon the canals, of steam, caloric, electricity, or any motor other than animal power, for the propulsion of boats;" and appropriated for that object the sum of $100,000, to be paid to the owners of the successful plans, not exceeding three in number, which might be submitted for trial, and tested and approved by the commissioners appointed under the act. The act further provides that the commissioners shall demand and require:

First—The inventions and devices to be tested and tried at the proper cost and charges of the parties offering the same for trial.

Second—That the boat shall, in addition to the weight of the machinery, and fuel reasonably necessary for the propulsion of said boat, be enabled to transport, and shall actually transport on the Erie canal, on a test or trial exhibition, under the rules and regulations now governing the boats navigating the canals, at least two hundred tuns of cargo.

Third—That the rate of speed, made by said boat, shall not be less than an average of three miles per hour, without injury to the canals or their structures.

Fourth—That the boat can be readily and easily stopped or backed by the use and power of its own machinery.

Fifth—That the simplicity, economy, and durability of the invention or device must be elements of its worth and usefulness.

Sixth—That the invention, device, or improvement can be readily adapted to the present boats; and, lastly, that the commissioners shall be fully satisfied that the invention or device will lessen the cost of canal transportation, and increase the capacity of the canals. A means of propulsion or towage, other than by a direct application of power upon the boat, which does not interfere in any manner with the present method of towage on the canals, and complying in all other respects with the provisions of the act, may be entitled to the benefits thereof; but this shall not be construed to apply to the system known as the Belgian system, or to any mode of propulsion by steam engines or otherwise, upon either bank of the canals.

Previous to the passage of this act, steam had repeatedly been introduced, by way of experiment, on the Erie and Oswego canals, resulting in a speed of three miles per hour with cargoes of two hundred tuns, but it was only accomplished at such a cost as to preclude its profitable employment.

The reward offered by the State has induced a renewal of experiments, and it is to be hoped that it will result in some invention or device by which some motor other than animal power may be found practicable in the propulsion of boats upon the canals. As yet, the reward has not secured that object. It is believed, however, that it has caused an agitation upon the subject, which will, sooner or later, result in success.

While it would be very desirable to apply steam as a motor to the form of boats now in use, it is deemed by many to be impracticable with the canals at their present dimensions. The paddle wheel and the screw, since the introduction of steam as a motive power, have been the only methods successfully employed in the propulsion of vessels. It is claimed that, with a good propeller wheel working under the most favorable circumstances, as in the open sea, the loss of power amounts to from forty-five to fifty-five percent; but employed in the canals, the loss rises to seventy and even eighty per cent. If this be true, engines out of all proportion to the work to be accomplished would have to be employed, and hence unprofitable when brought into competition with animal towage.

The employment of tugs might, to a certain extent, be attended with success, but the loss of power adds correspondingly to the cost, which may in a measure be compensated by an increased speed. This method of towage has at different periods been introduced, and the fact of its early abandonment leads to the conviction that it is unprofitable.

It has been suggested that a railroad might be constructed on each side of the canal, and the boats drawn by locomotives. This plan has many advocates, but it is urged against it that the great outlay required to introduce this method renders its adoption impracticable.

The Honorable W. H McAlpine, late engineer and surveyor of this State, in a recent letter from Europe, where he is at present sojourning, mentions a method employed in Europe, and known as the Belgian system, which he had witnessed and believes to be just what is needed on our canals.

This system to which Mr. McAlpine alludes was exhibited on the Erie canal, between Albany and West Troy, previous to the close of the navigable season of 1871. Its operation was witnessed by the State officers and distinguished citizens from different parts of the State.

The system apparatus employed may briefly be described as follows: A wire cable is laid on the bottom of the canal, passing through intervening locks, and fastened at the two extreme ends; and a steam tug or tow boat provided with an engine to which is attached a clip drum, or grooved driving wheel, with suitable guiding and tightening pulleys. The boats to be towed are made fast to the tug, and the process of towing is performed by lifting the cable from the bottom of the canal by means of a grapple, and placing it over the clip drum and under the tightening or press pulleys. The clip drum is then put in motion (turned) by the machinery in the tug, causing the cable to pass over it and fall back again into the canal at the stern of the tug. Thus the tug is drawn along the cable with the same facility as a locomotive is drawn on the rails, though there is no slipping as in the case of the locomotive. All the power of the engine is directly employed in the propulsion of the tug.

It is claimed by the advocates of the system that its general introduction would be attended with complete success in diminishing the time of trips, the cost of transportation, and increasing the capacity of the canals.

This plan of towage appears to have been excluded from competing for the reward offered by the State. No good reason is seen for the exclusion of this or any other apparently practicable system from the benefits of the act. The policy of the act is the encouragement of inventors and others to perfect and test their several plans, and enable the State to select from all that which shall promise the best results. Any plan which will practically combine economy with greater speed than is now attained, and employing the boats at present in use, will not only prevent the diversion of trade, but largely increase the business and revenues of the canals.

