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HISTORY OF ROCKET PROPULSION

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XI. JULY, 1944 No. 130

FAIR COMMENT — BY THE EDITOR

The Future of Aviation

SOME most important views were expressed by Lord Brabazon of Tara (president) and Sir Frederick Handley Page (member) at a recent meeting of the Roadfarers' Club. Lord Brabazon, in introducing Sir Frederick, said that we beat the Luftwaffe because of the unequalled quality of the machines used by our Air Force. Now we are concentrating on quantity, and to-day we have reached the state in which the Allies are making about seven aircraft to one produced by Germany.

In commercial aircraft quality is not the thing which is required. Commercial aviation, said Lord Brabazon, will be what is known in America as customs built, and when you get the customs built machine, we in this country can hold our own as to price and in the excellence of design with anyone in the world. "I have been head of a committee whose function has been to formulate users' requirements for post-war civil aviation. My committee is not responsible for what type of machine emerges; that is for the manufacturer. In the House of Lords the other day Lord Beaverbrook said that, due to the delay in getting on with these machines, America would be willing to sell us machines for commercial flying.

"I view that statement as very disturbing, because it looks as though much of the very hard work which my distinguished committee has been doing might be of no avail if we are going to use foreign aircraft. I quite follow the difficulties of the Air Staff when they consider the proposition of transport machines. I quite see their point when they lay down that no man is to be spared from making war machines for making transport machines. But I cannot help drawing attention to the fact that America is just as much in the war as we are. She has put her problems to the Air Staff, and she gets a very different answer. Her Air Staff says that transport machines are a very definite part of air warfare. On the technical side I think we are superior to America. What we cannot do is to give her three years start, which is what is happening to-day; that is handicapping ourselves too much.

"We hope that through wise and capable management there will not arise from commercial aviation causes of dispute and bickerings between nations. It will want a good deal of steering and wisdom in high places, but I sincerely hope that flight will really be a blessing to the world."

Sir Frederick Handley Page said that "air transport was coming to the world at a time when all the other methods of transport had been developed. Fundamentally I am against having planned civil aviation, planned by Governments, subsidised by Governments, and used eventually as a method or means of State policy. It eventually leads to the fact that you must operate through some chosen instrument. When one chooses an instrument the Government generally take a Calvinistic view in that they take as their text, 'many are called but few are chosen.' In consequence one or two companies form the elect and the élite and the others are left out in the cold. When we embark on a new enterprise, when one has to have new ideas, new thoughts, and a great deal of energy, Government-sponsored things in which everything is right from top to bottom, they are generally enterprises whose characteristic is that in no circumstances will anybody be called to account for making a mistake.

"In the problem of commercial aviation there are difficulties. We have to make certain that it is safe for everybody to fly where they wish to fly. In this country we have moved in the right direction, in that there has been set up an Air Registration Board to whom has been delegated all those functions in the air which on the sea have been dealt with by Lloyd's Register.

"On one side there is the view that there should be flying for everybody; that anyone who can put up a reasonable proposition backed by sufficient capital should fly where and when he likes. Another view is that we should only have a certain monopoly company flying these routes, and that there should be agreements between Governments, and that the Governments in each case should operate the air line.

"The money involved in setting up an air line is so great that people are not going into a business to throw away their money merely for the pleasure of running an air line. On the other hand, if air lines are going to be operated by the Government, immediately you introduce the question of subsidy and State policy. A country must have the whole of the State prestige behind its air lines, and it must provide a faster service than any other country.

"Many people think that aircraft of the post-war period are going to be of enormous size. That is nonsense. Time is the fourth dimension in regard to aircraft. The aeroplane flies so fast that it can carry an enormous number of passengers in a given time as compared with other forms of transport. If we are going to get civil aviation developed on a big enough scale, we have to get a far larger public and have people travel at far less fares than they are doing at the present time. Commercial aircraft will probably not be much larger than bombers.

"Another means of transport that will come into view is the helicopter, although it is admitted at the present time that the time you lose in getting from the aerodrome to your destination adds a great deal to the time length of your journey.

"I do not believe in the future of the helicopter. The future in our air lines is in long-distance transport rather than in short-distance transport. The problem which faces the aircraft manufacturer is the question of what happens at the end of this war boom. At the end we shall have a big stock of aeroplanes which can be transformed to carry passengers. How are we going to deal with the post-war problem of the skilled people and staffs in aviation whose services may no longer be required? These must not be allowed to drift out and to take their skill into other industries. We shall not be spending £16,000,000 a day when peace returns."

Petrol-driven Aircraft and Sailplanes

THE Air Ministry has lifted the ban on the flying of petrol-driven model aircraft. The following regulations obtained: The flying of petrol models shall apply only to members of the Society of Model Aeronautical Engineers; the span of models shall be limited to 10ft.; the engine run not to exceed 45 sec.; model when airborne not to exceed 2 min.; all timing devices to be approved by the S.M.A.E. Council; no petrol-driven model to be flown within two miles of any aerodrome; models to fly in circles; petrol models must not be flown between the hours of sunset and sunrise.

Rules governing petrol-driven models as approved by the Council of the S.M.A.E. stipulate that they must approve of the fitness of any flying ground. Applications in this connection should be made to Mr. H. J. Towner, "Trecrom," King's Drive, Eastbourne.

The Air Ministry offers no objection to the flying of sailplanes provided the wing span does not exceed 10ft.

Indexes

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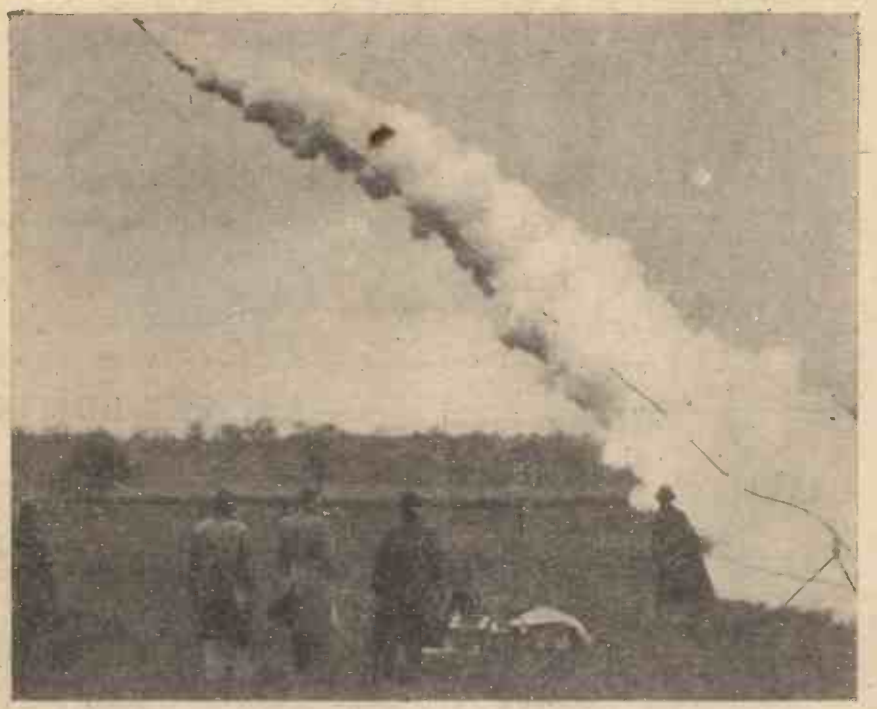
Rocket Propulsion

Its History and Development

By K. W. GATLAND



Schermuly multiple rocket electrically fired. Range 350yds. with 1in. circ. line.

Introduction

BEFORE commencing upon the survey of rocket development, it is desirable, on the outset, to define the two *reaction* systems — "*true-rocket*" and "*thermal-jet.*" The former, "true-rocket," is the simplest type of thermodynamic engine comprising a pressure-tight chamber, with an escape orifice, containing, or fed with a fuel with oxygen bearing content either as an integral part or as a separate component. There are two distinctive types of rocket motor. The earliest and most familiar is the powder fuel rocket, where the combustion chamber serves also as the fuel store. Examples of this type are the display ("fire-work") rocket; the rocket life-line, and the A.A. Battery rocket projectile. There are, however, obvious limitations governing the use of this rocket system—namely, the constantly changing chamber volume, and the limited period of reactive effort. The other rocket motor embodies a combustion chamber distinctly remote from the fuel, this being contained separately and supplied at a controllable rate, thus ensuring *constant* chamber volume, and a period of firing far exceeding that of the former. This motor form generally employs a liquid fuel, with oxygen (liquid) as the "supporting" element for combustion, but the "cartridge" fuel injector and certain variants of this system employing solid or paste fuel components come under the same category. In the other reaction system, the thermodynamic engine employs a solid or liquid fuel, burnt in a medium of highly compressed air *inducted from the atmosphere.* This is the "thermal-jet" reaction means, with which we are not concerned in this history.

The principle of *reaction* is common to both "true-rocket," and "thermal-jet" systems, tractive motion being effected by virtue of the reaction of the exhaust efflux on the producing plant, in accordance with Newton's Third Law of Motion.

It is obvious from the foregoing that, whereas the "thermal-jet" propulsion plant is limited for operation to the bounds of atmosphere (due to the need for inducting air to support combustion), the "true-rocket" motor is capable of penetrating the atmosphere, to operate in space itself. Indeed, once free of atmosphere, the rocket would operate at highest efficiency since the atmosphere has a "damping" effect acting to reduce the velocity of the exhaust gases. It is the mass velocity of the exhaust efflux that determines the reactive effort.

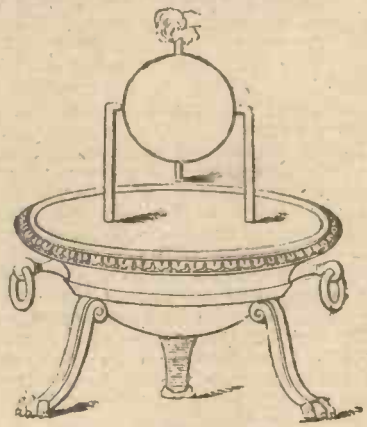


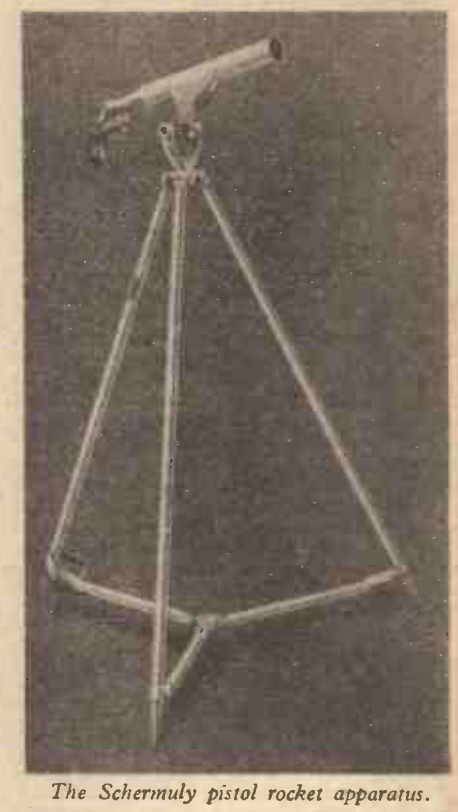
Fig. 1.—Hero's "æolipile."

It is of interest to note that the reaction principle was actually first demonstrated at the beginning of the Christian era by the Alexandrian philosopher, Hero. The apparatus employed, known as the *æolipile* (Fig. 1) consisted of a hollow sphere, into which were fitted two right-angle tubes on opposite sides. This was centrally mounted and free to revolve on two supports, one of which was hollow, to permit steam, generated in a "boiler" positioned below and supported over a fire, to flow into the sphere and out at high pressure through the escape tubes, thereby setting up a reactive force to rotate the vessel.

Finally, as a caution, it is desirable to point out that rocket experiments in time of war are an offence against the Defence Regulations. Formula relating to fuel compositions contained in this article series are included solely to illustrate the trend of development.

The Beginning

It is known that the origin of pyrotechnic compounds dates back to well before the B.C. era. A feasible theory of the evolution of combustible mixtures is held to be in the use of saltpetre (found in abundant natural supply in China and India), for which certain primitive Eastern tribes probably first found a use in the curing of meat. It is likely that the first discovery of the substance as a combustible was during the process of cooking, a small amount perhaps being accidentally dropped on the fire and, as the result, a sudden observed conflagration. The next step would appear obvious in the adoption of the newly found substance for fire-making, and wood being the first known combustible, the natural inclination would therefore be to combine the two. However, man at that period possessed no means whereby wood could be reduced to a workable medium, at least in any quantity, to obtain a comparatively uniform mixture, but



The Schermuly pistol rocket apparatus.

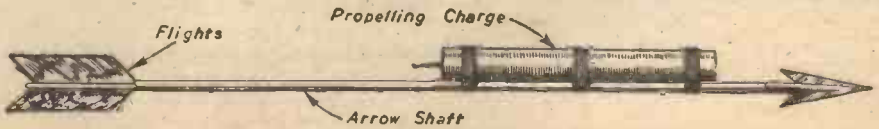


Fig. 2.—Chinese "rocket" arrow (A.D. 1220).

some further consideration, no doubt, would suggest the utility of partially burnt wood, and ultimately, in later development, charcoal.

Whether or not sulphur, or brimstone, was later incorporated in the mixture is uncertain, but it is established that a composition known as "Chinese Fire" (which contained the two base substances previously mentioned) was employed in the East long before the Christian era. An allied compound developed in Greece at about the same time was "naphtha," probably a composition of brimstone, pitch, resins, fats, and possibly crude saltpetre.

It is likely that these substances were first used in war as an incendiary weapon—being contained in clay balls, or small bamboo tubes, ignited and flung at the enemy. It might well have been in this way that a primitive "grenade" developed, as the result of explosions caused by confinement of the burning mixture. However, in all probability, the early "gunpowder" substances were not recognised as propellant medium until after the birth of Christ. It is conceivable that the first indication of propulsive effect came as the result of filling incendiary compound into bamboo rods, which ignited and used against the enemy as "javelins," or "arrows" (fired from the bow) might well have been observed to propel themselves, due to the reactive effect of the burning mixture. Thus it is probable that, in further course of time, the "fire-arrows," as the incendiary rods were later termed, developed into the "rocket-arrows" (Fig. 2), to which reference is made in a Chinese document of the year 1220 A.D., describing their use against the Mongols during the battle of Pieping.

Roger Bacon

Roger Bacon, an English monk, in the year 1242, first made known the composition of true gunpowder: Saltpetre 41.2; charcoal 29.4; and sulphur 29.4. It should not be considered, however, that the ingredient proportions then given have remained unchanged until the present day. The modern gunpowder affords an interesting comparison in this respect, approximating to: Saltpetre 75.0; charcoal 15.0; and sulphur 10.0. As previously mentioned, compounds of similar character to gunpowder had been employed in the East from almost the dawn of recorded history, and in consequence, Bacon cannot be credited as the discoverer of gunpowder. However, he undoubtedly played a considerable part in its development, and greatly enhanced its power by careful attention to the ingredient proportions of the composition and also by the purification of saltpetre.

Further Developments

Credit for further early development is due to a certain German engineer, K. Kyeser von Eichstaedt, who concluded with success many rocket experiments, using varying proportionate gunpowder mixtures, in the year 1405. Some fifteen years later, an Italian, Joanes de Fontana, is held to have conducted similar tests, and is even reputed to have designed a rocket chariot.

In the middle 1400's, the rocket was employed somewhat extensively as a weapon of war, being used against the English in the defence of Orleans in 1429; during the siege of Pont-Andemer in 1499; against Bordeaux in 1452, and Gand in the year following. A technical paper, entitled "Treatise upon several kinds of War-Fireworks," published in France in the year 1561, describes the use of rockets in the previously mentioned campaigns, and suggests a rocket case of varnished leather, as an alternative to the paper and bamboo cases used up to that time. Towards the close of the century, the rocket projectile was employed against cavalry, and also for sky illumination purposes. A document by Hanselet, written in 1630, contains references to rockets bearing a form of grenade, apparently intended to produce a similar effect as the modern light shrapnel shell.

Operating No. 2 rocket hand-fired pistol. Range 250 yds.

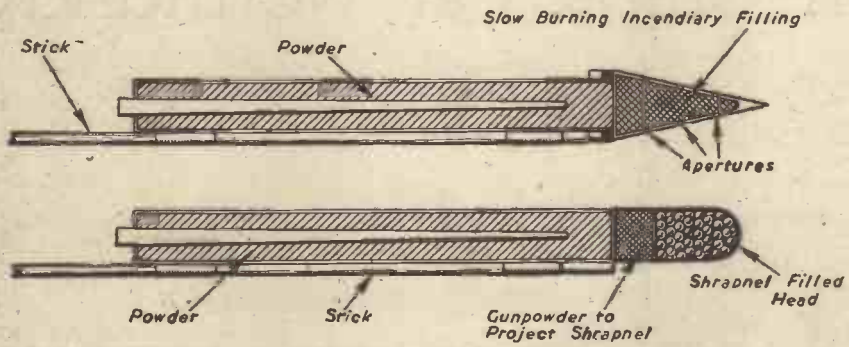


Fig. 3 (Above).—Congreve rocket (early 1800) and (below) a shrapnel anti-troops rocket.

Historical references exist which indicate a large scale use of rocket projectiles against Philippsburg in 1645, during the Thirty Years War, and accounts suggest that they played a substantial part in bringing about the eventual downfall of the city.

A treatise, published in 1650, "Great Art of Artillery," by C. Siemienowitz (Poland), contains a reference to a work of some 90 years earlier on the use of "fireworks" for military purposes, which is said to have given details of rockets up to 100lb., describing their construction.

Experiments carried out in Berlin in 1688 record rocket projectiles of gunpowder composition: Nine parts potassium nitrate (saltpetre); four parts sulphur; and three parts charcoal. The cases were of wood, linen covered for strength, the finished rockets being of 50lb. and 120lb. capable of carrying explosive charges of some 16lb.

It is significant to note, in passing, that as early as 1710, the use of rockets for "firing to the moon," was suggested by a Frenchman, Cyrano de Bergerac.

In the book "Asiatic Researches" (Vol. 3), published in the late 1700's there is given an account of the battle of Paniput (India),

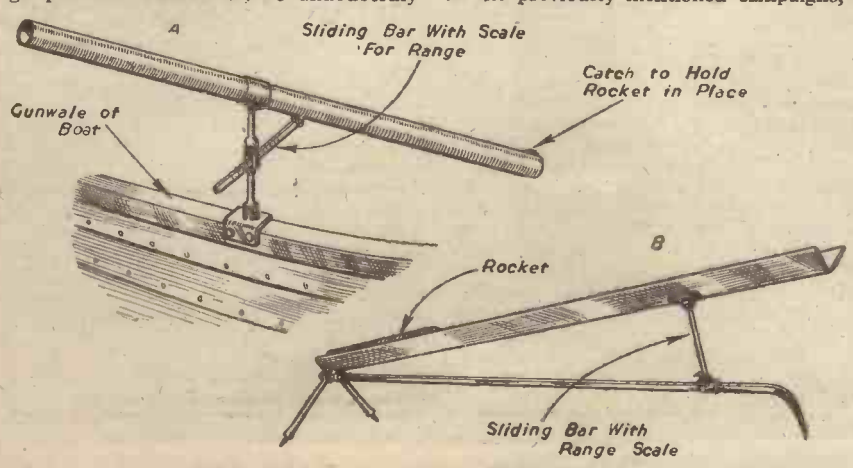


Fig. 4.—A rocket launching tube for use on boats, and (below) a launching trough for land use.

in 1761, in which the following paragraph is included: "As the Rohillas had a great number of rockets, they fired vollies of two thousand at a time, which not only terrified the horses by their dreadful noise, but did so much execution also, that the enemy (the mahrattas) could not advance to the charge."

According to accounts of the India campaigns, rockets were also used extensively against the British cavalry, towards the close of the eighteenth century. It is reported that the rockets employed were iron-cased, 8in. long and 1½in. in diameter, with a spiked nose, and balanced by a bamboo, or iron rod "stick" approximately 8ft. in length. The projectiles were hand thrown by specially trained "rocketeer" troops. Such was the effect of the Indian rocket weapon that militarists returning to England suggested the development of rocket artillery for the British Army.

English War-rockets

Experiments were commenced at the Royal Laboratory, Woolwich, in the early 1800's, by General Desaguliers. It was about the same time that Col. William Congreve, an artillery authority of some standing, first became interested in rocket artillery, and commenced a private investigation of composition proportions, and case efficiencies. As the result of subsequent experiments, Congreve obtained permission to use the laboratory at Woolwich, and there constructed several military rocket projectiles which when tested proved highly satisfactory, and realised practical application, with varying success during the European wars of the early nineteenth century. During the Napoleonic Wars, incendiary rockets, designed by Congreve, played a conspicuous part in the fall of Boulogne, in 1806, and also in the devastation of a portion of the French fleet, the projectiles being fired in salvoes from twenty-four specially constructed "projector" boats, which were conveyed to the scene of engagement by parent vessels. The rockets used, intended primarily for marine warfare, contained a liquid incendiary substance within a sharp-pointed nose, which on impact squeezed out a light through a number of radial holes drilled in the rocket head, liberally coating the target with fire. The pointed nose enabled the projectiles to stick to whatever they hit, and the devastation that such weapons were able to inflict on the all-wooden sailing vessels of that period, for instance, is easy to imagine. A year previous, Congreve had actually gone out with naval vessels, intending to witness his rockets in action against the French flotilla then anchored at Boulogne, only to be disappointed, weather conditions at the time of engagement being such to prohibit their use.

In 1807, rocket projectiles, once more, proved their worth, both on land and afloat, in the siege of Copenhagen, playing a considerable part in the city's downfall. The projectiles used were 32 pounders, capable of bearing explosive or incendiary charges ranging from 8 to 20lb. for a maximum distance of two miles, some 120,000 being used in the assault. Congreve is credited with the introduction of iron-cased rockets in 1808, although certain reports suggest their use earlier, possibly in the Boulogne attack two years previous. The rocket case was of iron sheet, gunpowder filled, the complete projectiles weighing up to 24 pounds, including a charge of either explosive or incendiary composition (Fig. 3). Launched from inclined iron tubes (Fig. 4), and guided by the conventional balancing "stick," tests proved that ranges of over two miles were easily attainable with rockets of the larger type.

In the year 1810, the first important technical paper on the subject of rockets was published, "On the Motion of Rockets," by W. Moore, London, which contained a mathematical investigation of rocket motion and trajectories.

(To be continued.)

Motor Chief on Roads to Be

OUR road engineers must have more vision, scope and encouragement to tackle the problem of traffic in an imaginative and logical way, Sir Miles Thomas, vice-chairman of the Nuffield Organisation, told the Engineering Industries Association in the course of a luncheon address, "Britain's Future Lies With Engineers," in Birmingham.

Nobody would imagine, he said, that it would be either safe or serviceable to carry gas and water through the same pipe. So with roads: it was illogical to make urgent, purposeful, high-powered vehicles fraternise with mercurial pedestrians and volatile cyclists on the same strips of roadway. Safety would only come through segregation; and only by that means would we get the real, time-saving advantages that the development of the automobile could provide, plus the degree of human safety in travel that we simply must attain.

Invasion Ships Off Normandy Coast

This photograph, taken as Allied invasion ships approached the coast of Normandy, shows a Rhino ferry, loaded with tracks and ambulances, leaving a tank landing craft for the beaches.

The Villiers Auto-cycle Unit

Notes on its Care and Maintenance

By E. S. BROWN

The Villiers auto-cycle unit.

THE inception of the Villiers "Junior" unit in November, 1937, has contributed enormously to the popularity of the autocycle. This sturdy little power unit is standardised by many manufacturers, the principal being the Norman, James, New Hudson, Rudge-Whitworth, and the Raynal. It has rapidly made a name for itself since its introduction for its economical and reliable performance.

The specification insludes a horizontally disposed cylinder of 98 c.c. capacity = 50 m/m x 50 m/m bore and stroke; combined flywheel and magneto with low tension coil supplying the lighting; single-lever control carburettor; and an endless chain in oil-bath to a counter-shaft two-plate cork insert clutch running in oil.

A "De-Luxe" model was introduced at a later date, and this has a deflector-less type piston, twin exhaust ports, and a detachable head.

Lubrication

The lubrication of the unit is by the petroil system. Too much emphasis cannot be laid on the necessity for seeing that the correct proportions of oil to petrol are always used, and that these are thoroughly mixed by shaking in a can before pouring into the tank. The mixture is 1 part of oil to 16 parts of petrol, or half pint of oil to one gallon of petrol.

Insufficient lubrication will speedily ruin and wear out the bearing surfaces of the engine, whereas too much oil will foul and carbon the engine, plug, and exhaust system and also induce "four-stroking."

The recommended grades of oil should be strictly adhered to. Castrol XL is recommended for the engine, and Castrol D for the primary chain.

Inferior oils, whilst promoting undue wear and overheating, usually gum the piston rings hard in their grooves, and their subsequent removal is very difficult indeed.

Doubtless there are, in normal times, many good oils upon the market, but it is obvious that Messrs. Villiers are in the position to know which suits their products best, and their experience in these matters should always be respected.

A two-stroke engine is very sensitive regarding the type of sparking plug used. Again the reader is urged to benefit from the maker's experience, and fit only the type recommended. The plugs recommended for this particular engine are the Lodge C.B.3 for the "Jnior De-Luxe" and the Lodge C.B.14 for the earlier model.

As the presence of oil with the fuel necessitates the plug being occasionally cleaned, a detachable plug is a very desirable feature, as otherwise with the non-detachable kind, cleaning is apt to be rather more difficult.

With most machines a secondary exhaust system is provided in addition to the cast aluminium silencer beneath the engine.

Dismantling and Cleaning

A restricted exhaust has a very adverse effect upon the running of the engine. It results in a seriously overheated engine, and a lack of power. Therefore about every 1,000 miles or so, the system should be dismantled and thoroughly cleaned of any accumulations of carbon and oil.

Probably the best and easiest method to do this is to block one end of the exhaust pipe with a cork, having of course first removed the pipe from the machine, and fill with a caustic solution made by dissolving 1lb. of caustic soda in half gallon of boiling water.

Leave for a few hours, then empty and thoroughly wash out with clean water. Be very careful not to allow the solution to come into contact with the hands or any aluminium component.

This chemical carbon remover is very effective, its only disadvantage being that its action is so strong that it will remove the paint from outside the pipe if it comes into contact with it. This is not, however, very serious, as fresh paint can always be applied afterwards.

The use of this carbon remover should be strictly confined to only the parts mentioned. Needless to say, this method should not be used on the silencer beneath the engine. This silencer is of extremely generous proportions, and will not require any cleaning attentions excepting perhaps at the outlet.

The writer had a machine where the exhaust pipe was blanked off at the end, and the gases escaped through a series of slots cut in the rear of the pipe. Difficulty was experienced in effectively cleaning this type of silencer.

The oulet pipe was therefore sawn off a little distance from the slots and a piece of tight-fitting tubing pushed over one end, leaving an overlap of four inches (Fig. 1). This was welded into place. The other end of the exhaust pipe required only to be pushed into the overlapping tube, and the fastenings made secure to the machine. To clean the pipe, it was then only necessary to release it from the machine, pull apart, and clean.

Decarbonising

Everyl 2,000 miles or so it will be found necessary to decarbonise the engine.

For this use only set spanners of the correct size. Adjustable spanners should not be used, as they result, soon or later, in badly mutilated nuts.

Remove the petrol feed pipe, and afterwards the carburettor. There is no need to remove the throttle slide from the instrument, and the entire assembly may be tied up by string out of the way.

Next remove the sparking plug, and secure the lead.

The release valve cable is next removed as follows: Operate the release valve handle bar control; this draws the two arms of the valve together. By pressing upon the movable arm with a spanner or pair of pliers, the strain is removed from the cable. Disengage the handle-bar control, and with the free hand loosen the lock-nut, then remove the knurled adjuster from the fixed arm, and slide the inner cable through the slot provided for it. It is now a simple matter to press upon and remove the nipple and cable from the movable arm. This done, tie the cable out of harm's way.

Next remove the silencer tail pipe by slackening the clip on the aluminium silencer, undoing the rear bolts, and pulling away.

Two nuts and a clip secure the rear of the silencer to the engine; these should be next removed. The nuts which secure the silencer to the exhaust port are now released, and the silencer detached, taking care not to damage or mislay the exhaust gaskets.

Now slacken the four cylinder nuts a quarter turn at a time, to avoid distortion and strain, then remove them and the washers, and put in a safe place.

The cylinder is now removed by grasping firmly with both hands and gently rocking up and down to break the washer seal between the base and the crankcase. Do not rock sideways, as the connecting rod may become strained.

When the cylinder is past the crankcase studs, continue to withdraw, avoiding any undue twisting motions. As the cylinder comes forward, place the hand between it and the crankcase, and support the piston to prevent it falling downward and damaging itself upon the final removal of the cylinder.

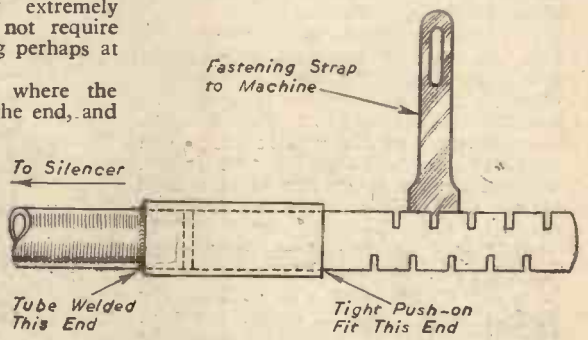


Fig. 1.—Showing method adopted to simplify the removal and cleaning of a blanked-end exhaust pipe.

Although the removal of the piston is not absolutely necessary, it facilitates the removal and inspection of the rings, and makes the removal of carbon, etc., easier.

