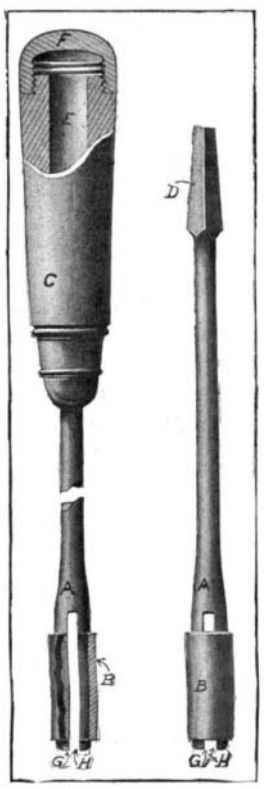
overshoes and like portions of the felt boots is constantly occurring when these foot coverings are worn, the heels of the felt boots quickly wear out and the boots become useless. The present invention, therefore, provides a waterproof leather heel protector shown more clearly in Fig. 2, which is adapted to be slipped over the felt boot, fitting snugly over the heel and extending well up over the ankle. This prevents the wearing of the boot by friction at the heel or at the top of the rubber shoe. A flap or skirt-piece is secured to the upper end of the heel protector, and is adapted to cover the top of the rubber shoe, preventing snow, slush or rain from entering the shoe. Messrs. S. W. Wehn and C. W. Oler, of Everett, Pa., are the inventors of this improved foot covering.

MAGNETIC TOOL HOLDER.

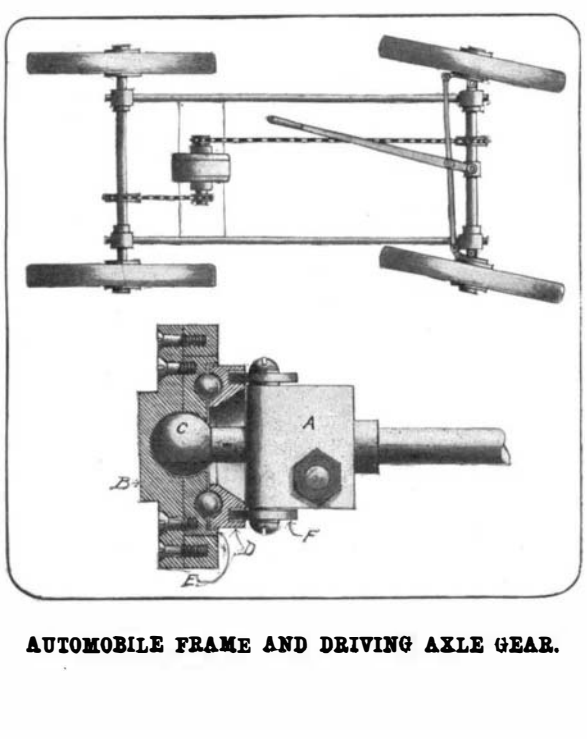
Considerable trouble is often experienced with the screw chucks of an ordinary tool holder, because the tool blade is either too loosely held or else so tightly gripped that it cannot be readily removed. These difficulties are overcome by a new type of tool holder recently invented by Mr. Charles Bellows, of 137 High Street, Boston, Mass. The tool holder as shown in our illustration comprises the shank *A*, with the usual handle, *C*, and the chamber *E*, for the various sizes of tools, also cap *F*, covering the chamber. The lower end of the shank *A* is slotted, forming fingers *G* and *H*. The fingers are of steel and are hardened so as to form a permanent horseshoe magnet. The shank of the tool blade is inserted between the fingers, fitting snugly therein, and is held in position by magnetic attraction. To prevent the fingers from spreading apart when the tool is in use they are encircled by a sleeve of non-magnetic material, such as Benedict metal, which is snapped into the seat formed on the fingers. While the tool is being used, for instance, in driving or removing a screw, the blade will naturally remain in the holder. The magnetism is merely strong enough to retain the blades when they are not in use. Obviously, this form of chuck permits a great saving of time in changing the blades. Where the holder is to be used with a brace or the like, in place of the handle, the shank is provided with a squared end to fit the bit stock.



