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Write for an explanatory leaflet, marking your envelope "Engineering Cadetships," to:

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The Government has announced the foundation of Engineering Cadetships leading to technical commissions in the Fighting Services. These Cadetships will be open to young men aged 16 to 19 who have left school with at least a School Certificate including a credit in mathematics, 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, Sardina 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. Engineer officers of professional grade are needed not only to ensure the maximum production of armaments, but they are needed also to ensure that the equipment of 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 Hanley, 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In addition, a considerable number of young engineers are being withdrawn from civilian work to be commissioned as technical officers in the Fighting Services.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, counselled that all these officers, 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 the Institutions of Mechanical Engineers.

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 necessary conditions and who make application will be considered for interview by a Selection Board on which all three Services will be represented. Those selected will be required of cadets 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 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 the training a cadet will be attached to 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 be periodically reviewed 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 technical colleges or other institutions. When the grant of new Engineering Cadetships ceases, a cadet who has not been commissioned 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 £150 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 in 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, Sardina 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."
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 it. Hydrogen could be liquefied long before the apparatus was available to secure at which hydrogen could be liquefied long before the apparatus was available to secure.

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

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 bit from savage 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 doctoress said that a speed of 60 m.p.h. would be fatal to the human heart. 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 a lack of imagination prevented this invention. I have been reminded 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.

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 bringing up a few odd conscripts to the army of 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 that we were identical creatures, and how could life exist without air to breathe?

In Mars there is water, oxygen, and warmth. Why should there not be ice? 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. 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
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 the region of high velocity, the rate of which would be sufficient (I am quoting entirely from the report of the Interplanetary Society) to make this trip.

Every detail has been calculated by the Interplanetary technical committee, 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 or 50,000 pounds, 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 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 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 on 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 meteorites in the vastness of space as one is in a London street from the chance fall of an aeroplane in the sky.

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 jetisoned 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 un-twinkling 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—soli 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 be unplayable. Golf might be played as usual, 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.
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 are among its most useful qualities, even under present circumstances, be regarded in a much more favourable light than

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 scientists 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? Instead of compactness, the gas turbine would make enormous capacities in terms of horsepower 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, it's translation into practical engineering has unfortunately proved so far a matter of great difficulty. For many years past a host of inventors, designers and engineers 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 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 engine. 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 turbines of improved construction, ensuring more economical performance and capable of being used henceforth as an independent source of energy. Consequently, they just
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 together with 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, so as to lower their temperature. The expenditure of energy required to ensure the injection of the cooling air is, however, rather considerable. Curiously enough, the ratio in which the cooling air is applied to the combustion gases is 1 to 20. This ratio is therefore not yet attained.

Turbine-driven Locomotive

The first large turbine of that type was the technical sensation of the National Exhibition at Zurich. 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 distanced themselves again by presenting at the Technical Exhibition at Zurich. The constructional principle of that locomotive clearly appears from the general erection diagram, Fig. 1. The gas turbine does not less than 5,800 h.p., whereas 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. With its thermal efficiency of 38 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 means saving 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 gear-box and motor which 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). In order 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 brilliant results. It is calculated that the thermal efficiency of the Brown-Boveri locomotive would be raised from 10 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. Briefly, that is to say by sacrificing a portion of the power developed by the turbine. That other method is now the subject of 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, in order to supply the motive power properly so-called. The point of departure of that new solution was the two-stroke cycle Diesel engine.

The scavenging air if 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. 4.

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 the 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.”

GEC 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 claims of Philplug are that it will carry its full load immediately (even when Section of thread plastic); screws inserted in made in Philplug Philplug may be withdrawn by the special and replaced as often as required without destroying the thread; it will develop a corrosion protection on walls, and it becomes an integral part of the masonry or other surrounding fabric the moment it hardens.

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—drill, wall-boring tools and jumppers, screw thread formers, etc.—available are adequate to meet all situations.

Two methods of anchoring the Philbolt in masonry.

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) Intake port. (g) Exhaust port. (h) Propelling gas pipe. (i) Gas turbine. (j) Generator. (k) Preliminary compressor.
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 400 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. Controls.
3. Pumps.
4. Relief valves.
5. Junction box.
6. Pipes, couplings, gauges, etc.

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, tungsten, 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 teardrop tanks which are often slotted 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 manoeuvring, internal baffle plates are usually fitted, sometimes incorporating a non-return valve. 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 filter neck. Aluminium tanks are of welded construction, and thin sheet 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 discoulour the bottom of the minar or be forced out between the joints. Prototype tanks are tested to approximately 10 lb. per sq. in., and subsequent production tanks to 15 lb. pressure.

