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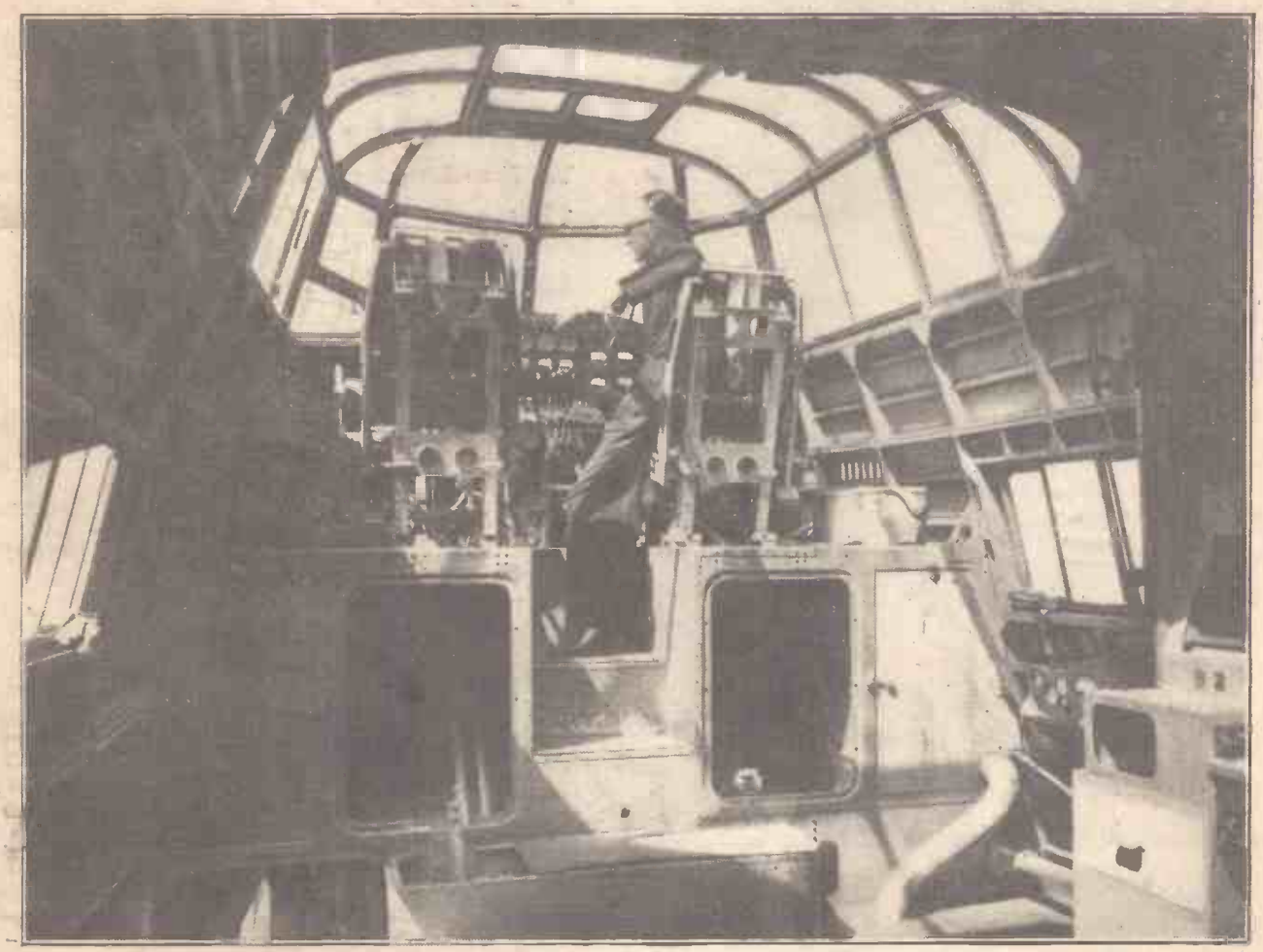
EDITOR : F. J. CAMM

SEPTEMBER 1947



THE SPACIOUS COCKPIT OF THE NEW SHETLAND FLYING BOAT (See page 373)

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XIV SEPTEMBER, 1947 No. 167

FAIR COMMENT — BY THE EDITOR

Technical Qualifications

I AGREE with the Advisory Bureau for Research in their statement that the mere acquisition of degrees or other qualifications is most deplorable; no matter how grandiose these qualifications may be, without any real practical efficiency to back them up the engineer or technician is doomed to failure.

For a young ambitious person the quickest way of gaining pre-eminence is to become a recognised specialist in a particular subject. Once experience has been acquired recognition can be achieved by publishing articles in the technical press and delivering papers before technical societies or institutions dealing with some aspect of specialisation.

Some distinction is necessary between the designer, the man who superintends the construction of a design and the man who greases the bearings. The latter is often prompted to call himself an engineer, whereas, of course, he is a mechanic. It is true that the ability of any person may be judged from the results he achieves, but when a comparison between individuals must be made then their relative merits can only be fairly assessed by comparing the extent and the success of their education, their experience and ability and their personal attributes.

Engineering and technical qualifications are a guide to the fundamental stability of an engineer, for they indicate the extent and success of a person's education, as well as its variety. By co-operation between the Board of Education and the various technical institutions National Certificates are awarded to evening school students at approved schools throughout England, Scotland and Wales. The certificates are awarded in two grades, Ordinary and Higher. The Ordinary National Certificate is awarded as the result of study in three grades. The student must pass a qualifying examination at the conclusion of each year's study before he is permitted to graduate to the next grade. Successes must be gained in at least five subjects at the qualifying examination, and among these subjects are pure and applied mathematics, machine drawing and design, electricity and engineering science.

The standard during the first year is approximately equal to that required for matriculation. At the end of the third year, with the granting of the Ordinary National Certificate, a standard is reached almost equal to that required in the intermediate examination for a Bachelor's degree.

The Higher National Certificate is awarded after two years' advanced study following receipt of the Ordinary National Certificate, and the standard which is attained at the conclusion of this course is higher than that required for the first part of the Bachelor's degree.

The award of these certificates is generally accepted by many of the professional institutions for exemption from some subjects in the Associate Membership examination. It is usual for exemption to be granted from examination in those subjects in which the applicant passed to qualify for a National Certificate.

It is important to note that all the holders of these certificates gained their education, which is of quite a high standard, by studying in their spare time after working in a factory or other engineering establishment during the day.

Many firms encourage their young apprentices to undertake these studies and offer them benefits regarding pay and promotion, while some grant time off to compensate for the hours spent at evening classes. It should also be noted that under normal circumstances these classes are only held during the winter months, so that the summer is left free for the student.

Study at a university is generally a full-time occupation. The courses generally last three years, or four years for an honours degree at some universities, each session being divided up by long vacation. Some students use those long vacations to acquire practical experience at some works.

Bachelors' degrees are also awarded by the University of London to external students as well as to the internal students attending the colleges. External students must register as students of certain approved schools or colleges and carry out their studies and laboratory work in exactly the same way as do the internal students.

A qualifying examination must be passed to enter any university. Before taking the examination for a Bachelor's degree (the finals examination) a student must pass the matriculation examination, after which he is qualified to enter the intermediate examination, after which he can take the finals.

I give these facts because I am so often consulted on the subject of careers in engineering. In every case I advise one of the above examinations. The prospective engineer would do well to get into direct touch with the Advisory Bureau for Research, at 70, Victoria Street, London, S.W.1, for their booklet on careers.

Prize for Inventions

The Thomas Gray Memorial Trust, which is administered by the Council of the Royal Society of Arts, makes awards annually for the advancement of the science of navigation and the scientific and educational interests of the British Mercantile Marines.

They offer a prize of £50 to any person of British nationality who may bring to their notice an invention, publication, diagram, etc., which in the opinion of the judges is considered to be an advancement in the Science or Practice of Navigation, proposed or invented by himself in the period January 1st, 1942, to December, 1947. Full particulars should be furnished with each entry and also a brief summary covering the essential points of an invention. Where practicable, a model or some other appropriate exhibit should be supplied with the entry. Entries which have already been considered by the judges in the years 1942-46 are not eligible for further consideration unless they have since been materially modified.

The Council reserve the right of withholding the prize or awarding a smaller prize if, in the opinion of the judges, no suitable invention is submitted, and in the event of more than one such improvement being approved the Council reserve the right of dividing the amount into two or more prizes at their discretion.

The Council do not claim any rights in respect of any invention for which a prize may be awarded.

Competitors must forward their proofs of claim, between *October 1st and December 31st*, 1947, to the Secretary, Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2.

In 1946 the Council offered a similar prize. Eleven entries were submitted. The judges were unable to recommend an award; but they decided to commend Mr. Gordon Murray for his resourcefulness and ingenuity in his improvisation of a condenser system designed to supply fresh water in a ship's lifeboat after the vessel had been torpedoed.

A second offer of an Award of £50 for Deed of Professional Merit has been made. This is in recognition of the remarkable skill which is so constantly displayed at sea. It is made to any member of the British Merchant Navy for any deed brought to their notice which, in the opinion of the judges to be appointed by the Council, is of outstanding professional merit. The period to be covered by the offer will be the year ending September 30th, 1947, and the judges will proceed to consider their decision on or after January 1st, 1948. Deeds of the type to be considered in connection with this offer may be brought to the notice of the Council by any person not later than December 31st, 1947. They will not, however, be considered by the judges unless they have been endorsed by a recognised authority or responsible person.

The Swiss Railway Centenary

An Account of the First Post-war Congress Held in Switzerland

By THE MARQUIS OF DONEGALL

SWITZERLAND is a happy hunting ground throughout this summer for those interested in railways and model railways. The International Railway Congress was held at Lucerne from the 23rd to the 28th June. It was presumably decided to hold this first post-war congress in Switzerland to link up with the extensive celebrations organised by the Swiss Federal Railways to commemorate the fact that it is just a hundred years ago that the first train to run in this country went from Zurich to Baden.

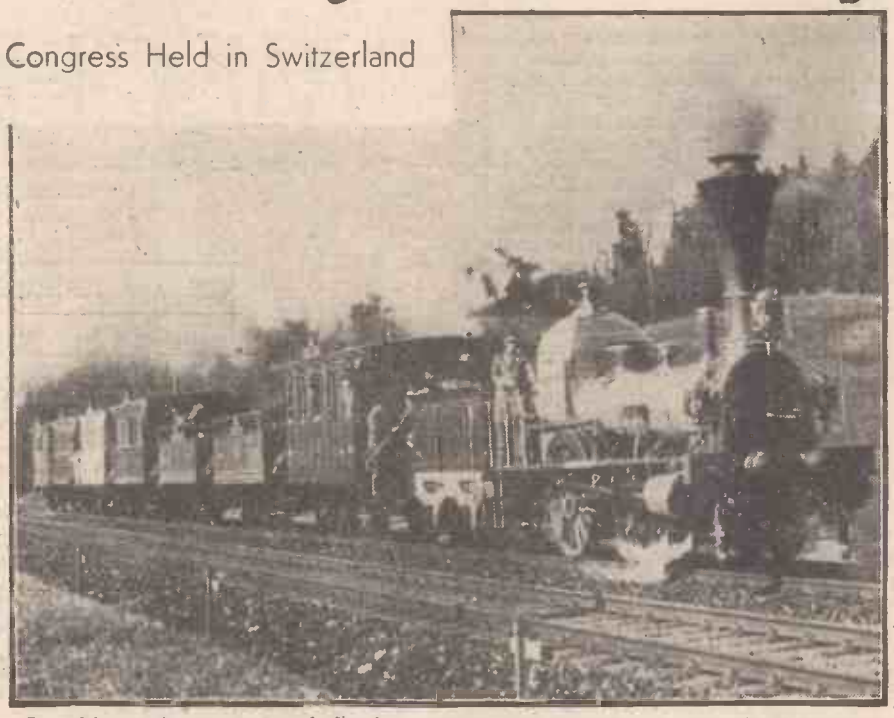
An Historic Train

Anyway, it was called somewhat picturesquely "The train with little Spanish cakes," and was reconstructed to take tourists on trips all over Switzerland during the summer. Tradition says that it got its name because it went so fast (for those days) that the inhabitants of Zurich were able to enjoy, piping hot, the cakes for which Baden is famous. Why "Spanish"? Ask me another.

The locomotive, which is called "Limmat," was reconstructed in the Winterhour factory with the help of parts taken from another ancient engine called "Speiser," which was shown in the Exhibition of 1939. The carriages were constructed in the workshops of the Federal Railways at Zurich from the original plan which had fortunately survived.

This 1847 train consisted of the locomotive, a first-class carriage, a second-class carriage, four third-class, of which two were open, and a baggage wagon. The latter and one of the third-class carriages are authentic, and were made in the middle of the last century.

The train seats 140 people and another 20 standing. The locomotive develops 170 h.p., and can do about 24 miles per hour. It is not necessary here to help prospective travellers on this unusual train as to the dates and itinaries, the last of which takes place on October 22. Details are displayed in every Swiss station, and in most of the larger ones there is an information bureau devoted to the sundry activities in connection with the centenary.



To celebrate the centenary of the first railway journey made in Switzerland, a replica of the original train was constructed in the workshops of the Swiss Federal Railways. The illustration shows the historic train on a trial trip.

Model Railway Exhibitions

Apart from these trips there are model railway exhibitions taking place all over Switzerland throughout the summer. It so happened that the one I visited was at Lausanne.

These exhibitions are designed to show the progress made throughout the past century.

For this purpose four whole trains have been professionally constructed as typical of the years 1858, 1882, 1910 and 1946. For the most part exhibitors seem to have stuck to a scale of 1-in-10, but there are also some excellent models in other scales of mountain railways, funiculars, electric installations and mountain tunnelling. There are also miniature demonstrations of the signalling and safety system in use on the Federal Railways, and a model of the hydro-electric power station of Rupperswil.

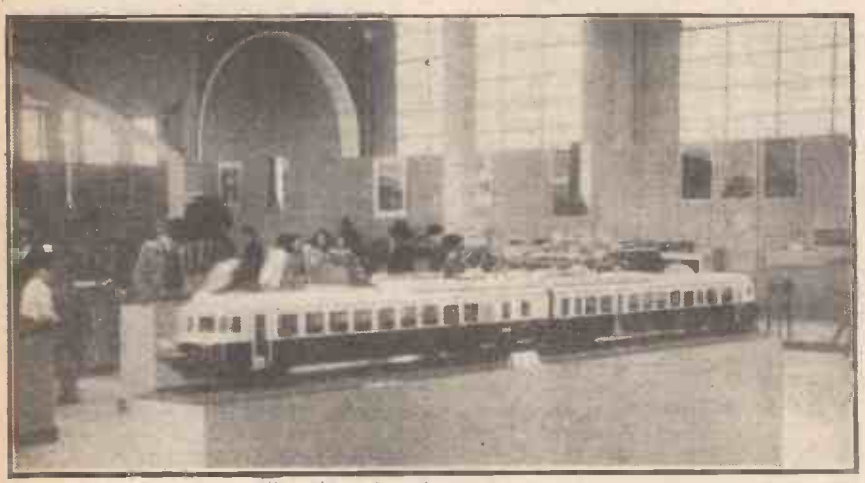
In Britain we hardly notice how smooth the electrified parts of our railway system are, because our tracks in general are so well laid that there is no great contrast between, say, the main line to Crewe and the electrified London to Brighton line, but after the student of railways has been thrown about all night on a war-battered French railway he will notice a great difference when the Swiss electric locomotive is coupled up for the Swiss stage of the international express's journey. It appears that in the whole of Switzerland there is still 850 miles of steam-hauled trains. Where this considerable mileage manages to hide itself I have never discovered, nor have I ever met anyone who has ever seen a steam locomotive used in Switzerland for anything but shunting.

Feats of Railway Engineering

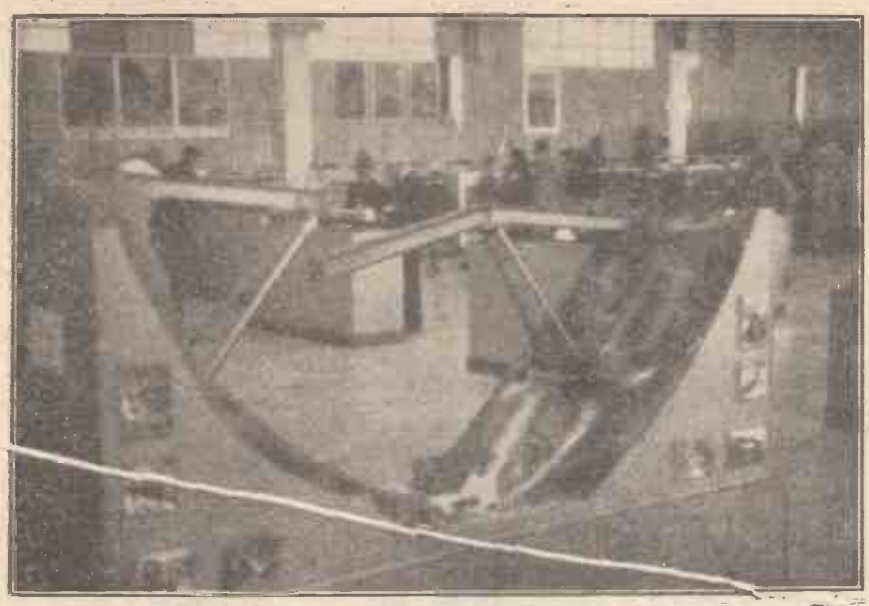
In 1844, when Europe and America had 5,000 miles of railway each, the Swiss had none. But they have caught up with extraordinary feats of railway engineering such as the intricate tunnelling of the Loetschberg from Brigue to Kandersteg, taking a normal train at a speed of 50 m.p.h. from 688m. to 1,169m. in about half an hour.

Then there is a mountain railway from Coire to St. Moritz, which does in about three hours a journey which at the beginning of this century could only be done by sleigh, with a halt for the night at Berguen.

Perhaps the tunnelling of the St. Gothard, with its tunnels that spiral inside the mountain in such a way that when you come out you can look down hundreds of feet and see the track over which you passed a few minutes earlier, is most remarkable. In order to haul the international expresses through this rabbit warren the Swiss have constructed a locomotive of 12,000 h.p., which, I am told, is the most powerful electric locomotive in the world.



A model of the new light auto-train which runs between Berne and Neuchatel in the Bernese Alps.



A model of the Stiffenback Bridge. Until 1935 the bridge had to be broken at avalanche time. The model shows how this was done.

Model Railways

To return for a moment to model railways, M. W. Siegwart, the well-known Swiss engineer and expert on model railways, admits that Switzerland was somewhat backward in this science, and that it was not until about 1930 that model building was taken seriously. He continued: "We have long realised that it was tolerable for a growing boy to be interested in building model railways, but until comparatively recently if the father of a family was so inclined he would have been held to be a bit of a crank. It was only in 1933, the date of the foundation of the Zurich Model Railway Enthusiasts' Club, that the science gained any appreciable foothold in Switzerland."

To-day the position is very different, and you will not find any sizeable town in Switzerland without its model railway club, where the members receive help from and have discussions with professional railwaymen.

As far as I am able to ascertain, the first model railway exhibition to be held in Switzerland took place at Zurich in 1939. There were a number of non-working models of scales of 1-in-20, 1-in-15 and 1-in-10. For their working models the Swiss follow the usual practice of using 32 and 45 millimetre gauges, and in later years 16 millimetres. It appears that one of their star turns is a model-builder living at Le Locle who has built a diesel-electric model train which runs on an 11-millimetre track. I think I am right in saying that this is in the same proportion to a 16-millimetre track as the narrow 1-metre track is to the normal Continental gauge.

