of the conversion of amorphous carbon into graphite. A brief resumé of Prof. J. J. Thomson's lecture before the British Association on Becquerel rays and radioactivity will doubtless be welcomed. How the oxides of nitrogen could be reduced directly by the contact process is likewise told. We have, from time to time, published accounts of the efforts of Americans to exterminate mosquitoes. In Europe no less activity has been shown. It may, however, not be without interest to our readers to learn from Dr. Louis W. Sambon, of Naples, something of the life history of *Anopheles maculipennis* (Meigen), and the methods employed in Europe for its extermination. Prof. Edwin G. Dexter describes interestingly quaint superstitions and proverbs relating to weather influences.

AIR BRAKES

The compressed air brake bears a very important relation to the subject of railway transportation; for it has a direct effect upon the economical operation and speed of trains, as well as upon their efficiency as carriers of merchandise, live stock and passengers. Without the general adoption of the air brake in the past few years the long, heavy, fast freight trains and speedy passenger trains, so comfortable, luxurious, and safe, would not now be running. For the most important consideration is the safe transport of passengers and merchandise, and this requires a brake of great power and always reliable, to control the speed of the train or stop it in a short distance with comfort and safety.

Few people realize the enormous energy stored up in these trains, giant catapults as they are, moving through space with tremendous force and speed. A very reasonable example is a train of freight cars loaded with grain, the total weight of which is about three million pounds. The energy stored up in such a train, when running twenty-five miles per hour, is greater than that which can be imparted to a projectile by the largest of modern guns. It takes a very efficient brake to check this enormous inertia in a short distance, smoothly and safely.

With the air brake, these trains are perfectly controlled. The air brake has kept pace with the great increase in weight, length, and speed of both freight and passenger trains. Much that is interesting could be said about the magnitude of the air brake business, and the details of construction, manufacture, and use under the different circumstances of operation. The employes of railways who have to do with the air brake apparatus are carefully instructed how to handle and care for it, through the publication of instructive literature. There are scattered all over the country, instruction rooms maintained by the railways, where illustrative samples of air brake apparatus are available to the men, and in which traveling air brake inspectors frequently give lectures. There are also instruction cars traveling from place to place in which sample brakes are set up, explained, and operated.

While the subject is technical and of considerable detail, the principles of the air brake can be described in few words. Briefly, the air brake comprises a pump for compressing air, a reservoir on each car for storing the air, a brake cylinder on each car in which the air is allowed to exert its force when it is desired to have the brakes act upon the wheels, and a triple valve on the car, connected with both reservoir and cylinder and controlling the flow of air in and out of each.

The triple valve piston is normally subjected to air pressure of equal intensity on both sides. A reduction of pressure in the train-pipe side moves the piston one way, and restoring the pressure in the train pipe pushes it back again. The former opens connection between reservoir and brake cylinder; the latter discharges brake cylinder air and allows the reservoir pressure to be replenished. An engineer's valve in the cab of the locomotive enables the engineer to cause the rise and fall of train pipe pressure referred to. The rest of the apparatus is the piping, cocks, and connections.

We give a more detailed description of some parts of the brake, selecting those that are representative of the most modern construction and in general use.

The air pump, mounted upon the engine, just forward of the cab, is operated by steam from the locomotive boiler, and compresses the air required for the air brake system throughout the train. The air compressed by the pump is delivered into the main reservoir, which is a large tank mounted somewhere about the engine and storing sufficient air to relieve the pump from excessive work, when more air is suddenly required in the brake system. Otherwise the pump would be subject to violent fluctuations; at rest one moment, and in violent operation the next.

The engineer's valve, or "brake valve," mounted inside the cab of the locomotive, permits the engineer to control the movements of the train by applying and releasing the brakes as the operation of the train may require. This valve controls the flow of air from the main reservoir into the brake apparatus upon the other vehicles, and also controls the discharge of train pipe air when the train is to be stopped, or its speed reduced. The engineer has perfect control of all brakes in the train by moving a small handle. The positions of this handle are: "running," "lap," "service applications," "emergency,"

