A Notable Steam Car of To-day.

The Doble Steam Motor.

THE Type "F" Doble steam car now being placed on the market has been developed from the company's model "E," which was produced from 1923 to the present time. It retains all of those features which have proved of solid value, such as the single-tube forced circulation steam generator, atomising-type forced-draft burner, and compound engine geared direct to the rear axle.

The wheelbase is 11 ft. 8 ins. with 4 ft. 10 ins. track. The frame with channel section heat-treated chrome nickel steel members is tapered from rear to front. There are seven large diameter tubular cross-members, with diagonal tubular braces. The springs are chrome vanadium steel with leather boots to retain lubrication. Front springs are 44 ins. long, and the rear springs are 56 ins. A Timken front axle is used, and Bendix two-shoe internal brakes are fitted front and rear, operated by the brake pedal. The steering gear is a Gemmer "Marles" type, fitted throughout with roller bearings.

The throttle is controlled by a wheel, similar to but smaller than the steering wheel, and is mounted above it. It stays at any position without need of holding. The reverse and cut-off is controlled by a pedal operated by the left foot.

The water-tank is carried under the middle of the chassis, with the filler spout alongside the front seat, and exposed when the door is open. It holds 30 U.S. gallons, which gives a large touring radius as the amount used is not great. Approximately 25 miles per U.S. gallon is obtained at high speeds in extremely hot weather, such as 100° to 110° F., while in cool weather between 50 and 100 miles per U.S. gallon can be obtained even at continuous high speed.

The fuel-tank, at the extreme rear, contains 26 U.S. gallons. The usual consumption when touring gives 10½ to 11 miles per U.S. gallon, with 34° baume fuel oil. In the city the usual overall mileage is 8 miles per U.S. gallon. The weight of the car filled and ready for the road is 4,300 lbs.

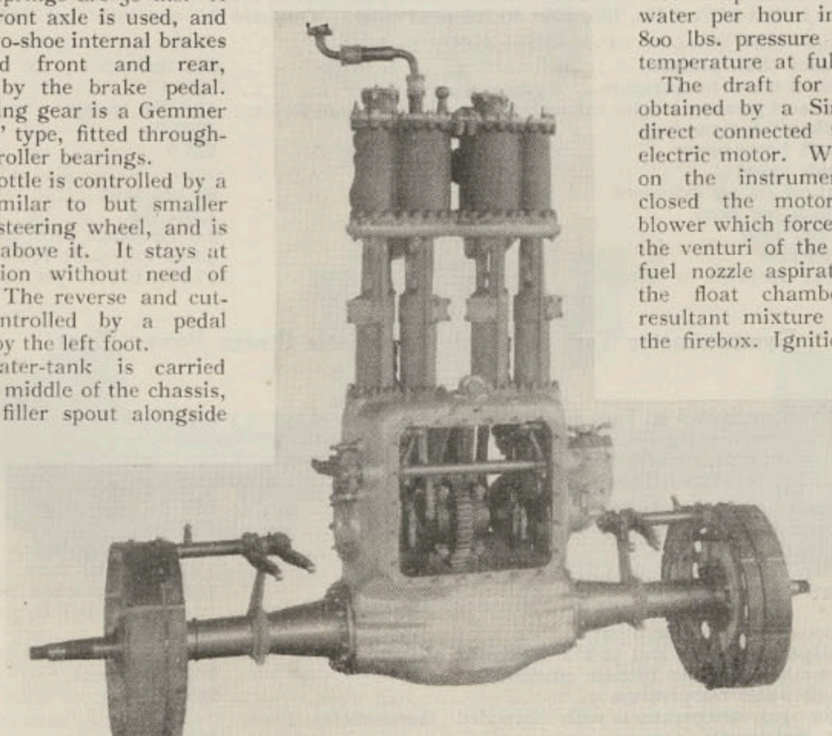
The Power Plant and Its Performance—the Steam Generator.

