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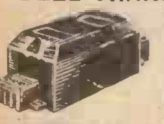

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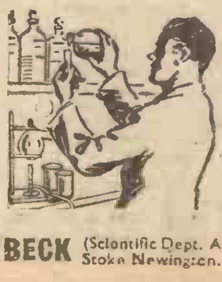

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Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor: F. J. CAMM

VOL. XI. JUNE, 1944 No. 129

FAIR COMMENT—BY THE EDITOR

Oil and Petrol from Coal

THE late W. H. Stevens expressed a wish that a series of annual lectures should be given to members of the Junior Institution of Engineers covering the general subject of the better utilisation of coal for the production of oil and petrol. The problem assumes, like that of synthetic rubber, important dimensions to-day, for we have seen how dependent we are on distant oil wells and distant rubber plantations for the supply of two of the most vital commodities of war. If we could produce oil and petrol in this country from our natural coal resources we should save heavy shipping costs, delays, and avoid the risk associated with shipping during the war. This country is one of the largest producers of organic liquid products. In 1911, for example, the carbonising industries produced larger quantities of these products than the quantity of petroleum oils imported—mainly kerosene.

Latterly the development of the internal-combustion engine has brought forth a demand for oils in quantities greatly in excess of the volume of tar and benzole produced. It is interesting to note that it was not until 1921 that the peacetime oil imports reached 5,000,000 tons.

Mr. J. D. King, O.B.E., D.S.C., gave the first of the lectures suggested by Mr. Stevens before the Junior Institution of Engineers in May, and gave some interesting facts concerning the present position of this new industry. The two main carbonising industries of gas and coke manufacture each consume about 18,000,000 tons of coal annually, and a third industry, smokeless fuel, was expanding rapidly before the war, and doubtless will again after the war.

Coal Tar

During 1938 it had reached 600,000 tons of coal. Its liquid products are less severely cracked than coal tar, and are produced in larger yields—17-18 gals. per ton of coal. Over 11,000,000 tons of petroleum oil were produced in 1938, and (including the Scottish shale oil) contain the following:

	Million gallons	*Million tons*
Motor spirit ...	1,463	4.8
Other spirit ...	26	0.1
Kerosene	216	0.8
Gas oil	168	0.6
Diesel and fuel oil	896	3.5
Lubricating oil ...	123	0.5
	2,892	10.3

Of the 2,000,000 tons of tar made before the war over 720,000 tons were used on the road and the remainder was distilled to provide naphtha, creosote, and other products for the chemical industry, leaving as a residue pitch. During the war tar has been utilised as a liquid fuel, for crude tar can be burned as such, requiring only filtration and some pre-heating. Its use, however, is limited, since in contact with petroleum oil pitch is precipitated. The only successful attempt to make a tar fuel miscible with petroleum was made by Lessing in 1916. He treated the tar with light petroleum, ran off the precipitated pitch, distilled the spirit from the solution, and recycled the spirit. From the normal tar he produced 62 per cent. of fuel oil, but the process was not developed because of the high loss of solvent.

A simpler method of making fuel oil from tar consists in blending pitch with creosote in approximately equal proportions. This fuel has a minimum flash point of 150 deg. F., density 1.15, calorific value 16,000 B.th.u., and a suitable atomising temperature is 200 deg. F. The burners may be solid jet or steam injection type, and do not need to be specially designed. This fuel has the advantages of low ash content and high thermal value per unit volume.

Another method of utilising pitch consists in carrying the distillation of the tar further by blowing with air, or steam, to give a higher yield of heavier oil.

Distillates

The distillates of crude tar, creosote, etc., have many uses in chemical industry, but attempts have been made to utilise the surplus by refining it for use in the diesel engine. Crude creosote behaves quite well in the slow-running diesel engine, but with increasing speed ignition troubles arise. Creosote has an ignition temperature of 480 deg. C. During 1938 105,000,000 gallons of creosote were made. Of this a large quantity was hydrogenated by Imperial Chemical Industries, Ltd., and the total spirit made by this process during that year was nearly 43,000,000 gallons. Since the material treated by hydrogenation was converted into an approximately equal volume of motor spirit, it can be said that by hydrogenation, plus suitable refining and blending to make suitable diesel oil, the surplus creosote could replace imported spirit and diesel oil by an amount not exceeding 90,000,000 gallons per year. An alternative outlet to these oils lies in adding up to 20 per cent. of refined neutral oil to petrol, and using the blend in the ordinary petrol engine. This was being done with success before the war.

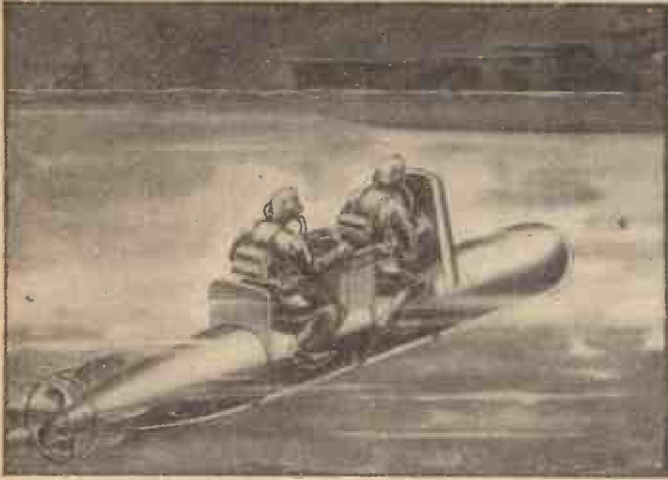
The carbonising industry could help the oil situation by improving the recovery of benzole. In 1939 the Coke Oven plant was recovering nearly all the benzole made, but the gas industry was recovering only about 53 per cent. of the coal carbonised. During the war this situation has changed, more plants have been put into operation, and the gas industry is now recovering fully the benzole made in 95 per cent. of those works which carbonise over 5,000 tons of coal per annum. If this position were retained after the war the carbonising industries could produce a total of 120,000,000 gallons of benzole, of which a high proportion would be available as motor fuel. The remainder would be required to satisfy the demand for pure benzine, toluene, etc.

It is impossible to forecast how the carbonising industries will develop after the war, but in the demand for fluid forms of heat, gas and electricity, and for smokeless fuels such as coke and low temperature coke, there are indications of considerable expansion. A partial step towards the direct conversion of coal into oil consists in rendering coal fluid by the admixture of oil with finely divided coal—a mixture incorrectly termed colloidal fuels.

In comparison with other methods of making oils from coal, hydrogenation possesses the advantage of giving the highest yield—about 72 per cent weight of the coal treated. The modern process is operated in two main stages of liquid and vapour phase treatment. In the first the coal is pulverised, mixed or pasted with heavy oil and catalyst (.1 per cent. of a tin salt) and pumped with hydrogen under pressure through a pre-heater into the bottom of the liquid phase converter and maintained there at a temperature of 480 deg. C.

Gas Producers

If coal could be applied directly and with equal efficiency to certain processes which at present employ oil, such replacement would be more satisfactory than by making oil from coal. One method which has been the subject of considerable experiment during the war is the use of transport gas producers. A producer has been designed which with a satisfactory fuel will give 90 per cent. of petrol performance, consuming 16lb. of fuel to do the work of one gallon of petrol. The fuel used mainly so far is graded anthracite, but this is limited in availability and not quite reactive enough for comfort. If encouragement could be given to the use of such producers after the war, and to the carbonising industries to make fuel, a graded coke could be made which would reduce operating difficulties to a negligible quantity.



The human torpedo, fully submerged, heads towards its objective.

The explosive head attached to the bottom of a hostile vessel, with time fuse set to enable crew to reach safe water.

The Human Torpedo and the Midget Submarine

By J. A. SPAR

The Story of Their Development from 1747 to the Present Day

THE Royal Navy knows how to keep a secret. Unlike Dr. Goebbels, who is always trying to make our flesh creep with blood-curdling secret weapons still up the Führer's sleeve, the Navy said nothing for nearly sixteen months about the human torpedo which had sunk an Italian cruiser and severely damaged a large transport.

The story only came to light with the announcement in the *London Gazette* of the award of two D.S.O.s and two C.G.M.s to the officers and men who took part. This is the Admiralty's account of the action.

"During a night attack, carried out in January, 1943, against the strongly defended enemy base at Palermo, several human topedoes negotiated a net defence and proceeded undetected across the whole length of the harbour. One craft sank the Italian Regolo class cruiser *Ulpio Traiano,* which was completing for service.

"A second human torpedo attacked the 8,500 ton transport *Viminale* lying alongside a jetty, and so severely damaged her aft that she had to be towed away for repairs. During this passage she was sunk. The crews of the two human torpedoes reached the shore safely, and were made prisoners of war."

The Admiralty then gave this description of its new secret weapon:

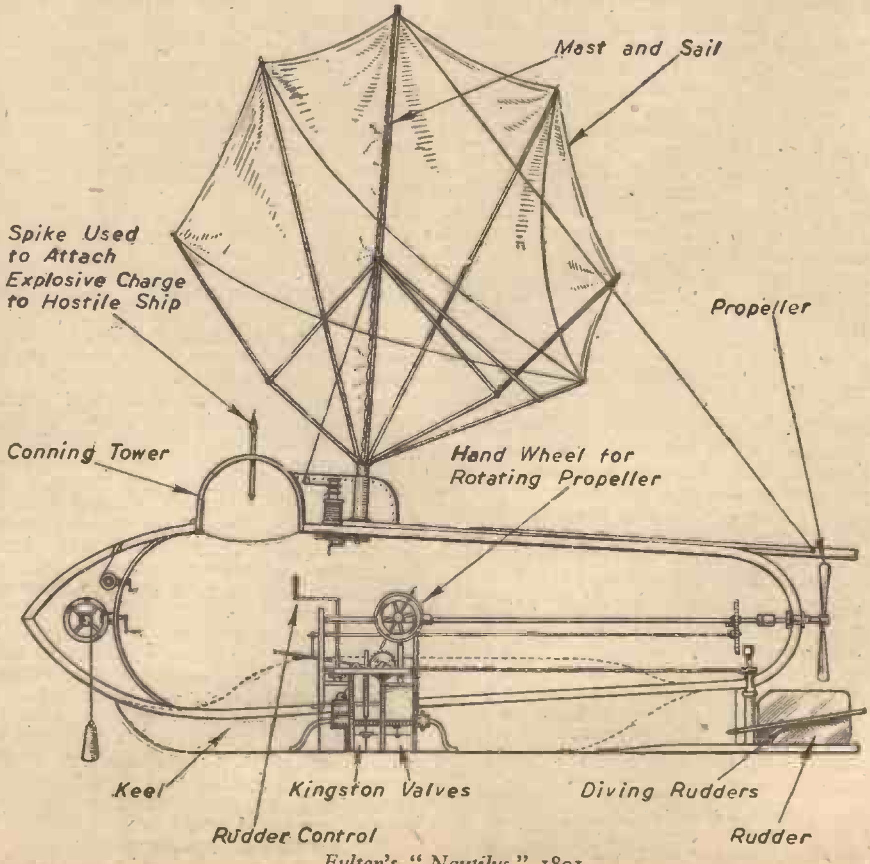
"Human torpedoes are of approximately the same shape and size as ordinary torpedoes. They are driven by electric batteries, and are manned by a crew of two, who wear diving suits and sit astride the body of the torpedoes. A charge, similar to the warhead of a torpedo, is attached to the nose.

"These craft are manœuvred at slow speed towards their targets, and dive under them. The charges are then detached from the main body and fixed to the bottom of the enemy ships. Time fuses are set, and the human torpedoes, now minus their warheads, are driven away in order to be clear of the target area before the charges detonate."

That is as much as the Admiralty is prepared to disclose, but an examination of the photographs suggests some further details. It seems obvious that the speed of these human torpedoes must be extremely moderate, probably not more than ordinary walking pace—say three to four miles an hour. That is because the men sit outside the torpedo, their feet in stirrups, and only their heads above the surface to act as periscopes. Any greater speed, if it did not actually wash the men from their perches, would be too great a physical strain to be borne for more than an extremely short period.

Allowing, then, for a speed of four miles an hour, the range must also be limited—possibly twelve miles. Even in the Mediterranean seas the water can be pretty cold in January, and three hours is a long time to sit up to your neck in it, even when protected by diving suits.

Having such limited range, it is plain that human torpedoes must be brought as near as possible to their target by a parent ship, and put over the side under cover of



Fulton's "Nautilus," 1801.

"Human" Torpedoes and X-Craft

It is now common knowledge how several human torpedoes of the Royal Navy carried out a brilliant exploit in January, 1943, when they successfully attacked and sank an Italian cruiser in the strongly defended enemy base at Palermo. The illustrations give a good impression of the appearance of these strange weapons of war, and how their intrepid crews sit astride them when going into action.

An officer of a "human" torpedo in his Sladen suit.

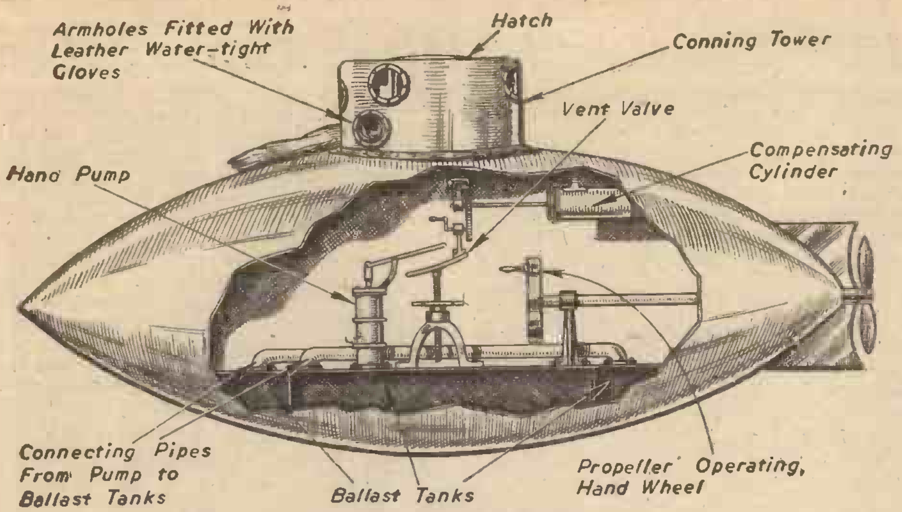
(Left) Front view of a "human" torpedo under way.

A "human" torpedo about to submerge on nearing its target.

A side view of a "human" torpedo and its crew of two.

(Above) An X-craft under way, showing a member of her crew on deck by the periscope.

(Left) An X-craft on the surface with a member of her crew sitting on the deck.



Garrett's first submarine, 1878.

darkness. That is why they could not be employed against the German battleship *Tirpitz*—the penetration of fifty miles of fiord in icy Arctic water could only be achieved by midget submarines in which the crews are totally enclosed.

The Italians employed human torpedoes in attacks on allied shipping in Gibraltar bay. In this case they got over the difficulty of a parent ship in a very cunning way, using an Italian oil tanker moored in the neutral waters of Algeciras, only three miles away from the Rock. How those human torpedoes reached the tanker in the first case remains a mystery—she had been lying there for a very long time. Either they were smuggled in by a parent submarine, or they came overland—possibly disguised as machinery.

The "Mignatta"

In the last war, when the Italians were our allies, they employed the human torpedo against what had formerly been the Austro-Hungarian Navy, but which had just been handed over to the Yugo-Slavs. On the night of November 2nd, 1918, two Italian officers, Engineering-Commander Rosetti and Surgeon-Lieutenant Paolucci, succeeded in penetrating the naval base of Pola. They came in swimming, pushing between them a strange contraption which its inventor, Rosetti, called Mignatta.

The Mignatta was shaped like a torpedo, the front part being composed of two detachable mines, each containing 350lb. of trotyl. The after part enclosed a little engine, actuated by compressed air, contained in a vessel at high pressure and of sufficient capacity to propel the whole apparatus at a slow speed for some hours.

The mines were designed to be attached at any given depth to the skin of the ship, and internal clockwork fixed the time when the explosion would take place. When the engine was running, the operators could sit astride its body and steer it by their arms.

In this operation the Mignatta had been carried to within 1,000 yards of the entrance to the port by torpedo boats and Mas (Motoscafi Antisommergibili—anti-submarine motor craft). From there on it slowly made its way under its own power, directed along by the two officers.

After passing seven successive obstructions, the Mignatta finally found itself in the open water of the harbour, free to select its victim among the many ships it contained.

The *Yugoslavia*, which only the day before had been the *Viribus Unitis*, flagship of the Austro-Hungarian fleet, but which now constituted the pride of the new Yugoslav Navy, and the steamer *Wien*, headquarters of the German U-boat flotilla in Pola, were selected.

The Italians fastened their mines to the two ships and set the clockwork. Soon afterwards they were picked up by a passing motor-launch and taken to the flagship, where they informed the commander of the imminent danger to his ship. While the crew began to leave the doomed *Yugoslavia*, the mine exploded, sinking the ship within a few minutes. Soon afterwards the steamer *Wien* went up in her turn.

Leaping Boats

The Mignatta was not the only example of Italian ingenuity in the last war. Earlier in 1918 they had designed and built four craft for the purpose of attacking shipping in defended ports. They were called naval tanks, or Barchini-Saltatori (leaping boats).

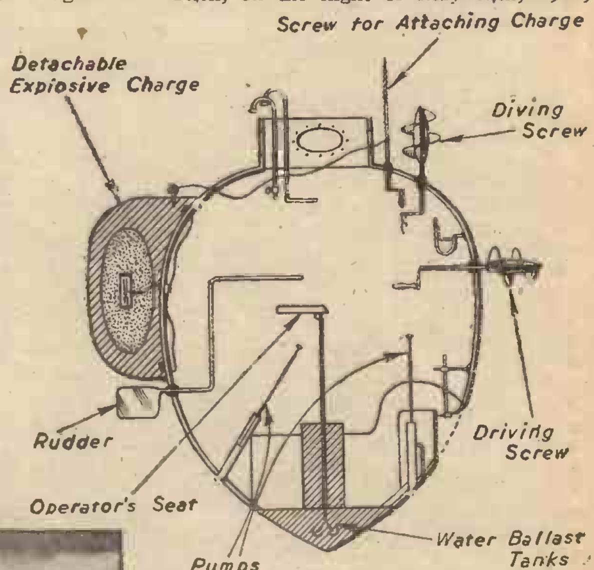
The leaping boat was 36ft. long, and forward the keel rose very gradually and gently towards the bow. On each side of the deck, and all along the keel, ran, by means of cogwheels, two stout, endless, flexible chains, from which protruded, at short intervals, three rows of steel teeth several inches long.

These chains could be set running by an electric motor of 30 h.p., and, when attacking a barrage, the toothed chains engaged with its floating parts, and raised first the bow and then the whole boat, which crawled over the whole net, boom or chain like a tank.

Another motor of 15 h.p., inside a tunnel, drove the propeller. The speed at sea was about 5 knots, and the range of action 20 miles. The leaping boat carried two 18in. torpedoes, and was manned by three men.

These craft were not very successful, on account of their slow speed. Several attempts were made on Pola, but the leaping craft arrived too late at the barricades to begin their hazardous work. Two of them had to be sunk on their way back, to prevent their detection by Austrian aircraft.

Then, on the night of May 14th, 1918,



External view and section of Bushnell's submarine, 1776.

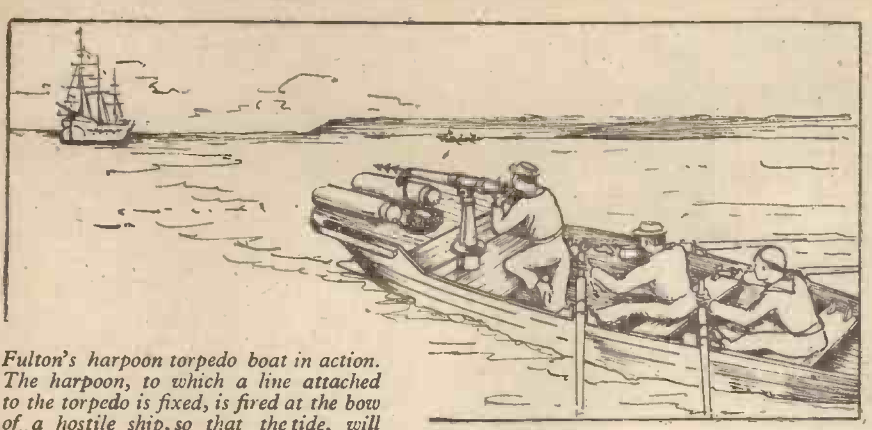
Commander Pellegrini succeeded in reaching his goal in time. But, even as his craft, the *Grillo* (cricket) started to crawl over the first obstruction he was spotted by the Austrian guards.

Projectors caught the *Grillo* in their light cone, guns began to fire and launches approached. Nevertheless, the tank pushed forward over the barricades, negotiating one after the other, until it reached the fifth and last. Almost in reach of his object, Pellegrini, surrounded and battered by the artillery of the guard ships, was finally forced to recognise that all chance of success was lost.

He decided to sink the boat rather than to let it fall into the enemy's hands. This, however, was made unnecessary by a direct hit, which sent the boat to the bottom. The commander and his three men were made prisoners.

Early One-man Submarines

But attempts to blow up warships in harbour by means of human torpedoes or midget submarines date from far earlier than the 1914-1918 war. As early as 1776



Fulton's harpoon torpedo boat in action. The harpoon, to which a line attached to the torpedo is fixed, is fired at the bow of a hostile ship, so that the tide, will swing the torpedo underneath the vessel.

an attempt was made on the 64-gun frigate, H.M.S. *Eagle*, then blockading America in the War of Independence. The *Eagle* was lying off Governor's Island in New York Harbour, flying the flag of Lord Howe.

The craft used on this occasion was invented by David Bushnell, a graduate of Yale University. This submarine was a one-man affair, containing only enough air to last the occupant thirty minutes. It had a number of small scuttles for observation purpose and three holes through which, when the emery ground covers were removed, it was possible to squeeze a hand.

Bushnell's one-man submarine carried a detachable magazine, containing 150lb. of gunpowder, with a wooden screw to secure it to the keel of the ship. A clockwork mechanism could be set for firing this charge at a sufficient interval of time to enable the boat to get clear away—this was arranged to be half an hour after the operator had made the charge dangerous.

The revolving mechanism released a trigger, which allowed a gun-lock to fall on a percussion cap and so fire the large quantity of explosive.

Inside the boat was a tube to act as a water gauge, which allowed the water to enter, showing the level of the water outside—a little piece of cork covered with some composition of phosphorus gave a glimmer of light to show the height of the water. A small compass was also fitted to allow of a fairly correct course being maintained, phosphorus again being used to illuminate the cardinal points—otherwise at night the boat was in total darkness.

A suitable night was chosen for making an attack on H.M.S. *Eagle* with Bushnell's submarine, manned by a sergeant named Ezra Lee.

The vessel was taken in tow by two rowing boats off the New York shore, and towed towards the blockading English Fleet. On arriving within a few miles the submarine was set adrift in a strong tide, setting towards the ships.

Sergeant Lee soon found himself swept outside the ships, but after the tide slacked, a couple of hours' work on the screw-shaped oar brought him close alongside the *Eagle*, which showed up clearly.

Sergeant Lee, with his imperfect weapons, tried hard to attach the magazine to the keel of the ship, but without success, probably because the hull was sheathed in copper. He tried two parts of the hull, but his luck was dead out. Daylight was near, so the sergeant had to give up the attempt, as he had four miles to go before reaching safety.

The tide, however, was now favourable, and he made good progress until, near Governor's Island, some British soldiers spotted his conning tower showing above the surface and put off in a boat and gave chase.

He, fearing that capture was certain, slipped the explosive magazine, as this slowed down his speed in the swell which was running. The soldiers, thinking this was a ruse, gave up the pursuit, and Lee got safely ashore—while the magazine subsequently exploded with a terrific bang.

By the year 1812 Britain was again at war with what had now become the United States of America, largely over the question of the right of British men-of-war to search American warships for deserters from the British Navy—we were at war with Napoleon and needed every man we could get.

In July, 1813, H.M.S. *Ramillies*, while lying at anchor off New London, under command of Captain Thomas Hardy (the same Hardy who was at the death of Nelson in the *Victory* eight years before), was attacked by an American one-man submarine.

The deck sentry, however, was on the alert. As soon as he saw a strange object rise to the surface astern of the ship he sang out: "Boat ahoy." The submarine immediately disappeared, an alarm gun was fired, all hands called to quarters, the cable was cut, and the ship got under way.

Once again the stranger surfaced, but before the guns could be trained on it it dived out of sight and fastened itself on the keel of the British ship. There it remained for half an hour, during which time the man inside it succeeded in drilling a hole through the copper sheath of the *Ramillies*, but the screw with which he was trying to attach his torpedo broke, so he had to give up, and make his escape. This particular diving boat was worked by paddles, could make three knots when submerged, and could surface or descend at will.

Robert Fulton's Submarine

Earlier than this, about the turn of the century, Robert Fulton, later to become famous by his development of the steamship, was experimenting in France with a submarine of his own invention, the *Nautilus*, 21ft. in length by 7ft. in diameter. With this vessel he conducted some reasonably successful trials both in the Seine and in the open sea.

Fulton, an American who had spent a couple of years working in Devonshire, was nothing if not businesslike. He formed a company and offered his invention to the French Government on the following terms:

(1) The French Government undertakes to pay the company of the *Nautilus* 4,000 francs for every English ship above 40 guns which the invention destroys, and 2,000 francs a gun for every ship below 40 guns, to be paid within six months of the destruction of each ship.

(2) All English merchant ships or war vessels to be the property of the company.

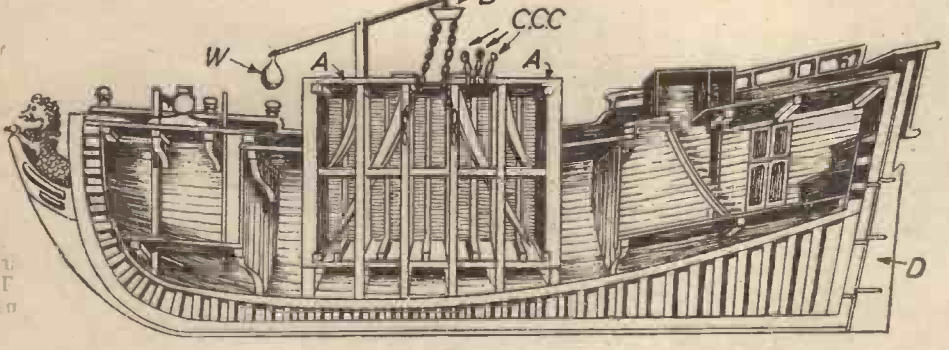
(3) The French Government to pay a Royalty of 10,000 francs for each *Nautilus* they should build.

(4) The invention not to be used against the U.S.A. unless the Americans used it first.

(5) If peace is concluded with England within three months, the Government to pay the cost of all experiments.

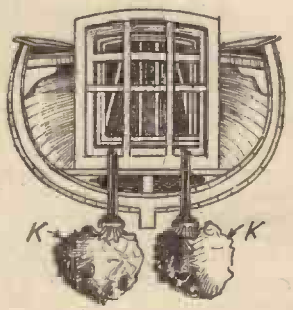
(6) As in the case of fire-ships or other contrivances for the destruction of ships which are considered to be against the laws of war, the people who take part in these enterprises are hung or put to death, the Directory, to prevent this, will accord to the company a commission specifying that every person taken prisoner in a *Nautilus* is to be treated as a prisoner of war, and any hurt done to them is to be met by similar reprisals on English prisoners.

After a lot of consideration the French Government turned the invention down, Admiral Pleville de Pelly, the Minister of



Day's submarine, 1773.

A.A.—Air chamber.
B.—Cover for air chamber opening.
W.—Counterpoise for cover B.
C.C.C.—Coloured buoys for signalling purposes.
D.—Vertical rudder.



Day's method of suspending stone ballast.

Marine, declaring that his conscience would not allow him to have recourse to so terrible a weapon.

The Dutch Government did not want the invention either, so Fulton came to England in 1804 and offered his invention to the British Government. He demonstrated his submarine before Mr. Pitt (the Prime Minister), and various admirals and naval experts. Admiral Earl St. Vincent, then First Lord of the Admiralty, fully recognised the tremendous possibilities of the invention, but openly opposed them in emphatic language, saying "Pitt was the greatest fool that ever existed to encourage a mode of warfare which those who commanded the seas did not want and which, if successful, would deprive them of it."

So once again Fulton's submarine was turned down. He gave the whole thing up in disgust, and went back to America. But even in his native land Fulton fared no better. He exhibited a model torpedo boat before Commodore Rodgers. This is how the commodore afterwards described it:

"This vessel is intended to be armed with two torpedoes on each side, applied by means of a spar 96ft. long, projecting from the vessel's side. This singular vessel, to my mind, deserves the name of *Nondescript* . . . judge whether such *torpid, unwieldy, six-feet sided, six-inch decked, fifteenth-sixteenths sunk water dungeons* are calculated to supersede the necessity of a navy, particularly when the men who manage them are confined to the limits of their holds, which will be under water, and in *as perfect darkness as if shut up in the Black Hole of Calcutta!*"

The italics are those of the gallant commodore himself.

A 1747 Experiment

One of the earliest submarines, which was described in the *Gentleman's Magazine* of 1747, was built by a man named Symons, and tried out in the Thames. To sink her in the water a number of leather bottles were placed with their openings in the bottom of the boat.

The pressure of the water, due to the height of water at that depth, caused them to fill if the necks were untied. To rise again to the surface the bottles were squeezed out by hand and then tied round the necks to prevent the water coming in again.

This is exactly the same principle as that employed in all the latest submarines, the squeezing out being done by compressed air and, instead of the string used to tie up the necks of the bottles, Kingston valves are fitted and the tanks substituted for bottles.

In 1773 an ingenious ship's carpenter named Day made some successful experiments on the Broads, near Yarmouth, and got his friends to put up £340 for more extended experiments. His new boat dived in 22 fathoms off Plymouth, with H.M.S. *Orpheus* standing by. It was never seen again, nor did the coloured S O S floats which had been arranged for ever reach the surface.

A London physician, Dr. Falcke, hearing of the accident, hurried down to Plymouth, having a great belief in his own professional capabilities. He thought that, since the fishes could not get at Day, and that his blood would remain in good condition in such a cool place, he could restore him to life if only the submarine could be raised before decomposition set in.

He applied to the Admiralty for help in raising the vessel, but the First Lord replied that, since the man was dead, he begged to be excused from taking any further steps in the matter.

The enthusiastic doctor then undertook private sweeping operations, and the wreck was grappled. Bad weather intervened, however, and the doctor had to abandon his attempts and return to London.

The Garrett Submarine

A Liverpool curate named Garrett, in 1878, built a submarine 14ft. by 5ft. This boat had two arms for catching hold of objects under water; these were made of leather well soaked with oil to keep them pliable and soft for use.

After successful experiments in Liverpool docks, Garrett built a second submarine, which he christened *Resurgam* (I shall rise again). This craft was ultimately lost off the Welsh coast, and Garrett became associated with Nordenfelt, the gunnery expert, in the further development of submarines which could fire a propelled Whitehead torpedo—the forerunner of the modern sea-going submarine.