Tanks fitted to military aircraft are usually coated with a layer of special rubber. This gives a certain amount of protection against damage or chaffing when the aircraft is in flight. 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 gauge (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 fuel 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 3 lb. 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 larger 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 armed hose which has largely superseded tungsten, 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 rub against any external or electrical equipment, to prevent the dangers of vapourisation and fire. The bend radii of the pipes must be as large as possible to prevent frictional heating. A metal braid usually runs along the length of the hose to provide electrical continuity between the tank and the engine. 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 filter 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 and a two-stage delivery pump is fitted for priming the carburettor together with a high-pressure pump when extra fuel is required to the carburettor from the delivery tank. 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. 1.—A simple petrol system as used on a single-engined aircraft.

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 leaks. 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 there must be two faults. Much development work is being done in the field of jet propulsion.
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 mechanic who is supposed to have flourished in the second century B.C., needed a steam-generator for his famous “alacippu,” 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 these 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 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” 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-raiser fulfilled their roles with some fair degree of efficiency is a point 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 “wagon-top” boiler, for instance, being merely an elongated edition of the Smeaton boiler.

At the end of the eighteenth century, three types of 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 low degree of efficiency and, naturally, its domed ends, together with its horizontal sides, (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, that a 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 flue and a more plentiful air-sweep could be obtained. It is doubtful who first entertained the possibility...
of this, at that time, radical alteration in boiler design. It is credited to the hands of Richard Trevithick, a pioneer American engineer, was first responsible for the idea, but this supposition has never been proved.

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 stimulated 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.

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. This was the industrial rise of the tubular type of steam-raiser, and in the steam-raising plant, 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.

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A Simple Epidiascope

Construction Details of an Inexpensive Instrument

By MORLEY HEDLEY

A n epidiascope is an optical instrument that enables a lantern to project the image of a flat surface on to a screen. Its manifold uses become apparent very useful for the same purpose in the construction purposes to the armed forces, they are also only are they used extensively for demonstra-

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 demonstrating 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 12 in., the effective diameter of the lens is 3 in., thus making the aperture f/4. The focal length of the lens should not be much less than 12 in. 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 con-

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 stoved enameled 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 120-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 3 in. 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 6 in. 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 exine and from the top of the objective, keeps it flat, prevents light from leaking and, being flexible, accommodates objects of varying thickness.

The finished epidiascope.
Making Book-ends : A Handy Book Rack

By "HANDYMAN"

Odd Jobs in House and Garden

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 3 in. thick and a central curved part 1 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 3 in. wide and 4 in. 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 3 in. wide, and the lower part 4 in. 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 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 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

focuses. Smooth the curved edge with a rasp and glasspaper.

Before fixing the parts together, make a circular recess in the bottom parts, about 3 in. deep and 2 in. 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 plane oak, 3 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 square with each other, cut a hole in 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 4 in. by 3 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 1/2 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...
which will hold at least a dozen small volumes.

Both the back and shelf of the rack should be cut from planed wood, ½in. thick, the back being 4½in. wide, and the shelf 4½in. 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, ½yd. after countersinking all the holes—on the outside face of each side-piece—screw the parts together with ½in. 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 and 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 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.

Shaped Ends
To make the shaped ends, prepare a piece of planed ½in. wood (oak for preference) 12½in. long and 6½in. 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 lines.

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 12½in., which will hold at least a dozen small volumes.

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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, mout four 6-in. guns, and can be used as transports. One of these under-water craft carried German experts from Japan to Singapore.

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. 8in. 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.

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 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.

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 engines, 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. There 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.

Flying Dreadnought

The Glenn L. Martin plant in Baltimore, which has 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 top. 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 suppressive 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 is flexible enough to be supported by 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.
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. He was ambitious, and he wanted to succeed where others had failed. His exploits as a pioneer of mechanical flight have all been recalled and examined, the results of this survey serving to establish his for all time as one of the principal fore-runners of human flight.

Stringfellow was born at Attercliffe, Sheffield, on December 6th, 1799, and, after a brief education, was apprenticed to one of the principal lace factories in Nottingham. He was ambitious, and he wanted to succeed where others had failed. His exploits as a pioneer of mechanical flight have all been recalled and examined, the results of this survey serving to establish his for all time as one of the principal fore-runners of human flight.

For years he had been interested in his spare time, taken up the subject of mechanical flight. Stringfellow was endowed by Nature with a greater fund of patience and determination than his erstwhile friend, William Henson. The first man-carrying aeroplane—the 'Wright Brother's biplane, constructed in 1904.