The steam generator is of the Doble single-tube forced circulation type, with patented compensating normaliser control of feed-water which maintains a constant steam temperature under all operating conditions, regardless of load, or rapidity of load change, automatically and with no attention from the driver.

The generator is 22 ins. diameter outside the casing, and 40¾ ins. high, including furnace and flue. It has 74 sq. ft. of heating surface, and weighs, complete with burner, 484 lbs. in working order.

It evaporates 1,330 lbs. of water per hour into steam at 800 lbs. pressure and 800° F. temperature at full load.

The draft for the fire is obtained by a Sirocco blower direct connected to a 12-volt electric motor. When a switch on the instrument board is closed the motor drives the blower which forces air through the venturi of the burner. The fuel nozzle aspirates fuel from the float chamber and the resultant mixture streams into the firebox. Ignition is secured by a standard pattern sparking-plug, current for which is supplied from the blower-motor circuit via a Delco breaker on the blower-shaft and a Delco coil located on the dash near the plug.



The Four-cylinder Compound Engine of the Doble Steam Car.

Steam comes up within thirty seconds and the vehicle may be driven off at once.

On the attainment of the pressure for which the control is set, generally 1,500 lbs. generator pressure, the blower-motor circuit is opened automatically. As soon as the generator pressure falls to 50 lbs. below the cut-off point the blower is again cut in.

The float chamber is kept supplied with fuel

Doble Motorbus Boiler Test.

TEST No. 193. *April* 3, 1929.

Run Number	86	87	88	89
Steam pressure, lbs. sq. in. (gauge)	600	600	700	700
Steam temperature, degrees Fahrenheit	850	850	850	820
Actual evaporation, lbs./hr.	1,087	1,300	1,222	1,655
Equivalent evaporation, lbs./hr.	1,570	1,880	1,760	2,358
Fuel, lbs./hr.	91·0	109·6	105·0	138·0
Blower Motor R.P.M.	2,900	3,500	3,510	4,500
Flue gas temperature, degrees Fahrenheit	—	375	345	470
Feed water temperature, degrees Fahrenheit...	66	66	72	66
Air pressure on burner, in water column	3·9	5·5	5·6	9·1
Equivalent evaporation, lb./fuel	17·25	17·15	16·8	17·1
Actual evaporation lb. fuel	11·93	11·87	13·0	12·0

Note.—In runs 86 and 87 gasoline was used for fuel. In runs 88 and 89 Cook's stove-oil was used for fuel. The data given in the Tables will no doubt prove of interest, and instructive, to the many *M.E.* readers who are specially enthusiastic students of steam.

Dynamometer Test on Doble Automobile Steam Power Plant.

TEST No. 212.

This test was conducted on August 9, 1929, with the same engine, after 72,300 road miles, engine No. 27, that was used in test of Test No. 198, after 46,200 road miles. (Compare this test with Test No. 198.)

ENGINE:	Fuel—Shell stove-oil, 34°-36° Baumé, 150° flash	19,610 B.T.U./lb.
	Steam chest pressure ...	845 lbs. per sq. in.
	Steam chest temperature ...	880° F.
	Exhaust pressure (engine exhausting into a low-pressure turbine)	11·5 lbs. gauge.
	Exhaust temperature ...	320° F.
	Shaft horse-power ...	125·0.
	Shaft speed ...	
	Cut-off (in all cylinders) ...	40 per cent.
	Steam per hour ...	1,201 lbs.
	Water rate ...	9·6 lbs./shaft H.P. hr.
	Fuel rate ...	0·916 lbs./shaft H.P. hr.
	Heat liberated in furnace ...	17.950 B.T.U./per shaft/H.P. hr.

Dynamometer Test on Doble Automatic Steam Power Plant.

TEST No. 198.

