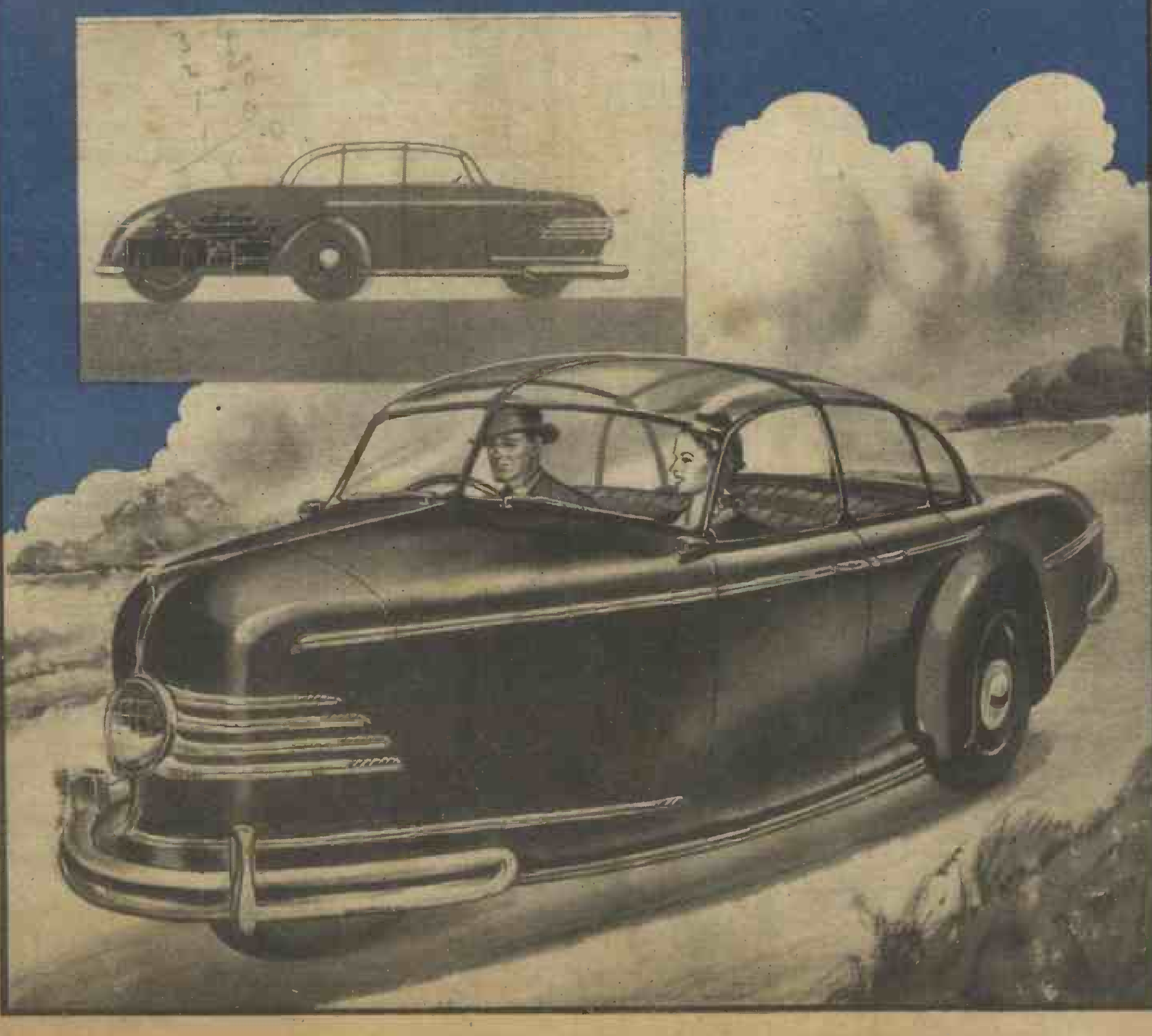
THE GAS-TURBINE CAR

NEWNES

PRACTICAL MECHANICS

9D.

DECEMBER 1942



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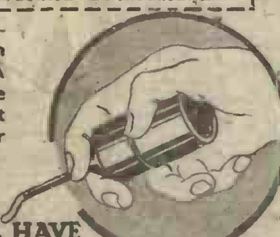

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Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor : F. J. CAMM

VOL. X. DECEMBER, 1942 No. 111

FAIR COMMENT—BY THE EDITOR

Technical Commissions—Chance for Youth

THE Government has announced the foundation of Engineering Cadetships leading to technical commissions in the Fighting Services. These Cadetships will be open to youths age 16 to 19 inclusive who have left school with at least a School Certificate including a credit in mathematics, physics, or science, and who are not employed in any branch of engineering. Successful applicants will be given courses in engineering at technical colleges before being allocated to the Forces for training as technical officers.

Applications will be received by local Appointments Offices of the Ministry of Labour and National Service, or by the Appointments Department, Sardinia Street, W.C.2.

Mechanical warfare makes unprecedented demands on our resources of technical personnel, not only for the design and production of weapons, but also for their maintenance and repair in the Services. We are now on the threshold of the offensive phase, and the trend of recent fighting emphasises the importance of the Engineer Officer. To-day he is right in the front line; it may be a tank battle, or an aircraft carrier, or an airfield. Engineers of professional grades are needed to ensure the maximum production of armaments, but they are needed also to ensure that the maintenance requirements in the Forces shall keep pace with the supply of equipment from industry. Measures for securing the supply of such men for all war purposes are worked out by the Technical Personnel Committee, which is a committee under the chairmanship of Lord Hankey, with representatives of the Ministry of Labour and of the Service, Supply and Education Departments.

State Bursary Scheme

The State Bursary Scheme at Universities and the Intensive Training Scheme for the Higher Certificate at technical colleges are now firmly established and are producing a very substantial number of trained engineers. In addition, a considerable number of young engineers are being withdrawn from civilian work to be commissioned as technical officers in the Fighting Services. The Technical Personnel Committee has, however, come to the conclusion that all these schemes, even when they attain their maximum output, will not be enough and that a fresh source of supply must be found. The scheme of Engineering Cadetships has therefore been planned; its success will reduce the future demands of the Services upon the personnel of productive industry.

The Institution of Mechanical Engineers has stated that Engineering Cadets who successfully complete their course will be exempted from Sections A and B of the Associate Membership examination. Boys satisfying the conditions mentioned and who make application will be considered for interview by a Selection Board on which all three Services will be represented. Those judged by the Board to have the personality and other qualities required for potential technical officers will be accepted for Cadetships subject to medical examination. On acceptance, cadets will be required to sign an undertaking to complete their training, and this undertaking must be countersigned by the cadet's parents or guardians.

Training

The training of cadets will be carried out under the directions of the Education Departments. So far as can be arranged, each cadet will attend a technical college near his home. Cadets will cover during their courses in the technical colleges the basic engineering science required in the Associate Membership examinations of either the Institution of Mechanical Engineers or the Institution of Electrical Engineers. During his training a cadet will be a member of one of the pre-Service organisations or of the Home Guard. Membership of a particular organisation will, however, not necessarily determine the Service in which a cadet will be commissioned upon the completion of his training.

Cadets will attend periodic lectures by Service officers and visits will be arranged to technical units and workshops.

Tenure of an Engineering Cadetship will be subject to satisfactory progress and conduct. Training will, as a rule, continue until the age of 20. The length and character of the training of cadets will be adjusted to their age and educational qualifications. In general cadets aged 18 or 19 will attend courses of training at technical colleges for 18 to 24 months; cadets aged 17 will attend similar courses for two years and six months. Boys of 16 will receive preliminary instruction at an appropriate technical college or other institution. When the grant of new Engineering Cadetships ceases, a cadet who has not then completed his training may be called upon to do so; if not so called upon and he wishes to complete the course which he has begun his cadetship will be continued to enable him to do so.

Educational Fees

The Government will pay the necessary educational fees and allow each cadet a maintenance grant of £140 a year (in London £160 a year) if he has to live away from home, or £75 a year (in London £90 a year) if he lives at home.

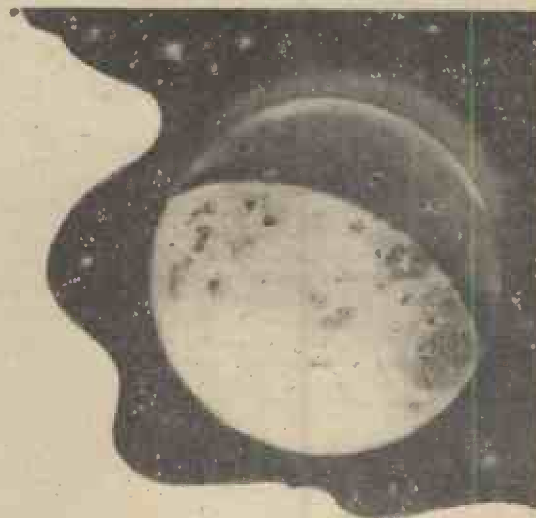
Upon the successful completion of his cadetship a cadet will become a member of one of the Fighting Services and will receive special training in that Service. He will then be qualified to receive a commission as a technical officer. Every successful cadet will be equipped to give outstanding service to our cause in time of war and to obtain for himself a foundation for a professional career in time of peace.

The standard of ability and character required of cadets will necessitate very careful selection in the award of cadetships, but every boy who is eligible for consideration should not hesitate to make application at once for an Engineering Cadetship. Forms of application can be obtained from the Ministry of Labour and National Service, Sardinia Street, London, W.C.2, or from any of the Appointments Offices as shown below. Requests for forms of application should be marked on the envelope "Engineering Cadetships."

Appointments Offices

London: Sardinia Street, Kingsway, W.C.2; Brighton: 74, The Drive, Hove, Sussex; Tunbridge Wells: 31, Upper Grosvenor Road, Tunbridge Wells, Kent; Cambridge: Regional Office, Sidney Sussex College, Cambridge; Colchester: 31, John Street, Colchester, Essex; Norwich: 48, Prince of Wales Road, Norwich; Oxford: Exeter College Annexe, Turl Street, Oxford; Reading: 10, Kendrick Road, Reading, Berks; Southampton: 10-12, Westwood Road, Southampton; Bristol: 1, Apsley Road, Clifton, Bristol 8; Plymouth: 1, Thorn Park Villas, Mannamead, Plymouth; Birmingham: 66½, Corporation Street, Birmingham 2; Coventry: 12, Manor Road, Coventry; Wolverhampton: 3, Queen Street, Wolverhampton, Staffs; Nottingham, 40, Parliament Street, Nottingham; Bradford: Britannia House, Broadway, Bradford; Hull: Fitzwilliam Buildings, Alfred Gelder Street, Hull; Leeds: Lloyds Bank Chambers, Vicar Lane, Leeds; Sheffield: The White Building, Fitzalan Square, Sheffield; Liverpool: Cotton Exchange, Bixteth Street, Liverpool; Manchester: Royal Exchange Buildings, Bank Street, St. Anne Square, Manchester; Preston: 32, West Cliff, Preston, Lancs; Newcastle-on-Tyne: 38, Great North Road, Newcastle-on-Tyne 2; Aberdeen: 80, Union Street, Aberdeen; Dundee: 30, Meadowside, Dundee; Edinburgh: 41, Manor Place, Edinburgh 3; Glasgow: 145, St. Vincent Street, Glasgow; Cardiff: 49, The Parade, Cardiff; Swansea, Metropole Chambers, Salubrious Passage, Wind Street, Swansea; Wrexham: 30: Grosvenor Road, Wrexham, Denbighshire.

If We Visited the Moon



This article is not so fantastic as it sounds. In all probability it will not be many centuries now—wars and "crises" permitting —before the first rocket leaves for the moon. Soon afterwards, no doubt, the pioneer newsreel cameraman will follow to take the most sensational photographs ever known. Here Professor A. M. Low describes the conditions likely to be encountered by the explorers. Professor Low, among other things, is President of the Interplanetary Society, President of the Institute of Patentees and inventor of the first radio-controlled aeroplane.

ONCE upon a time, as the fairy tales say, it was considered very wrong for any scientist to hint that the future could be predicted. Not predicted in the fashionable manner of those who connect one's existence with a tall man and a dark moustache—rather in the sense that scientific efforts can be foreseen, and are very definitely useful as part of ordinary research.

Electrical engineers forecast the probable demands upon their station's current output by the simple process of plotting curves, by visualising the rate at which supplies have been increased, and by noting points on this curve of progress. They say, "if for 20 years, each month has shown a 1 per cent. increase in output, it is reasonable to suppose that, other things being equal, another 1 per cent. increase will occur in the next month." Even stockbrokers adopt this method. Technicians knew the exact pressure at which hydrogen could be liquefied long before the apparatus was available to secure such a result in practice. The automobile engineer knew the temperature in the cylinder of an engine, by plotting curves between the rate of temperature rises in conjunction with positive movement, years before these flaming gases were introduced to a thermometer.

Prejudice

Now all this had a very great bearing upon the, at present fantastic, idea that films of a Martian world will one day, in the far dim future, be made possible. Always assuming that we can rid our minds of that horrid thing called prejudice, and remember that we are still very little better than savages—wild men, with hair on our bodies, throats which closely resemble those of our ancestor the fish, nails and claws like any other inhabitant of this earth. There are many classic examples of prejudice. Only 60 years ago in some countries poor old women were accused by children of witchcraft or of turning themselves into rabbits, and other strange practices. On this evidence they were wrapped in sheets and dragged through horse ponds, suffering death at the stake if they chanced not to sink. Eighty years ago doctors said that a speed of 60 m.p.h. would be fatal to the human heart, the Admiralty agreed that steam would be fatal to the British Navy, and, almost latterly, a great wireless expert opined that radio would never have any commercial value!

It seems strange that with such glaring cases of stupidity a love of the antique should have so retarded civilisation when 60 years ago the craftsmen existed who could have easily made a radio set, and only lack of imagination prevented this invention. I have been reminding myself that Antony might easily have met Cleopatra as she stepped from a Handley Page bomber, while only the accident of time has prevented us from possessing a gramophone record of his funeral oration for Caesar.

Our artist's impression of a rocket-ship travelling through space towards the moon.

Life on Mars!

Those people who say pyramids are wonderful cannot realise that they could be built to-morrow if it were worth while, and if we did not mind bricking up a few odd slaves during construction. It is a valuable lesson to look at an illustrated paper of 20 years ago and to note that change is the only factor in life which we can appreciate. So let us consider our films on Mars and our trips to the moon. Remember that it is vanity which makes us believe that the only life must exist on earth. Human life is not necessarily important, and I believe that if we had never seen a fish we might say they were impossible creatures, and how could life exist without air to breathe?

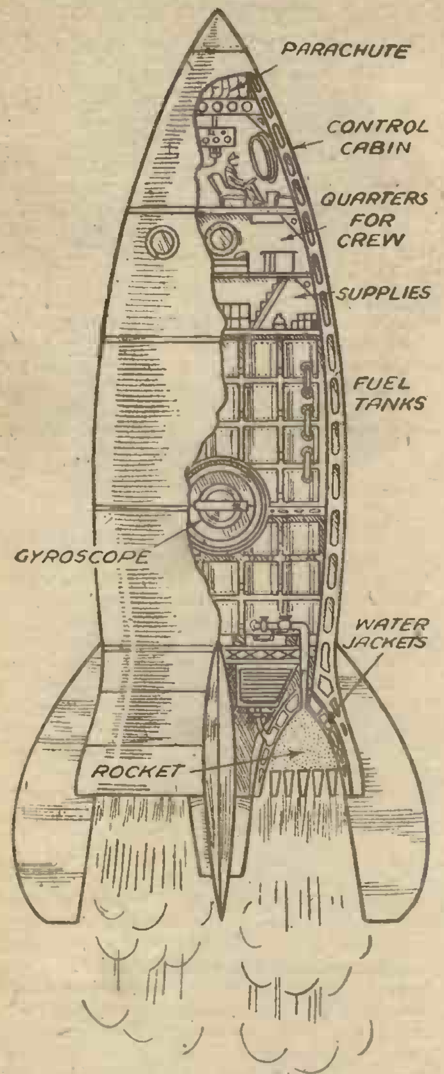
In Mars there is water, oxygen, and warmth. Why should there not be life? Perhaps on that older planet there is better life than our own. Just as Africa has produced people of a different colour, so it may chance that as life developed from the sea to produce animals and ourselves as branches of the same tree, totally different forms of sentient being may live, and fight, and love. In Mars the conditions may have developed creatures who see by heat, whose touch may be more delicate than that of the worm, whose hearing may be by some vibrational movement as infinitely different from our own as that of a bird when compared to our own relative deafness.

Conditions on the Moon

On the moon there is very little oxygen, and I think that it is in lunar regions that "interplanetary" films will be first obtained in some dim distant age. But we can see very easily what conditions will be met for we know that, to take one example, gravity is less than upon the earth. The cameraman would find it easier to run than to walk. Each little step might carry him far into the air. His body will be so relatively light that the hardest rock would feel more comfortable than a feather bed, and he would live in a perpetual mask fed by oxygen as though he were passing through some gigantic A.R.P. test of the most atrocious kind. Even now, there is an Interplanetary Society with branches all over the world, realising that if such research is foolish it would be infinitely more stupid not to undertake it while there is still time.

Rocket-like Space Ship

Even the journey will be an adventure far greater than anything yet conceived by the mind of man. The cameraman will travel in a rocket-like vessel, propelled like a rocket and carrying no wings. A system, incidentally, which has appealed to such experts as Lindbergh and Roe for ordinary aeroplanes, a system already operated on many successful terrestrial flight experiments. This space



Section of a rocket flying-ship, which was successfully demonstrated on the Continent a few years ago.

ship will start from the earth, not like the bullet from a gun in which the occupants would inevitably be crushed, but by increasing velocity as the solid propulsive fuel is gradually ignited by electrical means. Steering will be through side jets or through rockets, and the cost has been estimated for the return journey at approximately £250,000. Not much more than that for a small ship which sails for New York and at a cost not much greater than a trip by rocket to New York, itself an almost more difficult problem.

In such a space machine there will be a period when no normal gravity applies. Unless the ship were given a twisting motion the occupants might float about inside for several days, and although the total time occupied in the journey would be rather less than a week, a speed of nearly 33,000 m.p.h. would have to be given to the shell for the first four minutes, in order that the load of fuel carried would not be excessive. From this point onwards the velocity would be sufficient (I am quoting entirely from the records of the Interplanetary Society's Research Director) to carry the machine into an orbit where the gravity of the moon would draw them towards its surface. It is a fearsome thing to realise that without gravity it might be difficult to swallow or to eat halfway across the void, and to realise that until oxygenated foods had been invented, the film unit would have to live entirely on its own imported oxygen. Wonderful perhaps, but not more wonderful than what we see all around us already accomplished by Nature, and by man.

Camera Requirements

Some of the conditions to be met by the cameraman of the future are certainly somewhat queer. His instruments will be carried in carefully padded boxes, and en route he will be insulated from heat and cold as though he were in some form of vacuum flask. On the sunlit side of the moon he would be reasonably comfortable, but in the shadows he would suffer very much from cold in spaces where there was no air to distribute the heat. I think he would find it very difficult to fall down and hurt himself, and I am sure that if he dropped his camera, it would fall as softly as a bit of down. Mountain climbing would be most attractive for he could leap 20 or 30 ft. at a time in comfort. I am told that in his trip he will be as safe from meteors in the vastness of space as one is in a London street from the chance fall of an aeroplane in the sky.

Every detail has been calculated by the Interplanetary technical committee men, who have prepared for this trip for many years. They say there is not the slightest doubt of success, if only money was available to an extent which is often used to finance two or three famous films. Even the amount of fuel required has been calculated. It is in the region of 900 tons of which 50 are used to overcome air resistance on leaving the earth during the first 20 miles. One hundred tons would be sufficient to lift the load for 300 miles, while the remainder is used to overcome the earth's gravitation and to build up the velocity of the rocket ship.

Fantastic Conditions

It could indeed be a strange land for our film. Far stranger than any country on earth—a world with no atmosphere, no seas and no soil—a country in which we would have to employ our whole energy in producing the very things that Nature gives so freely upon this earth. But physical work would be easy in a plane where gravity is relatively unknown. Oxygen to breathe, water to drink; carbon dioxide and hydrogen to feed plants would have to be made with difficulty from rock, so that these commodities, free to us, would be as valuable as gold on the surface of the moon.

Conditions would be fantastically different from those we know. At low air pressures tea could only be made in an autoclave and drunk almost at once before it could cool. Trains would all be driven by electricity, while roller skates or even pogo sticks would be a safe means of travel. An occasional night's sleep, perhaps, is stated by authorities to be all that is necessary about once a month, to satisfy our habit. It is said that weather will be non-existent, with winter sports every morning and cooling drinks in the afternoon.

Million Horse-power Jets

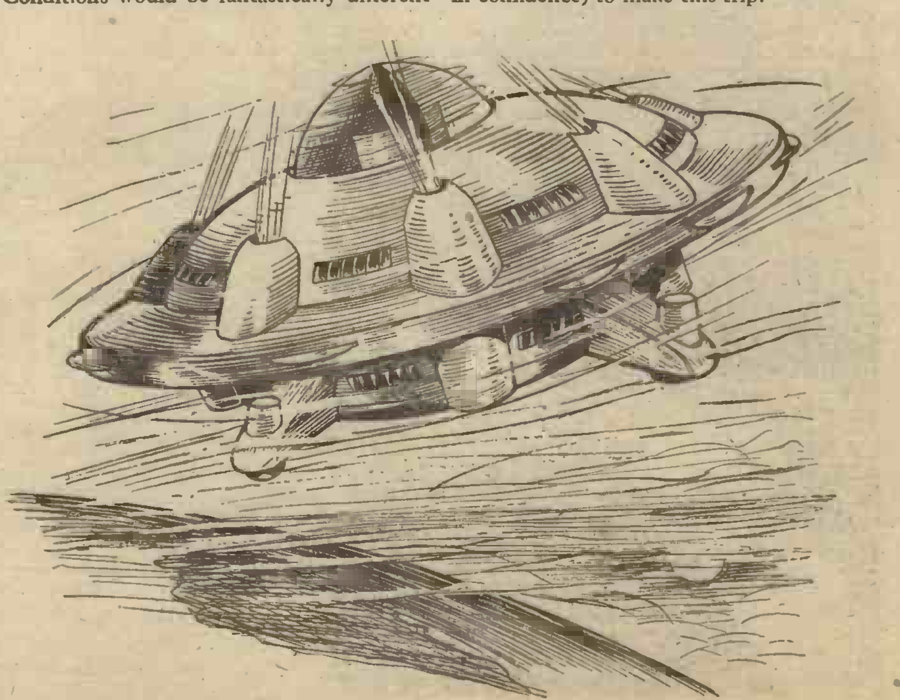
One must not be too confident, but I believe that when the space men first step from the hemispherical room in the nose of the vessel from which most of the million horse-power gas jets had been jettisoned on the way, they would find a mass of shimmering sunlit rocks beside which the richest flower gardens of the earth would be dowdy waste land. Above this brilliantly lit landscape will be a jet black sky, spangled with an incredible number of vividly coloured untwinkling stars. The night would be a blaze of glory by earth light sixty times as bright as full moonlight, radiating from an apparently gleaming earth—solid looking, blue-white, misted and ringed with red.

Tennis would be a game so fast only a few would dare attempt it. Ice hockey must be reduced to a crawl and football so slow as to seem ridiculous. Golf might be possible with a smoke bomb for a ball after a moderate drive of three miles, while bare-fisted boxing might be a gentle pastime if the ring was covered with a net to prevent the recipient of an upper-cut sailing over the audience.

Air and Water

Fountain pens might be cheaper than pencils, and sheets of aluminium might take the place of paper. Champagne would be no dearer than tea, but tobacco might be entirely prohibited, owing to the high cost of replacing the polluted air. As far as can be seen, air and water would be part of a social service supply, and income tax must undoubtedly exceed 18s. in the £.

On second thoughts I have decided to take these figures from my friends of the Interplanetary Society for granted, for although I shall certainly attend the first lunar news film, I am determined to encourage a number of people (whose names I will gladly provide in confidence) to make this trip.



An impression of a "space-ship" of the future.

The Gas-turbine Car

Will the Gas Turbine Take the Place of the Present-day Internal-combustion Engine?

THE following notes give particulars of some promising research work and achievements by the Swiss firms of Brown-Boveri and Sulzer Brothers. As is well known to our readers, the motor-car engine of orthodox design has attained a surprising degree of perfection. It is reliable, economical and silent in operation. Its resistance to wear and tear, its care and maintenance, and its cost of production can, even under present circumstances, be regarded in a much more favourable light than

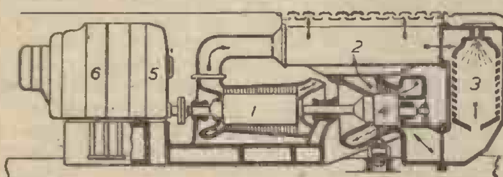


Fig. 1.—Principle of the Brown-Boveri gas turbine-operated locomotive: The gases used for propulsion originate from the combustion chamber (3), and after they have been mixed with cooling air they enter and actuate the gas turbine (4). In its turn the gas turbine drives the turbo-compressor (1), which supplies both the air needed in the combustion chamber (3) and the air required for cooling. Finally, by means of a set of gearing (5), the turbine also drives the generator (6), which produces the current needed to operate the electric motors of the locomotive. Before entering the combustion chamber, the air required for combustion is pre-heated by means of a sleeve through which are passed the exhaust gases (2).

we could have ventured to hope for not so very long ago. And yet the present-day petrol-fuelled engine is still far from being rightly entitled to claim that it represents the ideal motor-car power unit. Indeed, if it is considered not from the standpoint of its present capabilities, but rather from that of the performance which could justifiably be expected from it, the conclusion is that it still has quite a number of shortcomings to make good. In the first place, it still comprises far too many intricate components which increase its cost of manufacture, and make it a rather delicate piece of mechanism. Some of its working parts are still running under very poor conditions as regards lubrication, and they wear out prematurely. The pistons and their reciprocal motions within the cylinders do not very well lend themselves to great rotational speeds, and they accordingly prevent the attainment of very high specific efficiencies. Moreover, a considerable proportion of the heat developed by the combustion of the fuel escapes without serving any useful purpose, which is sheer waste.

For these reasons, and many others yet, we may be allowed to expect that, sooner or later, the piston-operated engine of the present time will almost certainly give way to another type of power unit. But the question may be asked, what will the new engine of the future be like?

The Gas Turbine

If, pending further developments, it be assumed that petrol as we know it, or any liquid fuel of a similar nature, will for the time being continue to be the fuel preferred for direct combustion, it is the gas turbine which, first and foremost, commands the attention of technicians as a means of propulsion. What wonderful strides forward would it not enable the technique of motor-car construction to accomplish as a result of its adoption. Apart from the advantage of compactness, the gas turbine would make enormous capacities in terms of horse-power readily available. The construction of motor-cars would be very considerably simplified: the adoption of the gas turbine would reduce maintenance to a negligible quantity, and make breakdowns almost impossible. Moreover, the operation of the gas turbine is practically free from noise and vibration.

On the other hand, however simple and highly attractive this solution may appear to be, its translation into practical engineering has unfortunately proved so far a matter of great difficulty. For many years past a host of inventors, designers and engineering firms have been hard at work on the problem without much success, and until a comparatively recent date only a very few examples of turbines of that type were in actual operation. These machines were of very large dimensions. They were regarded more like curiosities than as achievements of really practical value, so that, in short, the modern Diesel engine was preferred to them.

The construction of internal-combustion turbines comes against two essential difficulties: how to ensure efficient protection of the driving parts of the turbine against the effects of the heat, and how to secure a reasonable degree of efficiency. On the other hand, the practical execution of the combustion chamber also gives rise to certain thorny problems.

It now appears that the research departments of leading Swiss engineering firms have devised for these problems solutions which will probably prove to be of very considerable importance for the future development of the combustion turbine. Here is a brief survey of the essential points involved.

Essential Points

For some time past, Messrs. Brown-Boveri, of Baden, had been using gas turbines for the purpose of utilising the exhaust gases originating from their Velox steam boiler This type of turbine yields the entire output obtainable from such exhaust gases up to a

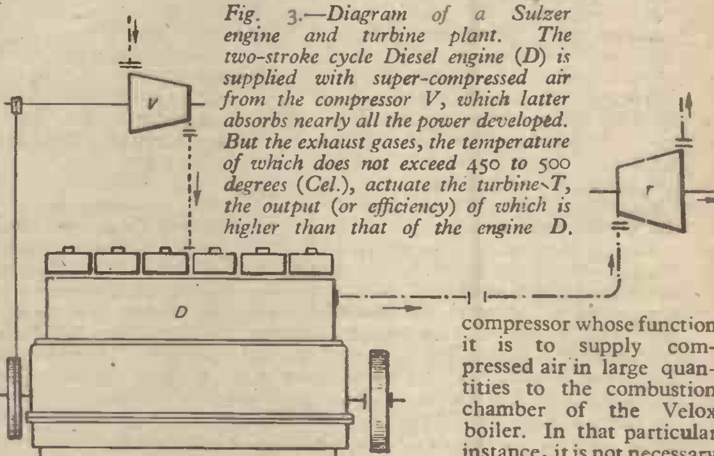


Fig. 3.—Diagram of a Sulzer engine and turbine plant. The two-stroke cycle Diesel engine (D) is supplied with super-compressed air from the compressor V, which latter absorbs nearly all the power developed. But the exhaust gases, the temperature of which does not exceed 450 to 500 degrees (Cel.), actuate the turbine T, the output (or efficiency) of which is higher than that of the engine D.

compressor whose function it is to supply compressed air in large quantities to the combustion chamber of the Velox boiler. In that particular instance, it is not necessary that the turbine should operate in any particular rational manner to ensure an already appreciable improvement in the efficiency of the whole plant. In fact, it constitutes only a *useful accessory.* But starting from that exhaust gas turbine, the firm's technicians have been working assiduously so as to design gas turbine of improved construction, ensuring more economical performance and capable of being used henceforth as an independent source of energy. Consequently, they just eliminated the steam generator of the Velox boiler equipment, and subsequently the steam engine itself. As hitherto, the gas turbine makes it possible to obtain the gases required for its operation, by reason of the fact that it continues to drive the turbo-compressor whose function is to blow air into the combustion chamber, the latter being supplied with heavy oil as fuel.

No doubt, the turbo-compressor still absorbs a large proportion of the power developed by the turbine, but there nevertheless remains a certain surplus amount of power which can be used as required. This will certainly prove to

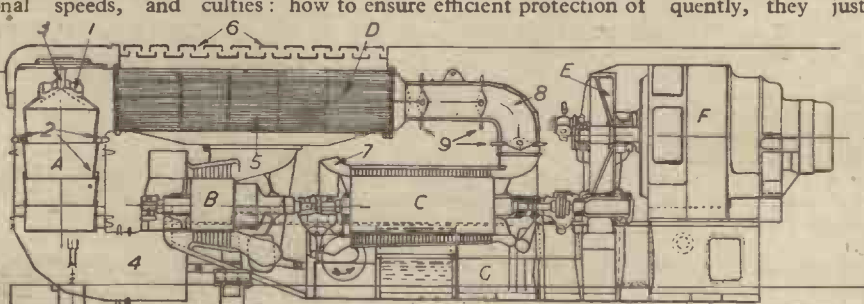


Fig. 2.—Diagrammatic section of the new Brown-Boveri turbine-driven locomotive: (A) Combustion chamber. (B) Gas turbine. (C) Turbo-compressor. (D) Preheater. (E) Set of gearing. (F) Generator. (G) Auxiliary frame. (1) and (2) Inlets for combustion air and cooling air, respectively. (3) Inlet for fuel (heavy oil). (4) Mixing chamber for propelling gas. (5) Inlet for exhaust gases into preheater. (6) Exhaust gas outlet. (7) Air inlet. (8) and (9) Pipe for compressed air.

be the signal for future striking developments in modern gas turbine design. In order to protect its driving mechanism against destructive contact with the very hot gases which come out direct from the combustion chamber, a portion of the air supplied by the compressor can be by-passed from the combustion chamber and mixed with the combustion gases, thereby lowering their temperature. The expenditure of energy required to ensure the injection of the cooling air is, however, rather considerable. Yet, this notwithstanding, the machine is already operating with a reasonable degree of efficiency.

Turbine-driven Locomotive

The first large turbine of that type was the technical sensation of the National Exhibition at Zürich. It was intended for the city of Neuchâtel stand-by thermal power station. Hardly two years later, in the autumn of last year, Messrs. Brown-Boveri distinguished themselves again by presenting to the world *the first gas turbine operated locomotive*.

