HATHAMITE.

BY WALDON FAWCETT.

Hathamite, the newest and what is claimed to be the most powerful known explosive, is the invention of Mr. G. M. Hathaway, of Wellsboro, Pa., a scientist who has devoted years of experiment to the solution of the problems involved in the manufacture of this new source of energy. Hathamite, which has, of course, been named for the inventor, is a coarse pow-

OPEN EXPLOSION OF ONE OUNCE OF HATHAMITE.

der of bluish-gray tint. The impunity with which the explosive may be handled under ordinary conditions constitutes one of its most remarkable characteristics.

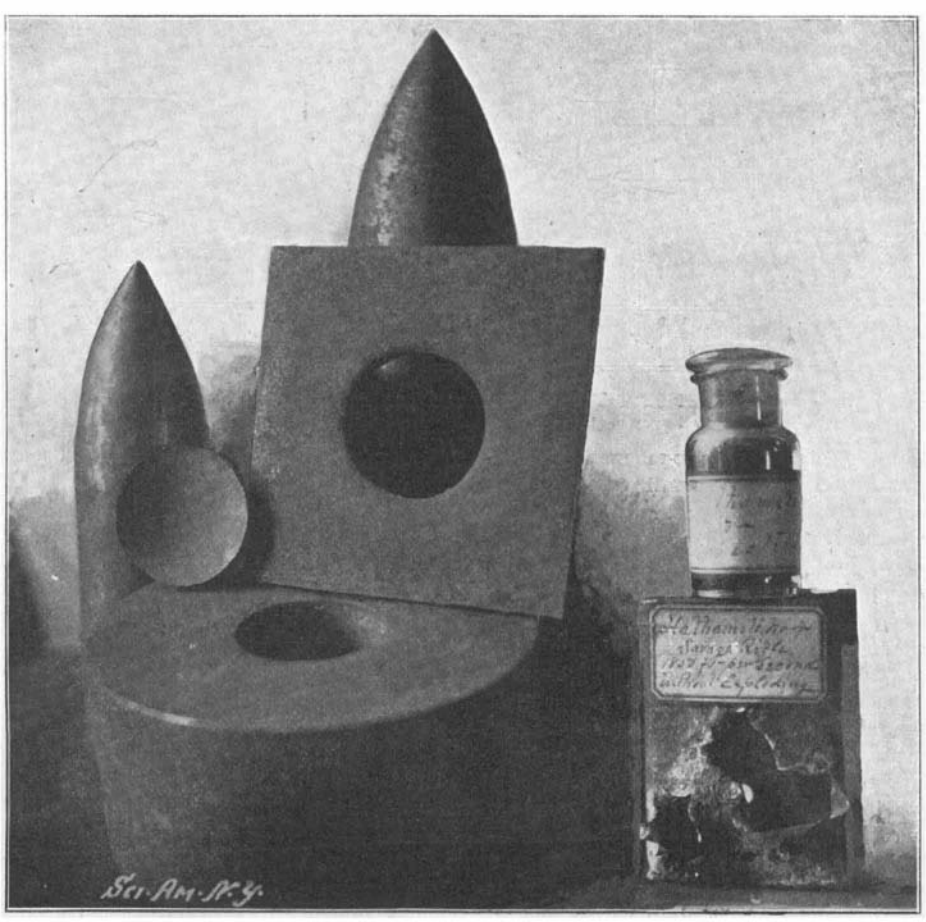
Lighted matches may be thrown into it without producing any effect, and a handful of the explosive may be laid on an anvil and pounded into impalpable powder with a sledge. Similarly, shells may be exploded near a quantity of hathamite without inducing disastrous results, and finally rifle balls fired into small masses of it are likewise without influence. This latter is, in a way, the most severe test to which an explosive may be subjected, and consequently no little surprise was created when, at the recent initial demonstration of the properties of hathamite, the inventor filled a tin box with the explosive and fired rifle balls through it at a speed of 1,850 feet a second.

