ployed for the measurement of strong magnetic fields. The Hall effect differs somewhat when the magnetic field is reversed in direction. This is no doubt due to the position of the axes of the majority of crystals forming the plate. The author cut a circular plate of bismuth sulphide and rotated it about its axis while keeping the position of the Hall effect electrodes constant. The difference between the two Hall effects obtained with upward and downward magnetic fields respectively varied from place to place and was reversed in sign at some points. To discover a possible effect of a surrounding magnetic medium, the author covered the plate with a thin coating of varnish and immersed it in cold water and subsequently in a strong solution of ferric chloride of the same temperature. No difference was observed in the Hall effect in the two cases.—E. van Aubel, Phys. Zeitschr., September 1, 1903.

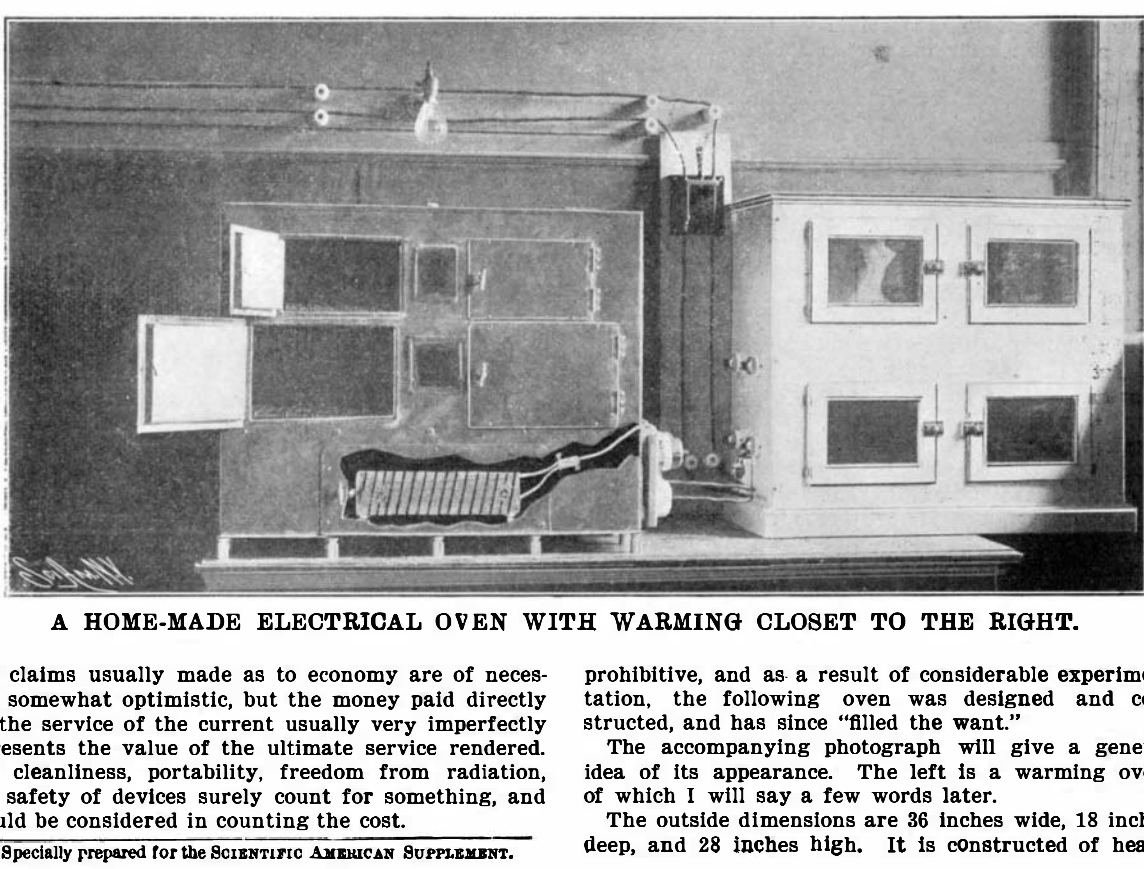
General Radio-activity of Metals.—J. S. McLennan and E. F. Burton have found that when a cylinder of any metal is inclosed within a second cylinder of the same material, insulated from it, and surrounded by air or other gases, it gradually acquires a negative charge, and after a short time reaches a state of equilibrium at a definite potential below that of the inclosing cylinder. The authors experimented with cylinders of aluminium, zinc, lead, tin and copper, and measured the potentials with a quadrant electrometer giving a deflection of 1,000 millimeters at a distance of 1 meter for 1 volt. The final potentials reached were — 179 millvolts in aluminium, — 160 in zinc, — 216 in lead, — 95 in tin, and — 73 in copper, these values closely corresponding to the Volta effects. Under the influence of Becquerel or X-rays, the same potentials were reached in a few seconds. The authors connect the facts specified with the discharge of positive corpuscles by a red-hot metal, and believe that every metal gives off more positive than negative electrons, thus acquiring a negative charge, which, owing to the ionization of the air, cannot exceed a certain value.—McLennan and Burton, Phil. Mag., September, 1903.