Switzerland also has a number of interesting open-air narrow-gauge model railways. There is one on the Zollikerberg outside Zurich. The gauge is 32 millimetres, and the miniature railway reproduces on a scale of 1-in-45 the Bernese Alpine Railway commonly known as "the Blue-Lake Line."

This is a complete reproduction of the real line. Heavy electric locomotives draw express trains through models of the real line tunnels, cross rivers on miniature bridges and disappear, having negotiated the famous Frutigen-Kandersted gradient from the Lake Thun into the Loetschberg tunnel.

Passenger-carrying Model Railway

There is a larger open-air model on the scale of 1-in-10 on the Dietschiberg at Lucerne. Perhaps even more fun, because one can travel on it, is the model railway at Horw, which is also near Lucerne. Two enterprising garage-keepers have constructed a railway on the scale of ⅛ with a gauge of 184 millimetres. On any fine Sunday you will find crowds of "children" from six to 80 waiting their turn to ride on one of the trains which are hauled by the three steam locomotives which the aforesaid enterprising garage-keepers built themselves.

To quote again M. Siegwart, he says that railway modelling in Switzerland at long last embraces every form of citizen from the mechanic to the locksmith, with a fair levelling of bank employees, doctors and lawyers.

"Youth and the Railway"

One branch of the centenary celebrations is the exhibition taking place in no fewer than 13 towns called "Youth and the Railway." In connection with this a competition was organised in all the Swiss schools for drawings and essays bearing on railway matters. There were over 10,000 entries, and 1,000 of them won prizes of varying kinds. Having collated the data from the schools, the Swiss Federal Railways organised this youth part of the celebrations accordingly. Here is what they found was popular material for the display, as indicated by the entries:

(1) More information about railway history.

(2) An opportunity to see the 1,000 entries that had won prizes.

(3) Lines on which those interested in railways could have it included in the school curriculum.

(4) A display of all kinds of technical problems which have specifically arisen out of the fact of the railways' inception.

(5) How the railway best serves the community.

(6) How the railway can serve youth in particular.

(7) The economic importance of the railway with regard to the Swiss Confederation.

(8) Where do we go from here?

One thing that I forgot to ask was the school-leaving age. But whatever it may be, I should imagine that satisfying the demands of this 10,000 gave the Swiss Federal Railways quite a headache.

Exhibition of Railway Bibliography

There only remains one angle of the celebrations that I have not mentioned, and that is that in five major towns there is and will be, up to October 26th, an Exhibition of Railway Bibliography. This has been organised with the collaboration of the Swiss National Library and includes a number of English and American books, pamphlets and early cartoons which are of great interest to the British tourist.

I must say that when the Swiss do something, there are no half measures.

A Realistic Model Town

This remarkable miniature representation of a typical small English town, with its model railway, is laid out in Bekonscot, near Beconsfield, Bucks. Set in 2,000 square yards of lovely rock gardens, there are little thatched cottages, tudor houses, and tiny railways, etc. Over half a million visitors have so far been the means of providing over £12,000 for charities.

A New Wind Tunnel

An Important Development in British Aviation

By "TECHNICUS"

SINCE the aeroplane was first invented the problem of designers has been the provision of means for testing and research on the ground, where conditions as met with in actual flight can be simulated. Without a knowledge of aeronautics one might think that this was not a particularly hard problem to solve, but in point of fact the solution is both difficult and very costly. The essentials of the problem are to move air over, or past, the aeroplane under test at the same speed as would be the case were the craft in flight, and to measure the results in such a way that they bear a close relation to practice.

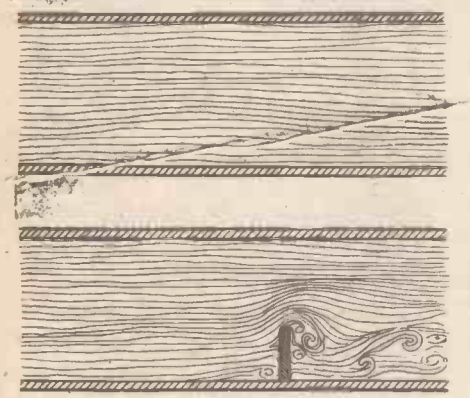


Fig. 1 (Above).—Showing streamline flow and (below) turbulent flow.

To illustrate these points, assume that the aircraft is flying at 200 m.p.h. In an atmosphere free from head- or tail-winds, one can say that the air would flow past the plane at about the same speed. It is not sufficient, however, to say that if we blow air at such a speed over an aircraft in a tunnel the results would be similar to those in the open air. The reason for this is bound up with the behaviour of air when flowing.

Streamline and Turbulent Flow

Air can flow in two ways: smoothly, without eddies or whirls, or in a series of vortices. The former is called streamline; the latter, turbulent flow. The two are illustrated in Fig. 1, and it will be observed that a small obstruction in a stream of air will induce vortices, just as a stick dipped into the smooth surface of a stream of water will produce little eddies and whorls. The flow of gases and liquids has been studied deeply and has formed the subject for beautiful and classical experimental work, not to mention a great deal of mathematical analysis.

The two conditions are encountered in aircraft, streamline flow being essential to lift and efficiency in flight. A great deal of research has been devoted to the design of aerofoils, as the cross sections of an aeroplane wing are generally called. The surfaces and contours of an aircraft must be so shaped that the air flowing over it is mostly streamline in motion. Turbulence, especially near the leading edge of the wing, would lead to instability of the craft in flight and must be avoided at all cost.

The Necessity for Wind Tunnels

It should be added that if we pass air through an ordinary tunnel it is possible that it will flow turbulently. The tunnel must be designed so that the air flows always in smooth layers and must, of course, be free from any projections or abrupt change of diameter. Then again, it must be of reasonably large diameter, for a narrow one would induce turbulence. There are many reasons in addition to the above which make it necessary to build the tunnel to a certain design, and if tests are to be carried out on large aircraft models or parts, additional problems enter, as for example, the power plant for supplying a considerable volume of air. The overall result is that a wind tunnel for aircraft research is an expensive item, which is one reason why the Royal Aircraft Establishment at Farnborough has been selected to receive the largest in this country. At the R.A.E. investigations are carried out which benefit the whole of the British and Dominion aircraft industry.

The R.A.E. Wind Tunnel

The sketch in Fig. 2 shows the layout of the large tunnel which has been constructed at Farnborough. It is 130ft. long and has an overall outside height of 37ft., and is a very large structure indeed. The outer walls of the tunnel are made of cork brick to provide insulation, both thermal and acoustic. A range of air pressures of 1.5 lb./sq. in. to 60lb./sq. in. can be achieved, while the humidity and temperature of the air flowing through it can be controlled. The air is dried by passing it through refrigerating coils, which condenses out moisture, after which it is passed through filters to remove all dust particles.

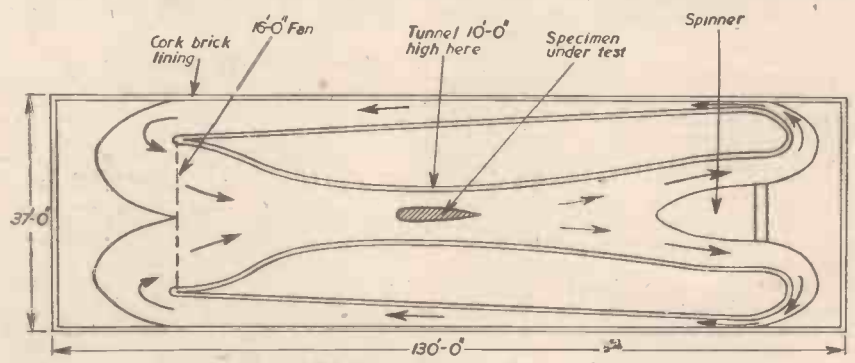


Fig. 2.—Diagrammatic layout of the new wind tunnel at the Royal Aircraft Establishment.

Measurements of wind effects, such as lift and drag, are made with the aid of steelyards of great accuracy. Small electric motors rotate a screw on the arms of the steelyards which, in turn, moves a jockey weight. In this way remote control and adjustment of the steelyards can be maintained, for it will be evident that manual operations inside the tunnel cannot be permitted at the higher air pressures. In addition to such apparatus there are the usual recording instruments and gauges, such as manometers, and these have been grouped, to facilitate control, in a central control room. Altogether the details of this wind tunnel are an example of theory and practical ingenuity well applied.

Power Plant

In itself a costly structure, a large wind tunnel like this necessitates much ancillary plant. The air supply is given by Browett Lindley compressors of the two-stage, two-crank, vertical type of 5,000 cu. ft. per minute exhausting capacity and 3,300 cu. ft. per minute compressing capacity. The respective power consumptions are 185 h.p. and 365 h.p., the cylinders being 29in. bore and 13in. stroke, the running speed of the compressor being 330 r.p.m. A special design of compressor was adopted for this work, to save the use of several units and to economise in space.

No less difficult, from the designers' point of view, was the problem of the air circulating equipment, which was carried out by the B.T.H. Co., Ltd. Bearing in mind what has been said about airflow, it will be readily appreciated that air cannot be merely pushed into the tunnel with a fan. For this a 16ft.-diameter fan was found necessary with a range of speeds of 0 to 950 r.p.m. Simple arithmetic will show that the peripheral speed of the fan blades at maximum revolutions is about 50,000 ft. per minute, which is more than 500 miles per hour. Careful attention to the design of the blades would be necessary to ensure absence of unwanted air currents at such a speed.

The fan is powered by two D.C. electric motors of 2,000 h.p. each, running in tandem. These derive their power from an A.C. motor, 6,600 v., developing 4,800 h.p., current being taken from the grid. This will convey an idea of the energy that is contained in a wind of high speed, for clearly the power required to drive the fan is a measure of the energy absorbed, less certain losses, by the air stream. Looking at it from the other way, if one develops a pressure of 60lbs. per sq. in., which is the maximum for this wind tunnel, it is easy to see that such air pressure bearing upon a square of six feet would amount to about 130 tons.

A Pantograph Drawing Reducer

A Useful Appliance for Draughtsmen and Others

By M. M. E. PEARSON

TO make a detailed design or pattern drawing to a smaller scale is frequently desirable, but can be an extremely tedious job if attempted without mechanical means of reducing. Often a design is only pleasing to the eye when made to a certain size, and the patience that can be saved by the preliminary outlining of a pattern to a reduced scale by a pantograph is enormous. Any portions requiring modifying to improve appearance at the reduced size can easily be undertaken.

General Description

The pantograph reducer shown in the accompanying drawings is in its basic form, and will give accurate reductions. Those who have a metal turning lathe at their disposal will at once notice a number of improvements that can be effected, particularly as regards improved means of adjustment for the pencil point and bearing. The reducer consists of five links (Fig. 1), these shown as details Nos. 1, 3, 6, 9 and 11; all of which are pin-jointed together, one corner being attached to a steadying weight (detail No. 2).

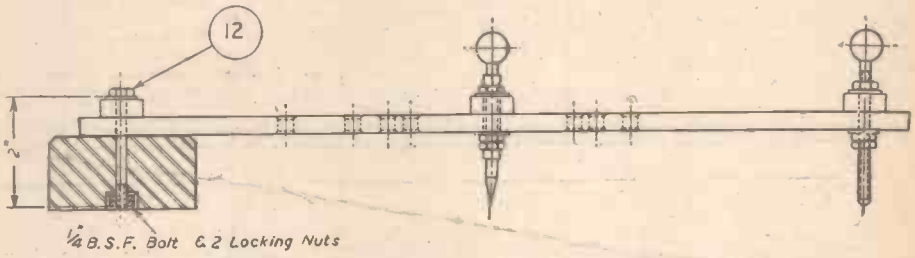


Fig. 2.—Part sectional end elevation showing detail of steadying weight and arm 1.

The centre member of the links (detail No. 11), carries the pencil point, the tracing needle being diagonally opposite the weight. With dimensions as drawn, the pencil will copy a design traced by the needle to the following scales, 2/3, 5/8, 3/5, 1/2, 2/5, 3/8, 1/3 and 1/4 full size, these being found by experience to be the most used scales.

Constructional Details

For the five link members a well-seasoned hardwood is best, although ordinary deal will give good service. Very careful attention to the size and smooth finish of the holes is essential; if there is any slackness or tightness true reproductions are impossible. As all the hole centres are relevant to each other they must have identical positions in each link, for example, where the four members (detail Nos. 1, 3, 6 and 9, Fig. 3) are connected to each other at the corners the pitch of the holes is 2oin., and similarly for the member carrying the pencil. To ensure accuracy, drill one link, say detail No. 3, with the two holes, the other four only one hole, then place them in turn under detail No. 3, with a bolt through the holes at one end, and transfer the second hole. With reasonable attention a hundred per cent. accurate job is accomplished. The next stage is to drill the holes for the pencil holder and the series of holes for the position of detail No. 11 through the various reductions. This can be done in a similar manner as the first set of holes by marking out and drilling detail No. 11, then placing under it in turn detail Nos. 1 and 6. With a bolt in the end holes spot through the positioning centres, but do not drill right through, for the outside links may require slightly smaller holes than the ones for the pencil holder.

The steadying weight shown can be of any heavy substance drilled and counterbored to suit bolts and lock nuts (Fig. 2).

Tracing Point

The tracing point is a ¼in. bolt reduced to a point at one end, the head being cut off and inserted into a small lifting handle, which can be pinned or glued to keep it in place. The point can be adjusted for height on assembly.

Detail Nos. 5 and 8 and two steadying pins, which ensure the framework always being horizontal whilst in use; they are merely ¼in. bolts with the ends rounded and well smoothed to facilitate the links sliding easily.

Pencil Holder

The pencil holder, detail No. 4 (Fig. 4), consists of a piece of sheet brass or steel bent around a rod, the inside of the tube to be a snug fit for the pencil. The lifting knob is a piece of wood domed as shown, the shank having a slight taper to fit tightly in the tube.

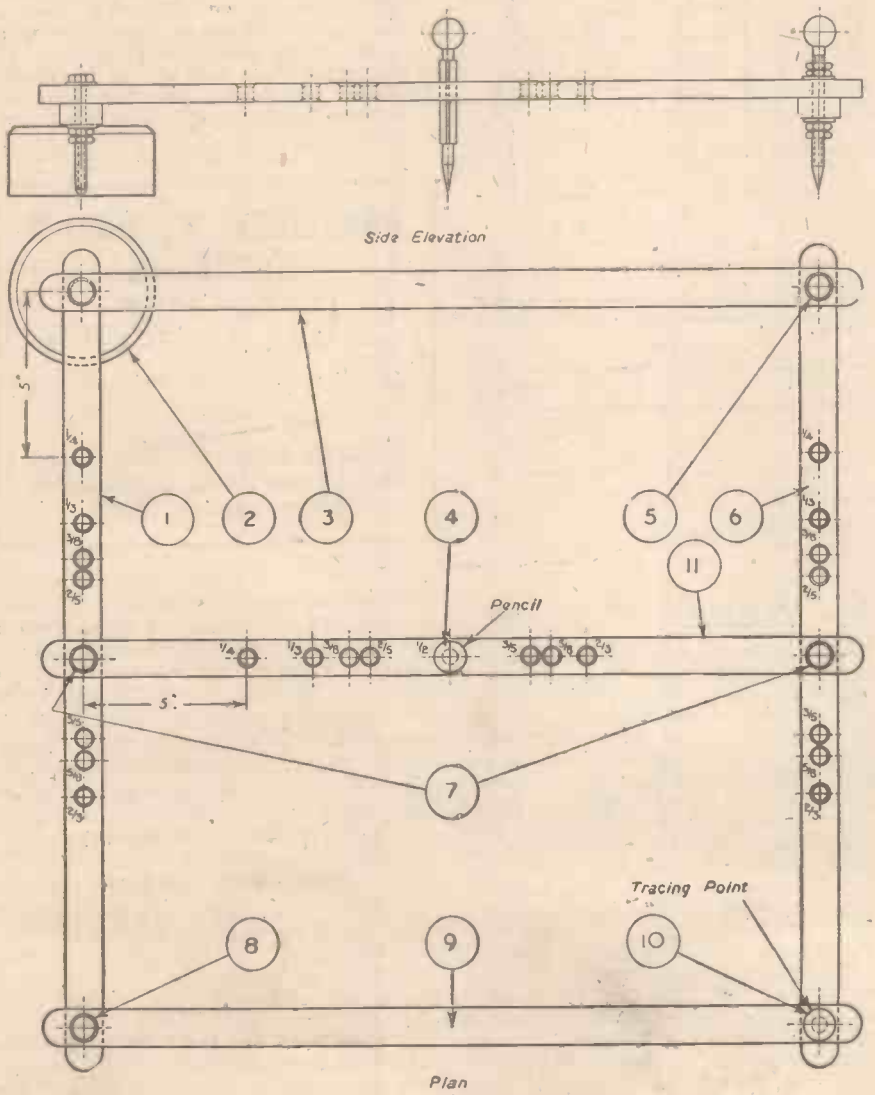


Fig. 1.—Side elevation and plan of the finished pantograph, showing numbered details.

When assembled, the taper shank of the knob expands the tube and tightens the holder in the link member. Make a few trial holes in a scrap piece of wood to find the most suitable size before drilling detail No. 11.

On assembly insert washers between the heads and nuts of the bolts to ensure a smooth action. A smear of tallow or similar substance acts as a lubricant and prevents corrosion between bolts and wood.

Using the Pantograph

As depicted, the pantograph is set to reduce a design to half that of the original. To obtain the other scales remove the bolts (detail No. 7), lift off the link carrying the pencil-point and transfer it to the corresponding pair of holes in detail Nos. 1 and 6, the scale of reduction being shown in the plan

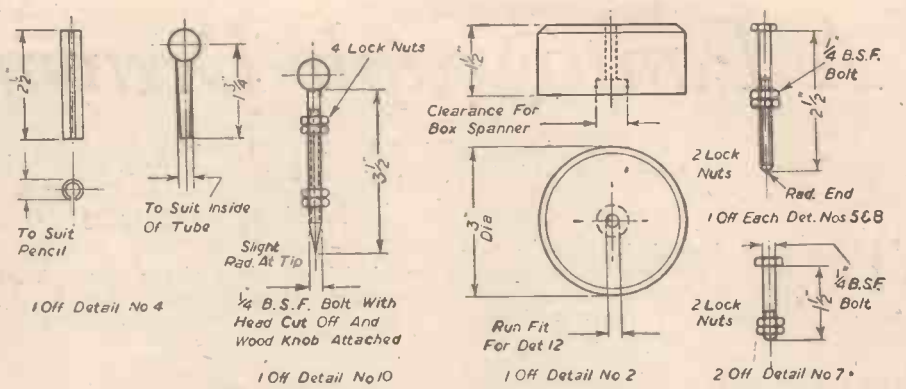


Fig. 4.—Various component parts, including the pencil holder and tracing point.