The test was conducted on June 16, 1928, with the standard power plant in the Research Laboratory of Doble Steam Motors, Emeryville, California. The following data were recorded :—

BOILER: Standard type, containing 88·0 sq. ft. total heating surface, with type 5 furnace of 3 cub. ft. volume; test was run without feed-water or combustion air-heater.

Steam pressure at throttle ...	850 lbs. per sq. in.
Steam temperature at throttle ...	850° F.
Actual evaporation... ...	1,173 lbs. per hour.
Evaporation from and at 212° F.... ...	1,678 lbs. per hour.
Fuel consumption ...	104·6 lbs. gasoline per hour (20.570 B.T.U. per lb.).
Forced draft motor input ...	980 watts.
Evaporation from and at 212° F. per lb. of fuel ...	16·03 lbs.
Overall boiler and furnace efficiency ...	77·75 per cent.
Feed water temperature ...	75° F.
Flue gas temperature with shrouded thermometer (error unknown) ...	518° F.
Air temperature entering burners ...	80° F.
Air pressure entering burners ...	5·8 inches of water column.
Heat liberation in furnace ...	716,000 B.T.U. per cub. ft. per hr.
Heat input at burners ...	2,150,000 B.T.U. per hr. = 17,976 B.T.U. per H.P. hr.

ENGINE: Four-cylinder compound; two high-pressure cylinders, $2\frac{1}{4}''$ bore; two low-pressure cylinders, $4\frac{1}{2}''$ bore, 5″ stroke; 40 per cent. cut-off in all cylinders. Engine No. 27, after 46,200 road miles. New piston-rings installed at 41,000 miles.

Steam chest pressure ...	710 lbs. per sq. in.
Steam chest temperature ...	826° F.
Exhaust pressure ...	$1\frac{1}{4}$ lbs. gauge; 15·95 lbs. per sq. in. absolute.
Shaft horse-power ...	119·6.
Shaft speed ...	937 revolutions per minute.
Water rate ...	9·8 lbs. per H.P. hr.
Fuel rate ...	0·874 lbs. per H.P. hr.
Heat input ...	13,970 B.T.U. per H.P. hr.

by means of a standard A.C. diaphragm fuel-pump driven by the blower shaft.

Water is supplied to the inlet end of the steam-generating tube by means of a direct-acting single-plunger steam pump, which takes steam from the generator delivery pipe. Its throttle valve is controlled in such a way as to maintain the feed-water supply as required by the load. This control is extremely close and rapid in its functioning. Should an insufficient quantity (or none) be available for the feed-control orifices, a 25° F. temperature rise above normal shuts down the blower, until the exact time when the feed equals that required. On account of this feature supplementing the feed control no flooding or overheating of the generator tube can take place.

The steam is passed through the throttle into the steam-line to the engine, which contains three chromium steel ball joints to permit the steam-line to follow the motions of the engine which is mounted on the back axle.

The Engine.

The engine is a four-cylinder double-acting, balanced compound with two high-pressure pistons ($2\frac{5}{8}$ ins. diameter by 5-in. stroke), operating the outside cranks, and two low-pressure pistons ($4\frac{1}{2}$ ins. diameter by 5-in. stroke), operating the two centre cranks.