The foregoing just touches on some high lights in the development of the midget submarine, and the human torpedo. It may not be generally known that torpedo is the Latin name of the electric ray or skate, which is held "to kill its prey by lightning." Here is one more case where Man has improved on Nature . . . or has he?

What Children Want After the War

By MARGARET MITCHELL

FIRST and foremost of the things I want after the war is at least one good holiday, away from home, each year. By this I do not mean a week at Margate, but three weeks or more in the country or at the seaside. Facilities should be granted to take all children away from the towns during the holidays, and cheap accommodation provided for them when they get away.

When children get older and begin to look outside their own country, as many as possible should be taken to other countries, especially the colonies and the U.S.A. Every child should have been abroad at least once by the time he or she is sixteen, *without* parents. This could be arranged with the other countries, they sending batches of their children here in return. They should all know what is going on in other countries.

Before the war you could have five-shilling "flips" at aerodromes, and you could take boats on to some ponds and rivers. After the war, services ought to be put into operation to take children into the air, and lakes and streams suitable for boating ought to be freely open to the public, with boats for hire at a low cost.

Parks should be expanded. London itself has many, but more should be opened in the suburbs and in many other cities. Children's playgrounds have hitherto been very neglected. They are, at the moment, dingy asphalt squares with a few rusty iron swings and a horrible machine for making you giddy. They should be larger, better cared for, with the swings, if they have to be iron, kept free from rust. There should be plenty of room to play hide-and-seek, and if possible, a refreshment bar with sweets and ices. More gymnasiums and swimming baths and roller and ice skating rinks would be good.

Many more libraries should be opened. I myself am at least six miles from a good library, except for a little place with a few mid-Victorian novels. These libraries should be large, with reference sections, and a children's department.

I think that school uniforms should be overhauled, casting out the most drab, so that children need no longer look like scarecrows when they go to school.

More scholarships ought to be awarded by colleges and universities, for those that have the ability. Special training ought to be given to those children who know what they want to do in after life.

Nowadays, when children want to see a film, a Walt Disney cartoon, perhaps, they find that it is sandwiched in between a horror and a sentimental love-story. There ought to be special children's cinemas, to which all children could go, with days for the very young, and days for the older children. Also there ought to be children's theatres at which only children would act; they have them in Russia, I believe.

Some of the things which I have mentioned were going on before the war, but have been stopped. I hope very much that they will be revived after it.

Items of Interest

For Farmers

AT the present juncture, when our minds are occupied with the war, it is refreshing to note inventions which will be useful during the piping times of peace.

It is necessary for the farmer at times to level the surface of his land. A tractor-drawn implement can, by means of this invention, be employed for the purpose of grading earth surfaces by collecting soil from one point and transporting it to another. Thus ridges may be lowered and hollows filled.

Hitherto, it appears, there have been used tine cultivators linked to tractors. On these tractors have been means whereby through the linkage the frame could be raised or lowered to carry the implement tools clear of the ground, or to lower them into operative position.

An improved device of this nature comprises a tine cultivator connected to a tractor by linkage and raising or lowering means from some, or all, of the tines. From this cultivator the shares or points have been removed and substituted by a curved plate of metal fashioned to fit against the tines to which they are secured.

Non-slip and Spin Wheels

ANOTHER device relating to farming concerns tractors in which the driving wheels are fitted with strakes or spuds to afford gripping power and prevent slipping and wheel spin.

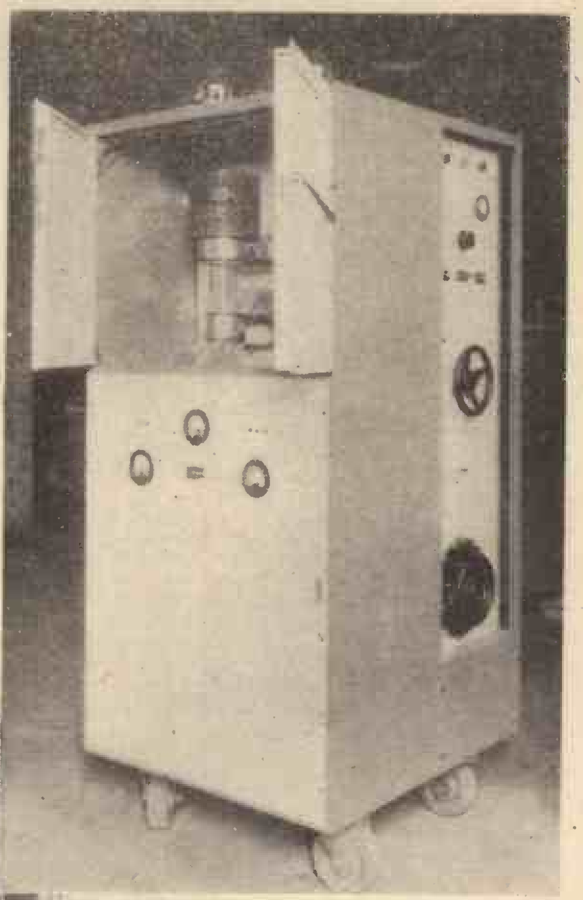
The chief aim of this invention is to provide a simply constructed tractor which, while possessing all the advantages of a non-slip wheel, also has the characteristic that the wheels with their strakes or spuds, and, consequently, the tractor, are less liable to damage from jarring or vibration.

In this case the wheel is provided with adjustable and completely retractable spade spuds, and adapted for use with a plain steel tread, a rubber or resilient tread, or one which is straked.

Radio-frequency Heating

Industrial Applications of Eddy-current Losses and Power Dissipation in Dielectrics

By DONALD W. ALDOUS, M.Inst.E.

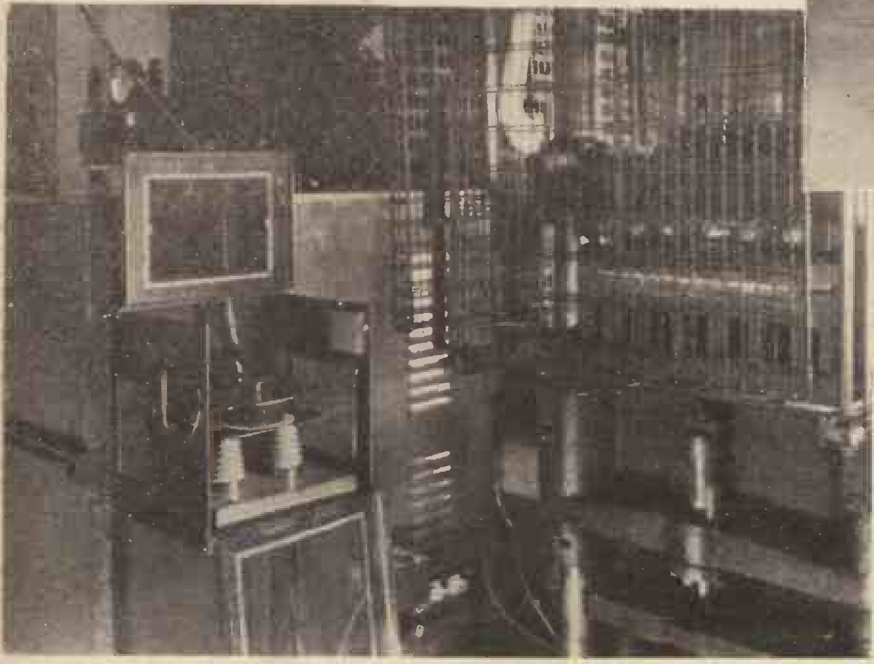


Radio-frequency generator, portable type, built by Rediffusion. Power output is 3 kW.

POPULARLY known in America by such names as *heatronics* and *radiothermics*, and in this country as *radio heating* or *plastic heating*, these new applications of eddy-current and dielectric heating are simply the turning to useful purpose of what radio experimenters have long known as "losses" in their receiving and transmitting equipment. In the electro-medical field, too, diathermal heating of body tissues has been used for many years.

Other familiar uses of eddy-current heating are in melting steels and various alloys, without the introduction of impurities or contamination from ordinary furnace gases, and the process in valve manufacture in which the glass envelope, during exhaustion, is surrounded by a coil, forming part of a high-frequency oscillatory circuit, to heat the metal electrodes, thus releasing the adsorbed and occluded gases.

With the exception of electro-medical diathermy, which uses frequencies in the 20-60 mc/s. range, for all the foregoing applications high audio- or comparatively low radio-frequencies are employed, but the latest applications of R.F. heating in industry to-day involve much higher frequencies, e.g., up to 2 mc/s. with eddy-current, and up to 20 mc/s. with dielectric heating.



Radio-frequency heating equipment, built by Rediffusion, and installed in the I.C.I. Laboratories, Welwyn Garden City. The heating chamber, entirely screened and with doors opened that break H.T. circuit, is on the left. Moulding powder pre-form, shown between the electrodes, is transferred to the moulding press on the right after R.F. pre-heating.

Before discussing these applications the precise difference between the two R.F. heating methods should be clearly understood. Although terminology has not yet been standardised, heating due to eddy-currents induced in a conducting charge (i.e., the "work" or material to be treated) is referred to as eddy-current heating (E.C.H.), and heating due to displacement currents in an imperfect dielectric (the "work") is generally termed capacity-current heating (C.C.H.).

One important application of E.C.H. is to establish a thin case of hardened metal on the surface of a hardenable steel, e.g., crankshaft bearings, machine tools, without distortion of the part, scaling of the surface, or disturbance of any prior heat treatment of the core. The whole process can be completed in a period of seconds, and is produced by means of the well-known "skin effect," which increases the effective resistance of coils and conductors, due to the crowding of radio-frequency currents towards the outer layers of a solid conductor, which effect increases with frequency. The complex process of tinplate manufacture has been considerably assisted by using E.C.H. treatment of the metal strips employed in making tin cans.

Capacity-current Heating

Coming to C.C.H., the second R.F. heating method, which heats non-conducting materials by reason of their power factors as dielectrics, many more equally important applications can be mentioned.

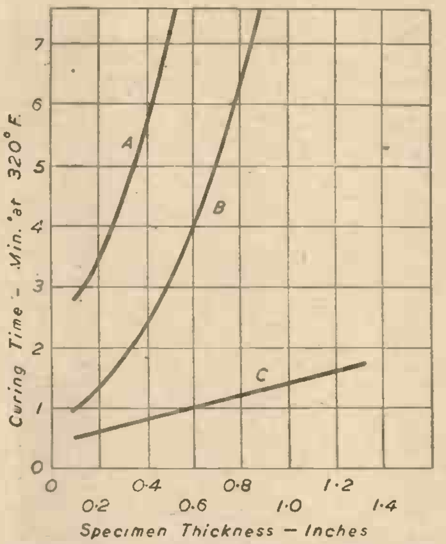
The radio-frequency current is applied to the work to be heated by means of parallel electrodes so as to form, in effect, a condenser. Then, because of dielectric dissipation, the work becomes heated throughout its thickness, which is a valuable merit of this method. A theory that has been put forward to explain this mode of heating visualises that the internal production of heat is attributable to the friction of the molecules while repeatedly changing their alignment under the influence of an alternating electrostatic field of radio-frequency. The rate of heating is not only directly proportional to the applied frequency, but also to the dielectric loss factor, which is the product of the dielectric constant and power factor of the work. Thus is can be seen that such low-loss materials as, say, polystyrene, give only slow rates of heating. The highest possible frequency is usually desirable, as this enables the voltage across the electrodes to be reduced for any given rate of heating, and the voltage must not be excessive or flash-over across the plates will occur.

Heating Plastic Materials

One of the earliest applications of C.C.H. to reach commercial production was that of heating laminated plywood to give quick setting of the glue, and one of the more recent applications is the heating of plastic materials, both thermo-plastic and thermo-setting. In the latter case, such problems as securing uniform field distribution and insulating one half of the press have to be overcome to permit the application of radio-frequency current direct to the material in the mould, and this imposes severe restrictions on the design of dies. The technique generally advocated is to pre-heat the plastic and then transfer it rapidly to the press. For heating plastic in powder form, a ceramic container is used, but the use of pre-formed pellets or cakes is preferred. In this manner uniformity of shape, density and thickness is obtained, which are important considerations for successful operation. The temperature to which the pellets should be heated is dependent on the nature of the particular article to be produced and its thickness. For thick block mouldings a temperature of 150 deg. C. is usually the highest practicable value, and the heated pellet must be transferred very quickly to the mould to avoid undue cooling. On placing it in the mould the material flows immediately, and is cured within a fraction of the time required when all the heating is introduced in the mould itself, or even with oven pre-heating of the plastic. The marked reduction in curing time, compared with normal and oven pre-heating, with R.F. heating, is shown in the accompanying diagram.

This ability to mould thick sections, up to 2½in., with a comparatively short curing time, will have an important effect on the future design of plastic articles, permitting the production of mouldings of much greater section than the former wall thickness, which has limited the majority of plastic articles to thin shell-like objects, e.g., electric switch covers, ash trays.

Thermionic valve oscillators are capable of generating all the R.F. power yet required for any of these heating applications, and in very large plants often sufficient heating capacity is available as a supply, with low impedance feeders tapping off to separate loads. Operating costs are reasonable, although the actual equipment is costly and takes up space, but because of the reduction in curing time, the number of moulds required, and, therefore, the expensive presses, is smaller.



Curing times of Woodflour and Fabric-filled Phenolic plastic. A : Standard moulded, with no pre-heating. B : Standard moulded, pre-heated. C : R.F. pre-heated.

An important practical matter in the installation of such equipment is the prevention of radio interference, which necessitates complete screening of the R.F. heater, and automatic frequency control of the oscillatory circuit is desirable to compensate for changes of dielectric constant, etc., during the heating cycle.

Latest Applications

Finally, some of the latest applications of R.F. heating must be recorded. Insect pests can be killed in grain, as it has been found that the insects absorb more R.F. energy than the cereals, and hence become rapidly cooked. Tobacco can be dried without removing it from the hogsheads. Sheets of thermo-plastic material can be rapidly joined together by this "electronic sewing machine," which also permits the welding of fabrics. Spot-welding of thin metals is another use, and up to 1,800 spot-welds (or "stitches") in a minute are possible. The dehydration of foodstuffs, with improved keeping qualities, etc., over the oven drying method, is another important application. R.F. heating obviously has enormous possibilities, although much difficult development work will be necessary before the technique becomes routine in industry, and many engineers believe that, for certain industrial purposes, existing methods should first be explored.

Thermionic Valves in Power Systems

The Various Applications of Radio Valves in Engineering

By J. H. M. Sykes, Assoc.I.E.E.

NOT so many years ago power engineers looked at the radio-type valve as an interesting toy which, although capable of miracles in its own field, was on nothing like the same plane of reliability as, say, the turbines and transformers with which they were more familiar. But the younger generation of supply engineers does not suffer from inhibitions nourished on the early and experimental vagaries of thermionic valves, and the ubiquitous glass tubes are finding new and more responsible applications on power systems each year.

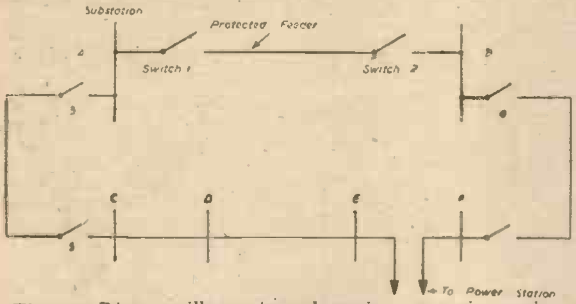


Fig. 1.—Diagram illustrating sub-stations on a ring main.

Perhaps the most responsible task given to a valve is that which it performs in superimposed high-frequency protective systems. One of the major problems in power supply networks is to devise a protective scheme for any feeder or transformer which will ensure that not only will the switches controlling it itself trip if a fault occurs, but that the switches controlling the alternative supply, and other switches on the system, will *not* trip. The first objective is comparatively easy of attainment: the second is more difficult.

One method can be explained by reference to Fig. 1.

The feeder under consideration is that between sub-stations A and B. If a fault occurs between these two points, it is essential that the switches marked 1 and 2 *should* trip and remove the fault from the system, and it is equally essential that the switches 3 and 4 should *not* trip, thus leaving the sub-stations A and B supplied from the network, with no interruption to the supply.

The method adopted is to measure the direction of the fault current through the switches 1 and 2, and if it is inwards in both, that is, towards the protected feeder from both ends, then the switches are allowed to trip, since the fault is obviously inside the feeder zone. But if the fault were outside the protected section, say on the feeder A—C, then the fault current would still pass through the switches 1 and 2, and unless means were taken to prevent it, these would trip as well as switches 3 and 5, and possibly others in the ring, and sub-station A at least would be without supply. The protective scheme arranges that if the fault-current-measuring device shows that the current is *outwards* from the protected feeder, it locks out from tripping the adjacent switch 1, and sends back a signal to the remote switch, 2, which is then locked out as well.

The valve becomes of great importance when we consider the means used to send the signal back from A to B, or vice versa. Some systems use a pilot cable, but if the feeder is an overhead line, and there is no cable route, this is very expensive. An alternative is to superimpose on the 3-phase 50-cycle power system a high frequency, say 1,500 kcs., which would serve to transmit the necessary signal.

To do this, an HF oscillator of about 10 watts output is required at each end, and a simple 2-stage receiver is also needed. This receiver operates a relay in its output stage

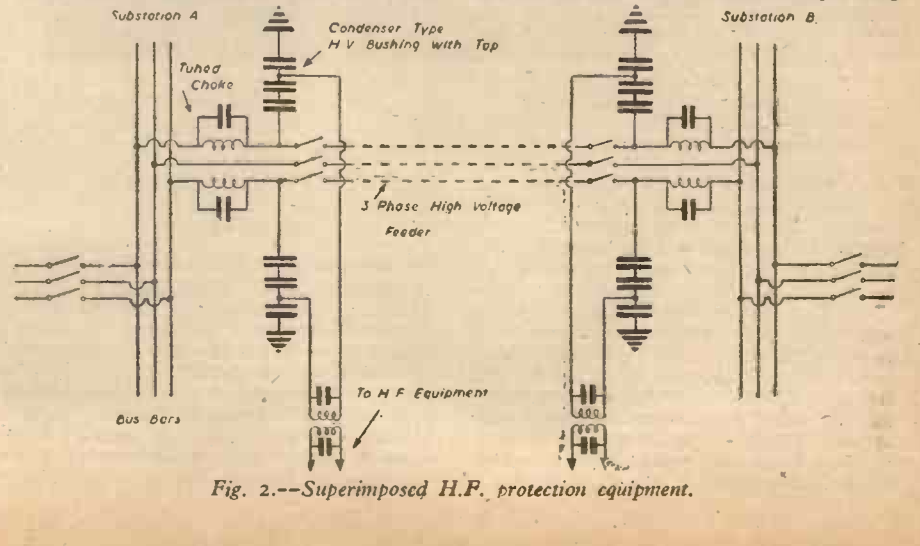


Fig. 2.—Superimposed H.F. protection equipment.

when a received signal is impressed on its input terminals, and this in turn sets in motion a train of other relays which lock out the tripping circuit of the adjacent power circuit breaker.

Tuned Choke System

The scheme requires a tuned choke in the power system, as shown in Fig. 2, and a means of injecting the high-frequency signal into the high-volage network. The choke is to restrict the high-frequency to the desired channel, and to prevent its dissipation into the whole of the system, and the injection is done by means of a tapped condenser bushing, designed for the line voltage of, say, 66,000 volts, and composed of alternate layers of bakelized paper and tinfoil. The figure shows the general arrangement.

As well as providing a signal channel between the two sub-stations for the protective gear scheme, the high-frequency gear can also be used for indicating and telephone purposes, by using different frequencies and crystal filters.

Another important application of the valve, this time a thyratron or gas-filled tube, is in neutral displacement protection.

If a feeder from a system with an earthed neutral supplies a delta-connected transformer only, at the remote end, there is a danger that when it trips on fault, the fault current may still be supplied from the lower-voltage busbars, from an alternative source of supply, and so cause damage to plant and possibly further interruption to supplies. The layout of such an installation, which is fairly common, is shown in Fig. 3.

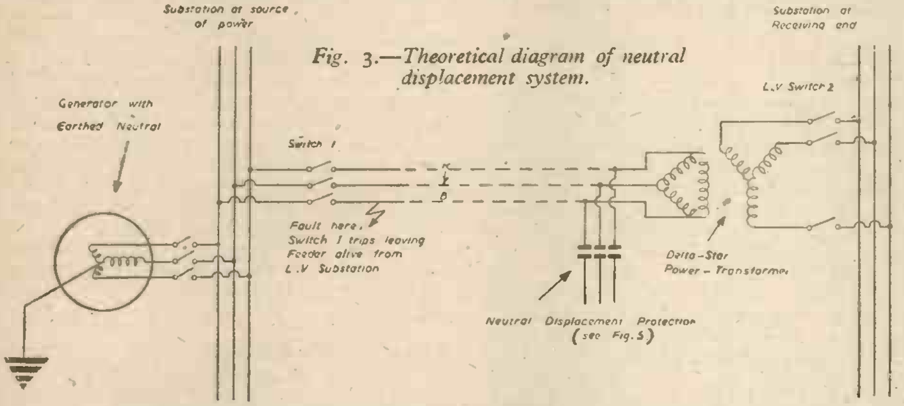


Fig. 3.—Theoretical diagram of neutral displacement system.

If a fault occurs at the point indicated, not only may the fault-current persist by being fed from the lower-voltage busbars, but the potential to earth of the red and yellow phases may rise to full line-to-line pressure, instead of the phase-to-neutral voltage normally existing. Since the line voltage is 1.73 times the phase voltage, serious flash-overs may occur. The situation really arises from a displacement of the neutral point, from the vector value shown in Fig. 4 (a) to that in Fig. 4 (b).

This condition is detected at the receiving end of the feeder by a neutral displacement relay which takes account of the fact that the normal balanced condition of a three-phase system means that the voltages have no vectorial resultant, and if three high-voltage condensers are connected to the lines, the resultant voltage between the point A, in Fig. 5, and earth, will normally be zero.

If, now, one phase is earthed, the resultant will be of considerable magnitude, and the potential developed across the tuned circuit —tuned for the normal 50-cycle system frequency to prevent unwanted operation by harmonic frequencies often present in power systems, especially during surges—is applied to the grid of a thyratron. This gas-filled relay, as it is often called, is so biased and adjusted that it "triggers off" at a pre-determined value, and the consequent anode current operates a relay to trip the low-voltage switch, No. 2 in Fig. 3. Thus the faulty transformer or feeder is isolated on both sides.

While the two applications given above are interesting in respect of the important place they allot to the thermionic valve in the direct protection of E H T power supply systems, there are many other uses almost equally important, but more in the general line of duty we have come to expect from valves.

"System Control"

The "system control" of power networks calls for a central control room in an area as big as, say, several counties, to which is connected by telephone all the power stations and switching stations in that area and from which they are all controlled throughout the twenty-four hours.

It greatly simplifies the work of the control engineer if he has, in addition to the normal telephone facilities, indications of the loads in important tie feeders, and other key readings, always available. Since only one pair of wires is available from most of the remote stations, it has to serve both the purposes of telephony and metering. This is done by the superimposition of currents of varying frequencies on top of the telephone connections, the frequency being cut off automatically during the time speech is actually passing. This calls for oscillator valves at both ends, and receiver circuits to operate relays to cut off speech circuits and perform various functions in connection with the meter indications.

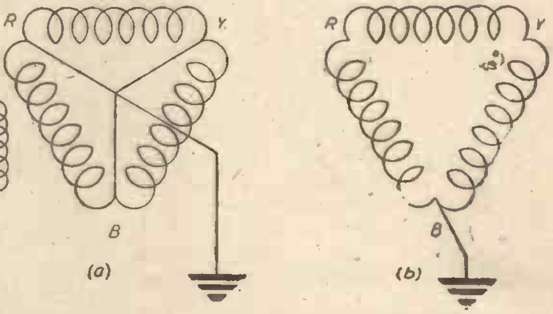


Fig. 4 (above). — Diagrams illustrating displacement of the neutral point.

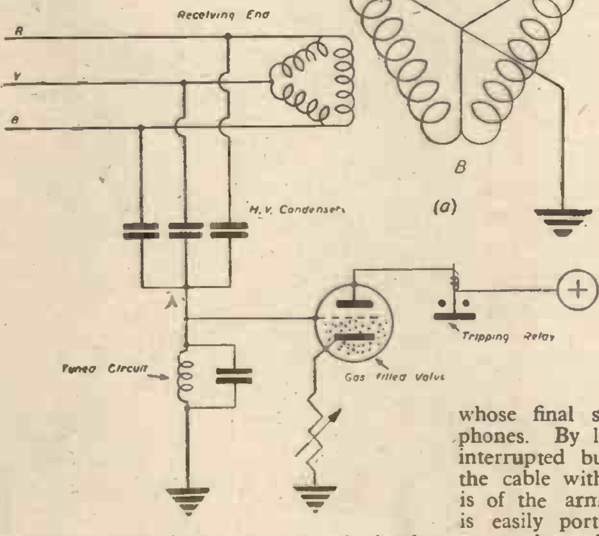


Fig. 5 (left). — Diagram of neutral displacement protection.

In another scheme, the meter reading is converted by means of valve circuits to a DC current of small magnitude, the *amount* of which, in a given period, varies with the value read by the primary meter. This current is superimposed on top of the speech circuits passing across the telephone pair, and is read by a damped milliammeter which, in effect, takes account of the amount of energy transmitted in a predetermined time interval, and this gives a reading corresponding to the primary current or voltage, or whatever is being metered.

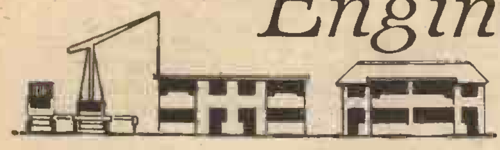
In power stations it is desirable to keep a close eye on the density and colour of the gases emitted from the stacks, and it is not always convenient to do this by simple visual observation. A photo-electric cell, with its attendant amplifying valves, is called into service, and by projecting a beam of light across the chimney through the gases, on to the photocell, it is possible to arrange for a meter at a convenient position for constant observation by the shift engineer, to provide readings which enable him, when the smoke becomes dense, to take the necessary steps to avoid causing annoyance and inconvenience to surrounding property.

Cable Identification

One of the difficulties encountered by the mains engineer is to identify a particular cable in a trench where there are perhaps twenty or thirty similar cables. Cutting the wrong one may result in injury to the men concerned, and it may shut down the electricity supply to a large area. A device which has been developed consists of a mechanical form of interrupter which causes a buzzer to send out trains of low frequency oscillations into the cable from one end, the other pole of the frequency generator being connected either to earth or to a return core in the cable if a loop is available at the remote end.

A detector, in the form of a search coil wound on a laminated core, is applied to all the cables in the trench, and the output from the coil is fed into a two-stage amplifier whose final stage supplies a pair of ear-phones. By listening for the characteristic interrupted buzz, it is possible to identify the cable without fear of error, even if it is of the armoured type, and the device is easily portable, simple to operate, and extremely useful. It has also been used for the location of cable faults.

Another development of the thermionic valve and its application to high-tension work is the latest high-tension "megger," which provides a DC voltage of upwards of 5,000 volts for measuring high values of insulation resistance by a simple Ohm's law method. Here the reliability, compactness, and efficiency of the simple diode rectifier have found an important application.



Engineer-built Houses of the Future—16

(Continued from page 266 May issue.)

Details of Pre-built Pitched Roofs

By R. V. BOUGHTON, A.I.Struct.E.

PITCHED roofs which are pre-built should be designed and constructed to accord with the following essentials: (1) Sufficient strength to support all the dead loads of roofing, ceiling, etc., and a superimposed load which includes wind force, as required by the by-laws. (2) The trusses to be of a size to suit transport, site handling and erection; this particularly refers to trusses which are framed at the manufacturers. There are methods whereby the various members of roof trusses can be separate and packed and transported in bundles and then assembled on site, bolted, or otherwise connected together. (3) Comply with reasonable standards of dimensions in relation to spans and distances apart of trusses, sizes of roofing and ceiling units, and areas of houses and their rooms. (4) Be rain and wind proof; and (5) have those other essentials of pre-built housing principles which have been explained in connection with floors and walls, such as economic initial and maintenance costs, durability, lightness in weight, and sound and temperature insulation.

Pitched roofs should have trusses and the roofing and ceiling units in a sufficient variety of standard sizes to allow architects and designers freedom in planning. It may be found that spans varying from about 12ft. with 6in. or 9in. increases up to about 18ft. will be useful for most kinds of housing work. Variations of a few inches in the overhang of eaves will permit a similar variation in sizes of rooms, etc., and for practical tolerances. Distances apart of trusses should be, say, 6ft., which will permit roofing and ceiling units 6ft. long to be used; this 6ft. may certainly be flexible, and, indeed, may vary from 4ft. to 8ft. if desired, subject, of course, to the trusses and units being designed structurally to resist the different stresses. Roof trusses need have no dimensional co-ordination or relationship with any main posts in external walls or internal partitions; they can rest on beams which ring the top of the walls and partitions. In the case of houses having gables to the flank walls, trusses at standard spacings could be used in the majority of the width of the house (or a pair of them) and a different spacing adopted between the truss nearest the flank wall, and that wall, and roofing units of a width varying from the standard truss spacing being used for the spacing over the gable wall; it may be practicable to let the roof units overhang the gable wall to an extent which may make the utilisation of standard width of units possible.

Simple Pitched Roofs

Fig. 98 is an isometric view of a typical pitched roof having light framed steel roof trusses, which, although spanning from one external wall to another, say, a distance of 28ft. or 30ft., derive intermediate support from an internal load-bearing partition.