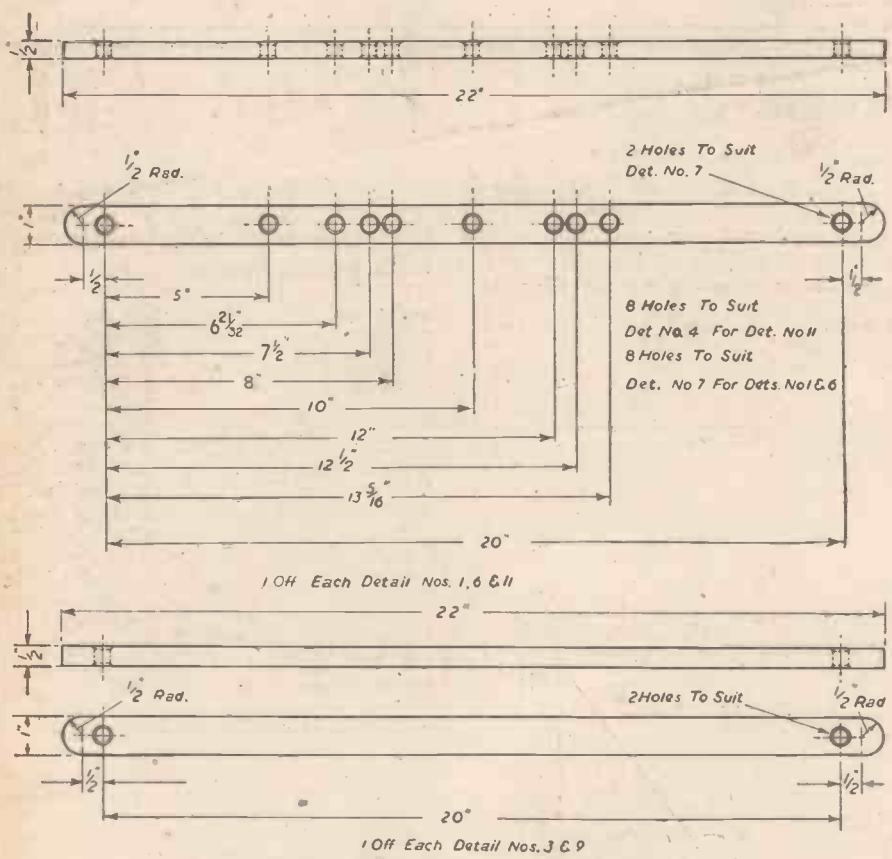


Fig. 3.—Details of pantograph arms.

view. Next remove the pencil and holder and replace it in the position required for the new reduction scale, which is also indicated in the plan. As an example, assume that a scale reduction of 2/3rds. is required. After removing detail No. 7, the member carrying the pencil is brought forward three holes, corresponding to the figure 2/3 marked on the left-hand link, and the bolts replaced. Next, the pencil holder is withdrawn and moved three holes to the right, which again is marked 2/3, and replaced. As a check on whether the pencil is in the correct position, a straight edge should show detail Nos. 12, 4 and 10 lying in the same plane for all positions of the pantograph.

Pin the drawing to be copied on to a flat surface, then affix the blank piece of paper for copying, this should be placed parallel to the drawing, the actual position of it being found by the limits of the design to be copied.

A Question of Weight

HERE is an interesting fact. If you put your hand on a spring scale and press hard, the scale shows your hand as "weighing" eight or ten pounds; and so it does, for weight is simply the pressure exercised by a body. The fraudulent shopkeeper who leans his elbow on the scale is not faking. He is simply weighing his elbow with the sweets or carrots or whatever it may be. He perpetrates his fraud when he fails to deliver the goods—or all the goods—he has weighed! A Shylock customer might insist on his "pound of flesh."

Weight is due to the fact that everything attracts every other thing. A scientist might find it difficult to calculate, psychologically how much you attract a girl, but not mechanically. All he wants is your weight and her weight and the distance between you. He knows that every pound of matter, whether it is chalk or cheese, attracts every other pound at a distance of one foot by 1/440,000th part of a grain.

Because of the shape of the earth and the constitution of the matter underneath it, a pound is not the same weight in different places. Of course, it will show the same on the scales if they are not the spring balance type, because the same change takes place in the scales; but a pound of sugar on the Equator is not always such a good bargain as a pound of sugar in England or the U.S.A. This difference in weight, or gravity, can be measured by delicate instruments and is very useful. For one thing it enables geologists to determine what is underneath the earth's surface.

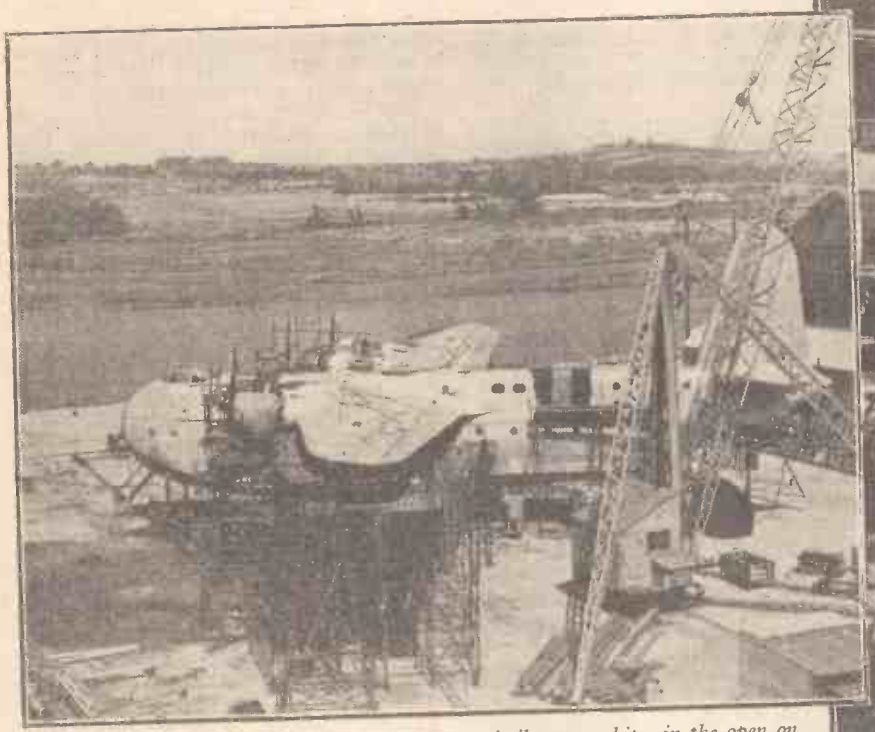
The pressure of wind is trifling compared with the pressure of water, because water is so much denser; the effect of a jet of water under pressure is much more devastating than a jet of air under the same pressure. The pressure (or weight) of water in the sea increases about 115lb. for every 30ft. The pressure at the deepest place in the ocean must be about seven tons to the square inch.

An interesting point, illustrating what this pressure means, is that if we could lower a gun far enough into the sea and pull the trigger, it might not go off—even if we took care that it did not get wet. The reason is that the pressure outside the barrel would be greater than the pressure of the explosion inside. The barrel, incidentally, would not burst, because of the external pressure. What would happen is that as we withdrew the gun slowly it would reach a position where the pressure was just equal to that behind the bullet, which would be very gently released.

We should see equally strange effects if we had "air oceans." For instance, if we ever dig a mine about 30 miles deep, we should not be able to have a wooden chair in it. The chair would float! The pressure of the air naturally increases as we descend a mine, and, at this depth, its weight would be greater than that of wood, so that the wood would float. Of course, human beings could not withstand this pressure.

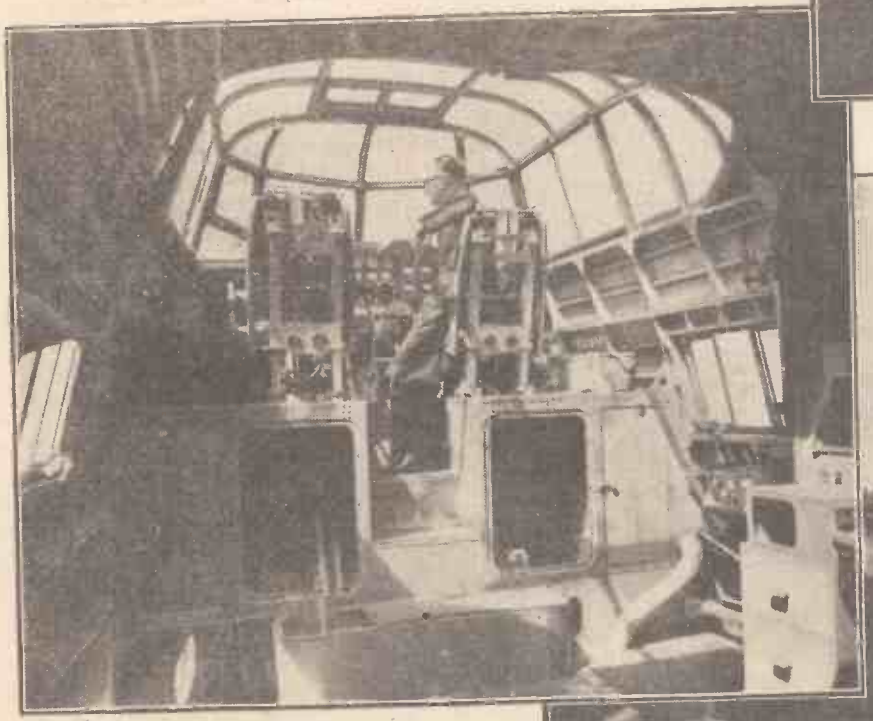
The New Shetland Flying Boat

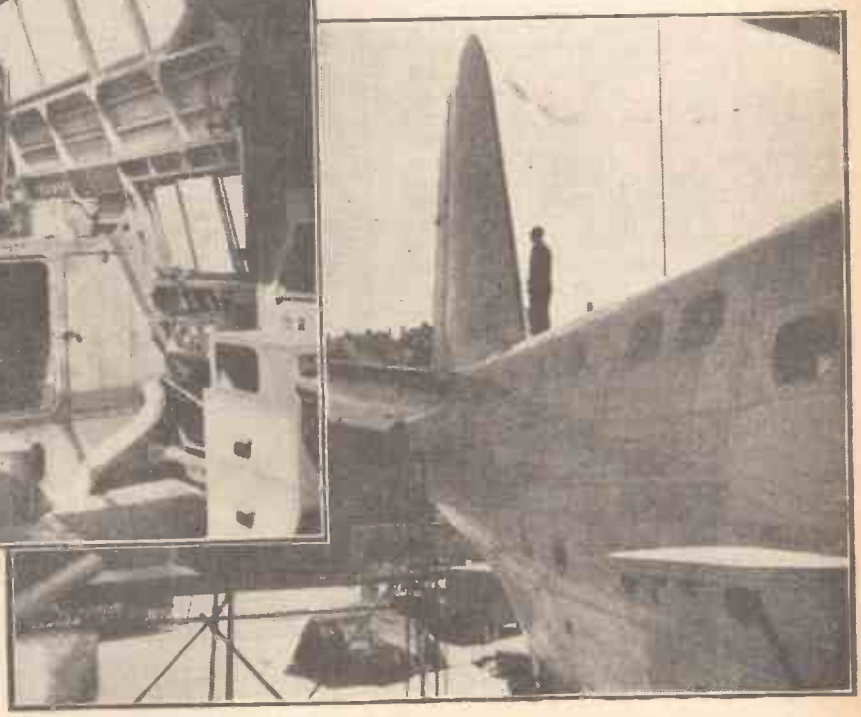
The task of constructing Britain's biggest flying boat, the Short-Saro Shetland, is almost finished, and the boat is expected to be launched this month. This huge machine will be twice as heavy as any aircraft yet constructed in Britain; it is 110ft. long, wing-span 150ft., it can carry 70 passengers plus a crew of 11, and the four Bristol engines give a maximum speed of 267 m.p.h. over a range of 4,650 miles. The machine is being constructed in the open air on a slipway on the banks of the River Medway, in much the same way as a ship.



The huge 'plane is being built in circumstances similar to a ship—in the open on the banks of the River Medway.

A front view of the flying boat on the stocks.





(Above) Interior of the spacious cockpit. (Right) Looking aft—this illustration gives a good idea of the size of the tail fin.

Observations

Further Interesting Facts About Everyday Topics

By Prof. A. M. LOW

If Only it Worked

ONE of my ambitions is to have a cigarette lighter which invariably works. Especially when I think of all the ways there are of obtaining light and of the old days when only one person in the village kept a fire and sold lights to the unfortunate inhabitants.

One can rub sticks together, although it is extraordinarily hard work when tired. One can compress air suddenly in a bamboo cylinder, and savages do this too. We can make phosphoreted hydrogen which ignites in contact with air, and even this has been used to obtain automatically lit acetylene.

But the common or garden flint shows by its name how popular was the tinder-box of our great-grandfathers. These little pieces of pyroforic metal are, of course, not flint at all, but are made of a mixture of bismuth, antimony and other friable metals. The steel wheel scrapes off particles so small that they ignite under the heat of cutting. Steel wool will burn furiously if given the chance. (I will now borrow a match!) Which reminds me that there were once cigarettes containing a lighting end which one rubbed upon the trousers or a convenient piece of furniture. Disadvantages—tobacco suffered in flavour.

I am so glad I wrote this, for an amazing thing has happened. I have discovered the Camlighter, which not only works but always works. I call it the "inclined plane" machine, for it is roller operated, no queer springs, no cogwheels. Nothing except a grand light; very clever.

It Knows Which Way

I HOPE you will think none the worse of me for being able to make my own coffee in a very common saucepan. Incidentally, I believe most of these infusions are wrongly made, and that there should be a slight vacuum to extract the essential oils which give the flavour. Just as in pressure cooking one prevents water boiling by allowing the pressure to increase.

You will realise that the pressure under which a liquid stands normally decides the temperature at which it would have boiled. It is not easy to cook potatoes adequately at the top of a very high mountain, while at the bottom of a mine the temperature might be considerably above 100° C., and vegetables could be overheated without difficulty.

There is a true story about some directors of a mine who celebrated a certain occasion with champagne at the botttom of the mine shaft. Under this pressure the wine was rather flat, but when they came to the surface it gassed violently upon release of pressure and the poor directors were quite unable to declare a dividend for a long time.

Now, in my coffee saucepan I observed an amusing phenomenon. Fill it with enough for one cup and twirl the saucepan in a clockwise direction, when the coffee follows suit and also twirls right-handedly. But putting enough milk and water for three people and giving a right-hand twist to the pot caused a left-hand revolution to the coffee.

This really puzzled me until I noticed that the pot had a kind of ledge which was not overclean. Of course, these ledges caused

(*Continued from page* 336, *August issue*)

a vortex action and being smoother on one side than the other the result was a "gear wheel" driving the coffee backwards.

Men on Mars!

I OFTEN think that we would have reached the Moon and other planets far sooner if we knew that there was gold on their surface. But I do not think there is what we call human life on any planet unless it chances to have the same conditions as those upon the Earth.

Life, as we know it, is the result of climate and many other circumstances. It might well be that on Mars totally different geological values have produced a different form of life. Beings might move things by thinking. They might see by what to us is heat, for these are merely relative matters of sensitivity to a certain set of wavelengths.

It will have occurred to you that the vast distances between us and other worlds could only be traversed at speeds inconceivable to our minds. Light is quite quick at 186,000 miles a second, but if on any of the stars they could see the earth by ordinary light the views would have taken so long to travel that by this time they might be watching Julius Caesar or be betting upon chariot races round the arena.

Average Speed

I WAS talking of averages to a sportsman the other day, and it was made clear how many people "slip up" over the simplest sum. Just suppose someone offers you a lift home, twenty miles away, and drives for forty miles an hour for the first ten miles and then, when you tell him to step on it, at sixty miles an hour for the second ten miles, what is your average speed?

Nine out of ten people will reply instantly, "Fifty miles an hour." But the right answer is 48 m.p.h. You take fifteen minutes to cover the first ten miles and ten minutes to cover the second ten miles—total twenty-five minutes for twenty miles, or 48 m.p.h.

This shows how deceptive averages can be. A certain quartermaster reported, quite truthfully, that the troops on a campaign had been supplied with the average rations. But this did not mean there were no grounds for complaint. Some of the men had next to nothing, while others had double rations. Nevertheless, the average was the correct amount.

Why Stars Twinkle

YOU may or may not know that the stars that twinkle so brightly are not the many-pointed objects which artists draw. In truth, they are anything but star-shaped. The tremendous forces and speeds of the heavens call for everything being round and ready to travel in curves. This is clearly shown in photographs.

The many-pointed appearance of the stars is due to the unsteadiness of the earth's atmosphere, arising from unequal heating of the air as well as to physiological causes. The twinkling is caused by the air, and not by the star. The light is unequally refracted and gives a distorted appearance to its source—the same effect is produced if a candle is looked at through agitated water.

This unsteadiness, by the way, is a great handicap to the astronomer who, at the best of times, has to be constantly adjusting his telescope as the star appears to move.

Incidentally, the refraction of the earth's atmosphere bends the light from the sun and the moon, with one curious result. When they have actually disappeared below the horizon we can still see them, apparently just above the line.

A full-size model of the monoplane in which Louis Bleriot flew the Channel, on view at the International Air Rally at Burnaston, Derbyshire, recently.

Dynamo and Motor Problems

Some "General Principles" in Tracing Faults

By H. REES, A.M.I.E.E.

IN setting out to write these articles I want to try to be of some help to beginners and apprentices as well as to those having a more extensive electrical experience.

That is always a difficult job. It means some things have to be treated as being so obvious as to be scarcely worth mentioning, whilst if one spends too much time on these matters the more advanced reader is apt to feel it is a waste of his time reading the article.

We shall do our best. Speaking from my own experience, I do not think any point is too "elementary"—unworthy of efforts at clear explanation. Again and again we come up against problems in electric circuits, simple enough in themselves, but somehow "theory" just seems singularly unhelpful.

Let us start these notes with a familiar motor fault which involves nothing more than fundamental circuit laws.

Motor that Would Not Start

In Fig. 1 (b) is shown a shunt-wound D.C. motor with hand-starter. For clarity some details are omitted, but 1 (c) gives a simplified sketch of the connections.

The motor is started by cutting-out the resistance R in steps. In the "full-on" position the handle is held against the tension of a spring by the electromagnet NVR (no-volt release). Fig. 1 (c) makes it clear how this coil is energised. It is put in series with the *shunt-field* circuit of the motor—an important point to understand in case of a no-volt coil burning out, because it will mean a "break" in the field circuit. In larger starters NVR is usually connected in series with a resistance across the supply.

You will notice that three wires go to the starter, "L" (line), "A" (armature) and "F" (field), there being similar markings in the motor terminal box—the "L" terminal of the motor, however, is the common junction of one side of the armature and shunt to the — line (which could equally be the +, with the — going to "L" of starter). These markings are now pretty well standardised in all D.C. motor installations.

Fig. 1 (a) is also a schematic diagram of a starting resistance. It was an improvised one for a small shunt motor, and, as there was no NVR coil, it was not thought necessary to bring one end of the field back to the starter as in 1 (b). The shunt was left connected directly across the armature as might be expected in any "shunt" machine.

But although this motor started up normally on a no-load test, it failed to start when mechanically coupled to its load. The resistance was observed to start smoking, getting red-hot very quickly, whilst if more resistance was cut out the fuses blew.

Obviously the motor could not exert enough starting torque. But why? Was the motor too light for its job? Should a series or a compound-wound machine be used to provide greater starting torque? Or is there something fundamentally wrong in the circuit connections?

A skilled electrician with any experience of motors will know the answer immediately, though not perhaps perfectly clear about the right explanation.

Analysis of Starting Conditions

Why is a starting resistance used?

A little theory on this subject will soon demonstrate the right answer to our problem.

Armature windings are of very low resistance; in Fig. 1 (a) we have shown 0.1 ohm.