The constructional principle of that locomotive clearly appears from the general erection diagram, Fig. 1. The gas turbine develops not less than 8,200 h.p., whereof 6,000 h.p. is absorbed by the compressor alone. But this leaves a margin of 2,200 h.p. available for traction purposes, which—in view of the conditions under which the locomotive is used, may be considered as highly satisfactory. Wtih its thermal efficiency of .18 per cent., the turbine driven locomotive referred to above does not yet attain the commercial economy of the Diesel type; but it already exceeds that of the steam-operated engine.

The application of this solution to road vehicles by simply reducing the equipment down to appropriate dimensions is provisionally precluded owing to the fact that transmission of the power to the wheels is effected by means of a generating set; the dynamo and motor would make the whole plant too heavy. But since it has been found that the gas turbine is capable of practical utilisation under certain conditions, there does not seem to be any reason why the day should not come when it will perhaps be possible to adapt it for practical use in the construction of motor-cars. There is no doubt that its degree of efficiency and specific power can be greatly improved. In the case of the Brown-Boveri locomotive the driving gases enter the turbine at a temperature of 550 to 650 deg. C. (Fig. 2). It would suffice to design driving parts better able to withstand the effects of heat in order proportionately to reduce the quantity of cooling air to be added to the combustion gases and, accordingly, the sum of energy required by the compressor. Even minor improvements in that direction would produce beneficial results. It has been calculated that the thermal efficiency of the Brown-Boveri locomotive would be raised from 18 per cent. to 35 per cent. if its turbine could operate no longer at the temperature above mentioned, but at 900 deg. Celsius. The future of the gas turbine therefore depends essentially upon the temperature of the combustion gases.

A New Solution

But there is yet another method for increasing the degree of commercial economy and the reliability in operation of the turbine without having recourse to the solution devised by Messrs. Brown-Boveri, that is to say, without sacrificing a portion of the power developed by the turbine. That other method is now the subject matter of highly interesting and promising trials carried out by Messrs. Sulzer Brothers, of Winterthur.

In principle, it consists in using the exhaust gases emitted by an internal-combustion engine in which combustion is carried to such a point that the engine merely acts as a producer of gases, while the turbine is used to supply the motive power properly so-called.

The point of departure of that new solution

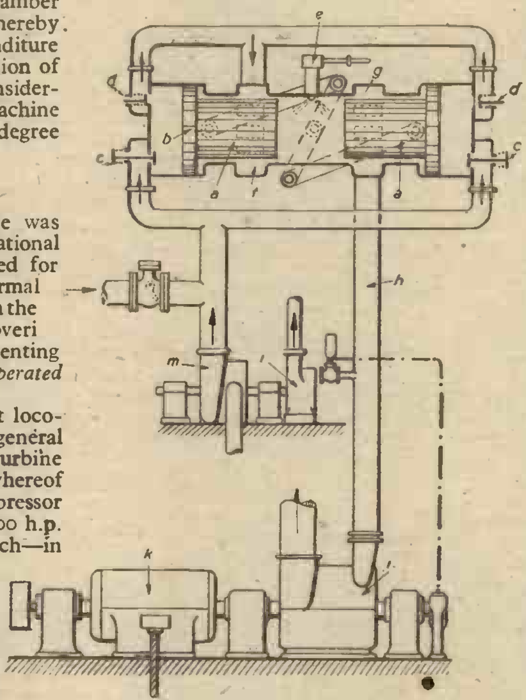


Fig. 4.—Diagram of a Sulzer engine and turbine plant in which the propelling gas is obtained from an engine without crankshaft or so-called "free piston engine." (a) Diesel piston. (b) Compressor piston. (c) Suction valve. (d) Compression valve. (e) Injection nozzle. (f) Inlet port. (g) Exhaust port. (h) Propelling gas pipe. (i) Gas turbine. (k) Generator. (l) Auxiliary turbine. (m) Preliminary compressor.

was the two-stroke cycle Diesel engine. After each stroke, the cylinders in this type of engine are normally scavenged by an inflow of compressed air. The scavenging air is supplied from a compressor of the piston or the rotary type, which is usually driven off the engine crankshaft. What happens if the power of the scavenging inflow is increased by making use of super-compressed air? Thus each cylinder will be enabled to consume more fuel and the power developed by the engine will increase. But, at the same time, the air compressor will necessarily absorb more power. Actual tests have shown that scavenging the cylinders with air compressed to 5 or 6 atmospheres will absorb the entire power developed by the engine, which latter would accordingly become useless—*if its exhaust gases were not utilised in their turn.* Now it has been proved that these exhaust gases can be used efficiently. In fact, the gas turbine will develop a sum of power appreciably higher than that derived from the compressed air generating and gas producing engine, if that engine were not artificially super-compressed.

The gas turbine operates with absolute reliability, when fed with exhaust gases, the temperature of which does not exceed 450 to 500 deg. Celsius. Actually, such a power unit has a thermal efficiency ranging from 35 to 40 per cent. (Fig. 3).

On the basis of this principle, all sorts of interesting variants are offered for our choice. Thus, for instance, the Diesel engine can be reduced in size so that it should act solely as a producer of exhaust gases, and the duty of driving the air compressor can be left to the gas turbine. In that case, the construction of the Diesel engine can be appreciably simplified. The crankshaft can be eliminated and the design made to comprise an engine based on the principle of a pump with free pistons. This principle is clearly illustrated in Fig. 4. A simple articulated coupling device ensures that each of the two pistons working in the same cylinder moves in opposite directions. Reversal of the motion is effected at the internal dead-point of the pistons as the result of the explosion occurring between the two pistons, and at the external dead-point by the cushions of compressed air which force the pistons back again towards the interior.—*By the courtesy of the Swiss Journal, "Touring."*

G.E.C. Philplug Products

SINCE its introduction the versatility of Philplug has been rapidly recognised. Its uses are manifold, and the fact that it is simply and quickly manipulated makes it an effective time-saver.

Briefly, it is a plastic asbestos compound which can be used for all wall-plugging operations, for anchoring machines to the floor, and for any similar operation in any climate—above ground or underground.

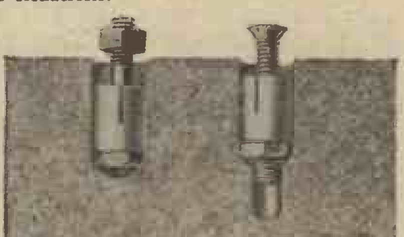
It is impervious to wide variations in temperature and humidity, is waterproof and weatherproof, and it is a most effective "damping" material so far as sound vibration is concerned.

Since it is used in a plastic state the careful drilling of the holes is not essential, thus obviating the necessity of skilled labour in the preparatory stages. Other characteristics of Philplug are that it will carry its full load immediately (even when plastic); screws inserted in Philplug may be withdrawn and replaced as often as required without destroying the thread; it will not cause corrosion, or the rusting of screws, and it becomes an integral part of the masonry or other surrounding fabric the moment it hardens.

Section of thread made in Philplug by the special forming tool.

Philplug Accessories

A variety of accessories for use with Philplug is available, and covers almost every need likely to be encountered in modern construction and equipment. For example, the Philbolt is an efficient and inexpensive accessory for fixing foundation bolts in any kind of masonry; and the tools—drills, wall-boring tools and jumpers, screw thread formers, etc.—available are adequate to meet all situations.



Two methods of anchoring the Philbolt in masonry.

Petrol Systems for Aircraft

Notes on Their Layout and Operation

AIRCRAFT petrol systems have progressed from the simple gravity-fed type installed in light trainers and sporting machines to the complicated systems required on heavy multi-engined transport or bomber aircraft. Great care is required in the design stage to ensure an adequate flow of fuel under varying conditions of flight, and to avoid air locks in the pipes. The system must be capable of delivering over 100 per cent. of the engine's requirements, the actual percentage varying for different aircraft.

The main items of equipment are as follows:

1. Fuel tanks.
2. Filters.
3. Pumps.
4. Relief valves.
5. Control cocks.
6. Pipes, couplings, gauges, etc.

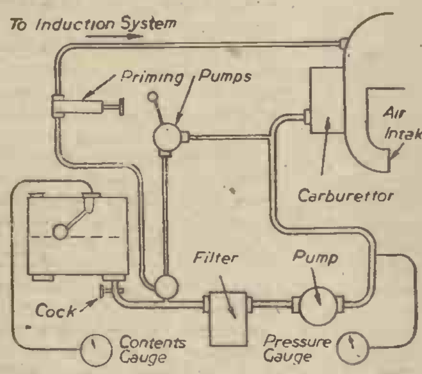


Fig. 1.—A simple petrol system as used on a single-engined aircraft.

Simple System

A simple system is illustrated in Fig. 1, and a more complicated layout supplying fuel to two engines from two tanks is illustrated diagrammatically in Fig. 2.

The fuel tanks in present-day use are constructed of light alloy, aluminium, tungum, or tinned steel, the most common material being light alloy. The shape of a fuel tank varies considerably, from the cylindrical type installed in the Short Sunderland flying-boat to the streamlined tear-drop tanks which are often slung underneath the fuselages of aircraft when extra fuel to increase the range is required. Hollow spars have also been utilised as fuel tanks, thus economising in space. The disadvantage of this idea is the difficulty experienced in the repair or replacement should any damage occur. The most common shape of tank is the rectangular box type, which is fitted in the wings between the front and rear spars. In order to prevent the fuel surging about inside the tank when the aircraft is manœuvring, internal baffle plates are usually fitted, sometimes incorporating non-return valves. These plates also increase the tank strength. Other items of equipment fitted include a sump with control cock positioned so as to be easily accessible, vent pipe, contents gauge (usually electrically-operated), and filler neck. Aluminium tanks are of welded construction, and those constructed of light alloy riveted after fitting a jointing material between the two flanges being joined together. The tanks are usually held in position by means of metal straps (steel) and bearers. This method allows a certain amount of flexibility.

Testing Fuel Tanks

It is important that tanks should be thoroughly tested to ensure that there are no leaks. The usual method of testing is as follows: Paraffin is poured into the tank and air is admitted under pressure. Should there be any faults the liquid will discolour the coating of whitening which is painted over the joints. Prototype tanks are tested to approximately 10lb. per sq. in., and subsequent production tanks to 2½lb. pressure.

Tanks fitted to military aircraft are usually coated with a layer of special rubber. This gives a certain amount of protection against bullets or other anti-aircraft fire. If a bullet penetrates the tank the hole is sealed by the rubber swelling and closing up the aperture. Various types of protected tanks are now in service and improvements are still being made.

The filter is positioned immediately before the pump, and usually consists of the wire gauze (fine-mesh) type. It must be positioned so that inspection, cleaning or replacement may be carried out as easily as possible.

Fuel Pumps

Fuel pumps may be either driven by the main power unit or independently by means of an electric motor. The method by which a small wind-driven propeller operated the pump has now practically died out. Both the diaphragm and vane types of pumps are utilised. A hand pump is also installed on the larger type of aircraft to be used in an emergency should the engine-driven pump fail, or to transfer fuel from the reserve tanks to the main delivery tanks.

It is essential that a relief valve be fitted either in the pump itself or as a separate unit to ensure a constant pressure (preventing the carburettor from flooding). With the diaphragm type no relief valve is necessary owing to the fact that the diaphragm remains stationary when the required pressure is exceeded. The average pressure required is approximately 3lb. per sq. in., depending on the type of engine and carburettor fitted.

Pumps are sometimes fitted adjacent to the tanks. This tends to overcome the possibility of air locks occurring, as the fuel is not being sucked through the pipes but is being forced along right from the tank.

The main cock which controls the supply of petrol is operated by the pilot and has two positions, *On* and *Off*. On large machines incorporating several engines the control cocks are operated by means of levers, cables or shafts. The supply from any tank must be able to be cut off, and at the same time allow fuel to flow from the remaining tanks, should a pipe line be damaged.

Pipe Lines

The pipe lines consist of flexible armoured hose which has largely superseded tungum, copper or stainless steel piping. The objection to the use of copper is the likelihood of the material fracturing due to hardening after the aircraft has flown for a considerable time. It is important that the fuel pipe lines should not run near to the hot exhaust system or any electrical equipment, to prevent the dangers of vaporisation and fire. The bend radii of the pipes must be as large as possible to prevent straining the pipe material. A metal braid usually runs along the length of the hose to provide electrical continuity between the various sections. By this method of bonding, interference with the electrical equipment is reduced to a minimum.

The gauges usually fitted include a fuel contents gauge and a pressure gauge. The modern type of contents gauge is usually electrically operated. A float inside the tank rises and falls with varying levels of fuel, and the movement is transmitted via an electrical circuit to a dial on the pilot's or engineer's dashboard. One gauge is sometimes used to indicate the contents of several tanks, the amount of fuel in the various tanks being shown one at a time by pressing a button and operating a selector switch.

Pressure Gauge

This type of gauge has taken the place of the mechanical type due to its reliability and the ease of installing electrical cables. A dipstick is sometimes incorporated in the filler cap. The pressure gauge is usually the type utilising a Bourdon tube and is connected to the pipe leading from the pump to the carburettor.

In Fig. 1 a priming system is incorporated to facilitate the starting of the engine. A hand-operated pump is fitted for priming the carburettor together with a high-pressure pump which forces fuel in the form of a spray into the induction system. If the tank is above the engine, the priming pump may be dispensed with as the fuel will automatically flow, due to gravity, when the cocks are placed in the *On* position.

Twin-tank System

Referring to the system illustrated diagrammatically in Fig. 2, it will be noted that the fuel travels to a common junction box and is then fed to the engines. This prevents one tank being emptied before the other, and balances the supply. To allow for the contingency of one pump being put out of action, the delivery side of the two pumps is connected as shown. This balances the delivery, assuring an even pressure.

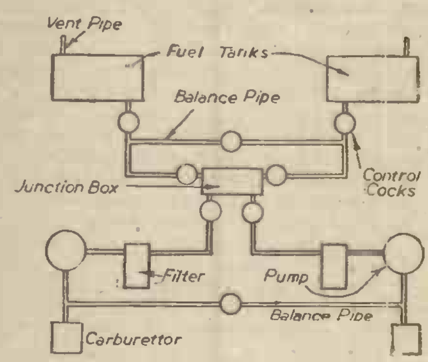


Fig. 2.—The layout of a petrol system for supplying fuel to two engines.

Provision is often made for the rapid jettisoning of the fuel in case of emergency. Large exit pipes are provided from the tanks for the fuel to be discharged through. Compressed air stored in high-pressure bottles is frequently used to force the fuel out. By this method the time required to jettison the fuel is considerably reduced. A valve operated by means of a solenoid is fitted to the Junkers Ju. 88 for jettisoning purposes and allows the tanks to be emptied separately or together.

It will be seen from the above description of aircraft petrol systems that in the larger type of aircraft the amount of plumbing is considerable, and that very great care must be taken in the initial design stage to avoid faults. Fuel must be capable of being supplied from any one tank to any one engine with the simplest possible controls. Before the system can be said to be satisfactory, the aircraft must be flown and flight-tested. Faults may develop in the air which were not foreseen on the drawing board.

The Story of the Steam Boiler

An Interesting Review of the Growth and Development of the Principal Types of Steam-raising Boilers

THE story of the steam boiler necessarily dates back to the earliest beginnings of the steam engine itself. Hero, that celebrated savant and mechanician who is supposed to have flourished in the second century B.C., needed a steam-generator for his famous "æolipile," which device constitutes the earliest written record of a steam engine, and which comprised merely a small hollow sphere having two steam-exit pipes projecting on opposite sides of it, the sphere being pivoted upon two oppositely-placed vertical steam pipes communicating with a boiler below. This latter device, the world's first steam generator (so far as we are aware), was probably heated by being placed upon a low brazier or charcoal fire. But as Hero's steam engine, for all its historical fame, never served any useful purpose, its utility as a steam generator would, in those far-distant times, never have been doubted.

From evidence found in the ruins of Pompeii, it would appear that not only were the Romans of that period utilising some primitive type of steam boiler for heating purposes, but, moreover, that those ancients were actually acquainted with the principle of the modern tubular boiler.

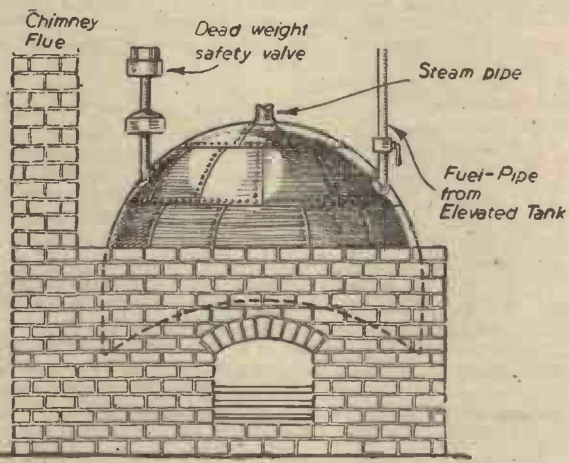
"Fire Engine" Boilers

Be that as it may, it was not until the advent of the eighteenth century that the demand for utility steam generators first arose with the coming into being of our industrial civilisation. In England, the steam boiler was first in demand for the operation of "fire engines," as they were then termed, and which were actually steam-operated contrivances which aimed at drawing up water from wells and mine shafts. When Thomas Newcomen, the Dartmouth blacksmith, invented his "atmospheric" engine in 1705, and subsequently erected such engines up and down the kingdom, the problem of constructing a suitable and a reasonably efficient steam-raising boiler for continual use first seriously arose.

The early "fire engine" boilers comprised spherical or globular shaped vessels which, for the most part, were generally built up of wrought-iron plates carefully riveted together. They permitted the raising of steam at only very low pressures of a few pounds per square inch. At the best, they were inefficient, leaky affairs, which, despite the low steam pressure which they contained, not infrequently managed to burst with startling, and sometimes unfortunate results.

"Mushroom" Boiler

The advent of the Newcomen engine necessitated stronger and more efficient steam generators. To cater for such a requirement, Thomas Newcomen developed what is nowadays termed his "mushroom" boiler. This was a boiler constructed of riveted plates, the lower half being cylindrical and the upper half spherical, this portion having a mushroom-like aspect. The "mushroom"



Newcomen's "mushroom" boiler, 1705.

boiler of Newcomen had all the strength of the previous smaller spherical boilers, and it possessed the advantage of greater steam-raising capacity and operational convenience. In practical use, it lasted until about the middle of the eighteenth century, being then replaced by the "haystack" boiler, which, at that time, assumed a position of great popularity.

"Haystack" Boiler

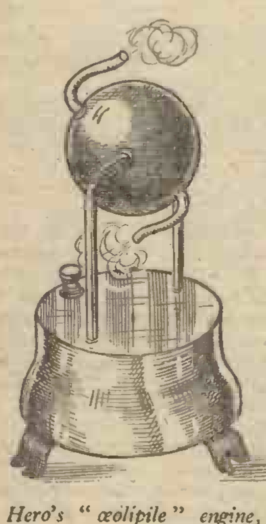
The "haystack" boiler is supposed to have been the original invention of Smeaton, the celebrated engineer and lighthouse constructor. It was designed to afford the maximum possible strength. In this boiler both the base and the upper portion were spherically curved. The boiler was usually let into masonry above a furnace provided with an adequate flue. That such types of steam-raisers fulfilled their rôles with some fair degree of efficiency is a conclusion which is to be drawn from the fact that they were employed in this country until well into the first quarter of the nineteenth century, when the high-pressure steam engine had definitely established itself.

James Watt, the supposed steam-engine pioneer, but, in actual fact, one of the biggest rascals in industrial history, adopted many types of boilers. They were, however, all based upon Smeaton's "haystack" boiler, Watt's "waggon-top" boiler, for instance, being merely an elongated edition of the Smeaton boiler.

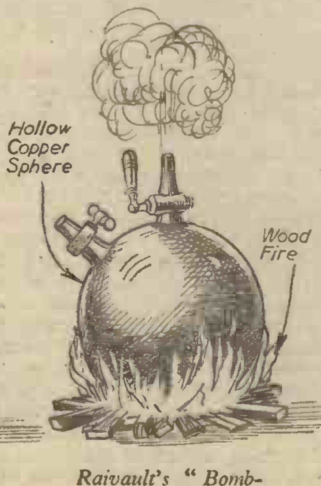
At the end of the eighteenth century, the "egg-end" boiler came into existence. It was a horizontal boiler having "egg" or dome-shaped ends, and it was usually set lengthwise in masonry above a long, low-set grate. This type of boiler had a greatly augmented steaming capacity and, naturally, its domed ends, together with its heavy side plates (which were often further strengthened by outside bandings), enabled higher steam pressures to be obtained than were previously possible.

The biggest weakness of the "egg-end" or "cylinder" boiler was its flue arrangements, it being difficult with this type of boiler to obtain the really powerful flue draught which the free and speedy combustion of the fuel required.

The next step, therefore, in the boiler's evolution, was to put the flue inside the boiler itself in order that a freer and a more plentiful air-sweep could be obtained. It is doubtful who first entertained the possibility



Hero's "æolipile" engine, 150 B.C. The base is hollow and constitutes the boiler.



Raivault's "Bombshell" boiler, 1605.

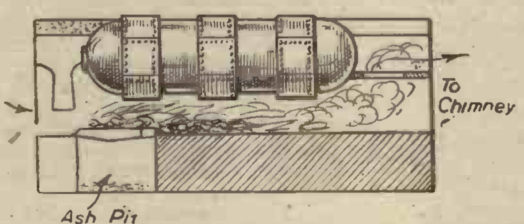
Savery's spherical boiler, 1698.

Dr. Denis Papin's steam boiler, 1680.

of this, at that time, radical alteration in boiler design. It has been considered that Oliver Evans, a pioneer American engineer, was first responsible for the idea, but this supposition has never been proved.

"Cornish" Boiler

However, the "cylinder" boiler, with the modification of a central or internal flue, developed at the hands of Richard Trevithick, the Cornish engineer and high-pressure steam pioneer, into the well-known "Cornish" boiler. Trevithick located the actual furnace inside the boiler in addition to the main flue, the first "Cornish" boiler being constructed with a large internal flue of sufficient diameter to accommodate a fire-grate assembly. This type of boiler derived its name from the fact that it was first used extensively for steam-raising in the Duchy of Cornwall, much of Trevithick's engineering work being done in that locality.



An early egg-end boiler of 1790.

The "Cornish" boiler had a great vogue for many years. It is, in fact, still being used at the present day, its advantages being simplicity and ease of operation, coupled with reliability.

The rise of the cotton industry in Lancashire, and the enormous dependence which it placed upon steam power, gradually necessitated the development of steam-raisers of still greater capacity. These requirements led, about the year 1840, to the introduction of the now long-celebrated "Lancashire" type of boiler plant, which, in its original form, was the invention of William Fairburn.

"Lancashire" Boiler

The "Lancashire" boiler was modelled upon its Cornish forerunner, but instead of having a single internal flue running along its length, it had two such flues, each complete with fire-grate and accessories. Until the industrial rise of the tubular type of steam-raiser, the "Lancashire" boiler maintained an almost world-wide degree of favour as a steam generator of great capacity, efficiency and reliability.

"Lancashire" boilers ultimately reached a total length of some 30ft., and a diameter of nearly 10ft., a boiler of such dimensions being capable of evaporating 12,000lb. of water per hour. Thick steel plates were necessary to enable such boilers to withstand internal pressures up to 200lb. per sq. in., and with large-size boilers the total weight of the steam-raising plant attained enormous proportions.

Such "outsize" boilers were transported only with the very greatest difficulty to the site of their erection. Hence, for all practical purposes, a "Lancashire" boiler having a water-evaporation capacity of about 8,000-10,000lb. of water per hour came to be accepted as constituting the limit of size for this type of boiler.

The coming into being of electrical generating stations and other large types of power plant, rendered necessary the adoption of boilers which had greater steam-raising capacities, and which did not take so long a time to raise steam at any required pressure, boilers, also, which responded more rapidly to varying loads of steam pressure than the "Lancashire" types of "shell" boilers were capable of doing.

Despite such needs, however, the "Lancashire" boilers retained their enormous popularity. To-day, in Britain alone, there are thousands of these boiler-plants functioning daily and giving all (and, perhaps, even more than all) the service which is required of them.

Constructional Development

Power stations, with their turbine generators, are mainly responsible for the enormous development which took place in the design and construction of tubular types of boilers, that is of boilers in which heat transference to the water is effected as rapidly and intensively as possible.

There are two main types of tubular boilers, although these divide up into innumerable modifications. The "fire-tube" boiler is one in which the hot gases of the furnace are carried along tubes which pass through the water to be heated. In the "water-tube" variety of boiler, the water itself is carried in tubes through the furnace.

The fire-tube boiler is the older of the two. In some respects, it is now considered to be an obsolete type, despite its many uses. For stationary engines, fire-tube boilers are rarely built to develop a greater pressure than 150lb. per sq. in. Both in their vertical and longitudinal forms, such types of boilers are limited to comparatively small steam-engine installations. Such boilers, however, may be fired externally or internally, the externally-fired boilers of this type having a separate furnace or firebox constructed outside the shell of the boiler.

Marine and locomotive boilers were at one time constructed upon this principle, as also

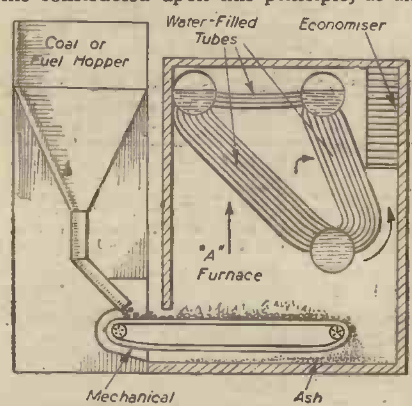


Diagram showing the general arrangement of a modern triple-drum water-tube boiler

were some of the once-popular small, "semi-portable" steam raisers.

The fire-tube type of boilers labours under several disadvantages, the more serious of these being that the steam-liberating surface area is relatively small, that the water circulation in the boiler system is apt to be sluggish and that, as usually built, the short distance which the hot furnace gases have to travel renders the boiler rather wasteful of fuel.

Water-tube Boilers

For these and other reasons, the "water-tube" varieties of boiler have come into being. This well-known boiler principle has permitted a very great development of modern boiler design, so much so that present-day water-tube boilers can be built in sizes to produce more than a million pounds of steam per hour. The water-tube boiler has, also, allowed the gradual pushing-up of the permissible internal steam-pressure limits, it now being possible to attain a pressure of well over 1,400lb. per sq. in. by means of suitable varieties of the water-tube boiler. These boilers, too, in their larger sizes and more advanced designs, permit the use of "superheaters" which raise the temperature of the steam to nearly 1,000 deg. F.

The first water-tube boiler was made in 1793 by James Barlow. It comprises merely a wrought-iron box of cubical dimensions, having within it a similar box-form structure. Straight tubes extended across from side to side of the inner box. The fire gases came into contact with the tubes through which the water passed and so permitted of a speedier heating of the water than was usual.

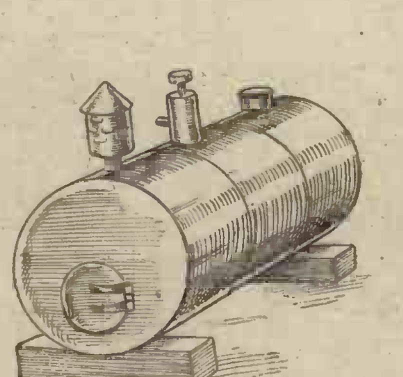
In 1856 came Wilcox's water-tube boiler, which was based on Barlow's principles, but which was much superior in design and functioning to the primitive Barlow boiler. Essentially, its novel feature comprised a nest of water tubes which were set in an inclined position and which traversed the firebox from front to rear. From this basic design, all the modern high-power water-tube boilers have been developed.

"Yarrow" Boiler

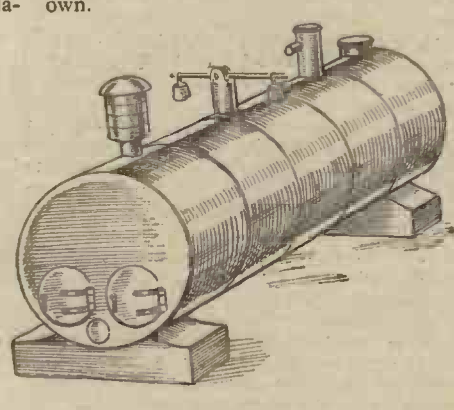
Water-tube boilers are much employed for marine work. Of these, one of the most celebrated types is the "Yarrow" boiler, which essentially is roughly triangular in shape, comprising two main water drums at the lower angles of the triangle and a steam collector or drum at the upper apex of the triangle. Parallel rows of water tubes pass between the upper and lower drums, these tubes being exposed to the direct action of the furnace gases.

The "Yarrow" boiler, like all the other modern designs of water-tube boiler, is capable of being made compactly in extra-large steam capacities. When used with a superheating device, such boilers allow of speedy steam-raising at high pressures. Indeed, such boilers, in many respects, represent the present-day stage in the long history of the steam-raising device.

In these brief notes the development of the highly important locomotive boiler has not been touched upon. Such a trend of engineering invention has a history of its own.



Trevithick's "Cornish" boiler, 1805.



Fairburn's "Lancashire" boiler, 1840.

A Simple Epidiascope

Constructional Details of an Inexpensive Instrument

By MORLEY HEDLEY

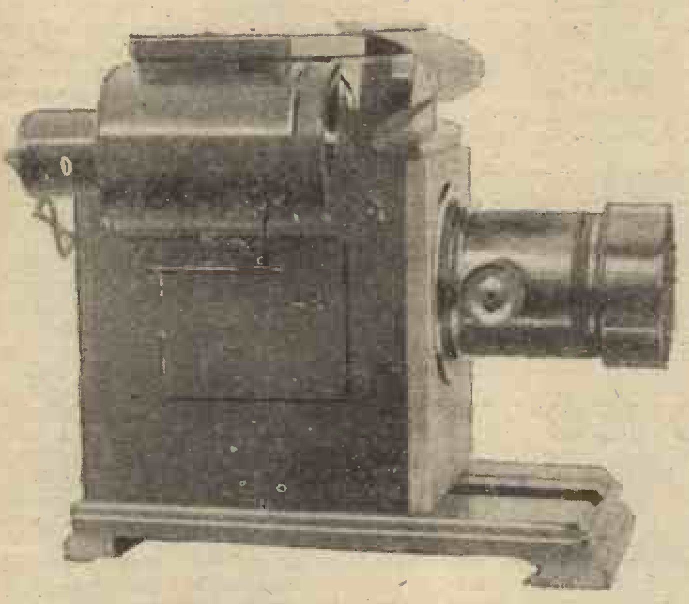


Fig. 1.—The finished epidiascope.

An epidiascope is an optical instrument resembling a lantern designed to project the image of a flat surface on to a screen. Its manifold uses become apparent with a little thought, such as the screening of maps, photographs, illustrations from a book, fingerprints, postage stamps and many other things that come readily to mind.

Usefulness

Consequently, in these days, an instrument of this nature is in great demand, because not only are they used extensively for demonstration purposes to the armed forces, they are also very useful for the same purpose in the Air Training Corps, the Home Guard, and many other organisations.

The difficulty experienced in obtaining an epidiascope, and the cost incurred, often prevents part-time organisations from enjoying the advantages of its use.

The epidiascope to be described was built for Home Guard use at a cost of under three pounds, and the lens accounted for two pounds ten shillings of that figure.

The Lens

Before embarking on the construction work—a lens is the paramount component—the limitations of the instrument must be understood. Even the most carefully designed and costly epidiascopes are unsuitable for demonstration before very large audiences. The principal limitation is the intensity of the illumination as the light is reflected light as compared to the direct illumination through a transparency in a lantern. Therefore a lens with as large an aperture as possible is necessary to collect the maximum amount of light from the object. Further, as the frame for the object needs to be a reasonable size to take picture postcards, etc., the lens has to be of long focus or the screened picture would be unduly large and the length of throw unduly short. The lens selected for this epidiascope is an old portrait lens, probably taken from an old whole-plate studio camera, and has a focal length of 12½in., the effective diameter of the lens is 3in., thus making the aperture f/4. The focal length of the lens should not be much less than 12in. for constructional purposes, but an effective instrument could still be produced with a smaller aperture than f/4.

Actually, the writer built the epidiascope before buying the lens, but it would be good policy to decide on the lens first.