Electrolysis and the Solvent.—C. A. Lobry de Bruyn has endeavored to obtain quantitative data bearing upon the question as to whether the ions carry the solvent with them in electrolysis. The matter cannot, of course, be decided by using purely aqueous solutions, since the solvent would then be everywhere the same. But the author uses a mixed solvent consisting of water and methyl alcohol. Then, if one of the ions carried with it one of the solvents, this would be found out by the difference in the proportion of the two solvents at the cathode and anode. The electrolyte used was silver nitrate dissolved in 25, 35, and 64 per cent solutions of methyl alcohol, with electrodes of silver. The apparatus was that used for determining transference numbers of the ions. The result was distinctively negative. If the silver or nitrogen-oxide ion had carried with it one molecule of the solvent, then for every 4 grammes of silver an increase or decrease of 0.6 to 0.7 gramme of water or of about 1.2 grammes of alcohol at the anode or cathode would have taken place. This would have been plainly detected by the analysis, even though the amount had been largely diminished by diffusion.—C. A. Lobry de Bruyn, Proc. Roy. Acad. Sc., Amsterdam, August 27, 1903.

HOW TO BUILD AN ELECTRIC OVEN.*

By H. Schmidt.

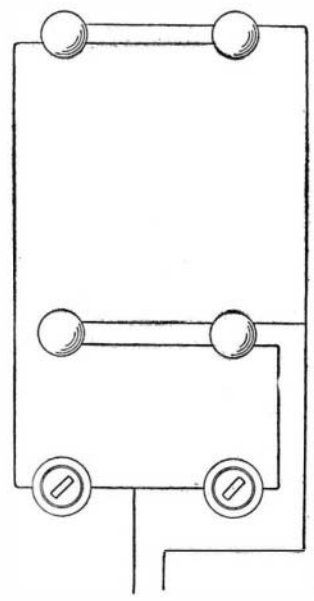
Of all the many useful applications of the electric current, there is not one which it so easily lends itself to as the production of heat. This is exemplified in the incandescent lamp, arc lamp, etc. To utilize this heat in an economical and easily transformed manner, is the object of all builders of electric heating devices.



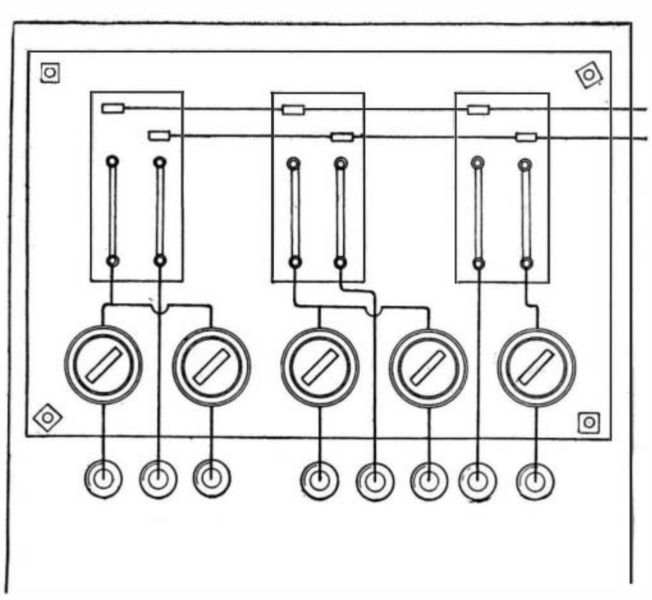
A HOME-MADE ELECTRICAL OVEN WITH WARMING CLOSET TO THE RIGHT.

The claims usually made as to economy are of necessity somewhat optimistic, but the money paid directly for the service of the current usually very imperfectly represents the value of the ultimate service rendered. The cleanliness, portability, freedom from radiation, and safety of devices surely count for something, and should be considered in counting the cost.