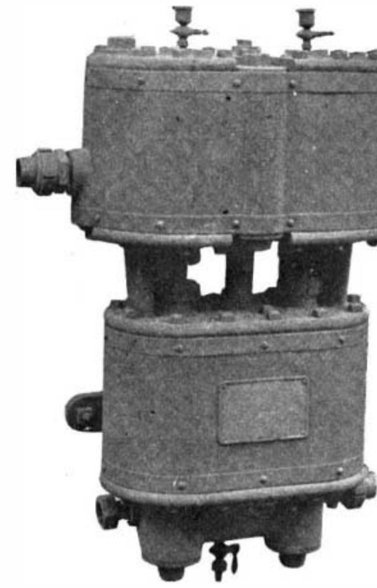


Fig. 1.—THE DUPLEX PUMP.

and "release." "Running" is the normal position of the handle while the train is speeding along and the brake system is charged with air at the proper pressure. In this position, air from the main reservoir, generally about twenty pounds higher in pressure than the rest of the brake system requires, is slowly fed through the engineer's valve into the rest of the system, thus taking care of leaks and keeping the air pressure up to standard.

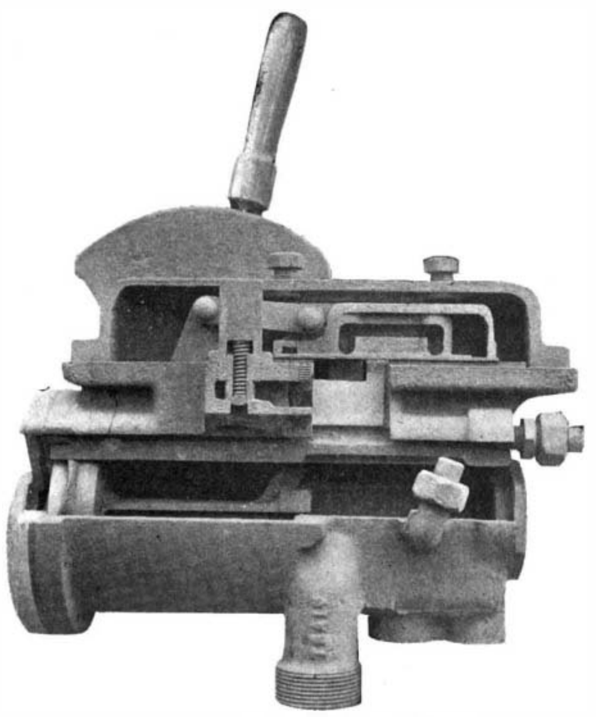


Fig. 2.—THE ENGINEER'S VALVE.

The other positions for the handle are explained by the names given them. The several positions for service applications, set the brakes with different degrees of force. With the handle in emergency position, brakes are instantly set with their greatest power. In release position, air that has been used to set brakes, is replenished from the main reservoir and pump, restoring all parts of brake system to normal condition. A modern type of engineer's valve is illustrated on this page.

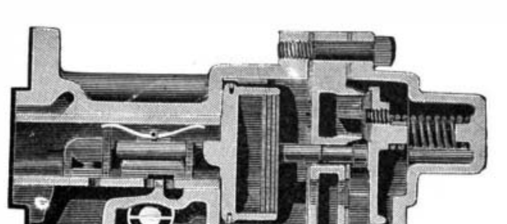


Fig 3.—THE TRIPLE VALVE.

The engine equipment includes a gage for showing the air pressure in both train piping and main reservoir, the pressure in the latter being kept higher than in the rest of the brake system; and a simple governor which controls the working of the air pump, automatically stopping the pump when standard air pressure has been accumulated in the brake system, and automatically starting the pump when the air falls below the desired standard.

The principal parts of the brake apparatus, mounted upon each car, are an auxiliary reservoir, for storing upon each vehicle sufficient air to operate the brakes thereon; a brake cylinder, ordinarily open to the atmosphere (through a port in the triple valve), and a quick-action triple valve.

When air brakes are applied, the triple valve allows air from the auxiliary reservoir to flow into the brake cylinder in sufficient quantity to give the brake-force intended by the engineer. The piston-rod of the brake-cylinder is connected to the levers and shoes by which the power delivered by the brake cylinder is evenly distributed to the wheels of the vehicle. When the brakes are released and the triple valve opens the port that lets the air escape from brake cylinder to atmosphere, a spring, surrounding the piston rod of the brake-cylinder, pushes the cylinder piston back to normal position, the forward movement of the piston having compressed this spring.

