

wheel which for the time being is on the inside of the curve, has a shorter distance to travel in a given time than its fellow on the outside, and consequently requires to run at a slower speed, or, like the man at the inner end of a rank of soldiers when wheeling, to "mark time." Where both wheels are rigidly connected and unable to turn independently, one or both must slip on the road surface, to the destruction of the tyres and the discomfort of the passengers. The tendency has been to make these differential gears too small for the work they are called on to perform, but this defect has been remedied in most cars.

WATER COOLING.

Some system of cylinder cooling is necessary to the proper working of the petrol engine. Cooling may be by air or water. Air cooling, which is only used on small-powered engines, may be by simple radiation (as on the motor bicycle), or by a forced draught from a fan or scoop arranged to supply a current of cold air to the outside of the cylinder and combustion chamber. Water cooling is effected by causing a constantly moving or circulating body of water to flow through an outer chamber or jacket surrounding the cylinder and combustion chamber. In gravity, or thermo, feed, a tank is placed above the water jacket; as it is heated by the engine it rises, and emerging from the top, finds its way through radiators back to the tank. Forced circulation by pump, however, is preferable. Sometimes it is so arranged that if the pump fail, natural circulation will take place. It is possible to keep the water too cold. If the temperature of the water is below that at which the vapour is formed, a large proportion of the heat generated by the combustion goes to heat the cylinder walls. The circulating system should be designed to prevent air locks, and an air cock should be provided at the highest point of the system and a drain cock at the lowest, so that for cleansing purposes and in frosty weather the water can be easily run off. The car should have not less than half a gallon of water per indicated horse power. The temperature of the water leaving the cylinder jacket should be about 170 degrees Fah.

LUBRICATION.

Pure gravity feed consists of a sight feed cup of toughened glass with a metal cap, in which is a little shuttered air-hole, the closing of which regulates the supply through the tube beneath the cup to the part to be lubricated. This is the simplest form of gravity feed. Splash lubrication is very universal for all bearings inside the motor, such as those for the crank-shaft, cam-shaft, and cams enclosed gears and the lower ends of the connecting rods. It simply consists of a bath of oil inside the crank chamber, the cranks dashing the oil over all the working parts. It is a dirty but thoroughly effective system, and is also used for the differential gear and the change speed gearing. In the physical system, means are employed to utilise the pressure from the exhaust or water system; under this action special means are employed to force the oil along the branch pipes leading from the lubricator. In pressure feed the reservoir may be placed in any position, and below the level of the parts to be oiled. In this case either the oil is forced through the pipes by an automatic force feed pump worked by the engine, or part of the exhaust gas is diverted through a non-return valve into a reservoir, maintaining a pressure on the oil of two to four pounds, as may be required.

THE CLUTCH.

A satisfactory clutch is one of the most difficult things to secure. The ordinary type of cone clutch, which is covered with leather, can rarely be maintained in a normal condition, for the following reasons:—A great command over the car, especially in driving through traffic, is secured by allowing the clutch to slip. When the slipping has been going on for some time the clutch will not grip at all, or it grips violently or harshly. The result is that driving is not only most unpleasant, but is very injurious to the car itself.

FRAMES.

The frames are built up in a number of ways.

(a) Lengths of channel steel, shaped section, united at the angles of their ends, and cross pieces with strong angle pieces or braces.

(b) As described, but armoured internally with ash, which greatly increases the strength with very little weight.

(c) Built of ash and armoured on both sides with steel fitches with channel steel arms or cross pieces.

(d) Tubing frames screwed into joints which also make joint with cross pieces and stays.

(e) And lastly, the one-piece pressed steel frame, perhaps the strongest and lightest of them all.

With regard to the wheelbase, the longer this is, the steadier the car, and the greater security from side slips.

Greater care must, however, be paid to securing sufficient strength on account of the extra length.

SILENCERS.

A perfect silencer should muffle all exhaust noises without setting up any back pressure whatever. This is effected, first, by gradual expansion in a closed chamber divided up into a series of freely inter-connecting expansion chambers, and secondly, by turning the stream of gases at a right angle to its last direction, and splitting it up into smaller streams.

BRAKES.

Double-acting brakes are now fitted with a pair of metal clips arranged about the brake drum, and hinged together at one end. The motion of the brake pedal causes mechanism independent of the remainder of the braking mechanism to close the two halves inwards and grip the brake drum. This arrangement is equally effective in either direction. Expanding internal brakes are coming largely into use, one advantage being that they can be eased in away from the dirt; but a disadvantage is the adjustment, which is not so easy as external.

BEARINGS.

The types used for motor cars are plain, roller and ball. There is still a diversity of opinion amongst makers as to the best. For heavy cars excellent results without risks can be obtained from plain bearings, constructed of phosphor or manganese bronze. Roller bearings are usually fixed on back live axles and give good results. With ball bearings there is always a certain amount of risk of a ball breaking and playing havoc with its cone and journal, especially in the case of a wheel hub.

STEERING.

It is, above all things, necessary that the steering of an automobile be steady, and, in order that this steadiness may be obtained, some device must be employed which inequality of road surface will not affect. This is obtained in practice by employing a worm gear for operating the steering arms attached to the axles of the front wheels. The irreversibility of the worm gearing provides against shock being carried back to the driver, and at the same time the screw action of the worm provides a powerful control over the direction of the wheels. For light cars it is not always deemed necessary to employ such a complicated arrangement, and tiller or side lever steering is fitted.

SPRINGS.