Fig. 1 is an illustration of the completed instrument. It is constructed entirely of "bits and pieces," the main items being some scrap wood to make the box, two "Ostermilk" tins, two health-salt tins, some tinplate, a sheet of glass and a mirror.

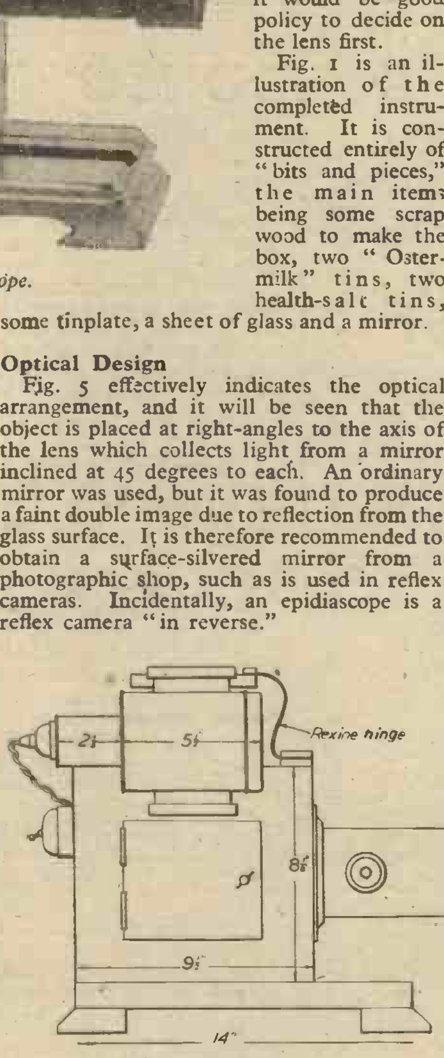
Optical Design

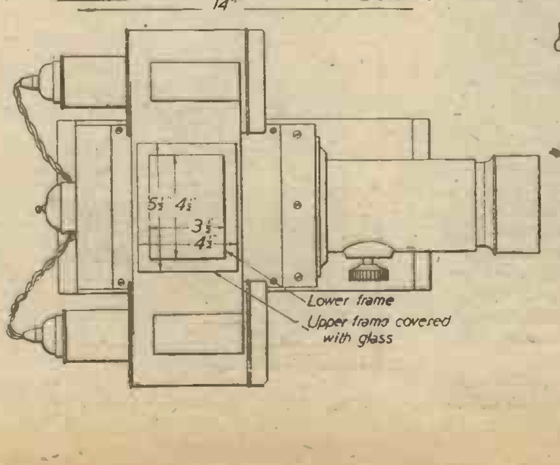
Fig. 5 effectively indicates the optical arrangement, and it will be seen that the object is placed at right-angles to the axis of the lens which collects light from a mirror inclined at 45 degrees to each. An ordinary mirror was used, but it was found to produce a faint double image due to reflection from the glass surface. It is therefore recommended to obtain a surface-silvered mirror from a photographic shop, such as is used in reflex cameras. Incidentally, an epidiascope is a reflex camera "in reverse."

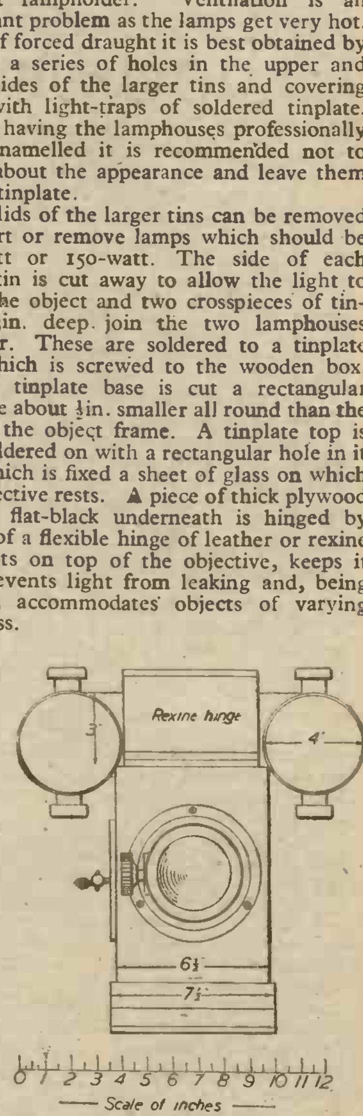
Construction

The drawings in Figs. 2, 3 and 4 show the main constructional details and give the principal dimensions. The tins make the lamphouses after removing the paint, cutting a hole in the bottom of the larger tin and soldering the smaller tin to it. A hole is then cut in the bottom of the smaller tin to take the bayonet lampholder. Ventilation is an important problem as the lamps get very hot. Short of forced draught it is best obtained by drilling a series of holes in the upper and lower sides of the larger tins and covering them with light-traps of soldered tinplate. Failing having the lamphouses professionally stove enamelled it is recommended not to worry about the appearance and leave them bright tinplate.

The lids of the larger tins can be removed to insert or remove lamps which should be 100-watt or 150-watt. The side of each larger tin is cut away to allow the light to reach the object and two crosspieces of tinplate 3in. deep join the two lamphouses together. These are soldered to a tinplate base which is screwed to the wooden box. In this tinplate base is cut a rectangular aperture about ½in. smaller all round than the size of the object frame. A tinplate top is then soldered on with a rectangular hole in it over which is fixed a sheet of glass on which the objective rests. A piece of thick plywood painted flat-black underneath is hinged by means of a flexible hinge of leather or rexine and rests on top of the objective, keeps it flat, prevents light from leaking and, being flexible, accommodates objects of varying thickness.







Figs. 2, 3 and 4.—Side, plan, and front views of the epidiascope showing the principal dimensions.

The Main Body

The main body is simply a wooden box on a baseboard and presents no difficulty even to a carpenter of the meanest ability. Keep the sides square with each other, cut a hole in front to accommodate the lens, a hole in the top over which is screwed the base of the lamphouse, and a door in the side to enable one to dust the mirror.

The Mirror

The mirror should be at 45 degrees, but it is simpler to pivot it at the top and make it adjustable. The mirror is clipped to a sheet of plywood and the top either pivoted or hinged to the body of the box. A circle of wood is then screwed eccentrically to the side of the box and supports the mirror at approximately 45 degrees. An image is then projected on to the screen and the circle of wood is rotated until the image at the top, and bottom of the picture is equally well defined. The circle of wood, which should be about 2in. diameter, is then screwed up tight in this position.

Focusing

The ideal method of focusing is by rack and pinion, or helical slot. These methods are often embodied in the lens housing. It is possible however that a lens might be used without these refinements. In that case a simple method would be to mount the lens on a piece of wood that slides in guides underneath the baseboard. A light trap such as bellows will then be necessary between the lens and body of the epidiascope. In any case the movement of the lens is very small, and a simple and effective replacement for the bellows would be two tins with the bottoms removed, one being a loose fit inside the other and a ring of felt or plush glued round the inside of one or the outside of the other to make a light trap.

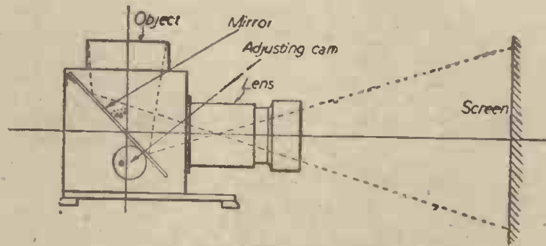


Fig. 5.—The optical system for the epidiascope.

Odd Jobs in House and Garden

Making Book-ends : A Handy Book Rack

By "HANDYMAN"

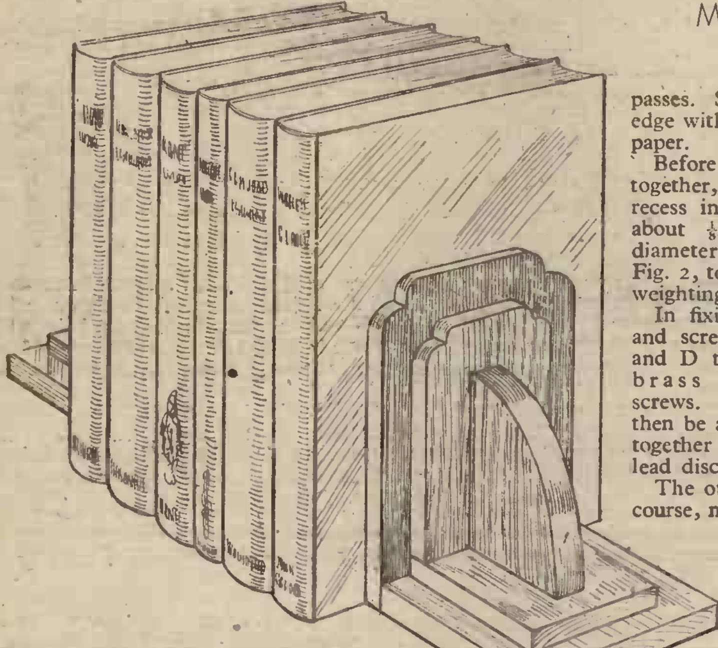


Fig. 1.—Serviceable book-ends made with plywood.

AT this time of the year many people think of Xmas gifts, but suitable ones nowadays are only obtainable at prohibitive prices. The following notes, however, show how the handyman can make some useful articles—chiefly out of odd pieces of wood and a few screws.

For instance, a pair of book-ends (see Fig. 1) can be constructed with pieces of thick plywood. Each book-end is made up of four pieces $\frac{3}{8}$in. thick and a central curved part $\frac{1}{2}$in. thick.

The back part consists of two pieces with shaped top ends, the larger piece A being cut to the dimensions given in Fig. 2. The smaller back part B is 3in. wide and 4in. long. Use a pair of compasses for marking out the curves at the top corner and cut these roughly to shape with a coping saw. Smooth the edges with a rasp and finish with fine glasspaper.

The bottom part also consists of two pieces, cut to the lengths indicated, the upper piece being 3in. wide, and the lower part 4in. wide. After cutting these parts to the sizes required, well rub the surfaces and edges with glasspaper.

Cut out the angle piece C with a coping saw, after marking out with a pair of compasses. Smooth the curved edge with a rasp and glasspaper.

Before fixing the parts together, make a circular recess in the bottom parts, about $\frac{1}{8}$in. deep and 2in. diameter, as indicated in Fig. 2, to take a lead disc for weighting the book-end.

In fixing the parts, glue and screw the pieces B, C and D together first, using brass countersunk-headed screws. The other parts can then be assembled and fixed together after placing the lead disc in position.

The other book-end is, of course, made in exactly the same way, and when finished they can be painted with enamel to match any colour scheme.

Alternative Design

Another type of book-end, shown in Fig. 3, has a metal base-plate attached to the upright. As two or three books will rest on the plate, the weight will prevent the book-end from slipping, so that this type of end need not be weighted. Pieces of planed oak, $\frac{3}{8}$in. thick, should be used in preference, but failing this, any other hardwood will answer the purpose. Cut the uprights to the dimensions indicated and carefully trim the edges squarely. Glue and screw the upright to the base piece, and allow for the thickness of the metal plate which is fixed to the bottom of the upright with three brass countersunk screws. The plate, which is 4in. by $3\frac{1}{2}$in., can be cut from a piece of thin sheet brass, and should be slightly tapered from back to front.

After cutting the sloping part to the length required, plane the ends to an angle of 45 deg., so that they fit against the upright and base piece.

Cut the two triangular pieces to the size required and glue these to the upright and base piece with the outer faces $2\frac{3}{4}$in. apart. Fine panel pins can also be used for additional fixing, as shown in Fig. 4. A thin piece of baize or similar material can be glued to the underside of the book-ends to prevent marking any surface on which they are placed.

Book Rack

In the case of book-ends, any number of books, up to about a couple of dozen, can be

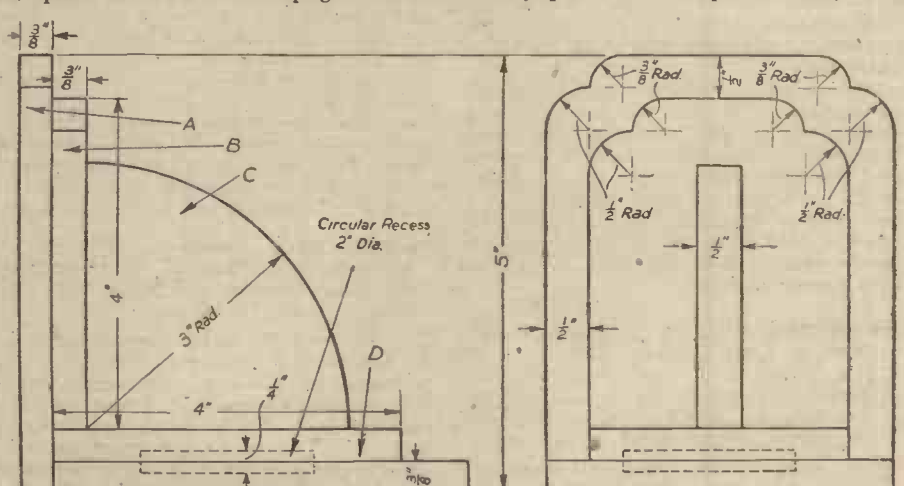
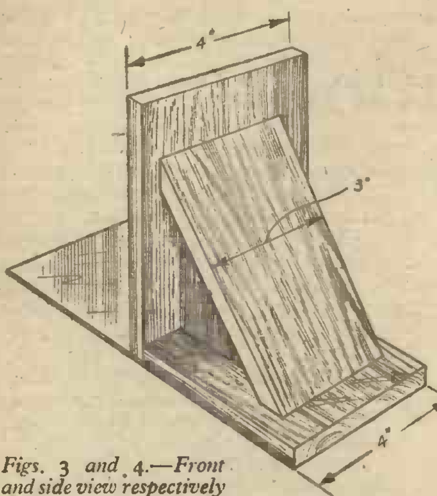
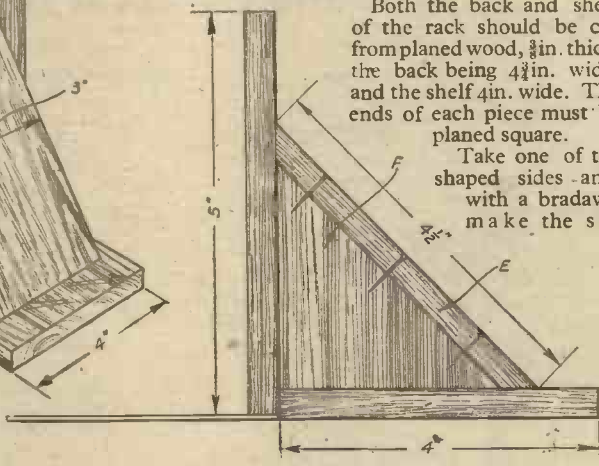


Fig. 2.—Side and front elevations of plywood book-end, showing chief dimensions.





Figs. 3 and 4.—Front and side view respectively of an alternative design for a book-end.

lines in Fig. 6. Use a set-square when doing this, as the two lines for the back must be at right angles to the lines for the shelf. When marking out, note that these ends are right- and left-handed.

Both the back and shelf of the rack should be cut from planed wood, ⅜in. thick, the back being 4¾in. wide, and the shelf 4in. wide. The ends of each piece must be planed square.

Take one of the shaped sides and, with a bradawl, make the six holes for the fixing screws in the positions indicated in Fig. 6. Prepare the other side in the same way, and after countersinking all the holes—on the outside face of each side-piece—screw the parts together with ¾in. brass countersunk screws. If made of oak, the finished rack can be stained and polished, but if deal or other soft wood is used, the rack can either be coated with varnish stain or painted with enamel or cellulose paint.

Another method of fixing the shelf and back to the sides is to cut recesses in the sides, to coincide with the dotted lines (Fig. 6), and then glue and screw the ends of the shelf and back in position.

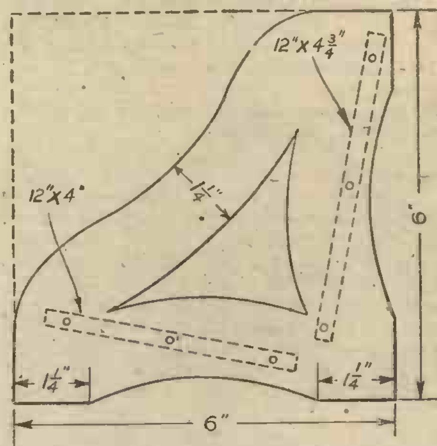


Fig. 6.—Shaped side for book-trough, giving dimensions.

accommodated; but with a book-rack, or trough, the length must be determined according to the number of volumes it is required to hold. A useful length is 12in., which will hold at least a dozen small volumes.

Shaped Ends

To make the shaped ends, prepare a piece of planed ⅜in. wood (oak for preference) 12in. long and 6in. wide. Saw it in half, and on one piece mark out the shape to the dimensions given in Fig. 6. With a coping saw, cut round the outline and smooth the edges with a rasp, and finish with glasspaper.

Use this part as a template for marking out the shape on the other piece of wood, which can be cut out in the same way. Hold the two parts firmly together with a couple of screw clamps so that the edges can be smoothed down and finished together.

After separating the parts, mark out on one side of each piece the positions of the back and shelf of the rack, as indicated by the dotted

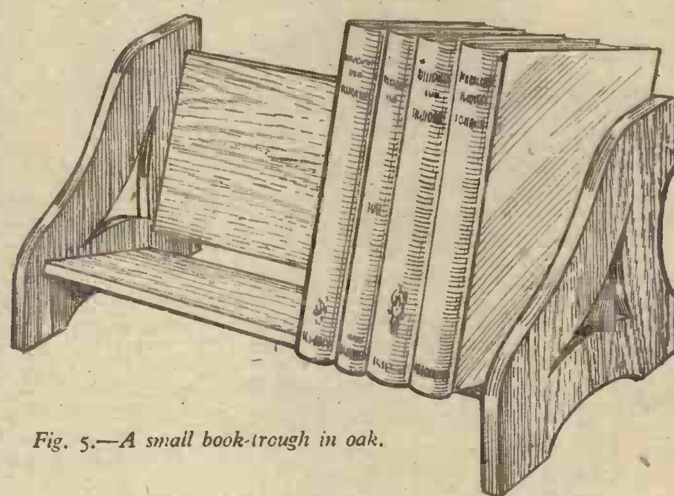


Fig. 5.—A small book-trough in oak.

Books Received

The Elements of Sheet-Metal Work. By W. Cookson and A. Bold. Published by The Technical Press, Ltd. 120 pages. Price 6s. 6d. net.

THE object of this text-book is to provide apprentices, improvers, draughtsmen, and others interested in pattern development with practical information on some of the elementary problems met with in sheet-metal work.

Without going deeply into technical details the authors have made the information as practical as possible, and they have dealt with the various problems in such a manner that the explanations can easily be understood. There is a chapter on a method of triangulation which the authors have evolved, which should prove useful to the craft of pattern development. The book is illustrated with numerous diagrams.

Introduction to Valves: including Reference to Cathode-Ray Tubes. By F. E. Henderson. Published by "The Wireless World," on behalf of the General Electric Co., Ltd., of England. 111 pages. Price 4s. 6d.

THE writer of this book is a prominent member of the Osram Valve Department, and his many years' association with thermionic valves and cathode-ray tubes enables him to cover the subjects in a manner which is bound to have a wide appeal.

The book is primarily intended for those who already possess a knowledge of the fundamental theories of electricity and magnetism, but who have not yet become familiar with electron devices such as thermionic valves and cathode-ray tubes. The 111 pages—including 130 illustrations—however, contain such a vast amount of information that the service engineer and advanced radio amateur will find the work a valuable asset, while the student will have at his disposal a book which will greatly assist him during his studies, and provide the answers to most of the problems he is likely to encounter. We recommend it with confidence.

Machine Shop Practice. By W. C. Durney, A.M.I.Mech.E. Published by Sir Isaac Pitman and Sons, Ltd. 184 pages. Price 7s. 6d. net.

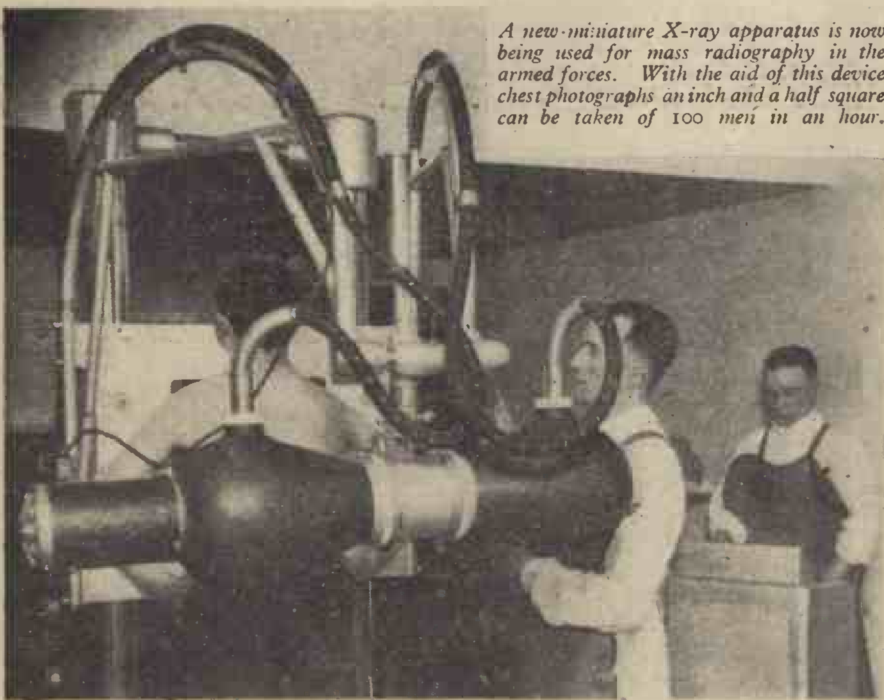
IN this work the author has explained the fundamental operations required in the processing of standard, light-weight work, such as may be found in any engineering machine shop. All the examples given have been carefully selected, the operations being listed in practical sequence, and illustrated by diagrams. The book is primarily intended for the use of Ministry of Labour trainees, apprentices, and technical students.

Handbook of Heating, Ventilating and Air Conditioning. By John Porges. Published by George Newnes, Ltd. Price 17s. 6d. net.

THIS handbook is virtually a library in miniature of the particular subjects dealt with, and contains useful tables, technical data, and scientific facts for ready reference. It is arranged in loose-leaf form to enable additions to be made to the text from time to time. The book, which is divided into sections, is designed for daily use, and a comprehensive bibliography has been included for the benefit of those who wish to pursue the theoretical side of any particular branch of the subject. Each section is numbered separately. Six folding charts are included, and also a full index.

THE MONTH IN THE WORLD OF

Science and Invention



A new miniature X-ray apparatus is now being used for mass radiography in the armed forces. With the aid of this device chest photographs an inch and a half square can be taken of 100 men in an hour.

Camouflage Glass

SEVERAL American war plants are using special camouflage nets of non-inflammable glass fibre. Finer than human hair, the fibre is laid over wire netting, and painted leaf green.

Concrete Ships

THE first all-concrete ship to be constructed in the United States since the last war was recently launched at a West Coast port. The vessel, which has been built in six months, will be used as a fuel carrier. She is the first of 100 cement-hulled ships now being constructed for the U.S. Government.

Japan's "Super" U-boats

IT is reported that Japan has built four super-submarines with a cruising range of 20,000 miles. The submarines, it is stated, carry two collapsible 'planes, mount four 6-in. guns, and can be used as transports. One of these under-water craft carried German experts from Japan to Singapore.

Huge War Output

A NEW YORK newspaper recently stated that General Motors' war output for the first nine months of this year totalled £3,000,000 worth. This included aircraft engines, flashlamps, parachute flares and cartridge cases, in addition to the delivery of Army trucks, tanks and ambulances.

Concrete Railway Sleepers

TWELVE million cubic feet of timber a year may be saved as a result of experiments with reinforced concrete railway sleepers of a new type. According to an official of the Railway Executive Committee, replacements are now 4,000,000 sleepers a year, and war traffic is making the number bigger.

Concrete sleepers tend to disintegrate under rolling pressure, but after trying out new types on sidings and loop lines a method has been discovered of overcoming the difficulty.

A Remarkable Exhibition

ONE of the strangest exhibitions ever seen in London, and named "Photography in Science and Industry," was held during November at the Royal Photographic Society's premises at Prince's Gate, Kensington. Its aim was to show how scientists working in different fields are using photography as a tool, and the exhibition suggested many ways of using the camera in war and peace.

Each of the 300 photographs displayed had a purpose, whether it was acting as a mechanical spy searching out the enemy's secrets or by radiography helping to cure the sick whom the surgeon's knife dare not touch.

Among the remarkable applications of photography for scientific purposes was that of the English scientist, Dr. W. F. Hilton, who, with an electric spark lasting only a minute fraction of a second, can take photographs of sound waves generated by the propeller blades of aircraft running at over 10,000 revolutions a minute.

The purpose of these photographs is to study the mechanism of noise made by running airscrews, for until this is fully understood it is impossible to design a really silent aeroplane.

Bomber-an-Hour Factory

MASS production of aircraft is now in full swing at Henry Ford's Willow Run factory at Detroit. There was nothing on the 975-acre factory site in the middle of last year; now workers flock into the plant in thousands. They were drawn from the motor-car industry, and all they knew was cars. Now they make 'planes piece by piece. They installed conveyer belts—one is two miles long—lifted wings and fuselages with cranes, moved them along the line, rolled them on carriages, "furnished" the interiors with complicated instruments, slipped on tails, fitted wings, and coaxed engines enabling the giants to fly 3,000 miles at 300 m.p.h. without refuelling.

They rolled them to another section, painted them, fuelled them, camouflaged them, towed them on to the flying field to be tested by Ford's own pilots and straightaway flown to their final destination.

Utility Locomotives

A NEW type of locomotive is being built in this country to meet the needs of essential goods traffic in Britain and of railway transport demands which may arise overseas. The new engines, khaki in colour, have eight coupled wheels and two leading wheels, and will haul any type of rolling stock. They can run on any 4ft. 8½in. gauge in the world, and can be quickly converted to oil-burning if necessary. The engines are capable of hauling from 500 to 700 tons at a speed of from 30 to 40 miles per hour.

Flying Dreadnought

THE Glenn L. Martin plant in Baltimore have recently completed the 70-ton flying boat Mars, built for the U.S. navy. This huge aircraft is more than an air-freighter. It is virtually a flying Dreadnought, able to attack without warning over a vast distance. The Mars bomb load is counted in tons. It mounts guns of terrific fire power and its vital parts are armoured. This flying battleship can carry 150 men—or more. The range is secret, but from bases now in United Nations' possession, it could strike to-day at any spot on the globe.

A Carrier for Medals

A KNOWN form of carrier for medals has consisted of a metal plate furnished with a safety-pin fastening at its rear. It had horizontal slots for the medal ribbons to be passed through. In some cases, there were holes to permit of ribbons being stitched to the plate.

The objection to such a method is that medals can be removed from garments only by unpinning. This, often repeated, has an injurious effect on the coat.

A newly designed medal carrier has the usual safety-pin or other fastening at the back, but has integral with it a hook or hooks from which the medal can be conveniently suspended.

Eye Shield

IN many instances, when it is necessary to protect the eyes from the glare of dazzling light, it is not enough to provide a shield which merely reduces the fierce illumination. For example, oxy-acetylene welders require protection both from the oppressive light and from particles of white-hot metal which may fly off from the work.

Again, in fighting incendiary bombs, particularly of the type which scatter fragments of metal, it is highly important to shield the eyes from the glare and from the scattered metal.

These requirements have been borne in mind by an inventor who has devised a simple inexpensive shield of light weight.

His invention consists of an eye shield having a light-transmitting portion which comprises a sheet of wire gauze combined with transparent plastic material coloured to constitute a light filter. It is so disposed that light reaching the eye of the wearer passes through both the gauze and the plastic material.

MASTERS OF MECHANICS

No. 80.—John Stringfellow, and His Work for Aeronautical Science

MORE than fifty years before the brothers Wright made their memorable pioneer flights in a power-driven aeroplane, a West Country lace manufacturer, John Stringfellow by name, had, in his spare time, taken up the subject of mechanical flight with such a deal of gusto and enthusiasm that those who knew him seldom hesitated to dub him a foolish crank, and an impracticable dreamer. Nevertheless, his visions all converged to a practical end, to a culmination which he was able to prove would ultimately come to pass.

But because Stringfellow was never fortunate enough to create a man-carrying flying machine, his name is little heard of nowadays. Lesser minds than his in the aeronautical world have come in for a greater measure of fame in view of the fact that the immediate results of their activities have been more apparent and tangible. Nevertheless, John Stringfellow was an aeroplane pioneer of the first order. It was he who produced, in 1848, the first power-driven aeroplane to fly, and although the 'plane was only a large-scale model, it was sufficient to demonstrate the fact that, given a suitable power unit for a heavier-than-air machine, mechanical flight would not only be possible but, also, eminently practicable.

In recent years, the memory of John Stringfellow, the lace manufacturer, has been revived. His exploits as a pioneer of mechanical flight have all been recalled and examined, the results of this survey serving to establish him for all time as one of the principal forerunners of human flight.

Stringfellow was born at Attercliffe, Sheffield, on December 6th, 1799, and, after a brief education, was apprenticed to one of his relations in the lace trade in Nottingham. He appears to have shown a liking for mechanics at a very early age. In his 'teens he constructed a number of lace-making machines, some of which incorporated ideas of his own. Had he been an ordinary individual, Stringfellow, no doubt, would have remained with his relatives in Nottingham, and would have been content to succeed to their activities in that noted industrial centre.

A steam-driven aeroplane model, constructed by Sir Hiram Maxim about 1895. It was unsuccessful.

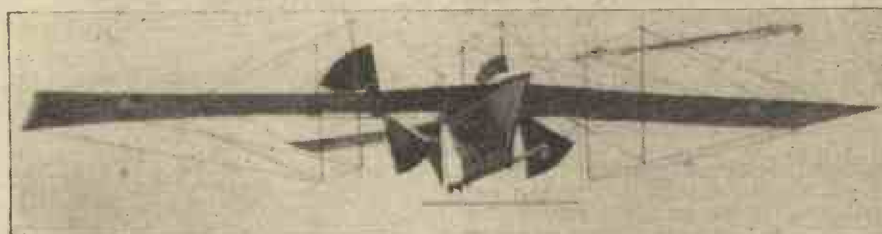
Early Activities

But Stringfellow had ideas of his own. He was ambitious, and he wanted to succeed along lines of his own devising. Consequently he threw over the claims of the Nottingham trade and, when he was only 21 years of age, removed to Chard, in Somerset, in which town he set up for himself in a small but a successful way as a lace maker.

His first year or two at Chard was taken up by his activities in establishing himself as a manufacturer in that town. Possibly, during those formative years, he gave little or no thought to the possibility of mechanical flight. It was only after he had met a certain William Samuel Henson, who came to live at Chard, that his interests in the problems of human flight were aroused.

This William Samuel Henson, a Leicestershire man, had been trained as a mechanical engineer. For years he had been interested in the possibilities of mechanical flight and he had actually contrived to construct a few experimental aeroplane models which, for various reasons, were all unsuccessful.

Henson and Stringfellow met at Chard, and it was not long before Stringfellow himself, despite the pressing claims of his growing lace factory, had fully shared Henson's, at that time, almost passionate devotion to the subject of mechanical flight. Between them, Henson and Stringfellow made a power-driven aeroplane model, but it was unsuccessful. Stringfellow was mainly responsible for the steam engine which powered the 'plane, whilst Henson had designed the general structure of the aeroplane. The final trials of this aeroplane were made on Bala Downs, not far from Chard, in 1847. They lasted more than six weeks. In the end, as we have just noted, the experimenters had to admit almost total failure.



Stringfellow and Henson's power-driven model aeroplane, 1847. It was unsuccessful.

It was not long after this that Henson, the more impulsive worker of the two, abandoned his experiments. He left England for America the year afterwards (1848) and, in consequence, he fades out of the picture of the early pioneers of the aeroplane.

Engine-driven Model 'Plane

John Stringfellow was endowed by Nature with a greater fund of patience and determination than his erstwhile friend, William Henson. After the latter's departure for America he continued to experiment in the realm of aeroplane construction, and in the same year (1848) he produced an engine-driven model 'plane which actually did support itself in the air and fly a distance under its own power.