To secure such results, the State should offer every encouragement and essential aid, and should exclude no system from her bounty which promises the successful and speedy introduction of steam on her public works. The reduction of time, in making a trip to and from tide water and the lakes, is a matter of the greatest importance, and should receive the most careful attention of the Legislature.

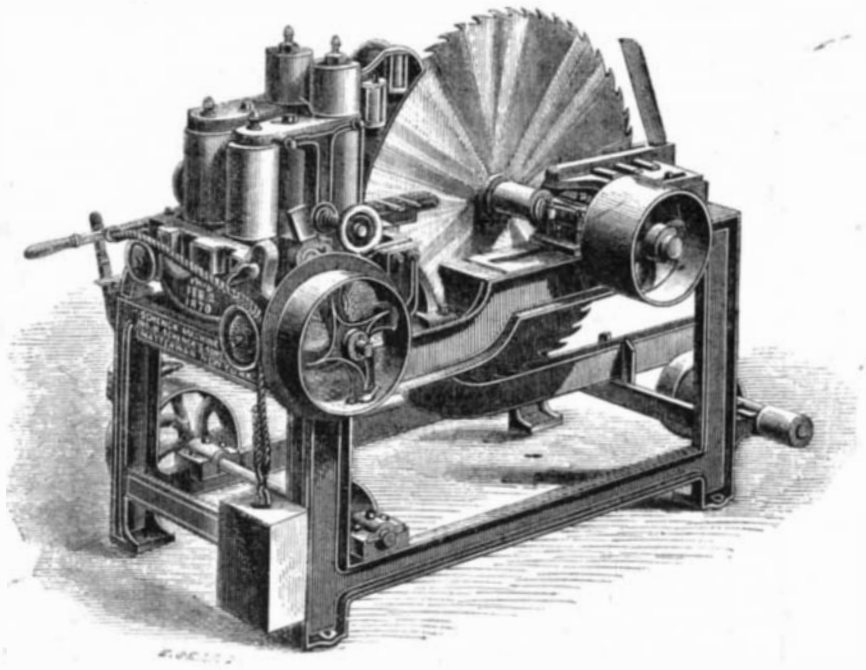
Improved Circular Re-Sawing Machine and Siding Saw.

Our engraving is a representation of a re-sawing machine, to which was awarded the first medal and diploma at the Exhibition of the American Institute for 1870. The award was made with discrimination and justice, as the machine is undoubtedly one of the best of its kind.

A prominent feature of the saw is that the feed rolls may be set inclined to the saw, so as to saw siding. This adjustment is made simultaneously for all the feed rolls by inclining the table to which they and their gearing are journaled, a set screw holding the table when set, and a simple adjustment compensating for what would otherwise be the increased tension of one of the belts when the table occupies this position.

The feed rolls have an adjustable speed motion through the use of a system of cone pulleys intermediate between the first pulley, from which motion is carried to the feed, and the last, which imparts motion to the gears of the rolls. They are also self-centering, so as to guide the stuff for uniform thickness through all inequalities on each side of the saw; or they may be made not self-centering, and may be held in a fixed position by the adjustment of a single screw.

The machine is constructed in a very substantial and workmanlike manner. It was patented February 2, 1870, and is manufactured by John B. Schenck's Sons, the manufacturers of the celebrated Schenck's planers, at Matteawan, N. Y. The salesrooms are at 118 Liberty street, New York, where the machine may be seen and the firm addressed.



SCHENCK'S CIRCULAR RE-SAWING MACHINE.

Museum of Natural History.

The Museum of Natural History in Central Park, New York, is rapidly becoming an attractive and important institution. It is open to the public free, and is daily visited by thousands.

Since its first opening and reception last year, many valuable acquisitions have been received; the more valuable being the collection of Prince Maximilian of Germany, which contains a vast number of fine specimens, accumulated by the labors of a lifetime. Beside this collection and the remarkable Verreaux cabinets, a fine specimen of ichthyosaurus has been added. This fossil is imbedded in a slab from the lias formation of Europe, and is one of the most perfect ever found; the plates of its enormous eyeballs are peculiarly distinct. Over 14,000 specimens of birds, besides several hundreds not mounted, are in course of rapid preparation for public inspection and study. A case recently received from Paris contains many finely mounted birds and mammals. Another valuable acquisition is a fossil elk from the bogs of Ireland. This is a perfect skeleton, the antlers being of enormous size. Two very fine specimens of quartz in crystals have lately been presented to the museum. One consists of a block about two feet in diameter, completely studded with prisms from half an inch to two inches in diameter, each prism being perfectly six-sided. A department of building stones has lately been introduced, the design of which is to afford builders and all interested an opportunity to examine at a glance the various building stones of this country and of the world. Other additions are constantly received. A list of the mammals has just been completed and put in the hands of the printer, and a full catalogue will be ultimately prepared.