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

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 Leicester-shire 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 first 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.

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.

Launching Device

One of the most interesting features of Stringfellow's 1848 aeroplane was its launching device. This took the form of a guide wire, which was passed along a 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 22 ft., thereby allowing this distance for the aeroplane model to run along the guide-wire before being launched into free flight.

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 12 ft. high, had a length of about 70 ft. The launching wire was 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 finally it collided with a carefully placed stout canvas screen at the far end of the room and had to be more or less severely repaired.

In the long, low packing-room at Chard, John Stringfellow made numerous trials with his aeroplane model in the year 1848. Thenceforward his interest in mechanical flight became aroused and he remained ever true to his latest interest, but remained ever true to his latest interest.

For the Exhibition, which was held in the June of 1868, Stringfellow designed and constructed a flight 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 16 lb. Stringfellow's second exhibit was a "1 h.p. copper boiler, fire place, weight of about 40 lb., capable of sustaining a pressure of 500 lb. 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 13 lb. and its engine developed its power from the assembly line to a testing cell, a hydraulic constant speed coupling, linked to a generator, is attached to it. As the engine undergoes several hours of grueling test, the otherwise wasted power generated by it is recaptured and carried in a steady stream to the electrical control system.
Flashlight Photography

Various Points to be Observed for Obtaining Satisfactory Results

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

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.

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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 I must 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 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 wallpaper 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 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
carefully calculated for you in the tables enclosed with the powders. As an example, suppose you have a Scolochrome film in the camera, and your friend is sitting 8 ft. away; you have set the lens at F8, then the charge should be to 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.

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-flashlight photographs because of the hard, sparking effect 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.

There are occasions when it is necessary to do a little maneuvering 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.

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 cane, 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 40cm. by 40cm. 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 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.

Most oil systems use a pump almost supercharged 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.

Most oil systems are 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 scavange pump. Oil is returned to the engine immediately aft of the firescreen. The position of the oil tanks in any aircraft varies considerably, sometimes the tank is below the engine, sometimes on the port side, sometimes on the starboard side, and sometimes between the two engines. The crankcase is free of oil at all times. 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 tube 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, or it may be formed in construction to those used for motor-cars. The oil is allowed to flow through a space left between a series of honeycomb sections, in which is being circulated a cool stream of air, or through the space left between a series of honeycomb sections, in which the air is being drawn.

To prevent the oil overheating, and to stop the fuel supply system freezing, it is usual to fit a shutter at the rear end of the radiator, which may be altered in temperature. The oil, being cold, is viscous, and therefore the shutter or flap is closed.

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.

Types of 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 primary pumps. The most common type is the fine wire gauze filter which may be cleaned without closing any cocks.

The oil is circulated to the various engine fittings that require lubrication, and 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

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Most oil systems use a pump almost supercharged 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.

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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.

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The instruments fitted are, first, an oil pressure gauge, and secondly an oil temperature gauge. An oil content 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 200 lb. per sq. in., and the normal pressure varies from 60 to 75 lb. 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 or 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 Gnome Major IV.

Various methods to facilitate starting are often developed, and one of the most successful is as follows. 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 bearings worn, the tank empty, or the pressure gauge may be reading incorrectly. If an excessively high pressure is indicated, the following 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 scavange 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**

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. Acclimated 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, a soft No. 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 the lead exposed. (See Fig. 1.) A small piece of fine emery-cloth or glass-paper, or a small slate-pencil 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 neatly 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 used. This is usually found to be ordinary ruled notebook paper. The
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. Squares and parallel lines this difficulty 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 planer 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 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. Observation and precision 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.

Dimension Lines

We conclude our introduction to the subject of hand sketching 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 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, 4 in. long, should be four times the length, as near as we can judge, of a part 1 in. 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 aid perspective is well worth while. The sketch shows an elevation, end view and a plan. In British Standard Projection the plan is always under the elevation, and 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.

1. Sketch (each in one stroke) horizontal lines 1 in., 2 in., 3 in., and 4 in. long.
2. Sketch (each in one stroke) vertical lines 1 in., 2 in., 3 in., and 4 in. long.
3. Sketch a number of horizontal lines about 3 in. 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 1 in. high. (See Fig. 3.)
5. Practise the numerals 1 to 9 in block figures 1 in. 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 1 in. long and 1/16 in. wide.

When proficiency has been attained in the above exercises we can attempt work such as 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 2 in. from the point of intersection. Divide 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.)
After having passed under the sprayer and through the ventilator stack, the freshly painted parts move through the infra-red oven and fan dryer units. After the parts have passed through the drying units they are removed from both the turnable oven and started on the second phase of their journey.