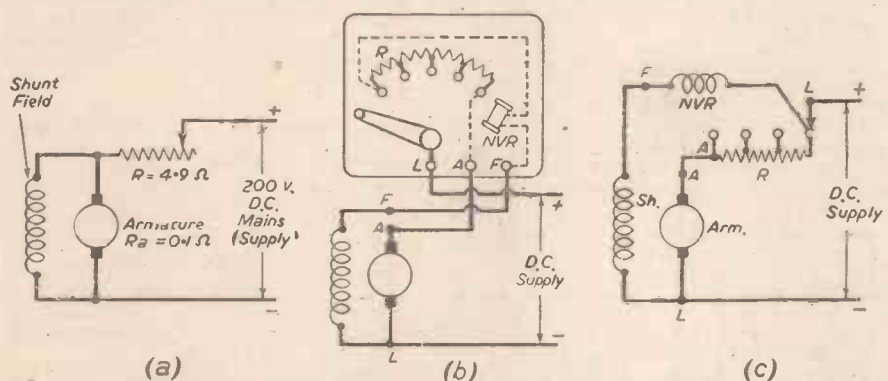


Fig. 1.—A "shunt motor," connected as in (a) fails to start under load. Why? Correct connections of a typical starter are given in (b)—omitting some details. Fig. 1c.—Line diagram of 1b, showing how NVR is in series with the motor shunt-field.

In a larger motor it can be much less than this. Well, if we switched 0.1 ohm directly across 200v. mains, the current would be something like 200/0.1 = 2,000 amperes, i.e., it would tend to rise to this enormous value were there no fuses to take care of matters. As soon as the armature started turning, however, another kind of "opposition" would arise, namely, the *back e.m.f.*, generated as a result of conductors cutting lines of force. With the acceleration of the armature the back e.m.f. will increase, finally keeping the current down to a value determined by the load conditions on the machine.

But clearly, at the instant of starting, additional resistance must be put in to restrict the current. Suppose we decide to restrict the starting current to 40A. Then, by Ohm's Law, we want a total circuit resistance of 200v./40A = 5 ohms.

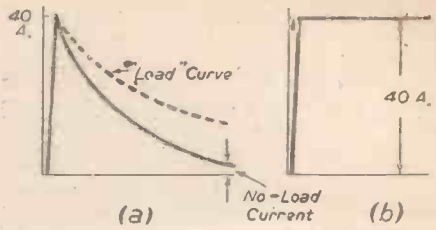


Fig. 2.—If a motor starts normally, current rises to a momentary peak (a), and falls off rapidly as armature accelerates. In Fig. 1 (a) armature fails to start, and a heavy current of 40A. passes all the time as in 2 (b), dropping most of the volts in the resistance R.

The armature incorporates 0.1 ohm, so the maximum starting resistance R must be 5 − 0.1 = 4.9 ohms.

If the motor started normally the current would rise to a momentary peak of 40A, as in Fig. 2 (a), and fall off as the back e.m.f. increases with the speed. Fig. 2 (a) shows the current falling to a small final value, because the motor is assumed to be running "light," i.e., with no mechanical load on the shaft. If loaded, the final steady current would be some larger value indicated by the dotted curve.

What if the motor does not start, as in Fig. 1 (a)? If the starter was held on the first resistance step we should have a steady current of 40A passing all the time (Fig. 2 (b)). Since R is designed to carry only a momentary peak of 40A, this sufficiently accounts for its rapid rise in temperature.

It also accounts for failure to start. There will be a "drop" of 40 x 4.9 = 196v. in the starting resistance, leaving across the armature *and field* a p.d. of only 200 − 196 = 4 volts!

This is quite sufficient to pass 40 amperes through 0.1 ohm—through the armature. But the shunt circuit is an electro-magnet designed for 200v. It will have a resistance of a few hundred ohms. We needn't worry about that. If you had an electro-magnet designed to work off 200v., how much "pull" would you expect with only 4v. across its terminals? By simple proportion it is getting only *1/50th* of the normal magnetising ampere-turns!

Apply the reasoning to the motor. How much starting-torque may be expected with hardly any field at all? Probably quite enough to start the armature running if there were no load on the shaft. Otherwise it is seen the problem reduces to nothing more difficult than Ohm's Law.

The remedy is to connect the shunt directly across the 200v. supply, or rather to the first contact of the starting resistance, as in Fig. 1 (b) and Fig. 1 (c), leaving R in the armature circuit only. That is the real reason why the "F" connection must always be brought back to the starter.

A question students like to ask is this: When R is cut out of the armature, will it not be put in the field circuit? It will. But, once more, consider one or two quantities. R is 4.9 ohms; the shunt may be, say, 500 ohms, taking 0.4A at 200v. How much difference will another 4.9 ohms make to that current? Work it out, and for all essential purposes your answer will be 0.4A.

A Misleading "Test"?

Well, perhaps you will agree that a little theory can be worth while. The "ounce of practice" adage can work "in reverse" if we proceed blindly without trying to understand *why* things should happen.

Again referring to Fig. 1 (c), I can well recall as an apprentice trying to "test" for a break between the armature and starter by connecting a lamp across the brushes and asking an assistant to hold the starter

on the first contact. With the main switch closed, the lamp should light if continuity was O.K. via the "L" and "A" cables.

So I thought then, and was led chasing quite a few red herrings. Of course, the reason for testing was that the motor failed to start owing to a break in the field circuit or a fault of the nature of that indicated in Fig. 1 (a). The armature voltage would then hardly be sufficient to light any 200/250v. lamp, even though all armature circuit connections were intact.

The heavy arcing on putting the starter arm to "off," with other symptoms of overheating, should have been sufficient to show the armature circuit was O.K.—though taken by itself this indication would be consistent also with a "dead short" across the armature leads.

Let us continue our discussion of "principles" by considering a few more practical illustrations.

When a Dynamo "Motors"

An important principle mentioned in the textbooks is that a dynamo is a *reversible* machine. It means that it *can* run as a motor, whilst any motor can also be used as generator.

In Fig. 3 is represented an engine or motor-driven dynamo charging batteries. As long as the generated e.m.f. E1 is slightly greater than the back e.m.f E2 set-up by the battery, a *charging* current will pass. If E1 is less than E2, a *discharge* current will flow from the battery, tending to "motor" the dynamo—generally an automatic cut-out switch protects against this, e.g., it would be utterly impossible for a small generator to act as a motor driving a heavy engine, though "tending" to do so; if the engine were shut off, however, the armature would simply form a dead short across the battery and would probably be burnt out.

If belt-driven, the simplest way of demonstrating the fact is to remove the belt and, using reduced voltage from the battery, close the cut-out by hand. The dynamo will at once run up to speed as a motor, and might be used to drive other machines, etc. A starting resistance should really be used for the experiment, but with a much reduced voltage, and on light load the current will not be excessive.

Now one or two questions arise here. Will the reverse current reverse the polarity of the dynamo? Secondly, why is not the direction of rotation as a motor *opposite* to that of the dynamo?

Reference to Fig. 3 shows: (a) that the armature current will reverse; but (b) the direction of the shunt-field current will be the same as in the dynamo. The magnetic polarity will not reverse or be in any way impaired. The + and − terminals retain the same "signs" as when an internal e.m.f. was generated as a dynamo—as far as the shunt is concerned, the + and − of the battery simply take the place of the dynamo electrical polarity.

The relative direction of rotation as generator and motor is one of the questions which provides a good test of your knowledge of electro-magnetic laws.

Lenz's Law

First, in the generator we have by Lenz's Law: *the direction of the induced current is such as to tend to stop the motion producing it.* In other words, the normal armature current in the dynamo will exert a "magnetic drag," tending to rotate the armature in the opposite direction to which it is being driven. This is the way an electrical load appears as an increased mechanical load on the prime mover.

It thus follows that a *reversed* armature current (opposite to the dynamo) will cause rotation in the *same direction* as the armature was driven as generator, i.e., with the same field polarity. A discharge current from the battery is opposite to the normally generated current, so the machine continues to run in the same direction.

Motor as Generator

Conversely, suppose you decided to buy a 100-volt 1 B.H.P. shunt-wound motor whose rated speed is 1,000 r.p.m.

Will this work perfectly satisfactorily as a dynamo? What output may be expected? If it fails to "generate," what is the probable explanation?

As seen from the foregoing example, one and the same machine can function as a generator or motor. It will operate quite as satisfactorily one way as the other. As regards output, if an engine, water-wheel or

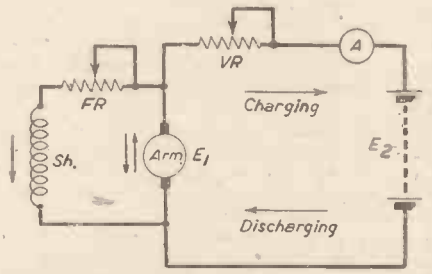


Fig. 3.—When E1 > E2, charging current will flow. When E1 = E2, no current will pass either way. When E1 < E2, the battery may drive the dynamo as a motor—if there were no cut-out in the circuit.

other motor is available to drive this one at 1,000 r.p.m., it will give approximately an open-circuit voltage of 100v. Because of the falling voltage-characteristic of a shunt generator, it will be necessary to run at a slightly higher speed to get 100v. at full load, unless the shunt can be separately energised from an independent D.C. source greater than 100v.

If 1 b.h.p. is used to drive, we should, theoretically, get about 746 watts output. But some power will be required to excite the field, and there are other losses which altogether will reduce the "output" to, say, 80 per cent. of the "input"—the conversion efficiency will be considerably less than

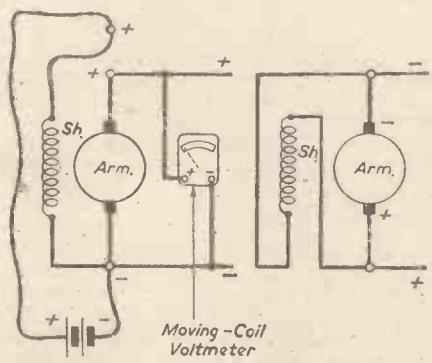


Fig. 4.—A method of giving the poles the correct residual polarity, relative to a given direction of rotation, to enable a dynamo to "self-excite."

this in very small machines owing to the comparatively large proportion of power necessary for field excitation. However, 0.8 of 746 = 596.8, or, say, 600 watts = 6 amperes maximum load at 100v.

What is the "correct" direction of rotation as a dynamo? This is bound up with our question of whether or not the machine will generate.

Failure to "Excite"

It is very probable that enough residual magnetism will be left in the poles of the motor to cause the generator to "excite," *if driven in the same direction as it was running as motor.*

Apart from this being an uncertain factor, we want to develop our knowledge upon a more firm foundation than having to depend on "rule of thumb." Suppose the machine is coupled up and driven clockwise or anti-clockwise, but fails to generate. How can we ensure that it shall build up?

The best plan, first of all, will be to connect it up as a straightforward shunt machine without any extraneous connections or resistances in the field circuit. If the rotation happened to be wrong, it will not be much use changing over the field connections because the residual magnetism will probably have been wiped out. However, it sometimes works, so is worth trying as a first step.

But there need be no doubts or uncertainties regarding magnetisation. Why not *magnetise* the poles to *any* polarity, then arrange the field connections to the armature to build up to this polarity? It is seldom that the terminals of a machine which has been working as a motor are marked + and −, and, in any case, that is a simple matter to fix.

Disconnect one end of the shunt from the armature and pass a magnetising current from a 2v., 6v. or 12v. battery, as in Fig. 4—one or two primary cells may do if accumulators are not available. For convenience, connect the free end of the shunt to the + of the battery, and make note of this fact.

Run up the armature to speed, connecting a low-reading voltmeter across the brushes. A small e.m.f. will be generated, and you should use a *moving-coil* voltmeter, noting which is the + brush − the one connected to + of instrument for normal pointer deflection to the right.

Stop the engine, disconnect battery and connect the free end of the shunt that went to + battery to the + brush lead found as above. If necessary, reverse the field connections.

A Generator that "Reversed Polarity"

To bring out some more facts relative to certain types of dynamos, consider the case of a generator used for battery-charging which several times caused trouble by reversing polarity.

This happened on starting after a shut-down. The terminal that should be the + came up to a − polarity, which, luckily, was revealed by a negative reading on the moving-coil switchboard voltmeter. Had the battery been switched-in, the fuses would have blown on the large circulating current that would pass at about double the normal voltage.

Of course, it was obvious that somehow the field polarity got reversed. As we have seen, that cannot happen in a shunt-wound generator by reverse current from the battery, so it became necessary to have a closer look at the field windings—or rather the connections thereto from the brushgear and terminal box.

As some readers will have guessed, a *compound* generator had been installed—a thing that should never be employed for battery-charging. There was a small *series* winding on each pole, i.e., a few thick wire turns in series with the armature an external circuit, which, therefore, carried the normal load current.

The object of compounding is to strengthen the flux and compensate for the tendency of the voltage of plain shunt machine to fall as the load increases. By suitably proportioning the number of series

to shunt turns, a compound machine can be designed to give nearly a "flat" voltage characteristic from no-load to full-load.

But a battery is more or less a constant load—except that the charging current may be adjusted to different values. There is no need for compounding, and it tends to cause trouble such as the above. Many types of cut-outs require a reverse current from the battery to open them when the dynamo is shut down. That would have no ill effects in a shunt machine, but in passing through the series winding of a compound generator it is apt to reverse the poles. The next time the machine is started it builds up the shunt-field to this wrong polarity, so giving also reversed terminals.

Of course, it is a somewhat foolish proceeding to shut down the generator *before* opening the switches on the board. If the battery circuit is switched off first, no trouble whatever can arise.

But many operatives get into the habit of relying upon an auto cut-out to break the circuit, finally opening the switches. If to be used for charging, the best thing to do with a compound dynamo is to take the series winding out of circuit by removing the outgoing connection direct to the brushes.

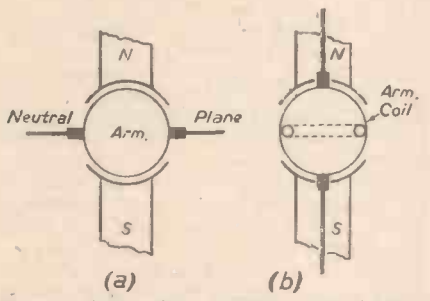


Fig. 5.—In modern machines the "neutral position" of the brushes is opposite the pole centres as in (b). The armature coil undergoing commutation will then be in the true neutral plane, as indicated.

Brush Position

I think I ought to say something now regarding correct brush position in generators and motors, without delving too much into the theory.

Fig. 5 (a) shows what may be called the "geometrical *neutral plane*," where the armature coils are *not* cutting lines of force, and therefore have no e.m.f. induced in their turns. In old type machines the brushes were fixed in this position, as shown, not only because it was the point of "sparkless commutation," but also because this was the position for getting *maximum output voltage*—in any other position (even if good commutation were possible) the armature windings would not be fully utilised and the voltage would be less than the maximum.

But if you examine any modern machine—generator or motor—you will invariably find the brushes set opposite *the centres of the poles* (Fig. 5 (b)). The result seems to be exactly the same as in Fig. 5 (a) as far as commutation and output voltage are concerned. Fig. 5 (b) seems to be the "neutral position" for all drum armatures

I have found this fact a little confusing to many people. Why, if 5 (b) accurately denotes the "neutral plane," should the brushes be set 90 degrees "out" as in 5 (b)?

It is really very simple. Because in drum armatures the coil ends are brought to the commutator at an "angle" (not straight), the coil connected to a pair of segments under a brush has its *sides* in the true geometrical neutral of Fig. 5 (a). I have tried to represent this by a single coil in Fig. 5 (b) without, however, showing the commutator. In obsolete types of armature the connections were brought out "straight" to their respective commutator segments, so the brush position coincided with the coil position as in Fig. 5 (a).

Testing for "Neutral"

As you may have ready, there were other queer things about dynamos in the old days.

Because of sparking troubles as the load varied, the brushes could not be left in the neutral position. We may imagine an attendant with his eyes constantly fixed on an ammeter giving the brushgear varying "angles of lead"!

All that is changed since the advent of interpoles. I shall have something to say about them in another article in the series. One big advantage is a fixed brush position. The best position for sparkless commutation at all loads is not found by "theory," but by prolonged tests at the works. When the manufacturer gives you red or other markings to show where the rocker should be fixed, it is a practical certainty that you cannot improve upon it by any further tests or experiments.

Nevertheless, it will be found in most cases that the brushes are fixed in the neutral position (Fig. 5 (b)). As there are still plenty of machines not fitted with interpoles, it will be of some interest to discuss how to locate the neutral points by measurements.

In a generator the rocker may be carefully adjusted for maximum reading on a voltmeter—usually without load. It is not a very exact method, since it will not be easy in many cases to determine the position that gives true maximum.

In a motor a voltmeter would be no use at all. It would simply register the constant voltage of the supply mains. What will change when the rocker is shifted is the amount of *back e.m.f.* available to *oppose* the supply voltage, and because of the low resistance of the armature a small change in back e.m.f. will produce a large change in *current*.

Thus, the proper instrument to use is an *ammeter*, put in series with the armature (or the supply leads). The rocker should be *very slowly* adjusted for *minimum* current. In this way the neutral position can be found much more accurately than by the voltmeter method (for generators).

There is one other somewhat novel test for finding neutral position with extreme accuracy.

The "Kick Test"

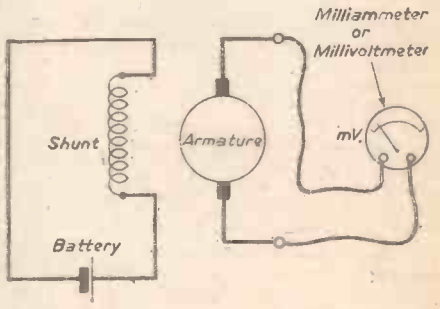
This is not so convenient "on site," but useful as a shop test.

A centre-zero millivoltmeter (or a milliammeter), mV, is connected across the brushes, Fig. 6, with the supply entirely disconnected, of course. An accurate instrument is not necessary. No actual *readings* are required; we have simply to adjust the brush-rocker for a "null" indication (instrument pointer remaining stationary), much the same as when balancing up a Wheatstone bridge.

The shunt field is energised by a battery. If carrying out the experiment on a generator, some thought will have to be given to the battery connections to avoid wiping out residual magnetism, though that is not so difficult to fix if the previous principles have been mastered.

Current is started and stopped in the field winding by making and breaking one of the battery leads. If the rocker is slightly out of neutral a large "kick" will be observed in the millivoltmeter *on break*—there will be a smaller deflection on "make." If the rocker is now carefully adjusted, it will be found that the direction of this inductive "kick" will reverse as we pass the neutral point. Hence, at exact neutral, the pointer should not deflect either way.

It is a most precise method of locating where the e.m.f.s induced in the armature windings exactly balance out or annul one another.



Make and Break one of battery connections, and adjust Brush-rocker until mV. gives zero deflection.

Fig. 6.—"Kick test" for exact neutral position of brushes.

Why is the E.M.F. "Zero"?

A puzzling fact about the kick test is the *zero* resultant e.m.f. when the brushes are set to neutral.

Normally, when using a voltmeter under running conditions, the neutral position gives us the *maximum e.m.f.*, as explained before. But in this standstill test the millivoltmeter indicates zero induced e.m.f.!

Of course, you will observe the conditions are rather different. It is just one more of those points which *test your knowledge* of electromagnetics. I will give you a "clue" to see if you can arrive at the right answer.

Armature coils may "cut" or *be* "cut *by*" magnetic lines. Which is it: (a) when the armature is running? (b) When the armature is stationary? What difference will follow from your answers as regards the relative directions of the induced e.m.f.s in the two halves of the armature of a two-pole machine?

It is well worth a little thought.

An "Exercise"

I am going to conclude this article by giving readers another "fault" to find.

A dynamo fails to generate. But on putting a voltmeter across the terminals it registers a small voltage—only a fraction of what the normal e.m.f. should be.