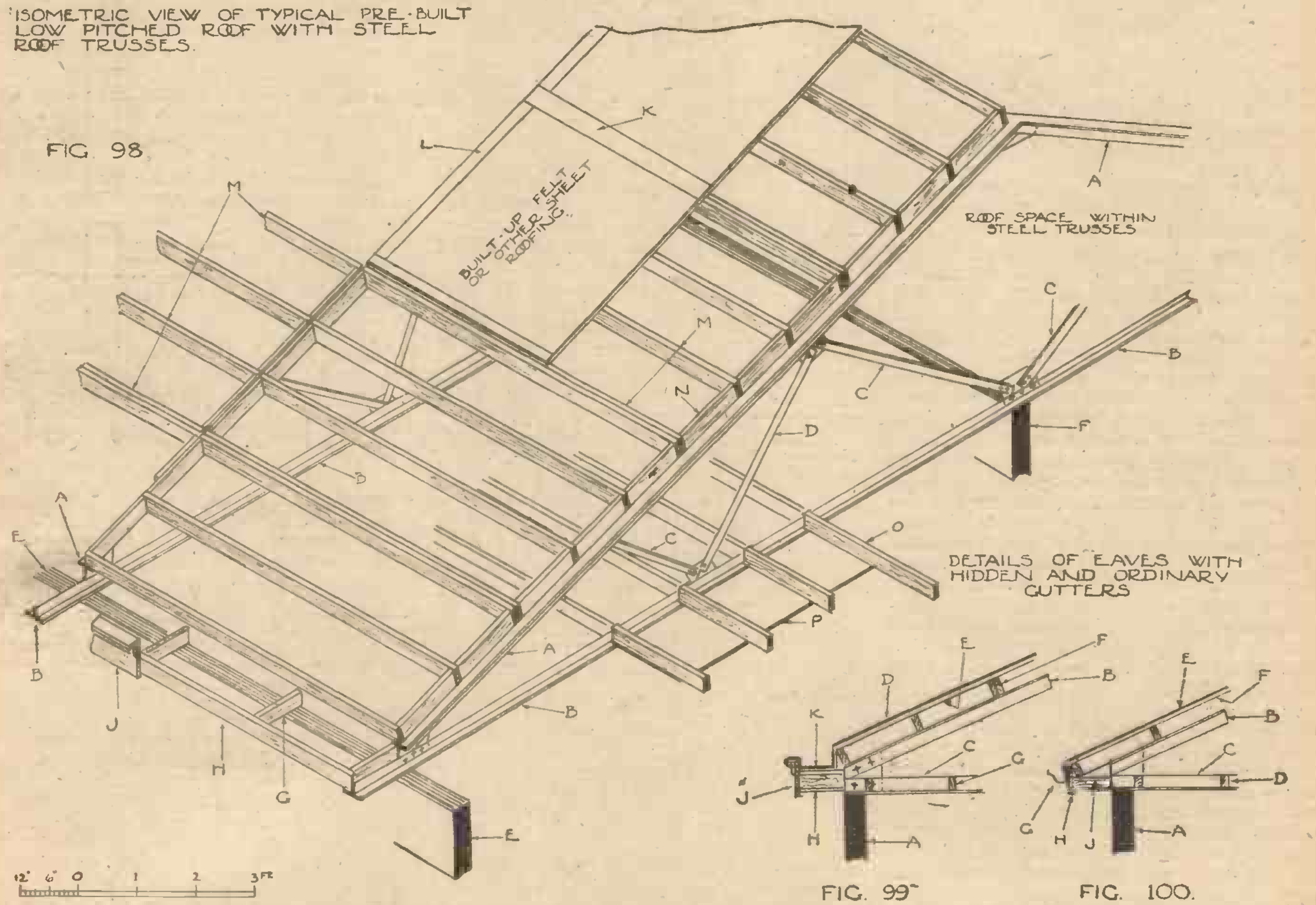


Fig. 98.—A—Steel tee principal rafter. B—Steel tee main tie. C—Steel angle strut. D—Steel flat tee. E—External wall. F—Partition of load-bearing type. G—Gutter bearer. H—Small section gutter beam spanning between steel ties of roof truss and forming with G and J a pre-built eaves unit. J—Fascia with moulding if desired. K and L—Watertight cover strips over joints in roofing. M—Timber bearers or framing of pre-built roof units. N—Edge boards of roof units. O—Timber bearers or framing of ceiling units. P—Ceiling covering.

Fig. 99.—A—External wall. B—Steel principal rafter. C—Steel main tie. D—Sheet roofing. E—Roof boarding. F—Framing of roof units. G—Framing of ceiling units. H—Soffit lining. J—Fascia. K—Hidden gutter.

Fig. 100.—A—External wall. B and C—Principal rafter and main tie. D—Framing of ceiling units. E—Roofing. F—Boarding. G—C.I. gutter. H—Fascia. J—Bearer.

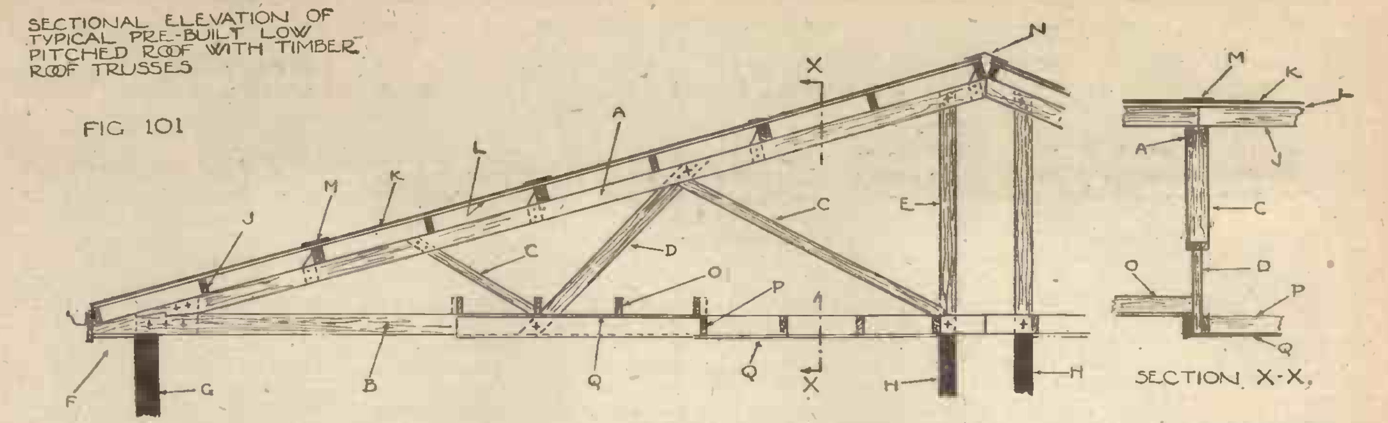
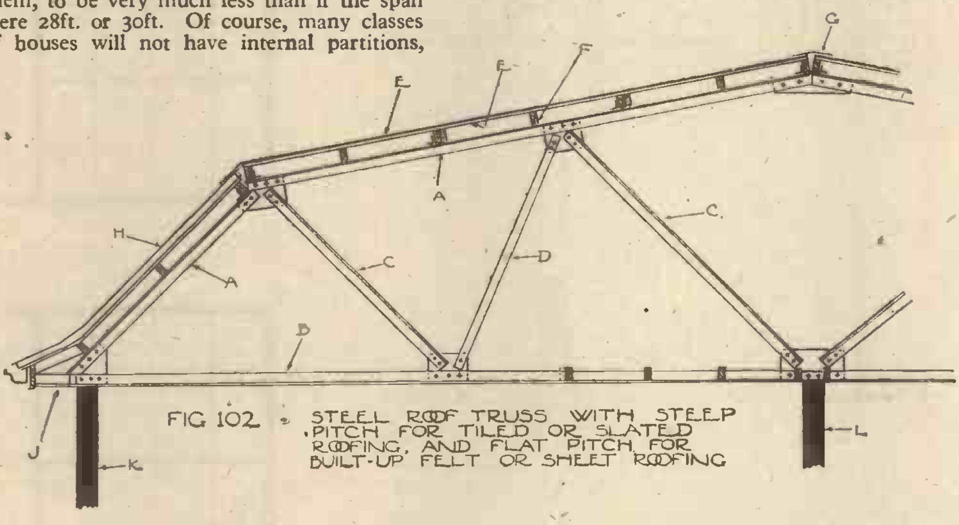
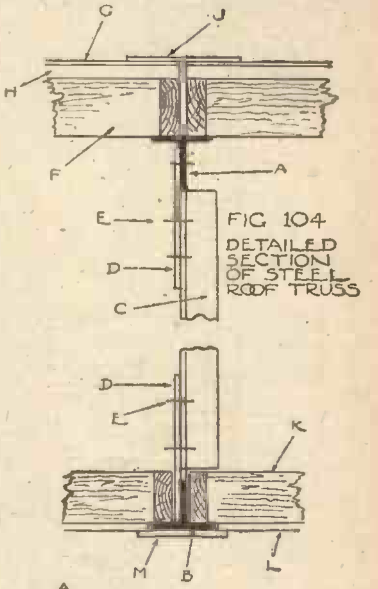


Fig. 101.—A—Timber principal rafter of twin formation. B—Timber main tie of twin formation. C—Single member strut. D—Single member tie. E—Junction and binding member. F—Gutter unit. G—External wall. H—Internal load-bearing partition of double type. J—Framing of roof unit. K—Sheet roofing material. L—Roof boarding. M—Watertight joint strip. N—Ridge strip. O—Framing of ceiling unit supported on top of main tie of roof truss. P—Ceiling unit slung down to side of main tie. Q—Ceiling covering.

Such support has a considerable influence on the design of the trusses and their weight because the effective span of the trusses is only the distance from an external wall to the partition, viz.: say, from 12ft. to 16ft., and thus causes the stresses in the various members, and the size of the steel to resist them, to be very much less than if the span were 28ft. or 30ft. Of course, many classes of houses will not have internal partitions, or partitions suitable in design or position, to support roof trusses, and in such cases trusses without intermediate support may be essential. If so, it will be found that the trusses will not be very heavy if designed correctly. The roof units, which may be from 3ft. to 4ft. wide—the width being in the direction of the slope of the roof—are timber framed and of a length suitable to span from truss to truss, and from truss to gable wall where such is used in the general design. Each unit must be secured to the roof trusses; simple angle cleats bolted or riveted to the principal rafter of





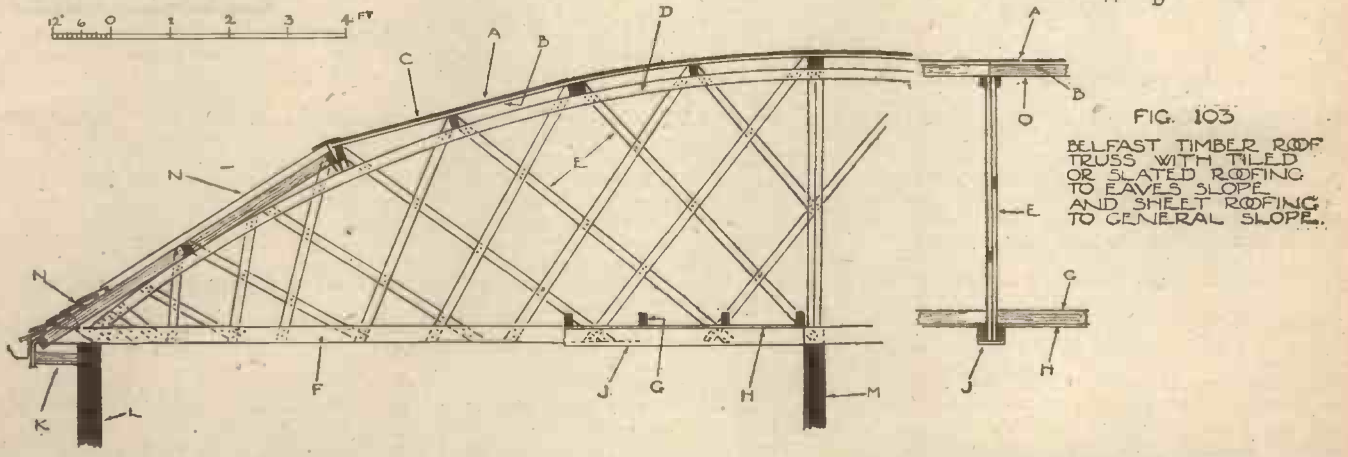


Fig. 102.—A—Principal rafter. B—Main tie. C—Strut. D—Tie. E—Sheet roofing on roof boarding. F—Timber framed roof unit. G—Ridge strip. H—Tiled or slated roofing. J—Sprocketed gutter unit. K—External wall. L—Load-bearing partition.

Fig. 103.—A—Sheet roofing. B—Boarding. C—This unit to have straight surface and framing. D—Bent top chord of two small section timber members. E—Lattice members. F—Bottom chord of two boards or small section timber members. G—Framing of ceiling unit. H—Ceiling covering. J—Lining. K—Gutter unit. L—External wall. M—Load-bearing partition. N—Tiled or slated roofing. O—Roof unit.

Fig. 104.—(Enlarged detail)—A—Steel tee principal rafter. B—Steel tee main tie. C—Steel strut. D—Gusset plate. E—Rivet or bolt. F—Timber member of roof unit. G—Sheet roofing. H—Roof boarding. J—Joint strip. K—Timber member of ceiling unit. L—Ceiling covering. M—Cover strip.

the truss will provide means to allow the units to be bolted to the upstand of each cleat. The adjoining units should be bolted together at the middle of their length to obviate any unit riding above or below its neighbour. The roofing material and the boarding or other material on which it is laid is described later in this article. The ceiling units are of similar construction to the roof units, the method of connecting them to the main tie of the roof truss being a little different, as shown by the various details. The eaves construction is important, as it may conform to any of the various methods, which are depicted by Figs. 98 to 103. The eaves, whether it consists of a simple overhang with plain fascia, soffit, and ordinary gutter as Figs. 100-101 and 103, or with an overhanging eaves with a hidden gutter as Figs. 98 and 99, should be separate units which are fixed easily to the structural eaves.

Another type of steel roof truss is shown by Fig. 102. The object of the two pitches or slopes on each side of the roof is to allow the steeper to be used for such traditional roofings as ordinary tiles or slates, and the flatter slope for such roofings as built-up felt or other sheet material. The steep tiled or slated slope, although moderate in extent, would provide a pleasing appearance, and the flat slope behind it would not be too obvious. Although the units to the steeper slope would be pre-built complete with tiling or slating battens, the tiles or slates would be site laid; the remainder of the roof would be almost entirely pre-built, the only site work being the fixing of the water-tight cover strips over the joints between the units.

Timber Roof Trusses

Fig. 101 depicts one of many types of timber roof trusses which can be designed in accordance with modern codes of practice to suit pre-built principles of construction. The truss, if considered as spanning from eaves to eaves or between two external walls, would consist of two half trusses to simplify transport and site erection, and would be constructed as shown with principal rafters and main ties of twin formation, and the internal struts and ties of single members. The joints may be of a combination of proper timber joints so arranged and framed as to partly resist the stresses in the various members, and strengthened with tubular bolts and nailing; or, alternatively, timber connectors may be used. The roof and ceiling units may be of similar design to those described for steel trusses. The steel roof truss principle as Fig. 102 may also be applied to timber construction.

The old Belfast type of roof truss may be adopted for pre-built house roofs. This roof, when designed and constructed properly, and with correct joints, ensures a very strong roof with the use of small size timbers. If desired, the lower part of the curved surface from eaves to several feet up the slope may be tiled or slated, as depicted, a design which is not only simple, but effective in appearance. Pre-built Belfast trusses may be in two half spans as detailed.

Roofing Materials

The low pitched surfaces of the roofs shown by Figs. 98-101, 102 and 103 may have a sub-roofing of rough or prepared boarding of an actual or finished thickness equal to not less than 1/24th of the clear distance apart of the timber bearers. The roofing may be of built-up felt which consists of 2, and preferably 3, layers of suitable quality felt bound together with compound, and the joints between the units covered with a similar strip material. Sheet metal may be used if desired with the joints capped in metal where they run in the direction of the slope and lapped or cohesed in the case of the horizontal joints. In lieu of the sub-roofing and the roofings described in the foregoing, metal-faced plywood may be used which will combine the sub-roofing and roofing; there are suitable cappings to ensure watertight joints. It is also practicable to use any of the asbestos sheet or large-tile roofings, but as a general rule these would have to be site fixed; such fixing is neither difficult nor costly, as roofing specialists can cover the roof of an ordinary sized house in a few hours. It must be borne in mind that whatever roofing material is used, the pitch must be suitable and preferably comply with the table given in May issue.

As before stated, the steeper slopes may have site-fixed tiles or slates fixed to battens which are part of the pre-built roof units.

Ceiling Materials

The ceiling pre-built units should be complete with the ceiling covering which

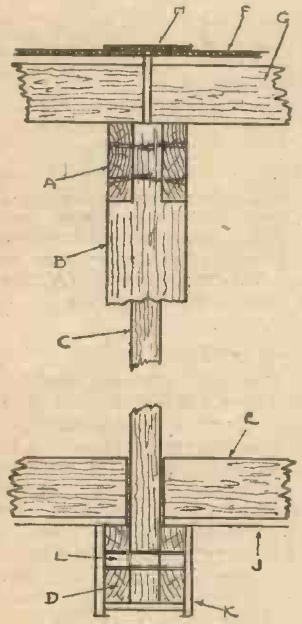


FIG. 105.
DETAIL OF TIMBER ROOF TRUSS WITH ROOF AND CEILING UNITS HAVING DEAD BEARINGS

12" 9" 6" 3" 0 1 FT

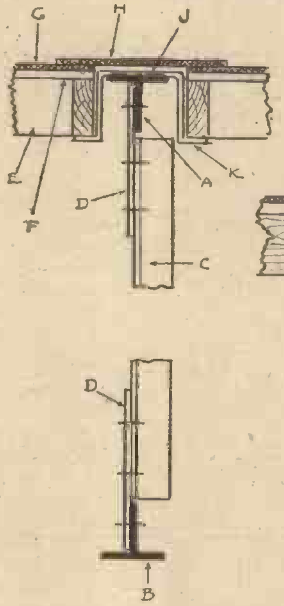


FIG 106.
DETAIL OF STEEL ROOF TRUSS WITH SLUNG ROOF UNITS

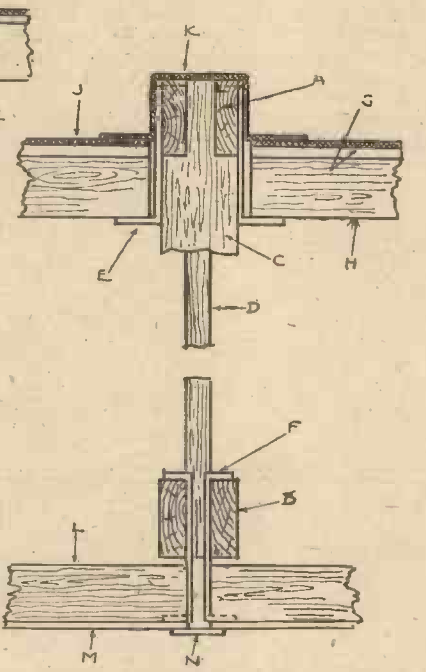


FIG. 107 - DETAIL OF TIMBER ROOF TRUSS WITH UNDERSLUNG ROOF AND CEILING UNITS

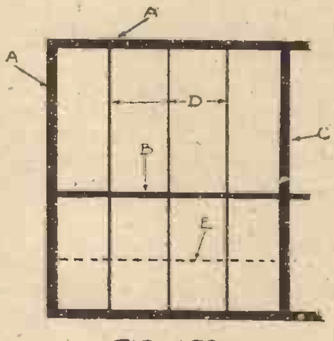


FIG 108

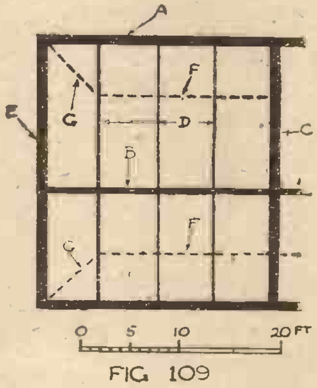


FIG 109

Fig. 105.—A—Timber principal rafter of twin formation. B—Strut with shoulders bearing on principal rafter and part of strut extended between the members of principal rafter and nailed thereto. C—Tie. D—Timber tie of twin formation. E—Ceiling unit. F—Sheet roofing. G—Roof unit. H—Watertight cover strip over joint between units. J—Ceiling covering. K—Lining. L—Tubular bolt.

Fig. 106.—A—Steel tee principal rafter. B—Steel tee main tie. C—Steel angle strut. D—Gusset plate with rivets or bolts. E—Roof unit supported on slings. F—Boarding. G—Sheet roofing. H—Cover strip. J—Packing strip if necessary. K—Metal sling.

Fig. 107.—A—Principal rafter. B—Main tie. C—Strut. D—Tie. E—Metal sling to support underslung roof units. F—Metal sling to support underslung ceiling unit. G—Roof boarding. H—Underslung roof unit. J—Sheet roofing. K—Lapping. L—Underslung ceiling unit. M—Ceiling covering. N—Cover strip.

Fig. 108.—A—External wall. B—Partition. C—Party wall. D—Roof trusses. E—Break in pitch of roof as Figs. 102 and 103. N.B.—This lay out allows for gabled end to house roof.

Fig. 109.—A—External wall. B—Partition. C—Party wall. D—Roof trusses. E—Hipped end. F—Break in pitch of roof. G—Hips. N.B.—This layout allows for hipped ends to house roof.

may be of any of the great variety of materials which are on the market, such as insulation building boards, hardboards, plaster boards, plywood, plastics, decorated asbestos-cement sheets, etc. The joints between the units may have cover strips, filled joints, and in certain cases bold open joints equal in depth to the thickness of the ceiling sheets or boards and otherwise closed to prevent a clear space between the main framing.

Saving Height of Houses

A study of most of the traditional kinds of pitched house roofs will show that much useless space occurs; this is so, not only in respect to the actual open roof space, but in the overall depth or thickness of ceilings, and in rafters and roofings which in their turn causes a rather deep eaves construction, all of which affects the height of gable and party walls, chimney stacks and other constructions. Unless required for æsthetic objects, pre-built roofs can conform to designing codes which not only dictate minimum pitches to suit the roofing material which is used, but minimum thicknesses of ceiling and roof units. Also advantage may be taken of the underslinging systems of supporting the roofing and ceiling units as shown by Figs. 106 and 107, which should be compared and analysed with the construction as Fig. 105, which shows the roof and ceiling units bearing on the top of the main members of the roof truss. The roof units in bearing on top of the principal rafter may have the effect of increasing the height of the building about 4in. more than if the methods of Figs. 106 and 107 are adopted. As for the ceiling units, much care is necessary in choosing the system of support; under building by-laws a beam may project within the minimum storey height of a room and therefore advantage may be taken of lowering the roof trusses to an extent which may reduce the height of a house to quite an appreciable extent. The projection of the principal rafter above general roofing level as Fig. 107 is not necessarily an objectionable feature if viewed æsthetically; in fact, it can give a character to the roof. Underslinging methods are adopted extensively on the Continent and in America, and metal slings are simple, effective and cheap. Where roofs are open, such as in factories, any reduction in the cubical contents of a roof space which is caused by underslinging purlins and other structural members, means so much less space to heat, which is indeed an important economic factor in structural design.

Figs. 108 and 109 are worth studying, as they indicate some of the problems of layout of roofs. It is not always easy to obtain ideal conditions. A house is not always rectangular on plan, but may have breaks caused by a bay, an annexe, or other projection. The roof may be gabled or hipped. I bring these matters to the front to impress an important point: designers of engineer pre-built houses really must allow for all normal planning conditions and grant that planning and structural designing must be balanced, and that one cannot take unreasonable precedence over the other.

What's in a Name?

Some Interesting Notes About Inn Names

By W. J. MILL

QUITE a lot, in spite of what the poet said, and especially when it comes to those friendly establishments where cyclists are wont to take their "elevenses," their midday meal, and their tea. The inns of this country revert to their original purpose, as far as cyclists are concerned, purveying food and drink to the road-farer, and, as regular users of inns, cyclists can be excused from knowing perhaps rather more about them than the average customer who looks upon his local inn as a "grogshop" pure and simple.

It would be only too easy to write a book about the changing face of the English country inn . . . its rise, through the coaching days, its decline when the railways ousted the coaches, its revival when cyclists took to the roads . . . and alas, its depreciation when motorists followed suit.

But this little article intends to deal only with names . . . the titles inscribed on so many weather-worn boards, swinging in the breeze outside our favourite ports of call.

Old Signs

What's in a name? Well, who wouldn't sooner sit and quaff a mug of ale in The Leathern Bottle than gulp a gallon in Government Liquor Establishment No. 387/42a? The name on the sign is the first thing we see, as we gently apply brakes and come to a stop in search of refreshment, and if the name be but true to the grand old tradition of pub names, why, then, are we not forewarned and prepared to step across the well-worn threshold, back into the atmosphere of the days when the inn was truly the working-man's club?

What are your tastes in names? You like antiquity? I can offer you a grand variety of "olds" . . . the Old Bell and Crown at Winchester, the Old Barrel at Wednesbury, the Old England at Windermere, the Old Hatchet at Windsor, the Old Jamaica in Southwark, the Old Quiet Woman at Chapel-en-le-Frith, the Old Rover's Return in Manchester . . . in fact, "olds" by the score.

You prefer something odd? Well, what about the Maund and Bush at Shifnal? Not so odd really, because maund is just an old English word for basket.

The King and Tinker at Enfield? This is a reference to an old legend about King James and the tinker of Enfield.

Why not the Bear and Rummer in Mortimer Street? A rummer, by the way, being an old Dutch drinking-glass.

The Cat and Fiddle is perhaps the best known of the "odd" names, Cat and Fiddle being supposedly a corruption of Caton le Fidele.

What about the Cow and Snuffers at Llandaff? Nobody knows how this name came about . . . it is the only one in the country, so a jorum at the Cow and Snuffers will be unique.

Coming back into London, we find the Five Bells and Bladebone at Limehouse, the Fountain and Star in Coleman Street, and the French Horn and Half Moon at Wandsworth (or rather we did . . . whether they have all survived the blitz I cannot say). Reasons for any of those odd names? Your guess is as good as mine.

Pig and Whistle

Suppose, now, you were asked to locate the Pig and Whistle, famed in song and story. There is such a pub, and it is at Burnt Fen, with two explanations offered locally as to the origin of the name. One says that Pig and Whistle is a skit on the Warwickshire arms of a bear and ragged staff . . . a bit far-fetched, but a ragged staff, in heraldry, could be a rather rugged whistle. The other explanation avers that Pig is Scottish for pot, and Whistle, from the same language, for small change. You pays your money . . .

Well, if it's queer mixtures you are looking for, you'll find plenty scattered alongside our English roads.

Perhaps you'd like a bit of uphill work, to work up a thirst? Well, in that case you can't go higher than the Tan Hill Inn at Swaledale, which, at 1,727ft., is the loftiest pub in the country. The Cat and Fiddle in Cheshire is next, at 1,690ft., followed by the Travellers' Rest at Flash Bar (1,535ft.) and the Island of Skye (1,505ft.).

More extremes? Well, what about the oldest inn of all . . . the Fountain, at Canterbury, which dates from the early eleventh century? Or the Ostrich, at Colnbrook, which can claim A.D. 1110 as its birthdate? Every London cyclist should visit the Ostrich at some time during his travels and hear the landlord tell of the "good old days," when an earlier Boniface boiled his coaching guests alive.

You're more interested in literature? Then I can offer you a choice between The Shakespear (Victoria), The Robert Burns (Darlington), The Avalon (Glastonbury), The John Gilpin (Cambridge), or, a bit more abstruse, the Altisidora at Hull (Altisidora being a character in *Don Quixote*).

Links With Royalty

There are links with royalty a-plenty . . . from the Monarch's Nob, as the King's Head is always known to its regulars, to the Shah of Persia, the Great Mogul, and a little lower in the Almanach de Gotha, the Grave Maurice at Whitechapel. What connection has the Grave Maurice with royalty? Why, it derives from Graaf Maurice, Prince of Orange, "graaf" being a Dutch count.

What about a pub connected with cycling, you will ask? There I must disappoint you, I am afraid. I am willing to be corrected, but all I can think of is The Cycle at Green Hammerton, and that has long since been closed. There is the Tandem at Oxford . . . but here the reference is to horses, not two men on a bicycle.

You've a taste for something musical? Well, there is actually a pub called The Musical at Barnsley, and if that won't do, try Hark Ye The Melody at Haverthwaite, The Musician at Huddersfield, The Harp, The Harp of Erin, The Welsh Harp, The Jews' Harp, and so on through the whole alcoholic orchestra.

Perhaps you are hungry? There's the Board at Carlisle, The Round Table in Leicester Square, The Frying Pan in Brick Lane, The Cow Roast at Tring, The Haunch of Venison in Bell Yard, The Shoulder of Mutton, The Leg of Mutton, The Beefsteak, The Baron of Beef, The Round of Beef, The Ribs of Beef . . . right down to the humble Bubble and Squeak at Stepney.

And so I could go on, ranging the gamut of names old and new . . . but mostly old. Come what may in the matter of rationing, be the beer never so thin, at least we can still drink it while under a swinging sign, from The Peep o' Day at Bath to the Eclipse in Pimlico, from The Great A at Yaxham to The Final in King William Street, right from the World at Devonport, through the World Turned Upside Down in the Old Kent Road, to the End of the World at Tilbury.

The Production of Gold Leaf

The Development of Gold-beating Methods

By C. C. DOWNIE

THE production of gold leaf represents one of the earliest industries, and in the intervening years has seen relatively little improvement in so far as gold-beating practice is concerned, at least as compared with the vast strides of development made in the working of other metals. The work of reducing gold to leaf or foil was for long considered to be a highly skilled occupation necessitating wide experience in the selection and application of specific hammers which delivered blows for a fixed period of time, followed by trimming of the leaves. As the matter of occupying time appeared to be of no object, this system is persevered with to the present day, and in many quarters it is contended that little advancement can be attained by substituting mechanical methods. It is well known that gold leaf lends itself to very considerable tenuity whereby the thinnest possible section of metal can be obtained. No other metal appears to be capable of reduction to such fine condition, and it is perhaps remarkable that more has not been done to take advantage of this physical characteristic for industrial purposes. As it is, the bulk of gold leaf produced appears to be utilised for ornamental and decorative purposes. Apart from pure gold, leaves of alloys with copper and silver have been prepared in wide variety to accord different appearances for book-binding, and gilding for outdoor constructions exposed to atmospheric influences. A list of these under the categories of different green, lemon, orange, red, ducat, and fine gold grades shows some twenty-one varieties. The poorest of these consists of 300 parts gold and 700 parts copper per 1,000, up to the richest or fine gold, comprising 990 parts gold, 5 parts silver, and 5 parts copper per 1,000.

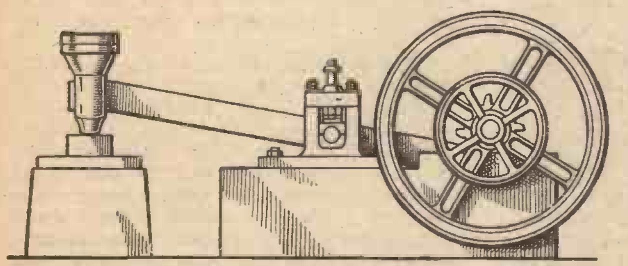


Fig. 1.—An early type of automatically operated hammer for producing gold leaf, but which, despite the use of added weights, had to be abandoned.

Initial Melting

The initial melting of the components was for long carried out in coke-fired furnaces using either plumbago or Hessian crucibles, which was later followed by gas-fired furnaces, but the corresponding electric resistance hearths and low-frequency furnaces which were specially adapted for the production of alloys of this kind did not appear to enjoy any great popularity, although they could ensure absolute purity, since no deleterious matter could be derived from the gases. Whether pure gold or one of these alloys is prepared, the *modus operandi* is the same in each case, and when the charge is ready it is poured into small moulds. With the alloys, the earlier practice of cutting up the metal so obtained, and remelting to ensure absolute uniformity of structure, is still persevered with. A template gauge is then used to check up the width of the small ingot after it has been manually beaten out with a hammer, which is followed by annealing and four successive rollings to convert it to ribbon condition. One of the machines used was represented by a double rolling mill with a power consumption of 1.5 h.p., a peripheral velocity of 7in. per second, and with rolls some 4in. wide.