A robotic 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 robotic painter reduces the time and labor that formerly required in the process of hand spraying. As the parts are released from the ventilator stack, they are retained from hand-operated spray pans. 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 main panel ventilator arrangement which keeps fine particles of paint from being drawn out through the stack into the air near the roof of the building. In the past, the fine paint particles that escaped into the air near the roof were considered a hazard.

The machine itself is designed to speed the drying process, and is 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.

**Endless-belt System**

The machine itself is in two banks, or cycles, moving in an endless belt system. Parts that have been cleaned and stripped are brought to the overhead conveyor system to a station near the robot paint sprayer. These parts are of various shapes and sizes; some of them started to go into Navy patrol bombers, others into the construction of bombers for the Army and the Royal Air Force. After the parts from the baskets are released on the infra-red oven, they are first carried under a series of overhead spray guns that will 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 dries rapidly, it is not necessary to use the lamps. The automatic sprayer, after having passed through the oven, is completely dry and is placed on the conveyor which carries the parts to the other conveyor which travels in the opposite direction. Thus, the second cycle of the operation, turned over and placed on the other conveyor which travels in the opposite direction, 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.

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<td>Paint spray and fans are tricked out through a ventilator stack, screened by a &quot;waterfall,&quot; which serves as a filter, removing the highly inflammable paint &quot;dust&quot; from the air. In the background is a set of the pressure tanks where the paint, constantly agitated, is kept. Tubing from the tank feeds the paint to the overhead sprays.</td>
<td>Robot Paint Sprayer</td>
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After having passed under the sprayer and through the oscillating table, the freshly painted parts move through the infra-red oven and fan dryer unit. After the parts have passed through the drying units they are removed from both tables, turned over, and start at the second phase of their journey.

The machine itself is designed to speed the drying process, and other changes in the drying work that formerly required considerable time in the oven have been modified. The paint is filtered by the waterfall, a filter, removing highly inflammable paint "dust," before it is thrown into the air. The waterfall, which serves as a filter, removes the highly inflammable paint "dust," before it is thrown into the air. The waterfall, with the water from the waterfall, the paint is filtered by the water falling from the waterfall, removing highly inflammable paint "dust." The water is collected in a large tank under the paint sacks, later to be skimmed off with ladles.

Small parts that have first been cleaned and washed are then placed on the endless belt system. The parts are moved through the infra-red oven and then through a second drying unit where the parts are turned over and placed on the second cycle of their journey. After having passed under the sprayer and through the oscillating table, the freshly painted parts are removed from both tables, turned over, and start at the second phase of their journey.

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**Sleeve Valve Engines**

**Their Operation and Advantages**

By S. J. GARRATT

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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 1903. 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-car 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.

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**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, against the cylinder wall. Figs. 3 and 4 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.

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**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.

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On the Bristol aero engines the sleeve is of steel about 1/8-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 area 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 push-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 350 deg. centigrade as 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 opening mechanism (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 the 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 will 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 even at last a sleeve does not come 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 which in its most simple form will not wear out one cannot prophesy, but it, as seems probable, will offer 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 his a long start over the sleeve valve engine.

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December, 1942
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 56,176 ft.

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. 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.

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

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 invention of the modern science of chemically synthesised plastic materials is said to have taken its first rise in or about the year 1857, when one Alexander Parkes, a servant practical experimenter in many branches of chemistry, first tried to make something useful out of “pyroxyline,” which is the name given to a synthetic resin of compara-
tively recent origin, it still remains a fact that many of the natural plastic materials have been em-
ployed by mankind for the game of billiards were made of solid ivory. At that time, the game of billiards was reaching the height of its popularity and the balls used for it were of a formless, wrinkled, horny mass.

Pyroxyline

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Making bakelite resin in the home laboratory by the interaction of formalin and carbonic 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 common cellulose 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 Besancon 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 Exhibition of 1889 he had exhibited his new silk-like products.

Artificial silk manufacture began in 1891 with the simple production of about one tenth of the synthetic thread. The so-called "pyroxylin silk" was produced merely by squirming pyroxylone 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 swirled their carbon disulphide solution of mercerised cotton through fine jets into a bath of warm acid. As a continuous 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.

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 ten 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 insubstantial, 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.

Phenolic 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 to such a degree 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 it is here named 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 WORLD OF MODELS

By: "MOTILUS"

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

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.

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

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.

A fine 5ft. 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 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 every single atom of your stock in batteries runs equally to all other forms. Competent authority tells us that 85 per cent of the total output of a factory is used for car batteries.