Once subjected, however, to the combination of flame and concussion supplied by a percussion cap, hathamite generates great explosive energy. However, the powder can only be exploded when a dynamite percussion cap of large size is used. The cap itself must be powerful. To illustrate this, light percussion caps were, in a recent test, placed in two ounces of hathamite and fired without exploding the material.

Thus far the only demonstration of the capabilities of hathamite has been made in tests of a purely experimental character. In one of these a small charge of the mixture, when exploded upon a sheet of one-quarter inch boiler plate, cut a hole in the steel as cleanly as it could have been accomplished by means of a machine. On another occasion a small charge of hathamite was placed between two large cakes of ice, each weighing in excess of one hundred and fifty pounds. The powder was allowed to remain between the ice cakes for nearly an hour and was then exploded by means of caps. All that remained of the ice cakes after the explosion was a small pile of snow—not finely crushed ice, but snow of the ordinary character. This test is particularly interesting as evidencing the possession by the explosive of properties which will allow of its use in mining operations in Alaska during the winter.

In a second test, in which circular pieces two inches in diameter were blown from one-quarter inch boiler plates, cutting the plate as clean as a die, one and a half ounces of hathamite formed a charge, and in each case was simply placed upon the plate and detonated in the open air. A collar of steel placed under the boiler plate in one instance served as a bed against which the steel was cut clean. In the test mentioned the heavy steel collar, three inches deep and made of the toughest steel, was broken into several pieces by the force of the explosion. On one occasion about one ounce of hathamite was exploded in a regulation United States government one-pound steel shell, and very thorough fragmentation of the shell occurred. A similar result followed the explosion of two six-pound shells in a heavy steel chamber, there being employed in this instance 3⅛ ounces of the explosive. In this experiment the hathamite was melted and run solid into the shells. A hole was then drilled into the explosive and primed with two grammes of granulated explosive, which was acted upon by the fuse.

The explosion of a small charge of hathamite produces a sharp report, somewhat resembling the crack of a rifle, and there arises a rather thick cloud of greenish smoke, but this quickly dissolves in the air. When, in order to demonstrate the safety of hathamite under ordinary conditions, the explosive has been poured upon flames or a bed of coals, it has burned slowly and with an immense amount of smoke.



DISK CUT FROM STEEL PLATE BY THE EXPLOSIVE. CAN OF HATHAMITE THROUGH WHICH BULLETS HAVE BEEN FIRED.

Purifying Water by Means of the Electric Current.

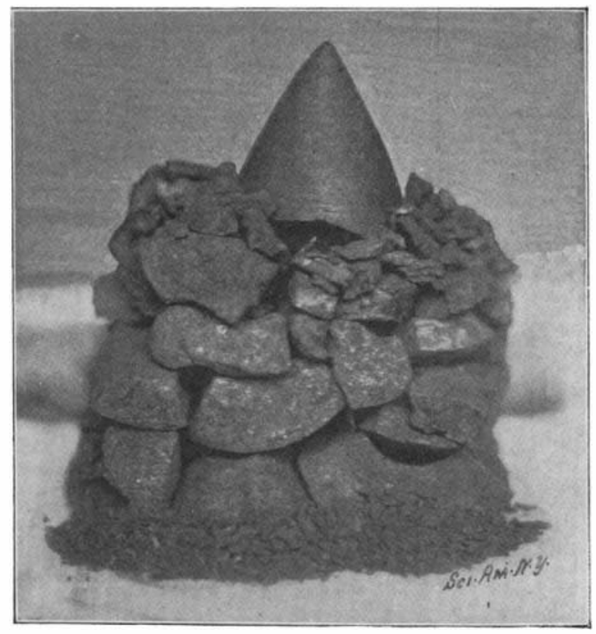
A large syndicate has been formed and is now preparing to begin extensive operations to exploit the process of purifying water by the means of the electric current. The patent is that of C. E. Holland, of New York, and the company is the Electric Purification Company. An experimental plant has been in operation for some time at Chartiers Creek, near Pittsburg, where the practicability of the system has been fully demonstrated, and a proposition will be made to the city of Pittsburg to purify a portion of the city's supply at first, and then all of it, and after this an effort will be made to introduce the system in other large cities. The inventor says that the cost of an electrical plant for this purpose, capable of supplying 75,000,000 gallons per day, would not cost more than $100,000, and after the installation of the plant the cost of purifying the water, as near as can be figured on the basis of the small plant now in operation, would be about 28 cents for a million gallons.