Stringfellow's 1848 aeroplane model had a 10ft. wing span, the wings tapering to points at opposite ends. Its two propellers were driven in opposite directions, and were about 16in. in diameter. The power unit comprised a peculiar conical-shaped boiler made from thin silver-soldered copper sheet. The boiler was fired by a lamp which burned naphtha or methylated spirit. Including fuel and water, the total weight of the aeroplane model was about 9lb.

Although the 1848 aeroplane of John Stringfellow was, in some respects, modelled on the lines of the previous year's unsuccessful model in whose construction William Henson had had a hand, the engine of the 1848 'plane was indisputably Stringfellow's own. It was solidly and efficiently constructed, and even after its inventor had discarded it, it worked for upwards of 40 years in a West Country lace factory before it ultimately found a well-deserved rest in the Science Museum, London.

Launching Device

One of the most interesting features of Stringfellow's 1848 aeroplane was its launching device. This took the form of a guide strip by means of which the model was run along an inclined wire. When it was about to be launched, the model was restrained by hand until its propellers had got up full speed. It was then permitted to run along the inclined guide wire until it made contact with a stop or a collar fixed to the wire, which stop served to actuate a simple mechanism whereby the model was released from the wire and launched into free flight. It was found by experiment that it was necessary to fix the stop on the wire at a distance of some 22ft., thereby allowing this distance for the aeroplane model to run along the guide-wire before being launched into free flight.

The first man-carrying aeroplane—the Wright Brothers' biplane, constructed in 1904.

Stringfellow made his first trials with his model aeroplane in the packing-room of a lace factory at Chard, Somerset. This room, although it was only some 12ft. high, had a length of about 70ft. The launching wire ran near the ground for about half the length of the room. After being automatically freed from the wire, the machine gradually rose in height as it travelled along in free flight until, ultimately, it collided with a carefully placed stout canvas screen at the far end of the room and was caught by a safety net.

In the long, low packing-room at Chard, John Stringfellow made numerous trials with his aeroplane model in the year 1848. These trials were all more or less successful and they were witnessed by numerous interested people. Frequently, the machine crashed at some portion of its journey along the room and had to be more or less severely and extensively repaired, but always the model plainly demonstrated the fact that it was well within its power to fly without support or restraint in the air. Stringfellow, indeed, had proved an important principle, to wit, that of the possibility of mechanical flight in a heavier-than-air machine.

In the same year, Stringfellow demonstrated his model aeroplane in London, but, singularly enough, comparatively little interest was aroused in the subject. And since John Stringfellow was not a "professional" inventor, but remained ever true to his lace-making trade, he seemingly became more or less indifferent to the general lack of enthusiasm in the possibilities of flight which the success of his model aeroplane had clearly opened out.

Stringfellow was not a publicist. He did not seek the commercial development and exploitation of his aeroplane model. For himself, he had had the satisfaction of demonstrating a principle of mechanical flight and of having had a long series of exacting and laborious (to say nothing of costly) experiments crowned with a measure of practical success. The rest, in Stringfellow's philosophy, was in the hands of the gods, and it apparently mattered little to him how those deities disposed of the subject.

In 1849 Stringfellow voyaged to the United States, partly on business, but, none the less, with a strong desire to visit his former friend, William Henson, and to acquaint him with the news of his aeroplane trials. However, Stringfellow failed to communicate to Henson any further resolve to embark upon more practical constructional work in the subject of heavier-than-air flying machines. Henson definitely maintained his decision to remain "out of the running."

And even Stringfellow, when he returned to England, allowed his practical interests in mechanical flight to lapse. His aeroplane had made a maximum free flight of about 120ft., and with that achievement Stringfellow evidently came to the conclusion that it was impracticable for him to go farther.

And so, in many respects, it was. We must remember that Stringfellow's practical success, remarkable as it had been, resulted from experiments with models only. Stringfellow proved the principle of powered flight in a heavier-than-air machine, but if he had attempted to construct a full-sized man-carrying 'plane powered by a steam engine, he would undoubtedly have ended in failure.

Perhaps Stringfellow realised this fact. Perhaps, too, he appreciated the fact that the real solution of the long-awaited man-carrying flying machine could only come about through the invention of a new type of power unit which would be freed from the weight and the general cumbrousness of the steam engine, with its heavy boiler, fuel and water supply.

Crystal Palace Exhibition

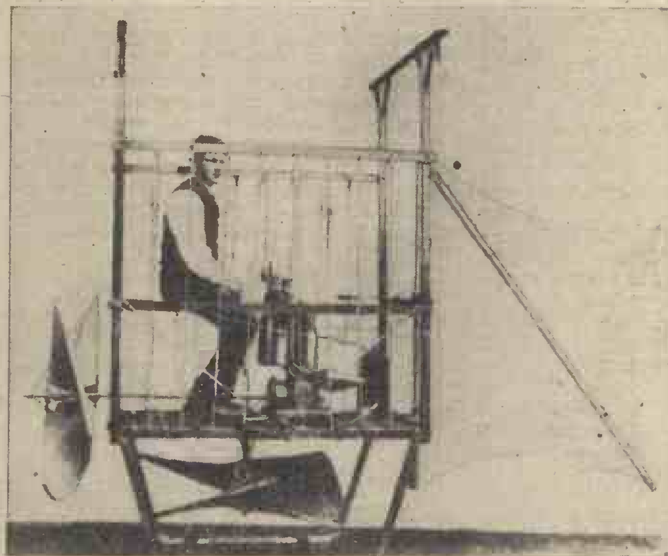
At any rate, after his 1848 successes, John Stringfellow entered into a "retirement" from practical aeroplane construction, a "retirement" which lasted until 1866, in which year the Aeronautical Society of Great Britain (afterwards the Royal Aeronautical Society) was founded in London. The new Society proposed to hold an exhibition in the Crystal Palace in the following year, but this was deferred until 1868. Stringfellow was asked to contribute "something of aeronautical interest" to this, the world's first Aviation Show. His dormant interest in mechanical flight became aroused and he entered upon his task with much of his former enthusiasm.

For the Exhibition, which was held in the June of 1868, Stringfellow designed and constructed a light steam engine power unit "and machinery for aerial purposes." The engine developed nearly 1 h.p., its total weight (inclusive of a full complement of fuel and water) being 16¼lb.

Stringfellow's second exhibit was a "1 h.p. copper boiler and fireplace, weight of about 40lb., capable of sustaining a pressure of 500lb. to the square inch."

Prize-winning Triplane

His third exhibit was the most interesting of them all. It comprised a "working model of an aerial steam carriage." Actually the "aerial steam carriage" was a triplane powered by a steam engine. The model weighed about 13lb. and its engine developed 1 h.p. For some reason, no trials of this model were allowed in the Crystal Palace. Possibly the authorities had their eyes on the extensive glasswork structure of the building! However, this model, which was undoubtedly a very fine and well-constructed one, was awarded the £100 prize for the model whose engine was the lightest in weight in proportion to its power development. In this model aeroplane, too, Stringfellow introduced for the first time into practice the principle of the superposed plane, one plane surface or wing being fixed over another, this principle being adopted by Stringfellow in order to shorten the lengths of the single wings which would otherwise have been required.



The first petrol aeroplane motor, constructed in 1888. It is a 4 h.p. Daimler motor operating vertical and horizontal propellers.

The exhibits of John Stringfellow at the Crystal Palace Aeronautical Exhibition of June, 1868, seem to have constituted the last of his practical work for aviation, for, in subsequent years, Stringfellow encountered ill-health and was much troubled with defective eyesight, which put an end to his experimenting.

Stringfellow, of course, remained a Member of the Aeronautical Society for the remainder of his life, but, with advancing years, coupled with the above-mentioned infirmities, the then embryo world of aviation heard less and less of him, until, soon after his death on December 13th, 1883, his memory became all but forgotten.

Curiously enough, Stringfellow's death occurred almost twenty years to the day before Wilbur and Orville Wright made their world-famous pioneer aeroplane flight over the sand dunes at Kitty Hawk, California, on December 17th, 1903, and by their achievement, gained the Gold Medal of the same Aeronautical Society to which Stringfellow had belonged. Had the petrol engine been available to John Stringfellow, there is no doubt of the fact that the first human flights in a heavier-than-air machine would have been made over British soil.

Salvaging Power Generated by Aircraft Engines

MORE than half of the electrical power required in the manufacture of American Ford-built aircraft engines is produced by the engines themselves. This use of "salvaged fuel" has cut by 53 per cent. the actual power costs of producing the huge 2,000 h.p. Pratt and Whitney engines in Ford's new aircraft engine plant at Ypsilanti, Michigan.

So successful has this ingenious system proved, Ford officials say, that when production hits peak the factory will turn out its entire aircraft engine schedule on such reclaimed power.

This latest example of Ford economy is accomplished by hooking up constant speed couplings with generators to engine test blocks and capturing electric power thrown off during test runs of the newly completed engines. With present test stands in operation enough electricity is generated to account for 53 per cent. of the factory's total power demand.

"Bootstrap System"

Called by Ford engineers the "bootstrap system," because the factory figuratively lifts itself by its own power bootstraps, the salvaging method is comparatively simple in operation. As each engine is transferred from the assembly line to a testing call, a hydraulic constant speed coupling, linked to a generator, is attached to it. As the engine undergoes several hours of gruelling test, the otherwise wasted power generated by it is recaptured and carried in a steady stream to the generator.

Although the "bootstrap system" has long been a feature of Ford operation, this is the first time it has been used to recover power developed by aeroplane engines. Company officials believe that if the Ford power salvaging plan was adopted throughout the war industries, vast quantities of petrol could be diverted to other vital channels. During the test of each engine petrol is simply converted into electric power.

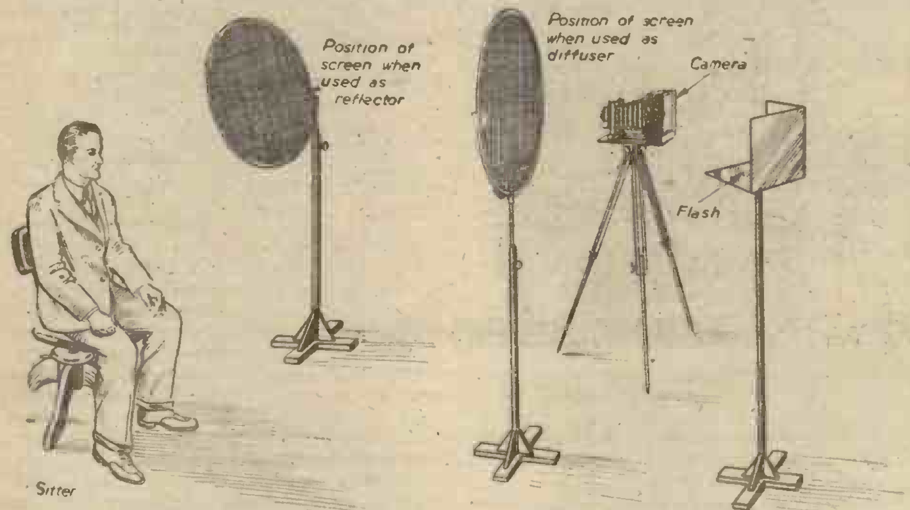
Flashlight Photography

Various Points to be Observed for Obtaining Satisfactory Results

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

IT has been frequently said of photography that it is without a rival among hobbies, for it can be enjoyed throughout the year, winter and summer, indoors and out of doors. A keen amateur can always find something interesting to photograph. When he has exhausted the printing of holiday negatives and there is no intensification or reduction to be done, he can turn his attention to a little indoor portraiture, either of single members of the family or of a few friends who may have dropped in for a chat.

Yes, even on the blackest night in winter it is possible to get quite a lot of fun if you happen to have three or four unexposed sections of a film in the camera and, amongst



The position of sitter and apparatus for taking a flashlight photograph.

the oddments in the darkroom, a carton of Johnson's flashpowder. I have done a considerable amount of flashlight photography, and am very fond of it as a winter sideline to my hobby; in fact, I have often wondered why more amateurs do not take it up, for it is a branch which offers great opportunities for originality in many ways.

Flashlight photography is not difficult, and it is not dangerous if one is careful; also, it is not expensive, for a 1s. 3d. carton contains enough powder for eight or ten exposures according to the subjects, and there is not much chance of making mistakes with the exposure if the tables are followed.

I have said that it is not dangerous, but perhaps I should warn you against trying to make your own powder; there is definitely a risk in this, and it is inadvisable to attempt to make it, as the prepared article which can be purchased is made in very large quantities by those who have the necessary plant, as well as long experience. The other point which I emphasise is that when the powder is ready for firing, make sure that it is well away from any inflammable material such as curtains and similar fabric, and do not stand the charge on a polished table; finally, keep your face and hands well away from it. By taking these precautions you will obviate any damage or burns.

Mixing the Powder

The powder when bought is in two tubes, and the contents of these have to be well mixed before they can be used; the more they are mixed the better and should you notice any small balls of powder, they should be broken up by pressing them between your finger and thumb.

If you have the impression that flashlight photography necessitates a lot more apparatus, then let me at once dispel this from your minds; it is one of the real pleasures of this branch of the hobby that you do not need anything special. You do not even have to move the furniture about very much, and so are able to get the "home" atmosphere into the work. As you advance so you will find advantages to be gained by the addition of certain "gadgets" such as diffusing screens, backgrounds and flashlamps, but at the commencement all that is actually required is an old tin lid from a biscuit tin, and if you can get the whole tin then it is useful for making a reflector and chamber in which to fire the powder. (See overleaf.) Cut away two of the four sides, leaving the other two with the bottom of the tin, bore a hole in the centre of the bottom and screw it to a stick, about 3ft. long. This enables you to fire the flash from any position at the back and above the camera, and well away from your hands and face.

Arranging the Sitters

When taking a portrait, or a small group at a table, see that the sitters do not look at the flash; turn their interest to the opposite side, to prevent the effect of staring, which is sometimes very noticeable in amateurs' first attempts. The best effects in single portraits are profile or half-profile.

Most wallpapers to-day are of a plain character without the ugly floral patterns so common a generation ago. These make excellent backgrounds if care is taken to avoid heavy shadows being cast on the background; that is why I suggested having the flash at a point above the camera. If a small-power electric light is kept burning on the opposite side of the room this will also help to diffuse the shadows thrown by the flash.

Focusing should be done with the largest aperture, and with the lights of the room full on. To those who have to rely on their viewfinder for focusing I must again give a reminder that the distance between the lens and the sitter must be carefully checked with a tape measure, and the distance scale set accordingly for, when dealing with close-ups, it is most important to have these correct, otherwise fuzziness is sure to occur in the negative. If you have not got a tripod, then commandeer the household steps and arrange the camera on these. You cannot hold the camera yourself unless you can get someone else to see to the flash.

A word of advice on mixing the powders: pour the contents of the small tube into the large one and shake for a few minutes until you are satisfied the mixing is complete. Be sure to keep this tube always corked, because the mixed powder is very hygroscopic, and if it becomes damp through exposure to the air it is very much retarded in its flash and may refuse to fire, therefore it is better to take just the amount required for the job, re-cork the tube, and put it in a safe place.

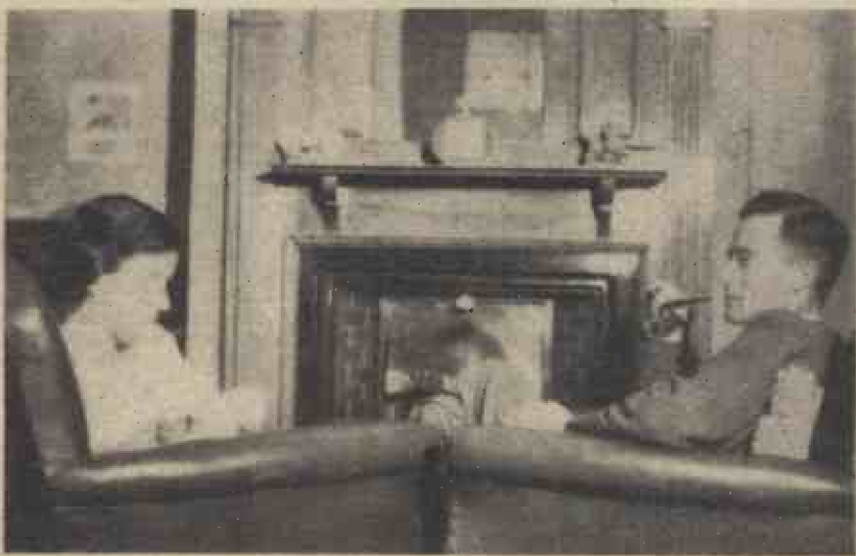
You will want to know how much powder to use for the exposure; this has been

Photograph taken when 10 grains of Johnson's flashpowder was used.

carefully calculated for you in the tables enclosed with the powders. As an example, suppose you have a Selochrome film in the camera, and your friend is sitting 8ft. away; you have set the lens at F8, then the charge should be 10 grains of the mixture, a very convenient amount to measure as the scoop given with the powder holds this quantity.

Firing the Powder

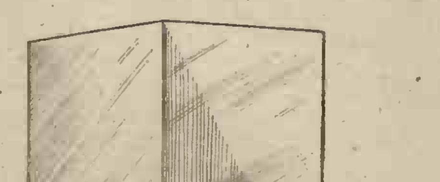
Place the 10 grains in a heap on the tin lid, take a piece of the touch-paper, which you will also find in the carton, fold it down the centre and stick it into the heap; having set the powder, return to the camera and make sure that most of the lights are turned down —you can keep a small one going. Now open the lens for a "time" exposure, then with a match or, preferably, a taper, set the touch-paper going and move away back to the camera. Immediately the flash takes place shut the lens and switch on the lights, then change the film ready for another exposure.



Photograph taken on Selochrome film. Stop F16 and 10 grains of powder.

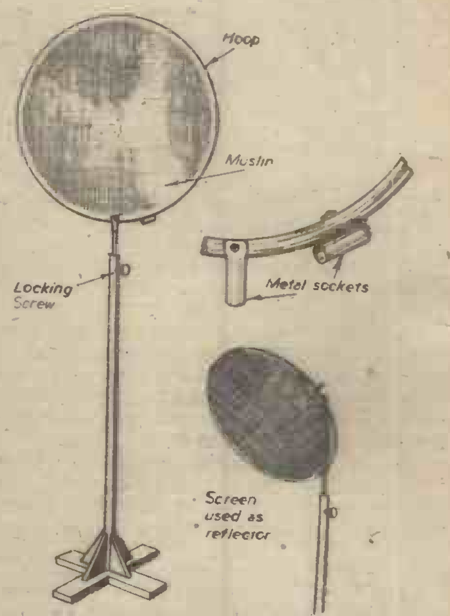
Here is a word of warning: if the flash does not occur in a few seconds do not be impatient, wait even for a minute or two, for it sometimes happens that the touch-paper is somewhat slow; and make sure that the spark has become extinguished before renewing the paper.

In the past there has been objection to flashlight photographs because of the hard, or as they were known, "soot and white-wash" effects which sometimes resulted, but it is now realised that these effects were not characteristic, and were really faults of manipulation, and therefore due to errors on the part of the operator, such as over or under exposure or development. As regards the former, I can only again advise you to follow the tables, and then for developing the films use one of the "soft" developing solutions such as Azol. Here again, develop according to the times laid down for you in the tables; if you expose and develop in this way then you should be quite pleased with the results you get.



An improvised reflector holder for flash-powder.

There are occasions when it is necessary to do a little manœuvring to avoid hard contrasts because of the subject or surroundings, and this can be done by using a diffusing screen between the flash and the sitter, or by placing the screen in such a position that it catches the full effect of the flash and passes it on by reflection to the sitter. A few experiments with one or two screens will soon make you quite expert in lighting your subjects, and will encourage you to apply flashlight to many other subjects than home portraits.



A child's hoop covered with muslin to form a diffusing screen and a deflector.

Material for Screens

For making the screens, butter muslin is best, but this is not easy to obtain in these days, and so one must turn to something which is a good substitute. Any white material that has been washed several times, and has therefore lost most of its "body" and consequently is not opaque, might serve as a diffusing screen, but for reflecting purposes a white calico will answer. The material must be stretched on a frame of thin laths or canes, and this frame will be found more useful if it is circular in shape; it is an advantage to make it with a stand, or arranged so that it can fit into one and be raised or lowered, and shifted to any position.

Exhibition of Bomb Damage Photographs

A REMARKABLE collection of photographs showing bomb damage in Germany, France and other places is now being exhibited by the R.A.F. for the inspection of the public. The photographic enlargements range in size from 40in. by 40in. to 6ft. by 4ft.

None of the photographs, of course, has been taken just for the benefit of the public or the Press, but to enable the Service experts to assess the degree of success of the particular raids concerned.

What appears to the general public to be just black-grey masses conveys a very different story to the experts with their special examining instruments and their inner knowledge of the meaning of these or those confused details—details unnoticed altogether by the average reader of newspapers. In view of the conditions under which these camera records are taken, it would appear surprising to the average man that any useful results at all could be secured. They are often taken from five miles up from aircraft flying at a speed of well over 300 m.p.h. This is the case in regard to the pictures now being exhibited.

Employed in the taking of them are many remarkable devices and gadgets, such as the protection of the surface of the lens from frost at great heights—to mention but one example. The specimens on exhibition represent, of course, only a small portion of the total of bomb damage inflicted on enemy targets.

There are two kinds of bomb damage—that caused by fire from incendiaries and that resulting from blast from high explosive bombs. The honeycomb effect seen in many of the photographs, especially in that of the centre of the town of Lubeck, is brought about by the burning out of whole blocks of buildings. The roofs are gone. The outside walls are often left standing enclosing mere empty spaces.

In a number of photographs will be noticed a queer stippling effect of white dots—noticeably in the Cologne photographs.

In some cases these white dots are produced by the sun shining on to the street through the holes where windows have been blown out. In other cases one is looking from the street into the roofless buildings inside which the sun shines down. Greyish-white patches in the pictures represent the effect of high explosives which levelled whole blocks of buildings.

In addition to being shown in the London Boroughs, the collection will be exhibited in many of the main provincial centres, including Hull, Grimsby, Great Yarmouth, Norwich, Ipswich, Newcastle, Birmingham, Sheffield, Coventry, York, Liverpool, Bootle, Manchester, Bristol, Bath, Cardiff, Swansea, Pembroke, Portsmouth, Southampton, Exeter and Plymouth.

Aircraft Oil Systems

Notes on Their Function and Layout

By T. E. G. BOWDEN, Grad.R.Ae.S., M.I.E.T.

THE function of the oil system is to ensure that an adequate supply of lubricant is delivered to the engine under all conditions of flight. Of the two types of engine lubrication, i.e., dry or wet-sump systems, the dry-sump method is the most commonly used for aircraft purposes. The reasons for this choice are as follows: Firstly, the fact that the engine may at times be inverted during flight would cause the oil in a wet-sump system to be flung about inside the crankcase. Secondly, the oil is cooled more efficiently, thus allowing the engine output to be increased. Thirdly, many modern engines are of the inverted type, i.e., the cylinder-heads are below the crankshaft, making the use of a wet-sump impossible.

Mineral oils have now almost superseded castor oil, which at one time was exclusively used, owing to the liability of the latter to cause gummed piston rings and an excessive deposit of carbon. It is important that the specification of oil used in any engine is the one quoted by the manufacturers, as harm may easily be done if the incorrect oil is used.

Items of Equipment

The main items of equipment which comprise a dry-sump oil system are as follows:

1. Oil tank.
2. Oil pumps.
3. Relief valves.
4. Filters.
5. Oil cooler.
6. Pipes, gauges, couplings, etc.

A typical oil system is illustrated diagrammatically in Fig. 1, by which the path of the oil may be followed.

Oil tanks are very similar in construction to petrol tanks, but there are several important details that must be catered for. The capacity of the tank must be large enough to enable the oil which has drained into the sump after the engine has ceased running to be pumped back to the tank by the scavenge pump without causing any overflowing or possibly a burst tank. The position of the oil tanks in any aircraft varies considerably, sometimes the tank being mounted above and behind the engine immediately aft of the firescreen. Alternative positions are in the leading edge of the wings (in this case the tank will be shaped to suit the wing profile), or, as in the case of the Spitfire, under the engine, being exposed to the airflow. The latest types of tank incorporate a "hot-well." This is to permit rapid warming up of the oil when starting the engine. The pipes are so positioned that the oil is returned to a special chamber inside the tank, and the same oil is re-delivered to the engine. The cold oil in the tank outside the hot-well is gradually heated by the hot oil which is being circulated, and thus time is not wasted in heating up the main volume of oil. Oil tanks are tested in a similar manner to the methods used for petrol tanks.

Scavenge Pump

Two oil pumps at least are required per engine, i.e., one delivery pump and one scavenge pump. They are frequently combined in one housing for simplicity and compactness. The most common pump is the gear type, although vane and plunger types have been used. A gear pump is illustrated in Fig. 2. The oil is carried round by the teeth and passed through the outlet. The scavenge pump, i.e., the one returning the oil from the sump to the tank, must be able to pump a larger quantity than the delivery unit. The reason for this is that oil must not be allowed to accumulate in the engine sump. The method of providing for this greater capacity is to use gear wheels of varying widths,

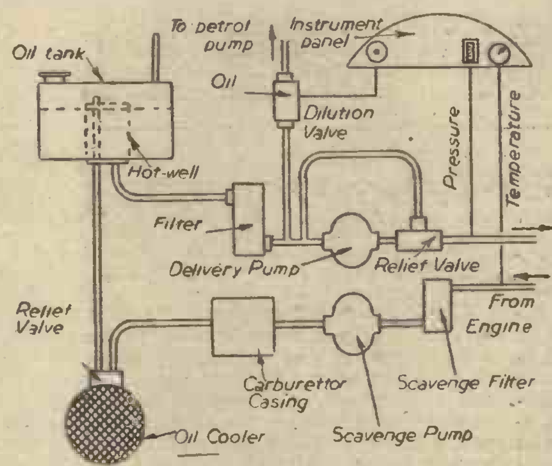


Fig. 1.—A diagrammatical layout of a typical oil system.

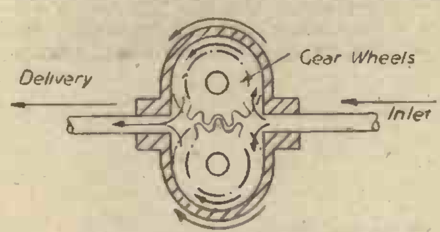


Fig. 2.—A gear pump, a type commonly used for scavenging and delivery.

the wheels used for the feed pump being less in width than the scavenge gears.

A relief valve is fitted to the delivery pump to allow oil to be by-passed when the pressure becomes excessive. The valve usually consists of a spring-loaded piston, which, when depressed, uncovers a by-pass allowing the oil to be circulated back to the delivery side. The valve's action is entirely automatic, and may be adjusted to suit the particular pressure required by any engine. When oil pressure is utilised, for example, to operate a variable pitch airscrew, multi-oil relief valves

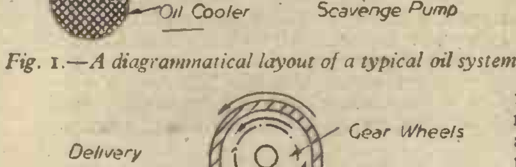


Fig. 3.—A typical pipe joint used in oil systems.

are fitted in which oil at various pressures is delivered to the appropriate pipe lines.

Filters

Filters are of various types, and are an essential part of any oil system. The filters shown in Fig. 1 are positioned before the two pumps. The most common type is the fine wire gauze filter which may be cleaned without closing any cocks. As the gauze is withdrawn the oil inlet is automatically sealed by means of a spring-loaded sleeve. Another type of filter has circular straining elements arranged one on top of the other. It is essential that the filters should be regularly inspected, and, if necessary, cleaned or replaced.

After passing through the delivery filter and pump, the oil is circulated to the various engine fittings that require lubrication, and then drains to the sump. The scavenge pump forces the oil (after passing through a filter) to the carburettor casing. The reason for this is to prevent the moisture present in the fuel supply system freezing when the aircraft is being flown in low temperatures.

Oil Cooler

To prevent the oil overheating, and thus losing its lubricating efficiency and its cooling properties, it is usual to install an oil cooler. This takes the form of a radiator practically similar in construction to those used for motor-cars. The oil is allowed to flow either through a series of tubes past which is being circulated a cool stream of air, or through the space left between a series of honeycomb sections, in this case the air flowing through the tubes. To control the amount of cooling it is usual to fit a shutter at the rear end of the radiator, which may be altered in position, so as to control the amount of air passing through the cooling elements. During take-off the shutter is left fully open, owing to the fact that the air speed is low and the engine is developing its maximum horse-power. When the engine is throttled down the oil does not require the same amount of cooling, and therefore the shutter or flap is closed.

A relief valve is fitted at the entry side of the oil cooler in order to by-pass the oil when the engine is being started up in low temperatures. The oil, being cold, is viscous, and a burst radiator may be caused if the fluid is passed through the cooler. The valve usually consists of a spring-loaded ball valve, which opens when a pre-determined pressure is exceeded, thus by-passing the oil to the return pipe. The operating pressure for this valve is approximately 50lb. per sq. in., but this figure varies considerably for different systems.

Oil Circulating Pipes

The pipes used to circulate the oil may be manufactured from tungum, copper, or, if necessary, flexible hose is often utilised. A typical pipe joint is illustrated in Fig. 3. The pipes must be well supported at frequent intervals to prevent excessive vibration, and if necessary rubbing pads fitted if the pipes run adjacent to any structure which may come in contact with them. The diameter of the pipes should be as large as possible to allow an adequate supply of oil to flow when the temperature is low. A vent pipe is fitted to the tank and a breather pipe to the crankcase. Cocks are installed in positions so that the system may be drained or the various items overhauled without draining the whole contents of the tank. When union nuts are used to join pipes together it is essential that they should be locked by means of a length of wire to prevent the joint working loose during flight.

The instruments fitted are, first, an oil pressure gauge, and secondly an oil temperature gauge. An oil contents gauge is not usually fitted, the capacity of the tank being marked on the outside and a dipstick being incorporated in the filler cap.

The pressure gauge connection is positioned so that the pressure of the oil entering the engine is measured. An outlet pressure gauge is fitted on prototype aircraft for checking purposes. Briefly, the gauge consists of a capsule, capillary tube and an indicator. Oil pressure on a diaphragm forces the liquid through the tube to the bourdon tube, which deflects and operates the recording mechanism. The main cause of failure for this type of instrument is the fracturing of the capillary due to vibration or careless handling. The tube must be supported at frequent intervals. The pressure range is from 0 to 100 or 200lb. per sq. in., and the normal pressure varies from 60 to 75lb. per sq. in.

Temperature Range

The oil temperature thermometer is positioned so as to record the temperature of the oil after it has passed through the engine. The temperature range is approximately 0 to 100 deg. C. It consists of a steel bulb which is inserted into a pocket leading from the pipe line, so that the oil flow is not impeded. The bulb is filled with mercury, and as the oil temperature increases the mercury expands, and the rise in temperature is recorded by the action of the mercury on a bourdon tube via a capillary tube. The normal working temperature varies for different engines, e.g., 90 deg. C. for the Rolls-Royce Merlin X and 70 deg. C. for the Genet Major IV.

Various methods to facilitate starting aero engines in low temperatures have been developed, and one of the most successful is as follows. The oil passing to the engine is diluted with petrol. A valve is fitted between the oil feed pipe and the petrol supply, and a switch is positioned in the pilot's cockpit to operate the valve electrically. Prior to the engine being stopped the valve is opened for the last few minutes' running time, allowing petrol to flow into the oil system. It will be found that the engine will start up very easily even though it is left for a considerable period in low temperatures. Gumming up of the pistons is also prevented. An alternative method is to heat the contents of the oil tank electrically, but the oil dilution system is the most efficient.

The oil system does not give a great deal of trouble provided it is correctly maintained and regularly inspected. Should the oil pressure drop, several faults are indicated. The relief valve may be sticking, pipes fractured, the filter choked, the pump gears worn, the main engine bearers worn, the tank empty, or the pressure gauge may be reading incorrectly. If an excessively high pressure is indicated the causes may be as follows. The oil pump may be blocked, the relief valve faulty, or the oil not sufficiently warmed. Over-oiling is usually caused by choked scavenge filters or pumps, thus preventing the oil being returned to the tank. It may also be due to defective piston rings.