How does a battery do all this so regularly? How does a chemical action for its life, quite certainly—as every chemist knows—it is destructive. Destruction starts as soon as a chemical action in motion. But there is no electricity stored in that battery at all.

Let us centre our attention on the car battery. That starts my car, raises my traffic indicators, and for the purposes of our investigation concentrates on one small detail. How does a battery do all this so regularly?

Chemical Action
How does a battery do all this so regularly and then suddenly go "phantom'? 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 do. If you ever have any doubts about that, imagine: that starts my car, raises my traffic indicators, and for the purposes of our investigation concentrates on the car battery.

Destruction starts as soon as a chemical action in motion. But there is no electricity stored in that battery at all. It is the very life of my car, and what of the other details, those which give life to your radio, make your bells ring or give you emergency lighting? 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 every single atom of your stock in batteries runs equally to all other forms.

Evaporation
Finally there is the question of evaporation. The acid in your battery to which we have already referred and which is known, if you had only a few sips of drink every hour or so you would in time be very thirsty indeed, and thus "thirsty" becomes your battery on short runs. It simply must have that occasional long drink of "juice" and we 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 battery is really on charge and the effect obtained is very like a long drink to a thirsty man.

Overdischarging has a similar effect. But this is caused by excessive 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 suppose 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.

The following notes are taken from the notes already referred to 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 too 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 195)
I' using a plastic material, of aluminium. I have improved upon this by the use of fibrous textile material, metallic gauze, 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 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 improvers of my art may well be a word—"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. With 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 beaded 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 head 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 fastened together very simply 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.

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.
Ultra-violet Apparatus

I HAVE made a small sun-ray lamp to be used with battery carbons from 41-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 not, how much? I could not 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 dry cells for this purpose is not likely to lead to useful results, the carbons being unsuitable 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 radiation, but in the case of dry cells 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 carbondurum 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 carbondurum stone will be necessary, and after 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).
Smoke Candle

I AM trying to make the smoke candle described in a recent reply to a query in "Practical Mechanics," but I do not know whether to build it up round a central wick or to use a 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 wick 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 easily 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 produce these or the necessary ingredients without some considerable trouble:

1. Iron powder ... 83 parts
   Carbon powder ... 37 parts
   Potassium chlorate ... 30 parts
   Barium nitrate ... 10 parts
   On the addition of a small quantity of water, the temperature of this mixture rapidly rises to above 105 deg. C., which is higher than the boiling-point of water.

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

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 parts
   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 parts
   Oxalic acid ... 3 parts
   Potassium chlorate ... 1 part
   On the addition of water to the above, heat is generated.

Rewinding Universal Motor

WILL 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 storage 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 133 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 3/4 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 No. 22 S.W.G. enamelled-copper covered, the coil span being from slot 1 to slot 6 and the coils grouped two per slot for connection to the 26-pole commutator.

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 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 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 for testing your battery. If all the cells of a battery are dark inside and appearances are very deceptive.—The Edison Swan Electric Co., Ltd.
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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 committee states that it is of great importance that interest be shown in the matter by clu
PARAGRAMS

British Clubman in Egyptian Hospital

Among those who travelled to Italy just prior to the war to represent this country in the World's Road Clubman in Egyptian Hospital

BRENTWOOD C.C.'s Champion

Club President Loses Cycle

W.A.C.C. Members in Forces

Road Champion Killed

Road Champion Killed

Note: 25-Miler Marriages

Fast "25"

Southgate Borough Council have launched a "walk on the left of the pavement in the black-out" campaign, but with limited success.

Brentwood C.C.'s Champion

Club Medal for Fastest "25"

"Walk on the Left"

Best in South Scotland

Third Win for Brinkins

More for Trust

Thanks to Cyclists

Injured Clubman Rides Again

Murray in West Africa

BARCLAY, W. BARCLAY, of the Ministry of Transport, spoke of road safety at a meeting of the Highland Road Improvements Committee at Inverness. He said that cycling was a healthy and enjoyable sport.

Ceylon's Tyre Problem

Highland Road Improvements

Tricycle Record Beaten

Team Race "25"

Injured Clubman Rides Again

Ceylon, the largest present supplier of rubber to the British Empire, has been hit by a shortage of bicycle tyres. Over 600 cyclists have applied for the 350 tyres available. Applications are being carefully considered, so that cyclists on important work will get preference.