Springs should be designed to swallow and conceal the inequalities of the road, and should rapidly absorb the work done on it while moving rapidly under the force applied to bend it. They should not oscillate much after each road "bump" has passed, and should be deflected through half their working distance when fully loaded. Springs are being made much longer now, which is a distinct improvement. The frame of the car should be slightly higher at the back from the road than the front end, so that when fully loaded the frame should be parallel with the ground. Cars can be made, and are being made, to run on solid tyres with comfort. It is, however, useless simply buying a standard pattern car and fitting solid tyres to it. Makers of pneumatic-tyred cars have counted too much on the tyres for shock-absorbing power.

While it is considered the proper thing to make bitter war on automobiles in the country, the fact remains that no other single interest is probably doing so much for farmers, the country and all concerned on behalf of good roads as the automobile. A powerful sentiment is being encouraged by automobile owners who have health, influence and ability to hasten the long-needed improvement.

There are also inspiring young engineers to make new discoveries in inventions and machinery. Hiram Maxim says:—"No other form of power producing apparatus in existence is as simple in concrete, and few more complicated in abstract have been invented since James Watt's first steam engine. It marks the greatest epoch in mechanics."

Steam automobiles were first used on country roads in England nearly three-quarters of a century ago, but it is only since the new inventions for using gasoline and electricity in producing powers that the recent stupendous progress has been made possible. In Europe kings, princes and millionaires have spent liberally to develop the industry in their various countries.

Twelve months ago "stagnation of design" was the stumbling-block of the British motor maker. The tendency to copy a certain type of popular radiator, body, or engine design seriously interfered with originality and invention. We are getting bravely away from this, and the motor engineer and body-builder alike are daring to think for themselves to the great advantage of motor evolution.

The All-British Argyll.

From all accounts, the success of the Argyll car on the English and colonial markets has been phenomenal, and it is affirmed to-day that the Argyll is one of the most popular All-British cars manufactured. One of the items that have contributed to the popularity of the Argyll is its simple and satisfactory transmission arrangement and gear box, as described in another column.

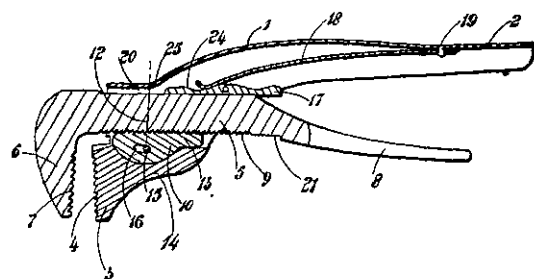
In addition to this capital gear box, the Argyll possesses many other features to recommend it—pressed steel chassis frame; tonneau bends of pressed steel, carefully tinned before painting, thus giving a roomy body for small weight; flexible engines, light weight per b.h.p., and consequently less tyre trouble. All parts are interchangeable and there is excellent coach work.

Argyll cars have scored heavily in reliability trials from 1901 to date, the most important being:—full marks for absolute non-stop run Glasgow to London, won by 10-12-h.p. car; John O'Groats to Land's End record, won by a 12-14-h.p. car, beating the previous record of Mr. Cecil Edge by three hours, twenty minutes.

The car illustrated elsewhere is a 2-cylinder 10-12-h.p. giving 13 b.h.p.; other types made are 12-14-h.p. 3-cylinder, 16-20-h.p. 4-cylinder, 20-24-h.p. 4-cylinder touring cars, and 10-12-h.p. and 12-14-h.p. 2-cylinder vans.

Carroll Patent Shifting Spanner and Pipe Wrench.

A large number of tools designed to fulfil the dual purpose of spanner and pipe wrench have been invented from time to time, but none are likely to become so popular as the Carroll patent shifting spanner and pipe wrench. This tool is the invention of Mr. Carroll, and arises from his knowledge of engineers' requirements derived from a long period of practical experience. The tool, as shown in our illustration, is constructed with one of the jaws (3) secured in a frame (20) upon a handle (1) the opposing jaw (6) is upon the stem (5) of another handle (8), which slides through the frame and has teeth (9) upon one edge. These teeth engage in a semi-circular rocking-piece (10) which fits in a corresponding recess in a frame. By this arrangement,



when the tool is used as a pipe wrench, the pipe is released by the jaws when the grip of the hand upon the handles is released. An important advantage of the tool is the ease of adjustment which can be effected when the tool is held in one hand—the tool being turned with its back edge down. When pressure is placed upon the edge of the handle stem at 21 it brings the teeth thereon out of engagement with the teeth in the rocking-piece against the pressure of the spring (18) which spring bears against the slidable wedge-piece (17). The handle stem can then be moved through the frame by the thumb in either direction to adjust the distance apart of the jaws (6) and (3). The tool has been patented in all the chief manufacturing countries of the world, and arrangements are now being made for placing it upon the market.

Municipalities have a right to insist upon the abatement of black smoke by all users of steam boilers, without regard to the purposes for which the steam is used, or the means to be adopted for abatement. This, because smoke is a public nuisance, and because it can be abated without hardship to the owner of the plant. Nevertheless, when the evil is present, and has been present for a period of years, it is not good policy to be too radical in the enforcement of the statutes. The law should be definite and stringent, and the penalties adequate, but they should be enforced with discretion by officials who have some technical and practical knowledge of smoke abatement. It is absurd to talk of putting this matter into the hands of the police or of the health officer. The official having charge of this work should be a trained engineer, if possible, a technically educated man, and he should be entirely above influence in any of its guises.