Which of the following causes do you consider most likely: (1) loss of residual magnetism; (2) brush troubles; (3) a resistance not set correctly to enable the machine to excite; (4) a broken connection, cable or resistance outside or inside the dynamo? Try to be somewhat more detailed than these particulars suggest.

Compare your answers with mine in the next article in this series.

(To be continued)

Inventions of Interest

Clothes Washing Reform

TO obviate the disadvantages of the current system of ablution of clothes, an inventor claims to have discovered a superior method of freeing our garments from dirt.

The originator of the idea points out that the present way of laundering is to place the soiled articles in a drum containing a rotary cage. This drum is fed with a succession of cleansing and rinsing liquors at various temperatures up to 212 degrees F.

The articles remain in the drum for an appreciable time, during which they are subjected to frictional movement. They are then removed and transferred by hand to separate and distinct water-extracting apparatus.

This process, the inventor declares, wastes cleansing materials, heat and labour. And there is risk of damage by tearing the articles by the method of removing them from one apparatus to another.

The severity of existing mechanical washing is due to the fact that most soiled or foreign matter is grease ingrained in the fabric. Before this foreign matter can be removed the grease must be liquefied by heat and subsequently emulsified by chemicals to prevent re-deposit on the articles.

The new method arranges for the articles to be fed by means of a conveyor belt into a bath containing a volatile organic solvent capable of dissolving grease. Through this they are conveyed between a conveyor belt and a series of guide belts narrower than the former and offset in respect to each other. As a consequence, every part of the article is subjected to treatment with the solvent while passing through the bath.

The articles are then freed from the solvent whilst being conveyed on a conveyor belt. And they are then washed in a further bath containing an aqueous washing liquid. Through this they are conveyed in such a manner that every part is subject to treatment by the aqueous liquid.

Potato Planter

THE potato is still an important part of our diet. And any method of assisting in its culture contributes towards the nutrition of the nation.

An invention for which a patent in this country has been applied belongs to that family of potato planting machines which have a rotary disc disposed approximately in a horizontal position. This disc has a circular row of openings. And there is a cup for each potato.

The potatoes are fed to the rotary discs at one or more positions, being moved around the axis of the disc as it rotates to a delivery position at which they leave the disc and pass into the ground.

In such machines the inventor states that it is known to use a rotary disc conveyor having a circular row of openings in which the potatoes are placed. These are supported between the loading and delivery positions by a stationary plate beneath a conveyor.

The object of the inventor in the present instance is to construct a potato planter of the kind referred to, wherein the potatoes are delivered at two or more positions spaced apart transversely and in which the distance between the deliveries can be varied.

The new device has beneath the conveyor a plate which can be moved to adjust the position at which the potatoes are delivered.

Lorry and Breakdown Vehicle

A RECENTLY accepted application to the British Patent Office relates to motor road vehicles designed to serve the dual purpose of a breakdown or salvage vehicle, or of a lorry for transport of material in bulk.

The main object of the device is a lorry which can be converted for the purpose of salvaging motor vehicles without detriment to the capacity of the vehicle used as a lorry.

According to the invention, a vehicle is fitted with a crane on bearers which are below the normal floorboards. This is so arranged that the crane can be lowered to take up its position entirely beneath the floor of the vehicle so that it does not occupy the normal loading space.

The arrangement may be such that, without any difficulty, and by means of a simple control, the lorry can be changed from its character as a carrier of loads into a salvage vehicle for breakdown work and vice versa.

In the main the invention is applicable to motor-driven road vehicles; but it can be equally well applied to rail vehicles.

Telescopic Ladder

IT is worthy of remark that during many centuries the ladder has not materially evolved from its original pattern.

However, the telescopic ladder is a variant from the conventional design. And a development of the telescopic ladder is the subject of an application for a patent in this country.

This collapsible ladder comprises a main portion formed from a pair of laterally spaced metal tubes. These at intervals are connected by transverse treads.

There is a secondary portion pivoted to the main portion. And side members in one pivotal position of the secondary relative to the main portion can slide within the tubes to form an adjustable extension to the main portion.

This can be housed practically completely within the tubes when not in use. Locking means are provided for securing the side members when extended.

Consequently, there should be no danger of the collapse of the ladder occurring at an unpremeditated moment.

Another Housing Plan

THE housing problem is ever with us. Yet another inventor has thought out a new scheme for the erection of a building cheaply, simply and quickly.

He has a further object in view. This consists of improved pre-formed panels for the walls of the building.

The design incorporates double walls formed by spaced inner and outer walls. These comprise pre-formed panels arranged side by side, each of which reaches the height of a storey.

There is horizontal metallic tubing extending longitudinally in the space bounded by the inner and outer walls, which is tied to the double walls.

There is also a continuous lintel course which is cast on the spot. Into this the upper ends of the walls are checked; also a pre-cast sill is formed in its upper surface with two spaced grooves in which the lower ends of the walls are arranged.

The vertical edges of the pre-formed panels may be made with what are known as "bird's-mouth" recesses.

The Westland-Sikorsky Helicopter

Representatives of Government departments and leaders of industry attended a demonstration recently of four-seater Westland-Sikorsky helicopters, the first commercial machines of this type to be seen in Europe. Great interest is being shown in these machines, one of which is seen in flight in the illustration.

The Lightest Substance Known

Hydrogen Gas and Its Industrial Production

By J. F. STIRLING

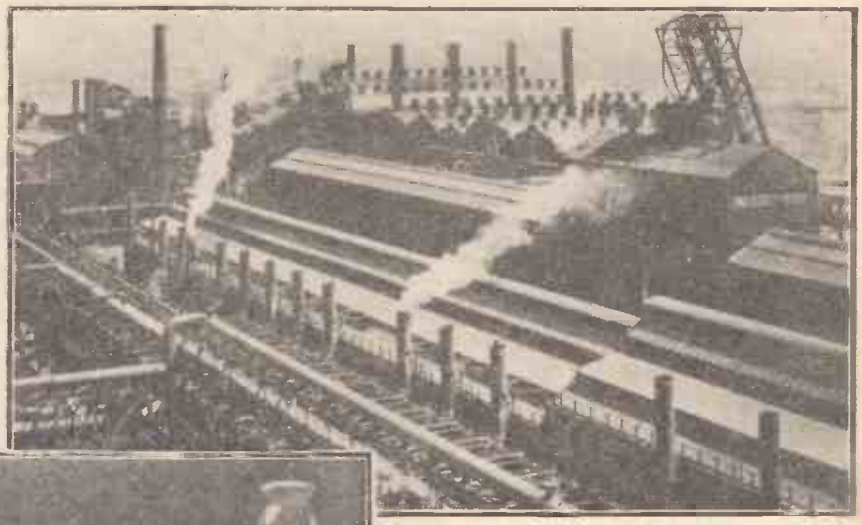
MANY of us well remember our schoolboy experiments in the making of hydrogen, No. 1 of all the chemical elements. How we fitted up, with some excitement, a jar containing fragments of metallic zinc or iron, and how afterwards we slowly poured dilute sulphuric or hydrochloric acid down a glass funnel which passed through the cork in the neck of the jar or bottle, thereby disengaging a rather impure hydrogen gas when it came into contact with the metal within the jar.

And, often enough, we have memories of a rather sensationally shattering explosion which brought the chemistry master hurriedly to the scene, this occurring when some impatient spirit applied a light to the end of the delivery tube before ascertaining that the air in the jar had been completely displaced by the generated hydrogen.

What the chemistry master would say on such occasions all depended on the precise temperament of the said individual. Nevertheless, the familiar explosion served to engrave on our minds for all time the well-known fact that:

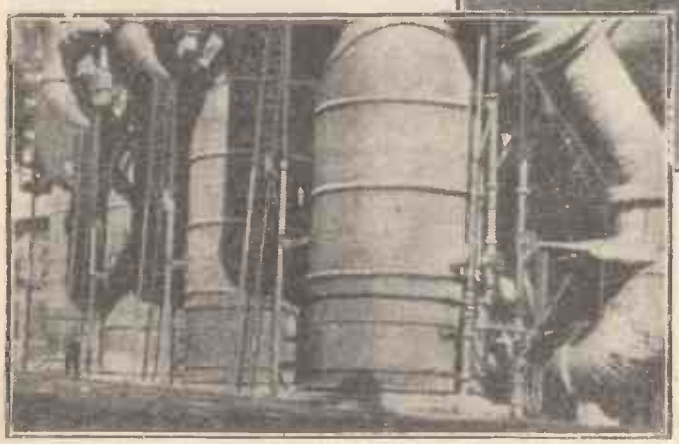
$$2H + O = H_2O.$$

It is a long cry from the making of hydrogen in a bottle to the manufacture of untold thousands of cubic feet of this peculiar and most important gas on an industrial scale. And yet the industrial methods of hydrogen production simply copy the well-known laboratory methods, bringing to a fine art the control of the chemical principles involved.



Exterior view of a modern water gas plant for hydrogen production.

The simple method of making hydrogen by the action of a dilute acid on iron or zinc contained in a bottle or jar.



Before, however, concerning ourselves with a survey of the modern industrial methods of hydrogen production, let us deal briefly with some of the more remarkable features of this very important gas.

Remarkable Lightness

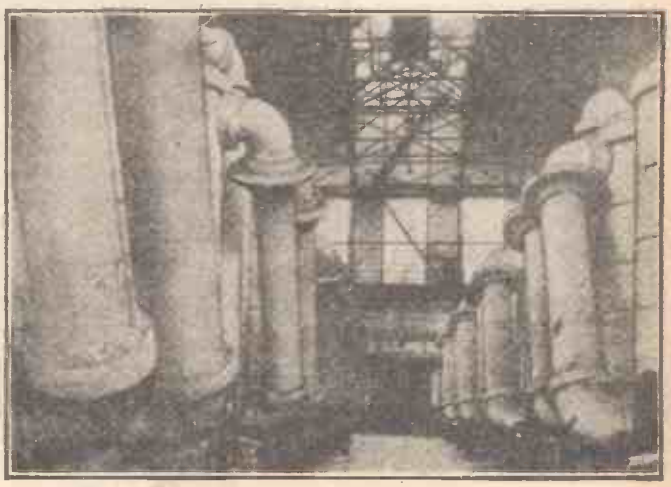
Its most outstanding character is, of course, its weight—or, rather, its comparative lack of weight. Apart from sub-material entities, such as electrons and protons, pure hydrogen is easily the lightest thing known. It is 14 387 times lighter than air and 11.124 times lighter than water. At a temperature of zero (0 deg. C.) and under normal barometric pressure (30in. of mercury), 1,000 cubic feet of hydrogen weigh 5.6lb. The same volume of dry air under similar conditions would weigh nearly 81lb.

A good way of demonstrating the essential lightness of hydrogen is to allow a small jet of it to issue in the path of a powerful light beam, such as that of a lantern projector. Owing to the difference in refractive powers of hydrogen and air, a distinct shadow of the issuing hydrogen will be thrown on the screen, and it will be seen that the gas instantly proceeds upwards after escaping from the end of the jet.

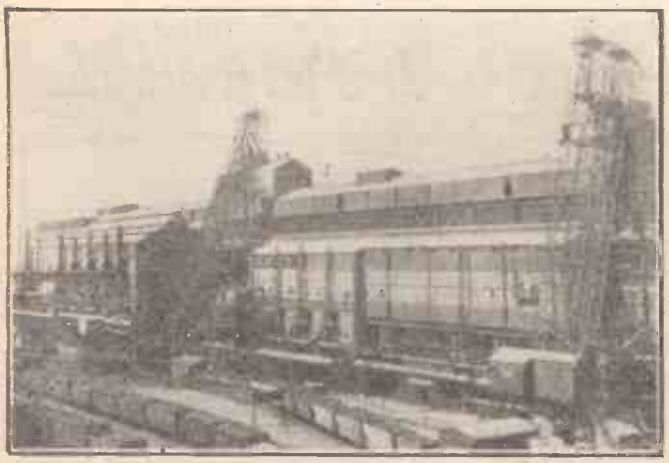
Because of its lightness, hydrogen is very difficult to store. It is a veritable escapologist of gases, being able to find its way through walls of vessels, through joints and connections and through an almost innumerable variety of materials, particularly when it is stored under pressure.

Even the earth cannot retain its hydrogen. Although this gas is present to some extent in volcanic vapours, it quickly ascends to the upper regions of the atmosphere, from whence it rushes off into free space. Hence it is that the stratosphere only contains the merest trace of hydrogen, say, one part of the gas in a minimum of 20,000 parts of air.

Hydrogen is completely colourless, non-poisonous and odourless. The rather bad smell of the gas, as it is commonly prepared by way of experiment on laboratory benches, is entirely due to impurities. The gas, as we all know, is inflammable. Indeed, mixed with air in the right proportions, a highly



(Above) Saturation towers used in the purification of industrial hydrogen. (Right) A vista of the giant I.C.I. hydrogen plant at Billingham.



Another view of the I.C.I. hydrogen plant.

explosive gas is produced. Fortunately, this explosive mixture requires a red-hot body to ignite it, but, given that requirement, the resulting detonation is almost instantaneous, producing a shattering gas pressure and a great amount of heat. Indeed, if the ignition temperature of a hydrogen-air or a hydrogen-oxygen mixture were lower than red heat, hydrogen would be too dangerous a commodity to use under any ordinary conditions.

The only available method of storing hydrogen for industrial uses is in steel cylinders which are usually painted red to distinguish them from oxygen cylinders. In such containers, the gas is stored under a pressure of some 1,800lb. per square inch. A large-size hydrogen cylinder of 8in. diameter and nearly 12ft. overall length weighs about a seventh of a ton and contains approximately 370 cubic feet of hydrogen gas. Larger storage cylinders have been used, but only for very special purposes.

The first large-scale use of hydrogen gas comprised the filling of balloon and airship envelopes, and at one time it looked as if a large amount of industrial hydrogen would be required for this purpose alone. But the exceedingly high degree of inflammability of the gas, coupled with its intense detonating properties, were emphasised again and again by severe airship disasters, so much so that designers of aircraft were willing to forgo the advantages of hydrogen's extreme lightness and to substitute the non-inflammable, more expensive helium gas for it whenever they could do so, in spite of the fact that helium, although the second lightest of the elements, is substantially heavier than hydrogen and consequently is incapable of giving the same "lift" as an equal amount of hydrogen.

The modern aeroplane, however, has taken the mastery of the air from the lighter-than-air airship, and for this reason the only employment of hydrogen in aircraft work is for the filling of captive balloons.

At the present time the two most important large-scale uses of hydrogen are for the purification and hardening of oils and fats and for the production of synthetic ammonia. These two industrial processes consume enormous amounts of hydrogen annually and the demands on them are still increasing.

Hydrogenation of Fats

Fat hardening by means of hydrogen is, indeed, of great importance in our modern times, for without this process we should have come through the last two major wars very badly. About the beginning of the present century two French chemists, Sabatier and Senderens, stumbled on the fact that when a vegetable oil or fat is heated with finely divided metallic nickel in the presence of hydrogen under pressure the hydrogen combines with the fatty substance, converting the oleic acid in the soft, fatty matter into the harder stearic acid. In this way it was shown that high quality, odourless fats could be obtained from cheap raw materials, such as vegetable oils, and, indeed, it became possible for a liquid or semi-liquid fatty substance to be hydrogen-purified and brought to any required degree of hardness. Not only was the soap-making industry practically revolutionised, but that once-despised commodity, margarine, took upon itself a new meaning, and its manufacture became an industry of almost gigantic proportions. Hydrogenation made the margarine industry.

Ammonia is a substance of tremendous commercial and industrial import. It is really a gas which is composed of one part of nitrogen and three parts of hydrogen—NH_3. For the manufacture of explosives, fertilisers and for many other purposes it is essential.

Now, a large amount of ammonia compounds used to come from the gasworks of Britain, but this source of supply was ultimately unable to keep up with the demand. Then synthetic ammonia—originally a German process—came along and demonstrated how the nitrogen of the air could be "fixed" by heating it under pressure mixed with hydrogen in the presence of a suitable catalyst, or reaction-promoter, whereby a proportion of ammonia gas is formed.

A certain amount of hydrogen is commercially used in the manufacture of electric bulbs and other types of lighting and discharge tubes, this hydrogen having to be of very high purity. For synthetic chemical uses, also, hydrogen is required, whilst, of course, the ordinary process of gas welding thoughout the whole gamut of industrial engineering activities brings a continual demand for hydrogen for the production of the intensely hot oxy-hydrogen flame.

It will be seen, therefore, that hydrogen gas is an industrial commodity of the very greatest importance. Because of this fact, its economic production in a state of purity has occupied the attentions of many minds during the present generation.

Hydrogen can be made commercially by several methods, the three most important being: (a) the electrolytic method, (b) by the decomposition of steam by heated metals, (c) from "water gas," which is a mixture of hydrogen and carbon monoxide together with a certain quantity of impurities.

Electrolytic Hydrogen

The electrolytic method of hydrogen production gives the purest gas, and for those purposes for which hydrogen gas of the highest degree of purity is essential, such as, for example, the manufacture of electric bulbs and discharge tubes containing hydrogen, the "electrolytic" gas must be employed.

The electrolytic process is exceedingly simple, cleanly and straightforward in working, consisting as it does merely of the continual electrolysis of acidified (or alkalinised) water in a multi-cell apparatus. Since water, H_2O contains two atoms of hydrogen for every one atom of oxygen, the volume of hydrogen which is liberated by electrolysis is twice that of the oxygen which is simultaneously generated. Both gases are collected separately, and a purity amounting to 99.5 per cent. for oxygen and 99.75 per cent. for hydrogen can be guaranteed.

The success of the process depends upon cheap electric current and on a ready means of disposing of the accompanying oxygen. The electrolytic process of hydrogen generation has the decided advantage that its plant is very compact and that it can be made into portable or semi-portable units. Many soap and margarine producing firms now make their own hydrogen by electrolysis of water, thereby eliminating the costly transport of heavy cylinders from place to place.

Undoubtedly, therefore, electrolytic hydrogen generation is the best of all industrial processes whenever such can be conveniently and economically applied.

Steam-generated Hydrogen

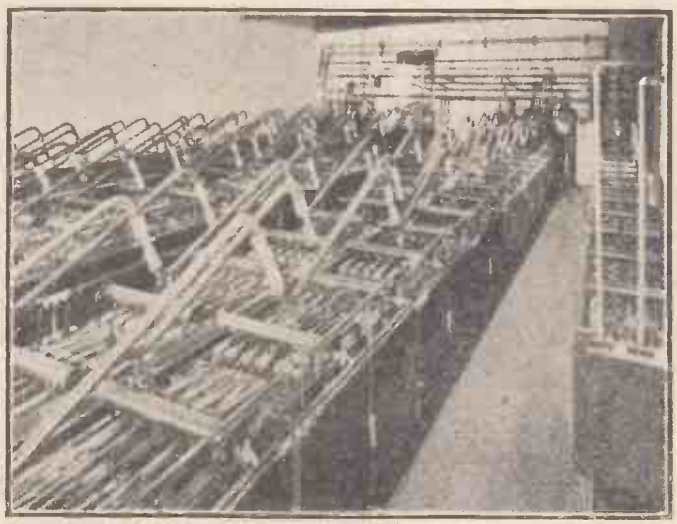
The principle underlying the industrial manufacture of hydrogen by means of the decomposition of steam by certain metals is to be seen in the following chemical equation:

$$3Fe + 4H_2O = Fe_3O_4 + 4H_2$$

Iron Steam Iron oxide Hydrogen

This is, perhaps, the process which is responsible for the greatest amount of industrial hydrogen. The plant can be operated at a low cost and a hydrogen of practically 98 per cent. purity can be obtained. An average plant of this nature will have a hydrogen output of about 7,000 cubic feet per working hour.