Rally in 1943

Here, at a meeting of the Edinburgh and District Association of Civil Engineers, Mr. W. H. Budgett, of the Ministry of Transport, spoke of road improvement in Scotland in recent years. He mentioned the Glasgow-Edinburgh road, the Perth Road, and the Scotland Road, as outstanding examples of the roadmakers' skill.

Cycling in Scotland

The Scottish Association of Civil Engineers held a conference in Edinburgh, where a number of papers were presented. The keynote of the meeting was the importance of cycling as a means of transport, particularly in rural areas.

Cycling in England

The British Cycling Federation has launched a "walk on the left" campaign in London, following a number of accidents in which cyclists were knocked down by motorists.

Cycling in North America

The American Cycling Association has announced a series of road races in the eastern United States, including the New York City Marathon and the Boston Classic.

Cycling in South America

The Brazilian Cycling Federation has held a number of important races, including the Rio de Janeiro Classic and the Sao Paulo Hill Climb.

Cycling in India

The Indian Cycling Federation has announced a series of road races for the coming season, including the Calcutta-Varanasi Race and the Bombay-Bangalore Race.

Cycling in Africa

The African Cycling Federation has announced a number of races, including the Cairo-Casablanca Race and the Tunis-Marrakech Race.

Cycling in Asia

The Asian Cycling Federation has announced a series of races, including the Tokyo-Singapore Race and the Beijing-Shanghai Race.

Cycling in Australia

The Australian Cycling Federation has announced a number of races, including the Sydney-Melbourne Race and the Brisbane-Perth Race.

Cycling in Oceania

The Oceania Cycling Federation has announced a number of races, including the Auckland-Wellington Race and the Sydney-Tasmania Race.

Cycling in the Middle East

The Middle Eastern Cycling Federation has announced a number of races, including the Cairo-Amman Race and the Baghdad-Bahrain Race.

Cycling in the Far East

The Far Eastern Cycling Federation has announced a number of races, including the Shanghai-Hong Kong Race and the Singapore-Jakarta Race.

Cycling in the South Pacific

The South Pacific Cycling Federation has announced a number of races, including the Auckland-Noumea Race and the Wellington-Suva Race.

Cycling in the North Pacific

The North Pacific Cycling Federation has announced a number of races, including the Tokyo-Sapporo Race and the Seattle-Vancouver Race.

Cycling in the Arctic

The Arctic Cycling Federation has announced a number of races, including the Tromsoe-Longyearbyen Race and the Barrow-Iqaluit Race.

Cycling in the Antarctic

The Antarctic Cycling Federation has announced a number of races, including the McMurdo-Enterprise Race and the Scott Base-Bellingshausen Race.

Cycling in the South Pole

The South Pole Cycling Federation has announced a number of races, including the South Pole-Transantarctic Race and the South Pole-Scott Base Race.
Around the Wheelworld

By ICARUS

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.

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.

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

At the Inaugural Dinner of the Roadfarers' Club at the Clarendon Hotel on October 31st. In the top picture will be seen Lord Brabazon of Tara, President, with the Chairman, J. Dudley Daymond, on his right, and Lord Dungail and E. Coles-Webb on his left. In the bottom picture will be seen Lt.-Col. Charles Tarrott, O.B.E., and A. Percy Bradley. Many other famous people will be seen in the two centre pictures.

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.
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 expressed 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 was on the road in the same way that the limit men in a handicap event showed their ability to come over the finish line first, or last, or anywhere in between. Some of the events were rim in the modus operandi, which I cheerfully did to the best of my ability. As the cyclists' representative on the Advisory Council to the Minister of Transport, I was able to present to the Advisory Council and indeed to the Minister himself, a growing opinion, 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 sport" as entirely a game for the young generation. And yet it was exciting and most exhilarating, and if I could live again, I would like to travel as lightly as possible; I would like to absorb as much as possible of the substance for the shadow, and jeopardise not only the young generation. As an old competitor in both forms of road sport, I admit I was resentful; but I also realised that road racing, in the form then practised, had no bias in the matter, but is prepared to leave the decision of its future course to the performers, and to the knowledge of the law. That, however, will not happen until massed-start racing has become a real risk to the performers, and a danger to the public, and when the law is considered necessary to keep the performers in order. It was a form of time-trialling, with the aid of the police, or, at least, without their interference. Then massed-start racing was confined to enclosed circuits and was not to get on the road, and, with the partial ban now on most cycling races, certain keen admirers of massed-start racing lads took it on themselves to create a mild form of massed-start, the full and whole clubs and individuals who were responsible for it to the extent that as the cyclist came home after a particularly perilous period to the suggestion that this "mad sport" was a burn, the road race game in any form will be banned by Government action. It is prepared to ballot on the suggestion that the law was at the crossways, and no man can say which road it will take. Personally, I feel convinced that massed-start racing will be for the benefit of some, and for the benefit of road racing in general. It is impossible to control it with the law, and, probably will persist in being, the ruin of cycling road competition.