Piston and Rings

The piston is removed from the connecting rod by pressing the two ends of one of the circlips or retaining rings together with a pair of sharp nosed pliers. This reduces the diameter of the circlip, enabling it to be withdrawn by the pliers from its position. The gudgeon pin may then be pushed out of the piston with a pencil, and the piston removed.

If the rings are bright all round, free and springy in their grooves, there is little need to remove them. Should they be, however, gummed up, they will have to be removed.

The writer has found the following method very effective in dealing with this difficult situation.

Soak the piston in paraffin for as long as convenient, then immerse in hot water. This causes the piston to expand and further softens the oil deposits gumming the ring to its groove. Careful application of a thin, flexible-bladed knife, introduced at the gaps and worked slowly round, will free the rings. This trouble will not be experienced, however, if the correct grade and quantity of oil is always used.

To remove the rings from the piston, use three guides of tin spaced at equal distance around the piston, and slide the rings over them. (Fig 2.)

The grooves must be carefully cleaned, and the rings likewise. The rings are replaced by the same method as their removal, care being taken to replace the rings in their respective grooves. Prior to replacing the rings, the piston, if it has been immersed in water, must be thoroughly dried, and all carbon removed.

Probably the best method of removing carbon from the cylinder is by chipping and scraping same with a screwdriver. The exhaust ports must be thoroughly cleaned, and likewise the ports communicating to the silencer.

The use of abrasives, such as emery paper, etc., for removing carbon is not advised. It is very difficult to remove every trace of the abrasive, and the damage done by any remaining residue is very great indeed.

Clean the interior of the crankcase by introducing a mixture of paraffin and engine oil, and swill round by cranking the connecting-rod, then drain the mixture by removing the drain plug. This is situated on the off-side of the crankcase. When completely drained, tightly replace the plug.

The cylinder bore and piston must be cleaned of any adhering particles of carbon by washing in the paraffin and oil mixture, and very particular care taken to see that the cylinder base and its mating crankcase surface are perfectly clean.

Replacing the Piston

To replace the piston, apply some engine oil to the gudgeon pin, and, holding the piston in position, slide the pin into place.

Replace the circlip by compressing with pliers and pressing into place with a finger. Make sure that the circlip is in position in its groove, otherwise trouble will follow. The deflector-type piston should be refitted with the steep side of the deflector facing upwards.

Should the cylinder base washer be damaged, a new one should be procured. If this is not possible, one can be made by placing a square of soft brown paper of approximately the correct size over the cylinder base and gently tapping same with a light hammer. (Fig. 3.) The blows will perforate the paper, and a perfect-fitting washer will result. Take care to see that the washer is cut away for the transfer passage.

Next smear engine oil over the cylinder bore and piston, and check the rings for their correct location on the pegs. Support the piston with one hand and introduce the cylinder with the other, making sure that the cylinder is correctly positioned in relation to the exhaust ports. That is with the port facing downwards, in the case of the old engine with deflector piston, sideways for the "De-Luxe" engine.

With the thumb and index finger, compress the first ring and slide the cylinder over it, following suit with the second. Continue to gently push the cylinder over the piston until it is finally in place on the crankcase. Do not twist the cylinder round the piston, but slide straight on. Tighten the four nuts on the studs finger-tight, then proceed to turn the nuts diagonally a quarter turn until all are completely tight.

Replace all the components in the order removed, taking care to leave a clearance of a postcard thickness between the release-valve stem and its actuating arm.

For appearance sake it is advisable to apply a coat of cylinder-black to the cylinder. If any difficulty is found in procuring the black, it can be easily made by mixing gold-size and lamp-black to a stiff consistency, then thinning with either turpentine or its substitute. This paint is heat resisting, and, moreover, does not easily flake off.

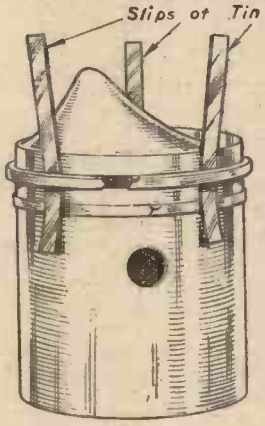


Fig. 2.—Illustrating the method of removing piston rings by three slips of tin.

The present-day "leaded" petrol adversely affects the sparking-plugs fitted to two-stroke engines. The corrosion of the points and central electrode are very apparent upon examination. But the real harm is done to the insulation. Upon micro-examination, fine surface cracks are revealed which, with prolonged use, gradually become more extensive, and correspondingly reduce the plugs' electrical efficiency. It is therefore an economical proposition to renew the sparking-plug every 10,000 miles.

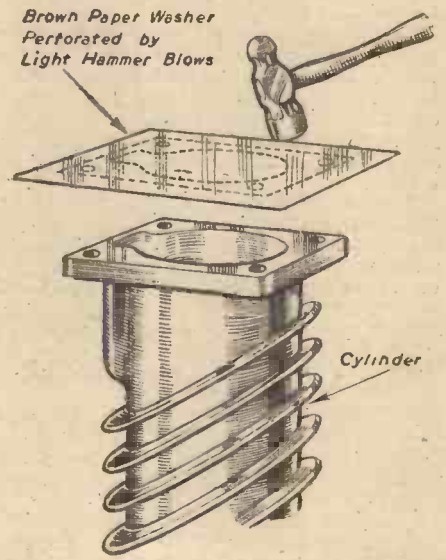


Fig. 3.—Method of making a cylinder-base washer.

Carburettor Adjustments

On the top of the carburettor body is a milled ring nut. Unscrewing this enables the throttle slide to be removed. In a recess on the top of the slide is a small screw which alters the setting of the carburettor. If the engine performs satisfactorily, with a petrol consumption in the neighbourhood of 120 to 130 m.p.g., leave well alone. Should, however, the petrol consumption be excessive and the engine very prone to "four-stroking," adjust the screw by turning clockwise a quarter to half turn, then replace the slide and note the results. If still not satisfactory, carry out further adjustments until the setting is correct.

The float chamber is removed for cleaning by unscrewing the brass nut at the bottom of same. The chamber together with the float will then come away. After cleaning, replace the float in its original position, and refit the chamber. Before finally tightening the brass nut, see that the fibre washer is in place between the nut and chamber. Do not use excessive force when tightening.

There are two filters which will occasionally require attention. One is fitted to the air intake, and is removed for cleaning purposes by unscrewing the domed cover. Wash the filter in paraffin oil, then replace. Avoid running the machine without this filter in place, as otherwise road grit, etc., will be drawn into the engine and cause undue wear.

The other filter is situated in the union between the carburettor and petrol feed pipe. To remove, unscrew the union plug, and slip the filter from it. Wash in petrol, then replace. See that the two fibre washers are correctly positioned, that is, one either side of the union, and do not use excessive force in tightening. Just enough to ensure a secure petrol-tight connection.

Magneto and Contact Breaker

The three-pole flywheel magneto fitted to the "Junior De-Luxe" engine should not be removed unless absolutely necessary, and then it is advisable to use a Villiers "Hammer-tight" spanner to undo the centre nut. The centre nut has a right-hand thread, and therefore unscrews in an anti-clockwise direction. After about one turn the nut will be found to tighten—this is when the extracting flange commences to withdraw the flywheel. The end of the nut should then be tapped sharply with a wooden mallet, after which the nut can be unscrewed without difficulty and the flywheel withdrawn.

To refit the flywheel, screw the centre nut in a clockwise direction until just finger tight; then take out the sparking-plug and rotate the engine shaft until the piston is at the extreme end of its stroke—nearest to the cylinder head. This position can be felt with a pencil through the sparking plug hole. Then position the flywheel by hand with the mark on the rim of the flywheel, in line with the mark on the edge of the armature plate, near the high-tension terminal. Hold the flywheel firmly in this position and lock up the centre nut with the "hammer-tight" spanner.

If the above is carried out correctly the magneto will be timed so that the contact-breaker points are just opening with the piston ¼in. before top dead centre.

It is advisable to occasionally clean and check the magneto points. These are made accessible by removing the flywheel cover. Should the cover be a tight fit, a gentle levering between the centre nut and the cover with a thin-bladed screwdriver will remove same.

On the earlier models a contact-breaker cover was fitted. To remove this, rotate the flywheel until one of the openings is opposite the contact-breaker assembly. Remove the cover by sliding the spring strip on one side, being careful that the strip does not puncture and damage the coils in doing so. If the contact-breaker points are not in the open position, slowly turn the flywheel until they are fully open.

Insert the gauge on the magneto spanner between the contacts. The thickness of the gauge is 1/64in., and should just slide between the points when they open.

If adjustment is necessary, loosen the lock-nut, and adjust the screw point until the gap is correct. Then tighten the lock-nut, and recheck the setting. When replacing the contact-breaker cover, if one is fitted, make

very sure it is correctly in place, as, should it come adrift while the engine is running, the entire magneto may be wrecked.

The chain case should be inspected for oil from time to time by removing the plug and noting the oil level. This plug is on the flywheel side of the engine. Fill with Castrol "D" until it overflows, then replace the plug. Should the oil be rather thick, a slight warming will make it more fluid.

The stand-by battery for the lighting set is of the flat torch type, and in the event of it running out, it should be immediately removed and a replacement fitted. If the worn-out battery is not removed, the activating materials in it will eventually corrode the head-lamp interior.

The clutch lever should have a slight amount of free movement before engaging the clutch. To allow for this movement, loosen the lock-nut, and with a screwdriver turn the centre screw until a clearance of approximately 1/16in. is obtained. Still holding the centre screw firmly with the screwdriver, retighten the lock-nut.

The clutch rod is in several pieces. If at any time it has been necessary to remove the rod, they should be reassembled in the following order: first, long rod; second, ball; third, short rod; fourth, medium rod.

It is bad practice to coast downhill with the clutch out of engagement. Likewise, when the machine is parked or garaged for any length of time, remember to release the clutch-lever, and so relieve the parts from any unnecessary strain.

Should the unit be removed from the frame, do not attempt to remove the lighting cable from inside the magneto. A connector is provided in the lighting cable circuit, a short distance from the magneto. Unscrewing this will release the cable if the removal of the unit is required.

The connector is normally covered by a rubber sleeve. Keep this sleeve always in position, otherwise a short-circuit will occur if the bare metal makes contact with the frame. Occasionally inspect the lighting cable for any chafings, etc., and make good any such damage by wrapping insulating tape round the part.

The correct bulbs to use in the "Junior" 3-pole flywheel magneto lighting set are: headlamp, main bulb, 6v. 1 amp., single contact; pilot bulb (early models only), 4v. .3 amp.; screw-in cap, and tail lamp, 3.5v. .3 amp.; screw-in-cap.

Recent Developments in Sound Control

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

IN a series of papers, presented before members of the Society of Motion Picture Engineers in America, Professor Harold Burris-Meyer, of the Stevens Institute of Technology, Hoboken, New Jersey, U.S.A., has revealed the successful conclusion of a research project directed towards the complete control of the auditory components in legitimate stage, operatic and cinematic performances in their respective auditoria.

Dealing firstly with the effects of sound, Prof. Burris-Meyer said, it can be used as a direct emotional stimulus; it can induce a physiological basis for the generation of emotion; metabolism can be influenced; muscular energy can be increased or decreased; the threshold of sensory perception can be controlled; and fatigue can be reduced, delayed, allayed, or increased by means of sound. The methods for accomplishing all these ends exist. It is susceptible of use as part of an artistic medium. To the extent permitted by technical limitations, it has been an element in the showman's art since there first were "shows." It still awaits, however, full conscious exploitation.

Moreover, not only can almost anything be done with sound, but an audience cannot escape it. You can shut your eyes if you will, but the sound comes out to get you. Obviously, if it is desired to use sound to create the maximum effects, it must be got under control and kept so.

Necessary Sound Controls

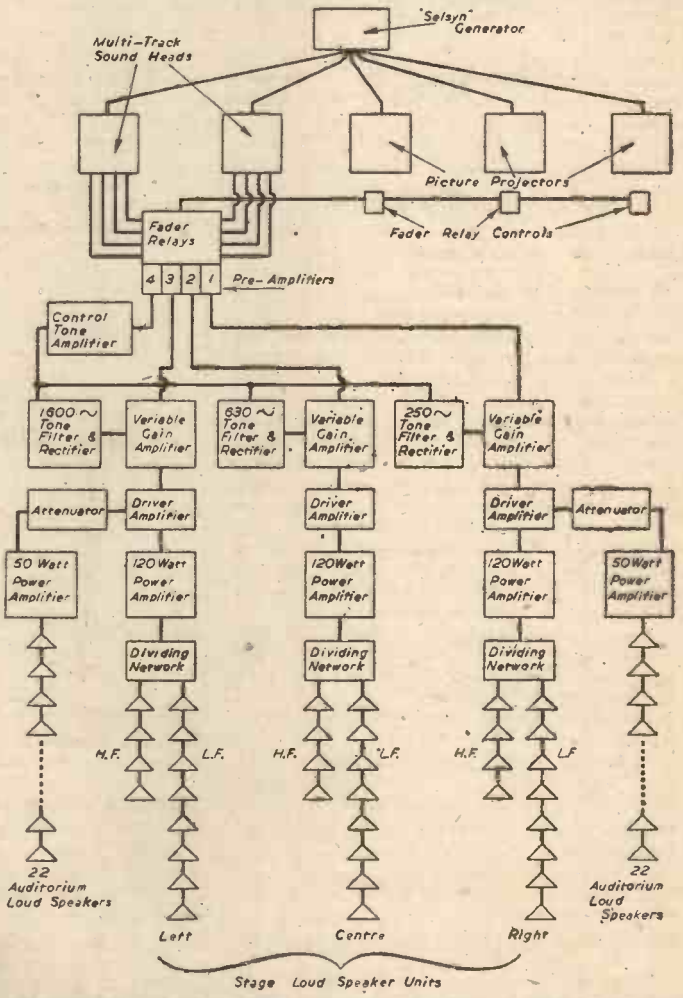
Referring specifically to the film medium, and its reproduction in a motion-picture theatre, Prof. Burris-Meyer explained that the aforementioned requirements necessitate: (1) Control of the intensity of the sound. The dynamic range must be from several db. below the ambient noise level (in a well-designed theatre, this level will stay substantially below 40 db.), to at least 120 db., which is a perfectly tolerable intensity with tremendous effectiveness when used with discretion. However, such a dynamic range must not be accompanied by harmonic distortion at the peaks. It must be possible to record and reproduce sounds with steep wave-fronts as found, for example, in explosions, or in some of Moussorgsky's compositions.

(2) Control of the spectrum, which involves the ability to get any auditory signal, including frequencies above and below audible range, on the track and back off it again, to all members of the audience. This means remaking, that is, electronically reprocessing or synthesising any sound to give it any predetermined spectrum. (The various devices for making speech out of other sounds include the simple pitch pipe on a rubber tube, the artificial larynx, and the complex Sonovox, Voder, and Vocoder.) It means a theatre in which the sound is so distributed that all the frequencies on the track reach everyone in the auditorium at substantially the appropriate levels. Only with such control of frequency spectrum will, e.g., the important drum sounds in Eugene O'Neill's drama *The Emperor Jones*, have maximum effectiveness, or cause the opera goer to prefer the celluloid to the stage production.

(3) Control of reverberation. This means not only electronically controlled overall decay time (the echo chamber, vibrational transmission along springs, and various film and magnetic recording methods, with near instantaneous playback, are employed for this purpose), but control of the *shape* of the decay curve in at least three separate frequency zones. This suggestion is due to Leopold Stokowski. It also means theatres with uniform sound decay patterns, with all variations therefrom carried on the film. Then an organ record may sound like a cathedral organ, echoes may be realistic, and a scene in a tent may sound like a scene in a tent.

(4) Control of the apparent direction of the sound. This means having the sound come from any point in a sphere surrounding the audience, i.e., from the projection booth, from below the stage, from over the proscenium, from the side wall, or from no spot in particular, or from an apparently moving source, that is, starting in one location and ending in another. It means freeing the sound from the spatal limits of the screen, so that, say, angels singing can be heard from above, or the laughter of the gods can envelop the audience.

(5) Control of the apparent distance from which the sound comes. This suggests that the sound must appear to originate from any point or area in a sphere of any size surrounding the audience. It must be able to move along a straight or curved line from any point in any sphere to any point in any other sphere, for example, a mile behind



Stereophonic sound recording reproduction, which is discussed in this article, has been successfully demonstrated in America, by R.C.A. Photophone engineers, when reproducing the original sound tracks for Walt Disney's film "Fantasia." A schematic diagram of the amplifier-loudspeaker equipment used is shown herewith.

the projection booth to a point within the ear canal of each member of the audience. This control of apparent distance involves, of course, control of direction and control of spectrum.

These requirements are a large order, commented Prof. Burris-Meyer, and yet the apparatus now exists by which all of these ends may be attained in the motion picture, and there is at least enough technique available to keep the artist from bogging down when first he tries his new wings.

To accomplish in full the flexibility of sound control, which has been outlined here, it will be necessary to have new apparatus installed; secondly, a revision of production technique; and, thirdly, new theatres.

The Multi-channel Record

The making of the multi-channel record requires that the script writer should know what his enhanced medium will do. The stereophonic recordings already made, and the theatrical and operatic productions that have used the Stevens' sound control technique, will serve only to point the way, for they have lacked either the visual component or the ubiquitousness which the motion picture provides. The artistic scope of the motion picture is, for the first time in history, literally bounded only by the limits of the artists' imagination.

The multi-channel record will demand a revision of current standard practice from script to cutting room. Music, dialogue, and other sounds will have to be planned with a view to where they come from, how they move, and what their reverberant characteristics will be. The sound score will have to be more elaborate than that currently employed in the animated cartoon, as those who have made stereophonic records can testify. The work of making the final sound track from the original will be increased and, for a while, until the new techniques are mastered, the engineers who make the sound track will have a difficult task keeping up with the artists' fancies.

New Theatres Needed

Then, again, new theatres are badly needed. Theatre building has languished for a decade, during which period we have almost learned how to build a good theatre. Many existing theatres are ready for demolition, and many more are economic liabilities. They will have to be replaced; and though, obviously, many will be built for productions other than motion pictures, none should be so constructed that they cannot exhibit motion pictures in a manner which is technically simple, artistically satisfactory, and financially secure. The English are already collecting theatre plans and specifications against the day when they rebuild after the air-raids.

In planning for the control of sound in the theatre that is to be, Prof. Burris-Meyer submitted the following fundamental considerations: (1) Two elements in the manner in which sound is heard determine its acceptability, namely, (a) percentage of definition; a subjectively determined standard embracing percentage of articulation and blending, and taking into account the direction and efficiency of sound sources; (b) a vibrant characteristic, embracing the cyclic pattern common to the decay curve, and the vibrato whose characteristics are to be determined by a subjective appraisal of the vibrato rate and decay curve form. (2) There is an optimum duration for decay of speech which is valid, irrespective of the size of the theatre. The decay time for sound must be same irrespective of the number of people in the theatre.

Regarding music, decay time has been used consciously or unconsciously by the composer as a musical device. It is, therefore, impossible to make one decay time suffice for all music. In a theatre planned to provide optimum decay time for speech, electronic control of all other sound can be simple and effective, and chamber music, organ music, and opera may then sound as the composer intended, irrespective of the size of the theatre or the audience.

There will have to be, of course, provision for loudspeaker placing to permit by direct transmission, or reflection for the directional and spatial characteristics the sound must have. Such provision cannot be made after a theatre is built. It must be designed from the start as a part of the acoustic planning, and it will have to be sufficiently uniform and simple to make one type of film print satisfactory wherever it is shown.

Prof. Burris-Meyer concluded by remarking that the objectives thus set are not easy of attainment, to be sure, but they carry the promise of dominance of the world market, and the greatest influence on the most people that any art form has ever had.

Probes and Problems

A Few More Mental Nuts for You to Crack

(*Solutions are given on page* 357)

A Geography Lesson

"I cannot congratulate the class on its knowledge of geography," said Mr. Squeers, addressing the Lower Fourth. "I asked you to write down the capitals of France, Germany, Italy and Poland; and I told you their names, so that you had only to allocate each city to its proper country.

"I find that Perkins, Smith Minor, Allen, and Jones are under the impression that the capital of France is Berlin, while Green, Thomas, and Smith Major suppose it to be Warsaw," he went on. "Harris, Jones, Marshall, and Allen describe Warsaw as the capital of Germany. No fewer than four of you have stated that the capital of Poland is Paris. Appleby names as the capital of Germany the city which Allen supposes to be the capital of Poland.

"I am at least satisfied that there has been no 'cribbing'," he added, "since no two of the papers are identical. But they display lamentable ignorance.

"This afternoon would normally be a half-holiday," Mr. Squeers continued. "However, instead of playing football, the class will remain in school and study geography. I make an exception in favour of the only boy who answered a single question correctly."

Who was that boy, and which city did he name correctly? And how many boys are there in Mr. Squeers's class?

The Jorkins Inheritance

"My father," said Jorkins, "left a most curious will. He bequeathed his whole fortune of £71,000 to his 17 grandchildren; and in order, as he said, to encourage large families, he directed that where there was only one child in a family that child should receive £1,000, where there were two they should each have £2,000, three children in a family would get £3,000 each, and so on."

"I suppose," I said, listening to the pandemonium that was issuing from the Jorkins nursery, "your kids have done fairly well?"

"Not badly," he replied. "As a family we tied for top place with my brother-in-law Harry."

How many families benefited under old Mr. Jorkins's will?

Who Told the Truth?

My friend Dithering has tried very hard to inculcate the virtues of truth into his three sons, Alfred, Bertram and Charles. He has been very successful with the youngest one, who has never been known to tell a lie. The eldest, however, is persistently untruthful; and the third boy constitutes even more of a problem, since he tells truths and lies alternately, and there is no means of knowing whether his first statement will be a falsehood or not.

I questioned the three lads yesterday as to their names and ages. The first assured me that his name was Alfred and that he was younger than Bertram; the second declared that he was called Bertram and that he was older than Charles; while the third, introducing himself as Charles, maintained that he was Alfred's junior.

Which of my friend's three boys is the consistently truthful one, and in what order did I question them?

Ruritanian Finances

At the induction of the new Archduke of Ruritania, I was surprised to see this dignified potentate attended by only one train-bearer. But my friend Bumpoffski, the Press attaché, explained to me that this is an old-standing custom. The Archduke, on his accession, is allotted one train-bearer; two more are appointed when he has ruled the Duchy for a year; a further three after his second year of office; four after the third year; and so on.

"When an Archduke dies," said Bumpoffski, "we have to remunerate all these train-bearers. Each one of them is given a thousand ziskas for each year he has served."

"That must be rather a heavy drain on the Duchy's exchequer," I suggested.

"It is indeed," said my friend. "When the late Archduke Maximilian died, we had to pay his train-bearers no less than 286,000 ziskas."

For how many years did Maximilian hold office?

Dial 999

"Hallo! Is that the Winklesea Fire Brigade?"

"Yes."

"Send help at once. There's a fire in Applejack Alley."

"O.K. We'll be along at once. Are you dealing with the trouble?"

"Trying to; but we've only got a 30ft. ladder, and we can't reach the window we're trying for. We have to prop the base of the ladder against the opposite wall of the alley, and the top of it is 14ft. below the window."

"Right you are. We'll bring a 40ft. ladder."

"Fine. That will just do it."

What is the width of Applejack Alley?

An Island Census

The little island of Kwaaka-Kwaaka in the Pacific has 101 inhabitants, consisting of white men, black men, and half-castes. The blacks are twice as numerous as the whites, but no section of the island population is big enough to outnumber the other two combined.

White people always tell the truth; black people always tell lies. Of the half-castes half are unvaryingly truthful, and the other half are consistent liars.

At a recent census held in the island, 25 people described themselves as being black.

How is the population divided up?

Principles and Design of Transformers—3

Three-phase Transformers, Their Design and Operation

By J. L. WATTS

(*Continued from page 314, June issue*)

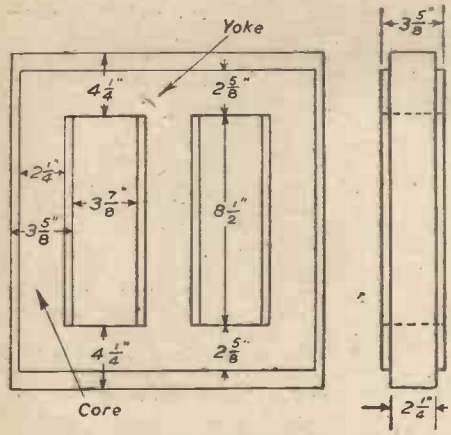


Fig. 2.—Core dimensions for 23 k.V.A. transformer.

IN a three-phase circuit the voltage in each phase of the supply reaches its maximum value one-third of a cycle displaced from the maximum values in the other two phases. If three-phase current is fed to three coils and three equal limbs of a laminated core an alternating magnetic flux will be created in the core, the maximum flux occurring at different instants in each limb of the core.

Temperature Rise

As in the case of practically all other electrical plant transformers are rated on a basis of temperature rise, the full load output being that output which the transformer can give without reaching a temperature more than 40 deg. or 50 deg. C in excess of the temperature of the surrounding atmosphere. The rate of heat generation is determined by the losses in the transformer, which depends mainly on the magnetic flux density in the core and the current density in the windings. On small transformers it is permissible to work both the iron and the copper at reasonably high densities, and without employing special cooling methods, other than ventilation. The volume of active material increases as the cube of the linear dimensions, but the surface area available for cooling only increases as the square of the linear dimensions. For large transformers, therefore, it becomes necessary to reduce the flux density and current density, which leads to a large and expensive design, or to employ special methods of cooling.

Oil Cooling

The temperature rise of a given coil is proportional to the watt losses and inversely proportional to the area of cooling surface. The final temperature rise of the coil can be found by the formula $T°C = \frac{k \times W}{S}$, where W is the watt loss, S the area of cooling surface in square inches, and k is a factor which depends largely on the design of the coil. As a guide it may be said that for plain coils in still air where heat is lost by radiation only, and there is no conduction to other material, k may be as high as 200. A good average value of k may be 120, but where there is good contact between the coil and frame, or forced ventilation, k may be 80 to 100. In general it is suggested that transformers having a continuous rating of more than about 5 k.V.A. be oil cooled. The magnetic flux density in the iron may then vary between 65,000 and 84,000 lines per square inch, and the current density vary between 1,500 and 1,600 amps per square inch, depending on the size. In large transformers it is desirable that the core section should be as circular as possible in order to reduce the mean length per turn.

Design of 23 k.V.A. Transformer

The k.V.A. rating of a 3-phase transformer $= \frac{1.732 \times \text{volts} \times \text{amps.}}{1{,}000}$. As an example we can assume it is required to construct a transformer having a capacity of 23 k.V.A. to operate from a 400-volt, 50-cycle supply to provide three single-phase supplies at 110 volts to neutral. The core size can be found from the formula core circle diameter $= 1.9 \times \sqrt[4]{\text{k.V.A.}}$, which works out at 4.17 inches. A figure of 4.25 may be adopted. The core may be arranged in sections of different sizes, as indicated in Fig. 1, the dimensions of the various parts of

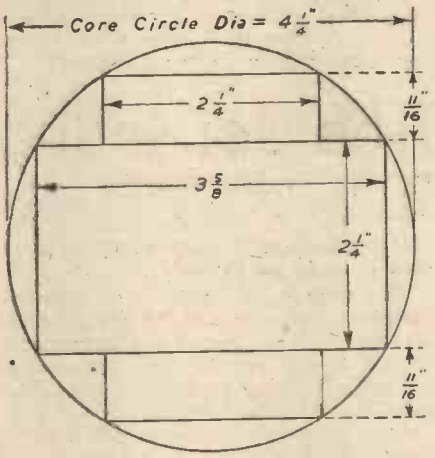


Fig. 1.—Core section for 23 k.V.A. transformer.

the yoke being arranged so that the sectional area of each portion of the yolk bears the same relation to the corresponding part of the core. This is indicated by the end view of the core in Fig. 2 The yoke section may be slightly greater than the core. The central portion of the core could be 3⅜ins. wide by 2¼ins., and the two outer sections 2¼ins. wide by 11/16in. This gives a gross area of core of 11.25 square inches, or a net area of 10.13 square inches, after allowing 10 per cent. for insulation between laminations. The spaces left between the steps are filled up solid to the circular section by wood blocks, so the core can be solidly clamped to avoid vibration. Clamping bolts which pass through the yoke should be insulated, otherwise they will provide a conducting path through which eddy currents can circulate and cause unwanted heating and loss of efficiency. The limb centres can be 1¾ times the core diameter, and the limb length twice the diameter, these values being subject to adjustment later, if necessary, to allow adequate space for the windings.

Volts per Turn

The number of turns can be found by means of the formula volts per turn $= \frac{B \times A \times f}{3{,}490{,}000}$ where B is the magnetic flux density in lines per square centimetre, A the cross sectional area of the core in square inches, and f the supply frequency. Adopting a flux density of 12,500 lines per square cm. (80,500 per sq. inch) we have volts per turn $= \frac{12{,}500 \times 10.13 \times 50}{3{,}490{,}000} = 1.82$. Assuming the 400 volt primary is to be delta connected, as shown in Fig. 3, the number of primary turns per phase or limb will be 220. The secondary will be star connected and will have 61 turns per limb. The primary full load current will be $\frac{23 \text{ k.V.A.} \times 1{,}000}{1.732 \times 400}$ volts, that is, 33.2 amps. The secondary voltage of 110 volts to neutral is equal to 1.732 × 110 = 190 volts between phases, so the secondary full load current will be $\frac{23 \text{ k.V.A.} \times 1{,}000}{1.732 \times 190}$, that is, 69.6 amps. Adopting a current density of 1,550 amps per square inch, we should require primary conductors having a cross sectional area of 0.0215 square inch, and secondary conductors having a cross sectional area of 0.045 square inch. Allowing for paper insulation the area

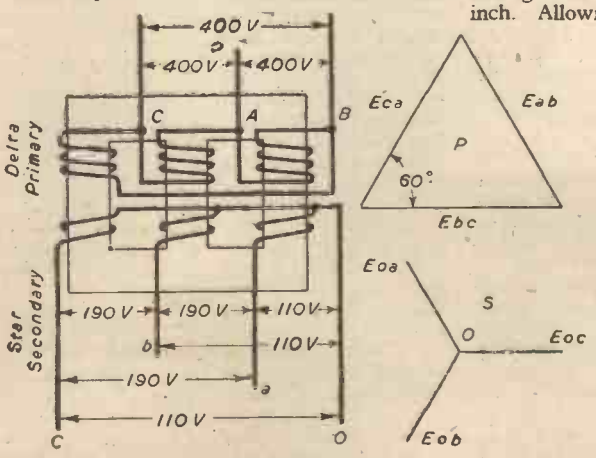


Fig. 3.—Connections and voltage relations in three-phase delta-star step-down transformer.