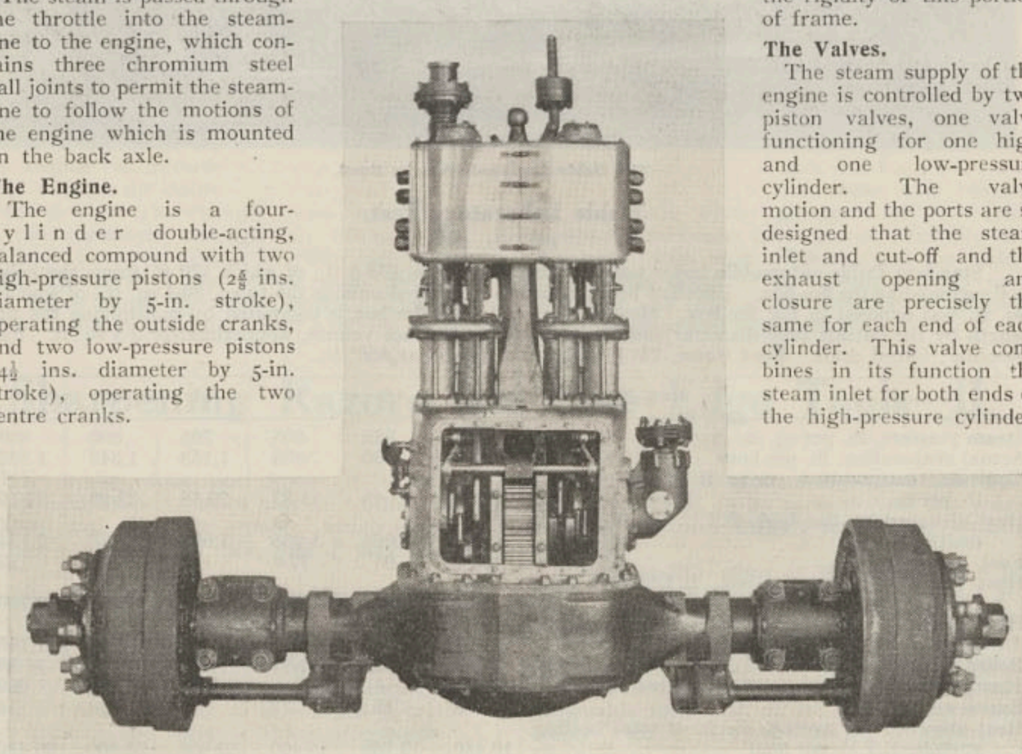
used for the four main crank-shaft bearings, and the eccentric-rod and connecting-rod bearings on the crankshaft. All valve motion bearings are hardened steel against hardened steel.

The engine is integral with the rear axle, the crankshaft driving the rear axle differential through Maag-tooth, hardened and ground the rear axle centre housing. Nickel steel tapered tubes, bolted on to each side of this crankcase, form the rear axle.

The front end of this engine is supported from a $3\frac{1}{2}$-in. chrome nickel steel tubular cross member by a ball-and-socket torque hanger. This cross member, which forms the engine support, is braced by diagonal tubular struts to the rear spring front hangers, thus increasing the rigidity of this portion of frame.

The Valves.

The steam supply of the engine is controlled by two piston valves, one valve functioning for one high and one low-pressure cylinder. The valve motion and the ports are so designed that the steam inlet and cut-off and the exhaust opening and closure are precisely the same for each end of each cylinder. This valve combines in its function the steam inlet for both ends of the high-pressure cylinder,



Another View of the Doble Steam Engine.