Although other metals, such as zinc and magnesium, will decompose steam into hydrogen, iron is found to be the best metal for this industrial use. In practice, lumps of spathic iron ore are packed into large annular retorts which are heated within a temperature-range of 600-750 deg. C. First



A battery of modern electrolytic cells for the generation of pure hydrogen.

of all, to start the process, water gas which has been purified from sulphur is passed through the red-hot iron ore. Since the water gas contains hydrogen, the hydrogen combines with the oxygen present in the oxide ore, forming water (steam) and leaving behind metallic iron in a peculiar soft or spongy condition. Steam is then blown through the spongy iron at a carefully controlled rate, whereby the metallic iron combines at that temperature with the oxygen of the steam, leaving the hydrogen unchanged. The outgoing gas is passed through suitable purifiers which remove any traces of carbon dioxide and sulphur, any remaining traces of impurities being only carbon monoxide and nitrogen.

After all the iron has been oxidised or "spent" by the steam, water gas is again passed through the retorts in order to reconvert the iron oxide into metallic iron. And so the process goes on.

Eventually, however, there comes a time when the iron becomes "poisoned" and, therefore, less active. This is due to the retention of tiny carbon particles in the pores of the spongy iron. The iron in this condition may, however, be revived and, for a time, given a new lease of life by passing a current of air through the red-hot material, the air burning out the carbon and leaving the iron free and unencumbered again. After two or three of such re-activations the iron begins to lose its cellular condition. It crumbles, and in such a condition it has to be rejected. A good hydrogen plant of this description, however, will only require two or three renewings with fresh iron ore every year.

The Water Gas Process

For the running of this process, water gas, as we have seen, is necessary for the periodic reduction of the iron oxide to metallic iron. Hydrogen gas may, however, be produced directly from water gas, which, as previously mentioned, is a mixture of hydrogen and carbon monoxide, plus impurities, an average analysis of this gas being as follows:

Hydrogen	50.0 per cent.
Carbon monoxide	42.0 „ „
Carbon dioxide	4.0 „ „
Methane	0.5 „ „
Nitrogen	3.2 „ „
Hydrogen sulphide	0.3 „ „

Plus traces of oxygen.

It is made by blowing steam over red-hot coke in iron retorts, whereby the following reaction takes place:

$$C + H_2O = CO_2 + 4H_2$$

Coke Steam Carbon dioxide Hydrogen

But the carbon dioxide produced in the above reaction takes up another atom of carbon from the glowing coke in the furnace and becomes transformed into carbon monoxide gas. Thus:

$$CO_2 + C = 2CO_2$$

Carbon dioxide Coke Carbon monoxide

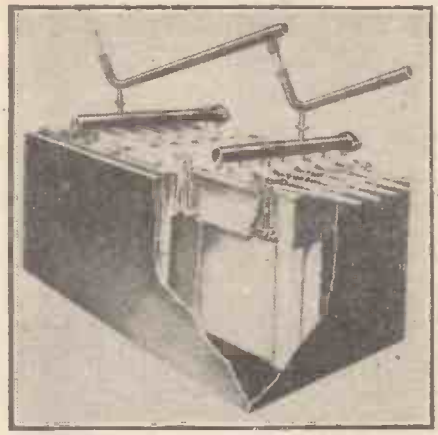
thereby giving a finished product containing approximately a 50 : 50 mixture (by volume) of hydrogen and carbon monoxide.

Next comes the work of removing the hydrogen from the "blue" gas prepared as above and so styled on account of the colour of its flame.

Freezing Process

One well-known process is to highly compress the gas and to allow it to expand in a special apparatus similar to a liquid air plant. The expansion causes strong cooling. After this has been repeated several times the temperature drops to the minus 200 deg. C. mark, at which point all the gases, except hydrogen, liquefy. The hydrogen passes on unchanged. The carbon monoxide is separately collected and is used as fuel for the gas engine compressor which operates the plant. Hence continuous running at very low cost is effected.

Another process—the Badische process—of obtaining hydrogen from water gas consists of mixing the purified water gas with steam and then passing it over a catalyst



A typical "Knowles" multi-cell for the manufacture of electrolytic hydrogen.

of finely divided nickel, iron or chromium which is heated to about 400-500 deg. C. Under these conditions the carbon monoxide combines with the water (steam), producing carbon dioxide and hydrogen:

$$CO + H_2O =$$

Carbon Monoxide Steam

$$CO_2 + H_2$$

Carbon dioxide Hydrogen

thereby generating an additional amount of hydrogen. The carbon dioxide is removed by passing the gas under pressure through water (which dissolves it—on the principle of the soda-water bottle), and traces of remaining carbon monoxide are removed by passing the gas through an ammoniacal solution of copper chloride.

The gas finally delivered up by this process consists of hydrogen containing anything from 4 to 7 per cent. of nitrogen, which latter gas cannot be removed economically. However, for many industrial processes, this degree of hydrogen purity is quite ample.

Hydrogen from Caustic Soda

A less known process of hydrogen manufacture is one which was operated some years before the war. It was the "Silicol" process, and it had the advantage of being operated in small portable units.

A hot, strong solution of ordinary caustic soda was poured into a gastight tank, and finely powdered ferro-silicon (containing some 90 per cent. of silicon) was dropped into the caustic solution from a hopper fixed above the tank. Immediately, a large amount of hydrogen was generated and the process continued until the soda solution lost its activity. The generated hydrogen was washed in a portable gas scrubber. It was estimated that a ton of a suitable ferro-silicon would generate about 56,000 cubic feet of hydrogen. Granulated aluminium could be used instead of the ferro-silicon, but the expense was greater.

A portable unit of this type required a rather skilled and experienced operator to control it, but, given this requirement, the hydrogen purity was quite satisfactory.

Other "small" methods of hydrogen production are still available and are, indeed, occasionally worked. Nowadays, however, apart from the mass-scale generation of hydrogen from water gas or from steam by the iron decomposition method, the industrial trend is towards electrolytic hydrogen, since this latter process is one which is simplicity itself, and which generates hydrogen gas of almost exceptional purity for all possible industrial uses.

(For permission to use the illustrations of industrial hydrogen plant accompanying this article, we are indebted to I.C.I., Ltd., and to the International Electrolytic Plant Co., Ltd., of Chester.)

VIRGINIA TO LONDON IN 24 HOURS

World-famous Virginia-cured hams now fly by Clipper to consumers in Europe. These hams, which are flown to Washington National Airport in a small wagon-type 'plane, are seen in the illustration being loaded on to a Pan-American World Airways Clipper for delivery in London.

Infra-red Photography

Making Infra-red Pictures Without Special Apparatus

By J. F. STIRLING

THERE is nothing particularly mysterious about the modern art of infra-red photography, and there is certainly nothing difficult about its technique, provided that one possesses a plate or a film camera which is capable of giving time exposures. In such an instance, all the apparatus necessary is a single infra-red filter to attach to the lens. This filter holds back all visible light and only permits the invisible infra-red rays to pass through the lens and so affect the plate or film within the camera.

An ordinary photograph of a garden on a summer evening.

The same view taken in the infra-red.

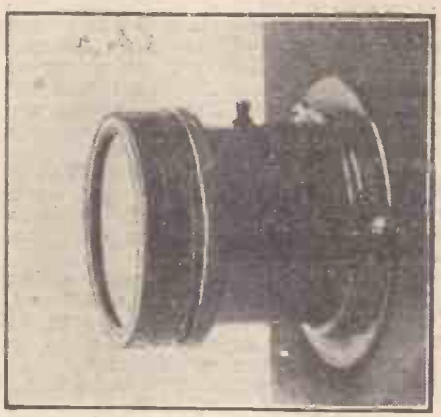
There is nothing particularly new about infra-red photography, despite the great amount of technical publicity which it received a few years ago. As far back as 1880, Captain Abney, one of the foremost technical photographers of his day, prepared infra-red plates with which he was able to photograph the solar spectrum as far as a wavelength of 10,000 A. Professor Wood, too, about 1906, made a number of excellent landscape views in the infra-red, but in consequence of the great lack of infra-red sensitivity of the photographic emulsions then available photography in the infra-red was, perhaps rightly, looked upon merely as a sort of technical curiosity.

It was the discovery of the blue dyestuff, Kryptocyanine, in 1919, that placed infra-red photography on the photographic map, as it were, for, although other dyestuffs are known to possess infra-red sensitising powers, it is this dye in particular which imparts to the photographic emulsion the power of "seeing" far into the infra-red and of responding to wavelengths of radiated energy to which our own eyes are hopelessly insensitive and "blind."

It is possible nowadays to obtain specially sensitised photographic plates and films with which infra-red pictures can be taken in the fraction of a second. This material is, of course, scarce at the present time, and it is not mainly for fortunate possessors of such material that this present article is written. Rather, our intention in these columns is to point out how good infra-red pictures may be produced with the average panchromatic or red-sensitive plates and films which are now becoming fairly freely obtainable. Naturally, such material is not sensitive to the very "far" infra-red rays. Nevertheless, if we are content to work in that region of the spectrum which is just beyond the visibility of the deepest red, and if we are prepared to give adequate time exposures, then all the spectacular and fantastic effects which can be produced in photographic infra-red work are ours merely for the little extra trouble involved in producing them.

Angstrom Units

The wavelength of light and of other kinds of radiated energy is commonly measured in "Angstrom units," one Angstrom unit being one ten-millionth part of a millimetre. Now, as the reader will be well aware, visible radiations which we term "light" range from the violet rays, having a wavelength of about 4,400 A., to the deep-red rays with wavelengths of around 7,500 A. Beyond the violet rays we cannot see visually. Neither can we visually perceive the infra-red rays which have wavelengths longer than about 7,500 A. We can feel such rays as heat, but our unsensitised eyes cannot detect them. This, then, is the region of radiated energy which, for the most part, we deal with and record in infra-red photography. It constitutes the invisible heat rays which are radiated from a hot body just before it reaches the temperature of dull-redness.



The infra-red filter in position in front of the camera lens. It completely cuts off all rays except those of the infra-red region.

Naturally, there are plenty of such wavelengths of energy in daylight—and still more in direct sunlight—because all our light is derived from the sun, and because the

A leafy lane. A normal photograph taken on a spring day.

The same leafy lane as it appears in an infra-red photograph.

A copper-beech tree in full foliage. A normal photograph.

The copper-beech as it appears when photographed in the infra-red.

sun is a hot body radiating heat as well as light it follows that such infra-red waves must always be present in natural daylight.

It is, of course, readily possible to filter out from white light all its infra-red content. This may be done, for instance, by passing the light through a special blue glass which retains all the various wavelengths of the light-energy except those which give rise to blue light. Such a glass will pass blue light and nothing else. There are also certain chemical solutions, such as alum solution, which have a strong absorptive effect on infra-red rays. Even glass itself absorbs these rays, so that if we were desirous of conducting our photographic experiments far into the infra-red region, we should have to use a lens made of rock-salt crystal, which is quite transparent to infra-red rays.

A Filter Essential

For our purpose, however, we need a filter to place in front of the camera lens. This is essential, and no infra-red photography can be done without it. The infra-red filter is practically opaque to visible light, but it transmits infra-red rays freely. Hence, when it is in position in front of the camera lens, only infra-red rays can pass through into the camera to affect the plate or film inside.

Infra-red filters are made by both the Ilford and the Kodak companies, from whom they may be purchased either direct or through any good photographic dealer. They are supplied in the form of glass discs (or squares), which are inserted into a special cell or holder and are screwed or clipped in position immediately in front of the camera lens. Such filters should only be attached to the lens when about to be used. At all other times they should be kept in the dark lest they tend to fade under continual exposure to strong light.

It is, of course, quite impossible to focus visually the image in the camera with an infra-red filter in position because, as previously mentioned, no visible light is transmitted by the filter. Hence all focusing must be done without the filter, the latter being secured to the lens immediately prior to making the exposure.

Now, although for really serious and scientific work in the infra-red one of the specially sensitised infra-red plates or films would naturally be made use of, the amateur, to begin with, may rely on any normal panchromatic plate or film.

In such an instance, the multiplying factor for exposure will be about 5,000. That is to say, with the infra-red filter in position, the duration of exposure which would normally be given for that particular panchromatic plate or film used will have to be multiplied by 5,000. This seems an enormous multiplication factor at first sight, but, in practice, it means little more than an exposure of a minute (or even less) in good sunshine.

All the infra-red landscape photographs which illustrate this article were taken on ordinary panchromatic plates which were not specially infra-red sensitised, and in no case did the exposure exceed 60 seconds at f/6.8.

Some writers have asserted that specially corrected and adjusted lenses are necessary for getting the best results from infra-red photography. If we except scientific photography far into the deep infra-red regions, such statements are sheer nonsense, because any amateur can get well-defined photographs with an average lens (not necessarily an anastigmat lens), working at f/8 or f/11, if only he will be content to give the necessary prolonged exposure. Any lens, therefore, which will give a reasonable performance in ordinary light will prove quite satisfactory for infra-red work.

Protecting the Plates

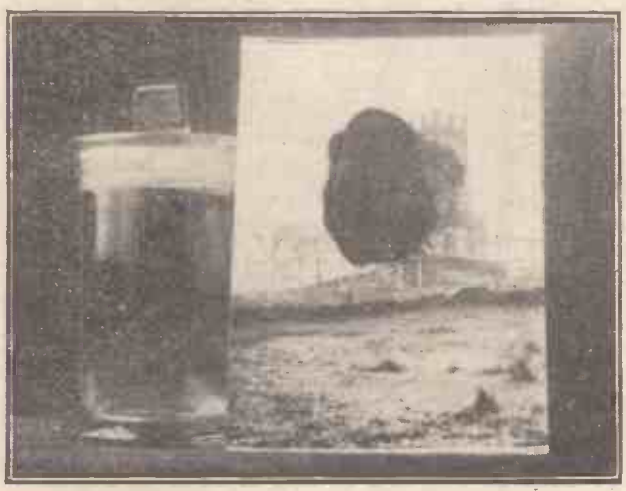
Infra-red roll film is adequately protected, but, as regards plates which are specially infra-red sensitised, it should be noted that wood is not particularly opaque to infra-red rays. Consequently, infra-red plates may become actually fogged whilst lying in wooden plate-holders. For this reason, metal plate-holders are better, since they are free from all possibility of infra-red fogging. When wooden plate-holders have to be used, it is a good plan to line them with the black paper wrapping in which the plates are packed, this material usually being quite opaque to infra-red rays.

Ebonite in thin layers is semi-transparent to infra-red rays. Hence, when the diaphragm or shutter blades of a camera are of thin ebonite or vulcanite, the possibility of infra-red fogging from this source must not be overlooked.

No Special Development

No special remarks concerning the development of infra-red pictures are necessary. The plates or films, whether of the ordinary panchromatic (red-sensitive) or special infra-red sensitised type, are developed in the normal manner, using either a dull-green safelight for the darkroom illumination, or else a bright green light, after prior desensitisation of the plates with Ilford "Desensitol" solution or other desensitising agent.

A good metol-hydroquinone developer is about the best for infra-red work since it is clean in working and does not tend to cause stains. Fixing of the negatives, washing and subsequent printing are all carried out in the normal manner, a contrasty paper being used for printing if the typical "infra-red



A badly stained photographic print taken by ordinary light.

The same print photographed in the infra-red.

characteristics" are to be stressed in the final print.

Infra-red Characteristics

Now, a word about these typical "infra-red characteristics." Sometimes an infra-red photograph, taken on a dull day, may turn out to be very little different from an ordinary photograph taken under the same circumstances, except that all haze will be eliminated and all red objects will tend to come out white.

But let us photograph, say, a corner of our garden or a green, leafy lane, through the infra-red filter. Provided that we have a clear blue sky at the time, we shall get some remarkable results. The blue sky will come out dead black and the foliage will be recorded as white. In other words, we shall get a picture looking as if it represented a night-time snow scene. This is due to the fact that the chlorophyll, which is the green colouring-matter of leaves, strongly reflects infra-red rays Hence these areas appear dead white in the finished photograph, just as a white surface strongly reflecting ordinary white light would appear perfectly white in an ordinary photograph.

The blue sky, however, and all other blue objects, strongly absorb infra-red rays, and for this reason, no infra-red energy proceeds from these quarters. The infra-red emulsion is unaffected in these areas. Consequently they appear black in the finished photograph.

Most red objects reflect infra-red rays and appear white in an infra-red photograph. A clean brick wall, for example, will appear almost as if it had been whitewashed. But if the wall is dirty and grime-laden, the whitewash effect will not usually be forthcoming.

Red leaves and red flowers reflect infra-red rays equally with the green chlorophyll of their leaves. Hence they all appear white in the infra-red photograph, as witness, for example, the accompanying infra-red photograph of a copper-beech tree in the full glory of its summer foliage.

Portraits in the Infra-red

Quite a lot of interest may sometimes be obtained from portraits taken in the infra-red. Using an ordinary panchromatic plate, the subject being in strong daylight and the lens aperture not less than f/6.3, a good portrait may be obtained with a minute's exposure. Using a specially sensitised infra-red plate, the exposure may be brought down to two or three seconds.

In an infra-red portrait, a girl with flaming red hair will appear as a platinum blonde, whilst, often enough, a dark man, despite the fact that he is clean shaven, will appear in the photograph as if he had a week's growth of beard on his face. This is because the infra-red rays "penetrate" the skin and reveal the growing hair roots therein.

Blue eyes in an infra-red portrait tend to come out black and detailless, whilst the skin photographs white. There is, indeed, little beauty in an infra-red photograph, although there is much of scientific interest.

Penetrating Powers

The penetrant powers of infra-red rays are frequently employed in infra-red photographs, not only in criminal-detection work but, also, in examining old paintings and manuscripts and in revealing details and markings which have long remained hidden from the normal sight.

Such an instance is illustrated on page 383 by means of a pair of comparison photographs. In the one, a badly stained photographic print is shown, the stain being brown-black in colour. Photographed on an ordinary plate, it prints out as black. The same print copied through an infra-red filter is revealed in its original state—just as though the stain were not there. Such is the power of the infra-red for "seeing through" obliterations and other markings. Note in this pair of photographs that the glass jar, being white in hue, photographs identically with and without infra-red technique.

Often, photography in the infra-red is of great aid in penetrating distance. An ordinary photograph taken on a misty day may reveal little or nothing in the distance, but the same view taken in the infra-red may render good detail in the far distance, thereby illustrating the power of the infra-red rays to travel unimpeded through haze and mist.

This, however, is not always the case. The power of the infra-red rays to pass through mist depends on the size of the water particles constituting the mist. If these particles are above a certain limiting size, the infra-red rays will not be able to penetrate them. Hence, it is quite untrue to state that the infra-red rays will under all circumstances penetrate atmospheric mist and fog.

Another very useful technical branch of infra-red photography is the photographing of furniture. Here the inner grain of the wood is brought up clearly—almost, perhaps, unnaturally. Despite this, such photographs often prove of use and value.

Using Artificial Illumination

Needless to say, infra-red photographs can be made by artificial light as well as by daylight. Arc lamps and the usual "daylight" fluorescent discharge lamps are not suitable illuminants for infra-red photography, but ordinary gas-filled filament lamps are excellent for the purpose. In all such instances it is advisable to use special infra-red sensitised plates in view of the very long exposures which would be necessitated by ordinary panchromatic plates.

Using a couple of 100-watt filament lamps, an infra-red plate and a lens aperture of about f/8, an average indoor infra-red exposure would be about 20 seconds.