Annealing

Annealing between each four passes using glowing charcoal is superseded by electric-resistance heating which, besides ensuring more accurate temperature control, prevents any minute particles becoming entrained in the ribbon. A review of modern developments in the annealing and general heat-treatment of magnesium alloys will reveal how much depends upon electric-resistance heating accompanied by controlled air-blast, but the gold alloys rarely necessitate such accurate handling. Any grease remaining from the rolling is burnt off, and the ribbon is given a final annealing, cut into squares, and piled into moulds for beating.

Time Occupied, and Moulds Used

The time occupied in the beating process is considerable, and has been known to reach upwards of some 18 hours, and as the system is still persevered with, it reveals one of the few metal-working processes which has not been speeded up, although in certain quarters abroad improvements have been made, which is all the more remarkable, as there has usually been more gold available in this country than elsewhere, at least in past years. It was known that automatic beating machines had been utilised, which mostly related to other metal foils, but which were slow of being accepted for gold-beating. This presented some unusual problems in that, although the same weight of hammer was engaged throughout some of the successive stages, the actual weight depended on the preference of the operator. This was accounted for by the fact that some men who beat with rapid strokes preferred a lighter hammer than slow workers, but which did not appear to conform to any fixed rule. With such a limited number of gold-beating firms available from which to gather information, and which was so long regarded as a highly skilled occupation, makers of automatic devices were placed at a disadvantage. This was further accentuated by the unpacking and refilling of moulds where selected skin and paper compositions had to be used. Familiar names in this connection are regular Puchridge skin moulds, Montgolfier paper, and Continental substitutes of these products. It is claimed that some of the skin moulds can be used for from two to three years, while the paper moulds mentioned could last some 40 or 50 times. The initial preparation of the moulds by dusting over with fibrous gypsum and beating until this agent had been absorbed, followed by repeated warm pressing, was for long regarded as one of the features of the work. A number of prepared papers which were soaked in alum and borax solutions, followed by successive coatings with isinglass and albumen, were treated in the same manner as gold-beater's skin, together with specialised making of the paper itself, and proposals for introducing collodion films. In the light of recent researches, where between developments of different artificial silk, and wide improvements in the paper industry, it is claimed that almost any desired surface can be produced, and it may be interesting to ascertain if still better substitutes cannot be obtained without difficulty, instead of depending on the traditional type of mould. In former years, most of the research in attempting to improvise on gold-beater's skin related to moulds for metals other than gold, and was before the artificial silk and paper industries had been raised to such a high state of perfection. For the making of foil of bronzes, the moulds do not necessitate the same care in preparation of the skin or fabric, where the dusting with gypsum is done more sparingly, and the treatment completed more rapidly.

Manual Beating

In the ordinary process the gold ribbon is cut up into squares, of which anything up to about 600 may be piled into the mould and beaten, followed by quartering with a knife, round which the pile is folded, and

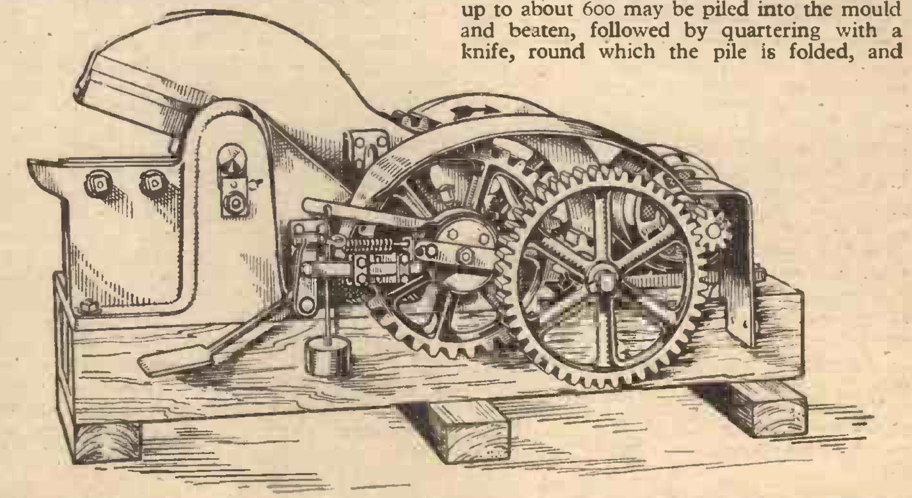


Fig. 2.—One type of shear tried out for cutting and trimming the leaves, instead of using the hand-trimmer.

cut transversely, whereby twice this number of sheets is obtained. During the different beatings, the hammers used have weights corresponding to 4 to 5lb., 6 to 8lb., 10lb. and 20lb., while finally a flat 16lb. hammer is applied when the sheets are struck some 20 blows. The 20lb. hammer is first used with the skin inserted between the sets of sheets, and fixed periods of times of beating applied. As these have been dealt with in detail previously, they are only tabulated shortly. The first beating occupies three-quarters of an hour, and the irregularly curved squares are placed in piles of 120, quartered, and some 1,200 to 1,250 sheets obtained, while the skin mould is not interfered with by the irregular curvature presented by the edges. The second mould is beaten up to 1½ hours, using the same hammer, and as the sheets are damp, these require drying, usually on steam-heated plates, followed by quartering as before and trimming. The third mould is beaten for three-quarters of an hour first by the 5lb. hammer, and again by the 8lb. hammer, and then for an hour first by a 10lb. hammer and again by a 20lb. hammer, when the final blows are applied. This means that in the third mould some 3½ hours' beating is required. As regards the moulds used, the arrangement is to use Montgolfier paper for the first, a simple gold-beater's skin for the second, and the best skin mould mentioned for the third. The gold leaf so obtained can be finer than the thinnest paper, and so far represents the only metal which can be produced in this exceptionally reduced condition. The trimming is next carried out by holding the mould by tongs, and with the assistance of a smooth wooden fork and gentle blowing, transferring to a trimming pad where a two-bladed trimmer is used to cut it to a square. The greatest care has to be taken to avoid coughing or heavy breathing, while screens are used to prevent draughts from scattering the light material, as the leaf-gold is so exceedingly thin.

Automatic Beating Machines

Beating machines have been tried from time to time, following experience with other metals with a view to increasing output with less labour, but experience of the accurate use of mechanically operated hammers was of no great account until the advent of the present war. Amongst earlier efforts, however, might be mentioned the use of machines which at the bottom of the stroke were checked by spring mechanism, where the hammer was not allowed to strike a dead blow upon the moulds. The idea of the spring apparently was a crude effort at reproducing conditions similar to the hand-operated hammer by means of the elastic recoil. Another arrangement was to mount several moulds on a rotating form of holder, so that any suggestion of heat manifesting itself as a result of the friction produced by the impact of the heavy unit would be dissipated. An alternative construction employed a set of hammers which were allowed to drop independently, while, further, provision was made in some models for replacing the weight of the different units, i.e., the successive beating using different impacts, at a fixed number per minute, again following the experience with manual methods. The movements were actuated by belt pulley to a shaft with friction coupling, while a pinion engaged a toothed wheel which revolved around a concentric ring equipped with slotted lugs. It was thus possible to arrange the number of blows delivered from anything up to 240 per minute, or more if desired. Various measures were taken, such as arresting the movements the instant the hammer was in contact with the mould, so that the sheets

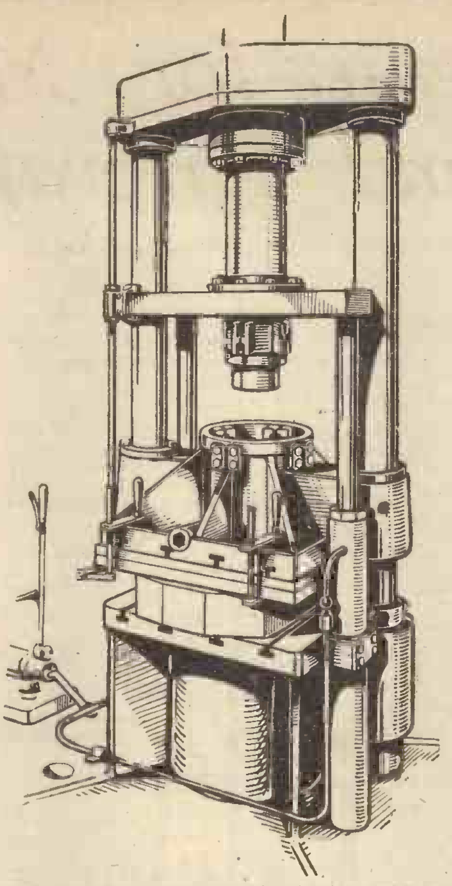


Fig. 3.—The modern small forging hammer equipped with air and rubber cushions developed for light alloy productions can to-day deliver blows with a precision which is beyond the capabilities of the human hand.

of gold leaf would not be exposed to destructive action, while the throw and adjustment of the lever was manipulated by a guide actuated by a cam. A further mechanical beater depended upon a counterstroke action, similar to what is to-day employed on a larger scale for the forging of crankshafts, but the elasticity of which did not come up to modern standards, as a spring was again the medium used. The nearest approach to up-to-date forging was seen in a miniature form of drop, or tup-type hammer, but the rendering of the desired elasticity to the stroke depended upon a bow-spring and belt arrangement. Systematic timing was ensured by employing channelled segments on toothed discs and wheels which gave the desired interruption, while radially faced cams instantly rotated the mould into position whereby the hammer could do the most work.

Industrial Uses

Despite all these efforts, the early hand method of producing gold leaf is still used, but it remains to be seen what there will be left to know about applying a hammer automatically after the present war, in view of the wide researches which have been undertaken with magnesium and its associated light alloys. The changing of the mould at different stages, i.e., first, second and third mould, indicates some form of interruption, but the most exacting strokes applied by different weights of hammers for specific periods should offer no practical difficulty. The counterstroke action has been developed to its utmost, while instead of depending upon springs, air-cushions with selected rubber inserts are utilised not only where the tup is connected, but where the stroke is delivered.

The reason for this is the changes which occur in the internal crystalline structure of the magnesium alloys, which allow only a very small margin in the way of latitudes during the time the metal is cooling, while the successful production of small parts entirely rests upon the precision of the automatically controlled hammer. As regards uses of gold leaf or foil for industrial purposes, apart from the usual bookmaking and artistic applications, a small feature which so far appears to have been taken but little into account is in the construction of certain electrolytic apparatus. The addition of exceedingly fine coatings of platinum, thallium, cæsium, and other rarer metals has always given rise to small practical difficulties, whereas gold leaf, because of its exceptional tenuity, might be applied directly. In other directions, electrodes are finely plated with platinum upon both common base metal and rarer metal structures for the production of a number of chemical products, and although gold is not so inert, it might yet find some uses when advantage could again be taken of the fine leaf.

On the one hand, hammered metals are better thermal conductors than when in cast condition, and the electrical conductivity is improved by annealing, whilst alternatively the soft disposition of gold is no deterrent to its use for these purposes.

Books Received

Signals for the Home Guard. By Lieut. J. H. A. Whitehouse. Published by Practical Press, Ltd. 80 pages. Price 3s. 6d.

THIS handy book deals with the important subject of signalling and technical design problems peculiar to the Home Guard. Such subjects as Training and Training Equipment; Switchboards; Visual Signalling and Lamps; Magneto Telephones and Radio Communications are explained in detail, the text being well illustrated with diagrams and half-tones.

Calculations from Drawings. By F. Holliday, A.F.R.Ae.S. Published by Sir Isaac Pitman and Sons, Ltd. 76 pages. Price 7s. 6d. net.

THIS book contains a collection of graded examples for the use of fitters, toolmakers, junior draughtsmen and apprentices to help them to carry out their own calculations. The outline solutions of the various problems given assume a knowledge of the trigonometrical ratios and of the sine and cosine rules for solving triangles. The last four examples in the book are compound angle problems.

Locomotives of the Taff Vale Railway, and of the Somerset and Dorset Joint Railway and Irish Narrow Gauge Railways. By M. C. V. Allchin. Published by the Author at Fareham, Hants. Price 2s. each net.

THESE two booklets are the fourth and fifth of this new series of locomotive registers. As in the previous booklets in this series, the information given is arranged in numerical order of the running numbers of the locomotives. Works numbers are included, and details of wheel-types, building dates and subsequent grouping numbers. These last two booklets in the series include illustrations which are representative of the locomotives dealt with.

Instruments for Motor-cars and Aircraft

Further Details of Their Uses and Methods of Operation. By JEREMY MARTIN

(*Continued from page 259, May issue.*)

IN the double spiral bourdon tube (see Fig. 5, May issue), the effect of temperature change will serve to expand or contract the mercury. In expansion the mercury will deform the bourdon tube, causing a radial movement. To this tube is directly connected a spindle to which is attached a pointer, and a reduced temperature will cause contraction of the mercury with resultant movement of the bourdon tube. The principle of Bourdon is that, if a tube of oval section is sealed at one end and the tube itself curved, pressure of liquid in the tube will cause the tube to tend to straighten. If suitable amplifying mechanism, e.g., quadrant and pinion, be attached to the end of the bourdon tube the slight movement of the tube will be magnified sufficiently to give considerable and clear indication by a pointer attached to the pinion over a calibrated scale. It is obvious that the capillary being of metal and therefore affected by temperature, will itself expand and contract on variations of temperature, thereby causing inaccurate readings. To obviate this in capillaries of over a certain length, small expansion chambers are fitted. These chambers contain a small piece of invar steel which, by its reaction to temperature changes, maintains the internal capacity of the capillary at constant.

These instruments are subject to further errors, e.g., compressibility error, which is caused by increase in temperature due to increased velocity of air flow and the resultant friction. Such errors are compensated for by the manufacturers.

The undermentioned are further types of thermometers, which although not necessarily subject to the same errors, etc., are all based on the same principle.

Temperature Thermometer

The radiator temperature thermometer, as used in aircraft, whilst being basically a bourdon tube instrument, differs completely in principle of operation, and is known as a vapour pressure instrument. The principle of this is that any pure volatile liquid possesses a vapour pressure, which is a constant for any given temperature irrespective of the volume of liquid. The bulb of the instrument is two-thirds filled with ethyl-ether. The capillary extends well into the liquid and the bulb is inserted into the engine cooling system. As the temperature of the coolant increases the liquid in the bulb vapourises thus increasing the pressure exerted by the vapourised liquid on the surface of the liquid itself.

With this increase of pressure tending to compress the liquid, the latter is forced up the capillary into the bourdon tube. Once again the principle of the bourdon tube comes into play, e.g., the tube tends to straighten and this movement, through magnifying mechanism, is communicated to a pointer moving over a calibrated scale.

Due to the fact that at reduced pressures liquids tend to reach their boiling points quicker than at normal atmospheric pressure, it is obvious that at high altitudes, the air pressure is greatly reduced, in consequence the coolant itself will give an erroneous reading of engine temperature. This is compensated for on the scale of the indicator proper by correct boiling point temperatures being indicated at certain given heights (Fig. 1).

Before dealing with the instrument itself, a few words are considered necessary on the subject of the medium actuating such instrument, viz., the atmosphere.

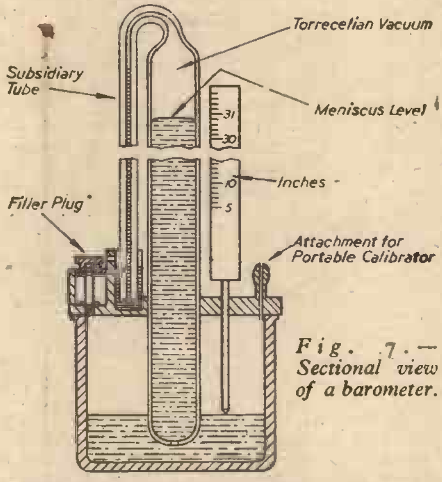


Fig. 7.—Sectional view of a barometer.

The Atmosphere

It is common knowledge that around the earth there exists a belt of air approximately 200 miles deep. Various gases go to make up this belt, e.g., oxygen, nitrogen, helium, hydrogen, etc. There is also a considerable amount of water vapour (hydrogen/oxygen). At sea level the air exerts a pressure of approximately 14.71lb. per sq. in., and this pressure decreases with height. This pressure is also effected by variations of temperature and humidity. To measure this pressure a unit known as the bar was decided upon, and this is equal to one megodyne per sq. cm. This bar is divided into one thousand parts, each known as a millibar, and this is the normal unit used. Normal atmospheric pressure at 14.71lb. per sq. in. will support a column of mercury 29.994in. in height, which is equivalent to 1,013.2 millibars.

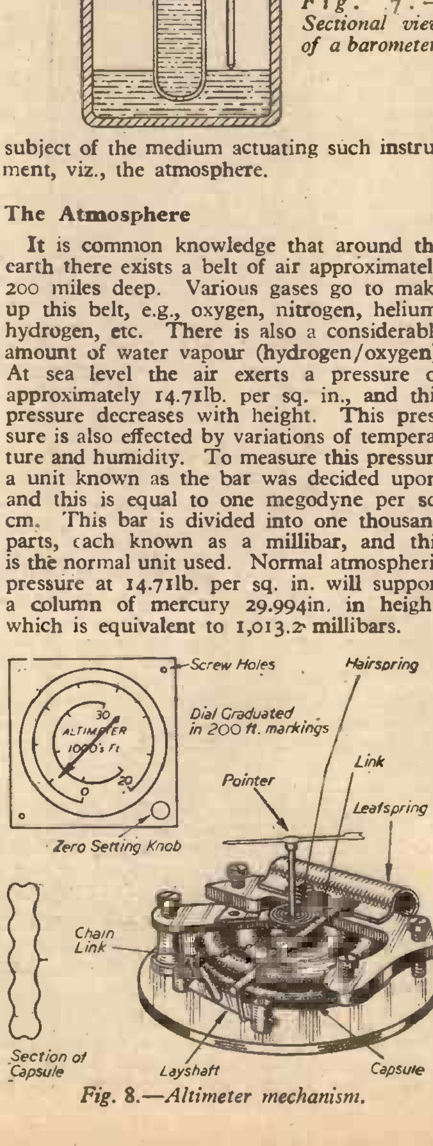


Fig. 8.—Altimeter mechanism.

From a fairly simple calculation it will be seen that we may convert millibars to lb. per sq. in. and vice versa, approximately. Since the figure 14.71 is approximately 15, we can accept the latter figure as being a good indicator, and also, since 29.994in. of Hg. is approximately 30, we can accept that latter figure, therefore from the ratio 15: 30 we can determine that a column of Hg. 1in. high requires ½lb. pressure to support it. Since 30in. is equal to 1,013 millibars, 1in. equals 34 millibars (approx.), therefore as a unit measurement for easy calculation we can state that ½lb. of pressure is equal to 1in. Hg., or 34 millibars.

The Barometer

This instrument, familiar to all, is intimately concerned with many aircraft instruments. Albeit, the common aneroid barometer, as displayed in many homes and public buildings, is not sufficiently accurate for aircraft instruments.

The barometer is an instrument for measuring the barometric pressure of the day and indicating same on a scale graduated in millibars or inches of mercury. The most widely used type of barometer in connection with aircraft instruments consists simply of an inverted U-tube, one end of which is submerged in a reservoir of mercury. The tube itself is attached to a scale calibrated as above. The other end of the tube is immersed in a small reservoir of mercury for the purpose of sealing the tube. It is obvious that were air to be present in the tube above the column of mercury such air would in itself be liable to variations in atmospheric pressure and would also contain water vapour and would therefore exert a pressure on the column of Hg., giving erroneous readings. To obviate this, during the process of filling the barometer this air is forced out, leaving a vacuum (known as Torricelli's vacuum) above the mercury column. We now have, therefore, a U-tube with a column of mercury in each arm of the tube and a vacuum between, sealed off from atmospheric pressure. The operation is as follows: an increase of atmospheric pressure upon the surface of the Hg. in the large reservoir will force the Hg. up the one arm of the U-tube. With the aid of a sliding indicator or cursor, on the tube the atmospheric pressure can be read off on the scale adjacent to the tube (Fig. 7).

When reading a barometer, certain factors must be taken into account, and these are known as Standard conditions and London Laboratory conditions. Comparisons between the two have been tabulated for reference as required.

The Altimeter

Since, to ascertain height, we cannot take a barometer, as described, up into the air, the aneroid principle has been adopted in the design of altitude recorders or altimeters, of which there are several designs in use. The simplest type consists of a spring-controlled metal capsule from which the air has been removed. Working in conjunction with the capsule is a leaf spring, which is attached to the capsule and to suitable magnifying mechanism, which will show the expansion and contraction of the capsule under varying pressures at varying heights or altitudes. The whole is encased in a container which has one small outlet to the atmosphere (Fig. 8).

Principle of Operation.—As the aircraft ascends, pressure decreases and the capsule expands, for the pressure exerted on the outside of the capsule is reduced. With the expansion of the capsule a proportionate movement is transmitted to the magnifying mechanism and pointer. The pointer moves over a scale calibrated in thousands of feet. On descending the reverse action takes place, the pressure increases, and with such increase a proportionate movement of the pointer takes place.

These scales are calibrated to either one or both of two laws, known as the Isothermal Law and the International Convention of Aeronautical Navigators (I.C.A.N.).

The Isothermal Law states that air temperature at all heights is 1 0 deg. Cent. (This would obviously appear to require correction, since the temperature at increasing altitudes is proportionately reduced.)

The I.C.A.N., which is the most accurate, states that the temperature decreases proportionately at the rate of 1.98C for each thousand feet, from 15C on the ground to 56.5C at 36,090ft. Above this height it remains constant.

Another type of altimeter is that which employs three capsules for increased sensitivity. The principle is the same as that already described. The three capsules are connected, and are in turn connected to three pointers through a quadrant and pinion.

In view of the changes in atmospheric pressure at ground level it becomes necessary to adjust the indicator to give a true reading. For instance, with the decrease in atmospheric pressure at ground level the altimeter will show a reading on the scale giving the appearance of ascent of the aircraft.

In the less sensitive type of altimeter there is a scale attached to the mechanism of the instrument, and this is found underneath the main scale. On each scale is enscribed datum lines. With normal atmospheric pressure (1,013.2 m/bar) these datum lines should coincide when the pointer is reading 0ft. The internal mechanism is attached to gearing which may be actuated by a small adjusting knob, so making provision for the change in atmospheric pressure.

The more sensitive type is manufactured with a scale which gives a reading in millibars, and this is also found beneath the main scale, and the indication is given through a small cut-out in the main scale. Thus at normal atmospheric pressure this subsidiary scale would read "1013," and at the same time the pointers would give a zero reading.

N.B.—The following instruments are air operated:

Air speed indicators, altimeters, rate of climb instruments. It is necessary, therefore, to outline the means of feeding the air to these instruments. This is done by what is known as a Pitot head, developed by a French engineer.

The Pitot Head

This consists of two tubes, one open at the end directly into the airflow, the other sealed but with small radial slots or holes cut in it. The former is known as the pressure feed line and the latter as the static pipe line. This is fitted to the outside of the aircraft where there is the smoothest air flow. The pressure side is connected to one instrument only, viz., the air speed indicator (which will be described later), and the static pipe line is connected to three instruments, viz., rate of climb, air-speed indicator and altimeter. The object of the slots in the static pipe line is to allow the pressure of the air in the cases of the instruments to

Rate of climb indicator.

be equalised with that of the air outside the aircraft regardless of height, e.g., as pressure decreases air flow from instrument cases through slots and vice versa as pressure increases. It is essential that the edges of the slots be at right angles to the pipe line and free from unevenness or burrs in order to prevent a venturi effect (e.g., air being sucked out by the passage of air over them). Only variation of air pressure must cause air to flow in or out of the holes. The reason

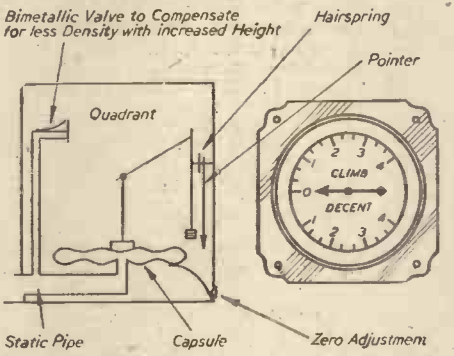


Fig. 9.—Details of rate of climb indicator.

why the air-speed indicator is connected to both pressure and static is that the principle of the instrument is that the difference between pressure due to the forward motion of the aircraft and the atmospheric pressure (or the pressure of the air) through which the aircraft is passing. The altimeter and rate of climb instrument are both entirely dependent upon the variation of air pressure.

The Rate of Climb Indicator

This instrument, although some years old, did not find the same demand in civil aviation as in warplanes. Its use is to indicate the rate of climb of the machine, which information might be used in avoiding mountains and for night flying.

The instrument is what might be termed a differential pressure gauge, and works on the principle of the difference in pressure between the inside and outside of the capsule. The capsule is enclosed in an airtight case, and it is essential that, apart from the feed lines, the instrument is airtight. The capsule is similar to that used in altimeters in that the materials used are the same (berylium/copper, etc.). The capsule is connected directly to the static pipe line of the pitot head, while the case is connected to the static pipe line through a calibrated choke (Fig. 9).

The principle of operation of this instrument is, with an increase in height, air can leave the capsule at a faster rate than it can leave the case, thus the pressure of air left in the case compresses the capsule and through a magnifying mechanism to a suitably calibrated scale, shows an ascent. The descent will cause air to flow into the capsule at a faster rate than it can flow into the case (due to the choke), thus allowing the capsule to expand, and through the same mechanism a descent is shown. This instrument is extremely sensitive, and it is necessary to incorporate a zero adjustment. The adjustor is in the form of a small spring, which is actuated by a conical eccentric screw.

A bi-metallic valve is incorporated in the choke to compensate for decreased density at increased heights.

(To be continued.)

Probes and Problems

A Few More Mental Nuts for You to Crack

(Solutions are given on page 321)

Blackout Bargain

"I'm afraid I can't sell you as many as two dozen of these batteries," said the shopkeeper, "but you are welcome to those I have left."

He took the batteries down from his shelf and pushed them across the counter. I handed him a note in exchange.

"That's the right amount, isn't it?" I asked.

"Near enough, sir," he replied with a smile. "I won't trouble you for the odd farthing."

How much does my particular brand of battery cost?

Mr. Baker's Job

The tradesmen in a country village are a butcher, a baker, a fishmonger, a tailor and a blacksmith. Oddly enough, their names are Butcher, Baker, Fish, Taylor and Smith; but none of them has a name that suggests his own trade

Mr. Smith, who is the oldest man in the village, was recently prosecuted for selling food unfit for human consumption, and Mr. Taylor, fearing a similar prosecution, has bought a refrigerator. Mr. Fish does not have to concern himself with coupons at all. The butcher has quarrelled with his father. Smith's shop is next door to the fishmonger's. Mr. Butcher and the tailor are in the final of the billiards handicap.

What does Mr. Baker do for a living?

Numerical Verses

The figures 0 1 2 3 4 5 6 7 8 9 stand for the letters spelling the name of an unpleasant affliction. Substituting the same figures for the same letters, the following is a verse describing the woes of an unmusical clergyman. Can you discover the key-word and decipher the verse?

612 830562 15629 612 8130819 81742;
12 80729, 12 62509 179 1570
179 12506 58129 59, 56 8107964596742,
12 12509 769 43978 0502.

The Vicar's Collection

"We had a silver collection for the poor of the parish yesterday," said the vicar, "and each of my seven girls took out a collecting box. It was rather odd, because each girl's box was found to contain exactly a pound in half-crowns, florins, shillings and sixpences, each girl had exactly ten coins, and yet no two boxes contained the same selection of coins."

How many sixpences were included in the £7 collected?

The Riches of the Volcano

Volcanic Action, and Its Significance

Mount Fusi—an active volcano in Japan.

THE recent eruption of that historic volcano Vesuvius, has once again demonstrated to the world the fact that these fire-blitzes of Nature are far more terrible, formidable and relentless than any of the effects and consequences of man-made warfare. For when nations clash even in intensive modern mechanised combat only local areas of territory are temporarily affected, but when a volcano becomes active it is, indeed, possible for the whole of the surrounding terrain to be blown sky-high, let alone to be buried deep under the crushing weight of a colossal and totally-denuding mass of semi-molten rock and sulphurous ashes.

The coming into activity of a volcano is usually considered to be a natural evil of the greatest possible moment. So, indeed, it often is for the populace in the neighbourhood of such a fire mountain. But for the rest of the world, a volcanic eruption, no matter how fierce and uncontrollable it may be, is more of a blessing than a curse. It is actually something for the human race to be thankful for, since, by acting as a terrestrial safety-valve, the volcano removes the possibility, or, at least, the probability, of a disastrous earth explosion of, perhaps, half a hemisphere's magnitude.

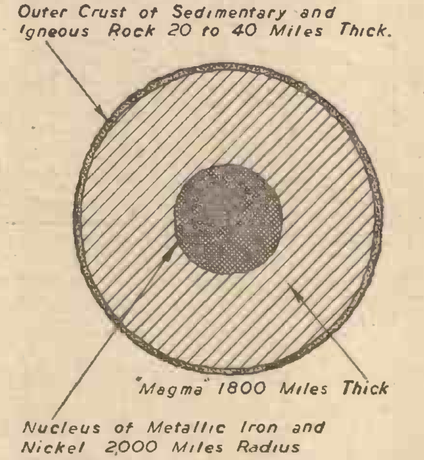
Such, therefore, is the true value of the volcano. It functions as an enormous earthly pressure valve to ease off the stupendous pressures which, as a result of various and incompletely understood causes, are continually being developed deep within the unknown interior of our globe. Were there no volcanoes we should all very much resemble some queer colony of miniature beings who lived out their transient lives on the outer surface of a boiler having a slow fire underneath and no outlet for relieving the steam pressure inside it.

The precise causation, initiation and mechanism of volcanic action, so far as it is known or has been reasoned out, is of very great interest, since the whole subject is intimately bound up with the question of the nature and composition of the earth's interior, a topic which we know—at least with any degree of certainty—very little about.

Earth's Outer Crust

The earth's solid outer crust is from 20 to 40 miles deep. Probably it is much nearer 20 miles than 40 miles in depth, although there must be some variations of its thickness from area to area.

This solid crust is made up of (*a*) a surface skin of powdery, friable, "loose," granular material which we call "soil" or "earth," (*b*) sedimentary rocks, (*c*) igneous rocks. The top skin of soil consists of grains of sand, clay particles, organic matter of vegetable origin, and sometimes a little chalk. Its lower layers are made up of sandy clay. It may go down in depth to about 20 or 30ft. Then comes about 400ft. of sands and clays, which layer rests upon an under layer of chalk some 600ft. in thickness. Under this comes another type of highly compacted greyish clay and then a deep layer of shales and sandstones.



The Earth cut in half. Diagram illustrating the approximate nature of the Earth's interior according to modern scientific opinion.

The above layers make up the "sedimentary" layer of the earth's crust, so called because this layer has been built up through the illimitable years by water deposition on the principle of a river depositing mud on its bed or the sea washing up sand on to the beach.