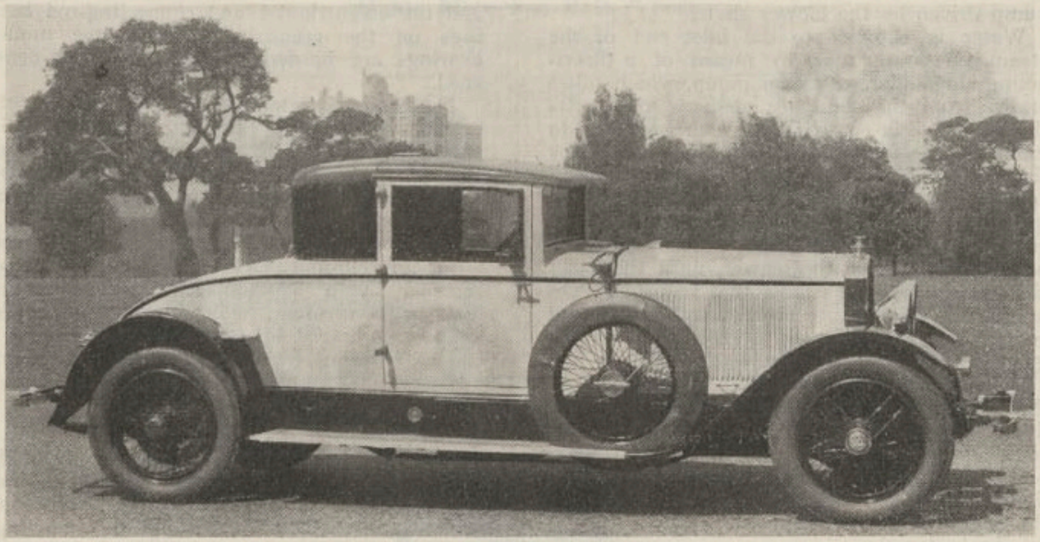
The cylinders are cast in pairs, one high pressure, one low pressure, and one valve chest in each block. To insure maintenance of shape and maximum strength, the low-pressure pistons are forged integral with the piston-rods and are heat-treated before grinding. The cylinders are entirely separated from the crankcase so that no deterioration of crankcase oil can take place. The crossheads, which take the thrust from the change of longitudinal motion into rotary motion of the crank, are cool at all times and properly lubricated. These crossheads are lined with best babbitt, properly peened and finished in accordance with the best practice.

The connecting-rod small end bearings and wrist-pins, on which they turn, are hardened and ground steel, insuring continuance of operation without wear. The crankshaft is a drop forging, all bearing surfaces being hardened and ground. Hoffman hardened roller bearings are

transfer of the steam from the high-pressure exhaust to both ends of the low-pressure cylinder, and finally exhaust from the low-pressure cylinder to the condenser. By this arrangement two valves are made to do the work of sixteen. The valves are driven by the Stephenson link valve motion, which provides for reversing and also three cut-off points.

Cut-off.

With the reverse pedal all the way back, steam is cut-off in the cylinders at 4 ins. of the 5-in. stroke. This point of cut-off is for use when moving from a stop or for extremely difficult climbing conditions. When the pedal is pushed forward to the first notch, the steam is cut-off at 3 ins. of the stroke, the best point for operation in traffic, as it gives maximum acceleration with considerable economy. With the pedal pushed farther forward into the second notch the steam is cut-off at 2 ins. of the stroke, which gives maximum economy and speed, and is used



The Doble Car ready for the Road.

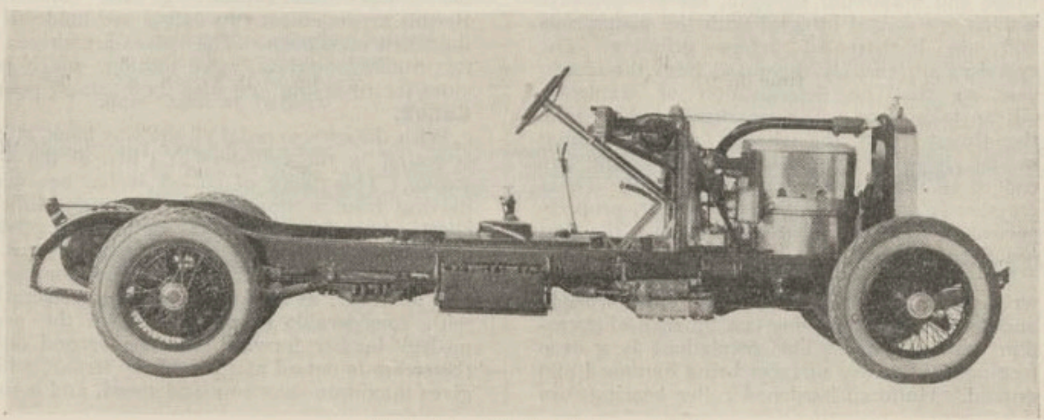
Doble Laboratory Test.

TEST NO. 186.