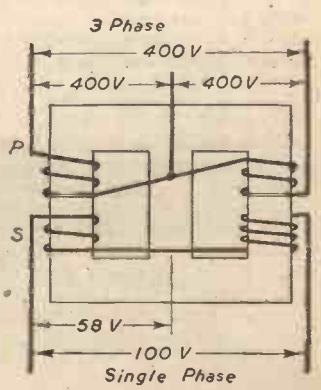


Fig. 4.—Open delta connection for three-phase, to single-phase conversion.

of the primary conductors will be about 0.029 square inch, and the secondary conductors about 0.055 square inch. If rectangular conductors are used the total cross sectional area of the primary winding per phase will be 220 × 0.029 = 6.4 square inches, and for the secondary 61 × 0.555 = 3.35 square inches, giving a grand total of 9.75 square inches. Ample space should, therefore, be provided in the core indicated in Fig. 2.

Parallel Windings

Eddy currents are created in the conductors as well as the core, this loss being approximately proportional to the square of the leakage magnetic flux density, to the total weight of copper in the transformer, and to the square of that dimension of the individual conductors which is normal to the path of the leakage flux. In transformers of high capacity it is usual to reduce eddy currents by limiting the dimension of the conductor normal to the leakage flux path, by subdividing the conductors and insulating the various portions from each other. Difficulties may arise if the various parts of each conductor are not equally disposed with respect to the core ; for example, if the parts of the conductor are not of equal length or not linked with the same magnetic flux, the volt drop in each parallel circuit may be unequal. Parasite currents will then circulate between the parallel circuits which will tend to cause overheating and loss of efficiency. To overcome this trouble the sections of conductor are usually transposed during winding, in such a way that each portion from terminal to terminal occupies each different position with respect to the core. For the 23 k.V.A. transformer under consideration, however, the conductors are

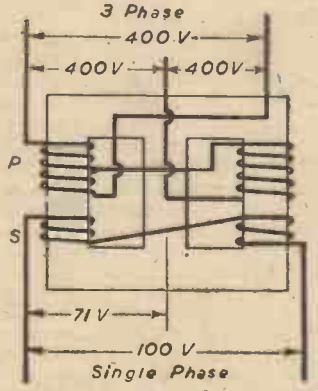


Fig. 5.—Tee connection for three-phase to single-phase conversion.

reasonably small, and such subdivision is not necessary.

Transformers form a convenient means of converting supply phases as well as voltages and currents. For example, it is possible to convert three-phase to six-phase, two-phase to three-phase, two-phase to six-phase, or three-phase to single-phase. It is also permissible to convert three-phase voltages by the use of two separate single-phase transformers.

Three-phase to Single-phase Conversion

Three-phase to single-phase conversion may be necessary when a fairly high single phase load is required, which the supply authority will not permit to be connected across two supply mains on account of the resulting unbalancing of the supply phases. One method employs a three-phase primary connected in open delta, the secondary windings being in series with one winding reversed. This transformer is shown in Fig. 4, and it will be seen that the centre limb of the three-limb core is unwound. On the secondary side the induced voltages in the two windings are two-thirds of a cycle out of phase, so the secondary terminal voltage is 1.732 times the voltage of one of the windings. This means that the number of secondary turns must be correspondingly increased, and the k.V.A. of the transformer must be 15.5 per cent. greater than the actual kilowatt output on a load of unity power factor. On such a load the power factor of the current in one of the secondary windings is 1/12th of a cycle in advance, and in the other secondary winding is 1/12th of a cycle lagging behind the voltage.

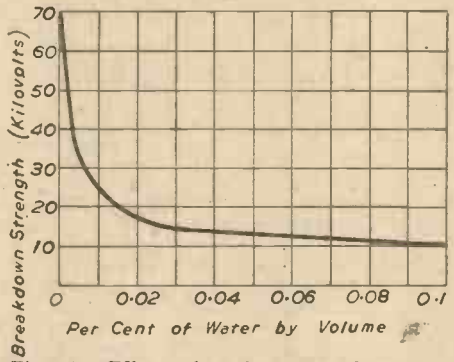


Fig. 6.—Effect of moisture on breakdown strength of transformer oil.

The tee transformer employs a three-limb core, the centre limb, which is unwound, having a cross sectional area 41.5 per cent. greater than that of the outer limbs. The voltages in each of the secondary windings are a quarter of a cycle out of phase with each other, and the terminal voltage is, therefore, 1.414 times the voltage of one secondary winding alone. The transformer k.V.A. must be 41.5 per cent. greater than the kilowatt output at unity power factor on the secondary side. With both types of connections for three-phase to single-phase conversion, the transformer does not distribute the single-phase load equally over the three-phase supply.

Transformer Oil

The oil used in transformers should be specially selected mineral oil, a typical specification for Class B oil stipulating that the breakdown voltage between 0.5in. diameter spherical electrodes 0.15in. apart shall not be less than 30,000 volts ; that the acid value, measured in milligrams of KOH to neutralise one gram of oil, shall not exceed 0.2 ; and the closed flash point shall not be less than 145 deg. C. As may be seen from Fig. 6, a very small amount of moisture will reduce the breakdown strength of the oil to a considerable degree.

Moisture may be absorbed by the insulation of a transformer during or before winding, and should be removed by drying out. For this purpose resistance units may be placed in the transformer with its oil and supplied with a controlled current, so the temperature at the top of the oil does not exceed about 80 deg. C. Alternatively the transformer may be heated by supplying a reduced voltage to one of its windings, the other windings being short circuited so the transformer is heated by its own losses. During drying out, insulation resistance tests should be made by means of a megger at frequent intervals, the tests being made between the core and primary and secondary windings, and also between the primary and secondary windings.

The Jet Induction Augmenter

THE true-rocket propulsion means is extremely wasteful in atmosphere, but it has been shown that efficiency can be considerably improved by the provision of thrust augmenters.

The principle on which the air augmenter functions is that air is drawn into the rocket by virtue of an area of negative pressure created by the flow of the exhaust efflux, the effect being to produce a relatively low velocity, high mass final efflux, as against the high velocity, low mass efflux of the unaugmented "free-jet" system.

Resistance at supersonic velocities. Whereas the resistance of a streamlined body moving through air at a speed below that of sound is largely accountable to form (frictional) resistance ; at supersonic speeds the air flow suffers a sudden change of transition, affecting a local increase in both pressure and density, producing a compression region at the nose of the body, resulting in turbulence taking the form of conical sound waves, which constitute the main drag. There is in addition a secondary turbulence produced at the rear of the body due to suction.

In view of the above considerations a new sounding rocket layout has been proposed (see diagram), combining the following advantages: (a) The layout improves jet efficiency by the provision of two stage augmentation (second stage augmenter increases mass flow in the more dense regions—later jettisoned at appropriate velocity). (b) Stability is effected by axial rotation and relative location of the C.G., and C.T., thereby dispensing with weighty and delicate gyro-stabilising mechanism. (c) Location of the augmenter duct at the nose acts to reduce head resistance by partial induction of compressible region. — *Official Bulletin of the Combined British Astronautical Societies.*

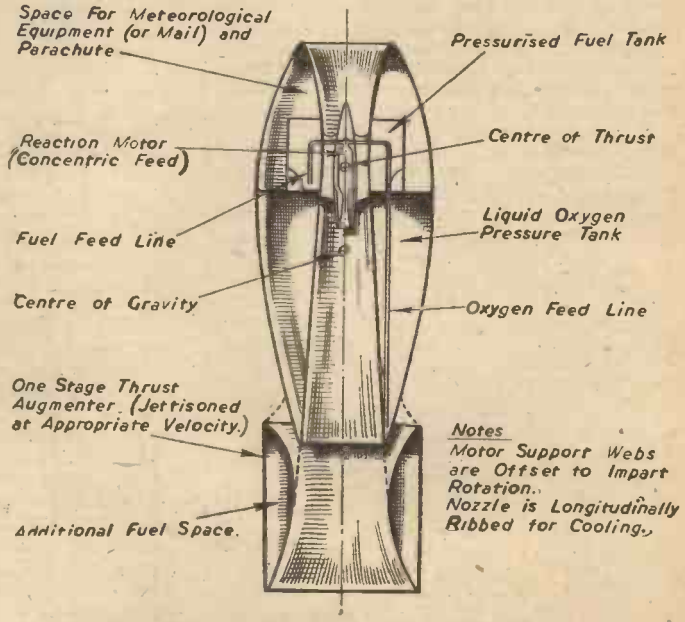


Diagram showing the component parts of a jet induction atmosphere-augmented sounding (or mail) rocket.

Masters of Mechanics—97

William Brunton

The Story of His "Mechanical Traveller"

TECHNICAL historians have blundered badly over the story of William Brunton. His memory has been much maligned. Because he invented a locomotive "with legs" he has been deemed a somewhat erratic, irresponsible engineer, a man whose mechanical fantasies were allowed to run away with his good sense and his practical abilities.

Even Brunton's curious contraption, which he named the "Mechanical Traveller," is frequently stated to have been a complete and an obvious failure.

All such assertions, however, are quite erroneous ones, for although Brunton's Mechanical Traveller did ultimately come to grief with tragic results, it functioned for a whole year and, what is more, it gave rise to imitations on the part of other engineers.

Brunton's Mechanical Traveller was undoubtedly freakish. Nevertheless, it provided a novel and a previously unthought of solution to a then widespread imaginary difficulty.

Ever since steam locomotives were first mooted at the beginning of the nineteenth century, inventors, constructors and designers all seem to have been literally obsessed with the idea that a locomotive would never be able to "hold" itself on to iron rails. Given a steam-powered locomotive, they averred, if you had not some positive means of securely anchoring it on to the iron rails other than relying upon its own weight, the wheels, when steam impelled, would merely go round and round, skidding, as it were, on the rails, and the locomotive itself would inevitably fail to make any reliable progress in a forward direction.

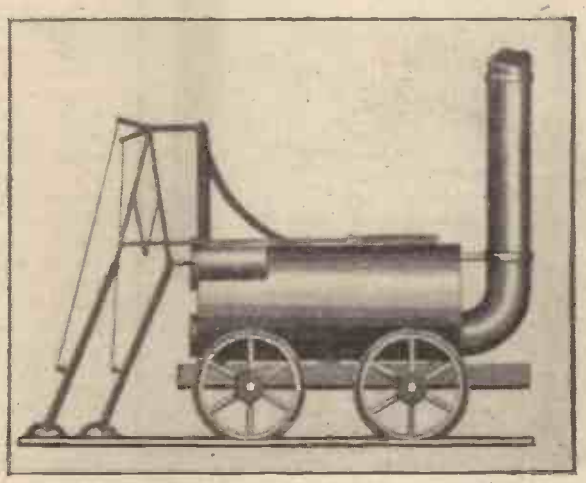
This was the utterly mistaken notions which so enormously held up steam locomotive development during the early years of the nineteenth century. Locomotive designers and inventors at that time experimented with a variety of systems intended to give the loco. a positive grip on the rails. They used ropes, chains, rack-rails, toothed driving wheels, and various other devices, all with the intention of getting round the purely imaginary difficulty of the locomotive's wheels slipping aimlessly around on the rails instead of serving to propel the vehicle forwards along the rails.

A Legged Locomotive

It was this almost universal engineering and technical chimera which was responsible for William Brunton's construction of his Mechanical Traveller, or "Steam Horse," as it has been called.

The Mechanical Traveller was, in effect, a legged locomotive, a locomotive that walked! Very ingeniously, Brunton fitted to his loco. a pair of mechanical feet which gripped the rails at the rear of the engine and so pushed the latter forward.

Brunton employed a wrought iron boiler, 5ft. 6in. long and 3ft. in diameter. The boiler was secured to a four-wheeled platform, and it was considered to be capable of withstanding a pressure of 400lb. On one side of the boiler was mounted horizontally a single cylinder, 6in. in diameter, with a stroke of 24in. By means of a system of levers, movable "legs" were constructed at the rear of the boiler. The piston rod was coupled directly to one of the legs. At the pressure stroke of the piston, the leg being firmly attached to the rail by means of its loose, claw-like foot, the engine was pushed forwards, in the same manner as a sailing vessel or a rowing boat can be pushed forwards by dint of pressing a pole against the quay side.



Brunton's "Legged Locomotive"—the "Mechanical Traveller."

As the engine moved ahead, the other leg was dragged forward into position ready for the next pressure stroke of the piston. This action was attained by means of an ingenious yet complicated mechanism which brought the "loose" leg close to the rear of the engine when the piston rod had reached its "all-out" position.

Such was the cycle of operations. The loco. appeared actually to walk with a jerky, shuffling gait. Hence its name, the "Mechanical Traveller," or the "Steam Horse."

Brunton constructed this remarkable locomotive at the Butterley ironworks, near Alfreston, Derbyshire, in 1813. So far from being a complete and ignominious failure, as many writers assert, the Mechanical Traveller was transported to the Newbottle Colliery, Co. Durham, and during the year 1814 it was regularly employed in hauling loads up a 1 in 36 gradient in that noted colliery district.

The engine, in consequence of its unconventional design and bold departure from acknowledged principles attracted a good deal of attention in technical circles. Its novelty, too, appealed to the public eye. It constituted, perhaps, a nine days' wonder. Even the afterwards renowned George Stephenson took a few hints from Brunton's constructions, for, subsequently, after examining another wheeled locomotive designed by John Blenkinsop, he opined that he thought he would be able to make a better engine than that "to go on legs."

The End of the Mechanical Traveller

Brunton's patent for his Mechanical Traveller was taken out on May 22nd, 1813. It was numbered 3,700. In the following year at least two other imitative patents were issued to Thomas Tindall and Lewis Compertz respectively. Tindall, in his patent, proposed to use four pushers or legs, but this contraption never materialised.

After functioning successfully through the inclement winter of 1814, Brunton's Mechanical Traveller came suddenly to a disastrous end early in the following year. Owing to some carelessness on the part of the driver (some accounts state the driver to have been intoxicated, which accounts are probably far from the truth) the wrought-iron boiler of the engine suddenly exploded. Apparently some sort of a demonstration was being given, for a number of interested spectators were present at the time, and, of these, 13 were killed and several others injured by the fragments of flying metal.

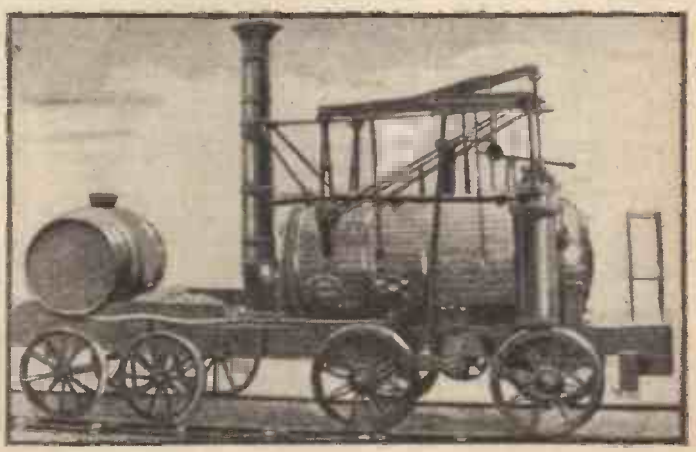
The tragedy caused a good deal of consternation among locomotive experimenters. Brunton at once dropped his practical interest in his Mechanical Traveller, and legged locomotives were never again constructed.

And what of William Brunton himself, the first creator of this daring innovation? He has become one of the "little-knowns" of historical inventions, there being but few accounts of his birth and career.

Actually, Brunton was a Scotsman. He was born at Dalkeith on May 26th, 1777, the eldest son of one Robert Brunton, who was a watch and clockmaker at Dalkeith.

William Brunton's grandfather had been a colliery "viewer" or foreman in the district, and had made a name for himself as a most competent wheelwright and mechanic. Hence the younger Brunton had the advantage of coming from a mechanical family.

He had little regular schooling, but he spent much time in his father's workroom, where he was allowed to pick up the rudi-



"Puffing Billy"—a contemporary locomotive of the "Mechanical Traveller" (1813).

ments of mechanics. He also learnt the elements of the wheelwright's trade under his grandfather in the local collieries.

In 1790, Brunton, who was then barely thirteen years of age, was set to work in the fitting shop of the New Lanark cotton mills. This cotton factory, incidentally, was owned by Sir Richard Arkwright and David Dale. The lad was not formerly apprenticed, but he remained at New Lanark mills for five years. Afterwards, hearing of the fame of Matthew Boulton and James Watt's foundry at Soho, Birmingham, he trudged southwards and, in 1796, managed to get taken on by Watt himself.

Brunton seems to have agreed with Boulton and Watt. He remained with them a number of years, ultimately becoming foreman and then superintendent of the Soho engine factory at Birmingham.

During his career with Boulton and Watt, Brunton met the majority of the eminent engineers of the day. Rennie, Telford, and others were well known to him, and there seems to be little doubt that he enjoyed the complete professional respect and confidence of these celebrities.

Butterley Iron Works

Eventually, seeking a freer atmosphere for his ideas and activities, Brunton said good-bye to Boulton and Watt's foundry and joined up with the Butterley Iron Works, Derbyshire. The Butterley works were owned by an individual named Jessop. They had functioned since 1792, and, employing upwards of a thousand workers, they made a speciality of turning out accurate castings for the then rapidly growing engineering trades.

Jessop gave Brunton complete freedom at the Butterley works. It was, as we have already seen, during his association with this historic foundry that he introduced his famous Mechanical Traveller, the world's one and only legged locomotive. Because of his many-sided activities the ultimate failure of the Steam Horse or Mechanical Traveller did not hit Brunton hard. His mind turned to other things, due, no doubt, to an increasing pressure of official business.

Whilst still retaining some connection with Butterley, Brunton, in 1815, became a partner in a business known as the Eagle Foundry, Birmingham. He was here for ten years, during which time he designed and superintended the erection of many important engineering works of large and small magnitude.

Brunton in London

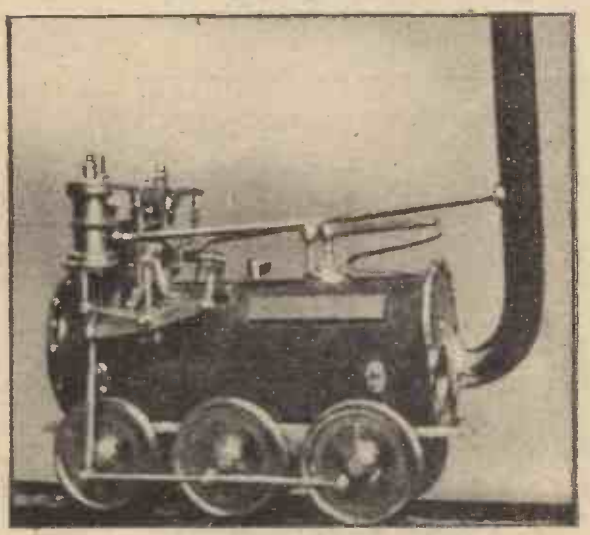
From Eagle Foundry, William Brunton went to London. We have very little knowledge of his career between the years 1825 and 1835, but, apparently, during this period, he was practising in the Capital as a consulting mechanical and civil engineer. Nothing is known of his detailed activities in "private practice" whilst he was in the Metropolis. It was, however, very largely a period of increasing engineering endeavour on every side. The construction of practical, passenger-carrying railroads, despite much opposition, was being mooted on every side. Doubtless, Brunton, as a railroad constructor himself, was consulted on many aspects of the projected lines and their locomotives. He would also come in for his due share of work in a civil engineering capacity.

Nevertheless, London seemed not to suit Brunton. Ever of a somewhat rambling disposition, he left that city about 1836 and turned himself westward in the direction of Wales.

Cwm Avon

At Cwm Avon, about two miles from Aberavon, in Glamorganshire, a tin-smelting works had been erected. Brunton purchased shares in this enterprise and became resident engineer there. At that time, the works were powered by means of a stone aqueduct, some 460ft. in length, which conveyed a rapid stream of mountain water to a large central waterwheel. It was one of the largest water-power plants in the country.

Brunton specialised in the development of smelting processes at Cwm Avon. Besides smelting native tin ores, the Cwm Avon works also undertook the processing and refining of copper. Brunton erected copper-smelting furnaces of his own design in order to increase the output of the works. He also installed rolling mills at Cwm Avon for sheet copper, tin, and even sheet iron.



One of the earliest of commercial locomotives — the "Stockton," built in 1826. The locomotive proved unsatisfactory.

Retaining his association with the Cwm Avon enterprise Brunton subsequently became connected with a foundry situated at Maesteg, near Bridgend, Glamorganshire. At the same time, he took up shares in a brewery at Neath, Glamorganshire. That was in 1838. But soon after, the brewery failed, and failed badly. The result was that, with the loss of his interest in the brewery concern, coupled with the call on his capital for the purpose of meeting creditors, Brunton witnessed the speedy disappearance of all his life's savings. It was naturally a great blow to him, and, furthermore, it proved to be a catastrophe from which he never recovered. For it is recorded that after the eventual failure of the Neath brewery, William Brunton made a forced retirement from his profession as a practical and a consulting civil and mechanical engineer, and that he never again embarked upon any engineering enterprise, although occasionally he undertook a few desultory items of consultative work.

He went to live at the house of his son, William Brunton, who was at that time an engineer connected with some Cornish mines at Camborne. And it was at Camborne that Brunton died on October 5th, 1851, leaving several sons who, afterwards, became well-known contemporary engineers.

William Brunton's career was one of continued and intense activity. Yet, by a strange whim of Fate, only the narrative (and an incorrect one, at that) of the curious Mechanical Traveller has survived as an item of "popular" engineering history.

Many Patents

Yet, Brunton obtained many patents during his lifetime. In fact, he appeared at times to have nearly crippled himself financially through patents, for the grant of Letters Patent in those days was a matter of the payment of some £140, a sum which few inventors, unless they were monetarily backed, could ever afford.

Brunton, however, derived little practical rewards from his patents, although many came into use. Many of them, indeed, brought to him real disappointment as, for example, a patent which he obtained when he was at the Butterley Works, Derbyshire. This protection covered the principle of the rapid rotation of a mould for the casting of iron pipes. After the patent had been granted he discovered that it was essentially worthless, since it had been anticipated by another individual who had used a similar means for casting terra-cotta articles, and who, in his patent specification, had quite incidentally mentioned that the process might possibly be applied to the casting of metals.

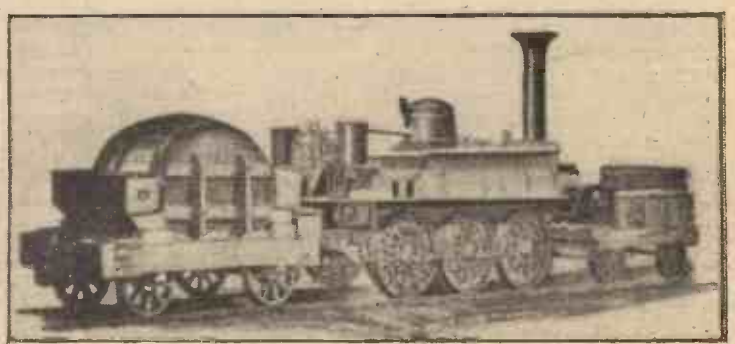
At Cwm Avon, Brunton devised a special form of calciner or ore-heater which had great success. But the subsequent failure of his brewery investments prevented him from deriving any benefit from this invention.

Steamship Interests

William Brunton had a considerable interest in the subject of steamships. He made some of the original steamship engines which were used in vessels plying on the Humber and the Trent, whilst, in 1814, he was responsible for the construction of the steam engine which powered the first Liverpool ferry vessel.

Ten years later, whilst a partner in the Eagle Foundry, Birmingham, he designed and constructed a marine engine for the *Sir Francis Drake*, which vessel he fitted up at Plymouth in the same year. It is said that this was the first steam-propelled ship to take a "man-o'-war" sailing vessel in tow.

In his years of retirement, Brunton's active brain still pursued its inventive career. He turned his attention to the then vitally important subject of the adequate ventilation of coal mines. He devised a new system of colliery ventilation, and he went so far as to submit models depicting the working of his system to the Great Exhibition which was held in Hyde Park, London, in 1851.



"Wilberforce"—a locomotive built in Brunton's days for the Stockton and Darlington Railway (1832).

Precision Clockmaking

Reviewed from the Aspect of Scientific Craftsmanship, With Special Reference to Self-contained Electric Clocks

By the Late GEORGE B. BOWELL

FOR a long time it has seemed to me that practical information outlining some of the essential features appertaining to precision clockmaking, and electrical clocks in particular, would be of use and interest not only to those engaged in the industry but also to amateurs to whom the remarkable beauty and virtue of the clock, possessed by few other kinds of mechanism, make a special appeal. There are already many books on the subject which can be referred to for the fuller history of clockmaking, or for the study of the mathematics of the pendulum, or even for the appropriate construction of a clock. Nevertheless, one cannot fail to notice in the "make-up" of different pieces of mechanism certain regrettable features, antagonistic to the best interests of any art, which suggest that insufficient heed of what has already been done is a common cause of blemish in the work of so many designers. A reference to the records of the Patent Office shows undoubtedly that many inventors built their work upon a slender foundation, whilst a little investigation into the established merits of previous devices would have avoided this resulting inefficiency, and would have rendered service both for the advancement of the art and for the peace of the inventors, or, to use a much more harmonious and less fatuous term, the designers.

This exhortation to designers to profit by the virtues of earlier mechanisms is not made in a wholly "arm-chair critic" manner, for I have made the same kind of mistakes, though refrain from giving any detailed account of such experiences since that would detract from the hoped-for utility of these articles in which neither padding nor reminiscences would be suitable.

Early Clock Movements

Since the introduction of the Pendulum (1641) and of the Anchor Recoil Escapement (circa 1656), also the Graham Dead-beat Escapement (circa 1700), clocks have been made more or less similar to those in use to-day, and little need be said here about their general form, consisting of a pendulum, an escapement, and a weight or coiled spring arranged to drive the escapement through a train of wheels and pinions, with which the reader will doubtless be familiar.

It used to be said that a clock could measure time more accurately than any other instrument could measure anything else. A clock going say to a second a month, for instance, is measuring to an accuracy within one part in two and a half million parts! Of course a "second-a-month" means a very nice clock, but not beyond the attainment of an "amateur." However, there are clocks and clocks; some go well and others fall short of praise! Design, workmanship and care are all essential contributions to good results—and, if good design is perhaps of major importance, it is certainly the foundation.

Electric Clocks

Soon after the introduction of the Electric Telegraph *electric* clocks began to be made. The earliest was the *Bain* (1841). In this clock the pendulum carried a coil of wire arranged to swing over a magnet system, and current was sent from a battery through the coil under the control of a sliding contact bar actuated by the pendulum. And the dial-work was driven by the pendulum.

The *Hipp* clock (about 1842) also consisted of an electrically-driven pendulum from which the dial-work was actuated; but this clock introduced a very clever arrangement for control of the impulse whereby the time-keeping was not dependent at all on the electro-motive force of the battery. This

The late George B. Bowell.

Hipp invention is still in considerable use to-day. The principle is that a fresh impulse is not given at regular intervals but only when the pendulum's arc declines to a prearranged minimum value. Thus with a new battery one impulse would maintain the motion of the pendulum for a longer period than an old one, yet in either case the pendulum receives the same mean value of impulse—just enough to balance the losses due to air resistance and the friction at the dial-work.

The use of electricity naturally brought with it the opportunity of the control, from one clock, of a number of others as "secondary" clocks. The earliest successful system consisted of secondary clocks each of which were like the Bain clock but without its sliding contact, and these secondary clocks were worked by currents sent out from a standard clock. An advantage of such a system is that an occasional "bad contact" (or split signal) or an accidental break in the line wires (if of a sufficiently *temporary* nature) would not prevent the clocks from continuing correctly.

Secondary Dials

However, in course of time a desire for some rather less elaborate system on which to work a number of "secondary" dials led to what is now often referred to as a "jumper" system. In this, each dial has an electro-magnetic mechanism by which the hands are jumped forward at each half minute in response to currents sent out by a master clock. This sounds such a simple thing to provide for, but actually many attempts were made before results of practical utility arrived. The advantages of having uniform time shown on a number of clock dials throughout a building are apparent; I remember that a Manchester firm at one time made a system in which a turret clock turned the hands of a considerable number of small inside dials, such as would be needed in office or warehouse premises, by means of an elaboration of rodding, bevel gears, etc.—a reasonably sure way of securing the desired uniformity but not exactly an ideal alternative to the use of electricity.

There were various difficulties in the early days of the "jumper" system's development, and progress was slow. One of these difficulties was due to imperfect transmitting contacts, whereby the half-minute currents sometimes took the form of "split" signals, so that if a receiving movement were sufficiently responsive it would make a double jump—or if sluggish it would be likely to miss.

It would be difficult to say at what date or by which system technical success really began to yield useful results. Obviously, so long as the dials could not be reasonably depended on to "keep in step" utility was absent and erratic results justified much disapproval, which, however, was "endured" by the pioneers, who felt sure that such were but the infants' maladies; to-day, of course, these infants have come quite to middle-age and have long outgrown their early complaints, though possibly there may be some exceptions.