The Igneous Rocks

The igneous rocks which lie under the sedimentary layer of the earth's crust are the "fire rocks." They have at one time been molten. Some of them have been ejected upwards from great depths by volcanic action. They all consist of hard masses of silica and silicates. These igneous rocks which have cooled slowly have large visible crystals within them. The more rapidly cooled igneous rocks, such as those which have been ejected from long-extinct volcanoes, are very finely crystalline. They form, as it were, the last solid layer of the earth's crust, separating the upper crust from the mysterious middle-layers of the earth.

Granite is the best known of the igneous rocks. Others are basalt, syenite, diorite, andesite and diabase. When these are found near the surface of the earth they have always been thrown up into such situations by some species of volcanic action.

If, therefore, we dig deeply enough at any area of the earth's surface, whether on land or on the sea bed, we shall always come eventually to granite rock, the rock which has not been deposited as the sediment of waters which have at one time covered that portion of the globe, but which has invariably resulted by the solidification of molten masses of material within the deeper layers of the earth.

Granite rocks exist below the earth's surface at a depth of four or five thousand feet. But how far down they extend we are quite unable to say with any certainty. Probably granite goes down in solid condition for some 25 miles, after which, for another 20 miles, it is present in a semi-solid, plastic state. No one has ever more than scratched the upper reaches of this granite layer by means of drilling. Not that the task of drilling a hole through a portion of this granite or igneous layer of the earth's crust would be impossible of attainment, but, rather, that the cost would be so high and the results so barren of practical utilisation that no nation or millionaire has ever been willing to stand even a portion of the necessary expense.

It has been supposed that ultra-deep drillings might disclose the existence of plentiful supplies of the rare metals in the igneous rocks, but such a supposition is highly improbable. Deep down, the igneous rocks would be found to consist of the common silicates of calcium, aluminium, magnesium as they do in their upper layers.

Now, what comes under the 25-40 mile layer of igneous rock? Here it is that our scientific doubt and perplexity begins. It used to be thought that at these great depths

"The Devil's Tower," Dakota, U.S.A. This unique natural rock formation is the solidified granite "plug" of an extinct volcano, the volcanic cone having been completely removed by the action of weathering.

the contents of the earth must be entirely liquid. Thus, on this view, our globe might be considered to be something in the nature of a thin-walled concrete ball filled internally with a white-hot liquid mass.

Evidence Which Conflicts

It is now pretty certain, however, that the earth's interior is in no way liquid. True it is that, when we construct a deep mine, we usually find that the mine increases 1 degree in temperature for every 100ft. of its depth, so that, working on this figure, we can calculate that a temperature of about 1,000 deg. Centigrade will be reached at a depth of 20 miles, a temperature sufficient to render even the most refractory of rocks plastic and soft in condition. On the other hand, however, a most careful study of the transmission of earthquake vibrations *through* the earth from one side of the globe to the other has clearly demonstrated the fact that the earth does not transmit such vibrations as if it had a liquid core. It transmits them as if its core were solid, there being, as the reader may, perhaps, be aware, a considerable difference between the transmission of vibrations through a liquid and through a solid.

So, at this juncture, we have two bits of evidence which conflict with each other. The interior of the earth must certainly be hot enough to melt even the hardest of rocks to a thin liquid, yet observation shows that the mechanical shocks due to earthquakes travel from one side of the earth to the other, as though they were transmitted entirely through solid matter.

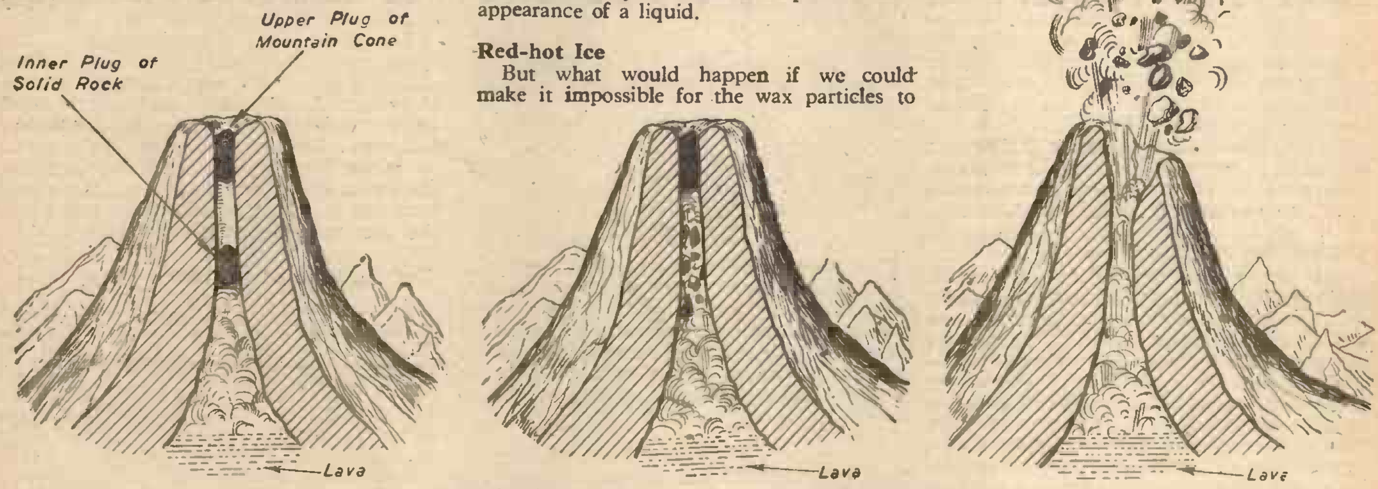
How, therefore, are we to square up these opposing inferences?

The position here, perhaps, is not so difficult as it seems. Suppose we take a lump of wax and melt it in a basin. What happens in such an instance is that, in consequence of their added heat energies, the individual particles or molecules of the wax material tend to rush apart from one another. Thus they refuse to hold together. The result is that the looser assembly of molecules presents the appearance of a liquid.

A close-up of a volcanic cone, one of the several "fire-mountains" in Java.

Red-hot Ice

But what would happen if we could make it impossible for the wax particles to fly asunder under heat influence, which action we can bring about by applying suitable pressure to the wax? Under such conditions, the wax would not melt until the heat energy of the particles was able to overcome the applied pressure.



Normal volcanic action. Three stages of its progress.

Uprising lava under pressure melts inner plug of solid rock. *Lava attacks upper plug of mountain cone.* *Upper plug suddenly gives way, and is pushed high into the air, part of the mountain cone also being disrupted.*

Massive granite rocks of volcanic origin at Pic Harvey, France. Having been flung up by a now extinct volcano, they have solidified into these curious crystalline forms.

Reasoning on these lines, it is readily possible to see that, provided that sufficient pressure could be applied, we could heat ice up to red heat without it melting. Red-hot ice is, for most people, a novelty of conception, yet, given the necessary enormous pressure, it would readily be possible.

The modern view of the earth's interior is fashioned on the above red-hot ice conception. Under normal conditions, the material underlying, let us say, the 40 miles deep earth's crust, would certainly melt to a nimble liquid at the temperature which prevails there. But the fact is that the material cannot possibly melt. It is physically restrained from so doing by the sheer weight of the rocks above it, which weight causes a pressure of millions of tons per square inch.

The "Magma"

This mysterious, pressure-restrained material is called "magma." It is supposed to form a layer around the earth's core of about 1,800 miles thickness, and to surround a central core of 2,000 miles radius, which comprises a central nucleus of metallic iron and nickel.

Such theories fit in very well with our observed facts of the earth's density and its physical properties, and hence they may be tentatively accepted pending further knowledge of the subject.

Volcanic disturbances are considered to originate in the upper layers of the earth's magma. An earthquake may at some time have produced a natural crack or fissure in the earth's upper crust. In a local area over the magma, therefore, pressure is reduced. The consequence is that up spurts the magma to the earth's surface, becoming liquified in its journey upwards and carrying with it all sorts of rock debris which it manages to melt away or otherwise detach from the layers of igneous and other rocks through which it passes.

Principle of the Soda Siphon

The principle is not unlike that of pulling down the handle of a soda-water siphon. As soon as the pressure is released locally, and the dissolved gas can find a means of escape, up comes the aerated water through the delivery pipe.

In the case of the earth's eruptions, local pressure of the magma having, in part, been relieved, the outlet or volcanic "pipe" (as it is termed) is sealed by plugs of solidified rock. If the sealing is sufficient it will resist the upwards pressure of the magma for many years, for centuries, in fact. Perhaps, even, it will resist the magma pressure for all time, as it manages to do in the instances of extinct volcanoes.

But usually, in the case of active volcanoes, there comes eventually a time when the internal pressure of the magma overcomes all obstacles. The deep-earth material ascends slowly upwards along the volcanic pipe, dissolving away all opposing rock masses. At last it comes up against the plug of solid rock material at the apex of the volcanic cone or mountain. This plug may be sufficient to resist the pressure for some time. Sooner or later, however, the plug will be blasted out of the mountain top with truly terrible force. Such will be the prelude to the renewed activity of the volcano.

At other times, the volcano will choose to relieve its pressure by blowing the mountain side away in one or two big explosions, which may cause great local devastation.

Outpouring of Lava

No matter how the volcanic process is commenced, the result is usually the same. It is just like the siphon of soda water when the valve is released. Only, in the case of volcanoes, there is an outpouring of semi-molten volcanic rock—"lava"—which is essentially a sample of the magma which has been brought up from deep within the earth. The lava trickles down the mountain side, impelled by the pressure of its own weight. It is irresistible. Everything which it makes contact with is at once burnt up, charred, or hopelessly buried.

Sulphurous gases (notably suphuretted hydrogen), steam, and other gases are ejected from the volcanic pipe. Some of these have been dissolved in the lava, and when this cools, the gases are forced out. They thus cause a swelling up of the molten lava, just as a mass of bread dough swells under the influence of the carbon dioxide gas which is generated within it.

Pumice stone is nothing more or less than volcanic lava which has been thus distended by the escape of dissolved gases. It forms, perhaps, our only commonplace sample of the earth's interior.

Accompanying most volcanic eruptions are rains of cinders, hot steam, volcanic muds and mineral debris of all kinds. Often enough the sky is darkened for days by the thickness of such volcanic rains, which devastate the countryside far and wide.

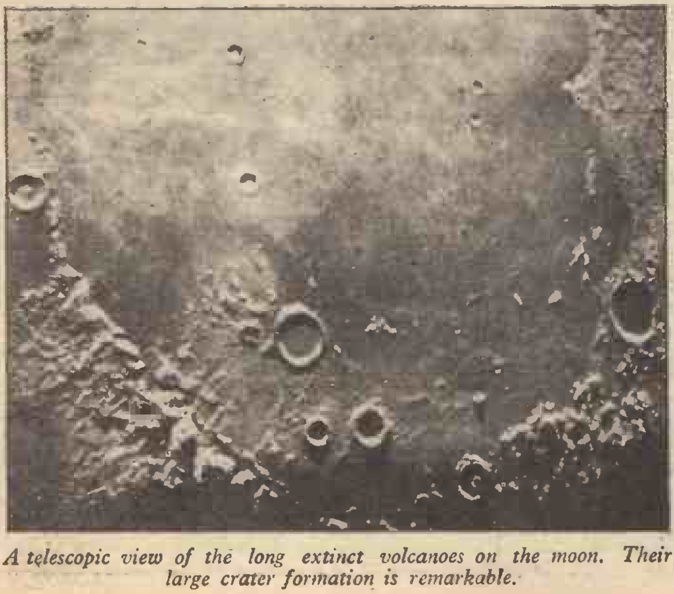
Ultimately, however, the internal pressure of the volcano will relieve itself. The eruption will quickly die down, although for months the mountain may still seem "angry," giving vent to minor eruptions, rumblings, and much smoke and steam ejection. Bit by bit, however, the signs of activity will cease until, at last, the mountain resumes its normal quiescent state.

What happens when an unusually large solid plug in a volcano "pipe" resists the pressure of the lava. "Something has to go," and in this case it is part of the mountain side, the hot lava and gases exploding outwards through the weakest part of the volcano's side. This is what happened when Vesuvius destroyed Pompeii in the year A.D. 79.

Causes of Volcanic Activity

What causes the sudden variations of the earth's magma pressure which results in volcanic activity? The answer to this question is not known. One school of thought (the most prominent at the present day) has it that the sediment of rivers accumulating in the shallow seas which border the regions of volcanic activity has such a downwards pressure effect that it is able to bring about an upwards displacement of the magma. In favour of this theory is the fact that many volcanoes are on or near the sea coast.

Another theory suggests that lunar or solar attractive forces have something to do with volcanic phenomena. This might be a feasible explanation if the earth's magma were really liquid within the interior of our globe, but one would imagine that, with a liquid magma, the sun and the moon would generate such enormous internal tides within the earth that volcanic activity would be a phenomenon of regular periodic occurrence in all areas of the globe.



A telescopic view of the long extinct volcanoes on the moon. Their large crater formation is remarkable.

Earthquakes, by displacing large masses of rocks, have been credited with inciting volcanic activity. It is difficult, however, to see how such a theory can be true, since, in many earthquake-free regions of the earth, volcanic occurrences are manifested from time to time.

We shall never, perhaps, really know the true initiating cause of volcanic activity until we are able, by some means or another, to obtain a greater knowledge of the nature and physical condition of the mysterious inner-terrestrial constituent which we call "magna." There is no doubt whatever that the cause of the volcano is to be sought in the layer of magma which exists below the deepest of the igneous rocks of the earth's outer crust. Pressure changes in that region must lie at the basis of all volcanic phenomena.

But when we ask "why," our knowledge returns, as yet, no certain answer.

It seems clear, however, that if the formation of volcanic "pipes" or upward channels were, by some natural circumstances, made impossible, and if, as appears to be likely, magma pressure continually increases, the time would eventually arrive at which hundreds or even thousands of square miles of the earth's surface would suddenly be blasted outwards as a result of the accumulated internal pressure.

The Instance of Krakatoa

An instance of this nature occurred on a minor scale on the island of Krakatoa on August 26th, 1883. This small island be-between Sumatra and Java was about 18 square miles in area and arose out of the Indian Ocean to a maximum height of 1,400 feet. On the above-mentioned day, a series of under-earth explosions occurred. The whole island was literally wrenched apart and blown into dust. Two days after, nothing remained but a gigantic cavity in the sea bed. The tidal wave which was set up as a result of the island's explosion is reputed to have drowned 30,000 people. The dust from the shattered island rock was hurled high into the sky, lingering there, so that the sky was almost completely blackened at midday nearly 200 miles away. The finest particles of the dust filled the whole of the earth's atmosphere, giving rise to magnificent sunset effects in all parts of the world.

The tragic dismemberment of Krakatoa was undoubtedly the result of volcanic pressure which had been long resisted in that region. Ultimately, the pressure became so enormous that the island literally "gave way."

Had there been a really serviceable volcano on the island or in the neighbourhood, Krakatoa might easily have been saved.

Here, therefore, in a practical and historical incident, we see the usefulness of volcanic action. The volcano has definitely a value. Without it, the human race might live comfortably and pleasantly enough for many years, perhaps, even, for many centuries, but, ultimately, there would come the inevitable pressure outburst and upheaval which might easily rend a continent in twain, and destroy in a short space of time more lives than even Hitler and his myrmidons have managed to do during their years of power.

Surely, therefore, the volcano is a friend of mankind, rather than a foe.

Principles and Design of Transformers—2

Working Conditions and Wiring Considerations.

By J. L. WATTS

(Continued from page 261, May issue.)

THIS is responsible for the secondary terminal voltage falling somewhat on load, some of the induced voltage being necessary to overcome the inductance. In addition there will be an increased volt drop on increased load due to the resistance of the secondary winding. The amount of secondary leakage flux and inductance volt drop will be increased with increased flux density of the core; and with increased distance between the primary and secondary windings. For instance, there is likely to be a fairly high inductance if the primary and secondary are wound on different limbs of the core. The primary and secondary leakage flux will

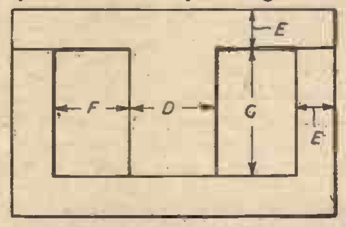


Fig. 7.—Suggested core dimensions. F = ½ D to D. E = ½ D. G = D to 2D. Core thickness = D to 3D.

be considerably increased if there is an air gap in the core between such limbs, in addition to increase of the primary magnetising current.

Desirable Conditions for Transformers

We can, therefore, summarise the conditions desirable in a transformer as follows:

1. The core should be built of insulated laminations, and should have an adequate cross-sectional area.
2. The limbs of the core should be as short as possible, consistent with there being adequate space for the windings.
3. There should be no air gaps in the core, unless it is required that the secondary voltage shall fall considerably on increased load.
4. The primary windings and secondary windings should be as close together as possible if a low volt drop in the secondary is desired.
5. Since the resistance of a conductor is inversely proportional to the cross sectional area of conductor and proportional to its length, it is desirable the conductors should be as large and as short as possible. This will reduce the volt drop which is proportional to current × resistance, and will also reduce the heating losses which are proportional to current^2 × resistance. There is a limit to the size of conductors which can reasonably be employed, as very large wires need more winding space and longer limbs on the core. This means that abnormally large conductors may increase the primary magnetising current, although they reduce the losses on load. A transformer having large conductors has its maximum efficiency at a higher percentage of full load than does one with smaller conductors In the case of a transformer which operates mainly on full load it is most efficient to use large conductors, whilst it is more efficient to use smaller conductors on a transformer which operates for long periods on light load, subject to the conductors being large enough to carry the current without overheating.

Design of 1 k.V.A. Transformer.

We can now proceed to design a transformer, the first stage being to calculate the output required. In a single phase transformer the product of the secondary voltage and current in amps. gives the volt amp. output, the output in k.V.A. being one thousandth of the value thus calculated. For example a transformer having an output of 20 amps. at 50 volts has a volt ampere output of 1,000 that is 1 k.V.A. In large transformers the core is usually built up roughly to a circular section, and the size is found from the formula, core circle diameter = $1.9\sqrt[4]{\text{k.V.A.}}$ The curve shown in Fig. 6, can, however, be used for small air-cooled transformers up to 1 k.V.A. and it will be seen that a core of 4.5 square inches net cross sectional area will be required.

A suitable flux density will be 65,000 lines per square inch, which gives a total magnetic flux of 4.5 × 65,000 = 293,000. We can use transformer stampings of the shape indicated in Fig. 7, and a central core 2¼in. wide (D = 2¼in.). Allowing a few per cent. increase to cover the thickness of insulation between the laminations

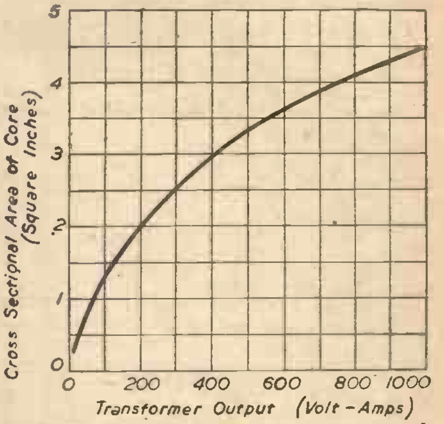


Fig. 6.—Graph indicating core sizes for 50 cycle transformers.

we could use 144 laminations 0.014in. thick, building the core up to 2¼in. thick. Alternate layers of laminations should be reversed so that the joints in one layer are covered by the next layer, the laminations being threaded through the coil after winding. A bobbin will be required to fit over the central core, this being wound first with the primary, over which will be the secondary. After assembly the laminations should be tightly packed to avoid vibration and noise.

The turns per volt induced in both primary and secondary are equal to

$$\frac{100{,}000{,}000}{4.44 \times \text{frequency} \times \text{total flux}} = \frac{100{,}000{,}000}{4.44 \times 50 \times 293{,}000}$$

or 1.55 turns per volt.

Assuming the core is well built up we can

WIRE SIZE S.W.G.	DIAMETER (INS.)	CROSS SECTIONAL AREA (SQ. INCH)	TURNS PER SQ. INCH D.S.C.	TURNS PER SQ. INCH D.C.C.	CURRENT RATING (1,500 AMPS.) (PER SQ. IN.)
10	0.128	0.01287	57	49.6	19.3
11	0.116	0.01057	69	59.2	15.85
12	0.104	0.008495	85	71.8	12.74
13	0.092	0.006648	107	89	9.92
14	0.080	0.005027	140	113	7.54
15	0.072	0.004072	171	135	6.108
16	0.064	0.003217	213	173	4.825
17	0.056	0.002463	274	216	3.694
18	0.048	0.001810	377	297	2.715
19	0.040	0.001257	528	400	1.885
20	0.036	0.001018	641	472	1.527
21	0.032	0.000804	793	567	1.206
22	0.028	0.000616	1010	692	0.924
23	0.024	0.000452	1320	865	0.678
24	0.022	0,000380	1600	977	0.570
25	0.020	0.000314	1890	1110	0.471
26	0.018	0.000254	2210	1280	0.379
28	0.0148	0.000172	3160	1630	0.258
30	0.0124	0.000121	4500	1990	0.181
32	0.0108	0.0000916	5650	2550	0.137
34	0.0092	0.0000665	7310	3020	0.0997
36	0.0076	0.0000454	10300	4110	0.0679
38	0.0060	0.0000283	14700	5100	0.0424
40	0.0048	0.0000181	20100	6100	0.0271

neglect the resistance of the primary in comparison with its inductance, especially as the volts required to overcome the resistance is one-quarter cycle out of phase with that required to overcome the inductance. For a 230 volt 50 cycle primary supply the primary will therefore need 230 × 1.55 turns, that is 356 turns. If the transformer was to work on 250 volts, 390 turns would be needed. It will be noted that the transformer could be designed to work on either voltage, in which case the primary should have 390 turns; all the turns being used on 250 volts, and a tapping brought out so that 356 turns could be used on a 230 volt supply.

To obtain a secondary induced voltage of 50, 78 turns will be necessary. As, however, there will be a certain voltage drop on load due to the resistance of the windings and leakage flux, it is best to allow an additional 5 per cent. and to wind the secondary with 82 turns. Again the transformer could be designed to give two or more secondary voltages by bringing out tappings at the required number of turns.

It is then necessary to find the size of wire. For this purpose it is convenient to adopt a current density of 1,500 amps. per square inch of cross sectional area of the conductors. To carry 20 amps. No. 10 s.w.g. could be used. (See Table 1.) Neglecting the primary magnetising current we can find the full load primary current by dividing the volt-amp. output by the primary voltage. If the primary is wound for two voltages the lower voltage should be used for this calculation. Primary current $= \frac{1,000}{230} = 4.36$ amps. Table 1 shows that 16 s.w.g could be used for the primary.

Since the voltage between adjacent turns in this transformer is only $\frac{1}{1.55} = 0.65$ volts, it is not necessary to have very good insulation between turns. The voltage between layers, however, may be as high as 2 × 0.65 × number of turns per layer, so the insulation between layers must be good. For the sizes of wire needed in this transformer enamel covered wire is not advised on account of the danger of cracking when winding and double-silk covered wire is advised; failing which double-cotton covered wire could be used. For small transformers enamel covered wire might be used up to about 20 s.w.g., provided this is carefully treated when winding. Suitable dimensions, F and G (Fig. 7), can be decided upon after calculating the winding space needed from Table 1.

Protection and Faults

The completed transformer should be protected on the primary side by fuses which are arranged to melt at about twice the full load current, say 10 amp. fuses. Fuses are not so essential on the secondary side as, if the circuit supplied should become short circuited, the secondary current might rise to a high value, but the primary current would also increase and should melt the fuses to cut off the current. If the primary fuses are too large, however, the excess current might cause overheating of both windings, and possibly destruction of the insulation.

In the event of a short circuit in the primary winding, possibly due to damaged insulation during winding, there will be a reduced number of turns in series across the mains. The primary current will, therefore, increase. In addition the induced voltage in the short circuited turns will cause an excessive current to circulate in these turns, the value of the current being limited only by the resistance and inductance of the short circuited turns. If a short circuit occurred in the secondary the short circuited turns would similarly carry a high current; in addition the opposing magnetism created by this current would cause the primary current to increase. A short circuited primary or secondary winding is, therefore, liable to cause overheating and probably burning out of the windings even if the secondary is not connected to a load circuit.

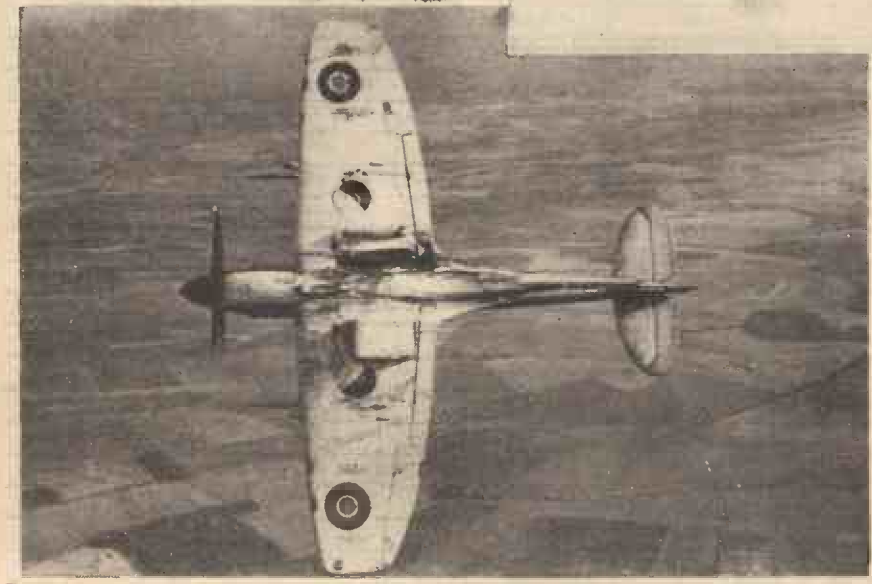
The Spitfire Mark XII

TO the famous family of Spitfire aircraft has been added yet another successful design—the Mk. XII, in which outstanding performance at low altitudes has been added to those fighting qualities which have kept the Spitfire series in the forefront of the air battles of this war.

It was realised even prior to the Battle of Britain that performance at low altitudes might well become one of the deciding factors of the air war. So to supplement the high altitude fighters already being built, Supermarine began the design of an improved single seater fighter to be powered by a Rolls-Royce Griffon engine. These two famous firms co-operated closely. This was in 1940, and in 1942 the first production machine was available for the R.A.F.

In the meantime some acute problems of design had been solved. The substantially increased size and weight of the new engine in comparison with the Merlin necessitated modifications to many sections of the aircraft: a new fuselage, reinforced and strengthened to support the heavier engine, was designed, and an entirely new type of engine mounting was introduced.


The new Spitfire in flight above the clouds.


The underside of the new Spitfire.

The prototype, first flown in 1941, was fitted with standard type Spitfire wings, but it was soon evident that still further improvements should be made. Clipped wings were substituted for the standard type, and an improved rudder was another addition giving maximum manœuvrability to the Mk. XII. The lines of the cowling were also modified, achieving a greatly improved aerodynamic form, and the fixed tail wheel was replaced by the latest retractable type.

In full operation by the R.A.F. the new "Spit" Mk. XII proved from the very first to be highly successful; greatly improved manœuvrability, increased speed, and rate of climb at low altitudes combined to produce a machine with a much better combat performance.

The Structure of Thin Films

A Study of Matter in Thin Layers, and Its Important Bearing on Practical Problems of Physical Science

WHAT is the thinnest thing in the world?

Pure metallic gold can, with great care, be beaten out into foil of extremely minute thickness approximating to about 0.000004 of an inch, in which

The growth of a soap bubble. At this early stage the bubble hangs downwards owing to the greater mass of its material being gravitationally attracted to its lower end.

attenuated condition the metal foil is almost transparent. Moreover, if the gold is electrically deposited by means of special processes, films even thinner than the above can be obtained.

Yet, viewing the thinnest possible film of gold from the viewpoint of an imaginary inhabitant of the atomic world, such an entity would appear as a solid, stable structure, many atoms across in thickness.

A soap bubble is a much thinner structure. Indeed, it is about the thinnest of all *visible* entities. Nevertheless, films of certain oils and greases on water or on other liquids are thinner even than the most tenuous soap bubble, for it can be shown that many of them are precisely one molecule in thickness, which dimension must necessarily constitute the utmost limit of material thickness.

The study of thin films or thin layers of material is still very much in its early stages. Although many individual facts have been ferreted out concerning this truly fascinating subject of material thickness, much information which we should like to be in possession of is still lacking. For, after all, the investigation of films or layers of substances which are only one or two atoms or molecules in thickness is not exactly an easy one. It demands the utmost exactitude of experimental working, if only in consequence of the fact that under such conditions of extreme tenuousness all these excessively thinned-out materials are, besides being specially prone to contamination, almost impossibly delicate in structure, and are therefore incapable of being processed, handled or manipulated in any way at all.

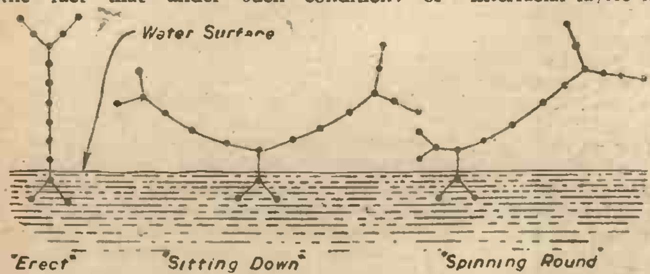
Physical chemistry has long been concerned with the condition of affairs at the boundary of two liquids which are non-miscible, say, for example, at the boundary or interface of water and paraffin oil. It used to be thought that at such liquid boundaries or interfaces, the two liquids were somewhat interwoven, that is to say, that they mutually admitted of some degree of penetration by the opposing liquid. This, however, is not the case. The "transition" or interfacial layer at the boundary of two immiscible liquids consists of two components which comprise a one-molecule-thick layer of each of the opposing liquids. In bulk, the non-miscible liquids, such as water and paraffin, tend to repel each other, but the

Here the bubble has become more spherical. Most of its surplus material has been drawn up from its lower end in consequence of the stretching of its sides. Only a small amount of surplus material is visible at the lower end of the bubble.

two-component interfacial layer between the opposing liquids acts as a sort of lubricating layer which enables the two liquids to flow over each other with extremely little friction.

Fourth State of Matter

It has been held, although not on any conclusive proof, that matter existing in such interfacial layers is neither solid, liquid, nor gaseous, but that it constitutes a fourth state of material existence, behaving according to special physical laws to which solids, liquids, and gases do not conform. To a certain extent, also, such a "fourth state of matter" has been supposed to exist at the boundary layer between a solid and a liquid, that is, for instance, in the boundary layer between a liquid and the sides of its containing vessel.



Showing the peculiar modes of attachment to the water surface of the individual molecules of different types of oils.

When we blow a soap bubble by means of the time-honoured juvenile clay-pipe method, the bubble, at first, tends to be oval, elongated or even sometimes semi-cylindrical, particularly when it is blown in a downwards position. This, in the latter instance, is due to the gravitational effect on the matter contained in the bubble. When, however, more air is blown into the bubble, the latter expands and, in so doing, uses up its surplus matter, becoming more and more spherical in consequence of the swelling of its sides.