Sketching Machine Components

Points to be Observed in Making Neat and Accurate Sketches

DRAWING is the handmaiden of the engineering profession and should be practised to the highest degree. While it is not given to everyone to have the specialised technical training of the draughtsman, it is open to all interested persons to acquire some measure of skill in the execution of the freehand sketch. How often it is found that some simple sketch explains very much more easily and quickly than dozens or even hundreds of words some idea that one person wishes to convey to another.

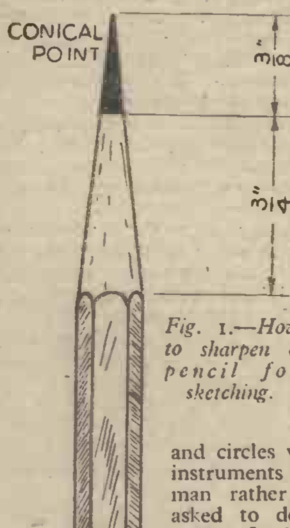


Fig. 1.—How to sharpen a pencil for sketching.

It does not follow that the trained draughtsman always excels at making freehand sketches. Constantly producing straight lines and circles with the aid of instruments tends to make a man rather helpless when asked to do this without them. It is the author's experience that many draughtsmen are poor at freehand work, and it is apparent that training in this field is, for everyone concerned, a necessary preliminary to the acquirement of the requisite degree of skill.

The construction of neat and accurate freehand sketches of machine components is extremely important to most practical working engineers. Many skilled artisans are called upon at some time or other to explain their ideas, or give expression to the requirements of their work by means of hand-sketches. Broken parts may have to be replaced, an existing component is to be duplicated, or some improvement to existing mechanism is required. In countless instances the engineer has to make a freehand sketch, and it is well worth while acquiring some degree of proficiency in so useful an art.

The hand sketch is simply the freehand equivalent of a machine drawing performed without the use of compasses, scales, or drawing instruments other than pencil, paper and india-rubber. Accustomed as the man in the workshop is to the reading of blueprints constantly in the course of his employment, it is found that he is far from intelligent when it comes to the performance of even a simple sketch himself. The reason is that a certain knowledge of projection, cross-sectional views and correct dimensioning are necessary. It is possible to interpret a drawing correctly without knowing how to employ these precepts of draughtsmanship in the creation of an original drawing. A good deal of skill can be acquired by practice, and the observance of certain fundamental rules.

With Pen or Pencil

The freehand sketch may be drawn in pencil or by the aid of a fountain-pen. We shall, however, deal only with the pencil drawing for instructional purposes. Choice of pencil is the first problem, and a soft H or hard HB pencil will be found most suitable, as a good black line is required which does not smudge too easily. Pencils should be sharpened to a long conical point with ¾in. of the lead exposed. (See Fig. 1.) A small piece of fine emery-cloth or glass-paper, or a small dead-smooth file should be kept at hand for maintaining the keenness of the pencil point, the penknife only being used for paring away the wood. The drawing instructor has the utmost difficulty in getting the beginner to sharpen pencils to the above specification, but it is the first and foremost requirement and cannot be too strongly insisted upon.

The next essential is the india-rubber, which should be the best quality obtainable, and of large size. The rubber should always be freely used when necessary. If a line has to be erased, it is nearly always necessary to take out other perfectly correct lines if the rubber is used in the free, copious way necessary to get the surface of the paper clean.

With regard to the question of the paper to use for freehand sketching, it is best to practise with the medium which is most commonly to hand. This is usually found to be ordinary ruled notebook paper. The

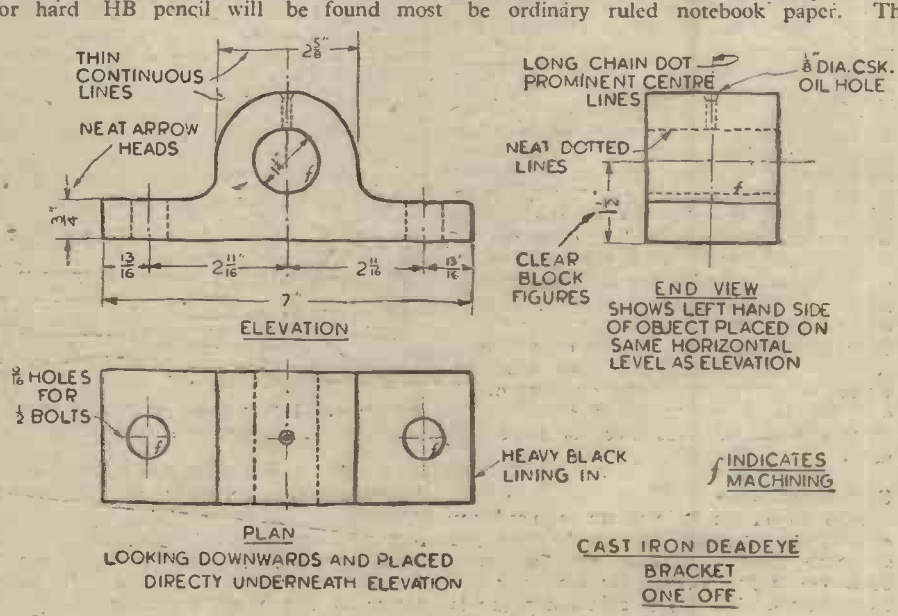


Fig. 2.—A freehand sketch of a cast-iron bearing.

presence of horizontal ruled lines is a great help at the outset in producing freehand horizontal lines, but we are still left with the difficulty of drawing freehand vertical lines. Square-ruled paper overcomes this drawback and is very commonly used for sketching in technical institutes; but it is found that the presence of so many ruled lines does not make for clearness. The plainer the paper is, the better the sketch shows up, and quite plain unruled paper is often preferred.

An Example

If we examine a freehand sketch of an ordinary simple cast-iron bearing for a small diameter shaft, such as is shown in Fig. 2, it may not at first be realised that considerable technique has to be used in its production, involving much practice. Observe that all notes and titles are done in upright block capitals, and underlined; centre lines are prominent, and in long chain-dot style. The arrow heads are all nicely tapering, and symmetrical. The figures and fractional sizes are all sufficiently large to be perfectly clear. Fractions particularly are the source of many mistakes in the machine shop owing to bad figures. The method of correct dimensioning is employed, and in this connection it may be mentioned that no dimension should appear more than once, and no important size necessary for manufacture must be omitted. Notice that dimension lines and projection lines are thin continuous lines, only slightly less prominent than the main drawing, which should be heavily lined in.

No particular scale need be employed for freehand sketching. This is one of the main points of difference between freehand and machine drawing, the latter being always made to scale. Nevertheless, in the freehand sketch we must be careful to make our sizes proportional. A part which is, say, 4in. long, should be four times the length, as near as we can judge, of a part 1in. long, and so on. Great care and concentration have to be employed to produce a freehand sketch which is approximately to scale entirely without the use of a rule or scale. If a scale is available there is no objection to its use, but this is not always the case, and we should practise making freehand sketches without a rule.

Notice also that a knowledge of projection is required. The sketch shows an elevation, end view and a plan. In British Standard Projection the plan is always under the elevation, the end view is usually placed on the right, and shows the view of the left-hand side of the object. If the end view is placed on the left-hand side of the elevation, it shows the appearance of the right-hand side or remote side. In America a different practice is adopted. The plan is placed over the elevation, and the end view, if on the right of the elevation, shows the right-hand side of the object, and vice versa. We must be careful to make it perfectly clear which of these two methods are employed, as both systems are commonly used in this country.

Exercises

The following examples will be found to provide good practice. Lines should be put in firmly without lifting the pencil from the paper too frequently. The bold single line is to be aimed at; avoid the hazy sketchy line which only produces an untidy appearance. To assist in the development of a correct eye, exercises should be practised freehand without drawing instruments, and the estimation of sizes should be judged without actual measurement by scale.

1. Sketch (each in one stroke) horizontal lines 1in., 2in., 3in., and 4in. long.
2. Sketch (each in one stroke) vertical lines 1½in., 2½in., 3½in. long.
3. Sketch a number of horizontal lines about 3in. long, and subdivide them by eye into 3, 5, 7, 9 equal parts.
4. Practise the 26 letters of the alphabet in block capitals upright about ¾in. high. (See Fig. 3.)
5. Practise the numerals 1 to 9 in block figures ½in. high. (Fig. 3.)
6. Practise the letters of the alphabet (small letters).
7. Sketch a series of horizontal and vertical centre lines in long chain-dot.
8. Do the same exercise using dotted lines, taking great pains, as sketches can easily be spoiled by careless use of dotted lines.
9. Practise arrow heads ¼in. long and 1/16in. wide.

When proficiency has been attained in the above exercises, we can proceed with those on the freehand sketching of circles and the estimation of angles, using the eye only, and not a protractor. Sketch freehand two lines crossing each other at right angles and measure along each of the four half lines a distance of 2in. from the point of intersection. Subdivide each right angle or 90 deg. into three equal parts by lines at 30 deg. Sub-divide each 30 deg. angle into three equal parts of 10 deg. by lines passing through the point of intersection. (See Fig. 4 for this exercise.) Measure 2in. along each line from the point of intersection. In this connection it might be useful to remember that the first joint of the middle finger measures about 1in. Then join all these points by one continuous line and a fairly good representation of a circle will be obtained. The beginner will find considerable difficulty in the exercises on the circle and only constant practice will achieve the desired result. It should then be possible to draw circles of all sizes with only the vertical and horizontal centre lines given. Practise subdividing the circumferences into 8 or 12 equal parts, which is a very common procedure in steam cylinder or pipework flanges.

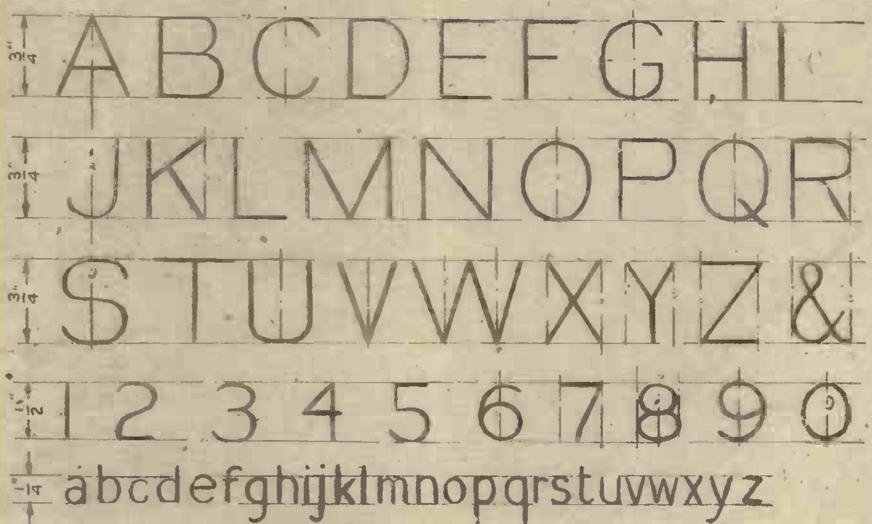


Fig. 3.—An exercise in lettering.

Dimension Lines

We conclude our introduction to the subject of handsketching with the rules of dimensioning. Largest dimensions are placed farthest away from the object, the shorter dimensions being closer in. Refer to Fig. 2 for illustration of these remarks. Place the figures in a gap specially left in the dimension line, the fraction line to be in line with the dimension line. Figures should be block printed at right angles to the dimension line. Vertical dimension lines will have the figures all the same way round so as to be read by the eye looking from the bottom right-hand corner of the sketch. When possible horizontal dimension lines in side view and elevation should be projected in line, and the same applies to vertical dimensions in plan and elevation. Observance of this rule adds considerably to the appearance of a sketch. Dimension lines giving diameter of circles must pass through the centre of the circle with arrow heads at the circumference.

If it is desired to give the radius of a circle, or part of a circle, the dimension line must run from a point on the circumference to the centre and must terminate exactly at the centre. The figures should be placed on the dimension line if there is room, and if not, then adjacent to the line. The position of circular holes should be located by dimension lines from the centres of the circles only. Never locate a hole by giving a size to a point on the circumference. When writing fractions it is necessary to take care that both the numerator and denominator are well away from the dividing line so as to make the fraction quite clear to read.

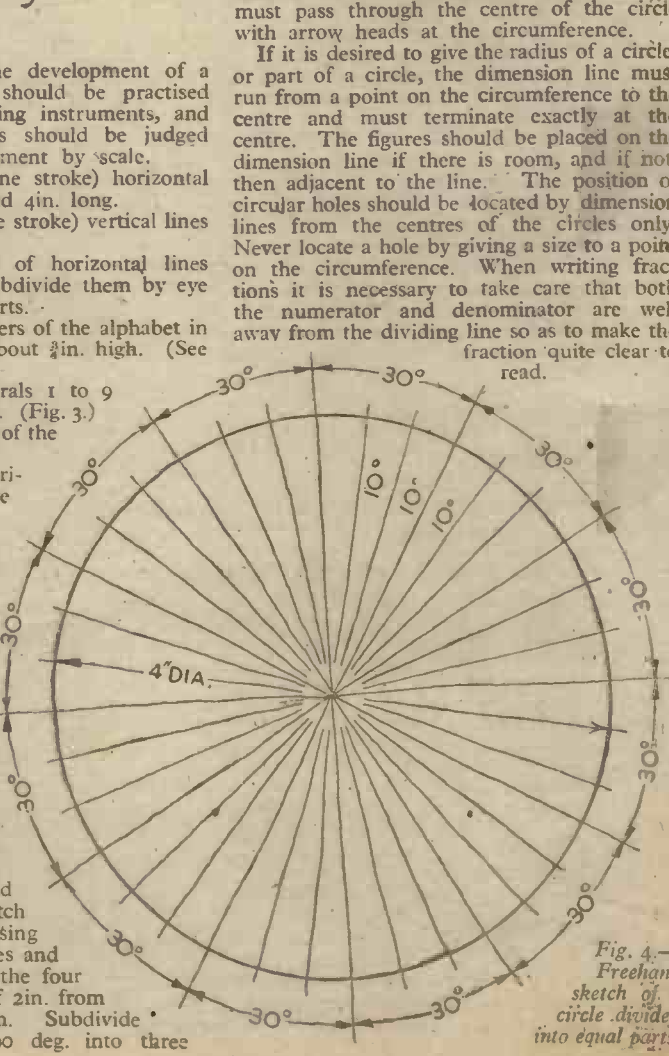
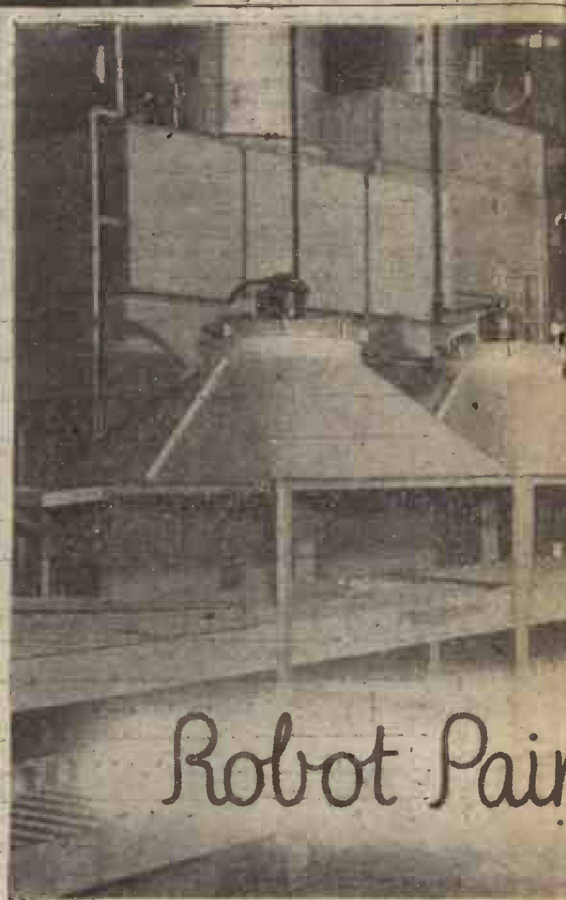


Fig. 4.—Freehand sketch of a circle divided into equal parts.

Fine paint spray and fumes are sucked up through a ventilator stack, screened by a "waterfall," which serves as a filter, removing the highly-inflammable paint "dust" from the air. In the foreground is one of the pressure vats where the paint, constantly agitated, is kept. Tubes from the vat feed the paint to the overhead sprays.



Robot Pain

After having passed under the sprayer and throu move through the infra-red oven and fan dryer uni units they are removed from belt, turned over, an

The Latest Apparatus f Coating Air with Anti-acic Pai

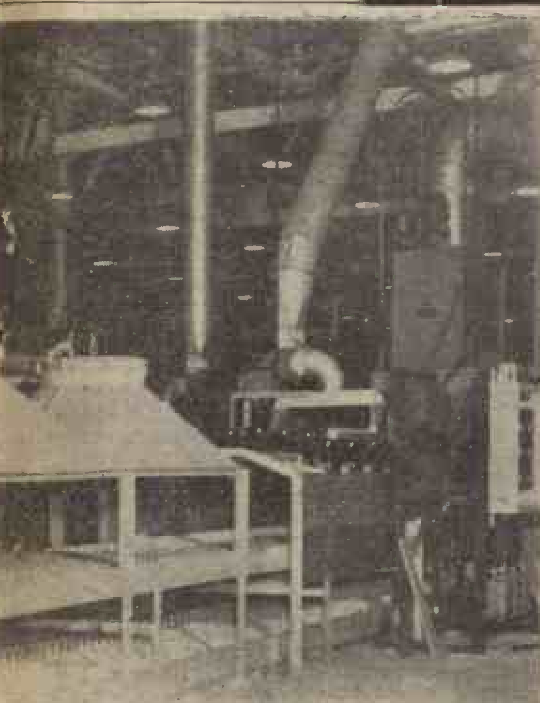
A ROBOT painter that sprays automatically the multitude of parts that comprise Martin bombers, has been installed by the Glenn L. Martin Company, of Baltimore. Operated by five men, the device does in a third of the time the work that formerly required fifteen men to do. Ten men, badly needed for other work, thus are released from hand-operated spray guns. Made for the Martin Company by a spray-gun manufacturer, numerous refinements and improvements have been added to adapt the machine to aircraft work. One such improvement is the stack and ventilator arrangement which keeps fine particles of paint from being drawn out through the stack into the air over the roof of the building. In the past, the fine paint "dust" presented a fire hazard. To-day, the excess paint spray is filtered through a veritable waterfall, and is collected in a large tank under the paint racks, later to be skimmed off with ladles.

Other changes in the machine brought about by Martin engineers include the addition of two hand-spray booths on each cycle of the machine, changes in the drying oven, and various improvements which were found necessary.

Endless-belt System

The machine itself is in two banks, or cycles, and works on the endless belt system. Small parts that have first been cleaned and anodised are brought in baskets on the over-

Whipping across the endless procession of small parts are the automatic spray guns, spreading an even coat of corrosion-resistant paint on the pieces soon to be included in the construction of a Martin bomber. Two such units comprise vital phases in the process.



nt Sprayer

gh the ventilator unit, the freshly painted parts it. After the parts have passed through the drying nd started on the second phase of their journey.

Automatic
for Rapidly
rcraft Parts
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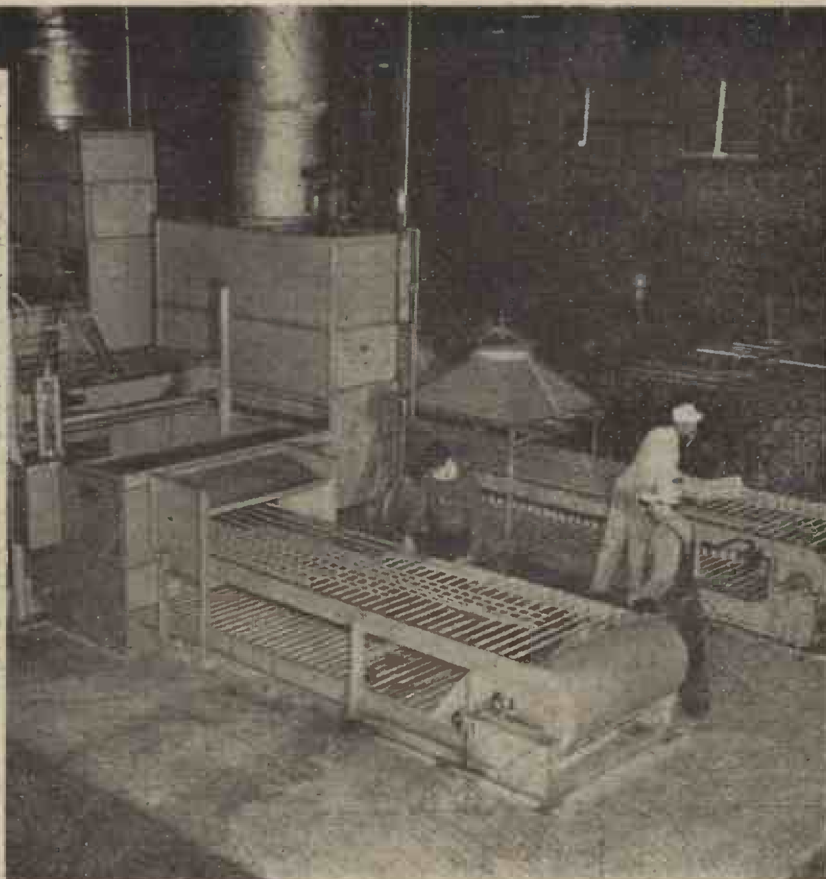
head chain conveyor system to a station near the robot paint sprayer. These parts are of various shapes and sizes; some of them slated to go into Navy patrol bombers, others into the construction of bombers for the Army and the Royal Air Force.

Taken from the baskets, the parts are started on their journey through the robot sprayer. Placed on the cross-bars of the endless belt, they are first carried under a set of overhead spray guns that whip back and forth across the moving pieces. As the belt moves on, the parts are carried through an oven equipped with infra-red lamps designed to speed the drying process, and then through a second drying unit where numerous fans force warm air on the parts.

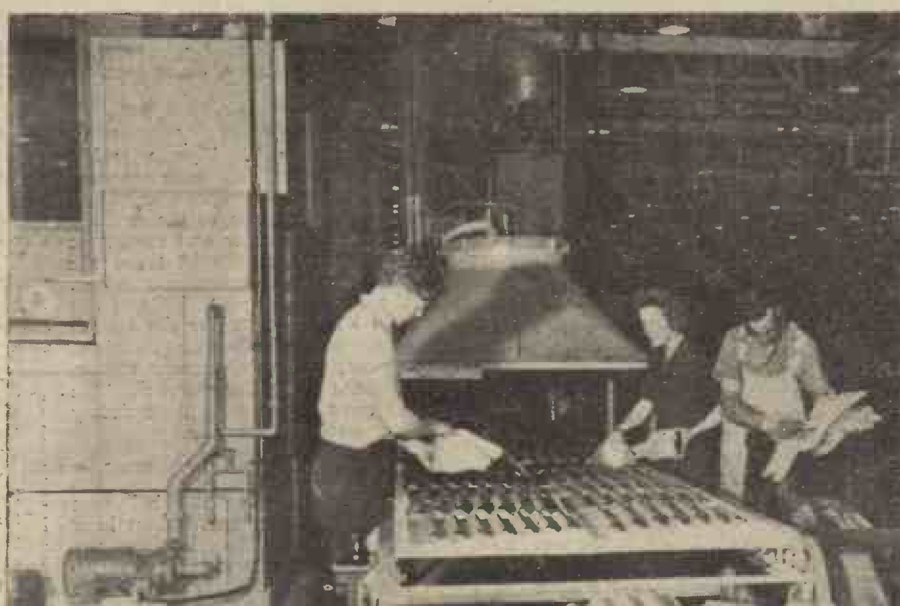
Infra-red Oven

The infra-red lamps are so arranged that they may be turned on in units of four or more, depending upon the type of paint being used at the time. If the paint drys rapidly it is not necessary to use the lamps.

The numerous parts, after having passed through the oven, now completely dry and painted on one side, are taken from the conveyor which comprises the first cycle of the operation, turned over and placed on the other conveyor which travels in the opposite direction. Thus, the second cycle in the operation is started. When the pieces have reached the end of the second cycle, they are completely covered with a primary coat of anti-acid paint.



Parts, painted on one side, are started on a duplicate of their first trip down the line. When they reach the end of the second phase in the robot spraying process they will be completely covered with a protective coat of corrosion-resisting paint.



At the end of their journey through the robot paint sprayer, parts are completely covered with a protective coat of paint. Here they are being removed from the endless belt and placed in bins, ready to move on to the production line. Parts of all shapes and sizes undergo the robot paint spray treatment.

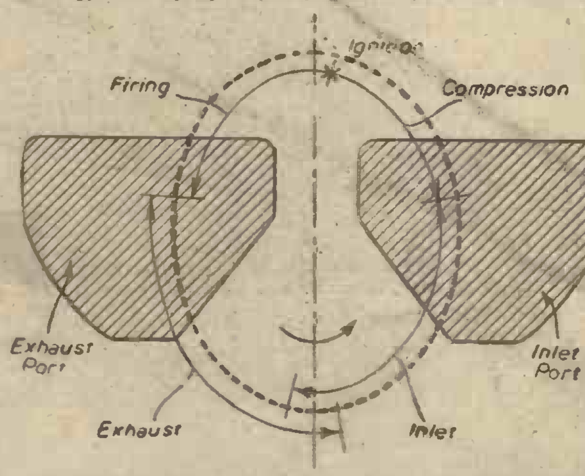
Sleeve Valve Engines

Their Operation and Advantages

By S. J. GARRATT

THE sleeve valve has been applied to internal-combustion engines for many years, and is not to be considered as an innovation. The first satisfactory engine to use this principle was the "Knight" double-sleeve type, which was made in Chicago as early as 1905. The "Knight" engine was introduced commercially into this country by Daimler in 1909. Both sleeves moved with a reciprocating motion, each being driven by a separate crank; very satisfactory results were obtained, particularly as regards silent running, the motor-car engine of that period not being as free from noise as more modern engines. Satisfactory lubrication of so many large area sliding surfaces introduced some problems which were, however, overcome and the engine made very reliable.

A single sleeve offers advantages in the matter of lubrication, and in 1909 the "Burt" single sleeve valve engine was introduced by the Argyll Company. Many readers will remember the "Barr and Stroud" motor-cycle engine which was on the market for a period of several years just after the last war. This was an example of the "Burt" single sleeve valve engine.



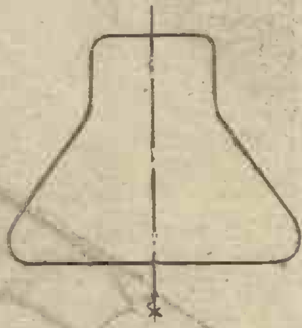


Fig. 1 (left).—Diagram of cylinder ports. Fig. 2 (above).—Shape of sleeve port.

Limitations

Experiments to determine the limitations of this class of engine were carried out with surprising results, and cylinder pressures of about three times those obtained in a poppet valve engine were experienced. The explanation of this is undoubtedly the absence of the hot exhaust valve from the combustion chamber. This hot spot limits the compression pressures obtainable before combustion takes place and thus precludes further increase of power from the cylinder with any given fuel. No such limiting factor was met with in the sleeve valve engine, the only factor preventing still further power output being the mechanical construction of the test engine.

These results were obtained by supercharging, but the tests referred to showed that the sleeve-valve engine is inherently capable of standing far more supercharge than a poppet valve engine.

Another advantage of the sleeve valve is its greater simplicity, and at the same time all working parts are enclosed. Less maintenance attention is therefore required; in fact, once the engine has been properly assembled, there is nothing to adjust or to get out of adjustment, except the auxiliaries, carburettor, ignition, and spark plugs. Valve grinding and valve tappet adjustment are eliminated.

The Bristol Aeroplane Company turned their attention to the single sleeve valve engine soon after the last war and they are the pioneers of sleeve valve aero engines. The largest engine of this type used in the Services is the "Hercules," a 14-cylinder double-row air-cooled supercharged radial of about 1,600 h.p. The success of this engine is sure to point the way to future developments.

Operational Details

With a single sleeve a simple reciprocating motion does not suffice for the requirements of the four-stroke cycle, but the required result is obtained by combining a reciprocating and an oscillating motion (i.e., a to and fro partial rotation in the cylinder bore), the effect then being that any point on the surface of the sleeve describes an ellipse against the cylinder wall. Figs. 1 and 2 give a clear indication of this movement and the manner in which the ports are opened and closed. The peculiar shape of the ports is to give the quickest opening and maximum port area. The reader should trace the outline of Fig. 2 on transparent paper, including the location point "X" and the vertical centre line; then apply the tracing to Fig. 1 and move it in the direction indicated so that the point "X" follows the ellipse, always keeping the centre lines parallel. The port opening can then be seen more clearly than with any static illustration.

Sleeve Port Control

The illustration shows a "double" port in which one sleeve port controls an inlet and an exhaust port. To simplify the induction and exhaust system it is usual to have only one double port in each sleeve, the other ports controlling either one inlet or one exhaust, but the principle is the same.

Movement of the sleeve is accomplished by means of a half speed crank working in a ball and socket joint at the bottom of the sleeve. This gives an up-and-down motion along the cylinder equal to twice the crank throw; the sideways or oscillating movement is, however, less than this because the ball joint is farther from the centre of the cylinder than the sleeve surface. The combined movement is therefore an ellipse as illustrated in Fig. 1. A circular movement would do but the ellipse is more convenient.

On the Bristol aero engines the sleeve is of steel about ⅛-in. thick and works directly in the light alloy cylinder. No liner is fitted in the cylinder, wear of the latter being inappreciable owing to the large areas of contact. The top end of the liner is closed by means of a kind of fixed piston forming part of the cylinder head and fitted with piston rings in the usual manner, the sparking plugs being screwed through this piston, or "junk head," to use the right term.

The crown or flat surface of the junk head is thus pocketed below the cylinder end, and presents some difficulty in cooling which has been successfully overcome in the Bristol engines. This is the hottest part of the cylinder and normally runs at about 250 deg. centigrade, compared with about 750 deg. for the usual temperature of an exhaust valve in a poppet valve engine.

Advantages

The single sleeve valve engine appears to offer advantages for motor-car purposes, for, besides doing away with valve grinding and tappet adjustment (to say nothing of rockers, pushrods, springs, etc.), it would overcome the pressing problem of cylinder wear and bring nearer the "everlasting" engine. At present the modern light car engine wears out more quickly than any other part of the car; even tyres will last 40,000 miles or more, while reboring is usually required at about 20,000 miles. The wear in the case of sleeve valve engines will be much less; for one thing, the wearing surface can be of steel instead of cast iron, and owing to the motion of the sleeve wear is more evenly distributed, and lubrication more effective. Pistons will probably be the first items to require replacement owing to wear in the rings and grooves, but when at last a sleeve does become worn out, it can be replaced by a spare part by the owner himself if he feels inclined.

What the motor industry will think of an engine that never wears out one cannot prophesy, but if, as seems probable, it offers advantages to the community it will come in due course.

The poppet valve engine has been the subject of an enormous amount of research work in design, materials and production methods, and in this respect has a long start over the sleeve valve engine.

Training High Fliers

How British Pilots Undergo Various Exercises for Ascertaining Their Suitability for Flying in High Altitudes

DURING the present war fighter aircraft and bombers of the warring nations are striving to operate at higher altitudes. To a fighter, height means tactical advantage over an opponent, and to a bomber, relative immunity from ground defences.

For this reason there is a race between all designers to produce aircraft with higher "ceilings," and engines which will function at great altitudes. A freak aircraft, a specially built machine, the Caproni Ca 161 bis, obtained the world's height record for Italy by flying to a height of 56,176ft.

But Britain and America are not behind in this race to carry the war into the sub-stratosphere, and the accompanying illustrations show some of the tests which are now almost a routine matter for R.A.F. personnel.

While the men are inside, a constant watch is kept through peepholes outside the chamber.

The controller now makes the conditions for 50,000ft. He controls the time taken for both "ascent and descent."

Inside the chamber the pilots and the doctor put on oxygen masks and earphones. Then the heavy steel doors are closed and a machine begins to reduce the air pressure at a steady rate. They are now on their way, while on earth, to the upper atmosphere.

Reactions of pilots to heavy exertion, such as pedalling a bicycle, are recorded. This cycle works on a friction-adjusted spring balance.

Reaction tests of pilots in the rarefied atmosphere. Writing their names is one test. Some men react at much lower levels than others.