Automobiles.

BY EGBERT P. WATSON.

Surprise is sometimes felt by laymen at the speed attained by automobiles, but from an engineering aspect it is a natural result of the forces applied. Take the case of an automobile weighing 2,000 pounds more or less—one short ton. Such a vehicle would have an engine of or rated at 40 horse power and be capable at racing speed of a velocity of 60 miles an hour. A locomotive of 100 tons weight will develop at high speeds 1,000 horse power, and draw a load behind the tender of say 200 tons at 60 miles per hour. In the former case, of the automobile, the power available is as 40 to 1, while in the locomotive it is only 5 to 1, so that it is not singular that the former should, even upon common roads, attain high velocities. Comparison of the work done by the two types is not made, because it is not an element in this discussion.

The frequency of accidents occurring through the use of automobiles has prejudiced many unthinking persons, who decry them as dangerous to the public safety, but these same persons ignore the numberless casualties arising from horses before the automobile was heard of. It is urged that the latter are in the hands of careless persons, unskilled in the knowledge of mechanism, but the same may also be said of the horse. Those who employ him are quite as ignorant of his internal arrangements, and come to grief just as quickly as those who have a thorough training in his anatomy. Knowledge and familiarity with machinery in action is by no means superfluous to drivers of automobiles, and there is no question that study of their principles would be of great benefit to all concerned, and such accidents as have occurred arise usually from lack of ordinary care and precaution. All machines in motion require attention constantly to keep them up to their work, but modern vehicles of the class in question have been so perfected that a person of ordinary skill and intelligence can easily control them. To do this, however, without disaster involves close supervision at all times, for an automobile upon a comparatively rough highway is liable to swerve from its course if there is a very slight obstruction in it. One forward wheel meets with a check and the machine is diverted. In going at high speed it is very difficult to get it back in its place immediately, for the momentum of a heavy body going at an ordinary speed has



FRAGMENTATION OF A 6-POUND SHELL BY HATHAMITE FILLER.

to be reckoned with; it is of importance that the steering gear should be firmly in hand at all times.

Legislative enactments to limit the speed of automobiles upon highways are generally based upon the danger to others using them, but there are two aspects of this proposition, one of them being the injustice to owners of automobiles, and another that it has not been established that the machine itself is a source of danger. The horse is a vagarious animal; any horse is. According to his moods, he will accept one day a real peril with equanimity, and the next shy at the family wheelbarrow if he comes upon it unexpectedly. He will endure placidly the spectacle of an express train not fifty feet away, belching thick smoke and steam in his very face, but a harmless piece of paper or a barnyard fowl hen squawking upon a fence fills him with unspeakable terrors. To assert that automobiles have changed the disposition of horses in general is very difficult to establish; and while one may have misbehaved at the passage of an automobile, there is no proof that at that particular period of the horse's existence he would not have been equally perturbed at anything else. The sole object, or at least the principal object, of the introduction of automobiles is rapid transit upon common roads, and a demand for such vehicles has existed for years. Inventors have studied the subject in all its aspects; now that they have attained success, the first thing that is done by authorities is to reduce the speed to that of horse-drawn wagons. Fast driving in towns or villages, whether by horses or machines, is dangerous to pedestrians and others using the streets; there can be no argument upon that head, and all vehicles should be limited to the condition of common traffic; but outside of towns automobiles should be permitted to travel at speeds of at least twenty miles per hour without encountering the displeasure of some rural Dogberry anxious to earn his perquisite. Doubtless after the public shall become more familiar with mechanically-driven vehicles the present objections to them will disappear in great part; likewise better knowledge of the capacities and peculiarities of the machines themselves upon the part of their owners will enable them to avoid many of the present mishaps.