A MAGNETIC TOOL HOLDER.

AUTOMOBILE FRAME AND DRIVING AXLE GEAR.

The desirability of connecting the driving power of an automobile with the front instead of the rear wheels, is offset by the difficulty of making connections such that the steering will not be interfered with, and this difficulty has proved an interesting problem for inventors. We show herewith a very good solution of the problem, for which a patent was recently granted to Mr. George R. Boulding, of Wells, Nev. The patent covers also an improved automobile frame which is flexible, enabling the vehicle to ride easily over an uneven road, with all four wheels continuously in contact with the ground. The front and rear axles form part of the frame, being connected with the side frame rods by boxes, *A*, as shown in our detail view. The axles are mounted to turn freely in the boxes, so that the boxes can swing to take up any unevenness in the road. The hubs of the rear wheels may be of any desired pattern, but a special construction has been provided for the front wheels, which permits them to be slewed independently of the frame in steering, and which also permits one wheel to run faster than the other, in rounding corners, thus preventing sliding of the wheels. The front axle is provided with spherical ends, *C*, which enter spherical cavities formed in the hubs. Each hub is made up of two sections, a disk, *B*, and a ring lying along its periphery. Within this ring lies the plate, *E*, which has a ball-bearing on the member, *D*. The member *D* is provided with grooves, near the top and bottom in which the disks, *F*, enter, the latter being mounted on the boxes, *A*. The bottoms of these grooves are convex, so that the disks bearing against them will hold the member, *D*, firmly against the plate, *E*, when the former, which is connected with the steering rod, is swung about in rounding curves. Swinging the member, *D*, therefore, causes the hub to be turned, also, on the spherical portion, *C*, as a pivot. It will be observed that the center opening of the member, *D*, is tapered so as to prevent it from binding on the axle no matter at what angle it is turned. Connection between the hub and the axle is made by means of a pair of spring-pressed pins in the hub, which engage notches in the spherical portion, *C*. In our illustration, the section is so taken that neither of the pins can be seen, but one of the notches is shown. The ends of the pins are beveled so as to engage the notches only when the axle turns forward. In rounding curves, the outer wheel will have to run faster than the inner wheel and the axle by which it is turned. When this occurs, the axle will be moving backward relative to the outer wheel, and this is permitted by reason of the beveled ends of the pins, which slide freely over the notches when they travel in that direction.



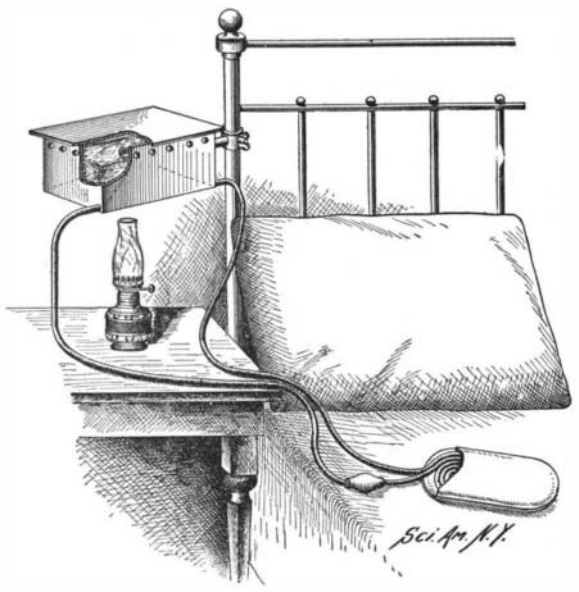
AUTOMOBILE FRAME AND DRIVING AXLE GEAR.

ODDITIES IN INVENTIONS.