Van der Plancke

Actually, on looking back, I think without doubt the first jumper system which achieved a promising measure of success was the Van der Plancke (1885); this system did not employ what nowadays might be regarded as an entirely satisfactory *contact* in the master clock, but it did make use of a very clever mechanism for the secondary dials, and one which was not so vulnerable to faulty signals. This mechanism consisted of a little flywheel geared to turn once for a half-minute advance of the hands: the flywheel received the electrical impulse by means of an electro-magnet, and thus could transform even an imperfect signal into a definite half-minute step. Some further reference to this mechanism will be made later.

Synchronome System

The next notable advances that were made were led by the *Synchronome* (1895) system, and subsequently other more or less similar systems became available. The dials' mechanisms consisted of a wheel having 120 teeth, and fed on by a spring-actuated "click" retracted by the pull of an electro-magnet. Previous to this 1895 arrival, the contacts in master clocks were usually insufficiently robust; or, alternatively, if set to give a firmer contact, there was risk of stoppage (except in such instances as those in which contact work was suitably fitted to a turret clock), but in the Synchronome

master contact there is no such objectionable retardation nor any need to be content with insufficient pressure at the contact surfaces, and the same plan has become quite the usual one. There are, however, other modes of operating master clock contacts which are entirely satisfactory. Before leaving these notes concerning jumper systems, some mention should be made of a mechanism introduced in 1905. In its first form this consisted of a cam-shaped armature to which was fixed a little counterpoise. The electro-magnet acted direct on this armature, causing it to make three-quarters of a turn when the current came on, and the counterpoise carried it over the other quarter-turn after the current ceased. Subsequently (1909) this was modified to a half turn action and a permanent magnet acting on a pair of interpoles replaced the counterpoise.

"Synchronous Motor Clock"

All these various half-minute systems are in considerable use, but now another system for working "a plurality of indicating dials" has come into perhaps even greater vogue. This is the "Synchronous motor clock," which has become possible in consequence of the modern developments in electrical supply. Large alternators at power stations have access to interconnection (the "Grid") between stations. To connect d.c. *dynamos* to feed into the same load it is necessary to adjust first the *voltage* of the incoming machine to equal that of the load, but to connect *alternators* it is further necessary to make sure that *frequency* and phase are correct. The mode of providing for this ready interconnection is normally to keep all power stations working at a *standard frequency*; the pioneers in this matter were Messrs. Everett, Edgcumbe and Co., who also took up the patent rights of the Warren "Telechron" system (U.S.A.), which was the first of the synchronous motor clocks, or "time from the mains" vogue.

To achieve this standard frequency (which in this country is 50 cycles per second) each power station has a "comparator" clock, one part of which is kept to Greenwich Mean Time, and another part is driven, by a synchronous motor, from the station's mains. In this way, the least error in rate of alternations is at once shown, and adjustment of the alternators' speed is made accordingly to bring the comparator clocks back into agreement.

So it is that *any* synchronous motor clock connected to any part of such a "time controlled" supply will, if so set when started, show correct time. A "synchronous" motor is one in which the speed is strictly proportional to the frequency of the supply.

The foregoing is intended to explain the otherwise rather mysterious nature of this popular "clock" frequently found in domestic service, but certainly not as clear to the average householder as the old grandfather clock, with its weights and its pendulum.

Of course, strictly speaking, the synchronous motor dial is not a "clock," but merely one part of a convenient system, whilst the other part is attended to by someone else.

These notes have now touched upon the chief types of clocks in use, namely:

(1) The old established key-wind clocks.
(2) The more modern half-minute jumper systems.
(3) The still more modern synchronous motor clocks.

All these types are likely to remain in continued usage, and in general are well developed so that perhaps very little scope for further improvement is left. But there is another section of the clock family which contains quite a promising vista for further useful development, and this comprises *electric self-contained clocks*, which will be dealt with in a later article.

"Time Element"

A clock pendulum, in common with a countless number of other things, is an example of an oscillating body which, when set into vibration, continues to evince a very definite preference to swing in a time of its own.

One is apt to take for granted such things as clock pendulums merely because they are so familiar—they have been used for clocks since about 1641. But it will be useful to review various aspects of the matter with the special object of noting what a clock, and particularly its escapement, should do and should not do.

The "time element" in all these oscillating bodies is due to a *force* acting on a *mass* free to move accordingly. The attraction due to gravity is the main force to consider in this connection and it may be regarded as the controlling force, but it is important to keep clearly in mind the differences between that force and impulse, because it may be assumed that the controlling force is constant whilst added forces, though much smaller, are unfortunately not so constant even in a very good clock.

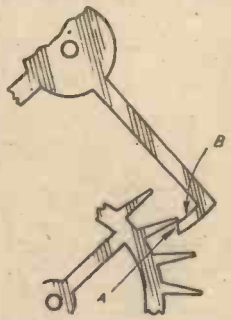


Fig. 1.—Part of a dead-beat escapement, showing how a pallet engages with the teeth of the escape wheel.

When a pendulum bob swings from one side to the other the motion becomes reversed at zero relatively to the controlling force of gravity. If, therefore, one applies an impulse to the pendulum it is equivalent, if it be added before zero, to an increase of controlling force, or, if it be after zero, to a decrease. Hence, if added equally before and after zero, the effects of such added force will be neutralised and the time of vibration will remain unchanged.

There are other disturbing forces besides that of impulse. There is air resistance, and locking friction. The impulse acts always to increase motion, and the others to diminish motion. At the arc at which a pendulum "settles down" a compromise exists between the impulse and the other disturbing forces.

Clock Escapements

Of clock escapements the most extensively used are the recoil and the dead-beat, and their general scheme is familiar. The pallets are arranged to oscillate with the pendulum to which they are coupled by means of a crutch. The escape wheel is placed between the pallets so that at each vibration the wheel escapes the distance of half a tooth. In Fig. 1 is shown one of these pallets of a dead-beat escapement, and one tooth of the escape wheel resting on the surface B. As the pendulum moves from left to right this tooth is held by the pallet which slides under it until the surface A arrives and allows the wheel tooth to press it forward and impart impulse to the pendulum. When the wheel escapes from the pallet, it is similarly arrested by the locking face of the other pallet. Whilst the impluse is being given the pendulum is swinging through the "escaping arc" and whilst a tooth is resting on the locking face, the pendulum is continuing its motion through the "supplementary arc." The impulse is given from, say, one deg. before to one deg. after zero and should be the same for either pallet. Any motion of the pendulum beyond the angle of impulse is subject to an opposing force due to friction of the wheel tooth on the locking face of the pallet. The magnitude of this opposing force is the product of the pressure of the wheel tooth and the co-efficient of friction at the pallet face. This friction, it will be seen, always acts alternately with and against gravity.

Before noting the differences between the dead-beat and recoil escapements it is necessary first to refer to another cause of time-keeping variation, namely, "circular error."

When an oscillating body behaves in such a way that the times of vibration are of equal duration whether the arc is large or small, the motion is said to be isochronous. The balance of a watch can be made to approach isochronism by means of a properly applied balance-spring, but a pendulum with an ordinary suspension spring cannot be exactly isochronous, whilst, if its arc of vibration increases its time of vibration becomes longer, and that difference in the period of vibration is "circular error." More is said later on about this, but for the present it is sufficient to remember that if a clock causes its pendulum to vary its arc an error in timekeeping will result. Thus, if an escapement can itself either help in preventing any but quite small arc changes or, if it can in some way quicken the long ones, the time keeping may be improved.

In the dead-beat escapement the run on the dead locking faces tends to check arc changes very much as compared with what would happen for a similar supposed change in driving force if the pendulum were free, or detached, during the supplementary arc. The dead-beat is certainly a very good one and is only found a little unsuitable when used for small clocks with going barrel spring drive. But here it is that either the "recoil" or the "half dead-beat" may be found more suitable.

The recoil escapement is very similar in action to the dead-beat except that there is no corner dividing the run from the impulse part of the pallets, but these are formed as one curved surface and the "recoil" of the escape wheel thus produced serves to increase the controlling force so that it hastens the long arcs. The latter scheme being the more suitable for small and relatively cheap clocks, the former is much more appropriate for seconds regulators and clocks of superior construction.

The half dead-beat has very slightly modified locking faces, so that it partakes of this "long arc hastening" character, but only to a very small extent and not nearly enough to justify any accusation of the pendulum being "forcibly pushed to and fro" as some writers have expressed it, possibly from prejudice.

There are several alternative forms of construction for the dead-beat escapement. The pin wheel dead-beat is frequently used for turret clocks, the pins being set in the side of the escape wheel rim. The pallets are both placed to work at same side of the wheel so that after finishing its impulse to the upper pallet a pin drops on to the locking of the lower pallet. Wear at the crutch pivot holes will not prevent the escapement from working properly. Another form is the Brocet dead-beat, which was used on some French clocks, where the pallets are just half-round pins, usually cornelian, and the run occurs not by the point of the tooth along the pallet, as in other dead-beat escapements, but by the flank of the tooth over the top of the pallet.

(To be continued)

Making Rubber Stamps

A Practical Method of Making Facsimile and Ordinary Rubber Stamps

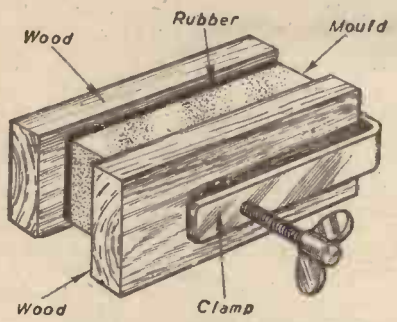


Fig. 2.—How the rubber for the stamp is prepared.

THE making of rubber stamps is an interesting and profitable hobby; this article shows how to do the work with the simplest of tools and materials. Stamp-making may be roughly classed into three divisions, i.e. (1) Facsimile signature stamps; (2) Moulded rubber from printers' type; (3) Made-up stamps needing no vulcanisation.

Facsimile Stamp

A small flat piece of metal plate will be needed for these, and it should be laid on a table perfectly level. Bend up a strip of cardboard to form a long rectangle, say 3in. x ¾in., lay it on the plate, pressing it down

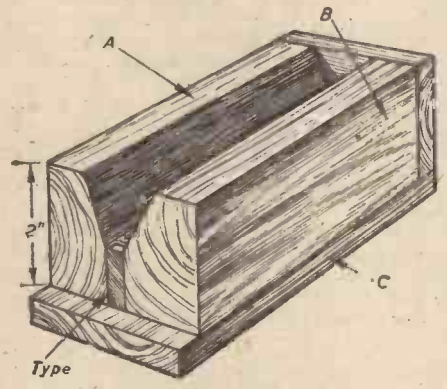


Fig. 3.—The wooden chase.

with one finger, pour in a little beeswax, sufficient to cover the plate about 1/16in. (Fig. 1.)

Let the wax just set, then remove the cardboard rim. Before the wax can get hard, with a sharp-pointed instrument write the signature penetrating the wax through to the metal plate. When hard, clean out all tiny chips, then replace the cardboard rim; all is now ready to make the plaster mould. Sift some plaster of paris through fine muslin,

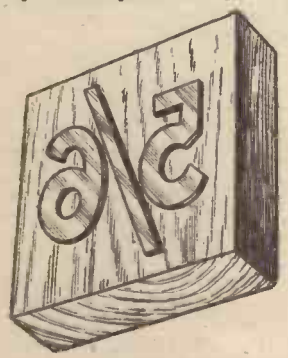


Fig. 5.—Larger stamps, as shown, can be cut from sheet rubber and glued to a wooden base.

then dry the powder in an oven, making it hotter than the hand can bear. Grind it up to remove all lumps, then sift again. Mix the powder with water to the consistency of thin cream, pour upon the wax autograph, and pat down lightly with the end of a stick to force the cream into the lines of the autograph.

When the plaster is set quite hard it should be a perfect facsimile of your signature. Coat it with blacklead, taking care not to fill in the eyes of your letters, place the cardboard rim around it, and make a plaster

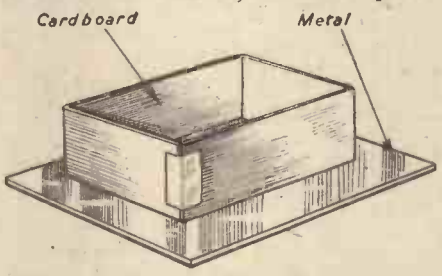


Fig. 1.—How the cardboard is bent and placed over the cardboard strip.

mould of it as before. This mould, from which the stamp will be made, should be dried in the oven until all moisture is expelled, otherwise it may crack during the vulcanising process.

The Rubber for the Stamp

For the stamps you will require some unvulcanised rubber sheet about ⅛in. thick; that used to repair motor tyres would do, but it must be unvulcanised, the ordinary kind for applying with rubber solution is already cured and no use for the purpose. Cut a piece as large as the mould, place the mould (blackleaded as before) and rubber face to face, lay a piece of wood on either side, and clamp together (see Fig. 2). It must now be heated gradually to 150 deg. C. to vulcanise the rubber. This can be done in a gas oven, but for the sake of economy it

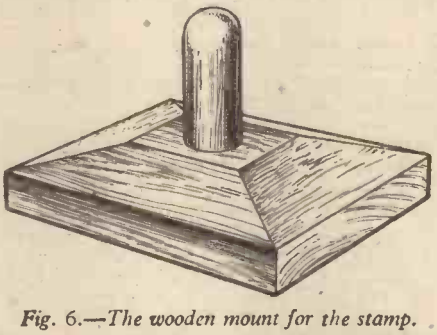


Fig. 6.—The wooden mount for the stamp.

is best to make up an improvised oven from an old tin, placed over the gas jet.

During the heating process, give the screw of the clamp an occasional turn or two to force the soft rubber into the mould. About twenty to thirty minutes should finish the operation, after which the stamp can be removed from the mould, and trimmed ready for mounting.

Moulded Rubber Stamps

Obtain a fount of printers' type suitable for rubber stamps, and make up the wooden chase shown at Fig. 3. The pieces A and B are nailed to the wooden base C, both ends being closed with pieces of wood. The space between A and B should just admit the size of the type chosen and the inside surfaces should be blackleaded to prevent the plaster sticking.

Set the name in type (reversed, of course) and fill up the spaces at each end with the slips of metal provided with the fount of type. See that the letters stand quite upright, and with a narrow strip of wood, hammer them on top so that they lie level. With a small brush, apply a little sweet oil to the type faces, then fill up the chase with plaster. This time there is no need to bake it, sifting alone will do. The stamps are moulded in rubber exactly as described for facsimile ones.

For small stamps obtain a child's rubber printing outfit; the cheap ones with the type only about ¼in. high are most convenient. Plane up a piece of wood suitable for a foundation, and on the top stick with glue, or cement, a piece of sheet rubber; any old motor tyre's inner tube would be fine for this.

Apply a coating of rubber solution to the sheet rubber and the bottom of the types, then leave until tacky. Next stick the letters on the sheet rubber (Fig. 4).

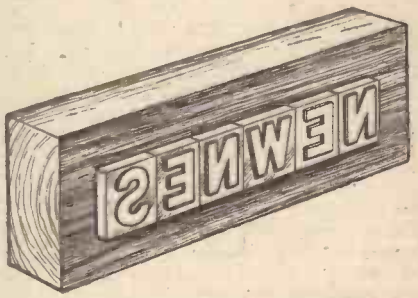


Fig. 4.—The letters should be attached to the rubber by means of rubber solution.

Larger stamps, as shown in Fig. 5, can be cut from sheet rubber and glued to a wooden base. A good plan is to attach a sheet of paper each side.

Draw the desired figures, or letters, on a sheet of stiff paper lay a piece of carbon paper underneath, coated side uppermost, then trace through. The paper can now be turned over and stuck with Seccotine.

A pad is shown at Fig. 7 and, for those who prefer to make their own ink, it is only necessary to dissolve some aniline violet in hot glycerine, and strain it while hot.

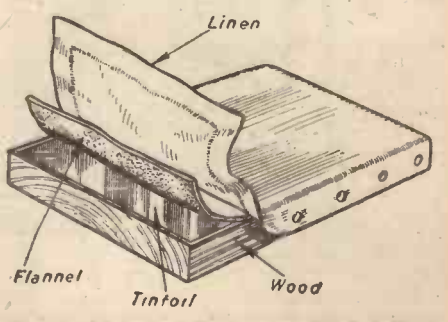


Fig. 7.—Method of constructing the inking pad.

Rustic Garden Woodwork

How to Make a Pergola, Garden Seat, Small Table and a Rose Arch

By A. J. BUDD

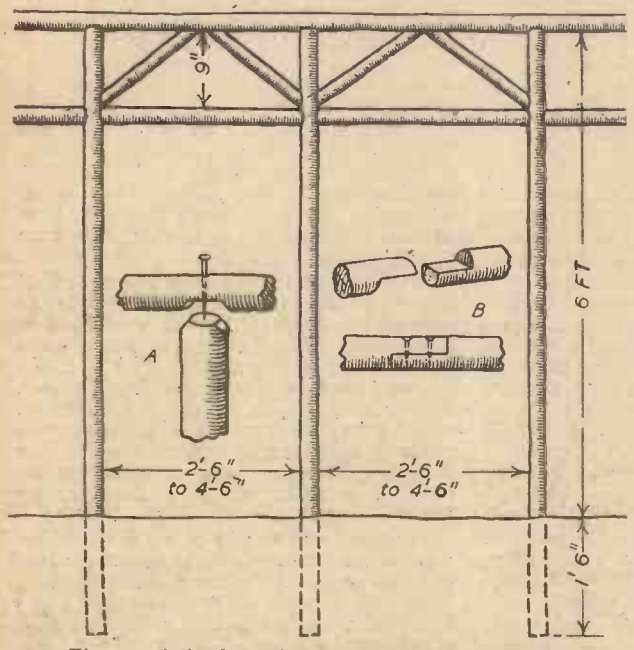


Fig. 1.—A simple rustic pergola, and details of joints.

A RUSTIC pergola, on which climbing roses or other plants can be trained, can be made with larch poles, which are obtainable from most nurseryman's yards. To ensure a rigid construction the uprights, as in Fig. 1, should be not less than 2½in. diameter, and can be spaced from 2ft. 6in. to 4ft. apart, as desired. Each post should be sunk about 1ft. 6in. in the ground, and the buried ends should be stripped of bark and well coated with hot tar before placing them in position.

To make a rigid job of the pergola, alternate posts can be bedded firmly on a flat stone laid on the bottom of the hole, as in Fig. 2, and large stones and earth well rammed down all round.

Jointing and Nailing

The top rail is joined to the uprights, as at A, and if the parts are cut to fit properly, a very neat joint will result. For joining the ends of two poles together for making the top rail the required length, a halving joint, cut and nailed together, as at B, can be used. The lower horizontal rails, after being cut to the length required, have the ends cut to fit the posts, as shown at C. The sloping filling pieces between the two rails need not be more than 2in. diameter. They are nailed in place after the ends have been sawn to the required angles and shaped to fit the posts and rails. Galvanised iron nails should be used throughout for fixing the parts together—on no account should ordinary iron nails or screws be used, as these would soon rust and cause loose joints. When nailing the joints, do not drive the nails right in with a hammer, but use a nail punch to avoid splitting or bruising the bark.

Usually it is not necessary to paint a larch pergola, as in time the bark turns to a pleasing grey tone which blends well with the foliage of climbing plants.

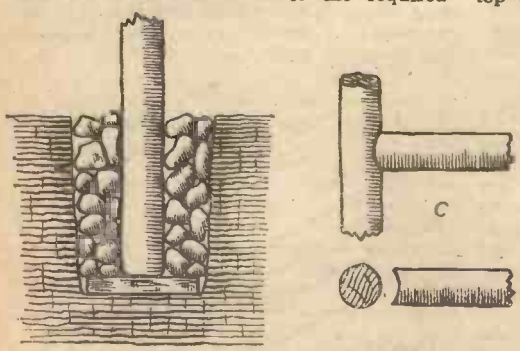


Fig. 2.—(Left) Method of embedding posts in the ground, and (right) how horizontal members are joined to uprights.

A Semi-rustic Seat

In the small garden seat shown in Fig. 3 there are no difficult joints to make, and all the parts are either screwed or dowelled together. The two back uprights can be cut from 3in. by 2in. deal, to the dimensions given in Fig. 4. After cutting the recess in each part to take the horizontal rail, saw the top part of the front edge of each upright to a taper, as indicated. The front legs, also of 3in. by 2in. wood, can have the front edges planed to a slight taper, as indicated in Fig. 5, which also shows the bottom part of the front edge of the rear support cut on a slight taper. The top ends of each front leg are recessed for a depth of ¾in. to take the horizontal rails, which can be cut from wood 3in. wide and 1½in. thick. The ends of these rails are halved, as in Fig. 5, for making the joints, with the front legs and back uprights. Use stout 1½in. galvanised screws for fixing the parts together—two screws for each joint.

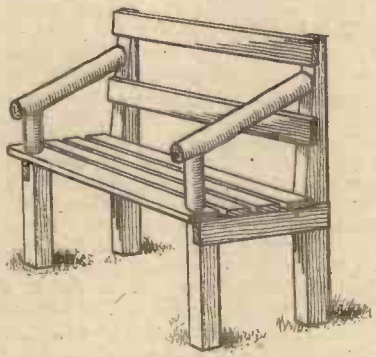


Fig. 3.—A semi-rustic garden seat.

Seat Battens

After fixing the two end frames together, as described, the four seat battens can be screwed on. These are 4ft. 6in. long, 3in. wide, and 1in. thick. Two back rails, also 4ft. 6in. long, are screwed to the back uprights in the positions shown in Fig. 5.

For the arm rests, any kind of rustic wood 2in. diameter can be used. Each arm is in two pieces, jointed as shown at D, Fig. 5. Fix the joints with pieces of ¾in. dowel rod glued into holes made with a ¾in. centre-bit. The joint between the sloping arm and the back upright can also be fixed with a 3in. galvanised nail.

The completed seat can be coated with creosote, or other wood preservative.

Garden Table

A small garden table, on the lines indicated in Fig. 6, can be made throughout with rough planed deal or pine 1in. thick.

The table top can be formed from two boards 22in. long and 7in. wide, butt-jointed and glued together. The edge of the table top is made irregular all round with a chisel and spokeshave, as indicated in Figs. 6 and 7.

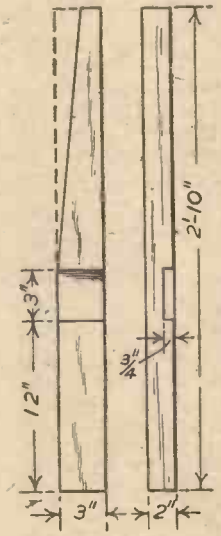


Fig. 4.—Details of back uprights for garden seat.

For the side supports, or legs, mark out two pieces of wood to the dimensions given at E, Fig. 7, and chisel the side to an irregular shape, as depicted. Cut away the curved part at the bottom of each part with a pad-saw, and also cut out the tenon slots at a distance of 3in. above the top of the curved parts at the bottom of each support. A slot, F, 1in. wide and 1½in. deep can be cut in the centre of the top of each support.

The top cross-rail, G, is 19in. long and 3in. deep, and has a

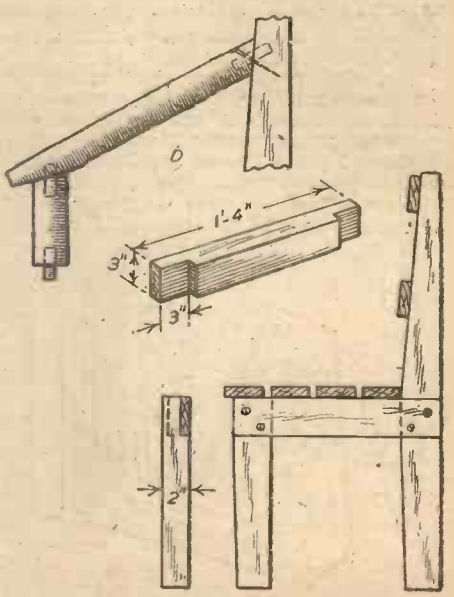


Fig. 5.—Side view of garden seat, and details of arm rest and seat rail.

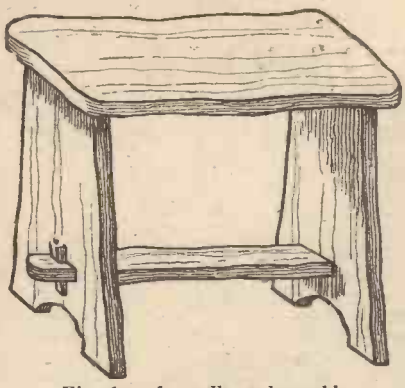


Fig. 6.—A small garden table.

tenon cut at each end 1½in. long and 1½in. deep, to fit the recesses in the supports. After glueing and screwing the tenons in the slots, the top edge of the rail should be planed flush with the top surfaces of the table supports.

Tenons and Clamping Wedges

The bottom cross-rail, H, is 24in. long and 4in. wide, a tenon being cut at each end, as shown. In each tenon a hole 1in. square is made to take a clamping wedge, as shown in Figs. 6 and 7. These wedges can be made from pieces of hardwood 1in. square and 4in. long. The tenons of the bottom rail must be pushed through the slots in the table supports before the top cross-rail, G, is fixed in place.

The table top is fixed in place with four screws, positioned as indicated in Fig. 7. The screw holes should be deeply countersunk and plugged with plastic wood after the screws are driven home.

The finished table can be stained and varnished.

A Rustic Garden Arch

A strong garden arch for climbing roses of the simple design shown in Fig. 8 can be constructed with larch poles. For the uprights, four poles will be required, each 7ft. 6in. long and at least 2in. diam. Each side of the arch is built up with four horizontal members, two diagonal pieces, and three vertical filling pieces, as in the illustration. The horizontal filling pieces should be cut to suitable lengths so that the side uprights are 1ft. 6in. apart after the joints are made. The ends of each horizontal member can be cut and jointed to the uprights, in the same manner as the pergola joints (see Fig. 2). Each joint can be fixed with a 3½in. galvanised nail. The ends of the diagonal pieces are sawn at the required angle, and jointed to the uprights as shown at J after cutting away part of each piece in the middle, where they cross, so as to form a halved joint. Cut the long and short vertical pieces to fit snugly in place after the ends are shaped, and nail them to the horizontal members. The bottom horizontal member on each side should be fixed at a distance of 2ft. from the lower ends of the uprights, so that they are 6in. above ground when the arch is erected. After completing each side of the arch, the lower ends of the uprights, for a distance of 1ft. 6in., should be coated with hot tar and allowed to dry.

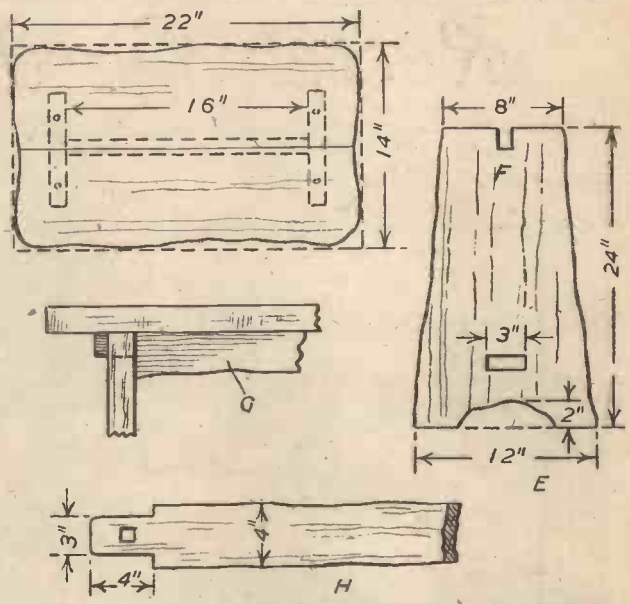


Fig. 7.—Constructional details of the garden table described in the text.

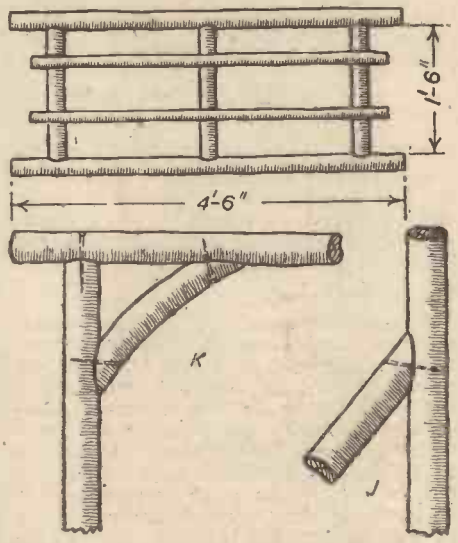


Fig. 9.—How the roof of the garden arch is formed, and details of some of the joints.

The top part of the arch is made with two pieces 4ft. 6in. long, joined with three pieces 1ft. 6in. long, as in Fig. 9. Make the joints as before described, and fix with a single nail. Two more pieces of a smaller diameter are fixed on top of the cross-members, as shown.

Before marking out the joints of the top part with the uprights, the latter should be embedded in the ground in the position chosen. Make the holes for the posts 1ft. 6in. deep, and spaced so that each side of the arch is as near as possible 3ft. 6in. apart.

Place the top in position, and after carefully marking where the joints come, recess the underside of the top rails slightly to fit the top ends of the uprights, and fix each joint with a single nail.

Finally, the short diagonal corner pieces can be nailed in place, as indicated at K, Fig. 9, after which the finished arch can be given two coats of outdoor varnish.

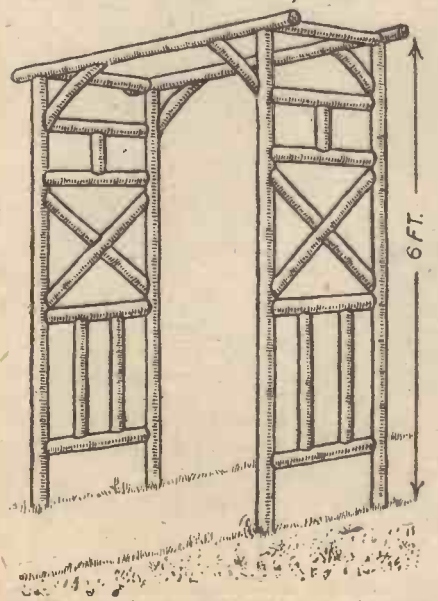


Fig. 8.—A simple design for a rustic garden arch.

