A COMBINED EXHAUST VALVE AND IGNITER FOR GASOLINE MOTORS.

Our illustrations show a novel combined exhaust valve and igniter now fitted to the motors of the Duryea gasoline automobiles, as well as one of the Duryea cars that is being used successfully in far-off Japan.

The exhaust valve, *a*, is carried by and seated in a cast-iron chamber, *b*, screwed into the wall of the engine. The valve stem, *d*, is screwed into a holder, *E*, carrying a roller, *f*, which is struck at the proper time by the cam, *g*, mounted on the cam shaft in the usual manner. A lock nut secures the adjustment of the valve stem, *d*, in the holder, *e*, at any desired point. A scissor spring, *h*, bearing against the cast-iron chamber, *b*, at one end and against the lock nut at the other, keeps the exhaust valve closed unless lifted by the cam, *g*. The stem, *d*, of the exhaust valve is hollow throughout its length, and a smaller stem, *i*, terminating in the curved arm inside the firing chamber of the engine, passes through the hollow valve stem, which serves as a bearing or journal for it. This stem also projects beyond the valve stem into the center of the roller holder, *E*, where it is provided with a clamp, *j*, and a hammer, *l*, connected together by a coiled spring. The clamp, *j*, is fastened to the igniter stem, *i*, by a set screw, and the hammer, *l*, is mounted loosely upon it. An upwardly projecting lug on clamp, *j*, fits in a notch in hammer, *l*, and the coiled spring crowds the lug against one side of the notch, as shown in Fig. 1. Under the point of the hammer is a flat plate, *m*, pivoted, as shown, in a bracket forming one of the slide caps. On the operating cam, *g*, is a roller, *n*, which at the proper time moves the plate, *m*, outward, causing it to rotate the hammer slightly and coil the spring tighter, which, in turn, forces the sparker stem, *i*, to rock until the point comes in contact with the insulated anvil or plug, *o*, projecting into the firing chamber. Further movement of hammer, *l*, is allowed for by the wide notch in same, and serves only to press the sparking points tighter together. When the point of the hammer slips off the plate, the hammer acquires a rapid velocity under the reaction of the spring, and strikes the clamp, *j*, a sharp blow, which knocks the point on the stem, *i*, out of contact, making a quick, sharp break of the electrical connection, and thus producing a large, hot spark in the firing chamber. After the burned gases have done their work, the exhaust valve is lifted by the cam, thus raising the hammer, *l*, out of the path of movement of the plate, *m*, and permitting the latter to move back into its original position. The seating of the exhaust valve brings the sparker parts into position again. The plate, *m*, is pivoted in an eccentric journal in its bracket, which eccentric permits adjustment for earlier or later firing, while the spring on the stem of the plate insures rapid return to position at high speeds. The insulated point, *o*, is a ring of nickel screwed onto a steel stud having a flange about midway of its length. Mica washers larger than the flange are placed on this steel stud, and clamped by union nut, *p*, to the body of the plug which, in turn, is screwed into the wall of the combustion space. Either the plug may be removed as an entirety, or the union nut, *p*, can be removed, which permits withdrawing the insulated part for cleaning or inspection. This arrangement places the mica washers well away from oil and soot, and thus insures long service without loss of insulating qualities. The outer end of the insulated rod is not threaded, but is slightly reduced; and on this fits a spring clip, which, by its elasticity, tends to bind itself tightly. It may be quickly detached, but will never rattle loose, and always has a good contact. Its construction is evident from the photographs. It is likewise split at its opposite end

spring, which may be caused to force the inlet valve off its seat, thus relieving compression when desired. If, however, an explosion occurs, the elasticity of this spring is such as to permit the valve to be forced shut, and no loss of power or back firing results.

One of the illustrations represents a Duryea surrey recently shipped to Japan. The photograph was taken in front of a Japanese temple, with the Lord High Priest in the carriage. This vehicle has a triple cylinder motor of ten horse power, placed under the operator's seat, thus concealing the mechanism, while permitting perfect accessibility by removing the cushions

brittle during the manipulation. When the leaves have been hammered quite thin, these have to be bathed in lye and cleaned. The production from the melting of the material for the alloy to the pounding to bronze powder is a very slow process, and causes the cost of production to be so high.

The unceasing pressure of competition has had its influence on the prices of bronze, and for a long time brass scraps have been used for the purpose, and, on the whole, the mixture cannot be described as having suffered by this change.

The copper used in the bronze color production is

A DURYEA SURREY IN OLD JAPAN.

and front panel of the operator's seat. The motor and transmission gear give two speeds forward and a reverse, and are a unit, being on the same shaft, very compactly placed and well housed from exposure to dirt. Large bearings, large clutch surfaces, and ample power are provided; the triple cylinders being $4\frac{1}{2} \times 4\frac{1}{2}$. The wheels are 30 inches front and 36 inches rear, with 3-inch tires. The rear axle is $1\frac{1}{2}$ inch diameter and extends through both wheels, one wheel being driven by a sleeve over one end of the axle. The most marked feature is the control, which is largely located in the single vertical lever at the center of the operator's seat. The four necessary controlling functions, viz., steering, throttling, speed changing, and braking, have been made as simple as possible, and three of them are operated by the single lever, while the brake is operated by the foot. Since throttling and steering comprise the major part of controlling the motor vehicle, this arrangement is quite satisfactory, a sidewise motion of the lever steering, and twisting the handle throttling. When desired, an up or down motion puts in either the high or low gear. The reverse is operated by a heel pedal. The long wheel base and low center of gravity contribute to carriage-like comfort.