FOOT-CYCLE.—A German inventor has designed a foot-cycle of improved construction, in which the springs for raising the foot usually found in such devices are avoided. The support is thus steady and solid, even when the person is at rest. The driving wheel is located under the center of pressure of the wearer's foot, and this enables the person to move in smaller circles than with the usual construction. The details of this cycle may be readily understood from the illustration. Two spring pawls are secured to an extension from the foot-plate, and are adapted when pressed downward to engage projections formed on an endless chain, but to slide by the same when drawn upward. The chain is thus driven forward positively at every downward stroke of the foot, and its motion is communicated through intermediate gearing to the driving wheel. A brake is situated on the forward end of the device, which may be operated by downward pressure at the toe to frictionally engage the driving wheel.

FOOT-CYCLE.

HOT-WATER BAG.—Hot-water bags as commonly made consist merely of a rubber casing in bag form, which is adapted to be filled with hot water. After a time the water loses its heat, and for further use the bag must be emptied of its contents and refilled with hot water. We show here a hot-water bag of improved design in which a constant circulation of hot water is maintained and the inconvenience of refilling the bag is entirely avoided. The device will be found very useful for the sick-room. The bag consists of a casing in which a rubber tubing is snugly coiled. This tubing leads to a reservoir, which may be clamped at a convenient height to one of the bedposts. The water in the reservoir may be properly heated by a lamp placed thereunder. The bottom of the reservoir is bent upward in the shape of a cone, from the apex of which a short tube opens at the top into the interior of the chamber. Heat from the lamp is thus utilized to the best advantage, the products of combustion being drawn up into the reservoir and passing out through perforations in the side walls. The rubber tubing, at a convenient point, is provided with a pressure bulb, at each end of which is a valve. These valves are normally open, so as not to interfere with the proper circulation of the water. By compressing the pressure bulb and subsequently relaxing the pressure, the flow of water may be positively regulated.



HOT-WATER BAG.

MILK-DIPPER.—With the ordinary type of milk-dipper considerable difficulty is often experienced on account of its awkward shape. The usual construction comprises a cup and a long handle, by means of which the milk may be dipped up from the can and poured into the bottles or measures. The cup, as a rule, cannot be filled to the brim, because a large quantity of milk is apt to be spilled in removing and emptying the dipper. We illustrate herewith a milk-dipper which is provided with a tightly-fitting lid. This may be opened by drawing together two levers on the handle. As soon as the dipper has been filled to its full extent, the levers are released and the lid drops down under spring pressure to closed position. The dipper may then be carried to the point desired without danger of spilling the contents. When the dipper is to be emptied the levers are again pressed, opening the cover, and the milk can be poured out as usual. Thus it will be seen that the dipper may also serve as a measure for the quantity taken from the can, since it may always be filled to the limit without danger of spilling.

MILK DIPPER.

Making Fuel from Garbage.

A recent patent granted to Mr. Eugene C. May, of 67 Wabash Avenue, Chicago, Ill., describes a new process of making fuel from garbage. The garbage after being first cleared of metal and glass pieces, or any other undesirable substances, is run through a crusher which breaks up the brittle portions and reduces the softer substances to pulp. About three per cent. of calcium chloride is added to disinfect the mass and it is then dried by evaporation. About 400 pounds of crude oil is now treated with 10 pounds of potassium protoxid, which causes the oil to coagulate and form a soapy substance. The oil is then thoroughly mixed with a ton of the dry garbage, and, with 3 per cent of coal tar as a binding agent, is molded into briquettes ready for use. It gives a clear, dry flame and is entirely free from offensive odors. The fuel was recently subjected to a test by Prof. W. T. McClement, of the Armour Institute of Technology, Chicago, and it yielded the following results:

	Per cent.
Moisture	8.10
Volatile combustible matter	80.387
Fixed carbon	6.06
Non-combustible matter	5.45