Items of Interest

Combined Rake and Hoe

THE noble army of diggers for victory will be interested in a combined rake and hoe which has been submitted to the British Patent Office.

By the use of this agricultural implement, which plays two parts, Mother Earth can be raked or hoed without changing tools. All the gardener has to do is to reverse the tool.

The rake has an extension from its back in the form of a hoe. And the hoe portion is riveted to a socket member which, it is pointed out, simplifies its manufacture.

Drawing Pins Superseded

AMONG draughtsmen the customary method of holding in position drawing and tracing paper on their boards is by the use of drawing pins. A substitute for this method has made its début.

The invention includes grooves in the drawing board combined with flexible bands which overlie the sheet in the grooves. These bands are formed with a slight concave curvature, so that they can be brought down on to the paper after their application to the board. And there are means whereby the bands may be clamped down into the grooves with the result that nothing stands out from the upper surface of the sheet.

New Cycle Fork

AN invention which is stated to be an improvement in front forks for "push-bikes" and motor cycles is the subject of an application for a patent in this country. This device relates more particularly to the type in which each forkside consists of a curved and tapered sheet-metal pressing as distinguished from those made of a single tube.

The inventor affirms that to obtain the best anti-vibratory effect it is desirable that the front wheel, in riding over an obstacle or road inequality, should have a controlled motion in practically a vertical direction in relation to the fork.

The improved fork is arranged in a manner which is the reverse of the conventional type. It has convex edges of the pressed forksides directed forwardly. This arrangement, the inventor points out, brings the lower portions of the forksides into practically a vertical position.

Salvage in Wartime

The Work of the Super-silent Service

By J. A. SPAR

View of the S.S. "Liseta" looking aft, showing the deck rolled back in both directions. (By courtesy of the Anglo-Saxon Petroleum Co., Ltd.)

WHEN it comes to avoiding publicity, Greta Garbo and Montagu Norman are limelighters compared with the Salvage Department of the Admiralty in the course of this war.

There is a reason for it. During the last war the German High Command was misled by the claims of Allied ships sunk which were made by the U-boat men. The U-boats claimed to have sunk between 18 and 19 million tons of shipping. In actual fact they sunk just over 12 million tons. But the High Command fell for the figures issued by the German Admiralty. They thought that Britain was at her last gasp—and they got an unpleasant surprise.

In this war the official German sinking claims are now approaching 32 million tons. These figures are grossly exaggerated—when the Teuton tackles anything, he always does it on the scale he proudly calls "kollossal." But it is reasonable to suppose that the Ober Kommand Wehrmacht (High Command) is still in the dark as to our actual losses. They do not know just how many ships we have available for invasion, troop transport, or supply work. They would give their souls, if they had any, for accurate figures. The Admiralty reply is a bland: "Nothing doing."

Many a ship which the U-boat commanders have claimed as "so badly damaged that her loss must be presumed" has been safely brought into port by the salvage ships, repaired, and lived to sail another day. Ships which have been sent to the bottom have been fished up, patched, and are now sailing the seas as good as new. Halves of ships blown in two in mid-Atlantic have been towed hundreds of miles to port, fitted with new bows or sterns, and sent back into the unending battle of the seas. The Nazis would dearly like details of our successes in these operations. They would like to know our rate of repairs, our new methods, inventions and devices. But the Admiralty lies low and says nothing. As far as salvage is concerned, that grey building in Whitehall might be called H.M.S. *Brer Rabbit*.

But by a patient study of White Papers and other published material it is possible to lift up at least a corner of the veil without obliging Admiral Doenitz and the Carpet-eater of Berchtesgaden. The job of the Salvage Department is to tow to safety ships damaged by enemy action—U-boat, aircraft and mines, and those vessels damaged by marine accident.

Marine Risks

Remember that in time of war marine risks are vastly increased. Lighthouses and flashing buoys are extinguished, ships are steaming on zig-zag courses in close convoy, without navigation lights in a blackout compared with which the blackout we know ashore is like a Brock's Benefit at the old Crystal Palace. Wireless is used sparingly or not at all. Under such circumstances it is inevitable that many fine steamers are in collision or run aground. It is the business of the Salvage Service to get these ships back to safety.

Again, ships sunk in comparatively shallow water have to be fished up and put back into service—it is easier to patch up a damaged ship than to build a new one. Although ships are being built with incredible speed, both here and in the United States, it is not generally realised that specialised ships, such as refrigerated ships, which bring us over meat ration, and tankers, without which the R.A.F. could not get a single 'plane off the ground, or a single tank move, take a much longer time to replace.

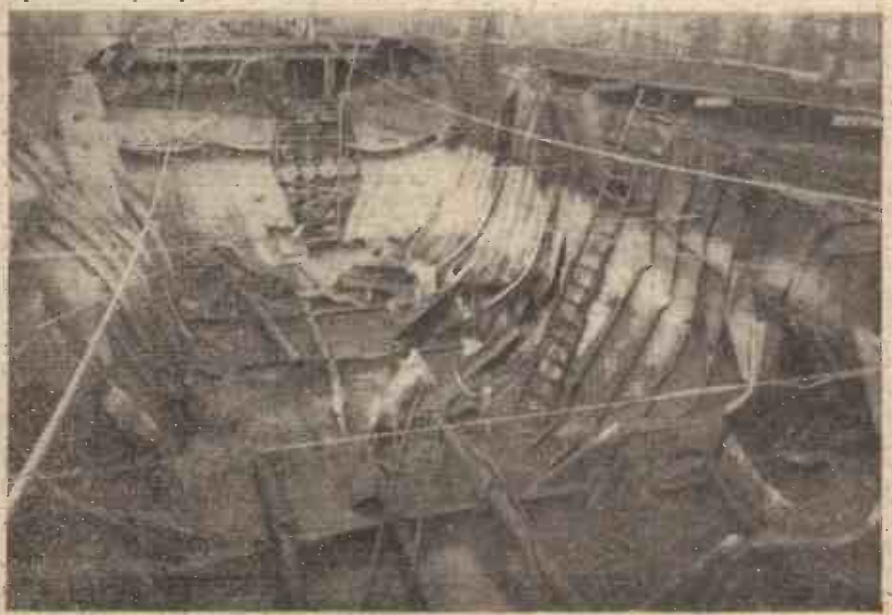
A third task of the salvage ships is to break up by explosives—or disperse, as the official term has it, wrecks lying in the narrow channels swept through the minefields round our own coasts, or sunk in the entrances to our harbours in such a way as to be a danger to navigation.

Raising the *Thetis*

In this war the Admiralty Salvage Department started from scratch. It had no salvage vessels or rescue tugs, except a few pumps in the Home Dockyards, to deal with minor casualties to warships. All the vessels acquired during the war of 1914-1918 had been sold at rock-bottom prices. Even such work as raising the sunken submarine *Thetis* was done under contract.

In the summer of 1938 the Admiralty held a census of what gear was available. This stocktaking shocked even the underwriters, who had been closely in touch with marine salvage.

An organisation of rescue tugs was set up early in September, 1939. It was found that there were only five tugs in British ownership suitable for the work—three were requisitioned by the Admiralty, and the other two were taken over for Government towage work. Meanwhile other rescue tugs were laid down in the shipyards. The object of the Admiralty was not to cut in on the preserves of existing salvage firms, but to supply them with extra technical resources.



View of interior of cargo spaces of the "Liseta" after dry docking, showing some of the empty oil drums in position. (By courtesy of the Anglo-Saxon Petroleum Co., Ltd.)

Types of Salvage Apparatus

A FEW examples of modern diving equipment used for deep-sea salvage work are shown in the accompanying illustrations, which include a view of the Italian salvage-ship *Artiglio*, which became famous in 1930 for her part in locating and salvaging £1,000,000 of gold and silver from the wreck of the P. and O. liner *Egypt*, sunk in 400ft. of water off the coast of Brittany. In December, 1930, the *Artiglio* was destroyed by an explosion in a wreck on which she was working.

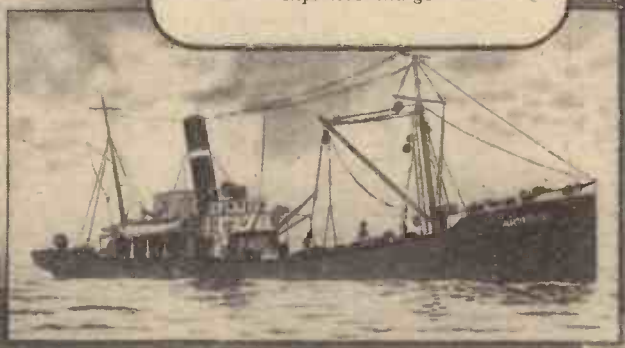
(Left)—Observation Shell—designed by Alberto Gianni.

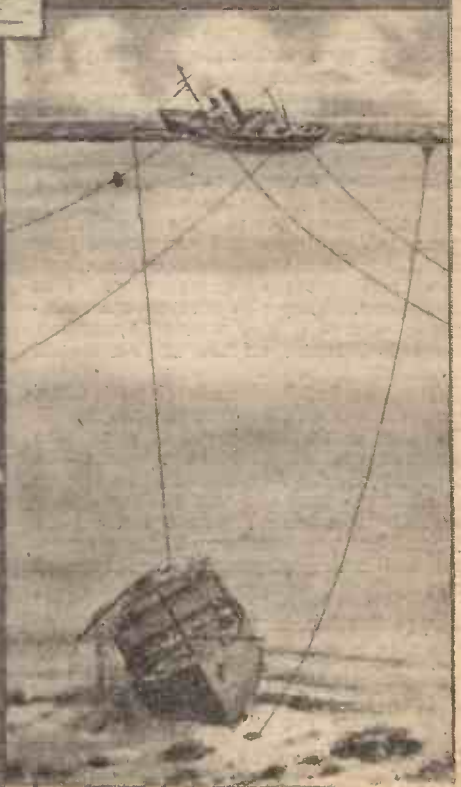
(Right)—Articulated Shell—designed and made by Messrs. Neufeldt and Kuhnke.

(Below)—The type of vessel used for Salvage Work. The illustration shows the famous but ill-fated "Artiglio."

(Bottom left)—Diver in Observation Shell directing by 'phone the removal of a safe seen in the jaws of a massive Steel Grab.

(Bottom right)—The Salvage vessel heels over as, with heavy steel cable, it drags away decking, torn open by explosive charge.





With this in view, the Admiralty in 1940 signed agreements with the five leading British firms, by which these enterprises placed their vessels and equipment in the possession of the Admiralty for the duration, together with their experienced staffs, and agreed to manage them.

Shortage of Salvage Men

In spite of this, it took the Admiralty three years to overcome the shortage of experienced men and suitable craft. In the meantime, it was necessary to concentrate available resources on salving the most valuable ships (such as warships) and those most easily salvable. The others had to wait. Thus, for example, a large tanker, full of oil, could run shore near Sunderland and lie there unattended, because there were other wrecks in the neighbourhood which must be given priority. On the other hand, many stranded ships which appeared to the layman easily salvable were, in fact, impaled on rocks, which would have made operations long and difficult, and absorbed too much of the meagre resources available.

That was the problem with which the Admiralty was faced. Not only had they to build, buy, requisition and convert suitable vessels, they also had to train young men as divers to take the place of men getting on in years. They also had to search every port on the Seven Seas for professional salvage officers and men.

Getting together equipment was easy compared with the task of finding trained men. A good salvor has to have a natural flair for the work, sharpened by long practical experience. Few men in the United Kingdom possessed the necessary qualifications.

The Admiralty sought far and wide for the right type of men and found a small number in places as far distant as Istanbul, Bombay, and the Yangtse river. In the period from the invasion of the Low Countries to the collapse of France a number of salvage men and vessels, including some of the very efficient Dutch tugs and crews, escaped to England and offered their services. And after that the pool was drained dry. It was necessary to train young civilian divers, and to call on the services of men with both sea-faring and engineering experience.

In the first four years of the war new salvage craft, portable equipment, and so on cost the Admiralty more than £3,000,000. Rescue tugs cost another £3,000,000. Salvage working costs were £4,359,800, and costs for rescue tugs £1,747,000.

In the same period, the Admiralty's agents, salvage bases and contractors have carried out successful work on merchant ships and cargoes worth more than £70,000,000. They also gave towage assistance to ships of a value of over £17,000,000. Not a bad return on the original capital investment.

Now, why had British salvage work fallen to such a low ebb between the two wars? The fact is that nobody had gone into salvage as a profession for twenty years. In August, 1914, the Admiralty had no salvage organisation. It is said that a lifting lighter designed for salving submarines was built in 1910, but was later turned into a water-tank, and its original purpose forgotten until June, 1918.

Salvage Section in 1915

In 1915 a salvage section was established under Captain Frederick Young (later Commodore Sir Frederick Young). By the end of the war there were six naval officers on the staff, thirty salvage officers, and a fleet of 15 equipped vessels and six converted hopper barges, used as lifting craft. The Admiralty also owned several hundred motor, steam, and electric submersible pumps, several hundred diving sets, hundreds of miles of wire rope, and a mass of other gear.

When the war was over they sold the lot. The public was convinced, even if the Admiralty was not, that we had won the war to end all wars—and it is the public which pays the piper when it comes to equipping the Navy. The Admiralty did not wish to turn in on the legitimate operations of private salvage firms—they contented themselves with clearing the blocked ports of Ostend and Zeebrugge.

For the rest, ships and equipment were sold for an old song. Pumps which had cost £1,900 went for as little as £90 and £150. Salvage vessels were almost given away. Most of the plant was snapped up by speculators with some knowledge of salvage, who liked to take a chance in the hope of making an easy fortune after the war, or by other speculators with a knowledge of human nature, who issued glowing prospectuses to the British Public, telling of the ships and cargoes lying there for the taking off the coasts of these islands.

The bottom soon fell out of the post-war salvage. For a short time fair profits were made by able and experienced men. But many of the mushroom firms which sprang up were soon driven out of business. The slump of 1921 sent the price of scrap metal down and down and down. One firm with a capital of £200,000 earned only £100,000 in the whole of its brief existence. The few firms which survived, in the face of foreign competition, could barely keep their essential plant up to date.

Many foreign countries, including France, Germany, Greece, Italy, the U.S.S.R., Spain, and Turkey restricted salvage work by law, in their territorial waters, to their own nationals. Belgium and the Netherlands did not pass restrictive laws, but national sentiment had just the same effect. In Norway, Sweden, and Denmark the salvage concerns combined, in a Scandinavian salvage union, to respect each other's territorial waters and keep out outsiders. No wonder the British salvage men were left out in the cold, and thought twice before sending their sons into what seemed to be a dying profession.

In fairness to our Dutch peacetime competitors it must be freely admitted that the highly skilled Dutch salvage tugs have been of inestimable value to us in the course of this war.

Salving the *Macbeth*

For example, when the 4,935 ton steamer *Macbeth* broke down in mid-Atlantic, the British tug *Prudent*, stationed at a Canadian base, was sent out to tow her back to Canada.

Searching for a drifting ship in the vast wastes of the Atlantic, without the help of wireless signals which would give away positions to the enemy, is like looking for a needle in a haystack.

But by the exercise of a sort of nautical second sight the *Prudent* found the *Macbeth* and took her in tow. Then the weather took a hand. Contrary winds reaching gale force slowed down progress and used up fuel to such an extent that after towing some 400 miles, the tug had barely enough fuel to get back to Canada herself.

The *Macbeth* had to be left pitching and wallowing helplessly, a sitting target for any U-boats which might be in the vicinity.

While the *Prudent* was refuelling at top speed for another rescue attempt, it was decided to send a tug from the British side to tow the *Macbeth* to a port over here. The well-known tug, *Zwarte Zee*, with her hardy Dutch crew, was detailed for the job.

The *Zwarte Zee* got a hammering from the Atlantic on her way out. Her lifeboat and jolly boat were washed overboard, the raft was smashed to splinters, all the hatch covers were torn off, and there was other damage. At times even this powerfully engined vessel was capable of only five knots. Nevertheless, she found the *Macbeth*, rolling heavily in a beam sea. Soon afterwards the *Prudent* also returned from the Canadian side.

The *Zwarte Zee* got her heavy six-inch towing wire ready—no easy job with heavy seas constantly crashing over the deck and throwing the gear all over the place. Then

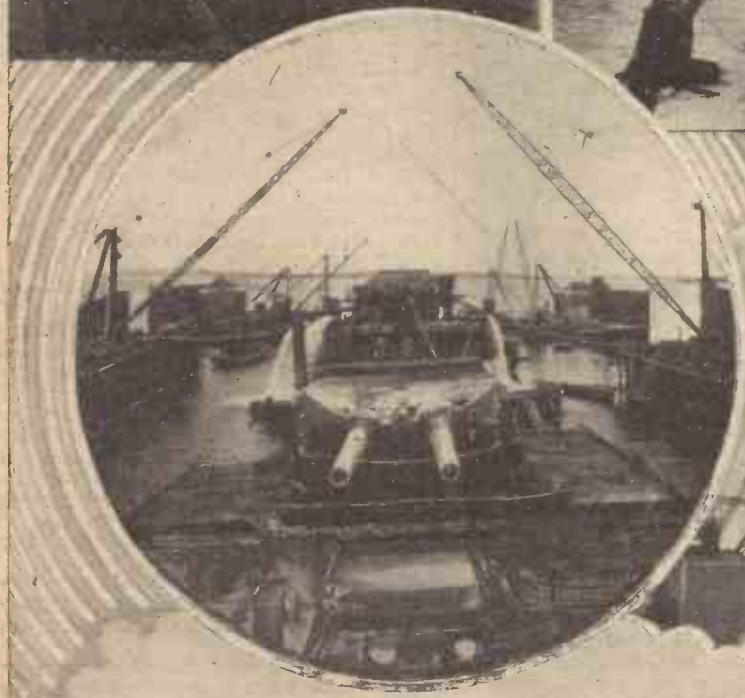
Repairs and reconstruction completed, the "Liseta" ready to go to sea again. (By courtesy of the Anglo-Saxon Petroleum Co., Ltd.)

Salvage Work at Scapa Flow

After lying for eleven years at the bottom of the sea, at Scapa Flow, many ships of the scuttled German battle fleet were successfully salvaged, and the illustrations on this page show some of the work in progress.

(Left) The battleship "Hindenberg" partly above the water after the fourth attempt to raise her.

(Below) Another battleship of the "Hindenberg" class after being salvaged.



(Left) This illustration shows water being forced out of the partly raised hulk by compressed air.

(Above) Showing a partly raised warship between the huge floating docks used in the operation.

(Left) Air-locks attached to submerged hulk down which descend the men to seal the hull preparatory to filling with compressed air.

Illustrations by courtesy of Cox and Danks, Ltd.

she steamed in very close to the *Macbeth's* forecastle on the starboard side, which, through the high sea, was moving very violently.

Some oil was pumped overboard to smooth the sea, and a heavy line was got across to the disabled steamer. Then a three-inch manilla was bent on to the heaving line.

As the *Macbeth* could not raise steam on her winches or anchor windlass, her entire crew was mustered to haul in the manilla by hand and finally the heavy six-inch towing wire. After tremendous efforts the wire was got on board and shackled to the anchor cable. The tug *Prudent*, which had been standing by, was ordered back to her base, while the *Zwarte Zee* started her long tow through hail and snowstorms.

The *Macbeth's* long spell of ill luck was broken at last. The weather slowly moderated, and in six days she was towed a distance of 900 miles and brought safely into port.

The Commander-in-Chief, never lavish of praise, signalled to the *Zwarte Zee* congratulating her on the "particularly fine achievement" in towing the *Macbeth* to the United Kingdom.

That is but one case amongst many scores, and that time there was none of the heartbreaking business of snapping cables, frost-bitten fingers and many other exasperations which are the common lot of the salvage men in rescue tugs.

The *Liseta*

Here is another salvage story of the war. The small tanker *Liseta*, with a carrying capacity of 3,600 tons, had just discharged a cargo of aviation spirit. Before the highly explosive gases remaining in her cargo tanks could be discharged in the usual way, a tiny spark found its way to a vital part. In a second there was a shattering explosion which did more damage than could possibly have been wrought by the largest torpedo or bomb.

The explosion was heard for many miles, windows of buildings were smashed quarter of a mile away, and parts secured to the deck, such as the spare propeller, weighing about 1½ tons, were hurled bodily a distance of 500 yards. The master and five of the crew, who happened to be on deck at the time, were killed outright.

Then fire broke out. Even while the survivors were fighting it, there was a second explosion, which lifted the deck on which they were standing three feet. Fortunately, the gas in the compartment beneath the deck must have been near the weak end of the explosion range, otherwise they must have all been blown skyhigh.

The fire was got under control but the *Liseta* was left a mere hulk, torn, twisted and contorted beyond recognition.

No longer even floating, she lay heeled over to an angle of 45 deg., and almost submerged. Practically the whole length of her decks was ripped open, revealing the formerly staunch inner fabric of the ship, the ends tenuously connected by a cracked, holed and unsupported outer shell.

If ever a ship deserved to be written off as a total loss and expunged from the pages of Lloyd's Register, that ship was the *Liseta*. But in wartime tonnage is precious—particularly tanker tonnage. If there is any possible hope of salvage, then salvage must be attempted.

The first thing was to move her out of the way of other shipping. By pumping her perforated hull at the rate of 2,500 tons per hour she was lifted just clear of the bottom and moved to a mudbank.

In this position she was high and dry at low water, while at high water her internal spaces filled up and she became almost submerged. With each tide the *Liseta* sank deeper and deeper into the mud, until it seemed that she would become completely buried.

Something had to be done, and done quickly. Somehow, she had to be made floatable, without the aid of pumps, and capable of being towed 40 miles (15 of which were in the open sea) to the nearest dry dock where she could be repaired.

The first attempt was to plug all the openings in the hull with wooden plugs and quick drying cement. But there was too little time at low water, and time could not be spared. With her weakened structure, the strain of rising and falling with the tides was already starting to break her back.

Lifting by Oil Drums

The next scheme was to fill her up with thousands of empty airtight 40-gallon oil drums.

The lifting force of these oil drums when submerged was naturally very great, and it was necessary to contain them in cages, so that the upward force exerted would have the desired result without imposing serious strains on the already weakened hull.

With this in view, the barrels were deposited at each low tide in predetermined positions. This made the *Liseta* floatable all right, but the distribution of the lifting forces was not as desired, and it was necessary to undo all the good work and allow the wreck to sink again.

At last, however, she was got into proper trim.

To provide the necessary longitudinal strength for a sea passage, for by reason of her damage the buoyant drums could only be placed at either end of the vessel, a long and deep double girder, surmounted by a heavy rider-plate, was welded and bolted to the narrow remaining strips of deck on each side. Cross lashings of stout wire were set up between the two. Once again the *Liseta* had a backbone.

Towed stern first, the *Liseta* was brought down twelve miles of river to the open sea. By that time the wind had freshened from the north-west, and a slight sea was running. In the ordinary way such a sea would have been considered smooth, even to a landsman, but to those on board the *Liseta*, whose freeboard was only a few inches, and inside which 3,000 tons of uncontrollable water moved like a tidal wave from side to side as the ship rolled, the slightest movement was watched with tense anxiety.

But there could be no turning back—the tide had already receded too far to permit it. Heaving and rolling, groaning at every lurch, the *Liseta* went ahead at two miles an hour.

Darkness fell. It was too dangerous to carry on by night. The *Liseta* had no anchors, so the tug had to hold her all night to prevent her drifting ashore. No lights were allowed.

All night those on board listened to the jarring groans of fractured plates and the snapping of rivets each time the ship rolled uneasily in the swell. Each time a rivet went they wondered whether the next might not be the signal to grab for a lifebelt before she broke up and sank.

Daylight came at last, and soon afterwards the towing hawser broke. There was no mechanical power available on board the *Liseta*, so her crew had to make Herculean efforts to connect up a new hawser by hand.

Next, the towing hawser fouled the propeller of one of the tugs. Things looked very black until superb handling of the tug got it clear.

Then, when they reached the mouth of the river, which was their destination, a new danger threatened them from a very unexpected quarter. This was caused by curiosity on the part of overtaking ships. All these could see from their bridges was two ends of something above water being towed by two powerful tugs. In spite of warnings, these overtaking ships approached so closely that their bow waves almost swamped the *Liseta*. It would be an understatement to say that they were glad to find the gates of the dry dock open and men ready to take them in hand.

The *Liseta* is now fully repaired and back in service, as seaworthy as ever she was—a floating monument to a fine piece of salvage, and she is only one among many.

Tugs for Towing 35,000-ton Ships

When you think of a rescue tug, do not imagine one of the small but sturdy craft which steady Atlantic liners in and out of ports such as Southampton in times of peace.

Some of the tugs in the Royal Navy are larger than corvettes and almost as big as medium-sized destroyers. They are designed to tow even 35,000-ton battleships and even bigger liners over hundreds of miles of open sea, and to do it at a reasonable speed.

These vessels are always standing by ready to go flat out through heavy seas to the help of vessels in trouble. Their engineer officers pride themselves on being able to get their vessels under way in less than five minutes.

Wartime experience has led to the incorporation of many new ideas and devices in these super-tugs. Winches, capstans and other gear are driven by electricity from powerful dynamos.

Jets which can hurl chemical extinguishing fluid from 40ft. to 60ft. to fight fires, and pumps which can suck water from flooded holds at the rate of about 800 tons an hour, are two essential items of equipment.

One of these tugs, H.M.S. *Samsonia*—she was built by Messrs. Henry Robb, Ltd.—recently towed a 7,000-ton merchantman a distance of 1,400 nautical miles. On the way she was attacked by the Luftwaffe, which thought it had found a sitting target—but rescue tugs have teeth as well as tow ropes. The *Samsonia* fought back with her guns and beat off the enemy, whose bombs fell harmlessly wide of the target.

Lt.-Cdr. Owen Jones, of Hull, a deep-sea towing master, said afterwards that this tow was the toughest job he had ever tackled. The ship had been damaged in the stern, and could not be steered. Imagine trying to tow a motor-car with a hopelessly bent back axle over ploughed fields, and you might get some idea of the problem involved. Throughout the whole 1,400 miles he yawed and steered from side to side, so that at times she was broadside on to the tugs. But they got her in.

It was the *Samsonia* again which, out in the Atlantic, received a wireless signal to search for a Lockheed bomber, "adrift on a raft."

The officers thought that there must be some mistake in the wording, but orders are orders and they started to search. Sure enough, after a few hours, there it was. The bomber had been lashed to a raft on the deck of a merchantman, the ship had been torpedoed and sunk, and the raft had floated off. It took three days to tow the bomber safely to port.

On some occasions the cargoes brought in on damaged ships are of infinitely greater value than the ships themselves. One such ship had a large consignment of American heavy bombers. On another occasion a tug had to steam at full speed through dense fog—a thing which every seaman loathes—to the rescue of a large merchantman laden with half a million pounds' worth of aero engines and 15,000,000 eggs. Maybe you ate one of those eggs yourself, for they got her in, though only with the narrowest margin of time separating her from complete loss.

Inventions of Interest

By "Dynamo"

Talking Clock

THAT mechanical chanticleer—the alarm clock—is *rara avis* in these days. To the same family, though more complex, belongs the phonetic timepiece. Instead of striking, this wonderful horologe literally tells the time after the manner of an announcer.

A clock of this description is the subject of an application for a patent in this country. Among the works is a drum carrying a roller sound record for mechanically reproducing the human voice.

Following the announcement of the time, this vocal clock may be made to add some wise admonition. For example, suitable advice morning and evening would be the familiar couplet:

"Early to bed and early to rise
Makes a man healthy, wealthy and wise."

To Heat Aeroplanes

AN improved apparatus for heating an aeroplane has been submitted to the British Patent Office. The inventor has had in view the comfort of passengers in a transport 'plane and of pilots, observers and gunners in military aircraft.

The virtues of this invention are stated to be compactness and light weight; capacity for the use of leaded gasolene as fuel; and ability to maintain proper combustion conditions in spite of variations in the temperature and pressure of the enveloping atmosphere.

The device includes an air-heating space; a combustion chamber; a thin-walled, metallic structure separating the combustion chamber from the air-heating space; and means for atomising gasolene, mixing the atomised gasolene with atmospheric air, passing the mixture into the combustion chamber, and discharging the products of combustion into the atmosphere external to the aeroplane.

Safety Stable Equipment

IN case of fire or other emergency it is desirable in stables to be able rapidly to release the animals which are tethered there. This is the object of an invention for which a patent in this country has been applied.

The device consists of an arrangement whereby each tethering chain is secured by a sliding bolt. All these bolts in the stable are connected to overhead rotatable shafting. And mechanism is provided which, when the shafting is rotated in one direction, simultaneously withdraws the whole of the bolts and returns them upon the shafting being rotated in the opposite direction. Each bolt also has means for independently releasing it.

An additional feature is proposed by the inventor. The shafting may be hollow and perforated at intervals. And there is an arrangement whereby water can be supplied to the interior of the shafting. This will make it possible to give incendiaries a shower bath.

Doll's Furniture

IN these difficult days when toys are in very short supply, an inventor proposes to substitute the material articles with doll's furniture made of pictorial cardboard. The structure is held erect by means of interengagement between the parts, and the articles, being collapsible, can be stored in a small space.

Reinforced by the lively imagination of a child, this locum tenens will act as a deputy until the more solid goods are available.

Waste Utilised

AWAY back in the alleged good old times of Queen Victoria, if I remember rightly, a bundle of sticks could be bought for a halfpenny. And the thrifty housewife could boast of how many fires she could light with one bundle. Then along came firelighters of various types which started the home fires burning.

According to the inventor of an improved brand who, by the way, is of Greek nationality, firelighters have generally had as a basis wood pulp, wood sticks, coal and coke, etc. His aim has been to devise a firelighter consisting largely of waste materials, so that the article can be produced very cheaply, without, however, sacrificing its efficiency.