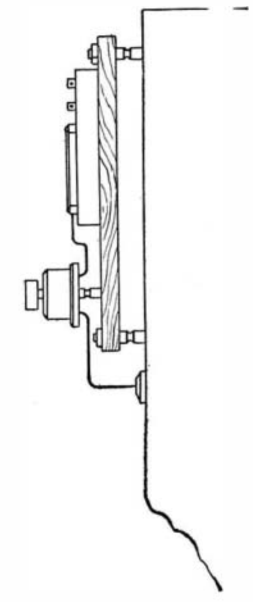
As this article treats essentially of an electric oven, I will confine my remarks to it. The electric oven, unlike any other, can be regulated so that the cook may know exactly what results will follow with a certain manipulation. The heat produced is always the same with the same setting of the switches. Cooks and domestic science teachers agree that all roasting and



WIRING OF WARMING CLOSET.

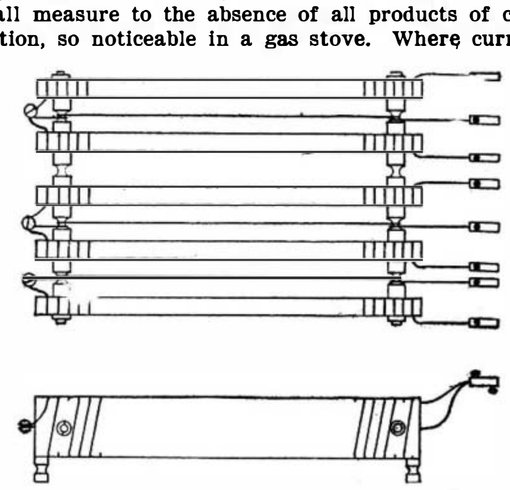


THE SWITCHES.



SIDE ELEVATION OF A SWITCH.

baking of meats can be done perfectly, and that in baking bread, pastry, etc., results are obtained far beyond all other methods of baking. This is probably due to the uniform heat and freedom from air currents. No oven can be made so air-tight as the electric one, and the air being in constant contact with and internally circulating over the heating coils, produces very remarkable results, which are attributable in no small measure to the absence of all products of combustion, so noticeable in a gas stove. Where current



HEATING COILS OF THE OVEN.

in same quantity is available, such as in isolated or private plants, the electric oven is the "thing."

Some time ago it fell to my lot to advise and plan for an electric oven which would fulfill certain conditions, in the domestic science department of a school. The heat to be obtained was to vary from 250 deg. to 700 deg. F., all processes going on within the stove to be perfectly visible, and the stove to have a capacity of thirty 6-ounce loaves of bread. The excessive cost of an oven made by electric heating concerns was prohibitive, and as a result of considerable experimentation, the following oven was designed and constructed, and has since "filled the want."

The accompanying photograph will give a general idea of its appearance. The left is a warming oven, of which I will say a few words later.

The outside dimensions are 36 inches wide, 18 inches deep, and 28 inches high. It is constructed of heavy planished iron on the outside. The inside is common sheet iron separated from the outside wall by a one-inch space all around filled in with asbestos. In the center of the top there is let in a heavy plate glass 4 x 18 inches, above which is mounted a 32-candle-power lamp, as shown. This in combination with the glass peep-holes in front of the oven render all interior parts of the oven visible. The shelves are of heavy iron screening.

The heating coils are of simple construction, and have the advantage that if burned out they can be replaced at a cost of a few cents. As shown by the diagram, there are five, made of 1-inch x 6-inch x 24-inch slate. In the top and bottom edges ¼-inch grooves, spaced ⅜ inch, are cut with a hack saw, making fifty-six grooves. In these are wound coils of No. 10 common iron stovepipe wire, making about 61 feet. This will permit a flow of about 33 amperes under a pressure of 110 volts when the current is first turned on; but on account of the high temperature coefficient of electrical conductivity of iron, the resistance increases very rapidly, so that at the expiration of about half a minute the current drops to about 15 amperes. This makes the wire barely red hot; after the slate gets hot the current is still further decreased, so that normally each coil consumes about 12 to 13 amperes. These figures will vary slightly, due to the differences in gage and quality of the commercial wire.

The wire should not be red hot, as oxidation sets up very rapidly at this temperature, and speedy deterioration results.