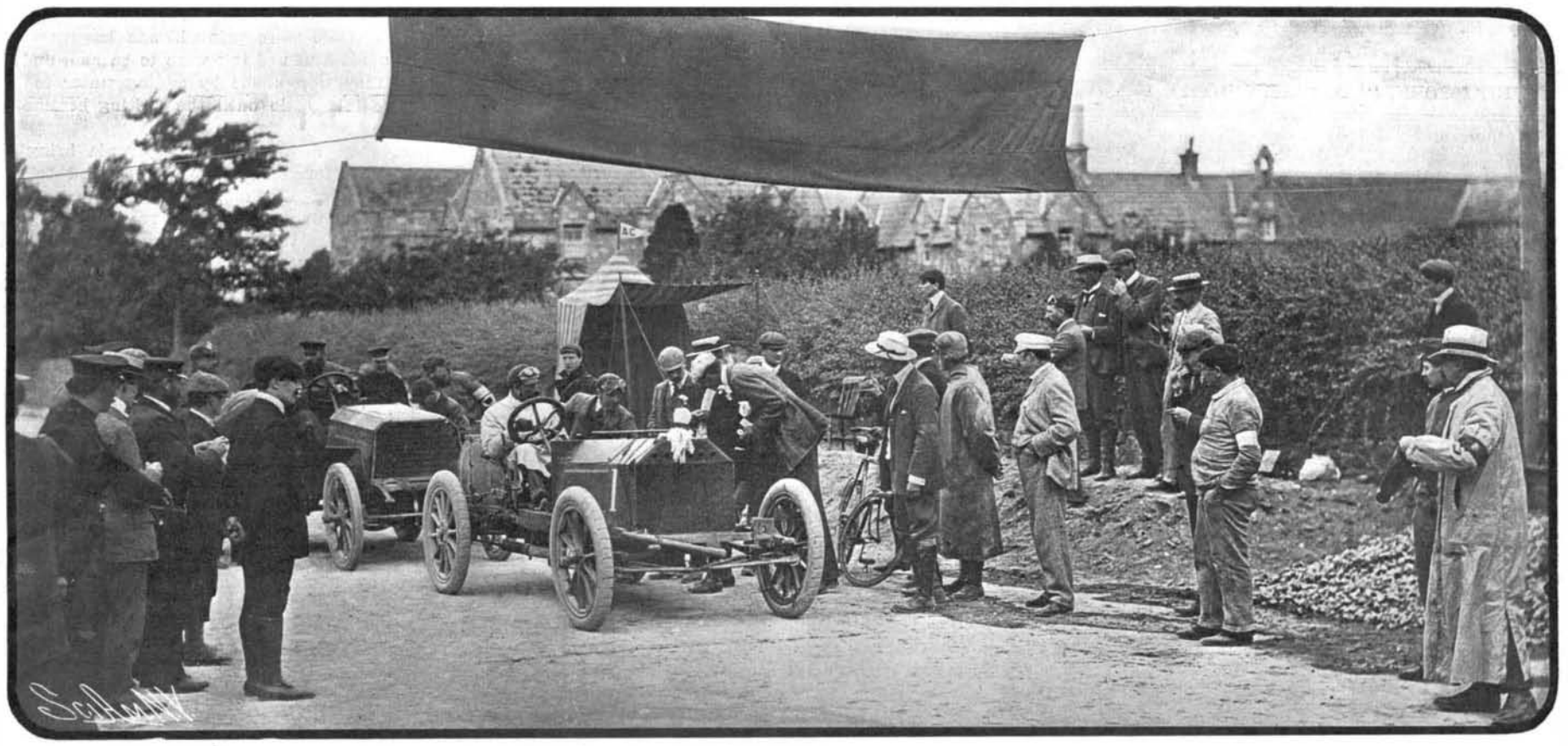
The calorimeter gave the following results, the fuel being burned in oxygen:

One pound fuel yielded 21,387.8 British thermal units. This is equivalent to evaporating 22.1 pounds of water per pound of fuel. Ordinary soft coal should evaporate from 11 pounds to 14 pounds of water per pound of coal. Anthracite coal yields sometimes a little more.