The inventor takes spent Fuller's earth or spent clay, which is, for example, the waste product obtained in oil refining. This he employs as the basis for his firelighter. It is combined with other combustible materials and, if necessary, with a binder and/or a small quantity of an oxidising agent.

These combustible materials are selected from the residues of dyestuff manufacture, varnish, petroleum and linseed oil.

Extensible Hand Lever

AMONG recent applications to the British Patent Office is one relating to a hand lever. The aim of the inventor has been to furnish such a lever which can be readily attached and quickly extended at will, thus providing a longer leverage when required.

Another object of the invention is a hand lever whereby, when two such levers are used in diverging relation to one another simultaneously by a single operator, the handle ends will be within reach of the two hands of the workman.

The lever comprises inner and outer members telescopically connected.

Incendiary Materials

IN the present day—or rather night—the incendiary plays a radiant rôle in the theatre of war. Incendiary and pyrotechnic materials are detailed in an application for a patent accepted by the British Patent Office. The specification includes also a process for making such materials.

The process comprises the reducing of magnesium oxide to metallic magnesium in vapour form. The vapour is quenched in oil to form a thin slurry consisting of finely divided metallic magnesium and oil. The slurry is passed to a settling tank. In this tank it is allowed to stand so that the lighter oil containing some particles of magnesium, recirculated for use in a further quenching operation, separates, leaving a thick slurry. This slurry is passed through a filter and drier, to produce a thick, heavy mud.

It will be observed that the word "pyrotechnic" is mentioned above. Possibly this invention will play a part in the display of fireworks which will celebrate the declaration of peace.

A floodlit tunnel, known as a light tunnel, first of its kind in Britain, which enables engines to be examined quickly during the blackout, has been completed by the L.N.E.R. at a locomotive depot on the East Coast main line. It is of great value when engines arrive after darkness and are required again for traffic before daylight. The tunnel is 80ft. long, and has whitened walls on which are fitted fluorescent lighting tubes. The illustration shows examiners inspecting the driving wheels of a British Austerity engine in the tunnel.

THE WORLD OF MODELS

By "MOTILUS"

A Review of the Model Railway Gauges from "00" up to ¾ of an Inch to the Foot—a Useful Record for Newcomers to the Hobby

Gauge 1—a scene on the Bekonscot electrically operated railway, a feature of the famous miniature village at Beaconsfield.

DESPITE the war there appear to be a number of newcomers to the model railway hobby, many of whom are in the Forces, and I am constantly getting queries passed on to me regarding the different gauges in use, and their special purpose in the model railway world. Therefore, I feel it an opportune moment to devote a little space to a brief review of the position as it stood at the outbreak of war.

Toy model railways were introduced into this country from the continent, first from France and later from Germany, and the earliest gauge really established as a standard was 35 mm., now known throughout the model world as gauge "O" (1¼in. gauge), and here I would like to mention that continental toy and model makers always measure the gauge from the *centre* of the rail, whereas in England we take the *between* rail measurement, which I consider the more correct way.

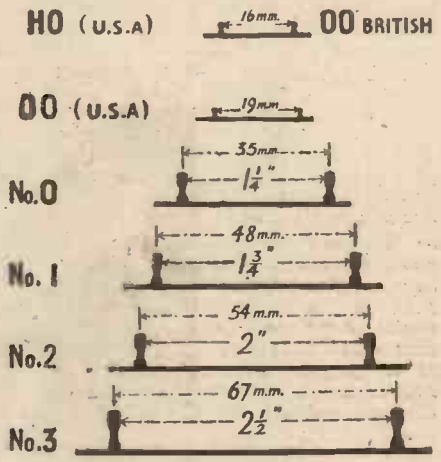
The Popular "OO" Gauge

Without preliminary preamble let us begin with the smallest of gauges—"OO" as it was first called—introduced into this country by Mr. W. J. Bassett-Lowke, in 1926, as a purely clockwork outfit for the miniature table railway. Actually it was 16½mm. or ⅝in. between rails with the locomotives and rolling stock to a scale of 3¾ or 4mm. to the foot.

This miniature gauge, before the war, was becoming a close runner-up in popular favour with gauge "O" and, from what I hear, is likely to be a more serious competitor in the post-war period.

"Trix" Trains

There have been two main developments since the first introduction of this inexpensive clockwork train set. The first the Trix Trains, which emanated from the continent and were being made in England under foreign patent rights before the present war broke out. This novelty outfit had a special feature of two trains running on one track, each under its own independent control. The propulsion was by electricity, 14 volts a.c., the locomotives being fitted with an a.c. motor, operated from a.c. house mains through a transformer. The Trix method of conducting the current is ingenious. The railway has three insulated metal rails, and the central rail is used as a common return. For this method the wheels of the locomotives and rolling stock are all specially insulated, and as the system grows more complex it can be sectionalised, each section having its own controller. It is a railway capable of enormous development, and an ideal one for those who delight in operation from a central switch-board. Trix engines can also be arranged to run off d.c.



Dimensioned drawing of the different model railway gauges mentioned in the article.

The "Dublo" System

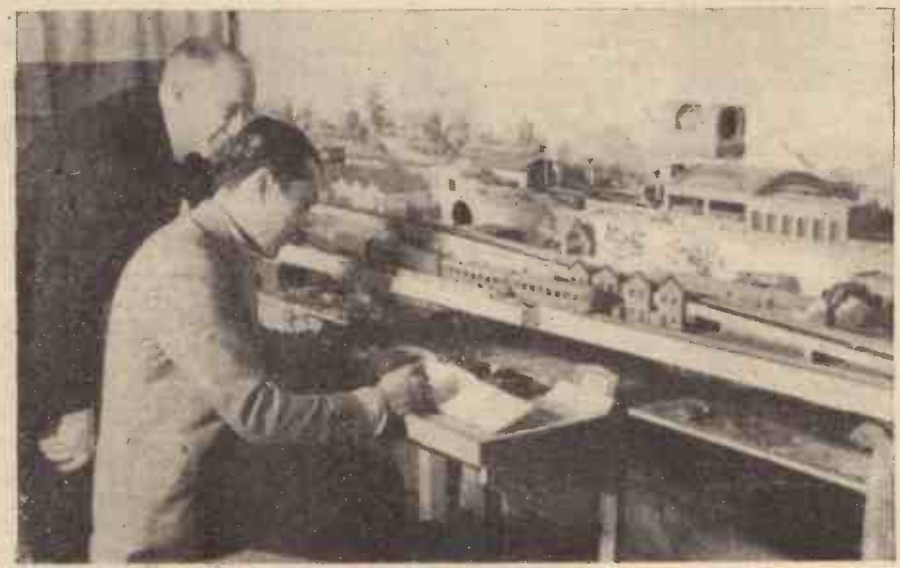
The second system mentioned is the "Dublo" introduced later by Messrs. Meccano, Ltd., of Hornby train fame. The Hornby Dublo engines are fitted with a permanent magnet motor and work off direct current, from a storage battery or through a rectifier.

In addition to these two productions there are numerous smaller manufacturers making scale model gauge "OO" locomotives, rolling stock and track, mostly hand-made and with very beautiful fine detail, though not very successful under operational wear and tear.

The English HO gauge differs very slightly from OO, being to the scale of 3½mm. to the foot, but I would like to explain at this juncture the United States miniature gauges, which are slightly confusing when compared with the British ones. The American HO is 16mm. worked out on a scale of ⅛in. to the foot. "OO" gauge, which is 3mm. wider (19mm.) is scaled at 4mm. to the foot.

Gauge "O"

Next on our list is gauge "O" (1¼in. between rails—35mm. rail centre)—still the gauge with the widest appeal the world over. Commercially made models are



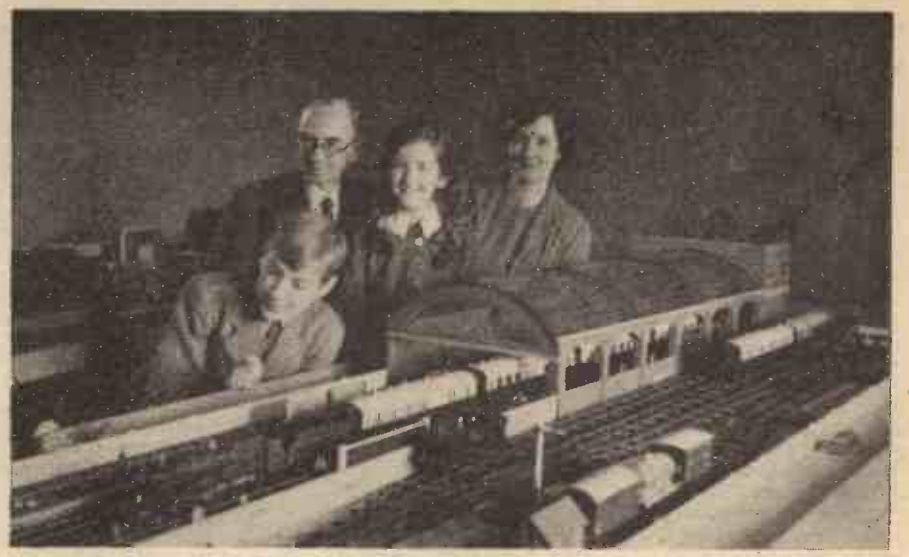
"OO" gauge—an interesting Trix railway—the property of Prince Bira of Thailand, the well-known racing motorist. Mr. W. J. Bassett-Lowke is seen with the prince.

practically all interchangeable in this size and it has the advantage of a choice in propulsions of clockwork, electric a.c. or d.c., and steam. The increase in size also gives model railway owners who like making their own equipment a better chance than when working in the miniature scale demanding such accuracy of detail. There are also more parts available.

The usual minimum radius for this is 3ft. and various types of track are available commencing with the inexpensive tinplate—the best portable track—and finishing up with accurate scale model permanent way with proper keys and switches, either hand, mechanically, or electrically operated. The locomotives and rolling stock are generally made to the scale of 7mm. to the foot, although many English model makers prefer to use ¼in. to the foot—probably more accurate—but the advantage claimed by those who favour the larger scale of 7mm. is that there is no less of realism in the larger locomotive and vehicle, compared with the track gauge, providing external details such as chimney, dome, buffers, hand rails and so forth are kept to the correct scale.

Gauge I

Gauge 1 (or 1¾in. between rails—48mm. rail centres) still retains enormous popularity, especially with the model railway owner who likes a combined indoor and outdoor track and is fond of carrying out experimental work with his various types of locomotive. It is also possible in this gauge to have a very satisfactory locomotive using solid fuel for the boiler.



"O" Gauge—Mr. Gilbert Thomas and his family with his super-detail clockwork layout

drawings, which enable the model to be built by anyone who possesses a lathe, a drilling machine and the usual bench tools. One of the best examples of a model the enthusiast can build himself is the 2½in. gauge "Flying Scotsman," which was fully described and illustrated in these pages just prior to the outbreak of war. As the issues in question are out of print, Messrs. Bassett-Lowke, Ltd., who collaborated in the production of this locomotive, have reprinted the complete articles and pictures, and the booklet can be obtained from Head Office, Northampton, or at London or Manchester branches, price 1s., postage 2d. extra.

Gauge 2½—a ½in. scale unpainted model of the "Flying Scotsman," for methylated spirit or solid fuel propulsion.

Mr. Victor Harrison's railway, which has already been described in these pages, is probably the best example of this gauge in this country, as regards operation, while for picturesque scenic effects the Bekonscot Model Railway and Village would be difficult to beat.

Often this gauge is used in exhibitions where continuous running is required. At Radiolympia an exhibit representing the Travelling Post Office had two 10mm. to the foot scale models of the Royal Scot fitted with electric motors, and these locomotives ran a distance of 125 actual miles!

The larger manufacturers after the war will probably only make this gauge of model to special order, because of the variety demanded by the gauge 1 enthusiast.

I would make a passing reference to gauge 2, but this was a purely British gauge, and never recognised as a commercial standard on the continent or in America.

2½in. Gauge

It is the 2½in. gauge which has increased so in public favour since model engineering has become such a fascinating hobby to those with a small workshop. Interest has been stimulated by several manufacturers producing sets of castings and really reliable

3½in. Gauge Models

We have now arrived at the point in size, when models become more accurately dimensioned and approach the museum or exhibition class. ¾in. to the foot—or 3½in. gauge—has always been recognised as an excellent size for exhibition, and many wonderful models have been made by amateurs and exhibited in peacetime days at the Model Engineering Exhibition at the Horticultural Hall, London.

The "Cosmo Bonsor"

Mr. James Crebbin stands out as the pioneer of this gauge, and for forty years has been experimenting in the perfection of small steam locomotives, almost exclusively in the ¾in. scale. His "Cosmo Bonsor" inside cylinder 4-6-0 engine has been on view since 1903, and the running of Mr. Crebbin's passenger hauling small steam locomotives has been one of the most "crowded" features of the "Model Engineer" show each year. On a nice level track a 3½in. gauge locomotive can be relied upon to haul several passengers, and queue up for rides at the exhibition of boys both old and young is reminiscent of the queue for oranges to-day, when they are available!

I think this article covers most of the questions of new model hobbyists, and I will leave the large gauges of 1in.-to the foot and over to a later issue.

For those who are interested in this subject, Messrs. Bassett-Lowke tell me they still have a small allocation of paper which has been used for their Model Railway Handbook, in limited supply from Head Office, and London or Manchester branches.

Gauge 3½—a ¾in. scale exhibition model of the G.W.R. locomotive King George V, showing the bell on the footplate, which was added as a souvenir of its famous tour of America.

A Brief History of Photography

How a Hobby Became a Subject of National Importance

By JOHN J. CURTIS, A.R.P.S.

IT is always interesting to trace the origin and development of a hobby, and it is also interesting to note that those hobbies which have developed into some form of general usefulness have had small and perhaps insignificant beginnings.

Many of us will remember our early attempts in the making of a wireless set, the experimenting with crystals and cat's-whiskers, wet batteries, etc. We little dreamed that in a few years we could get better results by simply turning a knob or pressing a switch, and that wireless transmission and reception would occupy such an important position in the national and international daily life as it does to-day.

Small Beginnings

Engineering and all its various branches had small beginnings: the tinkering about with a few wheels till a machine evolved which, with the aid of a spring, produced movement. Probably our turning lathes in their manifold and complicated forms, as used in thousands of workshops now, sprang from that original thought which rooted itself in the mind of the man who first used a wheel for helping him to shape and mould a lump of clay into a useful domestic vessel some thousands of years ago.

Many readers of PRACTICAL MECHANICS who have been interested in these photographic articles which have appeared regularly for some time now are possibly not aware of the intensely interesting history of the hobby, and the enormous progress that has been made in 100 years.

Daguerreotypes

It is just over 100 years since Fox-Talbot and Daguerre were experimenting to produce a photographic image of a permanent character on a base of metal or paper; the first was an Englishman, who had for his laboratory a crypt in an old abbey; Daguerre was a Frenchman, who worked with another of his countrymen named Niepce, and invented and patented the Daguerreotype.

Both Fox-Talbot and Daguerre showed specimens of their work in London within a few weeks of each other, so we must, in fairness, give them the credit of being the original authors of the photography as we know it to-day. At the same time there is no doubt that the action or reaction of light on salts of silver combined with other chemicals had been known for many years before, but that knowledge was not sufficient to enable a practical use to be made either industrially or as a "hobby," except by a very few. We know that Wedgwood tried it as a means of introducing designs on his wonderful china and pottery, but not with much success, for it was found that the image vanished on again being exposed to light, and he could not produce a means whereby it could be "fixed" and made permanent.

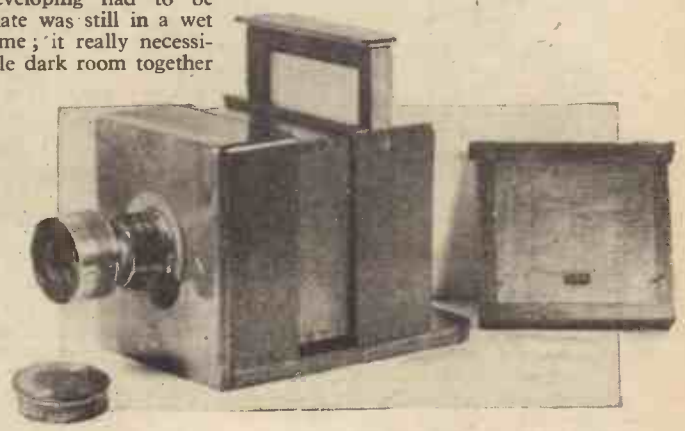
A short while after Fox-Talbot and Daguerre had made their discoveries, the "fixing" trouble was removed by the discovery of soda hyposulphite about 1839 by Sir John Herschel as a means by which the silver salts which had not been acted upon by the light, and therefore was not included in the photographic image, could be removed and the image made immune to any further exposure. Many of those early Daguerreotypes are still in existence, as "portrait makers" sprang up and travelled in various parts of the country using the coated metal plates for the work.

The work, however, was cumbersome and expensive, and there were men like Scott Archer and Maddox who were doing much experimenting to improve the initial process, and to find an emulsion which could be coated on glass so that the original image obtained as a negative might be copied through the glass base on to a coated or sensitised paper, thus producing a "positive" print.

Wet-plate Process

These and others of the early group of pioneers eventually produced what is still known as the wet plate process; a piece of glass was first made perfectly clean, then coated with a layer of collodion and, while still wet, was laid in a bath containing a solution of silver nitrate and sundry other chemicals. After a few seconds' immersion the coating was found to be sensitive to light, and while the plate was still wet it was placed in a carrier at the back of the camera, and the exposure made. Still in its wet condition, it was taken to the dark room and treated to a developing bath, and finally to a fixing solution consisting of cyanide of potassium.

You will recognise that although this was a considerable advance, yet because the coating, exposing and developing had to be completed while the plate was still in a wet state, it was cumbersome; it really necessitated carrying a portable dark room together with a fairly heavy, ponderous type of camera. A very fine specimen of the portable dark room can be seen in the museum of the Royal Photographic Society; it is mounted on wheels and is in the form of a barrow, complete with long handles, the main part being covered with a framework, which in turn holds a complete envelope of lightproof material. There was a suitable level base on which bottles, dishes and measures could stand; the operator would place his head, arms and shoulders inside the envelope and, after excluding all light, would proceed to coat and sensitise the glass plates, and after exposure would again partially hide himself in the contrivance to do the developing. Despite these inconveniences photography became popular, and, thanks to the great enthusiasm of its devotees, we have some excellent specimens of exposures made in the mountains of Switzerland and parts of other countries which had never been subjected to camera work before, and it is interesting to note that one of these cameras was actually used by a war correspondent to produce some true records of the battles and incidents of the Crimean campaign. An explorer once took some hundreds of pieces of glass 12 x 15ins., together with chemicals, camera and dark room, up the River Nile to Khartoum, and it is on record that many of his negatives were still in existence, and in excellent condition, 30 years afterwards.



An early camera, made about 1847 for portrait photography.

Dry Plates

The discovery of gelatine provided the medium by which the next big advance was made, for a man—J. Hill Norris—somewhere about 1870 coated some collodion prepared plates with a solution of this and found that the plates could be allowed to dry and could then be exposed. This seems to have been the commencement of dry plates, but long exposures were necessary; one record tells of one and a half hour's exposure in sunlight. There were more experiments on the part of amateur photographers—Dr. Maddox in 1871, Burgess in 1873, and C. Bennett in 1878—the last named must have been very successful, for he showed pictures in which figures in movement were included, thus proving the emulsion to be much "faster" than any hitherto.

Manufacturers were then springing up, and "dry" plates could be purchased which were 10 times as fast as the "wet" plates, and it is most interesting to note that since the first inception in 1877 right up to the present day the manufacturers' great aim has been to increase the speed of their products.

The next big advance came with the introduction by George Eastman of a roll-film system in 1884. The first of these had a base of paper, but this was not entirely satisfactory, and so, after several experiments were tried out with other materials, in 1889 the first transparent roll film was produced and in 1891 made in such a way that it could be loaded into a camera in daylight.

What tremendous strides have occurred since Fox-Talbot experimented in that abbey crypt in 1835 to the present day; those huge factories where film in thousands of miles is being turned out.

Future Developments

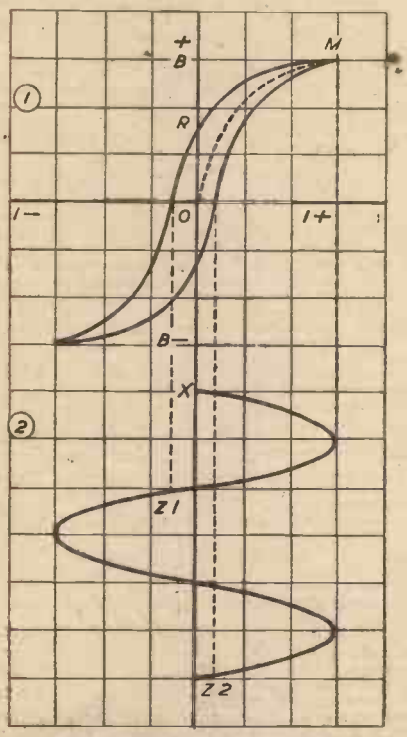
We have only considered the growth and development of "negative" material, and I have shown that it is due to the perseverance of Englishmen during the last century that we amateurs are able to use our cameras and produce some wonderful results far beyond anything which those pioneers could have thought possible. Colour photography is still very young, and stereoscopy is a field that has not been completely explored.

Letters from Readers

A Watch Demagnetiser

SIR,—I have read with interest the details appearing in the April issue of PRACTICAL MECHANICS for the construction of a watch demagnetiser, and would like to point out that in my opinion the possibility of effectively demagnetising a watch by this method is a matter of chance.

The accompanying curves show how a specimen of iron is taken through a complete cycle of magnetisation by means of an alternating current. Curve 1 shows how the flux B varies with the current I (the normal hysteresis loop). Curve 2 is a normal sine wave representing the current in the A.C. circuit, starting with zero current at X. B will increase until I reaches a maximum value corresponding to flux M. The graph OM being the B/H curve for the iron or steel.



Curves indicating cycle of magnetisation of iron by alternating current.

The supply current then decreases to zero, and the corresponding values of B will follow the line MR. It will be seen, however, that at this point the iron still retains some of its magnetism, which is represented by RO, and in order to reduce this to zero the current must be increased to a negative value Z_1. Thus it will be seen that if the circuit is broken at any point of the cycle other than Z_1 and Z_2, some residual magnetism will still remain in the iron.

I would suggest two alternative methods:

(1) After the watch has been held in the coil for a short time as described, it should be slowly taken out and gradually removed away from the alternating field *with the current still switched on.* By this means the alternating flux which links with the watch is gradually reduced until it is zero, when the watch has been taken outside the effective field due to the coil, and thus reducing the magnetism in the watch to zero.

(2) This can also be done by supplying the A.C. current to the coil through a potential divider and, *while the watch is still held in the coil,* the current should be gradually reduced to zero.

P. PRIDAY (Renishaw).

Ammeter Readings

SIR,—With reference to the article entitled "Instruments for Motor-cars and Aircraft," which appeared in the May issue of PRACTICAL MECHANICS, I should like to point out that your contributor is slightly in error when he states, re the ammeter—"This indicates . . . the rate of discharge when certain loads are put on the battery (starter motor, lights, etc.)."

Consideration of the wiring diagram of any car will indicate that the current taken by the starter motor does not pass through, and cannot be registered by, the ammeter. Of course, rate of discharge is registered when any other equipment is in use on the car.

WM. J. LIDDELL (Saintfield).

[*We agree.*—ED.]

A Sound-box Pick-up

SIR,—the accompanying sketches illustrate an idea for turning an ordinary sound box into an electrical pick-up. Although the sketches are reasonably clear, a few notes are required to help on certain points.

If the diaphragm is metal there are two ways of overcoming what may be a short cut for the current, i.e., the current can get from brass strip through a small amount of carbon to surface of diaphragm and short cut to other brass strip, thereby not using the main body of carbon (Fig. 1).

This can be overcome by painting the *inside* of the diaphragm with a hard-drying non-conductive paint, such as cellulose.

The second way is to put only one brass contact through the cork, making the head of the brass central in the cork, and using the frame of sound-box as the second contact. The diaphragm will make its circuit from the stylus bar, which is connected to the frame.

The amount of carbon used can be varied by putting a ring of cotton wool alongside the lower gasket ring. (See Fig. 2.)

The transformer may be rather difficult to obtain at present, but there seems to be a number of small microphones about on sale for 7s. 11d. The carbon from these could be used, also the transformer, for experimental trial.

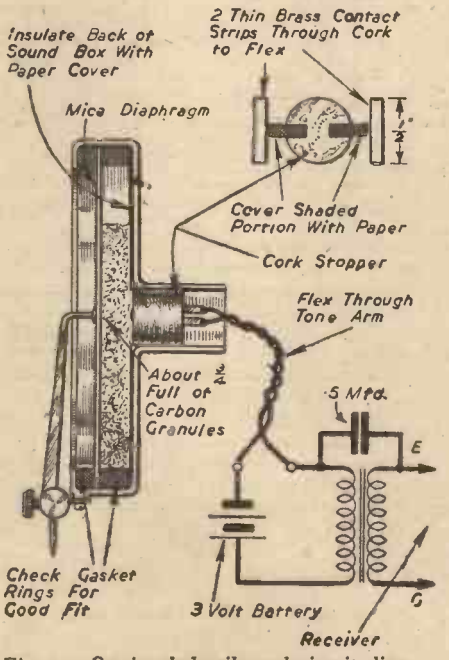


Fig. 1.—Sectional details and circuit diagram of a sound-box pick-up.

The ratio of the transformer will vary according to the amount of carbon, and distance between poles, and the distance between the diaphragm and back of the sound-box body. These factors will vary because of the vast number of different sound-boxes there are. The average transformer required will be what is known as a carbon microphone transformer about 20/1 step-up. (Fig. 3.)

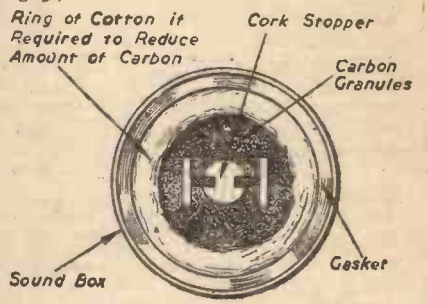


Fig. 2.—Front view of sound-box with diaphragm removed.

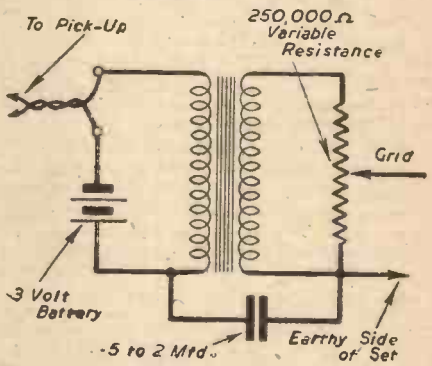


Fig. 3.—Transformer diagram of connections showing external volume control.

A little ingenuity may be required in fitting the cork into the hole at the back of the sound-box. If the tone arm fits *over* the sound-box neck it is simple. If the tone arm fits *into* the sound-box neck note how far it goes in, and make the cork short so that the tone arm will not push the cork in the place. Where the tone arm fits *right in,* and level with inside surface of the sound-box, then the sound-box, when dissembled, must be kept attached to tone arm, a tight fit, and the cork, etc., fitted into the tone arm end, and kept into position whilst the sound-box is reassembled.

I find that if the diaphragm is on the thin side over-emphasis of the bass is obtained. Replacement of the thin diaphragm with a circle of tin of fairly heavy gauge will bring the tone to normal. The inside surface of the tin is cleaned bright. The *double* contacts coming through the cork can be retained, the surface of the tin becoming a conductor for the battery current.

You can, of course, have a single contact through the cork and make the case a return pole. The size of the single contact will be the same as the two put together. These points will equally apply to a thin metal diaphragm sound-box.

The finished pick-up is very sensitive, and will overload an H.F. valve if it is not controlled by a volume control.

F. L. ALLANSON (Birkenhead).

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.

Removing Fur in a Kettle

I HAVE recently purchased an electric kettle, and, owing to the hardness of the water, it has quickly "furred" up.

Can you recommend the best way for removing this?—W. H. Appleton (Reading).

PROVIDED that your kettle is not made of aluminium, or aluminium alloy, you can best get rid of the deposited "fur" by placing a small quantity of caustic soda in the kettle and by filling it three-quarters full with water and bringing it slowly to the boil. The caustic soda solution will dissolve out the fur.

If the kettle is of aluminium metal, sodium carbonate may be substituted for the caustic soda. Alternatively, you can boil up a strong solution of sodium metasilicate in the kettle, or, again, you can dissolve out the fur by means of a cautious application of an acid, such as spirit of salts (which will dissolve the fur before it attacks the metal of the kettle).

In all such instances, of course, the kettle must be most thoroughly washed and rinsed out with plenty of hot water before it is returned to its normal service.

In our opinion, a gentle caustic soda or sodium carbonate treatment will give every satisfaction.

Nickel-iron Cells

I HAVE had in use for some years a battery of "Edison" nickel iron type cells, and, as a few of these appear rather dead, I would be obliged for the following information:

Your estimation of the A.H. capacity; the case is roughly 5in. × 5in. × 12in.?

What is the chemical action of this type of cell?

Why is it necessary to change the electrolyte periodically? Would it not suffice to filter it, and then bring up to correct S.G. by adding caustic potash?

What quantity of caustic potash would be required per gallon of solution, and where could I obtain it?

What would you consider the minimum charge rate for this size of cell? 10 amps. has been usual, and do you consider this sufficient for maintaining cells in active state?—W. Whalley (Burnley).

THE capacity of Edison accumulators of the size you mention may be taken as round about 11 watt hours per lb. weight. The capacity of your cells may be about 150 ampere hours.