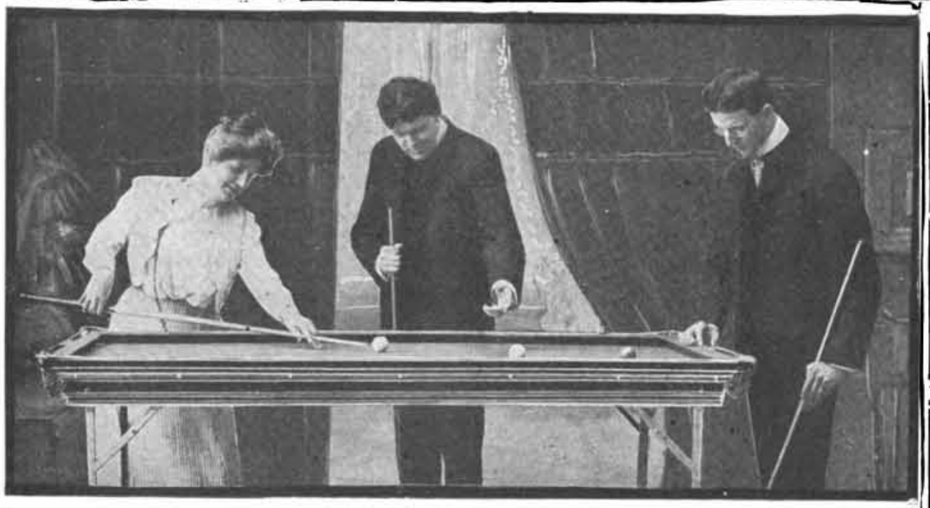
Fig. 1 is an external view of the duplex air pump, which is a construction peculiar to the New York Air Brake. The pump is constructed in a very simple manner and delivers sixty-seven per cent more air than other air brake pumps do with equal consumption of steam. The lower half of this pump is comprised by the steam cylinders, the upper half by the air cylinders, quite the reverse of former air pump construction. Thus the drainage of the steam cylinders is collected at the lowest point. The casual observer of this pump might suppose that it was merely a pair of ordinary pumps connected together, side by side, and that the total volume of air would simply be twice as much as would be delivered by one of the pumps alone. Closer inspection shows that this is not the case and that the pump compresses three volumes of air with two similar volumes of steam. One of the air cylinders has twice the volume capacity of any one of the other three cylinders. Its contents are compressed into half their original volume and delivered into the smaller air-cylinder. The smaller cylinder, which has the same volumetric capacity as the steam cylinder below it, will then contain three volumes of air, viz., the free air originally confined within it, plus the two volumes just received from the larger cylinder. The final compression of these three volumes of air is caused by the steam cylinder on that side of the pump, the air being delivered into the "main reservoir."

All working parts of this pump can be examined and replaced without taking the pump off the engine.

Fig. 2 is a photograph of the New York Air Brake Company's engineer's valve cut in half longitudinally. The novel feature of this valve is, that it discharges a definite quantity of train pipe air in each of the several positions for applying brakes, and is therefore called a "positive discharge" valve. An engineer having this valve on his engine, can apply brakes throughout the train with exactly the force that he knows, from experience, should be applied to the wheels to give the retarding power wanted at just that moment, and is not obliged to watch the pressure gage, in the cab of the locomotive, but can keep his eyes upon the rails, signals, or crossings ahead of him.

Fig. 3 is a sectional view of the quick-action triple valve. One is used upon each freight or passenger car. It is by the perfect working of this ingenious, yet very simple valve, that the brakes are all applied at the same moment on the long freight trains, of fifty to one hundred cars, now in use. The quick-action triple valve is really two valves combined in a single casing, one portion operating to make the brakes apply instantaneously and with maximum force throughout the train, as required in emergencies, and the other portion moving to produce a more gentle action and of varied force, as required by slow-downs, station stops, and other conditions of ordinary service operations. In service action the emergency parts remain inert. They are always at rest, except when emergency requires stopping a train at once and in the shortest distance possible.

The action of the brakes is transmitted from the engine to the first car, and from car to car, by an impulse that travels like a sound wave. When the engineer moves his brake handle so as to cause the brakes to apply for emergency, this wave, or impulse, travels through the air brake piping, from car to car, with great rapidity. A train of fifty freight cars of the standard box type is about a third of a mile long, yet brakes upon the last car apply within two seconds of those at the front end, and, therefore, instantaneously with all other brakes in the train. This is quite necessary, for if the emergency action was slow in reaching the rear cars, the forward part would be stopping, with the rear cars running into them. One can imagine the shocks that would result.