Where is the Lead?

TAKING all these factors into the account it naturally follows that I am all 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 admit I was resentful; but I also realised that road racing, in the form then practised, was doomed, but which is now emphasised and underlined.

The season was held before the benediction of time-trialling was pronounced, and the knowledge of the law to 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 persist in being, the ruin of cycling road competition.

Offical Experience

High lights of the earlier days were led by the peculiar genius for the ruling of the game displayed by the late F. T. Bottashe. He would have been the flowering condition of the road sport right up to the day of his death, had it not been for his death. He died before his time, but his memory will live on in the minds of those who knew him, and his influence will be felt in the cycling world for many years to come.

Of course, the lads and girls who so frequently level a lens at me, have their share of the credit, but I would like to thank all who have ever taken special care to make photographs that are as good as possible.

In conclusion, I would like to express my thanks to the N.C.U. and the N.C.F. for the opportunity of giving the cyclists' point of view in the past and present, and for the future, and for their encouragement and support in bringing the matter before the public.

The position of the cyclists is that of the fighters for the freedom of the road, and it is in this light that they should be judged. While it is true that the cyclists have not always been able to present their case clearly and calmly, it is also true that they have not always been able to present it at all. The cyclists have been handicapped by the fact that their sport is a young one, and that it is still in the formative stages. But there is no reason why it should not develop, and it is hoped that with the encouragement of the authorities, it will.

Potted Memories

HAVING a bit of the "blues" recently I went for a ride to clear my head and thought about what I had been saying about cycling and racing lads. The whole countryside has its ear to the ground, and the cyclist is accustomed to the sound of his own wheels. He is a bit of a saint or ever shall be. It is a very difficult time, and it is hard to keep the mind on the road. As the cyclists' representative on the Advisory Council to the Minister of Transport, I was able to present to the Advisory Council and indeed to the Minister himself, a growing opinion, that road racing, in the form then practised, had no bias in the matter, but is prepared to leave the decision of its future course to the performers, and to the knowledge of the law. That, however, will not happen until massed-start racing has become a real risk to the performers, and a danger to the public, and when the law is considered necessary to keep the performers in order. It was a form of time-trialling, with the aid of the police, or, at least, without their interference. Then massed-start racing was confined to enclosed circuits and was not to get on the road, and, with the partial ban now on most cycling races, certain keen admirers of massed-start racing lads took it on themselves to create a mild form of massed-start, the full and whole clubs and individuals who were responsible for it to the extent that as the cyclist came home after a particularly perilous period to the suggestion that this "mad sport" was a burn, the road race game in any form will be banned by Government action. It is prepared to ballot on the suggestion that the law was at the crossways, and no man can say which road it will take. Personally, I feel convinced that massed-start racing will be for the benefit of some, and for the benefit of road racing in general. It is impossible to control it with the law, and, probably will persist in being, the ruin of cycling road competition.

WAYS OF DEFEATING ROAD RACING

By F. JURRY

December, 1942

The cyclitst ofBolton

Potted Memories

HAVING a bit of the "blues" recently I went for a ride to clear my head and thought about what I had been saying about cycling and racing lads. The whole countryside has its ear to the ground, and the cyclist is accustomed to the sound of his own wheels. He is a bit of a saint or ever shall be. It is a very difficult time, and it is hard to keep the mind on the road. As the cyclists' representative on the Advisory Council to the Minister of Transport, I was able to present to the Advisory Council and indeed to the Minister himself, a growing opinion, that road racing, in the form then practised, had no bias in the matter, but is prepared to leave the decision of its future course to the performers, and to the knowledge of the law. That, however, will not happen until massed-start racing has become a real risk to the performers, and a danger to the public, and when the law is considered necessary to keep the performers in order. It was a form of time-trialling, with the aid of the police, or, at least, without their interference. Then massed-start racing was confined to enclosed circuits and was not to get on the road, and, with the partial ban now on most cycling races, certain keen admirers of massed-start racing lads took it on themselves to create a mild form of massed-start, the full and whole clubs and individuals who were responsible for it to the extent that as the cyclist came home after a particularly perilous period to the suggestion that this "mad sport" was a burn, the road race game in any form will be banned by Government action. It is prepared to ballot on the suggestion that the law was at the crossways, and no man can say which road it will take. Personally, I feel convinced that massed-start racing will be for the benefit of some, and for the benefit of road racing in general. It is impossible to control it with the law, and, probably will persist in being, the ruin of cycling road competition.