It is possible, by using solutions containing soap, glycerine and gelatine, to obtain very large soap bubbles the walls of which are only a few molecules thick. Yet, so determinedly do the soap molecules hold together that they are able to resist the air pressure within the bubble. They have, also, a certain resiliency or springiness in virtue of which a well-made soap bubble is able to bounce off smooth, hard surfaces.

By increasing the air pressure inside a soap bubble there comes a stage at which the stretched-out wall of the bubble is no longer able to resist the distending force. Consequently the bubble bursts and is no more.

Whether, on such occasions, the bubble bursts by a process of ripping up its side or whether it flies apart into a myriad fragments, like a bursting boiler, is a question which has not yet been decided. No doubt the latter explanation is the correct one, but an investigation by means of the technique of modern high-speed photography would throw greater certainty on to the matter.

Lord Rayleigh's Experiments

We shall return to the nature of the soap bubble film later. Meanwhile, let us now consider matter in its most attenuated state, to wit, the condition of a thin film of an oil on water.

Final stage. An almost perfectly spherical bubble. Further compression of air within the bubble would ultimately "explode" it.

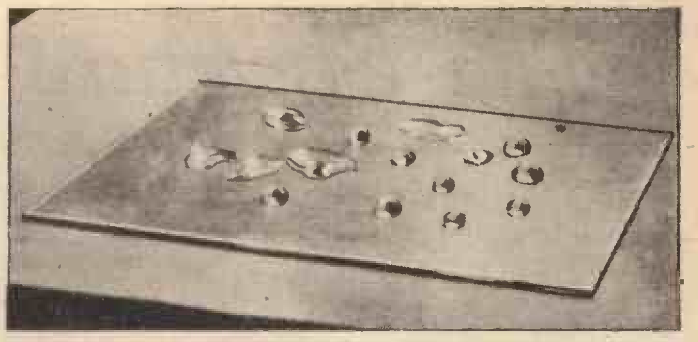
It was the late Lord Rayleigh who first conducted serious experiments on this topic. He had a long, narrow and shallow trough filled to the brim with pure water. The trough was capable of being divided into two portions by means of a strip of tin which slid along it.

Lord Rayleigh placed a single drop of an oil on the water surface in his trough. The oil rapidly spread uniformly over the surface of the liquid. When this stage had been reached the surface tension of the water was measured. The sliding metal strip was then slowly pushed up along the trough. The effect of this was, of course, to reduce the area of surface on which the oil film was able to extend itself. Lord Rayleigh found that after he had pushed the strip along the trough beyond a certain maximum limit, the surface tension of the contaminated water *suddenly* began to decrease.

Now, by methods of physical chemical calculations, knowing the precise quantity of oil which had initially been placed on the water surface, it became possible for Rayleigh to form an estimate of the thickness of the oil film which had spread on the water surface. He came to the conclusion that such a film was exactly one molecule thick. Furthermore, he suggested that when, by means of the sliding strip, the area of oil contamination had been reduced to the stage at which the surface tension of the water underwent a diminution, oil molecules actually began to pile themselves one above the other on the water surface.

Subsequently, other investigators confirmed Lord Rayleigh's opinions, but it is to the celebrated American physicist, Irving Langmuir, the inventor of the present-day gas-filled electric lamp, that we are mainly indebted for our present conception of the nature of an oil film on the surface of water. Langmuir showed that the chemical nature of the oil has a lot to do with its peculiar spreading properties and its formation of super-thin films on water surfaces. He drew attention to the fact that oils of low chemical activity, such as paraffin oil, could be placed on clean water surfaces without much film formation, whilst oils and greases of high chemical reactiveness very readily formed one-molecule-thick layers on the surface of water.

The available evidence of the present day shows that when an oil is placed on water, particularly if the oil is of considerable chemical activity, it rapidly spreads outwards in all directions (so far as it is free to do so) until it forms a film on the water surface. This film, as its maximum degree of attenuation, is exactly one molecule thick.

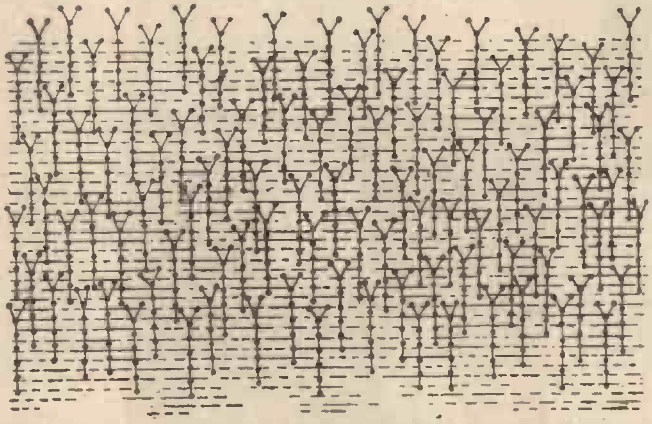


Water drops on an oiled glass surface. Note the coalescence of some of the adjacent drops which have been drawn together by mutual attraction.

Oil Molecules

Such a film, however, is not a continuous one. The individual molecules of the oil do not make individual contact with one another when the oil layer on the water surface is at the limit of attenuation to which it normally proceeds. On the contrary, the oil molecules seem to repel each other, or, at least, to place themselves at almost arithmetical distances apart.

In fact, all the evidence points to the fact that the individual oil molecules are positioned at certain average distances apart, just like service-men on a parade ground.

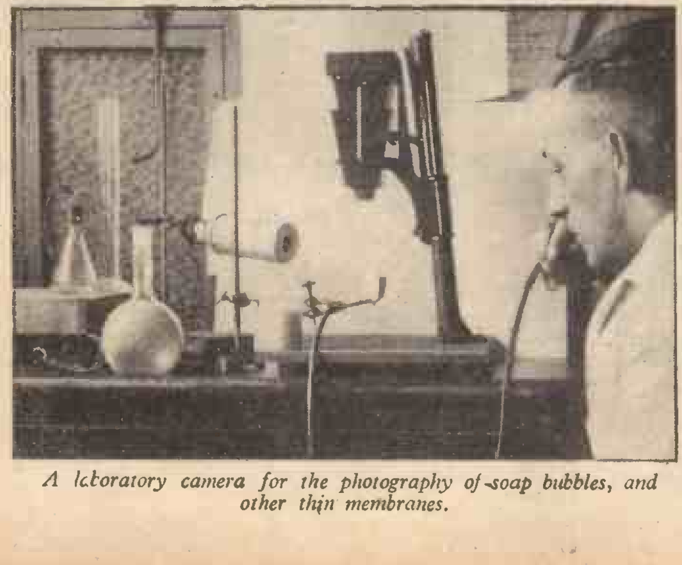


Illustrating the nature of a film of vegetable oil on water. The diagram shows the one-molecule-thick oil film, the oil molecules being spaced regularly apart and standing erect with their "heads" under the water surface. This is the state of affairs to which most oil films tend to bring about.

Now, when, by means of the sliding-strip arrangement above mentioned, or by virtue of some other compressing device, the area of water surface available for the oil film is reduced, the individual oil molecules become more and more closely packed together until, eventually, they contact one another, "shoulder to shoulder," as we may say.

If the water surface is still further reduced, what happens to the oil molecules? They interlock, one above the other, and so produce an oil film exactly two molecules thick. The analogy here is much akin to the soldiers on the previously mentioned imaginary parade ground, after moving closer and closer together, at last standing in two "vertical" ranks made by the upper rank of men standing on the shoulders of the lower ranks.

If the available water surface area is still more reduced, an oil film three molecules thick is brought into being, and so on until the film becomes perceptible to the eye.



A laboratory camera for the photography of soap bubbles, and other thin membranes.

The oils which spread the most readily on water surfaces are those belonging to the "fatty acid" group of chemicals. Now, the individual molecules of these oils consist of a long chain of carbon and hydrogen atoms with different groups of atoms at either end. We may call the long chain of interlinked carbon atoms the "body" of the molecule and the atomic groups at the opposite ends of the chain the "head" and the "tail" of the molecule respectively.

"Hydrophilic" and "Hydrophobic"

A fatty-acid molecule, in this aspect, is not unlike a long centipede, having a wriggly, jointed or interlinked body, with a head at one end and a tail at the other.

The curious fact about these fatty-acid molecules is that the group of atoms at one end of the molecules has a strong affinity for water. It is *hydrophilic* or "water-loving." The atomic group at the opposite end of the molecule, however, is *hydrophobic* or "water-fearing," while the long body of the molecule is also usually more or less water repellant.

The consequence of this fact is that the individual molecules of such an oil, when they spread out on a water surface, each stand vertically upwards from the water surface, being anchored to the water surface by means of the hydrophilic "head" of the molecule which alone penetrates the water surface. Thus we have the analogy of a fish or a marine centipede

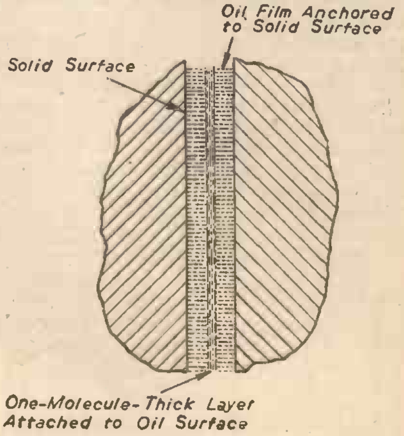


Diagram depicting the essence of lubrication according to modern theory. A film of oil between two rubbing surfaces divides itself up into two components each of which is anchored to its underlying surface. The friction is taken between the two "upper" or contacting layers of the opposing oil film components.

standing upwards on the water surface, its head just below the water, and its tail as far distant from the water as it can possibly manage.

That is actually the state of affairs which would be seen if we could microscopically view a one-molecule-thick "fatty-acid" oil film, such, for example, as a film of a vegetable oil, on the surface of water.

Sometimes, the hydrophilic or water-loving atom-group is not situated at the extremity of the long chain of carbon atoms in an oil molecule. It may be positioned about the middle of the "body" or carbon chain of the molecule. In this case, the molecule will not stand on its head in the water. It will, as it were, sit down in the water, both its "head" and its "tail" being raised above the water surface. Again, in some oils, the hydrophilic grouping of atoms is situated at the end of a short branch-chain of carbon atoms. In this instance, the molecule when forming an oil film on water will stand slantingly upwards from the water surface and will wobble round and round, much after the fashion of one of those little grotesque toy figures with lead-filled weighted bases.

Paraffin and similar mineral or petroleum oils do not possess hydrophilic or water-loving groups of atoms. Consequently, their molecules cannot attach themselves so firmly and individually to water or to anything of a watery nature. Such oils are entirely hydrophobic or water-repellant.

Molecules in a Soap Bubble

We now return to the subject of the soap bubble which, as we remember, represents matter in one of its thinnest states.

Soaps are made from vegetable oils, from the oils which have water-loving and water-repellant groupings. These characters are preserved in the soap. When a solution of soap is blown out into the form of an extending bubble, the hydrophilic (water-loving) molecules of soap firmly attach themselves to the water molecules, thereby forming a connecting web or matrix. When the soap bubble is small, this matrix is of multi-layer dimensions, but when, owing to the increasing air-pressure within the bubble, the matrix is extended, the soap molecules slide gently one over the other, each clinging to its own particular water molecule, and each water molecule clinging to an adjacent molecule of water.

There comes a stage, however, when the soap bubble film becomes attenuated to breaking point. Whether, at such a stage, the film is one molecule thick or more has not yet been settled. Nevertheless, the picture of the soap bubble film at this stage is highly interesting, for it is most probable that it comprises merely a one- or two-molecule-deep layer of water molecules having soap molecules standing perpendicularly outwards from the water layer.

In other words, the soap bubble is a sort of chemical hedgehog having spines extending outwards from its skin in all directions.

When the soap bubble bursts, the failure is due to the lack of cohesion of the water molecules (not the soap molecules), or to the disappearance of the water molecules through evaporation. When once a local area of the soap bubble fails the whole structure necessarily collapses.

Primary Spreading

When drops of liquids are placed on to a solid surface, such as a glass or a metal plate, the drops, provided that they are near enough together, tend to attract one another and eventually to coalesce together.

The mechanism of this effect has not yet been fully worked out, despite the fact that it is a most important phenomenon and that it has probably much to do with the "creeping" of penetrating oils.

Some investigators state that when any liquid is placed on any smooth surface, there is an immediate spreading of the liquid all over the solid surface in the form of a one-molecule-thick invisible film, analogous to an oil film on water at its highest state of attenuation or thinness. They call this the "primary spreading" of the liquid.

This "primary film" on a solid surface is supposed to draw the water drops together over the surface and to result in their eventual coalescence. If only one water drop is present on the solid surface, the drop is pulled outwards from its centre on all sides by the invisible "primary" film.

If the drop or drops are placed on a water-repellant surface such as a greased plate, primary spreading does not take place. The individual visible water drops are left undisturbed. Consequently, they remain "put," and do not tend to spread out. Rather, due to their own internal molecular forces, they tend to contract as much as possible

Mechanism of Lubrication

It is considered that the creeping effect of oils is caused by some molecular mechanism of this kind, although the actual mode of action of such oils has not yet been determined with certainty.

When, however, an oil film exists between two sliding or rubbing surfaces the film, as it were, divides itself into two halves or components (which may not actually be exact halves). Each component has a base layer which is attached to its underlying surface and a face-layer which makes contact with the opposing face-layer of the other oil film component. The friction, therefore, between the two solid surfaces is taken, not by the surfaces themselves, but by the two opposing liquid face layers. Even if each oil film component between the two solid surfaces is only one molecule thick, the friction is still borne by the oil film.

Car-radio Conversion to Mains

THE following description of a simple method of converting a car radio from 6v. D.C. accumulator supply to optional A.C. mains supply may be of interest to some readers. When normal receivers are so scarce, many owners of car radios can easily convert their sets to normal "house" sets, giving quite satisfactory results. Being on the move a great deal, I arranged mine so that, by actuating a double-pole double-throw Bulgin escutcheon-type switch, the set may be switched from A.C. mains to accumulator, without making any other alterations. In this way the vibrator is left in the whole time, though, of course, is inoperative on A.C. mains. The original power supply circuit diagram (which I think is representative of this type of set, a 6-valve superhet) is shown in (Fig. 1) along with the modified arrangement (Fig. 2). A pilot light, between chassis (negative) and nearest non-earthed valve filament pin, i.e., in parallel with valve heaters, was fitted to the front of the metal cabinet. In the A.C. position the negative leg (earthed) of the vibrator input is broken by the switch, thus switching out the vibrator. In the D.C. position the vibrator is restored, as in Fig. 1, and the positive vibrator input is also connected to the centre tap of humdinger, and built-in transformer primary centre tap, as before.

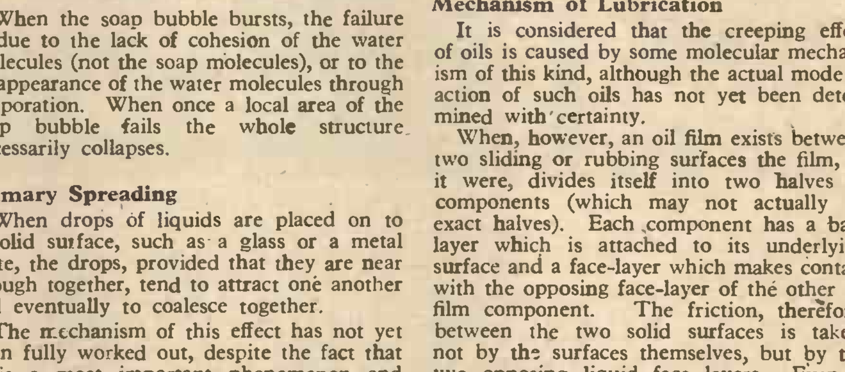


Fig. 2.—Circuit diagram of the modified supply.

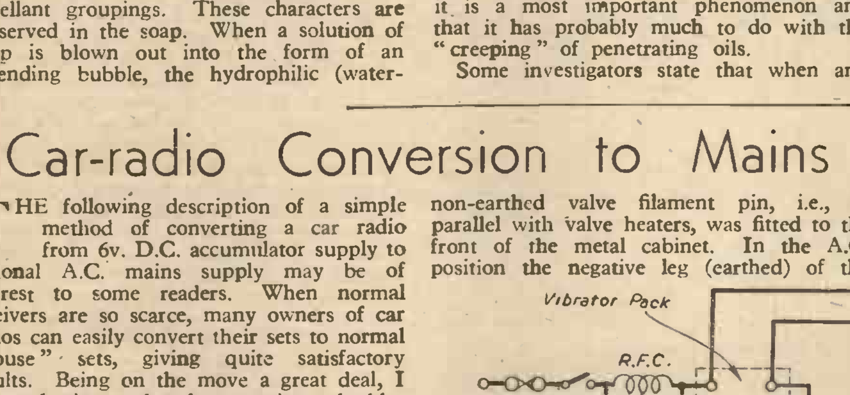


Fig. 1.—Theoretical circuit diagram of the original power supply.

I also rigged up a simple dial marked "Home Service," "Forces," etc., as the dial supplied with the set is usually for steering-column mounting, and is driven off the Bowden remote control cables from the set. A suitable mains transformer is, of course, required to give the necessary 6v. A.C. output.

Incidentally, I replaced the original mains energised speaker (the field coil of which was not for smoothing) by a Rola 6in. P.M. speaker, with greatly improved results.—R. T. MACTAVISH.

THE WORLD OF MODELS

By "MOTILUS"

Reminiscences of Marvellous Models, With Some Excellent Examples of a Few Exhibition Ship Models Made In Pre-war Days

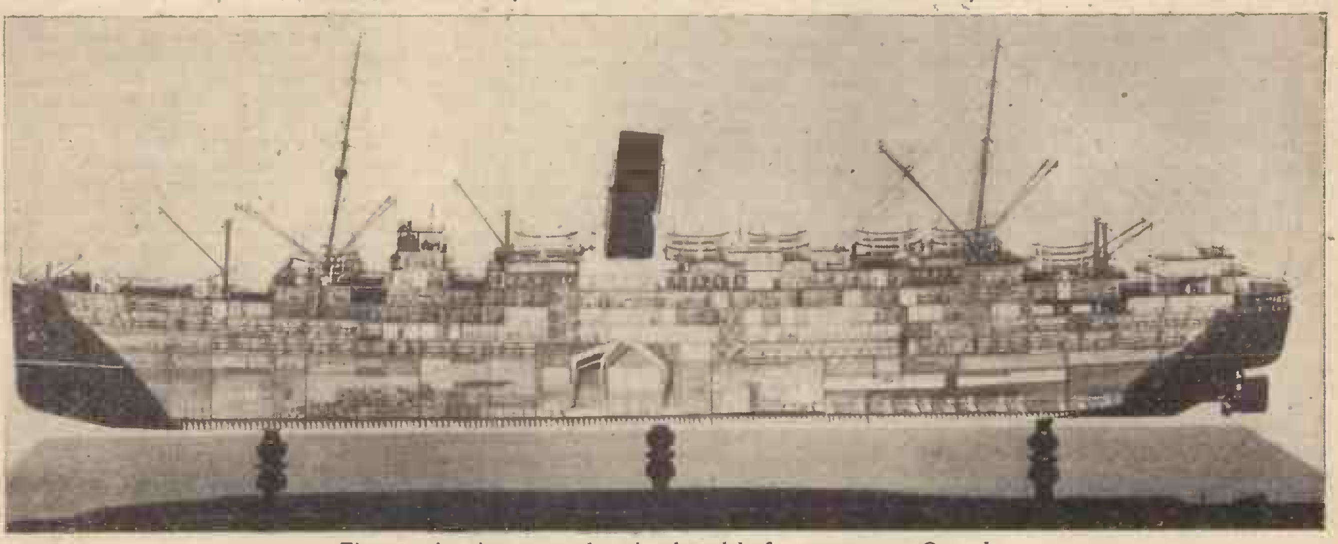


Fig. 5.—A unique type of sectional model of a 15,000 ton Cunarder.

IN these days of war it is often pleasant and instructive to look back upon peacetime activities.

In the model world this is especially interesting because at the present time, apart from model making for the national effort, and a few models done in spare or fire-watching time, model making is almost at a standstill.

Fig. 2.—The French Line's "Ville d'Alger" express service ship between North Africa and the South of France in peacetime. A waterline model 100th actual size.

Those who took an interest in pre-war model making were continually stimulated in their efforts by visiting the annual exhibitions of the *Model Engineer* and the Model Railway Club, and other smaller exhibitions held in different parts of the country, and by the displays from time to time of commercial model makers at the British Industries Fair and similar trade exhibitions. Here they could see for themselves examples of the best commercial work, and also the cream of amateur effort, put forward for competition.

But it is a strange thing that, despite the lack of these peacetime opportunities, the interest in model making to-day is even keener than ever, and I am confident that with the return of good materials and equipment for modelling there will be an enormous increase in devotees of the hobby.

This has encouraged me to sort through my huge pile of photographs to show you in picture form a few outstanding models that were being made a year or so before the outbreak of war.

A Passenger-carrying Locomotive

First let us take one of the earlier models made for a passenger-hauling garden railway. The illustration, Fig. 1, shows a model 2in. scale, 9½in. gauge L.N.E.R. (G.N. Section) "Atlantic" type locomotive, which is now in the possession of Captain C. F. Ward Jones. This model has been photographed many times in its present surroundings with Captain Ward Jones or some of his family driving along the well-laid and picturesque track at Harness Grove, but this earlier picture shows it in the process of being constructed. The boiler is 11in. in diameter, accurately modelled with Wootton firebox, and with a working pressure of 100lb. per square inch. The cylinders, of cast iron, with piston rings and bronze valves, are 2⅞in. bore by 4in. stroke. In working order, the model weighs 12 cwt. and is 9ft. 8in. overall; the maximum load advised, on the level, is

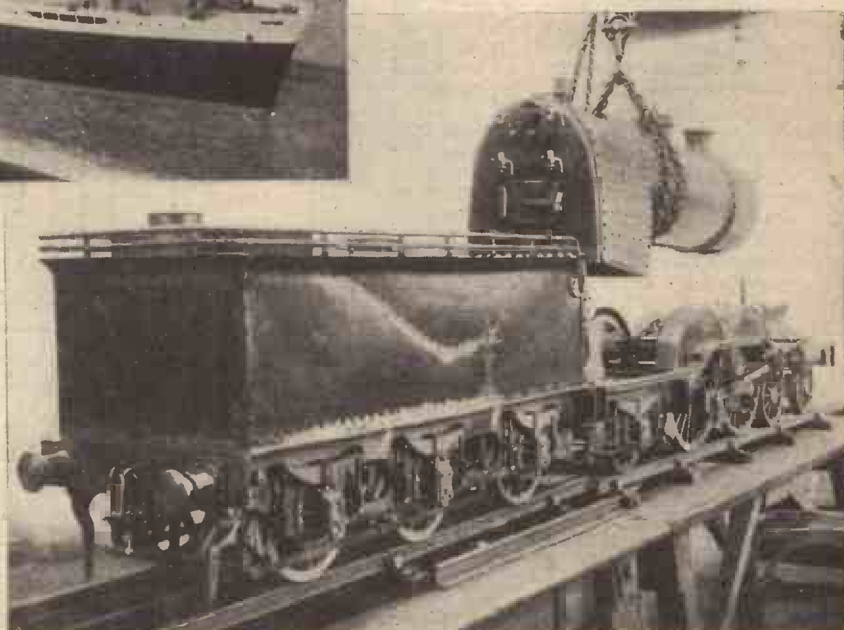


Fig. 1.—A passenger-carrying locomotive—9½in. gauge L.N.E.R. (G.N. Section) "Atlantic" type, during construction.

2 tons. It has the usual scale model fittings and is fitted with Stephenson's link motion. The tender is of the latest standard design.

The illustration shows the boiler being lowered into position on the chassis.

A French Waterline Ship Model

The illustration, Fig. 2, shows the *Ville d'Alger*, one of two sister ships, the second being the *Ville d'Oran*—very fast and smart-looking ships, which ran an express service, in pre-war days, between North Africa and the South of France, the ports being Marseilles and Algiers, and they reduced the trans-Mediterranean journey from 23 hours to 19. The scale of the model is 3/25in. to the foot, or 1/100th actual size—one of the standard scales adopted by Continental shipowners. The owners of the *Ville d'Alger* are the Compagnie Générale Transatlantique, known in this country as the French Line, and in pre-war days this model of her was on view in the French Line offices in Cockspur Street, and followed the usual practice of models for this company in being of the waterline type, whereas the general practice of British steamship lines was to have their models finished in the full hull style.

The "Champlain"

Another fine example of French shipbuilding is shown in Fig. 3. This is the ill-fated *Champlain*, which was one of the most interesting liners built by the French Line before the *Normandie*. She was the last one to be designed as a cabin-class ship, because later, with the coming to service of the *Queen Mary*, the designation "first class" was abandoned, and all liners between Europe and New York were called "cabin class." She was built in the year 1932 at St. Nazaire, and had a service speed of 20 knots. Her dimensions were: length 606ft., beam 83ft., and depth 46ft.

A unique feature of her large single funnel is the smoke deflector, shown clearly in the illustration. This deflector is similar to that used on some French locomotives. Another feature was her large open-deck space, astern of the funnel, which is not shown in the illustration. She was the high - water - mark in luxury cabin-class liners, being contemporary with the U.S. Lines' ships *Manhattan* and *Washington*.

As will be remembered, the *Champlain* was sunk by torpedo in the Bay of Biscay in 1940, soon after the fall of France.

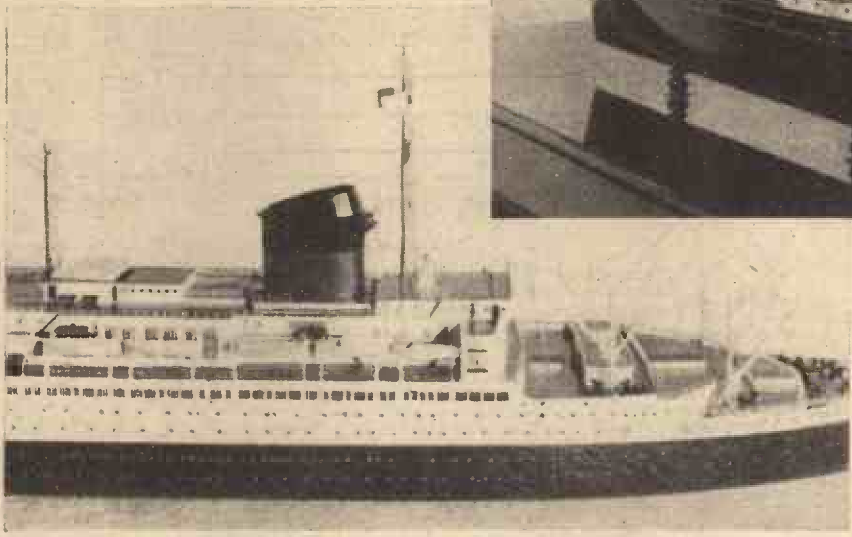


Fig. 3.—*The French Line's high water mark in luxury cabin-class liners—the "Champlain"—another waterline model.*

The "Cutty Sark"

Now we go away to the sailing days with a picture of the last of the famous clippers—a model of the *Cutty Sark* in her full rig (Fig. 4). There are few ships that have been modelled more times than the *Cutty Sark*. She had a marvellous career that has been immortalised in Basil Lubbock's book, *The Log of the "Cutty Sark."* Another reason for her fame is because she is the last of the sailing ships of that period to be still afloat. For a long time she was anchored off Falmouth, and was visited there by hundreds of tourists. She has now been moved to the Thames, and takes her place alongside the training ship *Worcester* off Greenhithe, where she is used for training boys entering the Merchant Service. Long may she live to remind the present generation of the days of fast and beautiful clippers. The best model of the ship ever made is considered to be that by Dr. C. Nepean Longridge, which is now in the keeping of the Science Museum in South Kensington.

Fig. 4.—*A full hull fully-rigged model of the famous "Cutty Sark."*

A Sectional Model

There was a vogue for some time among shipowners to adopt the idea of a model of a ship with one side cut away, and on the plain surface paint the interior in correct colours, to give intending travellers an excellent idea of the layout of the ship and the position of their accommodation on board. The illustration, Fig. 5, is one of a series of six single-funnel Cunard liners of about 15,000 tons built soon after the last war for Canadian trade. They were completely modernised in 1938 and used to operate from London, making the outward-bound

(*Continued on page 321*)

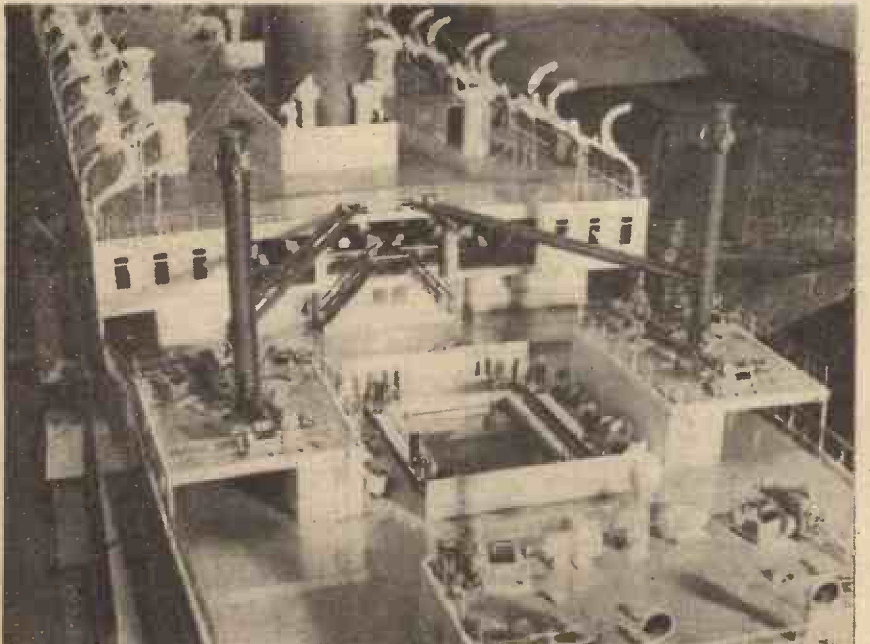


Fig. 6.—*Close up of the ¼in. to the ft. model of the "Dominion Monarch," showing the swimming pool and veranda café.*

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on back cover must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Winding Magneto Dynamo

I AM constructing a small A.C. dynamo, and am at a loss to know how to calculate the number of turns to put on the armature, which is to be of the simple two-pole type. The armature is 1in. diameter and 1in. long, with two slots of such depth that the centre section is ⅜in. thick. I have a supply of 28 s.w.g. d.s.c. copper wire which I would like to use if suitable. Voltage required is 4 to 5 volts at about 1,200 r.p.m.

The field magnet is a permanent one of ½in. by ½in. section. How do I calculate the current flow, and is it dependent on the gauge of the wire ?—W. E. Whitmore (Bletchley).

CALCULATIONS are not of much service when dealing with a machine of this class, with such small armatures, as the constants relating to field strength, airgaps, etc., are unknown. The No. 28 wire you have is rather small in diameter, and you would most likely do better with No. 26 or even No. 24, but so much depends on the strength of the magnetic field and the length of airgaps between armature and pole faces that it is impossible to advise definitely. The output in current depends not only on the voltage generated in the armature winding, but also on its internal plus external circuit resistance, therefore the larger the wire used the more likely the output in amperes will be increased.