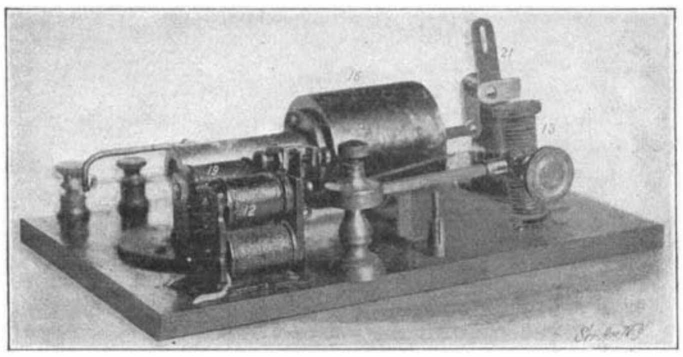
THE AUTOMATIC TRAIN CONTROLLER.

Despite the greatest precautions in the way of pneumatic and electric signals, serious railroad accidents are continually occurring. In devising these signals inventors do not take into account the personal element—the individuality of the engineer—which plays such an important part in many crises. We have read of engineers who, when suddenly confronted with danger, seem powerless to act, and rush on to destruction without making the slightest attempt to stop the train. In explaining the cause of a wreck which occurred in this vicinity, a railroad official of high standing said that it was probably due to that mad recklessness which sometimes overtakes an engineer, making him disregard all signals and risk his own life and that of the passengers. Obviously, then, the best perfected system of automatic signals, even though working perfectly, would be deficient in cases where the man at the throttle was blind to their warning or too dazed and bewildered to know just what to do. The only proper way to provide against all contingencies is to devise some suitable means, whereby the warning of danger would be immediately communicated to the engine, closing the throttle and applying the air brakes without the medium of human agency. In other words, since man is sometimes unreliable in critical situations, we must look for some trustworthy substitute which may be depended upon to act without fail in all emergencies.

A substitute of this character may be found in the system which is herewith illustrated. This system, which has been developed by the Automatic Train Controller Company, of 25 Broad Street, New York, is very simple, and the apparatus employed is very compact, being arranged to occupy not more than a cubic foot of space and, with the exception of the electrical mechanism which acts directly on the throttle and air-brake valve lever, the parts may be stowed away in any convenient corner of the engine cab. A complete understanding of the electrical action may be had by a glance at the diagram. The track is laid out in block sections of any desired length, the rails 5 at one side being electrically disconnected at the end of each section, and the opposite rails being electrically connected throughout the length of the track. At the end of each section, preferably between the rails, is a contact rail 7, which is electrically connected with the rails 5 of the section immediately ahead. Arranged upon the forward end of the locomotive, and preferably on the pilot, is a contact lever 8 designed to engage with the contact rails. This lever is pivoted on a shaft 9, from which the contact finger 10 extends upward and is adapted to normally engage the contact piece 11 carried by the pilot. The contact finger 10 is electrically connected to one pole of a battery, or other source of electrical power, conveniently located on the locomotive, while from the other pole a wire extends to an electro-magnet 12 and thence back through a resistance coil 13 to the contact piece 11. Magnet 12 is thus normally energized and its armature 14 attracted against the action of a spring. The current follows this course at all times except when a contact rail 7 is encountered. At such times the lever 8 is raised, rocking the finger 10 out of contact with the terminal 11. The armature of magnet 12 acts as a switch in a separate circuit comprising the battery 15 and electro-magnet 16, and when released from the attraction of this magnet serves to energize the electro-magnet 16, the armature, 21, of which, operates the air brake valve lever.