THE PRODUCTION OF BRONZE COLORS.*

By DR. EMMELL.

COPPER and zinc are original materials with which the production of bronze colors has to be started, and

FIG. 2.—PARTS OF EXHAUST VALVE AND IGNITER.

FIG. 1.—EXHAUST VALVE AND IGNITER AS ATTACHED TO MOTOR.

THE DURYEA COMBINED EXHAUST VALVE AND IGNITER.

and pinches the wire supplying the current. The sparker parts are placed directly in front of the inlet valve, where the incoming gases not only cool them, but where the mixture is most likely to be free from the burned gases retained in the combustion space. The inlet valve is quite light, and its motion is controlled by a stop adjusted by the throttle, so that a great or little opening of the inlet valve may be permitted as desired, and thus much or little power secured from the engine. This stop is likewise provided with a spring slightly stiffer than the inlet valve

since this industry found its origin centuries ago in Nuremberg-Furth, in Germany, the same materials have been used for the purpose. Gold bronze is nothing else but fine powdered brass, and brass is an alloy of copper and zinc, obtained by the well-known methods universally in use. The copper-zinc alloy is made into finger-thick rods, and then hammered by means of heavy mechanical hammers into thin leaves, which have to be annealed frequently, to avoid becoming too

nearly all made by means of electrolytical methods, and for this reason the electrolytical works use the cupriforous pyrites (i.e., the quantities out of which the sulphur has been burned), with sodium sulphate (after such has been pounded into small fragments and roasted), when a copper sulphate is formed, and this is lixiviated in suitable tanks. The cupriforous roasted material can easily be obtained from sulphuric acid works. Only Spanish pyrites should be used, as these only contain the needed quantity of sulphur.

It is different with the preparation of the zinc which has to be used. The zinc supply rests mainly in the hands of the old brigade, who produce it from zinc-containing materials, and not after the new electrolytical method, which is best described as the dry process.

The zinc obtained by the old method contains, in spite of refining (as has been proved by Schnabel), iron, lead, cadmium, copper, antimony, if only in small quantities, but sufficient for certain alloys, which, under given circumstances, can seriously affect the quality and the product for which it is used. The zinc produced by the electrolytical method becomes through the electrolytical separation of the impurities of the metal a pure zinc metal, and the latest methods make the production of a chlor-zinc solution quite easy.

It is natural that the excellence of a bronze or a metal alloy (brass) should depend on the purity of the metals employed. But for this one thing is still wanting, and that is the electrolytical production of metallic solid zinc by means of an effective and cheap method. It must be stated that prominent manufacturers have spent much time and money to find a proper solution of this problem. Had the attempts been successful to make electrolytic, solid blocks of zinc, it would have been possible to supply the bronze-color industry with a chemically-pure zinc metal. The electrolytic production of zinc has been successful, as a whole, but not for our purpose, because the soluble and insoluble anodes in the electrolytes produce, in spite of all technical care and foresight, a sponge-like, very difficultly refundable metal.

To obtain, on the one hand, pure metals as material, and on the other hand to avoid the wearisome and expensive hammer and annealing process, the electrolytic production of brass-leaves out of an electrolytic alloy comes very near. In this case, the chlor-zinc solution would have to be purified with the copper sulphate solution in certain concentrations and combinations, and, according to the desired color or tinge of the brass-leaves, a calculation would have to be made to find the quantities needed for the several alloys. These quantities would have to be fixed for both materials of the electrolytes, which could be added to from time to time as the electrolysis requires it. As the physical properties of both metals are very different, the mixed electrolytes would have to be worked with an alternating current to produce a mixture of metallic zinc and copper in the form of thin leaves, which could at once, without any other preparation, be used for pulverization. This process would only need an addition of suitable fatty substances. The unrippled surface of the leaves as produced by the purified and hammered metal can be obtained without difficulty. Technical reasons point out that in this way a more fiery and, in grain, softer material would be obtained. The experiments hitherto made on a small scale with mixed electrolytes have been accompanied by some difficulties, but they were successful, and point to an increased use of the method in future.

Several years ago experiments in this direction were made, but it is not quite clear if the same ideas

*From Oils, Colors and Drysalteries.

served at the time as a basis, or if other methods were intended. As the matter is of great industrial importance, further experiments should be made, and, without doubt, improvements in this line could easily be shown. A careful calculation as to cost should at first now be the deciding factor, because, at the present time, only the copper employed is of electrolytical origin, and the old kind of zinc metal has still to be used; but, as the future is sure to bring an improvement in this direction, the present calculation is sure to be materially altered. In some factories the new method has already been introduced and found of advantage; but to make it the real and needed success, it requires the support of the whole bronze-color industry, which will reap the benefit of all the advances and improvements.