When the cell is fully charged the positive plates contain nickel peroxide as active material, which reduces to nickel sesquioxide within a few hours of charging. During discharge the peroxide ($Ni\,O_2$) is reduced to sesquioxide (Ni_2O_3), and thence to nickelous oxide (NiO). The negative plates go through a series of oxidation at the same time.

$$2NiO_2 + H_2O \rightleftarrows Ni_2O_3 + 2OH^1$$

to

$$Ni_2O_3 + H_2O \rightleftarrows 2NiO + 2OH^1$$

and

$$Fe + 2OH^1 \rightleftarrows FeO + H_2O$$

to

$$2FeO + 2OH^1 \rightleftarrows Fe_2O_3 + H_2O$$

The electrolyte combines with carbon dioxide present in air and turns to potassium carbonate, which is useless in the cell. This is probably the reason why all authorities agree that the electrolyte should be renewed periodically. The specific gravity should be 1.200 to 1.210.

We suggest you apply to the makers of such batteries regarding caustic potash. If our estimated capacity is correct the normal charging rate should be about 25 amps.

Running 50-volt Motor on A.C.

CAN you help me with the following problem: I have in my possession a small A.C. motor (50 volts), and I wish to rewind same to run on 230 volts. It is a slip ring motor (3 in No.). Can you tell me how many turns to put on, and the pitch of the windings? I have stripped the original winding off and the first two coils are wound in slots 1 and 6 and 7 and 12, and it is this point which puzzles me. The following are particulars of the armature: Size 1½in. by 1½in.; coils per slot, 2; 57 turns per coil; gauge of wire, 27 s.w.g. d.s.c. Also, how are the connections to the three slip rings made? Where can I obtain a book on design and construction of small A.C. motors?—C. F. Harvey (Gillingham).

IN order to operate the 50 volt motor on 230 volts A.C., the stator should be wound with 4.6 times as many turns as at present, with wire having a cross sectional area 22 per cent. of the present wire, that is a diameter 47 per cent. of the present wire. This will ensure that the magnetic flux set up in the air gap is practically the same as when the present winding is supplied at 50 volts. The connections of the new stator windings should be the same as at present.

Since the magnetic flux acting on the rotor, and the number of stator poles will then be unchanged, it is not necessary to alter the rotor windings in any way. It is unfortunate that you have stripped the rotor windings as we can only advise you to replace them. You do not state the number of slots in the rotor so we are unable to advise you definitely regarding the coil pitch for the rotor. The rotor is almost sure to be wound for three phase, hence the three slip rings; although the motor may run from single phase. The rotor is wound as an ordinary D.C. armature with either a lap or a wave winding, but instead of being connected to a commutator, tappings are brought out to the slip rings from symmetrical points on the rotor windings. In the case of a two pole stator winding there should be the same number of active conductors in series between each pair of slip rings. The span of the rotor coils will be one pole pitch.

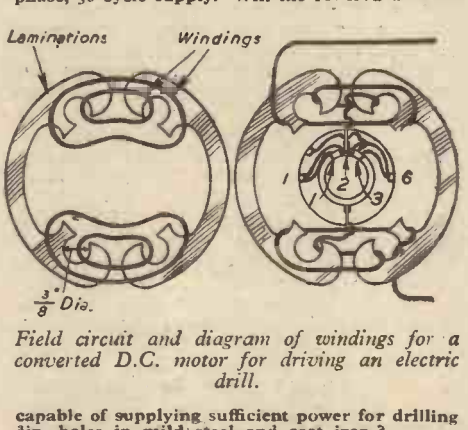
The book, "Induction Motors," by S. Gordon Monk, published by Blackie and Son, Ltd., deals with the design of induction motors.

Converting a D.C. Electric Drill

I HAVE acquired a D.C. electric drill, and wish to convert this into an A.C. machine. Could you please give me details of wire size number of turns per pole, and wiring diagram to assist me with this conversion? The field iron circuit is laminated, and is composed of two sections held together by four brass inserts which are complete rings interposed between the laminations, and cut to match the stalloy stampings. The armature has 11 slots, is slightly spiralled, and is fitted with a 22 segment commutator.

It is required to run the drill on a 230 volt, single phase, 50 cycle supply. Will the rewired drill be capable of supplying sufficient power for drilling ⅜in. holes in mild steel and cast iron?

The brush gear at present fitted is on a partially rotatable insulated plate. Could this brush gear be easily replaced by a shorting device, or must the machine be wound for universal use?—J. Glaze (Cardiff).



Field circuit and diagram of windings for a converted D.C. motor for driving an electric drill.

PRESUMABLY the motor drives the drill through gearing, so you will require the motor to run at a fairly high speed. We suggest you wind each field pole with 350 turns of 30 S.W.G. enamelled wire. Wind on as many turns as can conveniently be accommodated in the inner slots of the poles, making sure that both poles have the same number of turns; then wind the remaining turns round the outer projections of the poles. The turns should be connected in series to create two poles of opposite magnetic polarity, and in series with the armature.

The armature could be wound with 11 coils, each having 240 turns of 39 S.W.G. single silk-covered enamelled wire, a loop being brought out at the centre of each coil for connecting to the commutator. The coil pitch will be from slots 1 to 6. Placing the armature so that slots 1 and 6 are equidistant from the centre of one pole face number the commutator segment which then lies under the nearest brush, No. 2. Connect the start of the coil in slots 1 and 6 to segment 1, the loop to segment 2, and the finish of the coil to segment 3. Connect the start of the coil in slots 2 and 7 to segment 3, the loop to segment 4, and so on.

We would not advise you to attempt to convert the machine into a repulsion motor. It is not possible to say definitely if the motor could be used to drive a ⅜in. drill, as this will depend on the gear ratio, and such details as the air gap clearance between the rotor and stator, but we would certainly advise you to use a chuck which is capable of taking a ⅜in. drill.

Weathering Properties of Paints

CAN you please inform me if there is a method of testing the wearing qualities of the various paints and varnishes used for exterior work. At present, the only way is by trial and error, and with this method it takes several years to see how a particular paint wears. As sunlight is the biggest evil to paintwork, would it be possible to give a painted or varnished strip of wood a dose of concentrated sunlight, by means of an ultra-violet lamp, equal to 3 or 4 years exposure to the sun?—F. Middleton (Loughborough).

THERE are no simple means available at present for ascertaining the behaviour of any given paint when exposed to weathering influences. Many industrial scientists connected with the paint trade have given much time and thought to devising a simple method of estimating a paint's weathering or wearing qualities, but no such test has been evolved.

In some Research Institutes, paint-testing machines are in operation which expose specially-prepared panels of paint to ultra-violet rays, to moist atmospheres and actual rainwater, to the influence of freezing and to heat, the paint panels travelling along a continuous circuit in such machines. Machines of this type are highly complicated and cost (pre-war) about £600 each. They do not give any definite results indicative of a paint's durability within three weeks or a month. Hence it is that even with such specialised appliances, a quick test for a paint's wearing properties is impossible.

In ascertaining, or, rather, in predicting a paint's weathering properties, the experienced painter places much reliance upon his past experience with different grades of paint. He knows that a fairly slow drying paint containing linseed oil and genuine turpentine will, when dry, yield a film which will withstand many climatic extremes. He knows, too, that some colours are fugitive, while others will stand almost any influence.

Quick-drying paints of the turps-linseed oil variety are in some instances overcharged with patent "driers." These tend to make the paint film brittle and to cause it to crack and to "craze." On the other hand, cellulose paints are very durable when properly compounded. So, too, are the new bakelite-type varnishes and paints. Very cheap paints, however, are usually a snare and a delusion, and no great reliance may be placed upon them, owing to the inferior materials of which they are made.

A "fading" test for paint could be devised by exposing test panels of paint to the rays of an arc lamp for several hours daily for three or four weeks. The results of such a test would give you some idea of the probable influence of sunlight upon such a paint, and if the panels were, during the test, frequently splashed with water, some idea of the behaviour of the paint film to expansion and contraction would also be obtained. All tests of this nature, however, are very difficult to carry out thoroughly, and we would not advise you to expend much time or money upon attempting them.

Car Starter as A.C. Motor

HOW can I alter or rewind the *fields* of an Austin 7 h.p. motor car starter motor so as to make same an *economical* power motor for running a drill, lathe or similar purpose. These motors have only two brushes, most starter motors have four. I believe the position of the brushes could also be altered if this would help.—P. Loftus (Coulsdon).

UNLESS the fields of the motor are fully laminated, it is a waste of time to make the required conversion as an "economical" power motor for running a drill from the mains. In any case starter motors are only short-rated and usually have insufficient winding space on the fields for continuously rated power motors.

Your only chance of success is to wind a special pair of fields with about 3lb. of No. 32 s.w.g. d.c.c. copper, connected separately to the 230 volt A.C.mains, and short circuit the two main armature brushes together with a heavy copper wire, say No. 14 s.w.g., varying the position of the brush rocker until the best position is found for running, with the least sparking at the brushes. At best it can only be regarded as an emergency drive in place of anything better being available.

Sunshine Recorder

CAN you inform me how to construct an instrument to record sunshine, or where I can get a book on the subject ?—C. A. Loomes (Ampthill).

SUNSHINE recorders are very expensive meteorological instruments, costing upwards of £20. They have to be constructed with great precision, and the most successful of them embody many refinements. However, essentially, a sunshine recorder consists of a glass globe, ground perfectly true and spherical, which is mounted in a suitable frame. Mounted behind the glass globe, and at a distance of about 3in. away from it is a hemisperical strip of metal on the upper surface of which is secured a strip nf paper graduated with the hours of daytime. When the sun shines its rays are concentrated by the glass globe on to the strip of paper behind it and they burn a hole in the paper strip, or, at least, char it. In this way a record nf the number of hours of sunshine is obtained.

There are no books specially written on the making of sunshine recorders, but you will find a description of the sunshine recorder in any textbook of meteorology, some of which will be found in your local library.

Casts of Footprints

COULD you please inform me how to make casts of footprints from plaster of Paris ?—J. Day (Shepton Mallet).

IN order to take casts of footprints by means of plaster of Paris all you have to do is to mix the plaster of Paris with water to the consistency of a stiff cream, and, having flooded the existing footprint and its surrounding area with a solution of Vaseline in benzene (5 parts Vaseline, 20 parts benzene), pour the plaster of Paris cream over the footprint.

Time should be given for the benzene solution to evaporate before the plaster of Paris cream is poured over the footprint. By doing this you will obtain a thin film of grease over the footprint, which will allow the plaster cast to come away cleanly from it after the plaster has set.

If you require a rapid setting plaster this can be made by dissolving from .5 to 1 per cent. of ordinary borax in the water used to mix with the plaster of Paris.

The footprint cast which you will obtain in the above manner will be an "inverted" one, that is to say, the raised parts of the original footprint will be sunk in the plaster cast, and vice-versa. However, from this cast, you can make another one by heavily greasing or oiling the reversed footprint cast and by pouring another plaster cream over it. After this latter has set it will come apart, giving a replica of the original print.

This work is rather delicate and requires care and practice. It is better to cast the "reversed" print in cement, this latter material being more enduring than plaster of Paris.

Casts of footprints may deliberately be made simply by allowing the foot to imprint itself upon a quantity of plaster of Paris "mix" placed in a shallow tray, and having a carefully levelled surface. This method gives a direct print, but, of course, it cannot be applied for the purpose of taking casts from an existing footprint on the ground.

Electric Heater for Brooder

I HAVE constructed a small brooder for some chickens. The heat is supplied by two 60-watt lamps. The second week these are replaced by two 40-watt lamps, and so on. I would much prefer to be able to regulate the two 60-watt lamps by means of a small resistance. Could this be done simply ? The mains are A.C. 240 volts 10 amps 50 cycles.—C. Tandy (West Bromwich).

YOU could use about 40 yards of 36 s.w.g. nichrome resistance wire in series with the two 60-watt lamps, this resistance being tapped out at suitable points to a selector switch. It will be understood that the resistance should be placed outside the brooder, otherwise the heat generated in the resistance will be added to that of the lamps.

A more economical method would be to dispense with the lamps, and use a variable resistance inside the brooder as the heating element. In this case we suggest you use three elements, which can be connected in parallel for the full heat; reduced heat being obtained by using two or one element. Each element could comprise 25 yards of 38 s.w.g. nichrome wire closely wound on a rod of 1/16in. in diameter, and then stretched out to about twice its original length. The wires could be fitted on a frame and supported with asbestos or other material capable of withstanding 300 deg. C.

Cyanides

WILL you please give me replies to the following questions :

What are cyanides, and how many are there ?

Have they a prolonged manufacture by hand, or are they a mixture by hand of chemicals ?

Are they poisonous both internally and externally, and are they used in both medicines and ointments ?—N. Daws (Bradford).

CYANIDES are salt of hydrocyanic acid, HCN. They are pure chemical compounds, and are not mixtures of chemicals. All cyanides are extremely poisonous, and a very small amount of a cyanide, such as potassium cyanide, KCN, when taken internally, would be fatal. Applied to the external skin in small amounts, cyanides would not have any effect, unless absorption into the blood took place through a scratch or a cut in the skin.

There are very many different cyanides, both metallic and non-metallic. Almost every known metal can be made to form a cyanide of its own. Perhaps the best known cyanide is potassium cyanide. After this comes sodium cyanide. Another well-known cyanide is mercury cyanide.

Pure cyanides are not easy to make, and they cannot be made by dissolving metals in hydrocyanic acid. Potassium cyanide, the commonest of the cyanides, is made by heating potassium ferrocyanide and potassium carbonate in an iron crucible. Cyanides are not used as internal medicines, but they are sometimes employed in the manufacture of sterile lints and gauzes, and also in the preparation of materials for plugging wounds.

Potassium cyanide is used for electro-plating, for extracting gold from minerals, in photography, and in certain processes of gilding. Other various cyanides are employed in certain chemical reactions. Potassium and sodium cyanides are white solids, which gradually turn brown when exposed to air, light and moisture. They slowly give off vapours of hydrocyanide acid, and for this reason they are even dangerous to smell. Non-metallic cyanides often take the form of liquids.

In general, the cyanides are to be included among the most deadly poisons known, and you should on no account endeavour to prepare any such substances.

Solenoid Wingings

I WISH to operate the points of an "0"-gauge electric railway by solenoids on the remote control principle. I had in mind buying another transformer for this purpose which has two voltages available. One is 20 v. capacity 1 amp., and the others 3.5 v. 4.5 amps. I intend that only one solenoid can be operated at a time.

Could you please furnish me with approximate particulars for winding some of these coils, i.e., size of former necessary, amount and size of wire and amount of laminated core ?—R. Morgan (Stockport).

THE pull and travel required will, of course, depend on the type of mechanism used to operate the points. As a basis for experiment we would suggest that you use a former or bobbin 1¼in. long with flanges about ¾in. diameter. The bobbin could be wound with about 2,500 turns of 34 s.w.g. enamelled wire fed from the 20 volt supply. Presumably you will use a type of switch that merely energises the coil during the brief periods of operation of the points. The laminated iron core could be about ¾in. by 5/16 in. by 1¼in.

Condenser Capacity for Magneto

PLEASE explain how the value of the condenser to be used in a magneto or coil ignition is determined, and the effects of using one of a too high or low value.—A. Clark (Luton).

THE calculation of the condenser capacity for ignition apparatus is rather too complex a subject to be dealt with in a letter and, in fact, the exact capacity is best determined experimentally. In order to obtain a high secondary voltage the magnetic field flux linked with the secondary winding must change very rapidly, and this means that the primary current must also change very rapidly. If the capacity of the condenser is too high it will take longer to charge and consequently the rate of change of the primary current will be reduced, with reduction of the secondary induced voltage.

The voltage of the condenser builds up as it becomes charged and normally when the condenser is charged the contacts have separated to such an extent that the condenser voltage is not sufficient to cause a spark between them. If the condenser is too small its voltage would build up more quickly, and might reach a value high enough to jump between the contacts before these have properly separated. Sparking would then occur at the contacts.

Wave Winding for Motors

CAN you please tell me under what conditions a wave-connected armature is superior or inferior to a lap connected winding ?

Electrically the two different types of connection seem to result in the same effect, and almost the same total resistance between brushes, save for a possible economy of brushes in the wave connection.—J. Burrows (Weymouth).

A WAVE winding cannot be used in a 4-pole machine which has an even number of commutator segments or in a 6-pole motor in which the number of commutator segments is a multiple of 3, and so on. The lap winding and the wave winding are identical for 2-pole motors or dynamos. In the event of the magnetic field strength of a machine having 4 or more poles being unequal there may be unwanted circulating currents in the armature windings of a lap wound machine due to a section of the windings connected between one set of brushes being acted on by one pair of poles only. This is not the case in a wave-wound armature since each section of the armature winding is acted on by all the poles.

On a multipole machine the total number of armature conductors can be increased for a given voltage by using the lap winding. As there are more parallel circuits in a lap armature the size of armature conductors can be reduced. For this reason lap windings are often used in large machines. The wave winding with only two brush sets has an advantage for certain motors, and may be used for traction, if only a part of the commutator is accessible; a wave winding on a multi-pole motor enables these brush sets to be placed close together.

Epidiascope or Episcope?

COULD you tell me the difference between an Epidiascope and an Episcope ?—B. M. (Argyll).

AN Epidiascope projects both objects and slides and has a dual optical system.

An Episcope has a projection lantern which is used for throwing on a screen an enlarged image of a brilliantly illuminated opaque object. Where slides only are used, the correct term is Diascope.

Solutions to Probes and Problems

(See page 336)

A Geography Lesson

Allen gave Rome as the capital of Italy, and there are ten boys in the class.

There are only nine *different* ways of answering the questions wrongly, so that, including the boy who got one right, there cannot be more than ten in the class. But ten boys are specifically named. The possible replies are as under (No. 10 being the boy with one right):

Country	1	2	3	4	5	6	7	8	9	10
France	Ber.	Ber.	Ber.	Rome	Rome	Rome	War.	War.	War.	Ber.
Germany	Par.	Rome	War.	Par.	War.	War.	Par.	Rome	Rome	War.
Italy	War.	War.	Par.	War.	Par.	Ber.	Ber.	Ber.	Par.	Rome
Poland	Rome	Par.	Rome	Ber.	Ber.	Par.	Rome	Par.	Ber.	Par.

Boys Nos. 3 and 10 are Allen and Jones; 1 and 2 are Perkins and Smith Minor; Green, Thomas and Smith Major are 7, 8 and 9; and Harris and Marshall are 5 and 6. Thus No. 4 must be Appleby, who gives Paris as the German capital. No. 10 supposes Paris to be the capital of Poland, so he is Allen, who has answered one question correctly and gets the holiday.

The Jorkins Inheritance

Five families benefited under Mr. Jorkins's will; they consisted of 1, 2, 4, 5 and 5 children respectively.

The families of young Jorkins and Harry each received £25,000, leaving £21,000 to be divided among the remaining 7 grandchildren. Experiment shows this to be possible only if there were three other families, of 1, 2 and 4 children respectively, receiving bequests of £1,000, £4,000 and £16,000.

Who Told the Truth?

Charles is consistently truthful. The first boy to whom I spoke was Bertram, the persistent liar, who claimed to be Alfred and maintained (absurdly) that he was younger than himself. Alfred, the second boy, lied about his name, but admitted to being Charles's senior. The virtuous Charles gave his name correctly and added truthfully that he was younger than Alfred.

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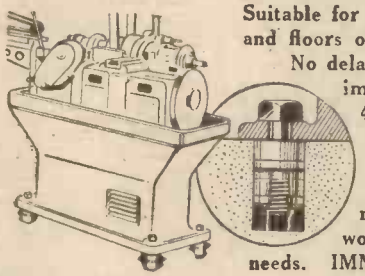

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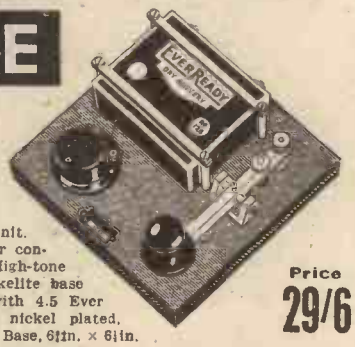

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THE Cyclist
Editor: F. J. CAMM

VOL. XII JULY, 1944 No. 269

All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

Comments of the Month.

By F. J. C.

Another Raw Deal?

THE Road Records Association exists to adjudicate upon cycling road records claimed, and according to its constitution it consists of cycling clubs joining it as a body, and of individual subscribers who shall be balloted for election by the committee. Each club joining the Association shall appoint two delegates to represent it at General Meetings, and the individual subscribers shall, prior to the Annual General Meeting, elect delegates to represent them in the proportion of one delegate for every six such members. Thus, the R.R.A. has power to refuse membership of clubs. It is not bound to give a reason for such refusal.

Now some members of the R.R.A. are opposed to mass-start racing on the roads run in accord with the rules of the B.L.R.C.—a body properly formed (as the R.R.A. itself was formed in 1888 by A. J. Wilson) to govern a new type of sport. This new body finds itself in conflict with the N.C.U., the R.T.T.C., and apparently the C.T.C. and the R.R.A. The N.C.U. is opposed even to time trials on the roads, for it threw that form of sport overboard many years ago and confined itself to the control of track sport on closed circuits. As a result of this there came into being the Road Racing Council, which had no real authority and existed largely to issue "recommendations," and out of this sprang the Road Time Trials Council, which virtually took over the Road Racing Council.

Mass-start racing on the roads is not the concern of the C.T.C. or the R.R.A. Neither of these bodies, according to their own rules, can properly have the slightest interest in racing on the road or on the track, and neither, according to their rules, should take part in political matters. In any case it should be the duty of these bodies to take the opinions of their members before expressing views. It is worth setting on record that the N.C.U. did, as a fact, take the opinion of its sections on mass-start racing, and there was a majority vote against it. The only thing the other two bodies have done as far as we are able to trace is to oppose it and to foment opposition among constituent clubs. Hence has grown the belief that the C.T.C. and the R.R.A. are not democratic bodies, but are virtual dictators.

One of the clubs taking a most prominent part in promoting mass-start racing on the roads is the Ealing C.C., which is affiliated to the R.R.A., and its application for affiliation has been accepted.

Another club which has taken a leading part is the Bradford R.C.C., which was affiliated but this year was turned down. From this point the story is best told by their correspondence. Here is a letter dated May 17th, 1944, from the Secretary of the R.R.A. to the Secretary of the Bradford R.C.C.:

"With further reference to your letter of the 10th inst., I have to inform you that your application to be affiliated to the R.R.A. was considered by my Committee at their meeting on Tuesday evening last. I regret to inform you that they find themselves unable to accept your application, and I am accordingly returning your postal order for 5s. herewith."

This is the letter sent in reply by the hon. secretary of the Bradford R.C.C. on May 18th, 1944.

"I beg to acknowledge receipt of your letter of the 17th inst., enclosing returned P.O. for 5s., and the intimation that the Bradford Racing Cycling Club's application for affiliation is unable to be accepted by your Committee.

"Whilst I had a suspicion that personal bias would be registered because of our affiliation to the British League of Racing Cyclists, I hardly thought it would be taken to the lengths of refusing affiliation to the R.R.A.

"To quote the R.R.A. handbook, 'The object of the Association is to verify and certify the genuineness of claims to best performances on record accomplished by male cyclists on the road and to prevent the publication of fictitious or uncertified records.'

"I submit that the Bradford R.C.C. is legally entitled to affiliation in the R.R.A., because you have no cause to show that we would act in any other than a genuine way in the establishment of any record; further, the R.R.A. rules do not stipulate that an affiliated club must be adherent to the R.T.T.C. or N.C.U., and our rejection is tantamount to saying that because we are affiliated to the B.L.R.C. our application cannot be considered. To take a leaf out of our critics' book it would appear that we can accuse the R.R.A. Committee of acting in an unconstitutional manner so far as the present rules go.

"As you give no reason for the rejection of our application, may I ask for a statement showing the Committee's reason for the singular treatment.

"I await the favour of your reply."

This elicited the following letter from the secretary of the R.R.A.:

"I have received your letter of the 18th inst., and shall be pleased to place this before the next meeting of my Committee, although I am afraid this may be some considerable time ahead.

"You will appreciate, of course, that I am not able to give you a complete account of the discussion that led to the rejection of your application. I feel, however, that my Committee will support me in offering you this explanation.

"My Committee were unable to accept your application as they considered that the policy of your Club was opposed to the best interests of unpaced road competition."

To this letter the Secretary of the Bradford R.C.C. replied as follows:

"I beg to acknowledge receipt of your letter, dated May 20th, and if the penultimate paragraph is an expression of your Committee's opinion, then I have no alternative but to regard it as a gratuitous insult to the officials and members of the Bradford Racing Cycling Club.

"Our policy, to which you refer, is to 'encourage and promote' all forms of cycle racing, and the manner in which we have carried out this policy leaves nothing to be desired in looking after the best interests of unpaced road competition.

"The R.R.A. has created a precedent in accepting the Ealing C.C. as an affiliated club—probably this fact has been overlooked by your Committee, and therefore they are now faced with the alternative of rejecting the Ealing C.C. from affiliation, or accepting the Bradford R.C.C.

"The whole subject is a matter which requires ventilation, and I am accordingly sending copies of the correspondence to the press."

That is where the matter rests at the moment of going to press.

Now in recent litigation Lord Justice Goddard had some pointed remarks to make concerning the R.R.A. He said that the litigant "felt that throughout this business he had had what is called a 'raw deal,' and if it is any consolation to him may I add that I rather think so myself." He was dealing with a statement read at an R.R.A. meeting in which the committee were not only the respondents but were actually sitting as judges on the appeal! It emerged from that case that the R.R.A. could refuse to give its reasons for coming to a particular decision, but if it does so "it behoves them to take reasonable and proper care."

As in the case of the Bradford R.C.C. they have seen fit to give their reasons (the secretary having stated that he feels sure the Committee will support him), the Bradford R.C.C. can now take the matter to appeal, and this we advise them to do.

The fact is that the Road Records Association is a small body which meets infrequently and it is not a national body in the accepted sense. Perhaps it has outlived its period of usefulness, like the old Road Racing Council, and the time has come when a new body should be formed to take over the homologation of road records, and to place the matter on a businesslike footing and entirely outside the realm of cycling politics.

Such a body should concern itself only with records and attempts at records.

Lord Brabazon of Tara speaking at a recent Roadfarers' Club luncheon. Sir Frederick Handley Page is on his right.

Paragrams

Stratford St. Mary, Suffolk.

L. G. Holmes, M.M.

CPL. L. G. HOLMES (Kings Lynn C.C.) has been awarded the Military Medal. He is well known in East Anglia as a short distance expert rider.

Serving Man's Mileage

J. W. LINDER, Norco C.C., who is serving with the R.A.F., managed to cover 21,705 miles awheel last year! He is serving in Scotland and almost each week-end rode from Dundee to Inverness and back, a distance of 280 miles.

Wedding Bells

JOSEPH COOK and Mary Phipps, popular members of Nottingham Clarion C.C., have married.

Still Fast

IN pre-war days Ian Stephen was a speedy member of the Douglas C.C. He is now a Spitfire pilot finding plenty of action in Italy.

Charlotteville Loss

AFTER three years overseas, Pte. W. C. Gittings, Charlotteville C.C., has been killed in action.

Tandem Pair Wed

WELL-KNOWN Mancunian hostellers, Frank Slater and Ada Silverwood have married. They are staunch tandem partners.

Gate Activities

THE Gate C.C., social sub-section of the Highgate C.C., have an ambitious programme for the season including holiday tours.

Strenuous Leave

A MEMBER of the Southgate C.C., Pte. G. W. Turner, road 70 miles one Saturday afternoon, competed in his club "25" in the morning and, after a day with the club, set out on his long journey back to his unit.

Mildenhall R.C.

THE Mildenhall Road Club is the latest Royal Air Force cycling club.

"Bill" Carter Promoted

AFTER three years in Iceland as a Leading Seaman, W. J. ("Bill") Carter, Southgate C.C., has obtained his commission in the R.N.V.R.

George Postlethwaite Killed

PROLIFIC time-trialist in pre-war days, George Postlethwaite, a Flight Sergeant in the R.A.F., has been killed in action. His club was the Sheffield Phœnix.

His First Offence

AFTER a cyclist, summoned for an alleged traffic-light offence, had told the justices that he had only a week to go before completing his Jubilee as a cyclist, the summons against him was dismissed.

Well-known Trader Dies

E. C. PASKELL, proprietor of The Colemore Depot, Birmingham, and a vice-president of the Motor and Cycle Trades Benevolent Fund, has died.

Clarion's Loss

WELL-KNOWN member of Harrow and Wembley Section of the London Clarion C.C., Bernard Slingsby, has been killed in action in Italy.

An Irish "Double"

ON the same day, John Hynes, Kenstown C.C., won both the senior and junior championships of Meath. He is a junior.

Sheffield Phœnix Loss

FLIGHT SERGEANT MORRALL, Sheffield Phœnix C.C., has been killed in action. He was one of his club's most active riders and, at one time, held the course record with 1.1.58 for a "25." In four months, just before he enlisted, he secured 21 prizes in 19 events.

Cyclist Decorated

FLYING OFFICER A. GRAHAM of Bexley, has been awarded the D.F.C.

Kingston Road Club

FORMER hon. secretary of the Kingston Road C.C., Sergeant N. Pullin has been awarded the Military Medal.

Lost at Sea

PROMINENT member of the Archer Road C.C., H. Ennis, is reported missing as the result of enemy action at sea. He was serving with the submarine service.

Second Claim

JEAN BROOK, well-known Cardiff 100-mile rider, has joined the Broad Oak C.C. as second claim member.

Innovation

SEVERAL old-time cycles, among them bantams and ordinaries, preceded 2,000 marching men in a "Salute the Soldier" procession.

North Road Old-timer Dies

MEMBER of the North Road C.C. since 1886, Tinsley Waterhouse has died in France where he had resided for many years. He was 80 and won the classic North Road "24" in 1887 with 270½ miles.

A Scottish Sensation

DAVID SCOTT, Crawick Wheelers, clocked 59 mins. 55 seconds, to win the Shotts Wheelers Open 25-mile event. He is the first rider to get inside the hour in wartime.