Whenever a new block section is about to be entered the contact at terminals 10 and 11 is broken as stated above, and if the track is clear, the current flows from the battery through lever 8, contact rail 7, rails 5, resistance 17, at the end of the section and back through rails 6, trucks 18 of the locomotive, and magnet 12 to the battery. In case of an open drawbridge, or broken rail, or where wreckers attempt to wreck the train by tearing up the rails, as shown in section 3 of the diagram, this flow would be interrupted, and the magnet 12 being de-energized would release its armature, thereby closing the circuit of the battery 15 through electro-magnet 16. The electro-magnet being energized, attracts its armature 21 which operates, through lever and link connections, to shut off the steam, and apply the air brakes, thus automatically bringing the train to a safe and gradual stop before it can enter the dangerous section of track ahead.

In case of a train in the block section ahead, the circuit through the electro-magnet is closed through a different medium. Connected in parallel with the magnet 12, is a magnet 19 which is provided with an armature 20. This armature also serves as a switch for the circuit of battery 15, but differs from armature 14 in that it is normally held back against the attraction of its magnet by the tension of a strong spring. Normally the attraction of the magnet 19 is unable to overcome this spring tension; but when the resistance in the track is short circuited by the trucks of a train, it develops sufficient energy to attract its armature and close the circuit of battery 15. We have already stated that resistance 13 is cut out of the circuit whenever the lever 8 rides over contact rail 7; but at the same time the resistance 17 of the section is looped in, and is such as to produce practically no change in the flow of current. However, if the current were short circuited by the trucks of a car, or a locomotive, in



APPARATUS FOR AUTOMATICALLY CONTROLLING TRAINS.

the block, as shown at 21 in section 4, a materially increased flow of electricity through magnet 19 would result, and the armature 20 would be attracted, closing the circuit through electro-magnet 16 which would stop the train as described above. Provision is made against any breaks in the roadbed as well as against danger of collision, and since the parts are self-restoring, they resume their original position when the cause of the danger is removed, thereby indicating to the engineer that the section ahead is clear.

Accidents are sometimes caused by cars on a siding which have not been drawn clear of the main track, but project over the same. In order to prevent such accidents, a section of the siding immediately adjacent to the switch is connected by shunt wires to the main track circuit, so that in case a car is standing in dangerous proximity to the main track, the current will be short circuited through the car tracks and the train approaching that section would be stopped. The apparatus is perfectly reliable, and no fears may be entertained of its failure to act in an emergency; for it will be observed that the parts are so arranged that, unless everything is in perfect order, one or the other of armatures 14 and 20 will be operated to complete the circuit through electro-magnet 16, thus bringing the train to a stop. In order to make the system doubly safe, the

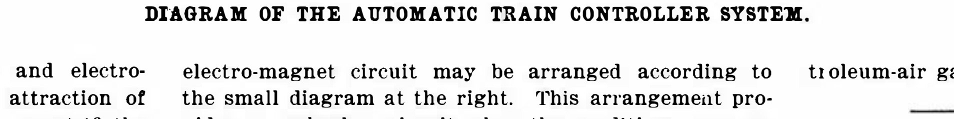


DIAGRAM OF THE AUTOMATIC TRAIN CONTROLLER SYSTEM.

electro-magnet circuit may be arranged according to the small diagram at the right. This arrangement provides an unbroken circuit when the conditions are normal. In case of danger, however, the current is interrupted by one or the other of armatures 14 and 20, and the electro magnet 16 is de-energized, releasing the lever 21, which, thereupon, springs back and operates the throttle and air brakes. Should either of the batteries employed become weakened or should any of the parts be broken or disconnected, the engineer would be immediately apprised of the fact by the automatic action of the mechanism. The Automatic Train Controller Company has just closed contracts to equip one of the Eastern railroads with its machines.

Acetylene has been experimented with for signaling in the Germany army, with great success. Mixed with a certain percentage of oxygen it is said to give three times the light of the oxy-hydrogen lamp and can be plainly observed in daylight at a distance of five miles. This distance is trebled at night.