The Story of Chemical Discovery

No. 17.—Pioneers of Plastics. The Origins of a World-wide Industry

ALTHOUGH the inception of that present-day miracle of mass-scale creative chemistry, the modern plastics industry, will, perhaps for all time, inevitably be associated with the name of the Belgian chemical professor and experimenter Dr. L. H. Baekeland, the originator of "bakelite," it would be erroneous to suppose that Baekeland himself was the first actual discoverer of synthetic resins.

That honour would appear, in strict truth, to fall to the celebrated German dye chemist Adolph von Baeyer, who, as far back as 1872, just after the close of the Franco-Prussian war, noticed that when phenol or carbolic acid is heated with formalin a solid resin results.

Speaking chemically, Baeyer remarked that "it seems that all the aldehydes will, under suitable circumstances, unite with the aromatic hydrocarbons to form resins."

Such a statement, if due attention had been given to it at the time, would have been seen to have comprised a very fundamental generalisation. But chemical science, in those days, had not time to concern itself with sticky, viscid resins of unknown and highly complex and problematical compositions. Chemical workers were far too interested in evolving new dyestuffs for the then rising synthetic dyestuffs industry. That, in a nutshell, is why plastic resins of the artificial type did not materialise in industry a quarter of a century before they were first heard of by the ordinary commercial user.

Although synthetic or artificially made plastics are of comparatively recent origin, it still remains a fact that many of the natural plastic materials have been employed by mankind since the remotest times.

Take, for example, bitumen, which is definitely plastic in nature and which is known to have been used in biblical times. Shellac, too, is another of the well-known natural plastic materials, as are also the various other natural varnish-resins, waxes and similar products.

In fact, the term "plastic" is applicable to a wide range of materials, both natural and synthetic, all of which are able to be moulded into definite and permanent shapes by heating and/or pressure.

Pyroxyline

The modern science of chemically synthesised plastic materials may be said to have taken its first rise in or about the year 1855, when one Alexander Parkes, a fervent practical experimenter in many branches of chemistry, first tried to make something useful out of "pyroxyline," which is the name given to nitro-cotton or guncotton dissolved in a mixture of alcohol and ether.

Celluloid—the oldest of artificial plastics—which in cinema film form is produced annually to the extent of millions of feet.

But pyroxyline proved itself to be an unusually difficult substance to handle. In the first place, it was excessively inflammable, and it was quite impossible to mould it, for, on the evaporation of the solvent, the stuff simply shrivelled up, leaving an almost formless, wrinkled, horny mass.

"Parkesine"

Alexander Parkes worked on the problem for about 10 years. He mixed various materials with the pyroxyline in order to stiffen it up. At last he tried camphor mixed with castor oil, and with the aid of these ingredients he produced a substance which he called "parkesine," and which had a small but limited commercial success.

"Parkesine" was the first artificial plastic, the forerunner of the vast multiplicity of highly efficient plastic substances which are nowadays annually synthesised by the hundreds of thousands of tons. But "parkesine" was not successful, its characteristics being far too unreliable for commercial utilisation.

In 1867, two years after the introduction of "parkesine," came the second of the world's artificial plastics, "xylonite," which was the outcome of experiments made by Daniel Spill, an acquaintance of Parkes. Spill's "xylonite" turned out to be a substance somewhat similar to "parkesine," but it was better compounded and was more stable in properties.

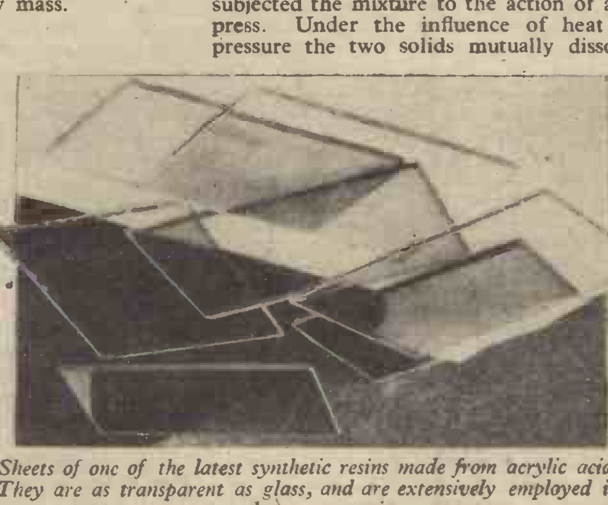
On the other side of the world, the problem of plastics was being taken up here and there by a few isolated experimenters. In America at that time the game of billiards was reaching the height of its popularity and the balls used for the game were made of solid ivory. But ivory was getting scarce for billiard-ball manufacture, and in the trade an appeal had gone round for some material which could usefully be substituted for it. In fact, the question of this substitute material became so pressing that a prize of 10,000 dollars was offered for the most satisfactory non-ivory billiard ball material which could be devised.

A young experimenter of Albany, John Wesley Hyatt by name, ultimately secured the prize. He succeeded just where the two Englishmen, Alexander Parkes, of Birmingham, and Daniel Spill, had managed to fail. For John Wesley Hyatt, instead of attempting to unite nitro-cotton or guncotton with camphor through the medium of an alcohol-ether solvent and with the aid of castor oil, cut out the solvent and the oil and combined the two together in the dry state by means of pressure alone.

"Celluloid"

Hyatt, aided by his brother, merely mixed camphor and nitro-cotton together and subjected the mixture to the action of a hot press. Under the influence of heat and pressure the two solids mutually dissolved

Bakelite resin which has been ground to powder form for packing into heated pressure moulds.



Sheets of one of the latest synthetic resins made from acrylic acid. They are as transparent as glass, and are extensively employed in aeroplane construction.

Making bakelite resin in the home laboratory by the interaction of formalin and carbolic acid.

in each other, resulting in an almost clear, homogeneous solid block of material which was named by its inventor "celluloid."

Thus celluloid, this still vitally important plastic material, arrived on the industrial scene. In 1869 the Hyatt brothers commenced manufacturing celluloid, and, with varied improvements in its technique of production, this material, the first of the commercially successful plastics, has been manufactured in enormous quantities ever since.

As a plastic material celluloid has, from time to time, masqueraded under many guises. The material can be dyed, coloured with pigments, made in an opaque or in a translucent (semi-transparent) form. It can have various filling materials incorporated with it during manufacture, and, naturally enough, it can be given a thousand or more different names. But, basically, all such materials (and their number has been legion) are nothing more nor less than celluloid, the compound of nitro-cotton and camphor which the Hyatt brothers originated in 1869.

Artificial Silk

After celluloid, chemical science waited for some 20 years before it produced another type of plastics. Again, cellulose formed the basis of the plastic material. The new material originated about the year 1891, when Count Hilare de Chardonnet, an intrepid French experimenter, commenced in a small factory at Besançon the commercial manufacture of a material which he called "pyroxylin silk."

This was the world's first artificial silk. Count de Chardonnet had commenced his experiments eight years previously, and at the Paris Exposition of 1889 he had exhibited his new silk-like products.

Artificial silk manufacture began in 1891 with the daily production of about 100lb. of the synthetic thread. The so-called "silk" was produced merely by squirting pyroxyline through fine orifices into a bath of warm water.

Chardonnet spent a vast sum of money on his invention, but, in the end, he was not extraordinarily successful. The technique of artificial silk production proved an excessively difficult one to master, and, to a certain extent, there existed a public prejudice against the material.

About this time, also, Cross and Bevan, two London experimenters who had devoted their technical careers to the study of cellulose, made the discovery that when mercerised cotton (that is, cotton which has been treated with a caustic soda solution) is warmed with carbon disulphide, it dissolves to a thick yellow fluid. This fluid, on being acidified, precipitates the cellulose in more or less its original form.

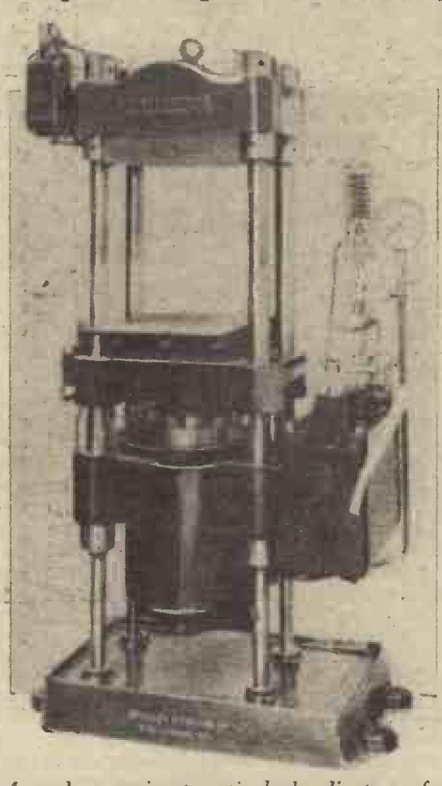
Cross and Bevan squirted their carbon disulphide solution of mercerised cotton through fine jets into a bath of weak acid. As each minute stream of fluid entered the acid bath it was instantly congealed to a solid filament. Hence, by twisting a number of such filaments together it was found possible to make an artificial silk-like thread which, indeed, showed a considerably greater resemblance to real silk than did Count Hilare de Chardonnet's "pyroxyline silk."

Cross (for he was the chief instigator of the new process) called his synthetic thread-like plastic "viscose," from the viscous nature of the solution used in its manufacture. The introduction of "viscose" may be said to have initiated the modern interest in "artificial silk," despite the fact that years had to elapse before artificial silks of the present-day standard could be produced commercially.

"Bakelite"

Then, after another interval of years, came L. H. Baekeland's introduction of "bakelite," and with this event came the beginnings of the present world-wide manufacture of synthetic resins which, in Great Britain alone, has reached the colossal annual figure of more than ten million pounds weight.

Dr. L. H. Baekeland was born at Ghent in 1863. After being Professor of Chemistry in the Universities of Ghent and Bruges, he emigrated to New York in 1889. At first his interests turned to photography, and he invented a "slow" form of bromide printing paper which could be manipulated under gaslight illumination, and which he called "Velox" paper. Thus did the nowadays well-known gaslight-paper originate.



A modern semi-automatic hydraulic press for the production of bakelite parts.

Baekeland's chemical reaction, resulting in the formation of bakelite resin, is a very simple one to carry out, and it may be imitated readily by any amateur who is interested in the process.

Mix together approximately equal quantities of formaldehyde ("formalin") and phenol ("carbolic acid") in a small heating-vessel and to this mixture add about five to 10 per cent. of its weight of solid caustic soda. All that is now required is to heat the mixture to its boiling-point for a few minutes, until suddenly the mixture turns yellow and then (rapidly) dark brown. The heating is immediately stopped, and the resinous product is well washed with water to get rid of all soluble matters.

Easily Moulded

This easily-made golden-brown resin is genuine "bakelite." When gently heated, it will become soft, in which condition it can be moulded. But when it is heated strongly, and particularly under heavy pressure, it becomes infusible, and no further degree of heating will soften it.

What has happened in the above chemical synthesis is that, under the "catalytic" or energising action of the caustic soda, the molecules of carbolic acid and of formalin have linked themselves up together to form long chains and clusters of atoms. The carbolic acid and the formalin molecules have, as it were, "condensed" together, forming a merger or an association of atoms. That is why bakelite and all similar synthetic resins are chemically known as "condensation" products.

The actual chemical composition of bakelite is quite unknown, as, indeed, is that of all the numerous other synthetic resins. One day, perhaps, some particularly ingenious experimenter will, after much toil, manage to elucidate the chemical make-up of these plastic compounds and he will tell us exactly how the atoms are held together in the different resins.

Carbolic acid and formalin are, of course, by no means the only two compounds which can be chemically "condensed" together to form resinous products of useful application. There are, indeed, hosts of other chemical compounds which can be reacted together by one more or less straightforward means or another to produce useful plastics.

"Condensite"

Another plastic pioneer was Jonas Walter Aylesworth. This experimenter was brought up, technically speaking, in what he was pleased to term "the greatest university in the world—the Edison laboratory." Aylesworth devised another phenol condensation product, allied to bakelite, which he termed "condensite." Condensite was found to be an excellent electrical insulator. It proved itself to constitute a first-class material for taking minute mould impressions, so much so that the great Edison himself took it over more or less completely for the manufacture of his still famous "Amberol" cylinder phonograph records.

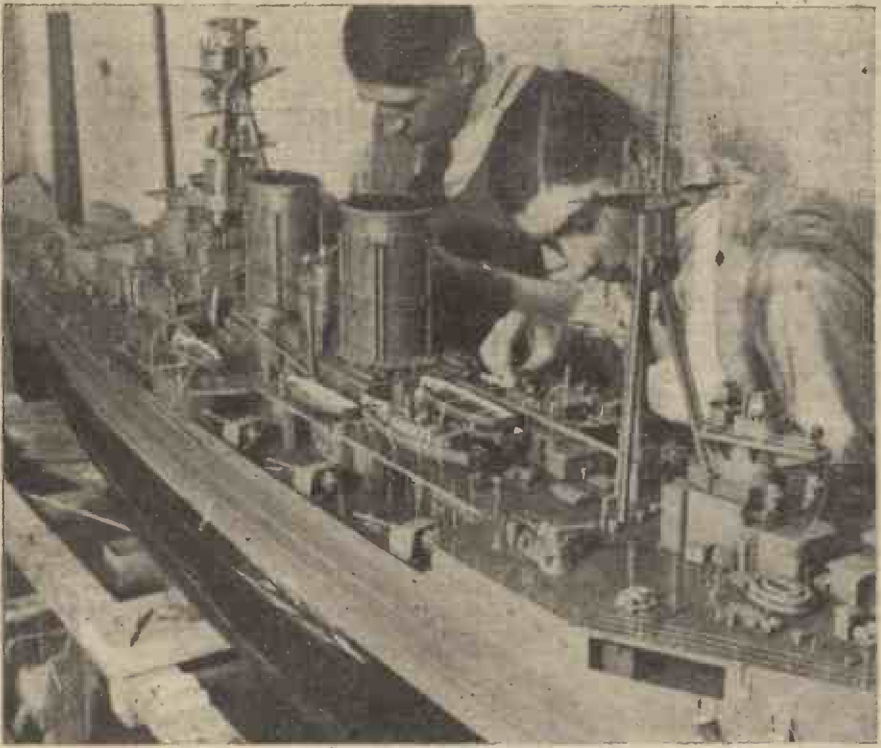
In conclusion, mention must be made of the present-day class of "casein" plastics which play an important industrial rôle in modern civilisation. Casein itself is a product of milk, being the chief constituent of milk curd. When formalin acts on casein, it forms a hard, horny substance, which, under the name of "galalith," was first produced in Germany at the beginning of the present century. Nowadays, much improved casein plastics are made for utilitarian and ornamental purposes by mixing dried milk casein with pigments and "fillers."

The result of the small-scale chemical reaction, illustrated at the top of this page. A mass of bakelite resin formed at the bottom of the porcelain basin.

THE WORLD OF MODELS

By "MOTILUS"

English Naval History from King Alfred the Great to King George the Fifth Told in Model Form



A fine close-up picture of a fully detailed model of H.M.S. "Hood," as she was built in 1916. The length of this model is 11ft.

MOST of us have our "favourites" in life—and when it comes to war-time we instinctively have a preference for one particular Service. You may like the modern and dashing Air Force, the Royal Marines or our brave new Army, but the Navy will always make the greatest appeal to me. It has the romance of generations behind it, for the sea has always been England's bulwark, and it was by sailing the rolling main that she built up the far-flung Empire she now fights to defend.

First Epoch

The first epoch of her sea history began in the reign of King Alfred, and, looking at a series of exquisite little models to a scale of 50ft. to 1in., compiled by Mr. E. W. Twining some years ago, I find he chooses for his first ship a Saxon-built vessel of the time of this famous English king. It is of the Norse long-boat type, with high curving stem and stern posts, and was propelled by long oars, when the wind was not favourable. The one mast carries a yard and square sail, and steering was effected by a large paddle-shaped board worked from inboard by a tiller.

The next model represents one of the boats in which William of Normandy and his soldiers invaded this country in 1066. The Conqueror "burnt his boats" when he landed, and the only record we have of them is to be found in the Bayeux tapestry, where they are shown to be complete with oars and pavises (round shields which protected the rowers), a single mast and sail, and carved heads on both stern and stem posts. Steering was by steering board and tiller.

13th Century Period

In the Seals of the Cinque Ports, and other seaport towns, excellent representations are preserved of vessels of the 13th century period, and our third model is of a vessel shown in the Seal of Winchelsea. This has many features in common with the two earlier ships. The sheer at each end terminating in a high stem and stern post, the single mast and square sail, and the steering board on the right-hand side are still there. The castles, fore and aft, are of elaborate Gothic design. These structures were first of all temporary ones, only used in times of war, and removed when the ship was used for trading purposes.

From the beginning of the 14th century the form and size of ships gradually changed. The forecastle and poop rose in height and began to extend beyond the length of the waterline. The fourth model in the series represents a typical vessel of the time of Edward III, date about 1360. Some of these ships probably had three masts and possibly a bowsprit, and a little later we find artillery in use on board. It is not definitely known which nation was first to make use of guns on ships, but it appears they definitely were used by the Spanish against the English Fleet at La Rochelle in 1372.

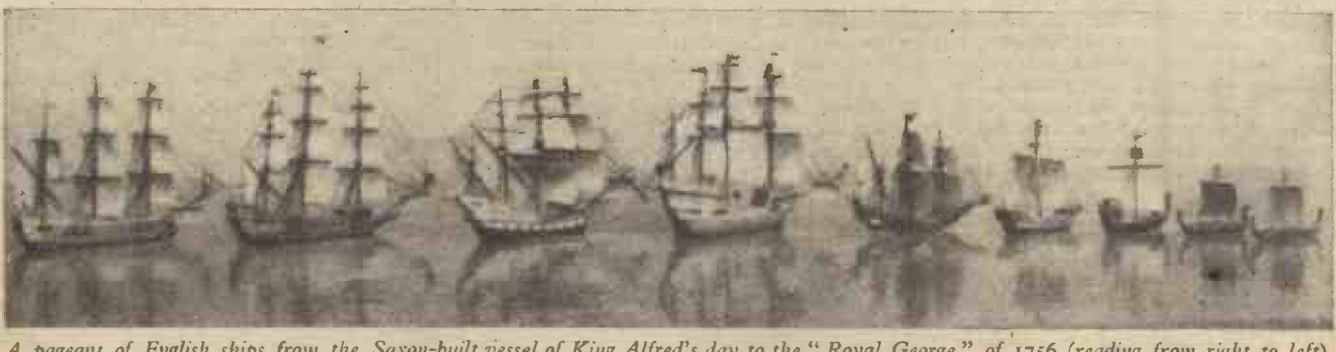
During the century following the period of this last model vessel, development and design were slow and our next model—a caravel of the time of Henry VII—is a typical one as used by most nations of that time. It was in such a ship—the *Santa Maria*—that Columbus, accompanied by the two smaller vessels, the *Nina* and the *Pinta*, sailed westward on his great voyage of discovery.

A 600-tonner

Henry VII gave much encouragement to the Navy. He built, in 1490, two large ships—one of which was 600 tons—and the sixth model, the *Henry Grace a Dieu*, is very similar to these, though built in 1514, during the reign of that much-married monarch Henry VIII. It is four-masted, having lateen sails on the two aftermasts, and a square sail carried on a yard on the bowsprit. The Merry Monarch, like his father, gave great attention to naval matters. He built or purchased the finest ships possible for those times, and during his reign the Navy for the first time became a separate fighting force for the protection of the country.

The *Henry Grace a Dieu* carried 21 guns, four of which were cannon throwing 60-pound shot, and by the end of the eighth Henry's reign the clinker system of construction, which had been in vogue since the time of Alfred, gave place to carvel building, resulting in faster and more seaworthy ships.

Some of my readers may be interested in a definition of these two competing methods of ship building. In a clinker-built ship the upper edge of each plank is overlapped by the lower edge of the one above, and they are secured to each other by nails driven through the laps. A carvel-built ship, on the



A pageant of English ships from the Saxon-built vessel of King Alfred's day to the "Royal George" of 1756 (reading from right to left).

A line of English ships from Nelson's " Victory " to H.M.S. " Hood " (reading from right to left).

other hand, is one in which the planks are all flush and do not overlap each other.

It is of interest to remember that the English Navy was first called the British Navy in the reign of James the First, when the Union Flag was adopted in 1606. About 200 years later came the union with Ireland (1801), and the Cross of St. Patrick was incorporated in the flag, which then became our Union Jack.

The " Ark Royal "

Seventh on the list is a vessel with a very famous name, the *Ark Royal*, which fought in the battle of the Spanish Armada, and eighth, the *Sovereign of the Seas*, built by Pett in 1637, a vessel of over 1,600 tons, carrying more than 100 guns. At the Restoration she was re-named *Royal Sovereign*.

Passing onward, we find several fine ships were built in the reign of Charles II, when Samuel Pepys, Clerk of the " Acts of the Navy," filled the post with such honour during eventful periods like the Great Plague, the Fire of London and the Dutch War, that the management of our Navy devolved almost entirely upon his shoulders. He rose to become Secretary to the Admiralty, and was the man behind Charles II's naval policy.

None of these ships is, in a word, epoch-making, so the next one we illustrate is the *Royal George*—by her tonnage alone (over 2,000), one of the most remarkable ships ever built—although it is owing to her tragic end that her name has become a " household word."

The " Victory "

Nine years after the launching of the *Royal George*, that is to say, in 1765, there was built the ship, which, in after years, became the most famous warship that ever went into battle. She bore, and still proudly bears, the imperishable name of *Victory*, and the tenth model in our series is intended to represent her in form and rigging as she originally was. Eleventh on the list is one of the last of the old " wooden walls "—launched at Pembroke in 1852 and named the *Duke of Wellington* in honour of the victor of Waterloo. Her tonnage was 3,771 and she was pierced for 130 guns, and was flagship of the Baltic Fleets in both expeditions against the Russians (1854-1855).

During the next decade very radical changes took place in both materials and methods of construction, as well as in the arming of ships, and in 1859 a number of shipbuilding firms, including the Admiralty office, were asked to submit new designs. None of these was accepted—but the fact that out of the 15 submitted, only two were of wood and the rest of iron—seems to have swayed the Admiralty's decision, for in 1859 two all-iron ships were laid down, the *Warrior* and the *Black Prince*.

The year 1862 marks the appointment of Sir E. J. Reed to the position of Chief of Construction. He was perhaps the first to visualise the ironclad steamship as a complete fighting machine, and proceeded to put his ideas into practice with the *Bellerophon*—the finest ship which had been built for the British or any other Navy of that day. She had the first warship hull built in cellular girder form with double skin, and she carried a central battery of guns—all previous vessels having been of the broadside type. This vessel is modelled as No. 12 on our list. She was launched in 1865, completed in 1866 and had a displacement of 7,550 tons.

Models of four leading warships of belligerent countries to-day—from left to right—the U.S.A.'s warship " West Virginia " showing characteristic lattice masts ; the German fast cruiser " Scharnhorst," which has had many hairbreadth escapes from the British Navy ; the " Nagato " one of Japan's mighty warships ; and H.M.S. " King George V "—the latest and most formidable type of British battleship.

H.M.S. " Benbow "

The next outstanding ship we come to is H.M.S. *Benbow*, one of the ships of the " Admiral " class of the early 'eighties. Then from the " Admirals " we skip another ten years and illustrate item No. 14, one of the battleships of the " Majestic " class. There were nine of these in all—displacement 14,900 tons, armed with four 12in. guns of a new type, as well as 6in. guns, 12 and 3-pounders and torpedo tubes—and they were laid down between 1893 and 1895.

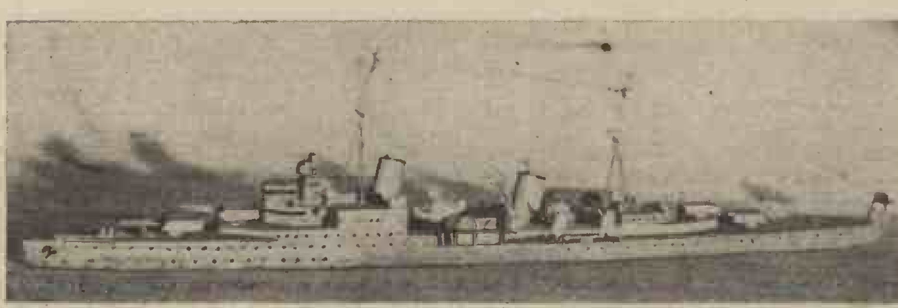
Under Sir Philip Watts came the " Lord Nelson " class, and in 1906 appeared the first all-big-gun ship, the *Dreadnought*, with 17,900 tons displacement. From 1906, ship succeeded ship along the *Dreadnought* lines, culminating in the " Queen Elizabeth " class of 1912-1913, with displacement of 27,500 tons. Our series ends with that gigantic vessel of 1916, H.M.S. *Hood*—the largest war vessel in the world, which was lost last year in battle against the German *Bismarck* off Iceland.

Warships of Four Countries

To bring our pageant right up to date (without giving away any vital facts which must remain secret until the war is won), I introduce our last picture. This shows models of the latest ships of four of the belligerent countries—the American warship *West Virginia*, the German battle-cruiser *Scharnhorst*, the Japanese *Nagato*, and England's newest type of battleship, the *King George V*.

Mr. E. W. Twining, who was personally responsible for making the whole of this model pageant of British naval history (with the exception of the four last-mentioned modern warships, which are the work of Bassett-Lowke, Ltd.), is probably one of the most versatile model makers in this country.

His sound knowledge of engineering and electricity was coupled with an attractive style of writing and expert draughtsmanship. He came to Northampton in 1913 and devoted himself chiefly to engineering and architectural models for exhibitions and museums.



A fine 50ft. to 1in. model of H.M.S. " Southampton," built by a bus-driver in his spare time.

The Care of Batteries

How to Maintain Them in Proper Condition

THE all-important subject of the care of batteries in war-time was stressed in an instructional film recently shown by The Edison Swan Electric Co., Ltd. The need for the conservation of batteries which are required for every vehicle and vessel of war was emphasised. The following notes cover the chief points outlined in the film, and should be of particular interest to all users of accumulators at the present time.

That battery, quietly working away in obscurity; do you *ever* think of it, except when it starts to give you trouble? It is not much to look at. and even if you take off the stoppers and pry inside, it is not so interesting as taking the back off a watch; you should see only the light glinting on the electrolyte. Outside, it is black and plain; ugly, if you like. That is a car battery, but even if your stock in batteries runs to an accumulator or two, with transparent containers you can easily see through, what do you see but grey plates, edges of brown and grey plates, terminals, acid, probably a few bubbles on the top? If your battery is not in good condition, even the plates will be discoloured. Very dull!

Does your battery ever inspire you to say to yourself: "This is the faithful little servant that starts my car, raises my traffic indicators, sounds my horn, keeps my lamps burning and my plugs sparking. It is the very life of my car"? And what of the other cells—those which give life to your radio, make your bells ring or give you emergency lighting? Do you ever give them a grateful thought? The fact is, you do not realise that those batteries do so much for you until they fail . . . and that is all your fault, usually.

Chemical Action

How does a battery do all this so regularly and then suddenly go "phut"? After all, the electricity which charging puts into it does not stay there; it goes in one side and out of the other just as all our words of warning have gone into the heads of many battery slave-drivers. There is no electricity stored in that battery at all. It is called a storage battery, yet it does not store anything except acid and its own parts. The plates and the acid in conflict set up chemical action and it is this action alone which *creates* electricity as it goes—when it is wanted—just when you "switch on." For by switching on you set that chemical action in motion.

Now if a battery depends upon chemical action for its life, quite certainly—as even the schoolboy chemist knows—it is self-destructive. All chemical action is self-destructive. Destruction starts as soon as a battery is charged, and upon the rate of destruction depends absolutely the life in hours of your battery. That rate of destruction you can control, advance or retard according to your treatment of the battery. Unless the instructions of the manufacturer are carried out, that rate of destruction will be rapid.

Competent authority tells us that 85 per cent. of battery casualties are caused by neglect; neglect which falls broadly under three headings, undercharging, overdischarging, evaporation. Let us investigate this, and for the purposes of our investigation concentrate on the car battery. Car batteries are the most frequently abused because they are out of sight, they wear out slowly and generally give the owner every opportunity to take mean advantages. The rules applying to car batteries apply equally to all other forms of batteries when it comes to care and attention.

Undercharging

First, then, undercharging. This means that, for one or more of several reasons, your car battery does not receive the electric charge from the dynamo for a sufficient length of time to keep the chemicals functioning properly. It may be through a faulty or dirty dynamo, but two of the most likely reasons are that you do not use your car frequently enough or that you do not take it for long enough runs. That is quite easy to understand. A battery is charged with electricity to keep the chemicals active, and the dynamo on your car should do, in a somewhat less degree of intensity, what the initial and subsequent booster charges at the service station do. To keep this process going satisfactorily you should take your car for occasional runs of 50 miles or so, for with the dynamo spinning merrily for so many revolutions that battery is really on charge and the effect obtained is very like a long drink to a thirsty man.

Sealing the cells. After the groups of plates are placed in the compartments, bakelite covers are placed on top and the whole sealed with bituminous compound.

The hydrometer test. The specific gravity reading indicates when the battery is below par, while the operation serves as a dip-stick guide to the amount of electrolyte in the cells.

That is worth remembering because it is a close parallel. If you had only a few sips of drink every hour or so you would in time be very thirsty ineed, and thus "thirsty" becomes your battery on short runs. It simply must have that occasional long drink of "juice" and woe betide you if it doesn't get it! The plates will buckle, they will become loaded with a layer of sulphate, and their efficiency will drop and drop until the horn squeaks, and the indicators develop the droops and the lamps just glimmer.

If you are unable to make such long runs, your battery must be taken out of the car and given an independent charge. If you are not equipped to do this yourself, the nearest battery service station, or garage, is your best friend.

Overdischarging has a similar effect. But this is caused by extensive use of the electrical accessories on your car, or too much night driving—or both. You are, in effect, taking too much out of your battery to balance what your dynamo can put in. Again—and even more imperative this time—it must have an independent charge.

Still considering these two causes of frequent battery failure, put it this way: If a tank holding 80 gallons of water receives from a supply pipe 15 gallons a minute and loses through a waste pipe 15 gallons a minute, the water in the tank will keep pretty level. That would be similar to the state of a battery could it receive from the dynamo the exact charge necessary to balance its output. But if the tank water supply drops to 10 gallons a minute while the waste pipe outflow remains at 15 it is only a matter of time before the tank empties—that is undercharging. Now supposing the supply pipe remains at 15 gallons but a tap is opened in the water system drawing off a further five gallons a minute, again in time the tank will empty—that is over-discharging. Two causes with but a single effect.

Technically, there would be a 10 per cent. loss in resistance and there would be probably the same percentage of evaporation in a water tank, but the analogy holds good.

Evaporation

Finally there is the question of evaporation. The acid in your battery to which we have already referred and which is known, as you know, as electrolyte, contains a good proportion of lead sulphate. If you allow the electrolyte to fall low enough for the plates to become exposed, sulphate of lead will be deposited upon those exposed parts and just that proportion of your battery will be ruined beyond redemption. Even though you cover the plates again with distilled water, once sulphation has taken place the battery can never be the same again. So if you allow the electrolyte to fall so low as a third of the way down the plates, one third of your battery will never work again.

You can stop these faults developing, that is the thing to bear in mind. You can watch

(*Continued on page* 105)

Our Busy Inventors

By "Dynamo"

Imitation Legs

OF recent years it has been customary to manufacture artificial limbs of an alloy of aluminium. An inventor now claims to have improved upon this construction by using a plastic material. His method consists in mixing together in liquid form a synthetic resin and a hardening ingredient. This is applied to a suitable base which may be of fibrous textile material, metallic gauze, or leather, and serves as a reinforcing medium.

The material thus produced is wound in layers on a shape resembling the artificial limb. This is dried preferably by the application of heat. After drying, the moulded plastic article is removed from the shape.

For this device a number of advantages are claimed. First, it is hygienic, as it is unaffected by perspiration. Next, being a bad conductor of heat, it is not liable to become uncomfortably warm. Then, for the purpose of adjustment, parts can be worked in in very much the same manner as wood. The material, also, will adhere to leather, metal, or wood, thus allowing adjustments in size to be made. In addition, the invention eliminates the waiting time entailed by drying processes necessitated by the use of wood and leather.

An innumerable quantity of artificial limbs will unfortunately be required as a result of the present conflict. Therefore, any invention which effectively replaces the natural limb will be of great service to mankind.

Stitch Salvage

THE war has caused the recruiting of an army of knitters.