Standard Doble automobile boiler tested. Length of tube, 858·5 ft., of which 120 ft. forms the helical coil surrounding the fire-box. Effective heating surface (measured outside the tube), 80·4 sq. ft., of which 10 sq. ft. was exposed in the fire-box. Heating surface in the fire-box is computed by multiplying the tube length by the outside tube diameter and the factor 1·4. Furnace volume, approximately 2·5 sq. ft. Fuel, gasoline; forced draft. Feed water, 74° F. Steam delivered at 850° F.

Run Number	3	9	13	14	15	16
Steam pressure, lb. per sq. in. (gauge)	460	535	605	765	860	980
Actual evaporation, lb. per hour	600	760	886	1,153	1,343	1,532
Equivalent evaporation, per sq. ft. of total surface, lb. per hr.	10·78	13·63	15·87	20·58	23·92	27·19
Heat absorbed by the fluid, B.T.U. per hour (000 omitted	842	1,065	1,238	1,606	1,876	2,124
Fuel, lb. per hour	50·1	65	77·6	103	120	138
Heat liberated in the fire-box, B.T.U. per hour (000 omitted)	1,002	1,300	1,552	2,060	2,400	2,760
Heat liberated per cub. ft. of fire-box volume, B.T.U. per hour (000 omitted)	400	520	620	825	960	1,105
Boiler efficiency, per cent.	84·03	81·92	79·77	77·96	77·79	76·96
Flue gas temperature, corrected, degrees Fahr. ...	430	—	—	588	642	690
Excess air, per cent.	8	15	12	9	10	11
Heat absorbed per average sq. ft. of total heating surface, B.T.U. per hour	10,450	13,250	15,400	19,950	23,300	26,420
Weight of flue gas, lb. per hour	860	1,190	1,380	1,790	2,100	2,440
Gas per average sq. ft. of gas passage area, lb. per hour *	1,310	1,810	2,100	2,730	3,200	3,720

* The average gas passage area is taken as the average calorimeter of all of the flat coils, or ·656 sq.ft.



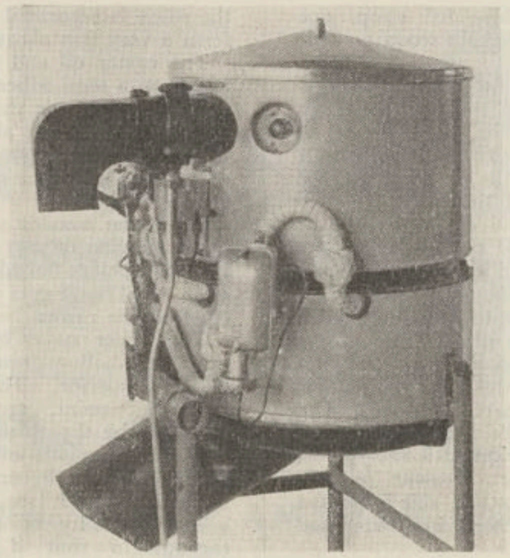
The Chassis of the Doble Steam Car.

for all running other than steep hills and traffic. The second notch is so arranged that the pedal cannot be pushed farther forward without pushing on a small latch button located directly on the pedal.

Reverse.

When this button is pushed and the pedal depressed to the floorboards, the engine is in complete reverse motion and will drive the car backward precisely as though it were running forward. The second notch, being arranged so that it cannot be released without touching the latch button, makes it impossible for the engine to reverse itself without the desire of the driver. The exhaust steam is conveyed to the condenser through an exhaust line similarly rendered flexible by three ball joints.

The operation of the vehicle is as follows: The driver closes the main switch. The fire starts at once, and within a half a minute steam pressure comes up on the gauge. The throttle is then opened and the car driven off. Nothing more is required. The main switch is left on. When through running, the main switch is turned off and the band brake pulled on. Nothing more is required.



The Steam Generator.