The Decay of Beachy Head.

The seven white miles of Beachy Head are fast crumbling away. The great chalk cliff in front of the lighthouse of late years has shown signs of insecurity, which in 1893 culminated in a very heavy fall, amounting, it is estimated, to no less than 85,000 tons of chalk. Again in 1896 another dislodgment occurred of an estimated quantity of 89,000 tons. By these serious downfalls the distance between the lighthouse tower and the cliff edge was reduced from 100 to 70 feet, and there are not wanting signs that further disintegration of the cliff may sooner or later take place. Thus has arisen the necessity for a new lighthouse, on a more stable and enduring site. The new lighthouse was fully described and illustrated in the Scientific American.

New York as a Foreign City.

In the city of New York there are only 737,477 white persons born of native parents, or but 21.4 per cent of the population of the city. This statement means that out of every one hundred persons living within the municipal boundaries of New York seventy-eight are either foreigners, or the children of foreign-born parents, or colored people. New York, however, is not the first, but the second city of the country having the largest foreign-born population. Fall River, Mass., is first in that respect. Official figures show that there are in New York city more males under twenty-one years of Slavonic parentage than of any other people, and the number of Slavonic men more than twenty-one years of age exceeds that of any other nationality except Germans and Irish. In the Fourteenth Assembly District of New York County the percentage of Hebrew families with nine children each is six times as great as the Protestant percentage, while the number of Hebrew families with no children is about one-half the Protestant percentage.—H. McMillen, Leslie's Weekly.

Ether-Air Gas.

Descriptions have been published recently of a new form of artificial illuminant made by saturating air with the vapor of ether, and then carbureting the whole with benzol. Ether-air gas itself has found occasional use for years under the name of eth-oxygen gas, being employed for optical lantern work in places where the oil light was too weak, and coal gas not laid on. A new carbureter has been invented in France which is claimed to be specially suitable for ether. The absorbent material is the fiber of a palm-like tree, which has an apparent specific gravity of from 0.114 to 0.122, and is so extremely porous that it will take up nine times its weight of ether, all of which is subsequently evaporated into the gas. Ether itself burns with a luminous, or even smoky flame, but when it is diluted with air, its vapor, as in ether-air gas, gives a blue flame, and, for purposes of illumination, requires either a mantle or the addition of benzol vapor. According to Langlois, incandescent ether-air gas gives a light of 1 Carcel-hour—about 9.5 candles—for every 6.7 grammes of ether burnt; while the material will bear cooling to 21 deg. Fah. without any of the ether condensing out, and without suffering any diminution in illuminating power. By carbureting ether-air gas with 40 or 50 grammes of benzol per cubic meter, a product resembling oil gas in stability can be prepared. It is stated that carbureted ether-air gas is almost twice as expensive as oil gas; but it has an advantage over the latter in the simplicity of the plant required, and in the rapidity with which a small installation can be erected. It may be noted that the introduction of this ether-air gas renders the term "air-gas" as applied to air carbureted with petroleum spirit ambiguous; and the latter product must now be called "petroleum-air gas," or something of the kind.—Engineer.

Galileo and the Magnetic Telegraph.

In his dialogues on the Ptolemaic and Copernican cosmogonies, which first appeared in 1627, Galileo places in the mouth of one of his interlocutors, Sagrado, the words: "You remind me of a man who wanted to sell to me the secret of communicating with a person two or three miles distant, by means of the sympathy of two magnetized bars. When I told him that I would gladly buy his secret, but that I first wanted to see the thing proved, and that it would be sufficient for my purposes to communicate with him in his room while I was stationed in my own room, he answered that the operation could hardly be observed at so small a distance. Thereupon I dismissed him, saying that I had neither the desire nor the time to travel to Cairo or Moscow, but that if he would journey to either of these two places, I would gladly act as his correspondent in Venice."