The pet aversion of these industrious interloopers—if I may coin a word—is the dropped stitch. Among the gadgets designed to prevent this is a stitch holder in the form of a pin with a fixed cap at one end and a detachable cap at the other end. By this means, the knitter is enabled to slip off any desired number of stitches and to transfer them to the holder to be securely held until again required.

With the same object a new device has been submitted to the British Patent Office. The appliance consists of a combination hand knitting outfit serving at will as a needle and a stitch holder. There are three parts, including a headed needle separable along its stem into at least two portions, and a separate member with head attachable by its stem to the stem of the headed portion of the knitting needle, when the pointed part has been removed.

Cockpit Cover

AN improved cover or hood for the cockpit of aircraft, motor boats, etc., is the subject of an application for a patent in this country.

The object of the invention is a construction which will permit the cover to be jettisoned very readily in an emergency.

A hood is formed in two portions hinged to the opposite sides of a main chassis, and secured together and to the chassis by means which allow the portions to be released simultaneously.

These two portions separate automatically from the chassis, when they are swung outwardly.

The Information on this page is specially supplied to "Practical Mechanics" by Messrs. Hughes & Young, Patent Agents, of 7, Stone Buildings, Lincoln's Inn, London, W.C.2, who will be pleased to send free to readers mentioning this paper a copy of their handbook, "How to Patent an Invention."

Wrapping It Up

THE final process in a laundry is packing the washed articles in such a manner that they are delivered to the customer immaculate and unwrinkled.

Professor George Constantinesco, the man who gave Britain air superiority over the French battlefields in 1916, by his wonderful invention for firing synchronised machine-gun bullets through the revolving blades of aeroplane propellers. Professor Constantinesco is here seen in his workshop at work on some of the intricate synchronising machinery he has invented.

Among applications for patents recently accepted by the British Patent Office, I note one relating to a device for facilitating the packing of laundered articles. The author of this invention states that, owing to the scarcity of paper, washed articles are now being packed either in fabric bags, which are returned to the laundry, or in bags which involve the use of a lesser quantity of paper than was required when the articles were wrapped solely in sheets of paper.

It will be appreciated that, when packing articles which have been ironed or pressed, care must be taken that they are not creased when placed in a flexible bag. To pack without crumpling requires some degree of skill and occupies a certain amount of time. The invention in question provides a means whereby bundles of laundered goods can be placed easily and quickly in a bag by comparatively unskilled labour. As a consequence, the linen is delivered to the customer without spot or wrinkle.

To Protect Packages

PACKAGES in a shipping case should be qualified to endure hard knocks. Their constitution is likely to be undermined by the possible rough usage of the case upon shipment, and also by the movement of their contents, caused by the pitch and roll of the vessel in whose hold they travel.

To guard against the stress and strain to which these packages are subject, an inventor has produced a shipping case which he maintains, is an improvement, upon its predecessors.

One important object of this invention is the provision in a shipping case for packages containing liquids, such as oil and milk, of means for preventing the packages from contact with adjacent packages. The consequence is that the sides of the packages may bend when forced out by the surging of the liquid contents. This obviates undue pressure on the seams and closures of the packages.

The new shipping case consists of an outer container and a number of cartons for holding liquids. These cartons, as already stated, are capable of being bent when subjected to pressure. As a result, when external or internal force is experienced, they bulge outwardly and increase the cross-section of the cartons with the bulged portions. And there are means at the ends of the cartons which cause a space between the walls of neighbouring cartons, allowing for the maximum amount of bulging without the walls coming in contact.

Motor-car Appendix

THAT supplement to the motor-car—the trailer—is a convenient appendage which, combined with the car, constitutes a miniature passenger and goods train. The simplest form of trailer is that with a single wheel, which appears to be related to the wheel-barrow.

According to one construction of trailer of this type, the fork which carries the wheel is joined to an upright shaft which is free to turn in bearings on a bracket fixed to the tailboard of the trailer. This tailboard is a rigid fixture and cannot be let down for loading and unloading. Moreover, in this construction the wheel of necessity projects behind the trailer. And, in the event of its coming violently into contact with some unseen object, while backing, the fork shaft is liable to be bent and rendered useless.

To obviate these drawbacks, an inventor has devised a trailer in which the wheel is fixed to or formed with a short pivot pin. This pin is pivoted in a bracket fixed to two side members of a chassis that extends from one end of the body of the trailer to or beyond the other end. And it forms a support upon which the body is fixed.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page iii of 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.

Ultra-violet Apparatus

I HAVE made a small sun-ray lamp to be used with battery carbons from $4\frac{1}{2}$-volt batteries. Can you please inform me what current is required to operate on these carbons, and will the lamp require a resistance? If the current is low enough, will this do the job? If a resistance is necessary, could you please inform me of the best means of wiring this?—A. Foster (Hucknall).

THE so-called "sun-ray" lamp for generating ultra-violet radiation may take the form of either mercury vapour, carbon arc, or tungsten arc as the generating source. The amount of radiation will depend largely upon the power available, that is, the current in amperes, and on the type of carbons employed, and your proposal therefore to utilise the carbon elements from $4\frac{1}{2}$-volt dry cells is not likely to lead to useful results, the carbons being of unsuitable grade and too small to carry a useful current. Both alternating and direct current can be used, but carbon arc generators are usually designed to take from 20 to 30 amperes, and if run from the mains would require a heavy resistance or choking coil to reduce the terminal voltage to about 80 volts, which would be a costly piece of apparatus in itself. The carbons would need to be 16 millimetres diameter for A.C. or 18 millimetres diameter for D.C. A long arc is essential to the production of ultra-violet rays, and as above stated the results would not be very beneficial on the small scale contemplated, although many small outfits are sold for home treatment to a more or less credulous public.

Sharpening Mincing Machine Knives

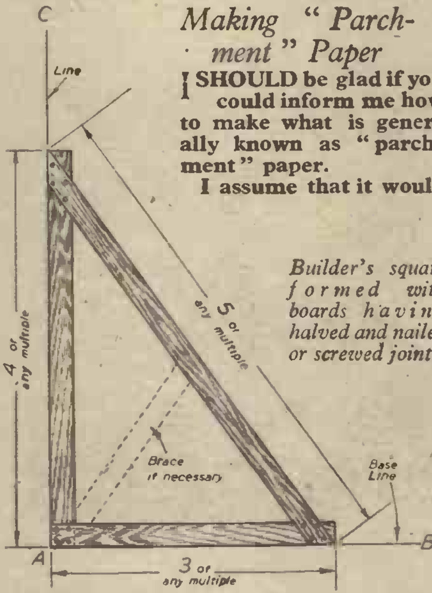
WOULD you please advise how to sharpen knives for a mincing machine, either on carborundum or stone, and what position to hold the blades?—W. Warburton (Bollington).

PLACE the stone at the same angle at which you find the edges have been finished. If they are very dull a coarser carborundum stone will be necessary than for putting the final touches on, and these require a fine stone or an oilstone, taking care to remove the wire edge.

Builder's Square

COULD you give me the system or formula for getting a building square when laying out the lines? I have a very elementary knowledge of the 3-4-5 method, knowing only its multiples, i.e., 9-12-15 or 15-20-25. I believe this is used for getting a correct right angle. I understand that there is a method of arriving at the correct diagonal on a known length and width when setting out.—D. T. Davis (Hungerford).

THE accompanying sketch shows the builder's square constructed on the "3-4-5 method," and it is intended for setting at right angles and, of course, checking them. In all setting out work there either exists or is formed a base line, and if the builder's square has its 3 (or 4) side set accurately on such base line, as sketch shows, the 4 (or 3) side is exactly at right angles to the base, and a builder's line may be sighted through or laid against the 4 side (or 3). When the builder's line is fixed—it may, of course, be of any reasonable length—it is advisable to check whether it is exactly at right angles to the base. This may be done as follows: From a point where the right-angled lines meet, as "A" on sketch, measure 15ft. along base line in direction of "B" and mark point accurately; next measure 20ft. from "A" to "C." If the angle is a right angle the measurement from "B" to "C" should be exactly 25ft.; if it is not the line "A"-"C" should be adjusted. The 15ft., 20ft. and 25ft. may be of any other multiple of 3, 4 and 5.



Builder's square formed with boards having halved and nailed or screwed joints.

Making "Parchment" Paper

I SHOULD be glad if you could inform me how to make what is generally known as "parchment" paper.

I assume that it would be possible to produce this after suitably oiling a good quality cartridge paper, but I should like to know the correct type of oil (and dryers—to ensure absolutely non-greasy finish) and the method of application. I am unable to obtain parchment from dealers at the present time.—J. Godfrey (Exeter).

WE are surprised to learn that you have not been able to obtain genuine parchment. Have you tried Messrs. Geo. H. Russell, Hitchin, Herts, who are makers of this material?

It is not possible for you to make a really satisfactory imitation of what is generally known as "parchment paper," for such materials usually contain resin, which is incorporated into the paper during its manufacture. You might, however, try wiping over the paper a little linseed oil containing about 10 per cent. of dissolved resin. Use the oil very sparingly. A somewhat similar result can be obtained by treatment in a like manner with butyl phthalate (with or without 10 per cent. of dissolved resin). Butyl phthalate can be obtained from Messrs. A. Boake, Roberts & Co., Ltd., "Ellerslie," Buckhurst Hill, Essex. It is cleaner to use and more permanent than linseed oil.

Another way to make an imitation parchment is to take a good quality paper, and to immerse it for a second or two in a bath of *concentrated* sulphuric acid. The paper is immediately withdrawn from the bath, held up to drain and then plunged into a bath of *strong* ammonia liquor, in which it is allowed to remain for another few seconds. Finally, the paper is well washed and dried under tension. This process gives an excellent hornlike material, but the method is not without its danger, owing to the employment of strong sulphuric acid and to the "spitting" of the acid in the paper when it is neutralised by the ammonia. The method is only suitable for small sizes of paper.

Multipolar Dynamo

I HAVE in my possession a Rotax starter-dynamo of the following dimensions: Armature, 29 slots, 6in. long, 4in. diameter (6-pole field). Commutator: 86 segments. Field magnets, 6. Would it be possible to wind such a dynamo to give a 25-volt output?

How are the armature, commutator and field magnets wound and what gauge of wire is required?

At what speed would such a dynamo cut in, and at what speed would it give its full output? Am I correct in assuming that the more poles a dynamo has, the less speed is required to run it? What would the output be approximately?—Harry Grant (Bourtie).

CERTAINLY you can wind your generator for an output of 25 volts, but its capacity in watts depends entirely upon the speed you wish to run. Multipolar field magnets are useful in obtaining high voltages at reasonable speeds, since the armature windings can then be wave-connected with all conductors in series, but it does not necessarily follow that they are suitable for specially low speeds, since this is also dependent upon the peripheral speed of the armature; that is, it is more a question of armature diameter than revolutions per minute. A fair output rating for your generator would be 25 volts 20 amperes at 1,800 r.p.m., but it cannot be stated that this is practicable unless the size of the commutator is known, as this current may be too heavy for the commutator bars and the brush sections. Judging from the odd number of armature slots, it is probable that a high-voltage wave-winding was intended for this design, in which case the commutator bars might be too small to carry more than a few amperes. It would appear to be a difficult winding, and it might be better to leave the armature as it is without rewinding, merely altering the field coils.

Smoke Candle

I AM trying to make the smoke candle as described in a recent reply to a query in "Practical Mechanics," but I do not know whether to build it up round a string like a candle or to let off the mixture alone. I shall be glad of any information on this point.—D. Courtier-Dutton (Herne Bay).

YOU should pack the smoke candle mixture into a long tube of fairly thin cardboard. A central wick is not necessary. The candle is ignited by means of a short length of wax taper, waxed tow or other touch-medium placed in the mixture at the upper end of the candle. Even an ordinary match can be used for this purpose.

You can also use for this purpose "touch paper," which is made by soaking tissue paper in a strong solution of saltpetre for a few minutes and then drying it.

Heat Generating Compositions

CAN you tell me of any chemical or combination of chemicals which, when contained in a porous envelope and immersed in water for several seconds, generates heat over boiling point for a period of minutes? I understand that such heat pads are made commercially for some trade purpose. The chemicals would require to be fairly inexpensive and readily obtainable.—N. C. Venables (Enfield).

HEAT-GENERATING compositions are varied in nature and somewhat unreliable in behaviour. The following, however, are fairly simple compositions, but we cannot, of course, guarantee that you will be able to purchase all the necessary ingredients without some considerable trouble:

1.	Iron powder	83	parts
	Carbon powder	37	,,
	Potassium permanganate	10	,,

On the addition of a small quantity of water, the temperature of this mixture rapidly rises to about 105 deg. C., which is higher than the boiling-point of water.

2.	Iron powder	92	parts
	Iron sulphide	3	,,
	Copper sulphate	5	,,

A similar composition to the foregoing. It is moistened with water. Maximum temperature about 100 deg. C.

A still simpler composition is:

3.	Iron powder	50	parts
	Potassium chlorate	50	,,

This is moistened with water, and gives a rapid but brief temperature increase.

The following is a more complex composition, but is said to be long-lasting in its effects:

4.	Aluminium powder	2	parts
	Copper carbonate	4	,,
	Oxalic acid	3	,,
	Barium chloride	3	,,

On the addition of water to the above, heat is generated.

Rewinding Universal Motor

WOULD you please inform me how to rewind a 230-volt AC/DC 400-watt blower motor so that it will work off a 12-volt car battery? I want to use the blower to draw up the fire on a gas producer.—A. Adlington (Rotherham).

SINCE the motor is required to run from a 12-volt battery there is no point in winding it as a "Universal" motor with series-connected fields, and if shunt-connected it will run at a more constant speed. Possibly, however, you have not realised that on such a low voltage the current it would take becomes extremely heavy. If, for instance, it was rated at 400 watts input on 230 volts, it would require 33 amperes input on 12 volts, and it is quite possible that the design of the commutator and brushes is not intended to deal with such heavy currents. It would be as well not to load it up to more than 160 watts input, with which it should develop $\frac{1}{8}$th brake h.p. if wound as follows, the speed being approximately 2,500 r.p.m.

Armature 26 coils, each wound with 5 turns of 2-strand No. 22 S.W.G. enamel-covered copper, the coil span being from slot 1 to slot 6 and the coils grouped two per slot for connection to the 26-part commutator.

F. P. Wood, one of the vice-presidents of the Roadfarers' Club.

The fields to consist of two coils, each with 400 turns of No. 23 S.W.G. enamel-covered copper, in series with one another and shunt-connected to the armature. Brushes $\frac{5}{16}$in. square of copper-carbon "CM/6" grade with copper pigtails.

Black Ripple Finish

I DESIRE to know what kind of enamel, or process, is used to produce a finish known as black ripple enamel. This appears to be a universal external finish for metal enlargers, and apparently can be produced in black, grey and brown.—John L. Dolphin (Wirral).

THE "ripple" and "crackle" enamel effects are brought about by a process of interfering with the continuity of a normal cellulose enamel film. There are several methods of producing such effects, one of the best being the following:

First of all, prepare a "crackle base," which comprises a metallic soap mixed with a suitable cellulose solvent. The following formula is a suitable one for the preparation of a "crackle base":

Aluminium stearate	25	per cent. (by wt.)
Ethyl acetate	74.5	,,
Pyroxylin	0.5	,,

This "crackle base" is added to the ordinary cellulose lacquer in amounts of between one-quarter and one-third the weight of the lacquer. The mixed lacquers are then painted or sprayed on the article to be treated, the latter then being placed in a warm atmosphere for the lacquer to dry out. A ripple-like surface is thereby produced.

Finish for Copper Articles

I HAVE made a number of models in copper, and should like to treat the metal to avoid it tarnishing. I am not keen on lacquer, and I would prefer to give the models a bronze appearance.

Will you please let me know how to do this, and what other finishes are easily applied to copper?—R. M. Colmer (Northfleet).

ONE of the best finishes to apply for the surface coloration of copper can be made readily by boiling for 10 minutes a teaspoonful of flowers of sulphur, and a like quantity of lime in about a pint of water. The resulting yellow solution is filtered, and then allowed to cool. For use, add about two teaspoonfuls of the sulphur-lime solution to about half a pint of water, and immerse the copper articles in this. The articles will quickly become coloured, the colorations ranging from a reddish-yellow to a dark bronze, the precise colorations depending upon the exact strength of the solution and the time of immersion of the copper articles in it.

The copperware must, of course, be scrupulously clean and grease-free. It is also advisable to perform one or two trials with a few pieces of scrap copper in order to judge the exact duration of immersion which is required to produce a given shade of coloration.

The Care of Batteries

(*Continued from page* 102)

your battery and slow down that very disintegrating process by which you get electricity because you are not left to guess what condition your battery is in. There is, indeed, a very handy tool which will tell you all you want to know—the hydrometer. Keep this in mind, that with a hydrometer, conscientiously used once a month, you have the remedy against battery failure and all its attendant irritations.

Using the Hydrometer

The hydrometer is a simple thing. It is, to look at, very much like the old fountain-pen filler enlarged. Inside the barrel there is the hydrometer scale which, in turn, looks something like a clinical thermometer with an enlarged end. All that has to be done is simply to unscrew the stoppers from the different cells of the battery, insert the rubber piping at the end of the instrument and suck up the electrolyte by the usual method of squeezing and releasing the rubber bulb at the top.

When you have thus sucked up the electrolyte until the scale floats, like a fishing float, you can take a reading. That reading will be the exact specific gravity of the electrolyte—the tell-tale clue to the state of your battery. If the reading you take is 30 or more points below that specified on the label, or tag, supplied with your battery—it must have an independent charge.

Usually, it will be necessary to test only one cell of any battery to ascertain the condition of all of them, but if you are inclined to feel a little conscientious, by all means try them all; you *may* find something different which would be an indication of a fault in one of the cells. This is only likely to occur in a battery which has been badly treated.

One more word about the hydrometer; it has yet another use. It makes, as you have probably already realised, an excellent dip stick for testing your acid level. Car batteries are dark inside and appearances are very deceptive.—*The Edison Swan Electric Co., Ltd.*

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Comments of the Month By F. J. C.

Massed-start Racing—N.C.U. Statement

THE N.C.U. Emergency Committee has issued a statement to clubs and N.C.U. centres on the massed-start question. This statement has been circulated to all affiliated clubs, private members' sections, and every N.C.U. appointed secretary, and the centres have been instructed to call special meetings in the near future for the consideration of this statement. All the clubs have been urged to do likewise, and to make sure that they are represented at the centre council meetings. The circular states the position as it is seen by the Committee. It states that since the outbreak of the war the usual venues for massed-start races, such as Brooklands, Donington Park, Blenheim Park and the Crystal Palace, have not been available.

The Emergency Committee has had difficulty in finding alternative suitable closed circuits. Early this year Mr. P. T. Stallard advised the Committee that he was not interested in closed circuit racing, and was considering organising massed-start racing on the roads. He was reminded that the N.C.U. rules did not permit this unless the roads were closed by the authorities. He disregarded this reminder, and, as is well known, organised the massed-start race from Llangollen to Wolverhampton without requesting an N.C.U. permit. He advised the Committee that he expected to be suspended. The Committee then took action. The race was proclaimed, intending entrants were warned against competing, and the organiser of the race was suspended pending appearance. Stallard was summoned to appear before the Committee, but he failed to attend and was suspended *sine die*. The race was held, and all the riders and officials were suspended and were summoned to appear before the Committee held for their convenience in Birmingham. Only a few availed themselves of this opportunity, and, as a result, three officials were absolved, and all others who entered, competed or officiated in the race had their suspensions removed, but were warned as to their future conduct.

Since this race three other similar events have been held outside N.C.U. rules, and each was dealt with on the same lines. The riders and officials were sentenced to varying suspensions, and the total number of suspensions to date is 67. The N.C.U. state that this tiny fraction of the union's membership has flouted the established policy and rules of the union.

The Committee states that at the outbreak of war the functions of the General Council and General Committee were delegated to an Emergency Committee, whose main duty it was to see that the N.C.U. is carried on during war-time in the best interests of all members, and it has followed the principle that its policy must be based on the policy of the union as in force when the Committee was first appointed. They rightly presumed that to have made radical alterations to rules would have been unfair to thousands of members on active service. They adhere to the position that this is not the time to alter rules. They deny the suggestion that the present massed-start rules were experimental. They were framed in support of the policy maintained for nearly 50 years of not countenancing any action which would imperil cyclists' interests by atagonising either the law or the general public. Massed-start racing became popular from 1933 onwards, and in November, 1938, the N.C.U. Council passed the present rule. It would seem, therefore, that the present mass-start enthusiast has decided to revert to conditions of 50 years ago, and the N.C.U. remind them of the following facts. Until 1895 all road racing was massed in the sense that the competitors were allowed to get together, ride together and finish in a bunch. There were no motor-cars and very little traffic of other kinds, but, nevertheless, public opinion opposed this form of sport, and the police made great efforts to stop it.

Bath Road "100"

SUCH events as the Bath Road "100" and the North Road "24" were driven on to the track for a period, but the situation was saved by the introduction in 1895 of the unpaced form of time trial racing. It can hardly be said that massed-start racing to-day can be conducted in safety where it could not in the 'nineties when the roads were clear.

A massed-start race was held in the Isle of Man on the public roads in 1936. There was considerable trouble due to interference on the part of motor-cyclists. In 1937 and later years the Isle of Man race was held on closed roads. The Transport Advisory Council considered the suggestion that for reasons of public safety cycle racing on the road should be prohibited, but this was averted owing to the efforts of our contributor, F. J. Urry, but in their report they expressed the following views: "We consider that most of the objections to racing and speed trials on the road in this country arose from a misunderstanding of the manner in which this sport is conducted. . . . We do not recommend that any new statutory obligations in this direction should be introduced." If massed-start racing continues on the open roads it is likely that such legislation will be introduced. It is obvious that massed-start racing *per se* is not illegal. The police have given permission for the recent races, when it is obvious that such permission need not have been asked. One Chief Constable who was approached said: "I have no authority to prohibit such events. I shall, of course, take any necessary steps to ensure that there is no breach of the law." The Emergency Committee's opinion is that there is a great objection to bringing cycle races to the notice of the police unless it is done to obtain the closure of the roads. It is our view that the police have not the authority to close the roads for sporting events. A further disadvantage of approaching the police is that the practice may develop into a custom, and as a custom it can have the same effect as the law—it would become an obligation. The Committee is yet to be convinced that it is possible for competitors in a massed-start race to make a real race of it and abide by the rules.

Rules of the Road

THE following extract is from a local newspaper's report on one of this year's races, and it well illustrates this point: "The first consideration of every competitor is to observe fully the rules of the road. This was done on Sunday, and as the competitors reached the built-up areas they reduced a cracking pace, formed into single file and passed through villages quietly and almost sedately." From the point of view of public safety, the Committee fully appreciates the necessity for the exceptionally careful conduct shown by the riders, but the Committee asks, in all sincerity: "Is this racing?"

The facilities for holding road races in some countries on the Continent are immeasurably superior to those existing here. There, the roads run in a straight line for many miles, with few minor roads leading into them, and villages only at infrequent intervals. Here, in this country, these favourable conditions are completely reversed.

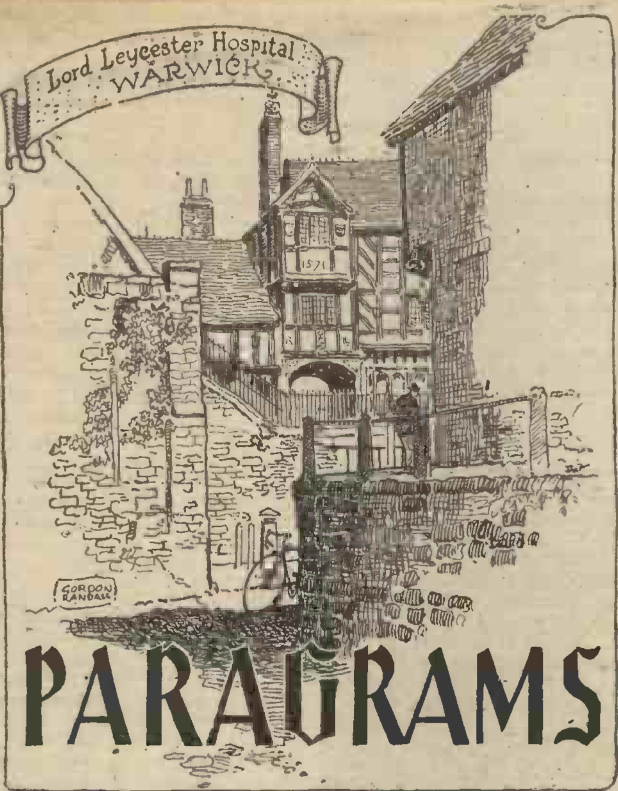
When Continental racing is being considered, it should also be remembered that the Union Cycliste Internationale, the Governing Body of the World's Championships, has a rule to the effect that its road championship shall take place on a closed road circuit. This rule was introduced in the interests of competitors themselves, to ensure that they should all be able to race under equal conditions. Bitter experience over many years proved to the U.C.I. that a fair race was not possible unless the route of the race was closed to all other traffic.

Road Accidents

FEWER people were killed on the roads during September than in any September since the war began. The total of 553 is less than half the number killed in the first month of the war and among pedestrians the decrease is as much as 75 per cent.

Comparisons with pre-war figures are less favourable, however, for although road traffic has been drastically curtailed, road deaths were only two less than in September, 1938. Fatalities among children last month were even higher than in September, 1938, totalling 120 against 89. They included 26 child cyclists, which gives an average of one nearly every day. This figure for child cyclists is the highest for six years.

Because of difficulties of supply, there may be a tendency for children to use machines which are too large for them. This is a dangerous practice, resulting sometimes in loss of control. Parents are advised to check any tendency of this kind and to make a point of overhauling their children's bicycles at regular intervals, giving special attention to brakes and tyres.



Club Secretary Injured

FORMER hon. sec. of the Western Counties R.R.A., W. Chappell sustained serious injuries during a flying accident in India.

R.T.T.C. Chairman in R.A.F.

MAYOR of Wareham for five consecutive years and chairman of the South District Council of the R.T.T.C. since its inception, Arthur Moss, Wessex Road Club, is now in the Royal Air Force.

Club Secretary as S.Q.M.S.

DENNIS WALTON, former secretary of Walton Athletic and Cycling Club, is now a S.Q.M.S. with the R.A.S.C. in India.

W.A.C.C. Members in Forces

WITH the exception of one or two members in reserved occupations all members of the Walton Athletic and Cycling Club are serving in the Forces. H. Rudding, former club champion, is in Canada with the R.A.F., and two members—R. Grubb and S. Venn—have been reported missing.

Club President Loses Cycle

AFTER cycling from his home at Gateshead-on-Tyne to London, "Tommy" Charleton, president Wellam C.C., had his cycle stolen in Holloway.

Misguided Keenness

TWO Littleborough (Lancs.) boys who stole two bicycles and then rode them to Blackpool and almost home before being caught, were charged in a local juvenile court. It was stated on behalf of the boys that they meant to return the bicycles.

Biggest Receiving Case

IN what is probably the biggest case concerning the receiving of stolen bicycles, since the outbreak of war, a Glasgow dealer was recently charged with being the receiver of 117 bicycles and four motor-cycles. Witnesses stated that bicycles and frames produced in court belonged to their machines which had been stolen at various dates.

Norwegians Like Cycling

NORWEGIAN fishermen at present quartered in Scottish coast villages are reported to be making good use of their spare time. They are keenly interested in seeing the countryside from bicycles, and often travel long distances to visit places of particular interest.

Ceylon's Tyre Problem

CEYLON, the largest present supplier of rubber to the United Nations, has a great shortage of bicycle tyres. Over 3,000 cyclists have applied for the 30 tyres available. Applications are being carefully considered, so that cyclists on important work will get preference.

Rally in 1943

AT the recent annual general meeting of the West of Scotland Cyclists' Defence Committee it was decided to go ahead with the arrangements for the 1943 Cumnock rally. Robert Marshall, the energetic organiser of the rally, the most famous war-time event of its kind, was re-elected secretary of the Committee, which includes representatives from all the leading Clydeside clubs.

Highland Road Improvements

AT a recent meeting of the Edinburgh and District Association of Civil Engineers, Mr. W. H. Budgett, of the Ministry of Transport, spoke of road improvements undertaken in Scotland in recent years. He mentioned the Glasgow-Edinburgh road, the Perth Inverness road, and the Glasgow-Fort William-Inverness road, as outstanding examples of the road-makers' skill.

British Clubman in Egyptian Hospital

AMONG those who travelled to Italy just prior to the war to represent this country in the world's championship was Reg. Harris. He is now in hospital in Egypt suffering from severe burns sustained in action against the Italians when the tank which he was driving was hit by enemy gunfire.

Road Champion Killed

REPORTED missing since November, 1940, Sergeant-Pilot W. F. Sidaway, road champion in 1934 of Aylesbury Wheelers, is now known to have been killed. He was buried with other members of the crew of a British bomber in Greece.

Noted 25-Miler Marries

EDDIE LEECE, noted pre-war 25-miler, now a second lieutenant in the Army, has married Dorothy Bradley, a Manchester girl serving in the W.A.A.F.

Fast "25"

THE fastest 25-mile ride of the 1942 season was accomplished by Edward Jones, Wolverhampton Wheelers, who clocked 1.0.10; only 43 seconds outside the previous best on record.

New Scots Official

JOHN B. CAMPBELL, the well-known secretary of the Royal Albert C.C., has taken over the duties of the secretary of the Mid-Scotland T.T.A., as the former secretary, Rob Richardson, has joined the Navy.

Clubman's Adventures in Middle East

FOUR months ago "Bob" Acutt, Southgate C.C., was reported missing in Libya, and it is now known that he is a prisoner of war. His unit was among those trapped in Tobruk. He had served in Palestine, Greece, Crete and the three Libyan campaigns, and, after the fall of Greece, was reported "missing" for six weeks. He subsequently turned up in Egypt, having crossed the Mediterranean in an open boat with a few companions.

North Road Riders in Egypt

CAPT. J. C. P. BINDLOSS, Dvr. G. Lawrence and F./Lt. A. C. Dollamore, all members of the North Road C.C., met in Egypt, where the latest North Road arrival is Sig. P. S. Bury.

Pre-war Champion Killed

THOMAS FRITH, pre-war champion of the Withington Wheelers, has died of wounds in an Italian hospital. He was shot down over Malta three months ago, and subsequently posted as missing.

Club Champion

RON WALTON is current champion of the Norion Road Club.

Clubman's Fatal Accident

WITH the death of Pilot-Officer J. I. Evans, R.A.F.V.R., who lost his life in a flying accident at a glider training school, Lichfield C.C. has suffered its first casualty of the war. Evans had only just returned from training in the United States.

"Walk on the Left"

SOUTHGATE Borough Council have launched a "walk on the left of the pavement in the black-out" campaign, but not with notable success.

Brentwood C.C.'s Champion

CURRENT champion of the Brentwood C.C. is D. W. Brunwin, with an excellent aggregate for 25, 50 and 100 miles. He also won the club's map-reading competition.

Club Medal for Fastest "25"

BRENTWOOD C.C. have, since the outbreak of the war, presented a medal to the member in the Forces who rides the fastest "25" each year. This year's winner is F. Pearce, who is in the R.A.F.

Balloon Fabric for Covers

IT is reported from Holland that the Dutch are using the fabric of shot-down barrage balloons as patching canvas for worn cycle covers.

More for Trust

THE National Trust has added to its possessions by the purchase of Hotbank Farm, and a further 2¾ miles of Hadrian's Wall at Housesteads.

Thanks to Cyclists

THE Scottish Y.H.A., Glasgow District Committee, has sent the West of Scotland Cyclists' Defence Committee a letter of thanks for the help given by cyclists to the hostels movement in finding new hostels.

Tricycle Record Beaten

ALTHOUGH now in his 30th year, George Lawrie, Viking Road Club, holder of several national tricycle records, including the 1,000 mile, has beaten his club's tricycle record with a ride of 1.11.52.

Club Members' Marriage

TWO popular members of the Warrington Road Club, Allen Barker and Dorothy Smith, have married.

Team Race "25"

WHEN members of Barnsley Road Club "invaded" North Lancashire for the last open event of the season, their team secured the team race in the North Lancashire T.T.A. "25" with first, second and third placings.

Injured Clubman Rides Again

JACK IVORY, Comet C.C., winner of the Southgate Open "25" in 1941, in addition to many other similarly important events, is now cycling again. He crashed on some ice in February and smashed a thigh. He hopes to race again next year.