Substitute for Tobacco !

WHAT is the nearest approach in flavour, etc., to tobacco for smoking purposes ? Dried rhubarb leaves are no good. Some people say dried buckthorn or may tree leaves.

Unsuccessful experiments by myself have produced semi-asphixia, " garden bonfire " effects and chronic coughing—hence the query. The lichen or tree moss tobacco substitute sold by herbalists is far from satisfactory.—P. Loftus (Coulsdon).

THERE is, unfortunately, no English plant or herb which, when dried, has a smoking flavour anything approaching that of tobacco. Coltsfoot has been tried for this purpose, and is, perhaps, the most successful, when mixed with ordinary tobacco. The use of lavender has long been known as a tobacco substitute, but it is really useless for this purpose. Dried dandelion leaves (mixed with coltsfoot) have also been tried. Used alone, these are useless, but when admixed with ordinary tobacco they are, to some extent, passable. There is, however, no really satisfactory substitute for tobacco.

Plaster of Paris Moulds : Casein Glue

COULD you please reply to the following queries ?

(1) I am eager to make a plastic mould for pouring into a warm or cold, slow-setting plastic material for shaping various miniature objects, and have purchased a small quantity of plaster of Paris (2lb.). Would this be suitable ?

When putting in the plastic material for setting, can I smear the inside of the mould so as to prevent sticking ? What is the material required ?

(2) Is there any other material than " glue " that will stick wood to wood to make a strong joint ?—H. L. Haigh (Grays).

(1) PLASTER OF PARIS will give accurate mouldings, and articles can be made of it readily. It will be only necessary for you to shake the plaster with water and to pack the material into the moulds as quickly as possible. Wooden or metal moulds can be used, and, in order to prevent sticking, it will be best for you to grease their inner sides and edges.

(2) Ordinary casein glue powder gives somewhat stronger joints than ordinary glue. This material is easy to make up and is readily applied. The casein glue is sold under various proprietary trade names, one of which is " Casco " glue. Such glues are normally obtainable from any large retail paint stores.

Fireproofing Solution

CAN you please tell me how to make a fireproofing solution which will render cloth or wood inflammable in the presence of an incendiary bomb, or whether any such solution is available on the market ?—A. W. Parker (Walthamstow).

SINCE an incendiary bomb, when in action, comprises a mass of white-hot metal which frequently attains a temperature of some 3,000 deg. C., and which can penetrate an iron plate with ease, it is obvious that there is no substance available which will render textiles and wood entirely immune from the effects of such bombs. All we can hope to do is to so treat the wood or fabric that they will not spread any conflagration and so that they will only char locally and smoulder when ignited.

Either of the following chemical solutions will impart this property to fabrics when they are soaked in the solution for 24 hours and subsequently allowed to dry (without rinsing).

(A)	Boric acid ..	1½ lb.
	Borax	1½ lb.
	Water	3 gallons.
(B)	Ammonium sulphate	2 lb.
	Ammonium chloride	4 lb.
	Water	3 gallons.

Either of the above solutions may also be sprayed on to the fabrics to be treated. Wood is best treated by immersing it in a solution containing 15 per cent. of sodium acetate and 3 per cent. of sodium phosphate.

Another method of treating wood is to soak it in a dilute solution of sodium stennate (say a 5 per cent. solution of this salt) for 3-4 days and then to immerse it in a solution containing 20 parts of iron sulphate and 80 parts of water.

So far as we know there are no special fireproofing solutions on the market for home use.

Electrified Fencing

I AM having trouble with my cattle ; they are continuously breaking fences, etc. There are on the market electric fences, which are said to be very effective, giving a shock of sufficient intensity to keep any cattle or sheep in their proper place. I would be grateful if you could give me details to enable me to construct one of these, preferably making use of dry batteries.—W. E. Ambrose (Oswestry).

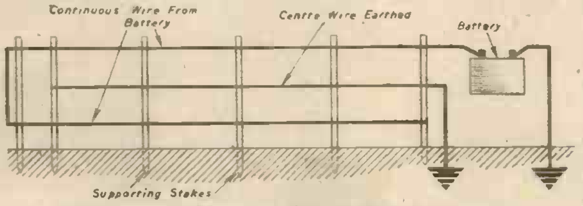


Diagram of connections for an electrified fence.

WE suggest you construct your fence with three strands of barbed wire connected up to a supply of about 20 volts, as indicated. Alternatively, you could use a single wire connected to one pole of the supply, the other pole being connected to earth. The connection to earth could be made at a cold water pipe, or a buried metal plate or a tube or rod driven into the ground, preferably in a damp spot. Although the voltage mentioned is not dangerous to life, it would be best to put up a few notices to warn persons that the fence is electrified.

A dry battery could be used to feed the fence. The only current drawn from the battery will be that due to leakage, and should be practically nil in dry weather, provided the wires are not allowed to touch each other or the ground.

Electric Water Heater : Condensation in Shelter

(1) I have a water-heater designed to heat water to boiling point in approximately 30 seconds. After considerable use, a substance which resembled hard chalk, was found to have been deposited on the two carbon rods, and the water took nearly 20 minutes to boil. After scraping the deposit from the carbons, it was possible to boil water in five minutes. Is there anything I can do to reduce the time taken to reach boiling point and to prevent the corrosion of the carbons ?

(2) How can I operate a 4-volt permanent magnet type motor from an ordinary bell transformer ?

(3) After several hours' use my " Anderson " shelter " steams up," and moisture runs down the corrugated iron walls. I believe it is possible to keep the air dry by keeping concentrated sulphuric acid in contact with the air, but I do not desire to use this dangerous acid.

Is there any other substance which I could safely use ?—P. G. Rutter (Streatham).

(1) IT is really impossible for you to completely prevent the deposition of hard scale on the carbon rods of your heater. If, of course, you could use soft water only, the difficulty would be solved, for then the formation of scale would not take place. Provided, however, that you do not require the water for drinking purposes and that there are no soft and perishable rubber connections, etc., in your heating apparatus, you can do much to prevent scale formation by putting a few grains of caustic soda in the water previous to its heating. This will, to some extent, prevent the water from depositing hard scale around the electrode rods. Apart from this treatment, the only thing you can do is to soften the water beforehand, but we anticipate that you will not wish to go to the trouble and expense of doing this.

(2) To operate a 4-volt motor from a bell transformer of the ordinary 4-6 volt type, merely connect the motor up to the output terminals of the transformer. The mains current is applied to the input terminals of the transformer. If, during the running of the motor, the transformer windings become unduly hot, you should switch off the mains current, otherwise the transformer (not being designed for continuous current supply) may burn out.

(3) It is quite true that concentrated sulphuric acid will absorb moisture from air in an enclosed space and so keep such a space dry. But this absorption is only practicable when small, confined spaces are being dealt with, as, for instance, the interior of an instrument-case, a small cupboard or some similar article. It is entirely out of the question to use concentrated sulphuric acid for moisture-absorption in any large space. The same applies also to fused calcium chloride, magnesium perchlorate, silica gel or any of the other " drying agents " which are nowadays extensively employed in laboratories.

The steaming-up of your Anderson shelter is due to the air in the shelter being hotter than the walls of the shelter. Consequently the air deposits its moisture through the process of condensation on the walls of the shelter, just as moisture is deposited on, say, a cold slate when it is held in a jet of steam.

There is no chemical drying substance which you can use to abstract the moisture from the air of your shelter and to prevent the deposition of the moisture on the shelter walls. In fact, the only thing which you can do to inhibit the moisture condensation is to line the shelter walls with some non-conducting material, such as asbestos sheeting, which will tend to keep the warmth of the shelter from passing outwards through the walls. Under these conditions the deposition of moisture on the shelter walls will be minimised.

Lacquer for Domestic Utensils

CAN you tell me what are suitable lacquers for metal hollow-ware pans, kettles, etc., black for the outside, and a tin or silver colour that will not peel off for the inside ?—P. Rutherford (Bishop Auckland).

YOU will find it extremely difficult to obtain a lacquer for pans and kettles which will resist heat and, also, the effects of boiling liquids. Indeed, only " burnt-in " or vitreous enamels will withstand such agencies.

For giving a silvered appearance to the interiors of pans you may use a lacquer composed of aluminium powder mixed with shellac or celluloid varnish. Celluloid varnish may be made by dissolving scrap celluloid in a mixture of equal parts of acetone and amyl acetate. Similarly, a black varnish may be made by dissolving bitumin in celluloid varnish, or by mixing lampblack with the latter.

A highly resistant lacquer to warm water may be prepared according to the following formula :

Urea resin	100 parts.
Tricresyl phosphate ..	20 parts.
Butyl alcohol	20 parts.
Toluene	45 parts.

With this lacquer, the pigment—either lampblack or aluminium powder—may be incorporated. The lacquer should be painted on thinly and, after lacquering, the articles should be placed in a very hot oven for some time.

The materials for making this lacquer may be obtained from Messrs. A. Boake, Roberts and Co., Ltd., Carpenters Road, London, E.15. Alternatively, they may be obtained from any firm of laboratory suppliers or wholesale chemists. Some of the larger paint stores also stock such materials.

Erden Resonators : Trimethylene

(1) CAN you tell me where I can obtain any information about Erden resonators ?

(2) How can I make trimethylene trinitroamine ?

(3) Can you tell me how to liquefy coal-gas ? Also, is there any highly inflammable liquid which will absorb large quantities of coal gas ?

(4) Is it true that electricity will travel along a powerful beam of ultra-violet light ?

(5) What is the most powerful sound amplifier in the world, and can a circuit be obtained of same ?

(6) Where may I obtain pentaerythrene, and how much an ounce is it ?—F. Prescott (Herne Hill).

(1) We do not think that you will be able to obtain any detailed information concerning the construction of Erden resonators, which name embraces a variety of special forms of acoustic resonators for sound-location purposes. In this instance, we can only suggest that you refer to any *modern* text-book of sound which may be available in your nearest reference library.

(2) Trimethylene (better known as "cyclo-propane") is very difficult to prepare. You can, however, make it on the laboratory scale by acting upon allyl bromide with hydrobromic acid. As a result of this reaction, trimethylene bromide is formed. The trimethylene bromide is then boiled with sodium, whereby sodium bromide is formed, and a gas, trimethylene or cyclopropane, is evolved. The trimethylene easily condenses to a liquid on passage through a tube cooled by a freezing-mixture. It is inflammable, burning with a smoky flame.

(3) We think that you refer to "trinitromethane," which is an explosive liquid, sometimes referred to as "nitroform." It is obtained by the simple hydrolysis of trinitroacetonitrile, i.e., by heating up this latter substance with dilute caustic soda solution. Such a preparation, however, is beyond the resources of any home laboratory, added to which there is the fact that this compound (and its derivatives) are *excessively dangerous.*

(4) You cannot liquefy coal gas by any ordinary means. In order to liquefy this gas, you would have to submit it to intense cold and high pressure. Acetone will absorb a certain amount of coal gas, but there is no inflammable liquid which will absorb large amounts of it.

(5) Air in the path of a powerful beam of ultra-violet light becomes ionised, and thereby becomes to a certain extent conductible. It is not true, however, that electricity will pass along an ionised beam with the same ease as it will along a length of wire. An ionised beam cannot be employed for conducting purposes to any great extent.

(6) There is no such thing as "the most powerful sound amplifier in the world," because certain amplifiers are only on use when dealing with certain frequencies of sounds. Thus, for instance, it is possible to design an amplifier which will pick up deep sounds of low intensity, but which would be almost "deaf" to high-pitched sounds. For your purpose, any normal valve amplifying sound magnifier using a sensitive microphone would be suitable.

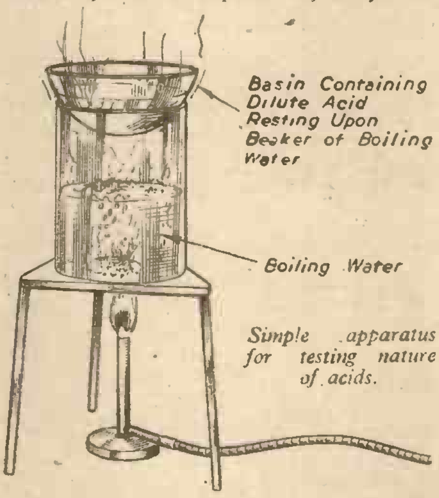
(7) We doubt whether you will be able to obtain pentaerythrene commercially. Try the British Drughouses, Ltd., Graham Street, City Road, E.C.1, or, alternatively, Kodak, Ltd. Research Department (Wratten Division), Kingsway, W.C.2.

Ascertaining Strength of Acids

I HAVE a bottle of acid which I think is sulphuric; it reacts with zinc to produce hydrogen. I have tried it with common salt to produce hydrogen chloride, though this experiment proved unsuccessful.

Could you please tell me of a few simple experiments which will prove this acid to be sulphuric or not ? Also, is there any means of calculating the strength of the acid with only the simple apparatus at my disposal (no balance). I have a graduated beaker and tube.—P. G. Berry (Rotherhithe).

FROM what you say, it seems fairly obvious that your unknown acid consists of dilute hydrochloric or dilute sulphuric acid. A simple test to distinguish between the two is to concentrate some of the acid in a porcelain basin placed on a water-bath, as shown in the accompanying sketch. If the acid is hydrochloric acid, it will all evaporate away and you will be able to smell it as it becomes more and more concentrated. Sulphuric acid will not completely evaporate at the temperature of boiling water.



Simple apparatus for testing nature of acids.

When you have concentrated the acid to about one quarter of its original bulk, heat a little of it in a test tube with manganese dioxide. If you obtain the pungent chlorine gas, hydrochloric acid will be indicated.

Again, take some of the dilute acid from your bottle —a teaspoonful will be enough—place this in a test-tube, and add to it a few drops of barium nitrate solution. If you get a white precipitate (of barium sulphate) it will be indicative of sulphuric acid.

With only a graduated beaker, we are afraid that it will be impossible for you to determine the exact strength of the acid, and even, given the necessary apparatus (consisting of balance, burette, standard solutions, etc.), the task is not easy unless you have much skill in chemistry. Usually, dilute acids are made up in strength of 1 part acid in 3 or 4 parts of water, and it is more than likely that your dilute acid conforms to this standard.

Dyeing Leaves

CAN you give me a formula for a liquid in which leaves could be dipped to preserve and dye them cherry, brown, green and any other dark colour ? After treatment, the leaves would be stored in boxes and used for wreath-making.—R. Cook (Banff).

IT is possible to dye many varieties of leaves by drying them and afterwards by immersing them for a time in a warm methylated spirit solution of an aniline dyestuff such as Bismarck brown, spirit red, etc. Usually, however, this process renders the leaves too supple and limp.

A better way is to make up a weak solution of scrap celluloid in a mixture of equal parts of acetone and amyl acetate. Soak scrap celluloid in this mixture until a thin varnish results, and then, to this clear varnish add sufficient methylated spirit dyestuff solution to colour the varnish strongly. Immerse the leaves in this liquid for a few minutes. Then remove them and allow them to drain. Finally, dry them without heat. In this way, the dyed leaves will be given a shiny, glistening surface, which, we take it, is the kind of effect you require.

We must add, however, that no process of artificially dyeing leaves and stems enables them to be kept for very long, the leaves generally withering and becoming limp and faded.

With naturally-coloured leaves gathered in the autumn it is possible, after carefully drying them, to paint each individual leaf thinly with a clear, quick-drying varnish. This, perhaps, is the simplest and the most satisfactory of all such processes, and the leaves so obtained are the longest lasting.

Failure of Model Electric Loco

I HAVE a gauge "O" electric model locomotive which has stopped. I took it to pieces and found it has a three pole armature and a field coil with laminated field magnet, the field magnet being divided to work the automatic reverse.

With a cycle battery and milliamp meter I tried each of the armature coils and there was a circuit. There was no circuit between coils and laminated core. This also applies to field coil and magnet. I also fitted new carbon brushes and reassembled it to find it worked, but had hardly power to move itself. I should be pleased if you could suggest where I can trace any further trouble.

It is 20-volt working off an A.C. mains transformer, with controller on the end.—S. R. Lingard (Grimsby).

IN the first place we presume you are quite sure that the transformer, the connections, and the track are not short-circuited, and that the motor is not running slow due to stiffness of the working parts or excessive brush pressure. If these are in order it is likely that the field coils or armature windings are short circuited or that there is a short circuit on the automatic reversing switch, or that the brush position is wrong. You might test the armature by connecting the field coil only to the transformer in series with a resistance about 40 ohms. You might use the element of a 2 k.w. electric fire as the resistance. With the brushes raised and current flowing only through the field coil it should be possible to turn the armature freely in either direction. If this is not the case and the armature tends to set itself in a certain position, it is likely that the armature is short circuited and needs rewinding. Should this test fail to reveal any armature fault, and particularly if the field coil heats up with the test current passing, it is probable the field coil is short circuited and we suggest you rewind this.

THE WORLD OF MODELS

(*Continued from page* 319).

call at Havre and Southampton. Models like this were exhibited at the various offices of the Cunard Line at home and abroad.

Close-up on a Dominion Ship

One of the finest ship models ever constructed was the large ½in. to the foot model of the Shaw-Savill *Dominion Monarch.* This ship was built by Swan Hunter and Wigham Richardson, and was the largest merchant ship built on the Tyne since the *Mauretania* was built in 1907. She was 682ft. long, had a registered tonnage of 27,000, and was driven by quadruple screws operated by Doxford diesel type engines. She inaugurated the new service for passenger traffic to New Zealand, calling at Cape Town and Durban en route.

The illustration, Fig. 6, shows the stern portion of the ship, including the swimming pool, and the covered veranda café ; also some interesting detail of the cranes and derricks for unloading cargoes at ports where full dockside facilities would not be available.

Here is a varied selection of models that many readers have seen or heard about, and will be glad to renew acquaintance with.

Solutions to Probes and Problems

(*See page* 309)

Blackout Bargain

Batteries cost 9¼d. each. A ten-shilling note and a farthing make 481 farthings, and this number is equal to 13 x 37. Since I purchased fewer than two dozen batteries, I must have bought 13 at 9¼d. each.

A pound and a farthing come to 961 farthings, and the only factors to this number are 31 and 31. But we know that I did not buy as many as 31 batteries. A note of higher denomination would make the batteries too unreasonably expensive.

Mr. Baker's Job

Mr. Baker is a tailor, Mr. Smith a baker, Mr. Fish a blacksmith, Mr. Butcher a fishmonger, and Mr. Taylor a butcher.

Numerical Verses

The key-word is RHEUMATICS, the verse being:

The curate hates the church's chime ;
He cries, he tears his hair.
His heart aches as, at Christmastime,
He hears its music rare.

The Vicar's Collection

The only ways of making up £1 with ten coins of the required value are the following:

2s. 6d.	2s.	1s.	6d.
7	0	2	1
6	2	0	2
6	1	3	0
5	3	1	1
4	4	2	0
3	6	0	1
2	7	1	0
—	—	—	—
33	23	9	5

Hence there were five sixpences in all.

Making a Watch De-magnetiser

SIR,—In the April issue of PRACTICAL MECHANICS, on page 237, at the end of the article on a Watch De-magnetiser, the author writes—"After a few seconds the current is switched off, by which time . . ." A much bigger improvement will be to gradually move the watch away from the de-magnetiser. It is just a matter of luck whether the watch will be de-magnetised or not if the current is switched off suddenly —this is a possible method for magnetising an article.

W. A. HENDERSON (Whitehaven).

THE Cyclist

Editor: F. J. CAMM

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Comments of the Month By F. J. C.

Post-war Road Policy

TWO public speakers during recent weeks have commented on post-war road policy, and Mr. P. J. Noel Baker, in the House of Commons, has hinted at the Government's post-war proposals in this direction. Apparently the Government accepts the principle of motorways for the exclusive use of mechanically propelled vehicles, although only experimental stretches are to be considered. Sir Miles Thomas, at a recent meeting of the Roadfarers' Club, which was attended by many important members of various interests associated with the roads, including Sir George Beharrel, chairman of the Dunlop Rubber Company, dealt with faulty construction of British highways. Sir Miles, who is vice-chairman of the Nuffield organisation, and a member of the Roadfarers' Club, is also chairman of the Public Relations Committee of the motor industry. Every cyclist will agree with him that one of the first things we must do is to achieve safety on the roads.

One of the best ways of tackling this problem is to foster in the minds of our road authorities the idea that it is not necessarily by cutting down speed that safety can be achieved, but by intelligent road planning, and instituting schemes to smooth out the traffic flow. He suggested that our roads should be streamlined.

The average traffic speed of roads of all kinds in this country, in urban and rural areas, is probably nearer 30 miles an hour than 50, and if by streamlining we can eliminate traffic blocks and other time-wasting factors, our point-to-point averages will be much higher, and our nervous condition will be very much better both during and at the end of the journey. We shall travel more safely.

Road Streamlining

HE defined road streamlining as the incorporation of such features as better sighting on corners, cutting out bottlenecks, the elimination of wrongly cambered turns, abolishing surfaces that are dangerous when wet, intelligent signposting, and, above all, adopting uniformity of usage and road custom in every part of the country.

He severely criticised our road planners, who, he thought, were either so busy or so wealthy that they are all chauffeur driven. They never incorporate in their siting of refuges or roundabouts the features that are going to help the roadfarer on his way. The whole psychology of British traffic control seems to be one of hindrance. Bring the driver to a standstill and they think you will be safe. That, of course, is quite an erroneous idea. If you want to get more water through a pipe you pump it faster, and if you do not enlarge the roads and traffic continues to increase you must allow it to travel faster, and not slower.

By our system of inverted traffic logic, largely supported by some cycling legislators who have a positive hatred of motor-cars and motorists, we endeavour to make our old-fashioned road suit an increasing volume of traffic by erecting dams along them in the form of traffic lights, roundabouts, and island refuges. All of the latter should be swept away, and with them those ridiculous monuments to Mr. Hore Belisha. Notwithstanding the curious and stupid attitude of the C.T.C. and the N.C.U., if we are going to achieve real safety on the roads of this country we must adopt an overall system that will enable the increased amount of traffic that we shall have on the roads after the war to move briskly but evenly. Everyone who has travelled on American roads knows how tremendously the sense of continuous progress at a flow-beneath crossing or a flyover intersection induces a sense of safety, and the kind of mental ease that leaves the roadfarer alert and unflurried.

Sir Miles dealt with the custom in this country of putting down the centre of comparatively narrow carriage ways a row of islands about 100 yards apart. White guiding lines are better than solid obstruction. Roundabouts should be made far less acute. Most of them are damaged every week. In some districts you are not allowed to pass a stationary tram on the inside; in others, provided there are no passengers alighting or being taken on, you can go through. In some places you are forced to keep to the left of islands, in others the regulations are not so rigid.

Of what use is the Highway Code if it does not secure uniformity? Let us get out of our minds the old C.T.C. bogy that motorists are always looking for trouble, and that they go out positively looking for cyclists to knock down. Let us eliminate the old joke that cyclists and pedestrians are either the quick or the dead. Let us have pedestrian crossings that are either above or below the surface of the road. Sir Miles is in favour of decent cycle paths for cyclists.

National Motorways

THE other speaker, Mr. A. F. Palmer Phillips, dealt with our national motorways. He said that the cost of a national system of motorways running into £100,000,000 represents the surplus payments made by motor users in the last seven years of peace. Experts in daily touch with the problem are satisfied that a comprehensive system of long distance roads is essential and overdue. The county surveyors have already provided the outline of such a system. He urged the Government to declare a policy of national motorways at least approximate to those suggested, and at the same time to arrange to tackle the equally serious problem of making suitable for their purpose the large number of existing roads which to-day, through growth of traffic or changing means of transport, are almost totally unsuitable for the work they are called upon to perform, and which, in the opinion of those competent to judge, provide the cause of the vast majority of road accidents to-day, the number of which will not be seriously reduced until such steps as are suggested are taken.

On the question of finance a good deal of misapprehension has been created by the loose quotation of large sums of money alleged to be involved. Apart from the fact that the estimated cost for the proposed system of roads of 100 millions would be spread over the number of years required for its construction, the balance of payments made by motor users to the Exchequer in the last seven recorded years before the war showed a surplus of just that sum over and above the total cost of constructing, maintaining, cleaning, sweeping and lighting every road, street, and alleyway in Great Britain during that period. The financing of such a programme should present no problem and could be done by way of a loan, the services for which could be provided out of a much reduced motor taxation.

Rubber After the War

THE vital part which transport must play in reconstruction, and the dependence of transport on the rubber industry are emphasised in a preliminary memorandum on the resumption of post-war trade which has been presented to the Board of Trade by the Federation of British Rubber and Allied Manufacturers' Associations.

The memorandum, which is signed by Sir Walrond Sinclair, President of the Federation, and Mr. H. L. Kenward, chairman of the Reconstruction Committee, points out that the Federation represents 24 Trade Associations, all largely dependent upon rubber as a common raw material, with 288 manufacturing firms and more than 300 factories in Great Britain. The present employment roll of about 50,000 is expected to rise to 65,000 on the resumption of normal trade.

Natural Rubber Essential

THE extent to which the rubber industry will be able to contribute to the revival of national trade is examined under seven heads. In the Federation's opinion, the availability of raw material, especially natural rubber, is a governing factor.

"Synthetic," the memorandum states, "no matter how freely available, cannot yet be regarded as a complete substitute for natural rubber in some important products. It is therefore desirable to emphasise that the entire industry can neither provide maximum employment nor recover its pre-war productivity unless and until an adequate volume of natural rubber is at its disposal."

The stabilisation of the price of rubber at a reasonable level for a specified post-war period is advocated and the importance of other industries being able to supply ancillary materials stressed. The products of the textile industry, for example, are essential to many branches of the rubber trade, including tyres, conveyor and transmission belting footwear, and sports goods.

Paragrams

Stratford St. Mary, Suffolk.

Champion's New Role

H. VANDERLOO, King's Lynn C.C., and holder of the Fenland R.R.A. 100 mile record, is now serving with the Military Police in South Africa.

Olympic Memories

FRANK SMITH, Wolverhampton Road Club, has met Binniman, the South African Olympic rider, in Capteown. . The South African recalls with great pleasure his visit to this country in 1939.

Jack Muspratt Ill

JACK MUSPRATT, notable North London veteran, now in his 8oth year, has been seriously ill.

Clubman's Return

LEONARD WEST, Gosport C.C., has been invalided from the Army on account of wounds and is riding with his old club.

Jubilee

THE National Clarion C.C. celebrates its Jubilee this year.

Cyclist V.C.

ALEC. G. HORWOOD, who was posthumously awarded the Victoria Cross for "resolute bravery and fine example of leadership" on the Arakan front, was a well-known clubman. He won the Anerley "12" a year before the war.

Veteran Passes

SECRETARY of the Fellowship of Old Time Cyclists for nine years and president of the Viking Road Club, T. G. Scarfe has died. He was 77.

Jack Lee's Achievement

JACK LEE has matriculated while a prisoner of war in Germany. He is also learning the German and Russian languages.

R.T.T.C. Paid Secretary

THE first paid secretary of the Road Time Trials Council is S. Amey, of the Dale Park C.C.

Missing

GEOFF JONES, Withington Wheelers, has been posted as missing following air operations in the Middle East.

Joint Conference

A JOINT advisory committee between the Bicycle Section of the British Cycle and Motor Cycle Manufacturers' and Traders' Union and the National Association of Cycle Traders, has been established.

New President

IVOR J. CLARK, of Harrow, has been elected president of the Rickmansworth C.C.

Darlington Rider Missing

WELL-KNOWN on road and path—he was also a trader in Skernside—J. W. Clemenston, Darlington Wednesday C.C., is reported missing in Italy.

100 *Per Cent. Membership*

PERTH, Scotland, has the distinction of being the first city to have 100 per cent. of its eligible traders as members of the National Association of Cycle Traders.

Death of F. S. Burgess

FRANK S. BURGESS, Anerley C.C., pioneer organiser of the classic Anerley 12-hour event, has died.

George Washington Killed

FOUNDER member, former chairman, time trial secretary and road and track rider, George Washington, Wembley Wheelers, was killed in action in Italy.

Wolverhampton's Loss

WOLVERHAMPTON touring and racing cyclists mourn the death of Pilot Officer V. G. Mundell, previously reported missing, who is now known to be buried in Flushing Cemetery, Holland.

Thanks a Million !

OVER one million National Savings Certificates have been purchased by employees who are members of savings groups of B.S.A. organisations.

Together in Germany

CORPORAL W. BILLINGS, Kings Lynn C.C., has met Hugh McGrath, of Liverpool, in the German prisoner-of-war camp Stalag 383.

Southgate Promotion

RON PHILPOT, Southgate C.C., is now a Captain in the Indian Army.

Novel Lecture

R. CHISHAM, Portsmouth North End C.C., a pilot in the Fleet Air Arm, was recently called upon at very short notice to give a lecture on any subject he cared to choose! He talked on his favourite topic, cycling, while the aircraft carrier was ploughing its sturdy way through heavy seas, and was bombarded with questions.

Banbury's Record

DURING its 53 years' existence the Banbury Star C.C. has only had four secretaries.

Ron Carey Honoured

SOUTHAMPTON WHEELERS have honoured Ron Carey, consistent hard worker for the Club, with life membership.

Trade Activity

THE National Association of Cycle Traders is organising a recruiting week in Scotland with public meetings in Aberdeen, Dundee, Edinburgh, and Dumfries.

Cumnock Rally News

THE 1944 Cumnock rally will be held over the week-end June 24-25. The trade has again donated a handsome prize list. John Miller, the Dagenham cycle dealer, is to act as chairman of the rally.

Uxbridge Bicycle Polo Club

ON Whit-Monday the Uxbridge Bicycle Polo Club are organising a cycling gymkhana and fête on the Uxbridge Cricket Field, Vine Street, Uxbridge. This is the opening event of the local "Holiday at Home" programme. There will be a mixed programme of cycling events, including a series of match races between teams from Uxbridge Wheelers, Yiewsley R.C., Hayes Swifts C.C., and possibly one other. There will also be a relay race on polo bikes, an old Ordinary race and one or two novelty races. So there is something for everyone to have a go at.

The usual refreshment marquees will be on the ground, also a cycle park. The show commences at 2.15 p.m., and will finish with dancing on the grass in the evening. Further particulars will be supplied on application to J. Marney, 9, Brunswick Terrace, Bassett Road, Uxbridge.

Club Notes

Record Passed

THE Scottish Amateur C.A. has passed the claim to the Scots "30" team record by Crawick Wheelers. The new time is 3 hrs. 50 mins. 56 secs.

Carr Out

JAMES CARR, Barnsley time trialist and official, has been discharged from the R.A.F. for a foot trouble.

Cumbrae Massed Start

THE West of Scotland Clarion's massed start event on the Island of Cumbrae will take place this year on June 10th. Permission has been received from the local authorities.

Joined W.A.A.F.

EILEEN KENNEDY, popular member of the Glasgow Nightingale C.C., has joined the W.A.A.F.

Stephen Home

IAN STEPHEN, Douglas C.C., who has been serving as a fighter pilot with the R.A.F. in the Mediterranean area, was home on leave recently, and helped in his club's open "25."