News of B. Deas

FRIENDS of Flight Sergeant B. N. Deas (Manchester Wheelers) were relieved to hear that, after being reported "missing" following a raid over Germany, he is now known to be a prisoner of war although slightly wounded.

His First Flight

ON his first operational flight, William Lammond, Lothians C.C., was reported "missing."

And 15th . . .

AFTER taking part in 15 operational sorties over enemy occupied territory, Herbert Richardson (Kentish Wheelers), a R.A.F. wireless operator, has been reported "missing."

Home Again

AFTER three years in the Middle East, C. P. Lynam (Brodsworth C.C.) is back in this country as is Herbert Hills (Hampshire Road Club) who saw service in Africa and in Italy.

George Olley's Trophy

GEORGE OLLEY, one-time holder of the End-to-End record, has presented his club, the Southampton Wheelers, with a trophy for their Open "25."

South Wales Veterans

SOUTH WALES is to have its own Veterans' Section. H. Clode, 8, Heeling Strading, Whitchurch, Cardiff, is hon. sec. of the South Wales Veterans' Association.

Death at 21

FLIGHT SERGEANT KENNETH GOSLIN, R.A.F., of the Notts Section of The Clarion C.C., was killed in action in the Middle East, at the age of 21.

Club Notes

Repatriated

SANDY LOWSON, White Heather C.C., was amongst the recently repatriated prisoners of war to return to this country. He was three years in a German prison camp.

Tocher in the Navy

J. TOCHER, West of Scotland Clarion, has joined the Merchant Navy.

New T.T. Secretary

ALEX. HENDRY is the new time trials secretary of the Glasgow Wheelers. His address is 208, Holms Place, Mount Ellen, Gartcosh, Glasgow.

New Club

A RECENTLY formed cycling club is the Chiltern Road Club, Aylesbury. The secretary is F. Mayclem, 137, Wendover Road, Aylesbury, Bucks.

Soutar Abroad

JAMES SOUTAR, vice-chairman of the Scottish Amateur C.A. until he joined the Forces, is now in Ceylon.

Munn in Scotland

J. E. MUNN, Northumbrian C.C., is now stationed in South-west Scotland, and taking part in time trials in that area.

Promoted Pilot

W. WILSON, White Heather C.C., has been promoted to the rank of pilot officer in the R.A.F. He is now stationed in the south of England.

Hendry Wins

J. HENDRY, St. Christopher's C.C., won both the quarter- and half mile races for cyclists at the National Fire Service Sports at Glasgow.

Mill Lane—a corner of picturesque Warwick.

Around the Wheelworld

By ICARUS

"Craving for Speed"

I NOTICE that a cycling club journal quotes the letter under the above title published in the *Daily Telegraph* on May 11th. It was written by Miss Julia Neilson-Terry, whom the club journal describes as "that charming and talented actress." It is perhaps hardly necessary to state that after introducing her in this way the journal is in entire accord with her views. Miss Terry regurgitates the threadbare theme that "speeding is a disease. The craving is similar to that of the drug fiend. It is not to be checked by fines or imprisonment. If we are to remedy the evil we must go to the root of the matter. Better roads, by-passes, and segregation of heavy traffic may do much, but the real cause is psychological." If the real cause is psychological then it is inherent and there is no cure. Perhaps it is as well to point out that the views of this charming and talented actress coincide with the views of the dictators of the club concerned—not of its membership.

Pen Names

THE object of using a nom-de-plume, a pseudonym, a nom-de-guerre, or what-have-you, is to obscure the identity of the writer. I am, therefore, entirely at a loss to understand why many of those who write for the cycling press use a nom-de-plume and then seem most anxious to add in parenthesis their real names. Surely there is no need for both. Perhaps the writers are so proud of their work that they are most anxious that the credit should not go to someone else. But it really is stupid.

A Chat with H. G. Wells

AS a member of the Roadfarers' Club it was recently my pleasant duty to call on Mr. H. G. Wells, the famous novelist (also a member of the Roadfarers' Club), and conduct him to one of their notable luncheons. Whilst travelling in the taxi I chatted with him about that most notable of all cycling novels, and one of the first books he wrote entitled "The Wheels of Chance," which was serialised in this journal just before the war. He told me that he collected the material for this novel during his first fortnight's holiday whilst he was a draper's assistant. Much of the detail was written from personal experience. The book deals with real roads and real inns—the Portsmouth Road and the "Bear" at Esher.

Mr. Wells told me that he thoroughly enjoyed writing the book which, even in those days, was a best seller. The fact that it is still in print (it is in the Everyman's Library Series of Books) shows that there is still a market for cycling literature. Mr. Wells happens to be an old townsman of mine, and his family and mine were well acquainted. He told me that he had purchased a bicycle for the purpose of the tour, and the play developed as he rode along. I will not spoil the story for those readers who may not have read it, but interwoven into this touring novel along roads and by-ways we all know so well is the story of Mr. Hoopdriver, the villain and the Lady in Grey. Incidentally, Mr. Wells told me that with most of his novels he endeavoured to survey the district in which they were set.

Sir Frederick Handley Page, Sir Harold Bowden, and A. H. Bentley, at the Roadfarers' Club luncheon on June 2nd, at which Sir Frederick was the principal speaker. He also is a member.

Sir Frederick Handley Page delivering his speech. The chairman is Lord Brabazon (president). Lord Kenilworth, Sir Harold Bowden, and Prof. A. M. Low are also in the picture. They are members.

"Electoral Blackmail"

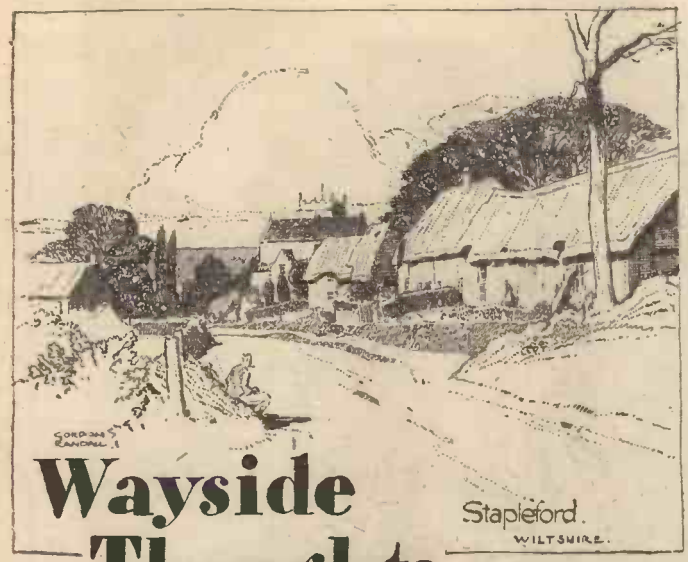
HEREWITH a letter which I have received from Squadron Leader C. G. Powell: "I read with interest your leader under the above title in the April issue. It has always appeared to me as a reader of cycling journals and a member of cycling organisations that organised cyclists were so much anti-everything, as you state, that they became pig-headed. It is noticeable that they oppose everything as soon as it is brought before them and endeavour to squash any suggestion made for their safety. For instance, when rear lights were enforced they immediately decided that this was the beginning of the end as far as cycling was concerned. This is childish. It is better to give way occasionally on small points like that, than to purchase 6ft. of earth. In fact, I have used a rear light ever since I could ride, and used cycle paths when the traffic has been too heavy for my safety, and shall continue to do so. I was always doubtful as to what type of organisation I should join. Should I become a member of the C.T.C.? There did not appear to be any possibility of my views being received by them. My views had to fall in line with theirs, or else. . . . Thanks to your Editorial I know now where I stand, and can steer clear.

"On the other hand, what cycling body can I join after the war? One where I shall be known as a cyclist, and yet not get mixed up with these people who have one-track minds? I hope your leader gets into the hands of those who are so stubborn."

Perhaps a new body will be formed after the war. Copies of the leader concerned, I understand, have been circulated to leading clubs throughout the country, and to the leaders on the mass-start controversy.

Councillor Ellis

LEONARD ELLIS, well known in record-breaking circles, has just been elected as a Councillor of the Denham Council. He has been resident in that district for a number of years and has taken a keen interest in the social activities of the village.



Wayside Thoughts

by F. J. URRY

Good Riding

A PARTY of three, average age 63 years, anticipated Whitsun by a fortnight, using that golden week-end in May to spend among the hills and dales of Wales. I make mention of age not for the purpose of bragging, but to impress on my readers the fact that this cycling game does not count the handicap the years must impose to anything like the extent that other games do. You can play it with full enjoyment and all the adventures of freedom of travel, right up to the last moment of healthy activity. Actually we rode 161 miles in three days and a trifle, spent one lovely morning in sunny idleness in the Llyfnant Valley, and crossed a couple of passes measuring some 35 miles of rough going. Yes, there were occasions when we toiled and a summer sun, anticipating the calendar, warmed our hides, but the worth-while things of this cycling life have to be compacted of a trifle of activity, or the very essence of the game would depart. Following an evening ride on the Friday, it was delightful to roam care-free and unworried from Shrewsbury to Welshpool, with the road all our own except for an occasional lorry; and this state of loneliness was with us during the whole of that glorious week-end. It was like a return to the days of last century when I was 21, and a motor-car was a novelty to be chased and beaten for speed on the first descent hill. Over the shoulder of the Brieddens the daffs. were nodding in the wind as we ran on into the hills by the gate of Welshpool, and then up and over to Llanfair Caerinion by the valley of the Vyrnwy; and at the little hilly town we lunched grandly with the burly Welsh farmers. It was a good start, and the food situation never let up on us at any hour.

Tough Bits

FROM Llanfair a mountain road runs over to Carno, a good road for six miles albeit on the grade, and then a track that in parts is only just rideable. But what visions of the noble Severn Valley this thousand-foot hillside cutting provides! Well, go and see, and give yourself an indolent three hours to traverse those 15 miles of wild loveliness. Above Carno we had eggs for tea and the information that we three old things were the first cyclists of the season. By Llanbrynmair we picked a fish-hook out of a rear cover close to that lovely gorge near the summit of the low pass, and after a lazy repair sped to Machynlleth and taking the Dovey Junction road approached the Llyfnant Valley as it should be entered, by the rough road that follows up the stream. Never have I seen the Llyfnant look so lovely and fairylike as on that evening of flaming sunset, when its crags and ragged forest were etherealised in the glow of colour that swam in the atmosphere. A gallant introduction for one of my friends who has not been there before, followed by a welcome at "Glanrafon," where the Prescotts made us specially comfortable and in very deed killed the fatted calf and cooked a delicate portion of it for our well-being. Under the stars we talked of many things, but always the conversation flowed back to the topic why we did not make these week-end journeys more frequently, especially in view of the fact that with threescore years past us, wisdom suggests no opportunity should be missed. I concur; but it is not always as easy as it sounds, what with meetings to attend and work and domesticity laying claims to some portion of one's time.

Under Plynlimon

IN the beautiful sunshine we wandered afoot on that Sunday morning to the head of the valley where the road dwindles to a track, which in its turn loses itself amid the bogs for which the Plynlimon group is famous—or infamous. An early lunch, the repair of an over-night puncture, and then we were away for Machynlleth, and the mountain road to Stay-a-Little and Llanidloes. The sun was hot on our backs and where the way starts climbing beyond Forges the grade seemed to have increased since I was last that way. We had no need to hurry, nor did we. As the road takes to the hills, the visions grow in grandeur until we had gained some 1,300ft. and were rolling amid the outlines of the Plynlimon group, high up on the moors with the "coloured counties" spread broadcast on our left, the barrier mountains on the right with the thin ribbon of road drifting straight on. But what an improvement in surface since I was last over this route; now it is all rideable if you have the power, up and down; then there were miles of slate slabs slippery as ice in wet weather, and always difficult to negotiate. Short of Stay-a-Little is a farm on the roadside known as Rhosgoch where Mrs. Wigley dispenses fare to hungry folk, and here we fed nobly, facing thereafter the hard road that climbs to Van and finally cascades into Llanidloes. No more, maybe, than 25 miles on that afternoon and evening, but what miles, and what a day to string them on. And on Monday we rode home with a favouring wind and an easy lope, still talking of the many week-end prospects we should turn to account. Such is cycling—very good indeed—for it keeps us young.

Looking On

MY wanderings at Whitsuntide were localised by family illness, but I did manage to get one full day along the road as a lonely and observant wanderer. Apart from the beauty of the year and the joy of riding capless and gloveless, I was specially interested in the great throngs of cyclists crowding the roads, happy and laughing, and so thoroughly enjoying the adventure. But it made me a little sad to see so many of them unconsciously deriding the pastime for sheer lack of knowledge of how to get the best from it by the cultivation of style. I do not want to be critical or denunciatory, for I would far rather see people riding badly than not riding at all; but what a difference it would make to these ragged-styled folk and to cycling if it could only be impressed on them that proper positioning, moderate gearing and the cultivation of ankle action not only meant accelerated speed and ease of movement, but the acquisition of comfort without undue exertion. I passed, and was overtaken by one group of nine young folk six times in 15 miles; they raced down slopes and along levels, but the modest rise brought them afoot very early; only because they knew so little of the real art of cycling. I saw elderly people hanging on to the tall gears of their 3-speeds, hunching their shoulders and working hard into a stiff wind when their progress would have been comparatively easy on the low ratio, and certainly not less rapid. I did not feel superior, because I knew better how to make miles easily, but sorry to think so many folk are missing the greatest pleasure of cycling for lack of a little knowledge.

How to Cure It

WHOSE fault is this, and who should be the folk to try and cure it? There cannot be any proper or lasting pride in the pastime of cycling until the majority of riders learn the undoubted fact that cycling is an art in athletics as necessary to adopt for comfort and joy as any other form of human activity or deportment. That is the truth of the matter, and I think every good cyclist knows it, and should use his influence towards improvement wherever and whenever he can. But that is not enough. Cycling is too good a game, too charged with the possibilities of joyousness of freedom, to be at the mercy of the few who are willing to teach. It needs now as never before since its introduction to the public and its great emancipatory powers, a treatise on the art of the game, how to ride, what to ride and where to ride, and it seems to me this business of teaching should be in the particular care of the industry. It is to them the full benefits of good cycling will finally derive in the provision of better bicycles and equipment, and a far wider spread of this best of all games. The matter has been neglected for years largely due to the fact that makers in the main are no longer cyclists, and have forgotten or never knew the finer points of the pastime on which their business still depends, and just as important can still further expand. Club people are said to be the finest cyclists on the road, not by cyclists, but by the other road users. Why? I think the answer is simple. They have exchanged views and experiences, have tested this and that, and freely criticised all things cycling, with the result that they have settled their own little problems of comfort and speed in the racing sense, or ease and enjoyment in the touring sense, know what they want, and, in normal times, see that they get it.

The Lucky Folk

AT the moment we cyclists are the lucky people. We can use our holidays and leisure time, if we so desire, travelling the land, going from place to place without let or hindrance, with a free conscience that we are inconveniencing no one. We are free of car and train and bus, our engines are muscular, and in using this mode of progress we are preserving health, and adding something to that valuable possession. Never since the bicycle was invented has it given to its advocates so happy a sense of freedom, that kindly degree of independence which does not make any demands on other people for its pleasure, its beauty of vision, its full share of the sunshine and the wind. I shall try to take my share of this graciousness during the summer and autumn when a string of free days falls to my lot; but there are also the evenings and the week-ends, those little oases of time hung amid the working hours of life that we so often fail to pluck and enjoy their fruitfulness. I was out recently for the brief space of two and a half hours with an old friend, and as we drifted through the lanes we talked of these things and of our good fortune in activity due so largely to our love of cycling. I think these evening excursions, when the heat and burden of the day is done and the telephone is at rest, are among the most gracious episodes in a cyclist's life. They help so much to keep you alive, to lend you the joys of anticipation that are the prelude to a longer holiday, and give you that sense of contentment which only a touch of natural beauty can endow. This is not sentiment, but a very material fact which I have proven over and over again, and yet the process of so doing seems to be as fresh and fair as the long gone day when I first set out on tour. "O! the pearl seas are yonder, the amber sanded shore," the hills that break the fleecy clouds, the dales adown which run the music of waters, these are the magnets which draw us on to the day's ending, and we must go. So it is with most folk, but more so, I think, in the minds and hearts of those of us who ride and sometimes linger to look or listen, to rest in the shade and burn a pipe of incense to the loveliness in our eyes. As you grow older the beauty of these simple things seems to deepen, which in itself is a sound reason why you should go on riding and never betray the pastime that has made you conscious of so much delight.

By the ford at Waterend, near Wheathampstead.

CYCLORAMA

By H. W. ELEY

"The City Barge,"

Strand-on-the-Green.

The old ceremonial barges of the City were moored near this part of the Thames. This interesting Inn takes it name from them.

Holiday Cycle-touring

I TALKED with a cyclist the other day, in the cosy bar of a village inn, about holiday cycle-touring, and found that my chance acquaintance was planning a fortnight's tour—and could not make up his mind just where to go. He was a true lover of England, and told me that he found as much beauty in East Anglia as he did in Devon or Lakeland; it was a *different* beauty . . . that was all. Well, we chatted long about tours undertaken in the good days of peace, and finally, to my amusement, this cyclist tossed a coin to decide whether he would tour in Hardy's Dorset, or whether he would journey to Shropshire, and laze along the roads of the sweet county made famous by Housman and Mary Webb. Shropshire won! And so I have a mental picture of my friend of the inn drinking in all the many scenic delights of Salop; of taking a peep at "The Feathers" at Ludlow; of cycling happily around Much Wenlock and Church Stretton; and of enjoying the old timbered houses of ancient Shrewsbury.

Cycle Pump Shortage

SEVERAL friends tell me that there is still rather an acute shortage of pumps, and that it is still necessary to borrow from a lucky pal when tyres need more air; and they need more air regularly! That old enemy, "under-inflation," is still with us, to rob cyclists of miles! Not all the propaganda put out by tyre makers and by the Tyre Control officials, has quite succeeded in convincing cyclists that air is plentiful—and free!

Inn Signs and Names

ON a recent Saturday night, sitting in the cosy tap-room of a Hertfordshire village inn, I heard an interesting talk about the popularity of various inn signs and names, and it seemed to be the general opinion that if a census could be taken, it would be found that the most common of all English inn names is the "Swan." Now, I did not subscribe to this view, and an intriguing little argument went on—to the accompaniment of many pipes and many pots of ale. "The Swan" is, of course, a common enough sign, but I doubt whether it exceeds in popularity "The Bell" or maybe "The Green Man." But no matter—all inn signs are interesting, and most have a history or some deep significance. Enough that in the countryside one may find inn signs which are appropriate—I love to drink my ale in an inn called "The Farmer's Boy" when I am in some land where farms abound and there is the goodly smell of cow-byres and stables. . . .

Sutton Coldfield's Park

I TALKED with two American soldiers recently in the ancient and Royal Borough of Sutton Coldfield, which, as you may know, is in Warwickshire. They agreed with me that it was an interesting town, and they confessed that they had never seen a more beautiful natural park; it is some 2,600 acres in extent, has five large pools, and provides delights for the walker, the cyclist, the swimmer, and the horseman. Large stretches of it are wild and lovely, and I have rarely seen a place where holly grows so abundantly. Once a year, near to Christmas, the residents of the "Royal Town" are permitted to take holly from the park, and on one day in the year they may enjoy free rabbiting. All this because somewhere about 1550 one Bishop Vesey, who was Bishop of Exeter, but a native of Sutton Coldfield, bequeathed the vast expanse of woodland to the Burgesses for ever! Blessings on his soul! His effigy may be seen in the ancient Parish Church, and there is a Grammar School named after him—founded, I fancy, about 1558.

"Learning" to Ride

I WAS thinking the other day how seldom it is that one sees a person being "taught" to ride a cycle! It is passing strange, because years ago one very definitely had to "learn" the gentle art of balancing, and I have memories of nervous ladies being "held up" on bikes, and tutored patiently by friends. And it used to seem an awful business to keep a straight track, or manage the machine at all. Have we "evolved" as natural cyclists? Does the art of the thing come to us automatically now? It is an interesting point. Certainly I believe that the modern boy seems able to jump on a bike and ride it straight away!

Literary Landscapes

ENGLAND has many "literary landscapes"—Lakeland, with its memories and reminders of Wordsworth, and Southey, and Ruskin. Yorkshire, with all the hallowed memories of the Brontës; and Buckinghamshire, which is rich in literary associations . . . for does not the lovely Chiltern region abound with links with Milton, and the gentle Cowper, and William Penn? Lately I have been fortunate enough to cycle amid some of the best of Buckinghamshire scenery and renew my old loves for such delightful spots as Little Missenden and Ballinger—that village of the cherry trees. And I have found that my love for this part of England is stronger than ever. It is an adorable land. Its villages are good. Its little churches are rich in history. And its inns are unique—just what village inns should be.

An "Old-timer"

I WAS reminded of a fine "old-timer" the other day when I received some documents about the Cycle and Motor Trades Benevolent Fund—for this excellent fund was founded by A. J. Wilson, universally known as "Faed." "A. J." is now living in some sheltered spot in the Cotswolds, but I gather that he is in fine form, and that he still manages to get about the countryside on a tricycle. Long years ago, "A. J." was with the Dunlop Company, and later was the famous head of a famous advertising agency—an agency which used to handle many motor-car accounts. It is good to know that his great work lives on in the activities of the Benevolent Fund. Long may it prosper!

Small Boys and Birds' Eggs

THE ways of small boys do not change much, I think—there may be a preference for making model Spitfires instead of for watching trains and recording their numbers, but in the main the small boy is what he was in grandfather's time. I make these comments, because I have been observing the efforts of several small boys in connection with birds' eggs. Collecting is still, it would seem, a great passion, and I know of one boy who has secured a few good specimens this season already—and he is a real collector, and respects the "unwritten laws" of the ornithologist, only taking one egg from a clutch, and paying due attention to the other laws. His "finds" include the eggs of the hawfinch, the song thrush, and the yellow bunting. His present dream is to find, in the rough tufts of a big field, the well-hidden nest of the skylark—but that is not easy!

The English Farm

WE hear a lot about mechanised farming, and the most unobservant can see how far the machine has invaded the domain of the farm and field. But somehow mechanisation has not been a spoiler . . . the tractor somehow "fits in" with everything about the land, and although I am told that we now have about 150,000 tractors working in England, they do not seem to intrude. And the horse survives in any case, even if he is no longer king of the plough-lands. I cycle past a farm, and through a gate a big chestnut gazes . . . such a friendly fellow that I have to dismount, and stroke his white nose, and pat his glossy neck. The English farm is still the English farm, and the swallows still build in the ancient barns, and foals still skip beside their mothers in the wide fields.

My Point of View

BY "WAYFARER"

Winged Nuisances

THERE will be no peace on the roads, so far as cyclists are concerned, until we have had a jolly good downpour of rain, which will drown (I hope) about 95 per cent. of the fly and midge population. These winged nuisances have been getting completely out of hand within recent weeks, at the time of writing.

Fame

A FRIEND of mine, touring recently through Wales, called at a certain catering etsablishment and asked for tea. He was refused—for impersonal reasons now within my knowledge. He then mentioned me by name, and (he says) "was served with an excellent tea." Such is fame!

The Changing Face

I SAW something in my newspaper the other day about the changing face of the English countryside. Which reminds me that in a book I was reading a short time ago a reference was made to the *spire* of Winchester Cathedral. Fortunately, I have no reason for thinking that the changes that are taking place in the English scene involve the conversion of the existing tower into a spire!

Crooked Ways

THE other Saturday evening a friend and I emerged from a tangle of hitherto unexplored crooked ways, struck a main road at right-angles, turned left, and "got on with it" towards (as we thought) home, just about a dozen miles away. The whole thing was automatic: we both knew the main road perfectly well and were satisfied as to our direction. At the end of a mile or so, we looked at one another sheepishly and announced, simultaneously, that we were going the wrong way. The road which we had recognised as an old familiar route, very often traversed, turned out to be an entirely different one. We reversed direction and slunk back to the point where we had joined the road. There we took stock of our position, realised the mistake we had made, and set forth for home along the correct way. The use of crooked ways *does* sometimes lead even experienced cyclists astray in this manner.

A Case in Point

THE following may be read as a pendant to a recent paragraph of mine under the head-line "Burnt Out": The other day I struck the trail of a lad who had done a day's ride of nearly 200 miles in order to reach his first night's destination on a brief tour. Not unnaturally he was vague as to the route he had followed, and was far from being sure whether the place where he had crossed a river and seen a biggish church was Worcester, or Hereford—or Tewkesbury! He was also vague as to his forthcoming itinerary, and had to be put right. Within the space of two or three days he was going to carry out the Grand Tour of North Wales, afterwards blazing home again, his total mileage shaping something like 600 in four days or so. In discussing the matter with my hostess—herself an old-time cyclist—I said that the youngster would see practically nothing, and that his mind would be filled with one long blur. I added that it seemed to me a pity for one who, normally, would have many years of cycling opportunities in front of him, to be trying to cram everything into less than a week, with, I feared, the inevitable result of complete fed-upness—and "a bicycle for sale"! We are insistently told that "life is short," but there *is* no need for all this haste.

New Plan

DESPERATE diseases, they say, require desperate remedies. The "desperate disease" arising from the war, in the form of catering difficulties, has recently caused me to adopf the "desperate remedy" of indulging in a new plan by tying up at one address for a whole week, and thus of relinquishing, for the nonce, my ancient habit of moving on daily from place to place. To say this is not to suggest that there is going to be any permanent change in my roving habits, or in my ideas of "living dangerously." It so happened that I was just in the mood for "playing safe," and it seemed good to try a new plan of spending holidays—one which, as a cyclist, I have never before sampled. The experiment was satisfactory, and I returned home very pleased with myself. I certainly missed the spice of adventure arising from the nightly gamble over sleeping accommodation, and I have an open mind as to the future.

I stayed at the highest village in Wales, about 100 miles from home, and I devoted the spaces between meals to wanderings awheel and afoot. One day I cycled 75 miles; another day I was content with a mere 13 miles. One afternoon I tramped the hills for four solid hours, enjoying the complete seclusion and the ever-changing pictures. My total cycling mileage, including the ride from home to the centre and back again, was 477. As I was away 10 days in all, that figure gives an average daily distance of 47¾ miles. I have no idea how far I walked, and, indeed, would prefer to consider the whole tour in terms of hours of pleasure rather than of miles. The weather was arctic for most of the time, making me glad of the skin gloves I had taken and causing me to long for one of my pullovers; and then, for the last two and a-half days, the climate turned tropical, culminating in the hottest Whit Monday for years. Several articles of clothing were then for sale!

Without prejudice to my future plans, it was certainly jolly to ride an unencumbered bicycle (even my spanners and repair outfit were left behind most of the time), to be free from the slightest concern as to accommodation and to be aware that four substantial meals per day were available for me, as and when I wanted them. The wheels of life ran smoothly—but I am not sure that I really like all this complete absence of risk!

Dunlop Director Honoured

THE Colwyn Gold Medal has been awarded by the Institution of the Rubber Industry to Mr. A. Healey, B.Sc., for conspicuous services in connection with the technique of tyre manufacture, with special reference to the problems that have arisen during the national emergency in the usage of synthetic rubbers. Mr. Healey, who is at present adviser on synthetic rubber usage to the Ministry of Supply at Rubber Control, is a director of the Dunlop Rubber Co., Ltd.

Notes of a Highwayman

By LEONARD ELLIS

Riding with an Object

THERE is one thing that can be said of cycling that cannot be claimed by any other form of physical recreation to the same degree. It positively offers the chance of improving our knowledge in many branches of learning. With football, tennis and many other games the only objects are physical exertion and the desire to excel. With cycling, except for those who "blind" for the sheer love of speed, there is always what is known as "riding with an object." An examination of any of the lists of club runs will show that apart from places that have an appeal to our sense of peace and beauty there are many places chosen because they have a geographical or historical interest or because there is some architectural feature that is worth going to see. It is unthinkable that a man will walk round the walls of Chester, and enjoy the view from King Charles's Tower and will not at least assimilate the fact that King Charles stood here, in September, 1645, and saw his armies defeated by General Pointz at Rowton Moor. He will probably remember the fact and his store of knowledge is increased. He will do this on many occasions until he has learned much of the interesting little incidents of history.

Learning without Tears

SIMILARLY it is impossible that a man will visit the ruins of Fountains Abbey, or Buildwas or Tintern, or gaze in awe at the massive columns or magnificent setting of Durham Cathedral without beginning to realise the broad differences in outline between Norman and Early English architecture. It is obvious that most keen tourists develop a sense of direction and a skill in map-reading, and it is equally obvious that with no conscious effort of learning he will build up a visual picture of the layout of the roads, towns, and physical features of the country, together with a more or less accurate idea of the distances between. I know others who take an interest in the stars merely because night riding is conducive to their study. I do not claim that cycling is the only pastime that has this beneficial effect. Walking is equally good, if not even better; motoring is by no means so good. Golf offers quite a few possibilities, but it is restricted. I know many golfers who, when off their game, will say philosophically: "Well, it's a lovely evening, and hark at that nightingale in the spinney." For the moment the game becomes incidental, the great thing is that it brings its devotees in closer touch with nature, and the beauty of the countryside.

Of Battlefields and Kings

IT is quite common to find cyclists, who having stood in King Charles's footprints, are anxious to make a collection of such visits. There are innumerable places in this country where the cyclist can put himself, and without drudgery can assimilate some of the facts of English History. There are scores of places where he can stand with the ghost of a dead king and survey the ghosts of dead armies. Two miles from Market Bosworth, in Leicestershire, will be found a small brick shelter over a well. This is the site of Bosworth Field where the Wars of the Roses came to an end. Tewkesbury in Gloucestershire is for ever associated with queens and princes, with battlefields and kings, as it was here that Margaret of Anjou was defeated in May, 1471, and Prince Edward met a tragic death. On the summit of the Edge Hills, on the Warwick-Oxford border is a tower overlooking the spot where Charles I fought his first important battle against his Parliament. And so we could multiply the spots where an incident in History is for ever associated with a particular spot.

King Charles's Tower, Chester.

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