Acceleration from 5 m.p.h. to 25 takes 2.3 seconds, and from zero to 40 m.p.h. requires 7.0 seconds, with a maximum road speed of approximately 90 to 95 m.p.h.

This same type of power plant is manufactured for use in motor-'buses, and the steam generator is manufactured for those who require an automatic steam generator of low cost, compact dimensions, great power, flexibility and reliability, with high efficiency, and the ability to use fuel down to 24° baume. It is non-explosive and requires no attention or cleaning in either generator tubing or burner.

Sharpening Razors and Fine Edge Tools—II.

THE writer does not know if it is a peculiarity personal to him or if others are inflicted with the same trouble, which is, that he has a very tender skin and a very tough growth of hair.

In his case the combination renders the use of a safety-razor about as futile and uncomfortable as trying to shave with a garden rake—a safety-razor simply hops over the bristles and takes a scoop of skin in between. The difficulty in using an ordinary razor is to sharpen it in the first instance and keep it sharp afterwards.

The first thing is to get a good razor or two if possible, and then, if not in good order, to set them. The writer has found that a slip of lithographic stone (which has no cutting action in itself), to which a mixture of Tripoli powder in spirit of turpentine has been applied, makes a perfect razor hone. The razor should be held dead flat on the stone so that the back and cutting edge bear equally and not pressed too hard but at the same time firmly. A reciprocating rotary motion is then given five or six times on one side of the blade and then on the other. When the edge appears sharp, the setting can be finished off by drawing the razor over the hone towards the cutting edge, at the same time drawing the razor off the stone from heel to tip, alternately on either side of the blade. The front edge of the stone should be slightly rounded off so as to prevent the possibility of the razor digging into it and spoiling the edge.

If lithographic stone is not available, a bit of flat iron, say 6 ins. long by $1\frac{1}{2}$ ins. by $\frac{1}{8}$ in., tinned all over on one side thickly with solder, which, in turn, is filed and scraped quite flat, answers as well if not better than the stone.

If the razor is in a bad state, "Diamantine," obtainable from any of the watchmaker's tool stores (which are as thick as plums in Clerkenwell Road) acts as a quicker cutting agent than the Tripoli powder, which, by the way, is obtainable from the same source.

The writer has set his razors once during the war, and one of them once since, when someone borrowed it!

The reason that razors require resetting so often in usual practice is due to a wrong system of stropping. This is illustrated in Fig. 1, to an exaggerated extent. As will be seen, the strop is bent down by the pressure applied to the razor blade and passes up over the edge of the blade at a more or less acute angle. In the illustration a strap strop is shown, but a stick strip has the same effect if too much pressure be applied or if the leather surface is too springy or a combination of the two.

Fig. 1.—The Action of Bad Stropping.

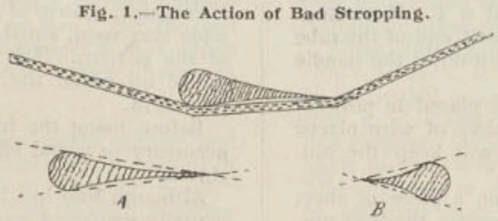


Fig. 2.—The Section of Razor Blade determines Angle of Setting.

The writer uses a double-sided strop, one side being covered with end-grain wood and the other with sole leather.

The best wood found so far is Ayous whitewood. Any of the bastard mahoganies, such as "Butter Nut," can be used—what is required is a hard wood with an open porous grain capable of retaining the dressing without springing under the edge of the razor. A strip of wood is sawn off the end of a 1½-in. plank about 3/16th in. thick, and pinned with pegs cut from the same wood and glued to the stock. The strip of sole leather should be soaked in water and dried fairly close to a fire to harden it and then the smooth side glued to the stock. When dry, both sides are planed down, the end-grain wood until dead flat and true, the leather side until all the soft pithy part is removed. The wooden side is dressed with a paste made of washed Tripoli powder (levigated is the correct term) mixed with one part beeswax to four of castor oil. The other, leather, side is treated with carbon obtained from charred straw, mixed with the same oil, etc.