(Cut shows corner pocket covers in position for billiards.)

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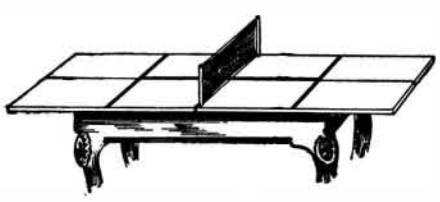

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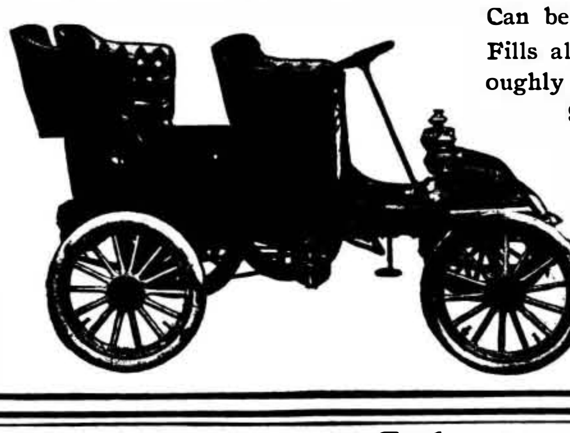

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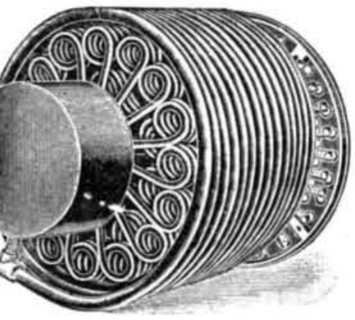

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PHAETON,	12 "	2 "	1,500
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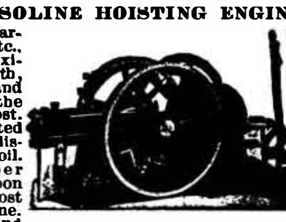

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Automobile News.

Recognizing the importance of the new transportation and the fact that it will endure, the faculty of Columbia University has added a course in automobile mechanics to the curriculum. Instruction will be given by a competent gas engine expert, and the course will cover gasoline and steam carriages only, the electric vehicle being included in the regular electrical course.

By the death in Paris recently of M. Elie Buchet, aerial transportation has lost one of the men who did much toward bringing it to its present stage of advance. Originally interested in the designing and manufacturing of light motors for automobiles, M. Buchet had his attention drawn to the needs of aeronauts for gasoline motors of this type. He finally succeeded in building the lightest motors per horse power in the world, and nearly all the airships that have succeeded or come to grief within the last few years were equipped with Buchet motors.

Col. John Jacob Astor has offered to give $10,000 toward the construction of the proposed road from New York to Chicago, if the Automobile Club of America will change the route to the east instead of the west side of the Hudson River. Mr. Astor also intimates that other wealthy men owning estates on the east bank will probably follow suit if the route is changed, as the road would benefit them as well as the many other inhabitants on this side of the river, whereas the west bank is but sparsely settled, and a road there would not be of so much use. If the east bank is chosen, vehicles will be ferried across the Hudson from Rhinebeck to Kingston, at which point the road strikes westward to Binghamton, Elmira, Erie, Cleveland, Toledo, Elkhart, and Chicago.

English automobile enthusiasts have formed a Volunteer Corps to be used by the government in time of war for carrying dispatches and bringing into communication distant points not reached by the railroads. Of late, to get themselves in training, they have organized several balloon pursuits. In these novel chases, an aeronaut starts skyward in a balloon, carrying some dummy dispatches, while at the same time the automobiles start in pursuit of the huge gas bag on *terra firma*. If a good breeze is blowing, the aeronaut gives the automobilists a lively chase; while if he is aided with clouds in or above which to hide himself, he keeps the modern "knight of the road" guessing as to his whereabouts. The one who reaches him first after his descent is declared the winner of the chase, which is said to be much more exciting than "hare and hounds" or a fox hunt.