At the ends of the slate 5-16-inch holes were drilled, through which passed a ¼-inch iron rod threaded at each end. "No. 5 standard" porcelain knobs were used as spacers. This makes it easy to handle the coils, and introduce them as a whole through the large bottom door of the oven. Wound around the knobs between the coils are short lengths of bare No. 6 copper wire. These are looped at the left-hand end, and a ¼ inch by ⅜ inch stove bolt with washers is passed through this, and the ends of the iron wire secured under the washers. For removal purposes the ends of the wires are provided with screw connectors, which are attached to the ends of wires to the switches. The coils are raised 1½ inches from the floor of oven by means of porcelain knobs.

About 9 inches above the bottom of the oven, on the right-hand side, eight ⅝-inch holes were made, through which 1¼-inch x ⅝-inch porcelain bushings were passed, luted in place by means of asbestos cement. These are for the purpose of passing the wires from the switches into the stove, and then making connections with the coil wires. As copper conducts the heat readily, the wires on the switchboard must be bare, and the switches must be mounted about an inch above the wooden base, by means of porcelain knobs. Details and connections are shown in the diagram. Switches are single-pole indicating "Hart" snap switches. The cutouts are 30-ampere "Noark" fuse-blocks. A No. 4 wire should be used to connect stove with electric mains.

When bread and cake are to be baked, three coils usually furnish enough heat, for pastry four, and for high heat five. The slates retain their heat for a long time, and furnish enough heat to complete the processes in hand if turned off 15 to 20 minutes before completion.

The warming closet on the right in photograph is used for raising bread, etc. It is 36 inches wide, 18 inches deep, and 32 inches high. It is made of wood, lined with asbestos paper; the front is removable. In the middle and near the bottom are two frames 4 inches deep and fitting the inside of the closet. They are covered on the top with a heavy wire screening covered with asbestos, leaving a 2-inch space all around for circulation. To either end of frames electric light receptacles are fastened carrying 16-candle-power lamps. By means of switches, any two or all of them may be lit, producing a temperature of 180 deg. F. in ten minutes. Almost any temperature may be maintained, from 75 deg. to 180 deg. F.

Both of these ovens have worked admirably, and the

* Specially prepared for the Scientific American Supplement.

dimensions given herein will suffice for almost any size oven, provided the proportions of spaces heated and energy consumed are kept.

COMBINED CONDENSER AND OIL ELIMINATOR FOR STEAM AUTOMOBILES.

THE accompanying photograph and diagram show the general appearance and construction of a condenser that can be fitted to any steam automobile. The condenser is attached by means of suitable lugs and brackets to some convenient place on the front of the machine. The exhaust pipe of the engine is connected to the opening, *A*, in the center rear face of the condenser. An overflow pipe, *B*, comes down behind the condenser as shown. The water from the condensed steam accumulates in the steam trap, *K*, after passing through the quarter-inch pipe leading from the bottom header of the condenser into it. The object of the

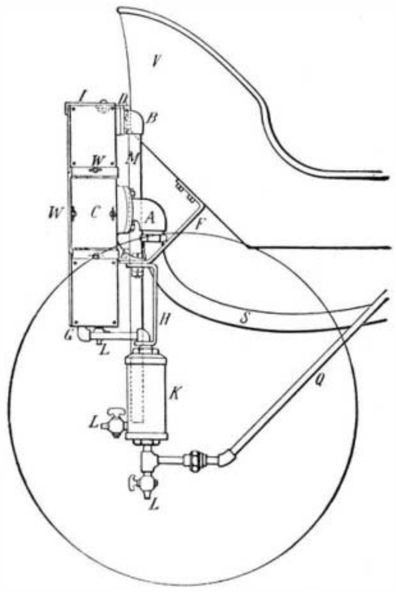
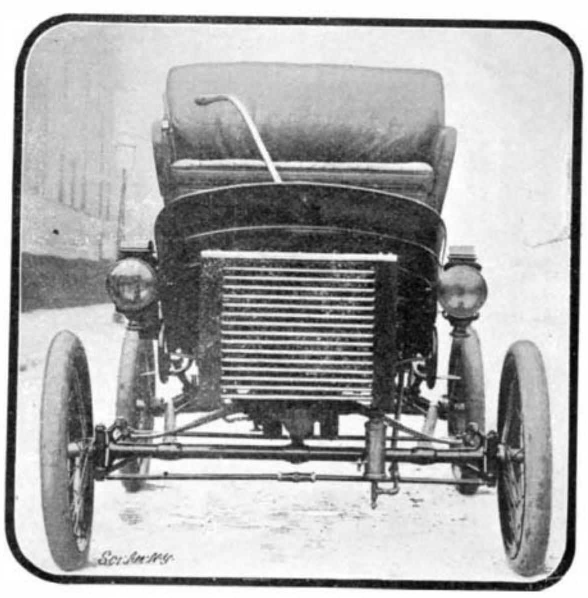


DIAGRAM OF CONDENSER AND OIL ELIMINATOR.

steam trap is to automatically send back the water into the tank without the use of the pump. For this purpose a ¼-inch pipe leads from the bottom of the trap up into the top of the water tank.