Perhaps the most spectacular of all experiments in infra-red photography is that of taking photographs in the dark. This is quite possible. A specially sensitised infra-red plate or film must be used, but in this case we do not need an infra-red filter in front of the camera lens, since the photograph is to be taken in complete darkness. The object, however, is strongly "illuminated" by invisible infra-fed rays proceeding from an electric lamp or lamps which are screened by an infra-red filter. In such instances, an exposure of a few seconds suffices to give a perfectly well-exposed image on the plate after development, the infra-red rays, which our eyes have not seen, having had sufficient energy to affect the plate or film and therefore to produce a developable image.

Mathematics as a Pastime—7

Falling Bodies

By W. J. WESTON

MANY of the truths, familiar and now obvious to you, were of comparatively recent discovery. In Queen Elizabeth's time it was assumed that if a body was in motion an impulse must be acting upon that body. The impulse ceasing, motion would cease. Such a fact as the motion of a cannon ball long after the propelling explosion was explained, for instance, by the reaction of the air; inertia as a force was hidden. It was believed, too, that nobody could have two motions at the one time—that the path of the cannon ball was straight from the muzzle and, suddenly, straight down.

Falling Bodies

Perhaps to you the most curious of the misconceptions was in regard to falling bodies. It was taught that a heavy body fell more quickly than a light body, the velocity being proportional to the weights. Galileo, our Milton's friend, by his simultaneous dropping of stones from the tower of Pisa, effectively showed the error of that notion at any rate.

It was left to Newton, however—who died after the eighteenth century had run a quarter of its course—to give exact measurements about falling bodies. One such measurement you need for this problem. His experiment whereby he showed that in a tube emptied of air a golden guinea and a feather dropped together was the forerunner of the measurement of the acceleration of a freely falling body, the acceleration, that is, due to gravitation. This g, as you know, varies for different positions on the earth; but 32ft. per second is near enough for our purposes.

Well, will you plot the first three seconds' path of a falling bomb? A little of the bomb-sighter's problem will then appear. Give your aeroplane, flying at 3,000ft. on a level course, a speed of 100 miles an hour; and leave out for a while the disturbing effect of air-resistance on the bomb.

Being released, the bomb will have its horizontal speed of 100 miles an hour (which is 146⅔ft. a second); and it falls—in the first second 16ft., in the second 48ft., in the third 80ft., and so on. And, since $\frac{1}{2}gt^2$ is 3,000, t is 13½ seconds. Before it reaches the target, the bomb will travel 146⅔ft. × 13½ft., or 660 yards, horizontally; and to obtain a hit the bomb-aimer must release his bomb that distance short of his target.

The bomb travels close to the aeroplane for a little while, but its velocity soon takes it far below.

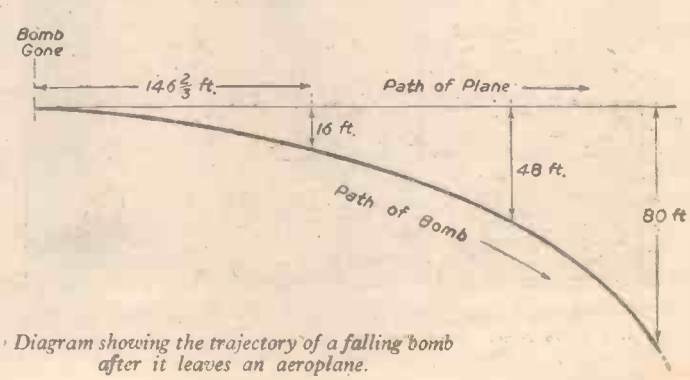


Diagram showing the trajectory of a falling bomb after it leaves an aeroplane.

Rocket Propulsion

Improved Aircraft Rocket Engines

By K. W. GATLAND

(*Continued from page 351, August issue*)

A short runway is no obstacle to this "Seafire" equipped with R.A.T.O.G. Its four rockets, containing 26lb. of cordite apiece, deliver a total thrust of approximately 4,400lb. for four seconds.

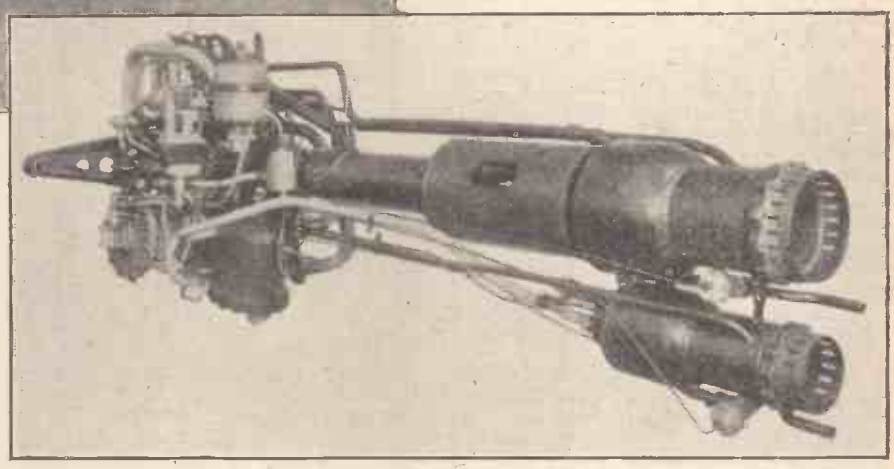
THERE are two further applications of rocket power that merit attention before leaving the subject of aircraft propulsion. One is the *rocket booster* for increasing the climbing rate of fighters and supplying them with excess speed during combat; the other, R.A.T.O.G. (*rocket-assisted-take-off*).

The Rocket-boosted Me.262

It will be recalled that one of the main reasons for the Ba349 "Natter" not going into service was the outstanding performance put up by the Messerschmitt 262 when rocket units supplemented its normal jet power. Germany's home defence squadrons demanded something more dependable than the pure rocket types, an interceptor, in fact, with the climb of a rocket and the endurance of a turbo-jet.

This conclusion came a trifle too late! Much valuable time and material had been gambled on developing the Me.163 series, the Ju.263, and the Ba.349, and the obvious solution to adapt existing jet fighters with powerful rocket-boosters did not materialise until the war was virtually over and the Rhineland's production centres almost too severely shattered to warrant defending.

High hopes were held of the Messerschmitt fighter thus adapted. Its auxiliary rocket unit was said to impart a rate-of-climb far surpassing that of anything the Allies could put into the air, and the two Jumo 004 turbo-jets, which operated as the main source of power, gave the machine a more practical thrust duration than could ever be expected from the use of rocket drive alone. The prospects were certainly encouraging.



The Walter 109,509C developed for the Ju.263. Its main chamber produced a thrust ranging from 220 to 4,400lb., and an additional 880lb. constant was forthcoming from the smaller "cruising" chamber. (*See* PRACTICAL MECHANICS, *Sept.*, 1946, *p.* 420.)

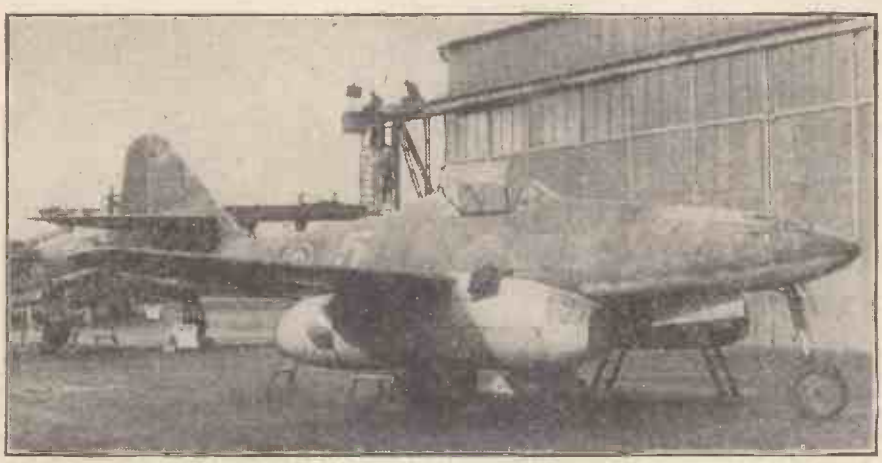
Jumo Engines Under Par

The use of rocket assisted engines in Me.262s seems at first to have been more the nature of a panic measure than a clear-cut scheme to improve the combat efficiency of fighters generally. The fact is that early deliveries of Jumo engines did not give expected thrusts. The rate-of-climb was consequently poor, and so it was decided to incorporate two bi-fuel rocket units to bring the overall thrust up to par.

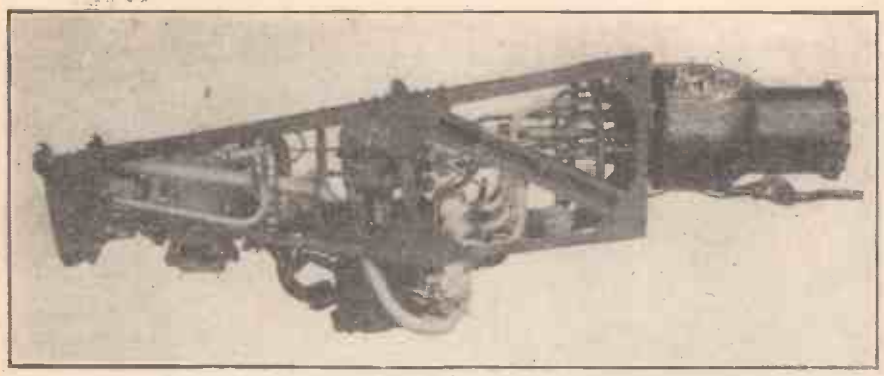
Produced by the Bayerische Motor Werke under the type number B.M.W.718, the two chambers of the initial scheme were rated to deliver a thrust of 2,760lb. apiece and ran on a self-combusting mixture of Salbei (98 per cent. to 100 per cent. nitric acid) and a brown coal fuel known as J-2. One was placed in each engine nacelle over the jet orifice; they fed from a common pump assembly, the control system fitting to a framework inside the fuselage.

There appears to have been a second version of this installation, one that, though it produced a lower aggregate thrust, improved the power duration. It was somewhat similar in conception to the R.11.203 unit used in the Messerschmitt 163A, but with one combustion chamber in each jet nacelle and the ancillaries separate owing to restrictions in space. The propellant was T-stoff (80 per cent. solution of hydrogen peroxide) with Z-stoff (calcium or sodium permanganate) and thrusts of from 220 to 1,550lb. per unit were available at sea-level, although the maximum thrust had to be reduced progressively to 790lb. after climbing 33,000 feet: this was because cavitation occurred at the pump inlets. An endurance of 110 seconds on full thrust was obtained for a total propellant weight of 3,750lb.

Flight tests of this installation were due in the summer of 1942, but the scheme (like



The Messerschmitt 262 might have been highly effective for "home defence" had rocket boosters arrived in time. This one was captured intact and is seen here with British markings.
('By courtesy of "The Aeroplane.")



One of the neatest rocket engines produced by Walter was this 109/509S2 booster for the Messerschmitt 262. It was mounted externally below the centre-section.

so many others before and after it) was cancelled before any proper trials could take place. Improved *jet* engines had arrived!

The Lull Between

Thus, an idea which might have turned up trumps had more time been given to its development was laid aside. Meanwhile, work continued with primary aircraft rocket engines with the results that we have already seen; but had Germany's technicians been allowed to proceed with controllable rocket boosters, and all efforts concentrated on producing the Messerschmitt 262, the story might have been quite different.

However, it was more than a year later that the German Air Ministry saw fit to revive the contract with Walter, and a second experimental programme was launched in the summer of 1944 under the title "Heimatschutzer."

There were several versions of boost rockets produced under this heading, both by Walter and B.M.W. The first was simply a modified Walter 109/509A2 (as used in the Messerschmitt 163B) fitted in the extended tail of a special Messerschmitt 262. The adapted engine, which had involved some rearrangement of its components in order to bring forward as much of the weight as possible, was known as the 109/509S1; the performance figures quoted for the two units were near enough identical.

The best figures for climb put up by this machine—with the rocket unit supplementing the thrust of twin Jumo 004 turbo-jets at "maximum safe" boost—was 170 seconds to reach 23,000ft. The test took place at Lechfeld in February, 1945, but although the performance was encouraging, the installation was so bad from the maintenance point of view that it could not be used in service. Therefore, work on a second Walter engine, the Heimatschutzer IV (the intervening type numbers having remained projects) was commenced, and this turned out a much more practical proposition. It was selected for immediate development as part of the R.L.M. Emergency Programme and given the official designation 109/509S2.

This second booster consisted of 109/509A2 and C components rearranged within a neat framework which hung below the wing centre-section, with two 600-litre tanks containing T-stoff fitted on the bomb racks. One of the internal tanks which normally carried "jet" fuel was modified to contain the C-stoff.

Complete in its mounting, but less cowling panels, the unit weighed 309lb.; the thrust it developed was reckoned to be 4,410lb., a figure that compared favourably with the rating of the main chamber of the 109/509C.

The external tanks could be jettisoned once they were drained, but it is not clear whether this applies also to the booster unit.

It would seem that a great deal of faith was placed in this prototype installation, and it remained on the emergency programme until the end; bench tests had, in fact, only just commenced when the Walter factory at Jenback was overrun by Allied troops in April.

Walter's Best Rocket Engine

The Heimatschutzer IV was expected to be the most efficient of all the rocket engines that Walter produced. It was by no means a makeshift unit as the "S1" sub-type, and, despite the urgency of its production, a great deal of prior consideration had been given to improving performance and *accessibility*.

The value of accessibility in fighter aircraft was made all too clear to the Germans during the "Battle of Britain." If in nothing else, the Luftwaffe pilots must have been amazed at the seeming large numbers of British fighters which, wave after wave, came up to engage them—fighters that their intelligence officers had told them were virtually non-existent. And yet "the few" it certainly was! The secret was in the speed at which the machines could be re-armed and refuelled after landing and then immediately returned to the fray.

What may be termed "ground speed" is designed into a fighter by the provision of convenient access panels, quick-release devices on gun-loading doors, fuel fillers, etc., just as air-speed is obtained by streamlining against air resistance. In fact, so strong is the case for accessibility that *miles per hour* have often to be sacrificed in order that time taken in servicing may be cut down by a few minutes. The rocket-adapted Messerschmitt 262 was an excellent example of this, for the suspended booster must have impaired the aerodynamic efficiency by no small degree; but it *did* allow the combustion chamber to be flushed out quickly and otherwise serviced and refuelled after use with the least possible delay.

Design Features

The control system of this engine differed from those of all previous production units in being *mechanical* instead of pneumatic operating. There were two elements governing combustion, one operating the propellant flow and the other, linked to it, controlling the steam supply to the turbine in sympathy with the thrust. An electric motor geared to the turbine shaft made the engine self-starting.

Another new feature was *combined* T-stoff and C-stoff injectors which were introduced into the combustion chamber to overcome the bad atomisation that had been present in all previous Walter engines when operating at low thrust. These were divided into three stages and were cut in progressively by the control unit.

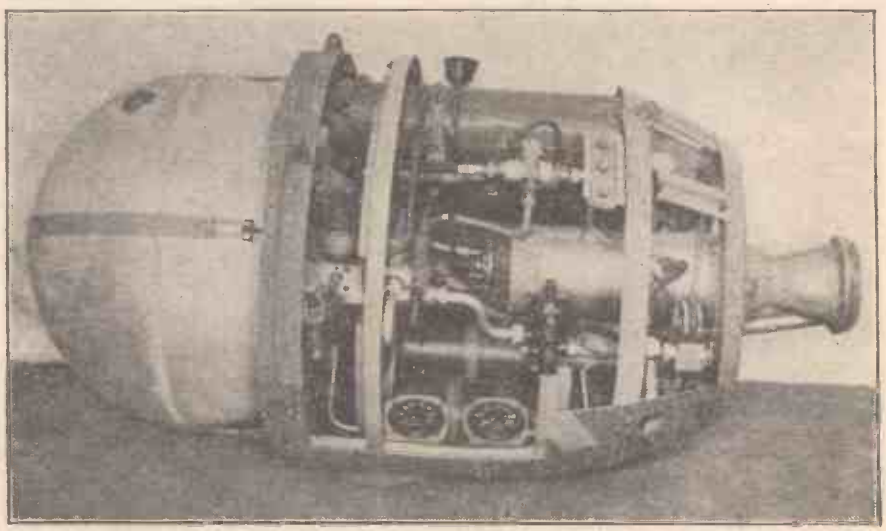
The steam generator was also subject to redesign, though there was no fundamental change.

More Engines of the 109/509 Family

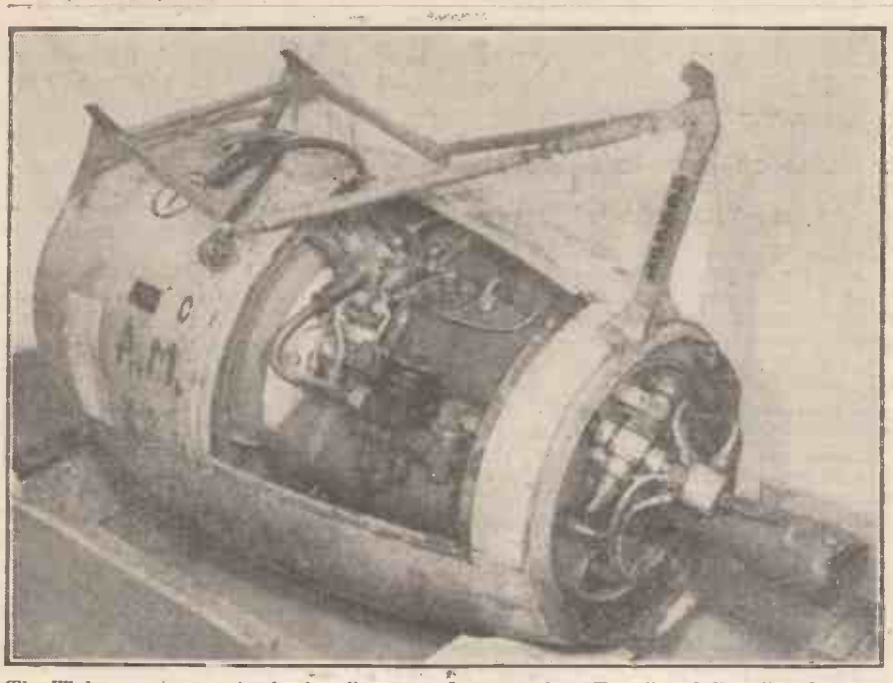
Finally, a word about the other rocket engines which were adapted from the basic 109/509A1 and "A2" units. The next positive step after these was the production of a "B" version having two combustion chambers, one normal size and the other smaller for economical "cruising." It was originally thought to be the "A2," but this sub-type has since been verified as being a simple development of the first production engine, in which the electric starter had been eliminated in favour of a gravity feed T-stoff starter. The 109/509B was a far more ambitious venture and should have replaced the "A2" version on Me.163s about the time of the surrender.

A second unit embodying two chambers was built specially for the Ju263 and was rated to produce a thrust ranging from 220 to 4,400lb., plus an additional 880lb. constant from its cruising chamber. This was the 109/509C.

The sub-type "D" employed exactly the same components as the "A2," but, whereas the latter had a single engine frame, the former was divided into three main assemblies—a pump and control group, combustion chamber, and connecting pipes. It was specially developed for the D.F.S.228 reconnaissance aircraft (see PRACTICAL MECHANICS, May-June, 1947, p. 266), and the perform-



A later A.T.O. unit was the Walter 109/501 which burnt petrol with the oxygen liberated from the reaction of T-stoff and Z-stoff. It produced a thrust of 2,205lb. for 42 seconds.