Premiums to Locomotive Engineers.

The first duty of railway managers is to secure skilled and reliable employees in every department, and to do this they must pay them well. It may not in every case be possible to give the workmen in the different departments a direct portion of the savings made, due to extra care and skill, as is done in many manufactories and workshops; but it is possible to reward them for these requisites in some manner. When the Philadelphia, Wilmington and Baltimore Railway was operated under the "contract system," pecuniary inducements were held out to all the men to make them careful and skillful, they receiving a percentage of the savings made over a given standard of expense. The system worked favorably to the contractors and the men, the company getting a proportionate benefit from it by the men being better educated to better habits of care, greater skill, and a feeling of responsibility for success in their different spheres of labor. There can be no question that this system, by fostering competitive excellence, was conducive to greater safety in operation, and eventual economy in everything. We learn that the Leavenworth, Lawrence and Galveston railway managers have adopted this system with the most favorable results, by awarding annual premiums to the best performances of engineers for the services following:

1st. For general efficiency and care of engine.
2d. For lowest cost of repairs per mile run.
3d. For best performance per tun of coal and pint of oil.
4th. For least cattle killed in proportion to miles run.

The premium is to be given either in lots or lands of the company—to be located by those receiving them, on certificates to be used as cash for that purpose. Premiums have just been awarded of $150, $100 and $75, under the first head; of $100 and $75 under the second; of $100 and $75 under the third; and $100 and $75 under the fourth; the total amount being $500. In his circular to the Master Mechanic announcing the policy, Superintendent Chanute says:

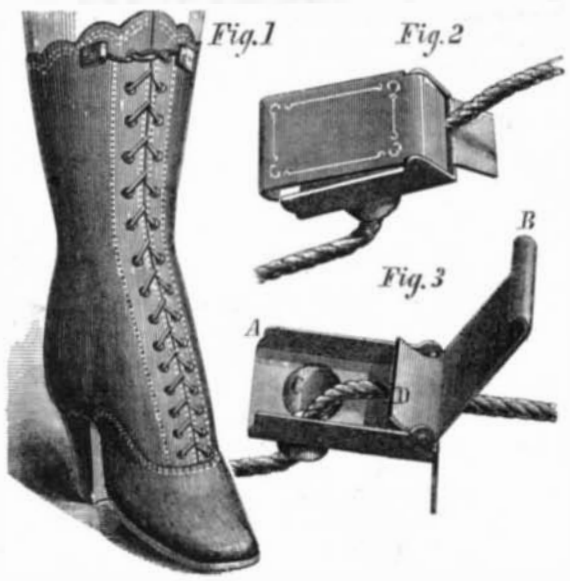
"I have long entertained the opinion that more was exacted from locomotive engineers, in proportion to their pay, than from any other class of operatives on railways. Their post is one of dangers, and on their skill, judgement and fidelity, the safety of the public largely depends. As a class, they thoroughly appreciate the importance of the trusts that are confided to them, and not only do they uncomplainingly endure hardships, exposure and necessary overwork, but they have furnished many examples of self-devotion, as noble as any in history. The past year, all our employees have worked well and faithfully to advance the company's interests. Not a passenger has been killed or injured on our trains, and it is the desire of the management to recognize the zeal with which the service of all has been rendered."—*Railway Times.*

TRISCOTT AND WHEELER'S SHOE FASTENINGS.

This neat and seemingly very convenient device, for fastening the ends of shoe or boot laces, is claimed to hold them very firmly, and, at the same time, to be tasteful and comely in appearance, obviating both the trouble in tying the ordinary knot, and preventing the annoyance caused by the knots becoming untied.

Fig. 1 represents a shoe with laces fastened as when worn. Figs. 2 and 3 represent the fastenings in different positions.

The device consists of two parts, A and B, which are hinged



together. The part, A, is fastened to the material of the shoe by means of the eyelet, C, and a tongue, which last is passed through the material of the shoe and bent down to hold the part, A, from turning on the eyele. The lateral edges of A are turned up, as shown, so that the part B, shuts down to meet them, like a cover. The forward end of B is turned down at D to press upon and clamp the lace when this part is closed into the position shown in Fig. 1. The opposite end is bent so as to form a spring clasp, which engages the notched ends of the turned up edges of A.

In fastening the lace, the part, B, is turned up as shown in Fig. 3. The lace is then passed through under the pivot joint which unites the two parts, and is then passed through the eyelet, C. B being then pressed down and clasped, the shoe is permanently fastened in such a way that contact with the dress of the wearer cannot loosen it.