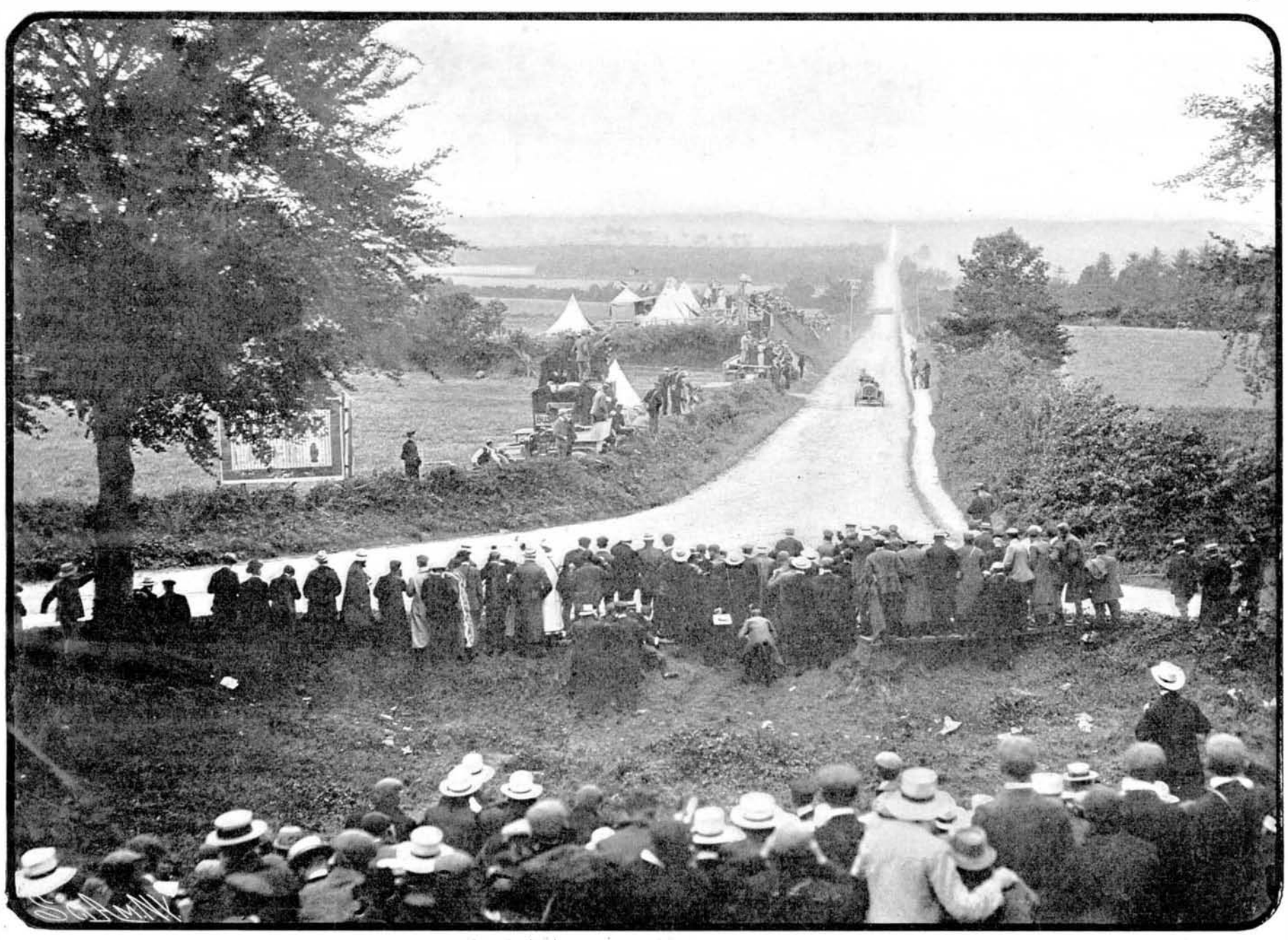
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1903, by Munn & Co.]

Vol. LXXXIX.—No. 4. ESTABLISHED 1845.] NEW YORK, JULY 25, 1903. [8 CENTS A COPY $3.00 A YEAR.



In the Athy Control. The First Car is Mr. Edge's Napier, the Second Baron de Knyff's Panhard.



Baron de Caters Climbing the Hill at Ardscull.

THE AUTOMOBILE RACE IN IRELAND FOR THE GORDON-BENNETT TROPHY.—[See page 61.]