The annual hill-climbing test of the Automobile Club of New Jersey was held at Eagle Rock, Orange, on Thanksgiving day. The road that winds up this rock is of hard macadam, with grades of from 3½ to 16 2-3 per cent. On the day of the test it was slippery and muddy. Notwithstanding adverse conditions, Mr. O. P. Nestman, in a Stevens-Duryea 8 horse power gasoline car, succeeded in reaching the summit of the hill—a distance of a mile and one-eighth—in 2 minutes 45 seconds. This was 1 minute 8 4-5 seconds better time than that made by one of the Duryea Power Company's gasoline machines last year, and but 3 seconds less than the record made then by Mr. W. J. Stewart in a locomobile. For the present test, Mr. Stewart installed a larger boiler in his machine, but with unsatisfactory result, as he only succeeded in making the ascent in 2:58¾. The third and fourth best times were made by Mr. Newton in a locomobile and Mr. Wells in a Prescott steam carriage, in 3:36¾ and 3:43¼ respectively.

The year 1902 has been a record-breaking one for automobiles. Following closely upon Fournier's reduction of the straightaway mile and kilometer times to 47 2-5 seconds and 29 1-5 seconds respectively on November 6 (each of which figures was robbed of its fraction several days later by the Frenchman's compatriot, M. Augieres) comes the smashing of Winton's new track record, made by the world renowned "Bullet," by Henry Ford, of Detroit. Mr. Winton, on the Glenville track at Cleveland, September 16 last, made a new track record of a mile in 1:02¼, against his previous record of 1:06 2-5, made about a year ago. Mr. Henry Ford, of Detroit, on a gasoline racer built by himself and Tom Cooper of that city, has just succeeded in beating Mr. Winton's time by more than a second, having established a new record December 1 on the Grosse Point track, Detroit, of a mile in 1:01 1-5. This brings the much-sought-for speed of 60 miles an hour, or one mile in exactly one minute on a track, within slightly over a second of being attained; so the probabilities are that before long the feat will actually be accomplished.

A fact that shows the remarkable development of the gasoline automobile is that during the past eight years the average speed of such machines in the long-distance road races held in Europe has risen from 15 to 60 miles an hour. It is interesting to note the course taken by the different countries and municipalities abroad in regulating the speed of machines capable of such space-annihilating capabilities. The general tendency seems to be to have government inspection and approval of the automobiles as to their brakes, steering gear, and various safety appliances, before these leave the manufacturers' hands; then to grant the owner a certificate of capacity, when he has demonstrated his capability to properly operate and manage the machine, which can always be identified by its number plate. The speed limits range from 6 to 12 miles an hour in cities and towns, to from 18 to 31 miles per hour in the open country. The punishment for violation of the speed laws is a fine and imprisonment according to the magnitude of the offense and the amount of damage done. In Germany, special restrictions on the use of steam boilers practically prohibit steam carriages. The idea of government inspection, as above outlined, is a good one, for if manufacturers are compelled to place thoroughly safe and efficient brakes and steering gear on their machines, there is much less likelihood of accident, even if speeding in the open country is occasionally indulged in.

To prevent the freezing in cold weather of the water in the tank, piping, and water jacket of the engine on a gasoline automobile, besides glycerine and chloride of calcium, which has already been proposed, chloride of magnesium and chloride of sodium can also be used. The following figures, from La Locomotion, give the temperatures at which different mixtures of the latter (sea salt or ordinary table salt) with water, freeze:

Sea salt (NaCl), 25 parts + water, 75 parts = temperature of congelation of —15 deg. C. (5 deg. F.).

Sea salt (NaCl), 22 parts + water, 77 parts = temperature of congelation of —12 deg. C. (8.6 deg. F.).

Sea salt (NaCl), 10 parts + water, 90 parts = temperature of congelation of —12 deg. C. (10.4 deg. F.).

At the same time, the writer adds, chauffeurs should mistrust the use of saline solutions of any kind, because of their corrosive action on metals. It is possible, according to the chemist Keller, that the chloride of calcium solutions, for instance, may have no action on metals, such as iron, copper, steel, etc., *when isolated;* but it is true, nevertheless, that when these metals are combined in the presence of this solution, as they are in the different parts of the water circulating system, a voltaic couple forms and one of the two metals corrodes rapidly in its presence. This may readily be seen if strips of iron and copper, fastened together, are dipped in a solution of calcium chloride. The iron, which forms the negative electrode, will be attacked and disintegrated. It is therefore prudent to employ exclusively for this purpose neutral liquids, such as glycerine or even the heavy oils.