The oil eliminator is in the condenser and is packed after removing the main plate, *C*, in the following manner: In the chamber in which the exhaust steam enters first place the screen and then clean cotton waste or excelsior. Replace the gasket and plate and screw the nuts up tight. The cotton waste or excelsior must be replaced with fresh packing when it no longer absorbs oil. If the oil eliminator is packed in too tight, it will create a back pressure on the engine. Care should be taken to avoid this. When the engine is first started, exhaust steam will blow out through the overflow, *B*; but as the machine gains speed and the air strikes the condenser, this exhaust steam will stop discharging and will condense, while the condensation will be periodically discharged by the trap into the water tank.



THE BRANCH CONDENSER ON A TOLEDO STEAM CAR.

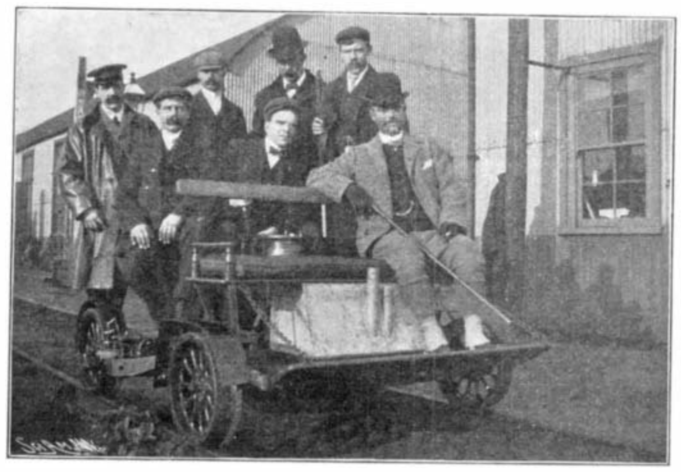
These condensers can be used with any boiler, whether of the flash, water-tube, or fire-tube type. As they are now made, radiating flanges are placed on every other tube. They are manufactured by the National Oil Burner and Equipment Company, of St. Louis, Mo.

American Fruit in Germany.—The present year has witnessed a great increase in the imports of American apples into Germany. For the first eight months of 1903 the imports were 3,696 metric tons of 2,204 pounds each, against 214 tons and 543 tons during the same months in 1902 and 1901. Of American dried fruits, baked and simply preserved, the German imports for the same period were 25,251 tons, against 11,981 and 12,060 tons, respectively, in 1902 and 1901.—Richard Guenther, Consul-General, Frankfort, Germany.

GASOLINE INSPECTION CARS FOR RAILWAYS.

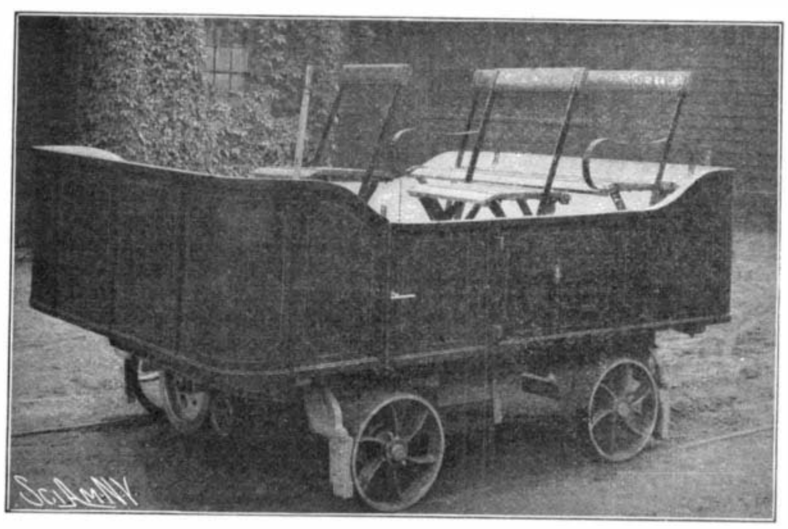
By the London Correspondent of the SCIENTIFIC AMERICAN.