Prisoner of War

HARRY CLARK, former Rochdale clubman, is now known to be a prisoner of war in Germany. He was serving in the Central Mediterranean.

Back Again

ETTA BOYD, pre-war speed girl of Glasgow, is now working with the W.L.A. in the West of Scotland, and will be taking part in time trials this year, riding for the new Belle Star Road Club.

New Clarion Section

THE National Clarion C.C. has founded a new section in Edinburgh.

Club Re-formed

THE Bellingham Wheelers, a London club, has been re-formed.

Missing

PILOT OFFICER LEONARD BUCKLEY, Rochdale C.C., has been reported missing from operational duties.

The ancient Pharos, Niton, Isle of Wight. An interesting relic of bygone years. A beacon light was burnt from the tower to warn ships of the dangerous coast below.

Around the Wheelworld

By ICARUS

Quality Bicycles

WHEN the war is over we may expect many new makes of bicycles to appear —bicycles intended to put quality first and price second. Some of these machines will have new braking systems, integral dynamo lighting, built-in gears, thief-proof locks, and will be sold completely equipped with toolbags, pumps, and lamps which cannot be stolen.

During recent years some makers have manufactured bicycles down to a price, with the result that the machines frequently give trouble. There is a good market for a quality machine selling at about £15 or so, provided that it is backed by suitable agencies giving satisfactory service to their customers. There are far too many cycle dealers selling gramophones, perambulators, greengrocery and sweets who do not know the first thing about bicycles. The cycle agent should know how to measure his customer for a bicycle, and what gear to provide. So many people take up cycling and find it hard work because they are using a gear which is too high. It is in the interests of the cycle trade to encourage the right type of dealer.

Tooth Form Cycle Chain Wheels

C. A. (Bath Road) Smith writes: "Your readers may remember that for some considerable time I have been urging cycle makers to use 'Hans Renolds' tooth form. I was able to announce last December that the B.S.A. had done so, and that this company had been doing so for some time. There is no reason why all the manufacturers should not produce their own gearwheels. It can be done very cheaply nowadays; indeed, much cheaper than 45 years ago. It would put an end to this chainbreaking and noisy running, which as a rule is the result of faulty tooth form. One reads of so many cases of chainbreaking that I would urge the racing man to look at his gear now before taking part in this year's racing.

As I pointed out years ago, the B.S.I. adopted Hans Renold tooth form as the best, and advised the trade of its decision. The trade, however, ignored this advice, and so the trade, ignorant of "tooth form" went on with the wrong type of gear. John Marston was the shining light for years. His 'Sunbeams' all had correct tooth form, and a J. Marston 'Sunbeam' to-day is well worth *any* price asked. B.S.A. follows the John Marston programme with correct tooth form, and as the news circulates this firm is on a big thing. You must remember that correct 'tooth form' is the secret of an easy-running machine."

At the Roadfarers' Club Luncheon: Sir Miles Thomas, E. Coles Webb, and Sir George Beharrel

Road Accidents—March, 1944

THE increase in the volume of traffic on the roads, due to the intensification of the war effort, has been accompanied by a sharp rise in road accidents during daylight.

There were 10,309 road casualties during all hours in March, which was 542 more than in March of last year. Deaths numbered 522 compared with 529. There were 23 fewer deaths during the hours of darkness, but 16 more during daylight. The increase of 549 in the injured occurred during daylight.

Until January of this year road casualties had been diminishing steadily since August, 1941. They have continued to show a reduction at night, but this decrease is offset by the increase during other hours.

During the first three months of 1944, daylight casualties numbered 925 killed and 19,562 injured. These figures show increases over those for the first quarter of last year of 41 killed and 1,104 injured. Casualties at night numbered 702 killed and 9,919 injured—a reduction of 43 and 360 respectively.

In the same period fatalities to children, which occur mainly in daylight, totalled 305, an increase for the quarter of 22. The number of children injured increased by 226 to 4,940.

Sir Frank Newnes, Bart., proposing the toast of the Visitors and Press. Bob Carlisle (rider in the first race on pneumatics), Sydney Camm, and Sir Miles Thomas are also seen.

Training Scheme for "De-mobbed"

AFTER 25 years in the technical department at Fort Dunlop, Mr. C. D. Law, B.Sc., is now giving the whole of his time to his new post of chief staff training and appointments officer to the Dunlop Rubber Co. Training officers appointed to ten of the company's main divisions are building up a complete card-index register of their men and women in the Forces or in Government Departments with a view to their suitable reinstatement when the war ends.

N.C.U. Massed Start Organiser

A. J. SPURGIN, of the Broad Oak C.C., chairman of the Nottinghamshire Centre, N.C.U., and a member of the N.C.U. Post-war Planning Committee, has accepted the invitation of the Union's Emergency Committee to act as organiser for massed start racing on N.C.U. territory for 1944.

Mr. Spurgin's advice and assistance are available to all N.C.U. centres who know of any circuit, or who contemplate running massed start races during 1944.

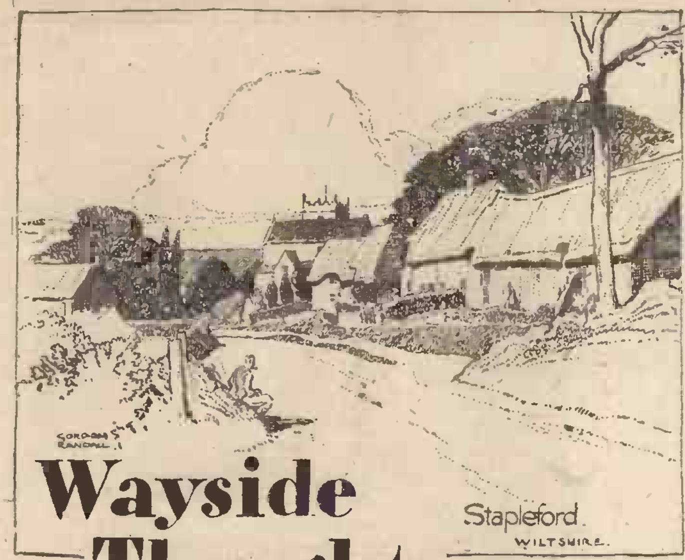
Mr. Spurgin is confident that the 800 clubs of the N.C.U. will be most anxious to assist in finding circuits, and expresses himself as glad indeed to have the opportunity of helping N.C.U. massed startists in every way possible. Clubs are therefore asked to send in their suggestions, particularly bearing in mind "Holidays at Home" programmes, etc., to N.C.U., Mr. A. J. Spurgin, Massed Start Organiser, 35, Doughty Street, London, W.C.1.

National Hill Climb Championship

THE South London District Council has accepted the invitation of the national committee to undertake the promotion of the National Hill Climb Championship, and it will be run in conjunction with the Catford C.C. Hill Climb.

Women's 25 Miles National Championship

THE North London D.C. Committee has accepted the invitation of the National Committee to promote the Women's 25 miles National Championship in 1944, and the event will be run in conjunction with the Bedfordshire Road C.C. 25 miles event on week-end No. 25.



Wayside Thoughts

by

F. J. URRY

What of the Future

WHAT is post-war cycling going to be like? I was asked that simple question some days ago by a man who is definitely interested in the commercial sense, and I presume the reason for it being shot at me is that I am a cyclist with a keenness for the pastime that has outlived all other forms of personal transport. Actually I do not know the answer, and doubt if anyone else does. Besides that, my own impressions are of necessity based on my love of the pastime, and I am conscious that the old adage of not "seeing wood for trees" may easily pertain. Of this I am fairly sure, that the folk who have become cyclists during the war have not had a proper chance to taste the genuine delights of riding that are associated with the best type of bicycle. This fact needs special stressing by all of us—and particularly the industry—immediately the opportunity arises for the return to the market of the very best in bicycle design and construction. In my opinion the trade would be serving the public and itself if it were to sponsor a volume on the sport and pastime, individually written from the experiences of a life-long rider who would be absolutely free to express his likes and dislikes, even his prejudices, in a similar manner to writers on other types of games and sport. The technical handbook is good in its degree, but it gives little encouragement to the reader to make his cycling a game and a pastime in the full meaning of those terms, and this is the idea, it seems to me, that needs far greater publicity. In other words cycling is greater than the bicycle, a fact which has not been sufficiently stressed during the last twenty or thirty years. Given this form of propaganda in a generous measure, then I think post-war cycling will enormously extend, and largely in the direction of better quality goods demanded by an older and better discerning public.

Get Out of the Rut

CYCLING had got into a rut before the war, too much of a rut concerned with its utilitarianism, and was married to output, so that the game, the pastime, was of secondary importance in the eyes of the industry. One can understand that attitude of mind among manufacturers, for the convenience of the bicycle as a travel vehicle must always be the basis of the trade, organised as it is on a mass production system. Yet I feel and believe that cycling as a pastime, as a healthy and economical means of roaming, has a very long way to go if people really know and are taught what it can do for them in the way of quiet pleasure, or vigorous sport, allied to the gift of silence and simplicity, and well within the money reach of most of us. And that brings me to another important point in answering this query. What will be our individual economic positions after the war? It is, I think, generally agreed we shall all be poorer in the sense that our money will buy less, a condition that will pertain in all walks of life. Therefore I think the question of expensive personal travel, via the motor car for instance, will automatically be curtailed however greatly desired, and to a considerable extent cycling will take its place. That change will not be undesirable from a health point of view, for we were growing soft in our reactions to travel, and missing half the fun of roaming because speed had taken the place of leisurely observation, and discounted by half the joy of travel. I speak on that question from experience, and know indubitably that, as often as not, it was mere ostentation and cultural idleness that made the motor car so popular, and the folk who used it so apt to look askance on cyclists. Well, that bubble is blown, for we are all cyclists to-day, and some of us must remain so by the pressure of economic conditions; and some because they have discovered a worth while thing.

The Political Aspect

IN the post-war world the position of the cyclist on the road is likely to provoke much argument, and it depends on the actions that follow whether cycling will retain its freedom of road travel as now enjoyed, or lose that right won as long ago as 1888. It is no secret among organised cyclists that the powerful interests connected with road transport would like to see us excluded from certain sections of the public highway, and the M.O.W.T. has already said it will finally exclude us from roads wherever cycle paths can be built, and the moment of such exclusion will be when the Ministry deems the mileage of cycle paths laid down is sufficient to justify that action. There is the threat backed by powerful interests concerned with using the public roads, for which you and I help to pay, for purely commerical purposes, and bent on excluding *all* folk who have the temerity to oppose their desires. If cyclists stand for this, then they will sell their freedom for a mess of cycle paths, for I believe the exclusion from the use of the public roads of any type of traveller will not end there. We shall become the pariahs of the road if the rights we won in 1888 are invaded. Yet all cyclists are not of this opinion, and many seem to believe by some means or other a solution of the road problem to meet all desires will be found. Organised cyclists have no doubt on the question: once the invasion of their road rights has started, it will go on, slowly but surely, until we are merely tolerated as a regimented section—and an unwelcome one—of the traffic stream. Now this is all wrong if democracy—of which our political leaders talk so glibly—is to rule in the new world. The roads of Britain are *public* property, paid for and maintained by the rates and taxes of which we as cyclists pay our full share. As an individual I love to think I own a personal interest in the road, and should hate to feel I was excluded from any portion of it, while still being made to pay my share for its upkeep. I believe if exclusion of any kind is meted out to cyclists, then cycling will suffer a blow lowering to its status to such extent that it will become the Cinderella of travel vehicles, to be degraded as the powerful mechanical interests see fit. This road question as it may affect cyclists in the not distant future is of the utmost political importance in answering the question posed by my trade friend. He and his like have one great asset to defend, the freedom of the road for cyclists, which cyclists won for themselves and the industry years ago, and the importance of which is surely more manifest to-day than ever. Resolve this question for me, and I think the future of cycling is specially bright. But if you think we shall somehow "muddle through" under the mercy of the big transport interests, you will, I am sure, experience a shock that will hurt every cycling interest.

Our Handicap

AS cyclists our difficulty is to convince the ordinary man, using his machine for sheer convenience, that the present freedom to do so is in peril. That man does not care a brass farthing for road rights; he doesn't even know how they were fought for and obtained; but I imagine he would be the first to complain if he found his regular work passage denied to him and was made to take another route. And such complaint would be laid at the door of the organised bodies of cyclists for ever allowing such a thing to happen. But this type of unattached rider point blank refuses to join any association for the purpose of preserving the road rights he has inherited from the early days, yet expects the comparatively meagre numbers of organised cyclists to fight his battle of rights with the enormous forces of commercial interests arrayed against them. Well, we shall do our best in the firm belief that we are striving to shield democracy from the aggression of the hauliers who want a cheap track along which to pursue their trade, and incidentally impoverish the railways. The real solution still rests on the building of motor roads, and that must be the final answer to the problem. Anything less will be mere tinkering with the problem, a fact which was apparent to our fathers when the railways came into being, but one that has become curiously befogged in the minds of the present generation, probably because the motor vehicle developed from an innocuous carriage little faster than the bicycle, to the present type of lorry and bus doing fifty miles an hour every day of the year over roads unsuitable to accommodate such heavy-vehicle speeds with safety. In my opinion that is the only possible solution to the impasse at which the road problem has arrived. It means great expenditure and a long distant view and finance; but it also means work, and a far greater degree of road safety.

The Centenary Club

THAT rather exclusive organisation of the Trade Executives went out club-running on St. George's Day, April 23rd, five and twenty of them, and a jolly crowd of grizzled youths they made. The idea was to keep the organisation not only alive, but lively, to see England in its spring-time loveliness, to dine and talk of the days when peace returns, and what they will do for cyclists—and themselves—and to hold the annual general meeting, the fiftieth birthday.

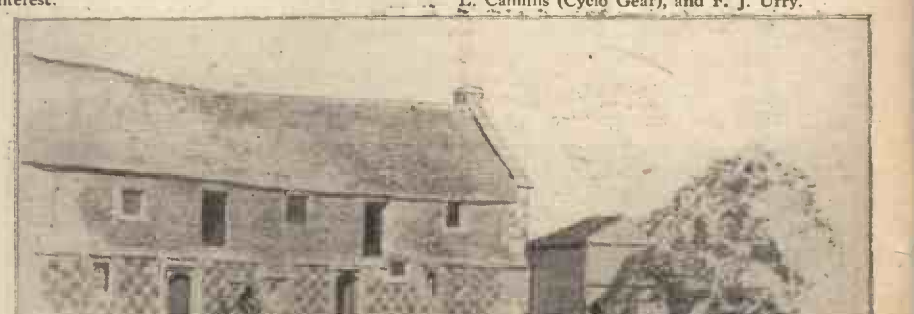
All these things they did, and thoroughly enjoyed the activity, for the luck was with them in the way of provender, and if desirable liquid was a trifle scarce, the glory of the day made up for it.

The only contentious item was the phrasing of a rule regarding the conditions of membership, and on this question they spent a lot of time and much talk before passing it to their committee for further consideration and report.

All the officials were re-elected, and despite his protest that the post of president should go round, the meeting insisted that F. J. Urry must remain.

A very cosy wind-borne run home ended a most enjoyable outing, until the time comes—and the accommodation—for week-end jaunting.

Among those present were: Major F. W. Smith (Enfield, and vice-president), H. R. Horden (Brooks' and hon. sec.), F. Parkes (Sun, hon. treasurer), W. A. Church (Phillips), Sir Edmund F. Crane (Hercules), W. Williams (Edward Williams), L. Williams (Armstrong), W. Tovey (Monitor Brake), T. F. Blomfield and W. H. Newman (Blomfields, Ltd.), W. Tildlesley (Tildlesley), W. R. Pashley (Pashleys, Ltd.), Lawson Clarke (Bolton and Brown), H. N. Bresley (B.S.A.), H. Gibbs (New Hudson), A. Caperner (Sun), A. Weston (Man-Power Board), L. Camillis (Cyclo Gear), and F. J. Urry.



The Mill, West Harnham, Wiltshire. Many centuries old, this fine building may originally have served as a rest house for Salisbury Cathedral, which stands eastwards across the meadows.

CYCLORAMA

By
H. W. ELEY

The Stepping Stones, Dovedale.

Digging for Victory!

AS I write, I can see across to some allotments, and there is a great scene of activity; digging, planting of seeds, burning of rubbish, consultations between "beginners" and "old hands"—I see them indicating distances between rows and obviously arguing as to the best spot to plant this and that. And what a goodly sight it all makes! Let us hope that this boom in allotments will not, as after the last Great War, fade away when the stern necessity to grow more food disappears. I fear that there will be a tendency for the same melancholy slipping back to waste . . . but I hope that the Ministry of Agriculture and the Ministry of Food will see to it that the enthusiasm is maintained, for it is one of the good things which cometh out of evil . . . this intensive cultivation of our own land, this growing of vegetables, with its healthy atmosphere, its friendly competitive spirit, and its aid to our cause. And let those of us who do not dig and sow not laugh at the disciple of Mr. Middleton who brags of his marrows and his peas and his record radishes; he is in the front line, and well deserves every first prize he secures at the local horticultural show.

A Sprig o' Shamrock!

SAINT PATRICK'S DAY has come and gone, and for once I did not receive a sprig of shamrock; usually, old friends in County Wicklow provide me with the necessary "bit of green"—but then, things are difficult just now, so I just thought about the little green plant which will grow nowhere else but in Erin, and wondered whether the Irish Guards received their quota, and had it distributed with the old-time ceremonial.

Tyre Economy

THE efforts of the Ministry of Supply, through Tyre Control, are most praiseworthy. The Ministry does not intend to let users of tyres think that we are "out of the wood" . . . and truly we are not. Recently I had the privilege of "seeing off" a wonderful "Tyre Economy Railway Coach"—fitted out as a travelling exhibition, to show folks that tyre abuse is a crime; to stress the importance of tyre care and economy. A good move . . . and I was struck by the roominess of the coach and the artistry of the exhibits and their setting. Yes . . . we shall "roll to victory on rubber" IF we are careful!

A Dunlop Veteran

HAD an interesting chat the other day with that grand veteran cyclist, "Bob" Carlisle . . . one of the stalwarts of Dunlop. "Bob" is going strong, and told me that he is looking forward to the next meeting of the Roadfarers' Club, of which organisation he is an enthusiastic member. Many are the stories which "Bob" could tell of the early days of the pneumatic tyre, of the time when the redoubtable du Cros brothers (six of them) swept the board in all the races, and did so much to popularise cycling. "Bob," of course, rode in the immortal race at Queen's College, Belfast, in 1889, when the pneumatic showed its superiority over the solid, and really started the bicycle boom. Long may "Bob" continue to adorn Fort Dunlop, and tell the youngsters of the pioneer days!

The Cuckoo

THERE are legends about many British birds, but I doubt whether any bird which visits us is more discussed, or has been the subject of so much speculation, as our friend the cuckoo. During April the cuckoo's monotonous note is heard from the trees. He is a mysterious fellow, this largish brown bird with the strange habits and curious note—everyone knows that the female cuckoo lays her eggs in other birds' nests, and that the young cuckoos, when hatched, have murderous tendencies, and throw out the youngsters of the foster-mother. But I think that everyone who loves the countryside loves to hear that first call of the cuckoo—it seems to indicate that spring is really with us, and that we may look forward to a chorus of song from hedges and trees, and once again see the fields dotted with flowers. To show how cuckoos, right through the years, have been observed and pondered upon, one has only to recall that as long ago as the thirteenth century a monk of Reading Abbey composed a song about the bird:

"Sumer is icumen in
Lhude sing Cuccu;
Groweth sed and bloweth med
And springeth the wode nu;
Sing Cuccu."

You see—our brown friend has always been "in the news," and you may be sure that in this very year of grace we shall have some nature-lover writing to the Press to record his first hearing of the monotonous note in some lane or field!

Light Evenings

THE light evenings are a joy, and there is time, after a day's work, to slip out on the bike to the nearby village and enjoy the quietude and beauty of English lanes, and to sit for a little while under the old oak tree opposite the inn. Ducks glide gracefully across the pond; sleek cows amble over the meadow, and the starlings make a great chattering on the roof of the old barn. Time for a smoke, a clearing away of the frets and fumes of the city . . . and a ride home before blackout time. Good days—and there are better to come!

Memories of Easter

AS I write, Easter has come and gone, and I have memories of good Easter tours in the old days! Memorable, magical rides to the coast; rides into the very heart of the enchanting Cotswolds—once, I recall, I took train to Cheltenham, and from there made my leisurely way into the Cotswold country of old manor houses and grey cottages and ancient churches. I know of no part of England to surpass Cotswold land, and I wish that I had been able to spend my 1944 Easter amid its many delights and myriad charms. But maybe next year. . . .

Spring Glory

MANY cyclists are, of course, "nature lovers" in a broad sense, but some (and I fancy a goodly company) are really naturalists, and it is always good to meet such—especially at this season of the year, when so much is "doing" among the furry creatures, and the feathered creatures, of our countryside. The naturalist finds something of interest all the year round, but there is something quite thrilling about spring, with its first flowers, and its call to the birds to build. Many are building now, and I know, from all the bustling activity of the last couple of weeks, that later on there will be many broods of blackbirds and thrushes hatched out in the bushes of my garden, and in that straggling hedge which borders the orchard. It is in the latter domain where Master Chaffinch usually builds . . . and it is from an apple tree bough that, a little later on, he will sing so sweetly in the early evening.

In the woods the anemones are out, and I know that in May, in that particular secluded part under the silver birches, there will be great carpets of bluebells; and I only hope that no vandals from the town will come and pull them up by the roots! In my own favourite wood, where in high summer I hear the screech of many jays, and occasionally see an English red squirrel, I have just seen a hedgehog, and I wondered if he were the selfsame fellow I saw last November, making such careful preparations for his winter sleep.

St Mary the Virgin. Adderbury (Oxon)
"For Strength"

My Point of View

BY "WAYFARER"

A Fine Thing—Chance

DESIRING, for obvious reasons, to postpone the evil day when it will be necessary for me to resort to war-grade tyres, I have been keeping my eyes skinned for any stray opportunity which might arise to pick up pre-war (or early-war) tyres of the breed I specially favour. A bagman friend secured for me a pair of "Sprites," which I accepted gleefully at normal price, plus tax. Then a young cycling comrade found me another pair at a country shop, and bought them on the same terms, in the hope that I still wanted them. Which I did! Later, a chance meeting with another friend produced a third pair, this time untaxed, and almost at the same moment I was supplied with a pair of "Sports" tyres, also untaxed. I am feeling somewhat better now, though I am still in the market for "Sprites" or "Sports," and I realise that chance is a fine thing. A few days ago I met an Ancient Gossip along the road, and he calmly told me that he had just bought four pairs of "Sprites." I was not a bit surprised when he refused to answer my perfectly simple question: "Where?"

Fanciful

HEARING, as one does from time to time, of the electrically-heated garments worn by our gallant airmen, prompts the rather fanciful question as to the possibility of applying the principle to cyclists' clothing, for the worst excesses of the winter months. Personally, I do not feel the cold unduly, but a spot of heat would be very acceptable in the shoes and the gloves, my feet and hands being the only portions of my anatomy to "catch it". However, there must be many cyclists—actual and potential—who would appreciate being able to keep warm on a bleak winter day. How nice it would be to depress a switch and then let Rude Boreas and Jack Frost do their damndest! For the time being, the idea may not be "practical politics," but it seems worthy of consideration for the benefit of those folks who really do feel the cold.

Since the foregoing paragraph was written, I observed in my newspaper the advertisement of a firm of manufacturers who specialise in clothing for flying-men. It looks therefrom as though the question of warmed clothing for sportsmen was not as fanciful as appeared at first glance.

Those "Holidays at Home"

I WAS recently invited to attend a meeting of the people residing in the Elegant Suburb I grace with my presence. The meeting was of those interested in providing entertainment for others (nominally) in view of the circumstance that (as the Chairman announced), "nobody would be taking any holidays this year"—a foolish assertion to which I registered my strong and instant objection. I made it clear that, if umpteen Second Fronts were opened, I would still take my holidays—and go away, withal.

My special function was to provide cycling itineraries for day runs applying to a particular fortnight in August. This appeared to be a job quite within my capacity, and I gave the matter some thought in the few days available before the meeting, finally arriving at the conclusion that there was "nothing doing." My Elegant Suburb does not contain a large selection of potential cyclists, though there are many people with bicycles. I could not conceive that the latter would be very greatly interested in undertaking day rides. I instanced two outlets from the city, one of which meant an hour's ride through suburbia before something that looked like the country was reached, while the other (the more direct of the two) possessed its quota of formidable hills.

What I wanted to know—and thus I spoke at the meeting—was whether the shopping cyclist, who would form the majority of my "clients," would be interested in itineraries necessarily prefaced by the conditions cited. What would be their physical and mental outlook after 10 miles of cycling (and walking) through bricks and mortar, and a like number of miles of walking (and cycling) on the alternative route, which also comprehended much suburbia? With a total of 20 miles achieved, or to be achieved, through this suburban zone, what distance could be safely arranged in the real country? Was the whole thing practicable, and, if so, how many people were likely to attend—and to what extent would the supporters be influenced by the weather?

I spoke as a realist, anxious to help any who desired these runs. But were there any such? I wished there were: I thought there weren't . . . in that Elegant Suburb. I added that I was open to conviction, but nobody tried to convince me. And so the scheme collapsed, and the meeting turned its attention to the question of arranging dances and concerts, which it was clear would be well supported—not of necessity by the people for whom, nominally, they were arranged, but by the actual arrangers! I came away from the meeting conscious of an evening wasted—satisfied that the cyclists who want day rides will either arrange their own or fit in with those held by the cycling organisations. In any event, "holidays at home" is not a matter concerning cyclists from the patriotic standpoint, for we are independent of public transport, and can do all our travelling without cluttering-up trains and things. And, whether we spend our holidays at home or abroad (meaning by "abroad," North Wales, or Devon, or the Lake District, etc.), nobody can point an accusing finger at us. On the other hand, it is obvious that we are doing the right thing—seeking recreation for the tasks which have to be faced, and in no way hampering the war effort.

The Dog Problem

AS I cycled home from business this evening I observed a small dog suddenly dash across the road. A motorist who was approaching at a reasonable speed "stood on everything" and came to a standstill without touching the canine, but, judging by the squealing of his tyres, the sudden pull-up was not in the least good for their health—and we are told, and told over again to conserve our tyres. This incident leads me to say that the time is surely coming when we cyclists, either alone or in combination with our motoring friends, will have to take steps to minimise the dog nuisance—in built-up areas, at the very least. There is no room now—and there is likely to be far less room in the conditions which will prevail after the war—for dogs to use the public roads as playgrounds and assembly points. This is a question of being kind, rather than unkind, to our canine friends, and I write as a lover of dogs—though I do not make a fool of myself over them. I retain a sense of proportion, and am of the opinion that the well-being of men, women, and children transcends in importance the happiness of dogs. Every cyclist of experience has had his "argument" with a dog: every cyclist has had his narrow escapes. The point is that we can no longer tolerate a condition of affairs which jeopardises the life and limb of folks using the public roads on their lawful occasions, and the time is surely not far distant when, in the interests of humanity (as well as of the canine race), dogs will have to suffer from some form of control—at least (as I say) in built-up areas.

Notes of a Highwayman

By LEONARD ELLIS

A "Beggarly" Village

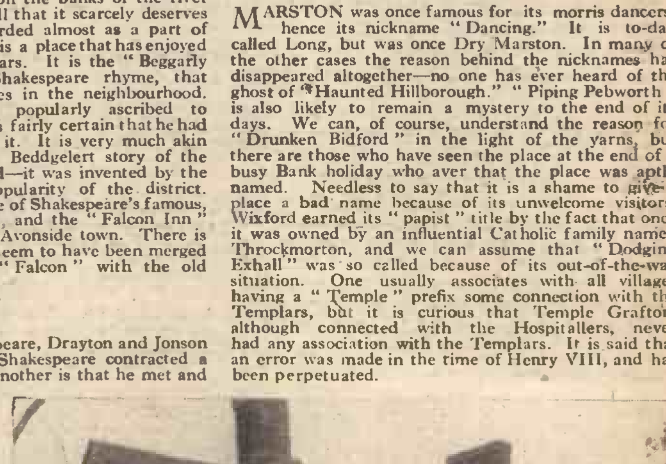
THE tiny little Warwickshire hamlet of Broom is so insignificant that most guide books ignore it altogether, and those that can spare the space merely mention that it is a hamlet on the banks of the river Arrow. It is, in fact, so small that it scarcely deserves a mention; it may be regarded almost as a part of Bidford. In spite of this, it is a place that has enjoyed a reputation for over 200 years. It is the "Beggarly Broom" of the famous Shakespeare rhyme, that mentions eight of the villages in the neighbourhood. Of course, the rhyme is popularly ascribed to Shakespeare himself, and it is fairly certain that he had nothing whatever to do with it. It is very much akin to the famous and touching Beddgelert story of the Prince and the famous hound—it was invented by the locals to keep alive the popularity of the district. Bidford is, of course, the scene of Shakespeare's famous, if doubtful, drinking exploits, and the "Falcon Inn" can still be seen in the little Avonside town. There is more than one story, but all seem to have been merged into the one connecting the "Falcon" with the old crab-apple tree.

Conflicting Legends

ONE story said that Shakespeare, Drayton and Jonson drank so heavily that Shakespeare contracted a fever from which he died. Another is that he met and engaged some local topers in a tremendous drinking bout, and then slept off the effects under the old tree. The tree, incidentally, can still be seen in the village, but we must use our discretion in believing that it is the same tree. The whole district is redolent with memories of the great English poet, so that there can be no doubt that there is a great deal of truth in the main story, if only we could strip it of the manufactured trimmings. At least a dozen villages hereabouts have some connection with him, and in some cases we find two or more places claiming to be the scene of his birth, his wedding or his death. Apart from Broom, the other seven villages of the rhyme are Exhall, Pebworth, Marston, Hillborough, Bidford, Wixford and Grafton. Pebworth and Marston are in Gloucester and the others in Warwick. Apart from Bidford, which now caters for holiday crowds on the river, the seven villages are still worthy of attention, as all are unspoilt and attractive, possessing many quaint old thatched, half-timbered cottages.

The Shakespeare Villages

MARSTON was once famous for its morris dancers, hence its nickname "Dancing." It is to-day called Long, but was once Dry Marston. In many of the other cases the reason behind the nicknames has disappeared altogether—no one has ever heard of the ghost of "Haunted Hillborough." "Piping Pebworth" is also likely to remain a mystery to the end of its days. We can, of course, understand the reason for "Drunken Bidford" in the light of the yarns, but there are those who have seen the place at the end of a busy Bank holiday who aver that the place was aptly named. Needless to say that it is a shame to give a place a bad name because of its unwelcome visitors. Wixford earned its "papist" title by the fact that once it was owned by an influential Catholic family named Throckmorton, and we can assume that "Dodging Exhall" was so called because of its out-of-the-way situation. One usually associates with all villages having a "Temple" prefix some connection with the Templars, but it is curious that Temple Grafton, although connected with the Hospitallers, never had any association with the Templars. It is said that an error was made in the time of Henry VIII, and has been perpetuated.



"Beggarly" Broom, Warwickshire.

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