Northern Club News

Best in South Scotland

A. ADAMS, of the Upper Nithsdale C.C., has won the 1942 championship of the Ayrshire and Dumfriesshire C.A.

Third Win for Brinkins

J. BRINKINS, Glasgow Wheelers, won the West of Scotland T.T.A. open hill climb for the third successive year with a time of 2 min. 10⅘ secs.

Scots Official Injured

JAMES CARLILE, secretary of the National Clarion C.C., West of Scotland Union, has been injured at work, and is at present making progress towards recovery.

Aberdeen Rider on Clydeside

BOB EMSLIE, in pre-war days a keen time trials rider in the Aberdeen area, is now serving with the Army in the West of Scotland, and is in touch with local clubmen.

Hamilton Rider Marries

R. J. CAMPBELL, former time trials secretary of the Hamilton C.C., and now in the R.A.F., was married last month to Miss Jean Rankin, sister of the ex-secretary of the club, George Rankin.

Murray in West Africa

BOB MURRAY, former time trials secretary of the Glasgow Eastern C.C., is at present stationed with the R.A.F. in West Africa. He retains his interest in the game, and is looking forward to riding with the boys again when peace returns.

Barclay Wins Classic Climb

W. BARCLAY, Gilbertfield Wheelers, won the principal Scots hill climb, the Hamilton C.C. event, with a record time of 1 min. 49⅘ secs. This is ⅘ second better than the previous record held by J. Brinkins, Glasgow Wheelers, who finished third in the 1942 event.

Changes in Scotland

AT a meeting of the war-time executive of the Scottish Amateur C.A. it was decided to call a special general meeting of the association for January 17th. Proposals from the executive will be laid before the meeting, and will include resolutions aimed at running the Scots controlling body on pre-war lines. In particular, the war-time executive will quit office, and delegates from all active districts will act in their stead.

At the recent meeting the resignation of Alex. Urquhart, secretary of the association, was accepted, and Harry Price, former secretary, agreed to act until January 17th at least.

Around the Wheelworld

By ICARUS

Major H. R. Watling, J.P., Ill

I GREATLY regret to learn from my old friend, Major H. R. Watling, J.P., that he is indisposed and has been in a nursing home for some weeks. I hope that by the time this appears in print he will be fully recovered. Major Watling was once described in *Punch* as the " Motor Cycle King." He has done a vast amount of work behind the scenes for cyclists, and for the cycle trade. He worked under Sir Henry Maybury, the famous authority on roads, and knows as much about roads, and road problems, as any man in the country. That is why his name appeared, with Sir Henry Maybury's, on the first list of invitations to membership prepared by the " Roadfarers' Club." They are both members of this important new organisation.

The Roadfarers' Club

A GLANCE at the names of some of the members, as given last month, indicates that the Club is representative of all road users, and that membership is an honour conferred for past work in connection with roads and roadfarers. By the way, I have searched the dictionaries and cannot trace the word " roadfarer." There are seafarers and wayfarers, but no roadfarers. I attended their inaugural dinner, and their subsequent luncheon on November 21st. Apart from the splendid objects of the new Club, and the immense amount of good it will do in helping to find a solution to road problems, the meetings provide an opportunity of meeting interesting people, and particularly one's old friends. I have already had some very enjoyable times at the meetings. There is keenness behind the membership, and I concur in the views expressed that the Club is in for a long and useful life. An attempt to bring all sections of roadfarers together was made a few years ago by the Order of the Road. A luncheon was held, but whilst various speakers praised the object nothing came of this praiseworthy effort. Those responsible for directing the efforts of the Roadfarers' Club will pursue the objects with energy, enthusiasm, and drive.

The Club is not antagonistic to any section of roadfarers; it does not favour any particular section of roadfarers; it aims to bring about a better understanding between them. As in other walks of life, when people get together in a non-controversial atmosphere, it is found that the other fellow, formerly perhaps regarded as an enemy, is not so bad after all. The policy of the Club is broad, and broad-minded, and I am proud to belong to it. Under the guidance of its famous President, Lord Brabazon of Tara, a great deal will be heard of it. The Club has already received the blessing of important sections of the press, and has received excellent press notices in several London dailies, and in important sections of the provincial and technical press.

At the Inaugural Dinner of the Roadfarers' Club at the Clarendon Hotel on October 9th. In the top picture will be seen Lord Brabazon of Tara, President, with the Chairman, J. Dudley Daymond, on his right, and Lord Donegall and E. Coles-Webb on his left. In the bottom picture will be seen Lt.-Col. Charles Jarrott, O.B.E., and A. Percy Bradley. Many other famous people will be seen in the two centre pictures.

N.C.U. Service to Cyclists

THE many small ways in which the N.C.U. is of service to its members is well illustrated by the following details. On October 15th a club member from the south reported that he had been charged what he thought an exorbitant amount for the carriage on his tandem from a suburb in London to Luton. The latest details from the Railway Clearing House were inspected by the N.C.U. department responsible, and the member's surmise appeared to be correct. The railway were, therefore, approached in the matter by the N.C.U., with the result that on October 31st the railway authorities notified the N.C.U. that they regretted an overcharge of 3s. 10d. had been made, and this amount would be refunded immediately.

N.C.U. Club in Prisoners of War Camp

THE N.C.U. report the formation of a Cycling Club in a prisoners of war camp in Italy. The hon. secretary, Mr. A. Ramsden, in a letter to the secretary of the Union, explains the formtaion of this club, which has a membership of 30, and hopes to have a monthly magazine and weekly meetings to discuss cycling from all its angles. The secretary would be glad to hear from any cyclist at home, and the Union will be pleased to give the address to any cyclist who would like to write to their newest club. In his letter to the secretary of the Union, Mr. Ramsden says that N.C.U. rules have been adopted as far as is practicable, and that it is their intention to keep the club in being when the war ends. The Emergency Committee have accepted the club and have affiliated the members thereof to the Union, without charge, and are making special arrangements to have N.C.U. news and views sent to them regularly. The name of the club is the Acquila C.C.

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WAYSIDE THOUGHTS

By F. J. URRY

HOLBETON
A charming little South Devon village a few miles from Modbury.

As We Were

I HAVE purposely kept clear of all the controversy connected with the question of massed-start racing on the road; in the first place, because I know something of the official attitude towards the road sport as propounded by the late advisory council to the Minister of Transport; and secondly, because I recognise that the years, though they may bring experience, are also apt to harden the arteries and thereby limit the flow of new ideas. Actually, there remain to the cycling interests very few writers who have had experience of the pre-time-trial days, when massed-start racing on the road in the sense that the limit men in a handicap event started first and the remainder of the competitors in the order of their allowance in time from the scratch man, who, of course, was always the last to start, with the whole field in front of him to chase. It was a form of road racing I thoroughly enjoyed, since there was a direct rivalry about it that was fascinating. Frequently it led to a big bunch of riders approaching the finishing point in mass formation, and jockeying for position to obtain the best chance in the sprint for the tape. Yes, it was exciting and most exhilarating, and if I could live my youth again it is the method of road racing I would gladly follow, as opposed to the lonelier journeying of the time-trial system. When the elders of the sport in their wisdom switched over to the time-trial system, I frankly admit I was resentful; I was prepared to run the risk of police prosecution, and all the talk about jeopardising the pastime seemed to me nonsense. The fact that some of my road racing friends were caught and heavily fined for riding to the danger of the public seemed to me a joke; they were not good enough or cunning enough to evade the country police, whose persecutions, I thought, would have their little day and fade out. But the old lads of the game knew better; they realised that road racing in the form then practised was doomed, doomed because the general public were on the side of the police, and looked upon these "mad cyclists" as highly dangerous travellers.

[These notes were written before the N.C.U. had published the memorandum dealt with on p. 17.—Ed.]

Official Experience

HOW right the elders of that day were (led by the peculiar genius for the ruling of the game displayed by the late F. T. Bidlake) has since been proven by the flourishing condition of the road sport right up to the outbreak of the war, and even the remarkable attraction it still possesses for our hard-worked young people. Now let me digress a moment to tell you my experience as the cyclists' representative on the advisory council to the Minister of Transport, which body elected a special committee to consider the future Government attitude towards the cyclist as a user of the public highway. It happened that the very first item on the agenda of the first meeting of that special committee was "road racing," and could you have heard the denunciations of ten members on the heinous offence of using the King's Highway for sporting purposes, you would have been astonished. The fact was these eminent representatives of other road interests were extremely faulty in their knowledge of cycling, and finally admitted they had never seen a road race, and asked me to tell them the *modus operandi*, which I cheerfully did to the best of my ability. When they discovered that road racing in Britain was practised in the form of time trials, each competitor riding singly, that events were run in the early hours of the morning, and were usually over before most people were awake, their attitude completely changed, and they came to the conclusion it would be a shame to debar so fine a sport. I was asked if I could guarantee the system then in vogue, including the early morning starts, would remain always the governing rules of the game, and, naturally, I refused to commit myself beyond the expression of opinion that I saw no reason why they should alter, since such rules had been operating quite successfully, and with increasing interest among sporting cyclists, for the past 40 years. So time-trialling had the blessing of the advisory council; and, candidly, I thought that little job had been well accomplished.

As I See the Matter

THAT was the position of road racing in 1938 from what one might term the official M.O.T. point of view. Then massed-start racing, hating to be confined to enclosed places, wanted to get on the road; and, with the partial ban now on motor traffic, certain keen advocates of the grouped troop of racing lads took it there, and successfully ran a number of events this summer, with the help of the police, or, at least, without their interference. The N.C.U., as the governing body of the sport, immediately banned the participants, riders and abetters, creating a mild furore among the advocates of massed-start racing, the folk and clubs who would like to see massed-start racing, and the folk and clubs who are opposed to it on the ground that as soon as the car comes back on the road with petrol to burn, the road racing game in any form will be banned by Government action. Now the N.C.U. is prepared to listen to the massed-start enthusiasts, and has published the decision of its emergency committee that it has no bias on the subject, and, by so doing, apparently refuses to give its associated clubs a lead. So the sport of cycling on the road is at the crossways, and no man can say which route it will take. Personally, I feel convinced that if massed-start racing flourishes it will be for a limited period only, and when the Government publish the ukase against it time-trialling will be included. That, however, will not happen until massed-start racing has become a real risk to the performers, and a real nuisance to other road users, and, incidentally, earned for the pastime of cycling rather an unenviable reputation. That is my considered thought on the matter, based on what I know of the official mind (including the mentality of Scotland Yard men towards cyclists), and the knowledge of the low estimate in which road racing was held before the benediction of time-trialling was firmly established. For you cannot control massed-start racing on the road to conform with modern road regulations, however excellent your intentions may be; and that impossibility of control to conform with the law, may, and probably will if persisted in, be the ruin of cycling road competition.

Where is the Lead?

TAKING all these factors into the account it naturally follows I am all out for the preservation of the time-trial system and against mass-start racing on the road. As an old competitor in both forms of road sport, I would prefer the latter; but that liking for the personal competition—natural, I think, in all of us—will never be tolerated by the great body of road users. The next best thing is time-trialling, a compromise, it is true, but a compromise that has withstood criticism for over 40 years of practice without serious challenge, and has certainly been popular with the young generation. Now, are we going to risk the substance for the shadow, and jeopardise not only the road sport, but something perchance of the wheeling freedom we now enjoy as club and touring cyclists? The emergency committee of the N.C.U. says it has no bias in the matter, but is prepared to leave the decision in the hands of its affiliated clubs. A very dangerous attitude to take, I think, particularly when one recollects that half the officialdom of the wheel-world is now engaged on a sterner task than road-racing in any form. Candidly, I deplore the fact that my friends of the N.C.U. have not given us a lead, and the considered reasons for holding it. They should know—none better—the history of the road sport; its start, its damning—in which they played a major part—its uprising, through the incidence of the time-trial system, and now this recrudescence, three or four generations later, of the old order of road racing, which in those far off times nearly brought about the cessation of the road sport. They, I say, know these things, and if they are unable to use that knowledge to reach a decision and give us a lead, I am truly sorry. There is one more point which my experience on the advisory council fixed firmly in my mind. It is this: Reading the answers to long questionnaires and listening to evidence from other and newer road interests, I came to the conclusion that cycling is not loved, and any excuse to limit or even destroy it would be welcomed. That may sound harsh; I believe it to be true, certainly true at the time the answers were given and the evidence taken. Antagonism to cycling and cyclists, and especially to their road freedom, was vigorous, sometimes vicious. And so I am left wondering how much rope we may be given wherewith to hang ourselves. The police are friendly towards massed-start racing; why? Be it known that four years ago the Chief Constables' Association of Great Britain answered the question whether cyclists should be taxed in these words: "Yes, ten shillings each annually, to reduce the numbers on the road." That didn't, and still doesn't, seem to me a very friendly attitude. I am still wondering.

Always the Escape

BUT let us get into the fresh fields where "through the sharp hawthorn blows the keen wind," and forget the troubles that beset our little interests. That is the best thing about this cycling business, we can get away from things, and see all the quiet loveliness that decorates the dying year. Some people say it is a sad time to be abroad in the country, and from that dictum I heartily disagree. There are days when storm rouses in me a sense of unusual energy, in a kind of endeavour to match its temper, and there are others so quietly pensive that they make you think the whole countryside has its ear to the ground listening for "the horns of elfland faintly blowing." The man who says December is a sad month really means it is only sad in comparison to the month of the year he loves best; and how tired he would become of that condition if the elements were static. I like all the months to cycle through: I don't like snow or fog, because they are apt to stop my galloping; but the rain and the wind, the wisps of the sunshine that dampness seems to have bleached, and those glorious sunsets of storm—how wonderful they are, and the promise behind them seems to envisage the coming of a greater perfection. The nearest I get to a saint—or ever shall—is when the nimbus of a sunset is round my grey head, and I am following my faint, long shadow on the way home. Then I feel good; and perhaps I am better—in the spiritual sense—than usual.

Here and in U.S.A.

MAYBE we in this country are more fortunate than our American friends in the matter of bicycle supplies. Their equivalent of our Ministry of Supply have decreed that only 10,000 machines will be made per month, sufficient to keep one or two factories in part-production for the purpose of supplying the needs of the Services, and any left over to be distributed among the strictly rationed riders. I cannot conceive many of these machines will find their way to civilians, judged from the point of view of our own military needs; so the American, however keen he may be to make use of the bicycle for convenience or pleasure or both, will be up against a problem. Wisely, however, the American authorities are arranging for the supply of replacements and accessories on the scale of supplies in 1941, in order to keep the 11,000,000 machines in U.S.A. on the road. That is the paper arrangement, how it will work out in practice remains to be seen. The position of cycles and spares in this country is growing tighter, and the difficulties are (1) labour, and (2) raw material. The former is common to all industry; the latter is the problem of getting delivery, rather than the trouble with permits. The season of 1943 will be a very tight one for supplies, and wisdom suggests that each of us should make the best and most of what we possess by taking special care of it. I will not say there will not be any new machines for sale; but I do know there will be fewer, and not quite so good as the maker would like them. Increasingly it becomes plain that 1943 will be a year of cycling holidays; the people who own bicycles and can ride them in comfort are on top of the holiday world, free, with a freedom the cyclist always possessed, but which is now emphasised and underlined. Really, I have no patience with the individual who derides cycling and still says it is hard work because he is too lazy to get fit or adjust the machine to his comfort. I would deal with all such grousers by taking the machine from them, and giving it to someone who would appreciate its silent service.

Potted Memories

HAVING a fit of the "blues" recently I went for a spin with an old friend. What did we talk about on that evening ride? Mostly, I think, holidays, where we would go if we could, and where we had been over a 30-years' comradeship during which a season seldom went by unless we joined forces. I think there are few subjects more calculated to make a man keen to keep his riding fitness than the recollection of the good and, sometimes, difficult times we have experienced along the road, and it is one of the topics that should never be discouraged. Most people have the happy art of recalling their joyous experiences and adventures, if you do not involve them in the corrective of syntax during the yarning; and I suppose I have listened to my full share of these stories, and am still unwearied. That very night, over the simple function of supper, I looked at a series of neat little albums enshrining photographs of some of my earliest tours in the days when I was a budding picture-maker. Now I am afraid I rely on the good offices of other people, and give as an excuse the reason that I like to travel as lightly as possible; but how often it comes to me, that desire to capture a scene or the memory of a comradeship, and I thereby envy the lads and girls who so frequently level a lens at me. Yes, there is no doubt the cyclist-photographer captures a lot of permanent pleasures that go joyfully with him down the stream of life that we lazier mortals miss.

Ely Cathedral in the early morning.

Cyclorama

By H. W. ELEY

The "Cycling" Novel

CHATTING the other day to a little company of cyclists, the talk turned to books; and the question was asked as to whether a truly "cycling" novel had ever been written—with cycling as its main theme, and cyclists as its heroes and villains. Frankly, I did not know the answer, although I did recall one or two short stories where a cyclist or a cycle has been a prominent feature. There is, for instance, a famous Conan Doyle story in one of the Sherlock Holmes volumes, "The Solitary Cyclist," and well do I remember being thrilled by it in the days when "Sherlock" was one of my greatest heroes. I am not sure that I do not still regard him as the king of all the "tecs," despite the legion of sleuths which now hold the stage!

[*Apropos the above paragraph, a number of cycling novels were listed in "The Cyclist" when it was published as a weekly. We have also published H. G. Wells's first novel, "The Wheels of Chance," in serial form, and this was entirely a cycling novel dealing with real inns and real roads.*—ED.]

The Oldest Cyclist : Wooden Cycle-pedals : Slogans
Invention of the Pneumatic Tyre : Turn Left Signal

The Oldest Cyclist!

IN these days when we see such a revival of cycling it would be interesting to know who is the oldest active cyclist in the country! One sees many old men cycling happily along our roads; and some, indeed, must have seen eighty or more summers. What man or woman can claim the distinction of being England's oldest cyclist . . . still riding, of course? I hope that this query will bring forth many interesting claims.

Wooden Cycle-pedals

SO, in view of the rubber shortage (and it is an acute shortage), we now have the wooden cycle pedal. I have recently been talking to one or two friends in the trade, and I understand that there is a difference of opinion as to the best and most suitable wood for the job. Some favour beech, some claim that elm is better, while I saw one or two samples made from oak and chestnut. I wonder how wood will wear in comparison with rubber? Anyway, if we cannot get rubber, I suppose that wood is as good a substitute as any, although I should not be surprised to learn that the manufacturers have experimented with many substances.

Slogans

LOOKING through a weekly journal the other day, and paying special attention, as I always do, to the advertisements, I fell to thinking of slogans associated with the cycle business. There have been many famous phrases used by the makers of some of our best known machines. "Built like a gun"—the famous phrase for ever associated with the Royal Enfield bike; "King of the Road"—a famous slogan used for many years by Lucas for their lamp advertising; and, in the field of tyres, we have, of course, that famous Dunlop phrase "First in 1888, foremost ever since." It is always interesting to try to trace the origin of slogans, and there can be no doubt as to their power as a weapon in the advertising armoury.

Invention of the Pneumatic Tyre

I WAS much interested to listen, on October 5th, to a broadcast on the Empire short-wave service, on the invention of the pneumatic tyre. It was to have been delivered by Sir George Beharrell, the chairman of the Dunlop company, but owing to Sir George suffering from a cold, the talk was given by Mr. Charles Tennyson, Dunlop's secretary (and, incidentally, a grandson of the poet). I found it most fascinating to listen again to the story of John Boyd Dunlop's early experiments, and to recall the excitement of those early days when the pneumatic first demonstrated its enormous superiority over the solid type of tyre. The broadcast included all the authentic material about the famous race at the Queen's College sports at Belfast, in May, 1889—when the late William Hume won so easily, and truly laid the foundations of the pneumatic tyre success. Hume only passed from us a year or so ago, dying in his native Ulster.

Racing Cycle Tyres

SIR GEORGE mentioned, in the broadcast, the racing cycle tyres of just before the war—those astonishing tyres which weighed only 4½ ozs., yet had such phenomenal strength. A very diverting radio talk!

"Turn Left" Signal

OF course, you will have noticed that there is a new "turn left" signal for cyclists! We are now permitted to indicate that we propose to turn left by fully extending the left arm, instead of by the old movement of the right hand. I gather that the National Committee on Cycling has been in close touch with the Ministry of War Transport on the subject, and that a suitable revision of the Highway Code will be made in due course. Anything that makes for clearer signalling, and lessens road dangers is to be warmly welcomed.

"Formation Flying" on bicycles being demonstrated by Purley A.T.C. recently, before King Haakon of Norway and Crown Prince Olaf.

My Point of View

BY "WAYFARER"

Phosphorescent Belts

I OBSERVE that the New York traffic policemen now wear a 2in. white canvas belt, which, being phosphorescent, shows in the dark. Here is a brand-new idea for those genial folk with one idea and with errand-boy minds who are for ever trying to push their responsibilities on to others. Mark my words! after the war we shall be confronted with the motoring battle-cry of "Phosphorescent belts for cyclists!" If such things should ever become compulsory, and substitutes are allowed, I shall vote for a kipper.

Why the Quotation Marks?

A MIDLAND newspaper, which always made a point of speaking of the late head of the Salvation Army as "General" Booth, recently published a little paragraph about a woman of 71 who is a regular tricycle rider. She "tricycled," we are told, from 12 to 19 miles each day. Why the inverted commas? I happen to know the editor of the newspaper in question. On meeting him in the country I have "walked" and "talked" with him. I have also "telephoned" and "written" to him. I have "bicycled" past his house, and, had I a three-wheeler, I would have "tricycled" thither, too. After this totally unnecessary display of quotation marks, I feel that honour is satisfied!

This "Old Chap"

EVIDENCE continues to accumulate in support of the view that I am getting on in years. One Sunday afternoon towards the end of last summer I was enjoying a quiet after-dinner "doss" in a secluded Warwickshire lane when I heard a voice say (in reference to my bicycle, which was leaning against a gate a few yards away): "It's that old chap's. He was here last Sunday." Well, "old chap" or not, I continue to keep the wheels a-spinning, and I find health and happiness in ever greater measure as I trundle along the road.

Plying for Hire?

ON one of my tours last summer I encountered a curious thing. At the entrance to a military camp a number of boys had assembled with their bicycles. It was evidently the hour when leave commenced, and, as the troops emerged from camp they made use of the bicycles to take them to the nearest town, three miles away. The soldier sat in the saddle and pedalled, while the owner of the bicycle occupied a precarious and uncomfortable position on the top tube. It was all very enterprising—and illegal. Moreover, it was a case of cruelty to bicycles, for some of the troops were hefty lads. However, their transport problems were readily solved, and that's all that mattered.

Not My Squeak

RECENTLY, without warning, my bicycle developed a wheeziness which was not only unwelcome, but was more than even a notorious neglecter of bicycles deserved. I anathematised the man who had just "gone over" the machine, threatening him, in his absence, with all sorts of pains and penalties—and the wheeziness increased. It drew alongside and forged ahead. It turned out to be the private property of another cyclist who, it was obvious, was really neglectful of his steed. When he had passed beyond my ken, and silence had been restored, I found that my bicycle was, as usual, running like velvet.

Desirable Record

MY newspaper the other day had something to say about the rather extraordinary case of a Yorkshireman, just deceased, who, in all his 88 years, had spent only one night away from home. In the face of this record—or what looks like a record—the instance of a man I knew (he also died recently) who, in the course of a mere 63 years of life, had spent but one night under an alien roof, pales into insignificance, or thereabouts. Personally, I am not vastly interested in such records—not as a cyclist, anyway—and I much prefer the circumstances attending a great cycling friend of mine who, for year after year, spent practically every Saturday night away from home. He had "the week-end habit" in a much more advanced form than even I, and it was only on the rarest of occasions that he returned home from his Saturday afternoon jaunt and went to bed under his own roof, setting forth again for another wheel excursion on the following morning. He was faithful in his attendance at club runs on Saturdays. After tea, he would assemble his "victims," as they were sometimes called, and ride forth to do 20 or 30 miles to some chosen inn, where accommodation would have been reserved. A man without home ties, he delighted in these week-end jaunts, which were carried on throughout the year, irrespective of weather conditions. I, personally, prefer this record to that of the folk who boast that they never sleep away from their homes.

Slow, but Safe

ON a mouldy evening recently I cycled through suburbia in my home town (carrying a box of 80 lantern slides in my saddle-bag) in order to deliver a lecture to a literary society. I went by bicycle because I considered it the easiest method of travel, and because I make a point of keeping out of public transport as much as possible, on principle. The ride was not too pleasant, thanks to the weather conditions, the darkness, and the reduced lighting which war imposes on cyclists—and occasionally on motorists, some of whom still manage to dazzle us!—and the journey of just over eight miles occupied an hour. After the lecture I lingered with friends over supper until 11 p.m., when it seemed time to depart. "It'll be midnight before I reach home," I said. "You can't ride fast unless you can see where you're going." The rejoinder was: "Well, that's the gospel you always preach, isn't it? Ride within the range of your lighting!" I entirely agreed; that *is* the gospel, and, if it were faithfully observed, there would be fewer accidents in connection with night-travel. In normal times I carry a light which enables me to "go the pace," and I probably travel as fast in the dark as in the day. But when I can't see, I don't go. In fog, for instance, my speed ceases to be "speed," and becomes a mere crawl; and that, it seems to me, should be the established policy for all vehicles on the road. It would be a great advantage if every road-user, particularly the motoring fraternity, were to adopt this slow but safe plan of action. The power to travel fast confers no *right* to do so. Movement must always be governed by visibility. And that statement, when you come to think of it, is a commonplace—but a commonplace ignored far too often.

Those "Once" Cyclists

SOME of these smug and self-satisfied former cyclists, who like to expand on the rides they once did, get me right down. I was talking to such a one the other day: at least, he was talking to me. Harking back to the Hungry Forties, or thereabouts, he dwelt at length on the delight of a day's ride he once carried out, reciting the names of all the places he visited. And then off he went at a tangent and began to sing the praises of the cycle-paths on some of the big roads in the London area. They provided, he thought (in his profound ignorance), ideal cycling conditions. That instantly "got my goat." Without making the slightest attempt to temporise, I said (with all the frankness and brutality I could command): "That's how cycle-paths may appeal to a non-cyclist, but we cyclists don't want them. Moreover, we won't have them." Mr. Smug very nearly dropped dead on hearing an opinion which seemed to be at complete variance with common sense, but which is actually impregnated with that quality.

Notes of a Highwayman

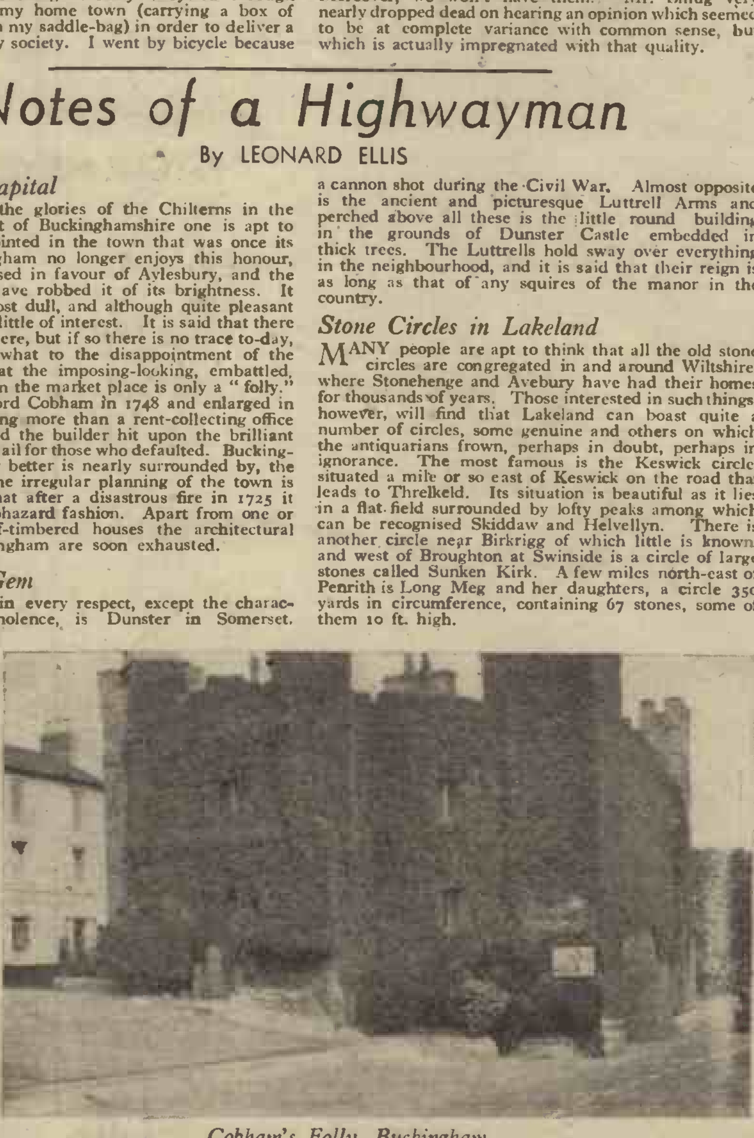
By LEONARD ELLIS

A Deposed Capital

HAVING seen the glories of the Chilterns in the southern part of Buckinghamshire one is apt to be a little disappointed in the town that was once its capital. Buckingham no longer enjoys this honour, having been deposed in favour of Aylesbury, and the shame seems to have robbed it of its brightness. It is very quiet, almost dull, and although quite pleasant there is singularly little of interest. It is said that there was once a castle here, but if so there is no trace to-day, and it adds somewhat to the disappointment of the tourist to find that the imposing-looking, embattled, ivy-clad building in the market place is only a "folly." It was built by Lord Cobham in 1748 and enlarged in 1839. It is nothing more than a rent-collecting office for the tenants, and the builder hit upon the brilliant idea of making it a jail for those who defaulted. Buckingham stands on, or better is nearly surrounded by, the river Ouse, and the irregular planning of the town is due to the fact that after a disastrous fire in 1725 it was rebuilt in haphazard fashion. Apart from one or two fine old half-timbered houses the architectural beauties of Buckingham are soon exhausted.

A Somerset Gem

VERY different in every respect, except the characteristic somnolence, is Dunster in Somerset. Here the same dreamy peace pervades the scene and there the similarity ends. There are few places in the whole of the country that can compare with Dunster for sheer loveliness and charm. A very wide street, bottlenecked at both ends, contains parallel rows of quaint old shops and cottages, all different and nearly all picturesque. The view from one end of the street, from the Nunnery, includes in addition the quaint yarn market, built by George Luttrell, and still showing the hole made by a cannon shot during the Civil War. Almost opposite is the ancient and picturesque Luttrell Arms and perched above all these is the little round building in the grounds of Dunster Castle embedded in thick trees. The Luttrells hold sway over everything in the neighbourhood, and it is said that their reign is as long as that of any squires of the manor in the country.



Cobham's Folly, Buckingham.

Stone Circles in Lakeland

MANY people are apt to think that all the old stone circles are congregated in and around Wiltshire, where Stonehenge and Avebury have had their homes for thousands of years. Those interested in such things, however, will find that Lakeland can boast quite a number of circles, some genuine and others on which the antiquarians frown, perhaps in doubt, perhaps in ignorance. The most famous is the Keswick circle, situated a mile or so east of Keswick on the road that leads to Threlkeld. Its situation is beautiful as it lies in a flat field surrounded by lofty peaks among which can be recognised Skiddaw and Helvellyn. There is another circle near Birkrigg of which little is known, and west of Broughton at Swinside is a circle of large stones called Sunken Kirk. A few miles north-east of Penrith is Long Meg and her daughters, a circle 350 yards in circumference, containing 67 stones, some of them 10 ft. high.

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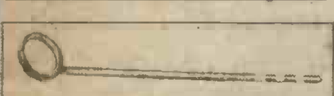

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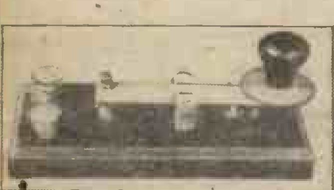

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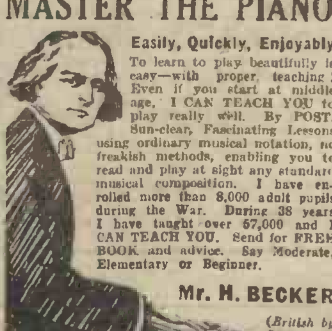

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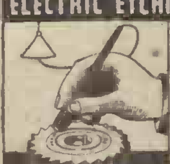

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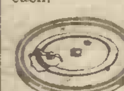

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