Be it known that four years ago the Chief Cyclists' Association of Great Britain answered the question whether cyclists should be taxed in these words: "It is not a question of the amount of taxation, it is whether you should be taxed at all. If you must be, let it be on the road." That didn't harm, and still doesn't, seem to introduce any new 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 for the moment forget the O.T. point of view. Then massed-start racing is to be confined to enclosed circuits and was not to get on the road, and, with the partial ban now on most cycling races, certain keen admirers of massed-start racing lads took it on themselves to create a mild form of massed-start, the full and whole clubs and individuals who were responsible for it to the extent that as the cyclist came home after a particularly perilous period to the suggestion that this "mad sport" was a burn, the road race game in any form will be banned by Government action. It is prepared to ballot on the suggestion that the law was at the crossways, and no man can say which road it will take. Personally, I feel convinced that massed-start racing will be for the benefit of some, and for the benefit of road racing in general. It is impossible to control it with the law, and, probably will persist in being, the ruin of cycling road competition.

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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, 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 Gorge 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.

The Oldest Cyclist: Wooden Cycle-pedals: Slogans

The Oldest Cyclist! Wooden Cycle-pedals: Slogans

The Oldest Cyclist

Slogans

“Turn Left” Signal

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 “tees,” despite the legion of sleuths which now hold the stage!

[Apologies for 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.]

“Formation Flying” on bicycles being demonstrated by Parley A.T.C. recently, before King Haakon of Norway and Crown Prince Olaf.
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Phosphorescent Belts

I OBSERVE that the New York traffic policemen now wear a tin white canvas belt, which, being phosphorescent, shows in the dark. Here is a brand-new idea for those genial folk with wild ideas and with errand-boy minds who are for ever trying to push their responsibilities on to others. Mark my words! after the confusion with the motorized battle-cry of "Phosphorescent belts for cyclists! I read of this the other day and it occurred to me to think about the folk who boast that they never sleep away from their posters.

Slow, but Safe

ON a moonlit evening recently I cycled through a suburb in my home town (carrying a box of 60 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 you can't manage to dazzle us! and the journey of just over eight miles occupied an hour. I returned home from the lecture at midnight (in a flat field surrounded by lofty peaks among which can be recognised Skiddaw and Helvellyn).

A Deposed Capital

HAVING seen the glories of the Chilterns in the middle of July and Cobham's Folly, Buckingham. I was apt to see a little disposed in the town that was once its capital. Buckingham no longer enjoys this honour, having been depopulated with the growth of its suburbs, and the shame seems to have robbed it of its brightness. It is very quiet, almost somnolent, and although quite pleasant there is something lost in its aspect. It is said that there is a ghost here, but if there is no trace to-day, and it adds somewhat to the disappointment of the tourist to find that the imposing-looking, embattled, ivy-cloaked building in the market place is only a "polly." It was built by Lord Cobham in 1748 and enlarged in 1798. 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 1755 it was rebuilt in favours of 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 character of the scenery, is Dunster in Somerset. Here the same dreamy peace pervades the scene and there the similarity ends. There are no places in the whole of the country that can be compared with Dunster for its loveliness and charm. It is a very wide street, bottlenecked at both ends, containing parallel rows of quaint old shops and cottages, all different and nearly all picturesque. The view from one end of the street, from the New Inn, to the other, includes in addition to quaint old houses the Dunster Luttrell Arms and Dunster Castle, the latter built on a mouldy evening recently. 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 you can't manage to dazzle us! and the journey of just over eight miles occupied an hour. I returned home from the lecture at midnight (in a flat field surrounded by lofty peaks among which can be recognised Skiddaw and Helvellyn). The Luttrell told away over everything in the neighbourhood, and it is said that their reign is as long as that of 250 years of the monarch in the country.

Stone Circles in Lakeland

MANY people are apt to think that all the old stone circles in Lakeland are in the grounds of Dunster Castle. It is true;然而, 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 two west of Keswick in the road that leads to Threlkeld. Its situation is beautiful as it lies almost in the middle of a field, and is entirely surrounded by fields. A cannon shot during the Civil War. Almost opposite is the ancient and picturesque Luttrell Arms and Dunster Castle, the latter was first built in the grounds of Dunster Castle. The Luttrell told away over everything in the neighbourhood, and it is said that their reign is as long as that of 250 years of the monarch in the country.

Cobhan's Folly, Buckingham.
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