The fastening has the further advantage that, one end of the lace being thus secured, the other may be drawn up as tightly as required, a great convenience with some kinds of laces that slip easily.

Patented through the Scientific American Patent Agency, December 26, 1871. For further information address S. P. Triscott, 50 Thomas street, Worcester, Mass., to whom the patent has been assigned.

MR. J. H. COLT, of Oregon Territory, informs us that there is snow twenty feet deep on the Blue Mountains.

Robertson's Telegraphic Insulators and Brackets.

This invention consists in the use of tubular slotted insulators provided with projecting lugs at the ends, and fitted into a bracket so as to be entirely held therein, the lugs entering recesses provided in the sides of the bracket. The insulator is made of glass or other non-conducting material. At its ends are projecting lugs or ears. The bracket, made of wood or other material, is as thick as the insulator is long between the lugs. It has one or more apertures through it for the insulators to be held in, one aperture for every insulator. To every such aperture in the bracket leads a slit, from front or back. The insulator is fitted through the bracket with its lugs in the slit, and when through is turned so as to bring a slot in line with the slit for the admission of the wire. When that has been applied, the insulator is once more turned to bring the slot out of line with the slit, so as to have the wire entirely inclosed. Staples may be driven over the ears into the countersunk parts or sockets of the bracket to prevent the insulator from turning spontaneously. The wire may be further fastened by a short wire drawn through a hole in the bracket, and twisted about the main wire.

Tubular insulators heretofore used were not slotted, and the wire could therefore only be introduced by being parted and then again united.

In actual work, the advantages and simplicity of this invention are that, the bracket being nailed or otherwise fastened to the post, the wire can be repaired, renewed, or removed without trouble, the slit in the bracket allowing the wire to drop into the insulator hole at once when the slit is in line.

The insulator can at any time be put on, without disturbing the wire, by means of the slot in it, and then pushed into the hole in the bracket, all that is necessary being to keep the lugs opposite the slit in the bracket, and then pushing it in till the lugs clear the bracket; then, by turning the insulator slightly round and putting the small staples over the lugs, (which latter can be done with perfect ease,) the insulator is secured in its place, and the wire effectually prevented from getting out.

To retain the telegraph wire in its place, all that is necessary is to pass a wire through the small hole under the insulator, and fasten it by twisting it to the main wire at each side, and the main wire is effectually retained; the whole process being exceedingly simple and effective.

There is, it is claimed, no risk of the insulator being broken or disconnected, or of the wire becoming disconnected; and any unskilled workman could do all that is necessary in repairing and fixing the line.

Mr. John Robertson, of Carbondale, Pa., is the inventor.

Noyes' Vacuum Tanks for Tanning Leather.

The object of this invention is to so construct tanks for tanning leather by the vacuum process, and for other purposes, that they will be sufficiently strong when made of wood, and tight enough to preserve the vacuum. It consists in one or more layers of pitch or cement of any suitable kind applied when in a fluid state, so that not only every crack and crevice in the walls and sides of the tank will be filled therewith, but so that the air shall be totally excluded from the tank.

These vacuum tanks have hitherto been made of iron, but it has been found that the tannic acid combines readily with and oxidizes the iron and colors the liquor, consequently coloring the leather, and making it to a certain degree unsalable. These tanks of wood overcome this difficulty, but the vacuum cannot be preserved in a wooden tank except by the use of pitch or cement applied according to this invention, or without one or more continuous and perfect partitions thereof surrounding the chamber on either side.

When the wooden partitions, boxes, or layers are placed, and the exhaust induction pipes are attached, the pitch or cement, in a fluid or semi-fluid state, is poured into the spaces, so as to entirely surround the chamber with one or more partitions, layers, or coats thereof. This hardens directly, excludes the air, and preserves the vacuum, while it preserves the wood from decay.

The inventor does not limit or confine himself to the precise form or arrangement described, as they may be varied in many ways without departing from the invention. Neither does he confine himself to vacuum tanks for tanning hides or leather, but designs to apply the invention to tanks for bleaching or extracting tannin from bark by the vacuum process, and for other purposes.

Mr. D. F. Noyes, of Lewiston, Me., is the inventor.

Gratitude all Around.

We desire to thank all our good friends who have supplied us, with early numbers of this volume, for the alacrity with which they responded to our call. Hundreds of new subscribers have thus been furnished from the commencement of the year, by the courtesy of those who supplied the numbers, and the publishers are saved the necessity of reprinting.

THERE is a trinity in the communication of heat. It is conducted, circulated, and radiated. It passes through solids by conduction, through liquids by connection or circulation, and from hot bodies generally by radiation.