Look, for instance, at the chemical industry, as an example. Means were found to open new ways, and the ceaseless work and energy have produced numerous, often unexpected, innovations and inventions which have made the chemical industry one of the foremost in the whole world. Look at the coal-tar industry, which, at its beginning, had not the means it possesses now; but enterprise has brought success.

The road to other experiments may be pointed out which undoubtedly will also lead to the reward to which it is entitled. The molten alloy of copper and zinc is led alternately through a thin spout in a constructed battery of tanks, which have been filled with a sufficient quantity of water. To maintain a constantly equal temperature of the water lower than the temperature of the air, it is necessary to cool the tanks by means of ice. Each tank receives only a few pounds of molten metal. There are already patents in existence for pouring the molten alloy into water, but without regard to the temperature of the water, when the metal forms into little balls, which have to be rolled to leaves and must be annealed several times during the process.

When metal of, say, 1,000 deg. C. and water of 5 to 7 deg. C. come into contact, the metal is cooled so sud-

where land is costly, the locomotive has the drawback of requiring supplementary tracks for its passage from one end to the other of the train, or of the terminal loops. The operation to be performed, moreover,

the traffic. In fact, it is advantageous to have a tractor normally haul only the load for which it was calculated, and so the conditions become defective when, at the time of a special rush, such load has to

FIG. 3.—COMBINED LOCOMOTIVE AND BAGGAGE CAR OF THE RAILWAY OF THE WEST.

is lengthy and incompatible with a quick service. In addition, the space occupied by the locomotive diminishes the effective length of the platforms. For metropolitan lines, preference is given to the use: (1) of isolated motor cars that do not possess the character of locomotives, since they carry passengers; (2), of, for more important traffic, these same motor cars coupled to one or two trailers, which, unfortunately,

be increased. This consideration is very important for all metropolitan and suburban lines, the traffic of which greatly varies according to the season, the day of the week, and even the hour of the day.

One of the most serious questions for city and suburban lines, as well as for those of which we shall speak further along, is that of adhesion. We know that the adhesive weight of a train, or the weight

FIG. 2.—FRONT OF THE LOCOMOTIVE OF THE RAILWAY LINE OF THE WEST.

denly that it is blown into fine metal dust, when it can be pulverized or pounded without hammering or annealing, giving an excellent bronze powder without much work.

ELECTRIC LOCOMOTIVES ON FRENCH RAILWAYS.

THE Paris-Orleans Railway Company has just decided upon the prolongation of its electric line as far as Jurisy, and the trains of its trunk line, which now change locomotives at the Austerlitz station, will, after the work is finished, be hauled electrically for a distance of about fifteen miles, starting from the Quai d'Orsay. In order to assure this new service, it will naturally be necessary for the company to increase the number of its electric locomotives. The new ones will, like the old ones, be provided with apparatus of American manufacture, mounted by the Thomson-Houston Company, the establishment that installed the entire equipment of the Quai d'Orsay-Quai d'Austerlitz line.

The Railway Company of the West employed electric locomotives up to last year for coupling at the Champ de Mars station to trains coming from Saint-Lazare and running to the Invalides. This operation of changing engines, which retarded the service, having been done away with, the electric locomotives are now employed for the traction of a certain number of the trains of the Versailles line.

In Figs. 1, 2, and 3 are shown the locomotives, or electric "locomotors" of the Orleans and West lines, which are of very different aspect and bear no resemblance to the engines that we are accustomed to see at the head of ordinary trains. Like steam locomotives, however, they are the result of the application of the same principle, which consists in the running of a train by a single vehicle and one that is designed for traction solely. With the use of the steam engine, this is obligatory because it is necessary to carry a boiler that may be of large size, and because the motive parts must be situated in proximity to the production of steam. With electricity, the case is no longer the same. It is easy to understand the inconveniences that are presented by the grouping of the motors of a train upon one vehicle designed exclusively for traction, that is to say, upon one on the principle of the tractor.

In terminal stations situated in the center of cities,

FIG. 4.—DIAGRAM OF THE TWO LOCOMOTIVES.

are no better adapted for reversal of direction than trains that are hauled by locomotives; (3) or, often, of trains with two motor cars, one at the head and the other at the rear, and capable of running in both directions.

Trains drawn by locomotives, trains consisting of a motor car coupled to a trailer, and trains having a motor car at the front and rear have one serious drawback, and that is of not readily lending themselves to a modification in length according to the necessities of

supported by the driving axles, limits the effective force that the latter are capable of yielding. If such force is greater than about seven times the adhesive weight, the wheels will revolve without moving forward. The result is that the motors of a train must be heavily weighted. Since, in electric traction, there is no longer any necessity of carrying with the trains the generating apparatus (boiler, etc.) which in steam traction constitutes a natural adhesive weight, it becomes necessary to supercharge the tractor, artificial-

FIG. 1.—THE ELECTRIC LOCOMOTIVE OF THE ORLEANS LINE.