The straw should be washed thoroughly to remove any grit, dried, stuffed into a cocoa tin and placed in a hot fire, a small hole or two being punched in the lid to allow the gas to escape. The writer believes rye straw is the best, but any ordinary straw seems to answer quite well.

The theory of the carbonised straw is that all grasses have a very thin coating of silica on their stems, and when the woody fibre is burnt away the silica is separated in very fine flakes which form a very fine abrasive.

The castor oil and wax keep the leather soft and form a semi-adhesive for the cutting agents.

The writer finds that it is only necessary to use the wooden side about once a fortnight and the leather side every day. The Tripoli requires smearing about once a year and the black paste once a month.

When the wooden side is used, care must be taken to wipe off any Tripoli paste adhering to the razor before finishing off on the leather side, as if any Tripoli gets on the leather it drags the edge off the razor.

The writer never could quite fathom why extremely hollow-ground razors were supposed to be superior. The cutting edge is the important point, and the angle of this is governed by the thickness of the back in relation to the width of the blade. These two dimensions fix the angle at which the edge is set and stropped (see Fig. 2).

The flexibility of the edge may be advantageous in that if too much pressure is employed in either of these sharpening processes the blade will bend up to adjust itself to the angle of the slip or strop. In the writer's hands a slightly hollow razor is just as good as an extra hollow-ground specimen, the two being used alternately without any appreciable difference in the cutting power being observed, in fact, sometimes one seems to work best, sometimes the other, but neither of them are ever far off from perfection.

Simplified Casting in Lead.

By. C. R. H. Simpson.

Pattern making is a necessity in order to obtain many castings, but in some cases it is possible to dispense with this, saving both time and trouble.

In this particular instance some lead hammers of varying sizes and some lead formers were required for the construction of a 1½-in. scale locomotive boiler.

When making hammers, if a special ladle and mould combined is available, the difficulty is that only one size of hammer can be cast from it.

The writer's method is to obtain a piece of aluminium sheet and bend to the given diameter. The ends should overlap slightly. At a point rather less than half way up, a semi-circle should be cut out on one side equal in radius to the tubing which is being employed for the handle. On the other side a U-shaped piece must be cut away to allow for the overlap.

The handle is prepared in the usual manner by slitting down the end of the tube and turning the ends over in the form of a T. Remember to place a wooden plug in the T end of the tube to prevent the lead pouring out down the handle when filling the mould.

The handle should now be placed in position and the mould closed. A piece of wire placed round the top and bottom will keep the aluminium in position.

Place the mould on end on a piece of sheet material before pouring, to prevent the lead running out at the end. On cooling, it will probably be found, more so in the case of large hammers, that the uppermost face assumes a concave shape. A little more lead may be poured in to fill in the concavity. Do not therefore fill the mould to the top at the first pouring.

When cold the wire may be removed and the aluminium unrolled.

In the case of the formers, it was necessary to make a pattern, but by the use of aluminium it was possible to dispense with a mould, in the accepted sense of the word.

The drawing of the plate in question was stuck on to a piece of wood which was cut out to the desired shape.

Thick wood should be employed as the risk of distortion will be reduced, and it should be well dried before use; if this precaution is not taken, on pouring the hot lead the moisture will be driven out of the wood and form bubbles in the lead, resulting in its spurting dangerously.

In the instance in question, 1 in. thick wood was employed, and as the former was required 1 in. thick, a strip of aluminium just over 2 ins. wide was used, equal in length to the periphery of the pattern. The aluminium was carefully nailed all round the wood and the lead then poured in.

Before using the formers, it was, of course, necessary to round off one edge by means of a chisel.

Although lead has been referred to, the metal actually employed was old battery plates melted down; these contain antimony and the metal is therefore harder and more suitable than lead.