Two new forms of inspection cars have recently made their appearance in London, the one the invention of Mr. Robert W. A. Brewer, and the other the invention of Mr. Frederick R. Simms, whose motor war-car, described in these columns not so long ago, readers will doubtless remember.



A NEW GASOLINE RAILWAY-INSPECTION CAR.

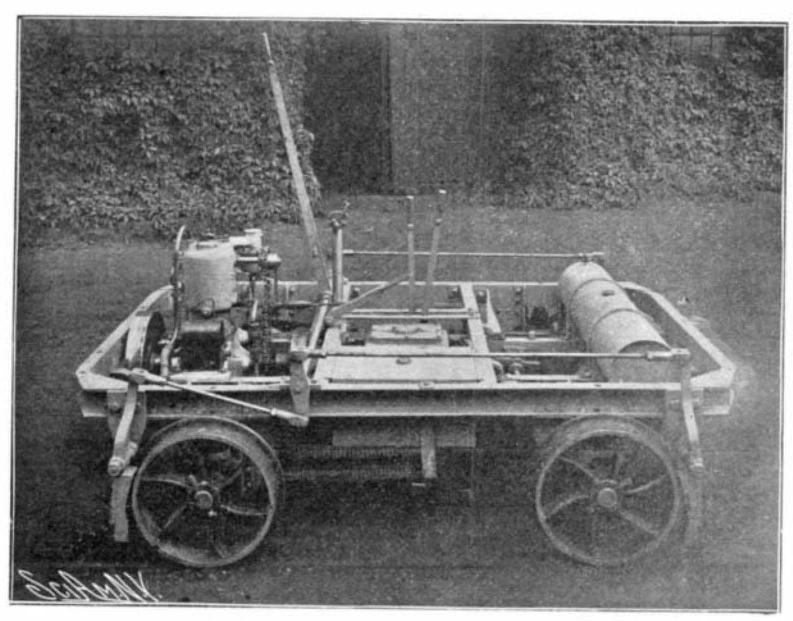
Mr. Brewer's car is distinguished by the simplicity of its construction. No springs are employed; the axles run in brasses bolted on the frame of the car. The cylinders are outside of the frame. All valves are vertical and are mechanically operated. The lever which controls the timing of the ignition spark also holds open the exhaust-valve when in the "off" position, so that, when running down grade, there is no compression, the ignition current being, of course, then cut off. The carbureter is located below the gasoline tank (the capacity of which is two gallons). The quantity for each charge is regulated by a needle-valve, the lever of which works over a graduated scale on the tank. Storage arrangements are provided for additional quantities of gasoline. The car, however, is said to run nearly one hundred miles on two gallons. The engine is of slow speed, making about 500 revolutions per minute, the wheels being twenty inches in diameter. This small consumption can be accounted for by the fact that there is no gearing, the speed of the engine being proportional to that of the car. The vapor-pipe branches on reaching the car-frame, one branch running to each engine. A check-valve is provided on the cylinder side for the regulation of the air supply to the engine, which valve requires setting only once. The strength of the mixture can be appreciably altered by the admission of air to the carbureter. The water circulation is by thermo-siphon, a tank of considerable capacity being located under the front seat. Owing to the very slow speed of the engine, very little heat is given up to the jacket-water. The ignition is of the single-circuit, low-tension, moving-contact type. Twelve dry cells supply the current. The induction coil is under one of the seats.



SIMMS INSPECTION CAR IN TIME OF PEACE.

Since there are no vibrators, no adjustment is required. The moving contacts work in lava insulators, and are screwed down in mica washers. Mr. Brewer finds a break of about 3-32 of an inch gives the best results. The cam-shaft is worked by a bicycle-chain, from the back axle. The cams are loose on the shaft, a tongue-piece being so arranged that the engine will work equally well in either direction, since it is driven by a fixed key on the shaft.

Mr. Simms' car may be used both in war and in peace. In time of peace it may serve for the inspection of the permanent way, for sending dispatches, as well as for piloting ordinary trains. In time of war, the car is intended for the protection of railway lines and for the maintenance of continuous communication. The machine is not intended to dispense with armored trains; on the contrary, its purpose is to assist these in their operations, by doing independent scouting work.



CHASSIS OF THE SIMMS INSPECTION CAR.

These railway war machines, being armor-plated and carrying a one-pounder Maxim gun, as well as a small machine-gun, are intended to be employed in larger numbers than the armored trains. Each machine forms, so to speak, a little self-contained fort ready