The Walter 109/500 assisted-take-off motor. It operated on T-stoff and Z-stoff and gave a thrust of 1,200lb. for from 24 to 28 seconds.

ance was precisely the same as the "A2," despite an increase in weight of 220lb. over the original 353lb.

A "Utility" Rocket Engine

Last in the 109/509 series was a "utility" engine for use in production Ba.349 "Natters." Initial work on this unit was carried out on a standard "A2" engine which, in modified form—the components simply having been repositioned to suit the new airframe—became known as the 109/509A2E. Again, the same performance as the parent was maintained, as also, on this occasion, was the weight.

Tests with this prototype engine were started in the autumn of 1944 and an order for 15 experimental units to a much simplified design (i.e., with an uncooled combustion chamber, a simplified pump and control arrangement and without electric starting) was placed with Walter shortly afterwards, only to be cancelled in February, 1945, by which time the war had become so desperate for Germany that all but the most outstanding projects—and out of these only the ones likely to be perfected quickly—were dropped. The Walter boost rockets and certain guided missiles were all that remained.

The "utility" engine received the designation 109/509E and would have had a controllable thrust reaching its maximum at 3,750lb.

Rocket-assisted Take-off

There were almost as many different versions of bi-fuel A.T.O. rockets produced by the Walter factory as actual propulsion units. A prototype motor known as the R.I.201 was tested as early as 1937, and a larger and more powerful unit, the R.I.202, was put into mass production late in 1940. Some 6,000 complete motors were eventually constructed, but, as it turned out, there was never really sufficient justification for them, and most eventually found their way to the scrap heap. The R.I.202 involved a considerable amount of maintenance and servicing after use, and with the successful application of dry-fuel rockets for take-off it soon fell into general disfavour.

First tests, all more or less successful, were carried out on four different aircraft, a Ju.88, a He.111, a Bv.138 and a Do.18. The units were attached to the wing undersurface, two, four, sometimes as many as eight being fitted; each could be jettisoned after the thrust period, and a parachute was embodied to ensure safe contact with the ground. After collection by the airfield personnel, they were flushed out with water to prevent corrosion—any damaged components being replaced—and then stored away for further use.

When approved by the R.L.M., the production unit was given the designation 109/500. The installed dry weight was 270lb., and the combustion of 23.8 gallons of T-stoff and 1.033 gallons of Z-stoff resulted in an average thrust of 1,200lb. which lasted for from 24 to 28 seconds. The propellant components were forced into the combustion chamber by air pressure, the permanganate decomposing the T-stoff to steam and oxygen at 480 to 500 degrees Centigrade.

More Powerful Assist-units

Despite the poor reception which had been accorded to Walter's "cold" units, research continued towards perfecting a more powerful bi-fuel motor, one capable of assisting really heavy aircraft, bombers, transports, troop-gliders and flying-boats, for which purpose normal dry-fuel rockets would have been grossly inadequate.

The first of the new motors was actually a development of the R.I.202, with certain modifications to enable oxygen, liberated in the reaction of T-stoff and Z-stoff, to be burnt with added fuel. This naturally meant higher combustion temperatures (in the region of 1,900 deg. Centigrade), and much time was given to the design of a practical coolant system. In the end it was found necessary to pass the T-stoff through a jacket around the combustion chamber before feeding it to the injectors.

The developed motor was known as the R.I.203, and in R.L.M. acceptance trials it proved capable of maintaining a thrust of 2,205lb. for fully 42 seconds, having a specific consumption of almost half that of the former model. It was afterwards given the designation 109/501. The overall weight of the propulsion unit was 1,208lb., including 485lb. of T-stoff, 25lb. of Z-stoff, and 42lb. of petrol which, as the secondary fuel component, was also fed to the chamber by air pressure. A small amount of hydrazine hydrate was employed to initiate combustion.

The R.I.210 was another bi-fuel A.T.O. unit, a development of the R.I.203, in which the size of the metering orifices was the sole difference. The result was an increase in the thrust to 3,307lb. and a reduction of the firing time to 30 seconds.

The R.L.M. type number allotted to this motor was 109/502 and, as far as is known, it was the last production example of the Walter assisted-take-off series.

There are, of course, many examples of dry-fuel rockets in regular use with the various air forces, but whether or not Walter type R.A.T.O.G. will reappear as more powerful and longer sustained thrusts are required remains to be seen.

The foregoing concludes the section dealing with rocket propulsion for aircraft, leading now to the story of Peenemunde and the development of German long-range rockets, the winged V-2 and the 98-ton transatlantic rocket with which it was planned to bombard New York.

(To be continued)

Items of Interest

A Neat Conjuring Trick

WOULD you like to be able to walk up to a table covered with glasses, seize a large jug of water and pour out any colour desired by the audience? What do you say? "Yes, you would." Right! In the first place you can let people bring their own jugs and even supply water if necessary, for all that is required are a few drops of aniline dye in various colours and a reel of dark cotton.

Choose thread, if possible, which is not shiny. You will remember that matt surfaces absorb the light and do not reflect it to people's eyes. Tie a piece of cotton across the room, with other pieces about 1ft. long joined to it at intervals of, say, 2ft. At the end of each short piece, tie small knots and dip each knot into dye of a different colour. As you take the glass in your hand you must casually hold it so that one of the knots with the desired colour is inside the glass. As the water is poured in, it promptly turns to the required shade without the audience seeing the cotton or having the slightest idea of how your extreme cleverness is simulated.

Cheap Light

LIGHT is probably the most important commodity of civilisation. Its efficiency seldom exceeds about two per cent. What will engineers think of us in the future? They will say we are savages and they will be right.

The latest plans are interesting, for it is cheaper to produce light outside the wavelengths of the visible spectrum. Naturally, this would be little use, for it would show objects in the queerest of colours; different, quite different to those to which we have been accustomed by centuries of sun.

This does not daunt the lighting expert who now produces cheap, invisible light and causes it to make substances glow or fluoresce. That is how a great deal of this tubular light is accomplished, although it still is less convenient than the friendly glow-worm.

Glow-worms are really beetles, and it is not yet known if the beetle switches on its lights to please itself, or for what modern novelists call "sexual emulation." It can control it, however, and often the tap of your foot upon the ground causes a blackout. Glow-worms are far more efficient than any man-made light.

Glues, Cements, and Adhesives

Further Notes on How to Make and Use

By "HANDYMAN"

PASTE and glue can hardly be classed as cements, but when added to other compounds of a gummy or resinous nature they decrease the brittleness of the mixture. Concoctions of glue, lime and vinegar may be termed glue cements, while mixtures of flour pastes and glue are cements of another character, useful in cases where the surfaces are not subject to moisture.

Dragon's blood is a resin and is useful to impart a reddish or brown colour to resinous cements. Canada balsam is another resin, and is largely used for cementing glass objects together where transparency is desirable. Burgundy pitch is a flexible resin mainly used in plasters, and is substituted by admixtures of resin, pitch and turpentine.

Dry clay powder and borax with water is another cement constituent. For glass instruments a cement composed of four parts of Canada balsam and one part of Venice turpentine, heated over a hot-water bath and added to a good quality glue solution, can be recommended.

White (clear) glue and curd soap mixed with plaster of paris is the basis of another useful mixture. Sulphur and plaster of paris can also be made into a paste with a solution of glue. This must, of course, be used right away.

Portland Cement

It is imperative that no free clay should be present in the water, the sand or ballast when making up Portland cement. It is seriously weakened by the presence of clay, and setting is entirely arrested if a large quantity is in the mixture. All ballast and sand should be washed.

Albumen is an animal food and is the chief constituent of the white of an egg. Mixed with lime this compound makes a quick-setting cement, especially suitable for fine work.

There are three sources of albumen; the white of egg already mentioned, animal blood and casein. This last-named material is the curd of milk and is now a commercial commodity.

When casein is made into a thick mucilage or pasty mass with lime it forms a hard-setting cement useful for a variety of purposes.

Egg albumen is commonly employed for uniting broken china and glass objects. It forms a reasonably fireproof and insoluble cement which hardens with age. In extracting the white of the egg it is important that none of the yolk should be mixed with it, as this yolk is an oily substance which spoils the cementing properties of the albumen.

Blood albumen is employed for coarser jobs, and is not usually required in work which comes within the scope of the handyman.

Casein powder can be dissolved in liquid ammonia to form a thick varnish which dries on paper objects with a nearly waterproof gloss. Solutions of other alkaline substances, e.g., carbonate of soda and sodium hydrate, also of silicate of soda (waterglass), also take up casein to produce solutions which act as a binding medium for various materials.

Rubber Compounds

Marine glue is an old-fashioned glue compound into which a solution of rubber or guttapercha is added in the attempt to produce a glue or caulking cement which will resist moisture more successfully than ordinary hide glue. Thickened with other substances, such as plaster or resin, marine glue would make a useful waterproof cement with a certain amount of contractile (sticking) power.

Rubber which has been vulcanised is useless for preparing cements. The material must be pure Para rubber ("caoutchouc"). This is perfectly soluble in benzine, petrol and other light oils and spirits. Waterproof cements may be made of heated mixtures of dissolved rubber, pitch, resin, shellacs, etc., and care must be exercised in heating them because of their highly inflammable nature.

Red Lead Cement

For pipe joints, red lead and linseed oil, or common vanish, is largely used. A linseed oil paint is almost as good, and in applying all these jointing preparations the steam or water tightness is much improved if it is put on with a gasket of string or other fibrous material. In the case of a flat or face-to-face joint which is drawn together by screws or bolts, the efficiency of the job is improved by cutting out a paper insertion—a replica of the jointing surface, pierced with the necessary holes—this being smeared on both sides with the cement in a state thin enough to be painted on. For joints which have to be broken, some pastes are made in which the red lead appears to be subordinate to a mixture of linseed oil and graphite (blacklead powder).

Plaster Cements

Mix dry plaster of paris with a weak solution of gum arabic. The paste must be used at once, and is very suitable for fixing silver and plated mounts on to glass vessels. A little alum will help to harden the final compound. Plaster of paris has the property of swelling slightly just before setting hard and therefore it fills the crevices of a hold very well.

Admixtures of alum or borax retard setting rates; common salt accelerates the time of setting. Alum hardens the plaster, as already noted, and this mixture makes the plaster into what is known as Keene's cement. Borax and plaster is called "Parian" cement, which also sets hard with a good, clean surface. A mixture of plaster with hydraulic lime is called Scott's selenitic cement. There are other forms of plaster of paris (gypsum) subjected to heat treatments which are used for building purposes and set less quickly than the common plaster.

Chucking Cements

Difficulty is often experienced in chucking a light or awkwardly shaped article in the lathe. Chucking cements, meltable by heating, are therefore used to grip the objects in the lathe. They may consist of pitch (five parts), plus one of tallow, both admixed with one part of wood ash. A similar cement can be made from resin, with a slight amount of Venice turpentine in it to render it less brittle.

Another hard plastic cement can be made by melting up two parts of resin with one-eighth part of Venice turpentine and a little linseed oil. Glue jelly is also prepared and mixed in. The compound so formed is again mixed with whiting. When cold the compound is hard, but becomes plastic by warming it. All these cements can be used to hold small metal objects for the purpose of engraving them.

Serbats Mastic

A mastic cement known under this name can be made of a mixture of manganese dioxide (pyrolusite), sulphate of lead in equal parts and linseed oil.

Miniature Sparking Plugs

A RECENT addition to the K.L.G. sparking plugs range is the Mini Series, developed primarily for Model Petrol Engines. These miniature sparking plugs, barely 1¼in. in length, have proved themselves equal in performance to the larger car and motor-cycle plugs, as might well be expected, since all the K.L.G. sparking plug features, manufacturing technique and quality have been incorporated.

Two miniature sparking plugs shown in comparison with a match box.

Enthusiastic reports on the performance of the K.L.G. Miniature Sparking Plugs for model engines have been received from many users and it is obvious that this new K.L.G. development is of great interest to model engineers. The success of these new plugs is largely due to the fact that they embody all the special and unique features which the K.L.G. Company developed during the war period and which are now incorporated in their range of car and motor-cycle plugs.

Technical Details

The weight per plug without external seating washer is .27 troy ozs. or .296 avoirdupois. With internal seating washer, .28 troy ozs. and .3035 avoirdupois. The thread diameter is ⅜in. maximum; threads per inch, 24; reach of thread, 7/32in., and U.S. thread form 60 deg. included flat top and bottom.

Further details are obtainable from K.L.G. Sparking Plugs, Ltd., Putney Vale, London, S.W.15.

THE WORLD OF MODELS

Swiss Model Making : An Historic Model Steam Engine : "Bathing-pool Express

By "MOTILUS"

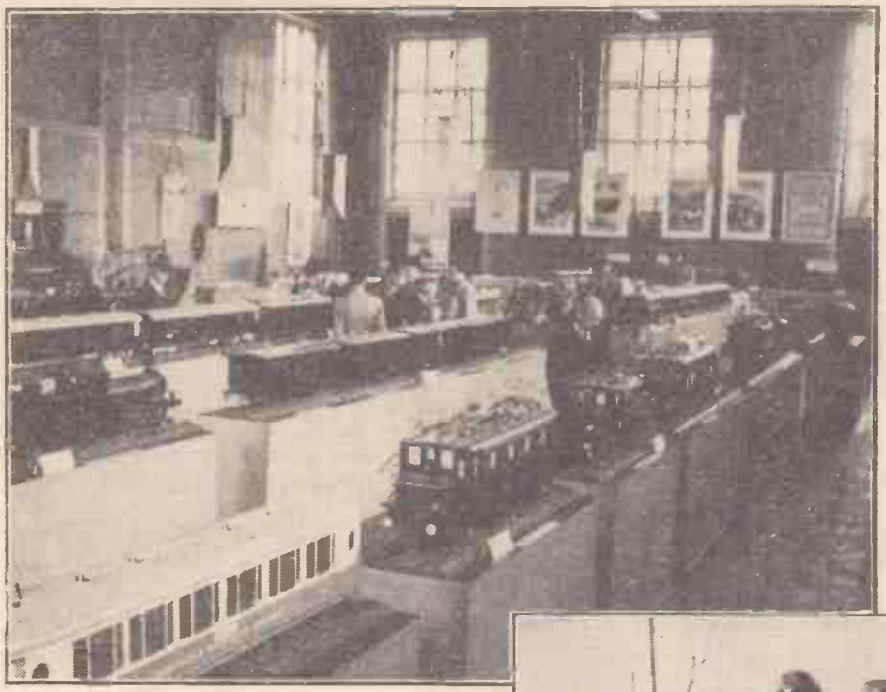


Fig. 1.—General view of the Railway Exhibition of models relating to railway transport in Switzerland.

FOR business reasons, and for a little well-earned leisure, I had occasion to visit Switzerland again this summer, and I would like to record for my readers some of the interesting progress in model making that has developed since I gave my first post-war account, published in the October, 1946, issue.

Naturally, all the Swiss, whether they are model-minded, railway-minded or otherwise, are taking a very keen interest in the Centenary Celebrations of the Swiss Federal Railways.

In connection with the Centenary Celebrations an Exhibition was held relating to railway transport in Switzerland (Fig. 1).

The Brast Brothers

When in Lucerne, I took the opportunity of calling on my friends, the Brast Brothers, garage proprietors in that lovely city. I was again invited to visit their layout at the village of Horw, about six miles from Lucerne, where the track has been extended to cover 500 metres. It was a sunny afternoon and the ground was crowded with many juvenile enthusiasts, all keen to take a trip behind one of the three express locomotives. One of these three locomotives was a new model of the L.N.E.R. "Flying Scotsman," No. 4,472 (Figs. 2 and 3), which was mentioned in my previous article as being under construction. Built by mechanics who have never yet seen a British steam locomotive, it was based on the official drawings, supplied to them by the L.N.E. Railway. Great credit is due to these Swiss modelmakers, as this model is complete in all external details. The colouring and lining is all that could be desired and the engine functions splendidly. A few technical details may interest readers: The model has a steel boiler, is fitted with Walschaerts reversing gear, the working pressure is 150lb., and it has axle pump feed. Wheels are of iron with steel tyres shrunk on. The engine is slightly heavier than the "Royal Scotsman," its weight being 350 kilos, and it is capable of hauling a larger load than this other steam-driven locomotive. Luckily, my visit took place on the second day that their new locomotive was in use and the keenness of all the regular "patrons" of the miniature railway to see the new model was astonishing.

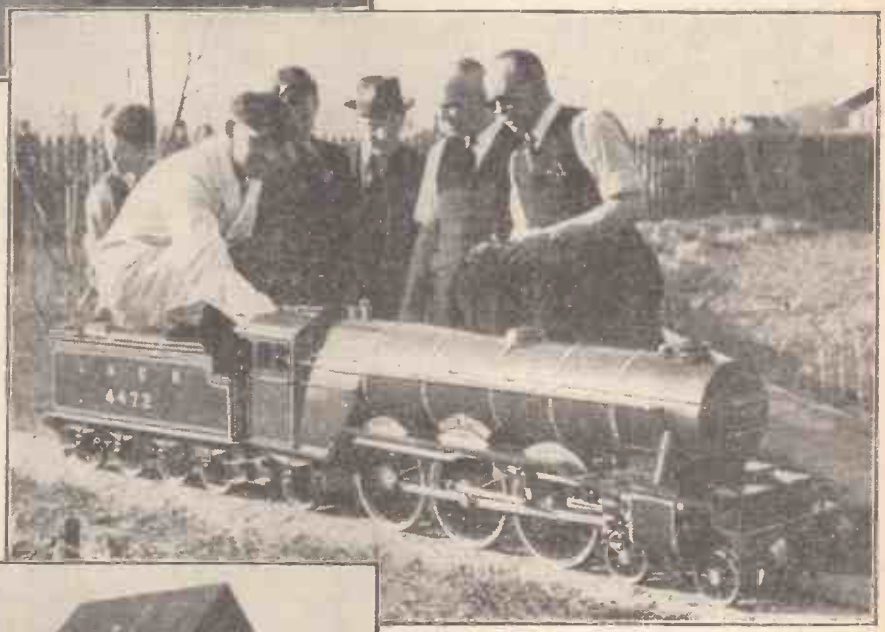


Fig. 3.—The 1½in. scale, 7¼in. gauge L.N.E.R. "Flying Scotsman," built by Messrs. Brast Bros., on the track. Reading from left to right the persons shown are: Mr. Hans Brast (driving), Mr. Ernest Hesler, Mr. Walter Brast, Herr Kupfer and Mr. Willi Gassman.

Fig. 2.—L.N.E.R. and L.M.S. locomotives on the track at Horw, near Lucerne.

An Historic Model

Quite recently I visited some old friends, at Bewdley, Worcestershire; Mr. and Mrs.

John Parker, Mrs. Parker being the daughter of the late Sir Joseph Tangye. These friends are collecting relics of all types associated with the famous Tangye family and have formed a museum in their own home. Many people who are great admirers of the work of Sir Joseph Tangye, who with his brothers contributed so much to engineering in his lifetime, may not know that Sir Joseph was a keen modelmaker. His first model is now in the Birmingham University, but in the Parkers' Museum is the model illustrated in Fig. 4. This steam engine has a cylinder of approximately ⅛in. bore and a 2in. stroke, the flywheel being 8½in. diameter. It was made in Henley Lodge, Handsworth, about 1870, and was supplied with the necessary power from a small steam boiler which fitted into the kitchen stove. When Sir Joseph was a young man, engineering, with its startling new inventions, was as much "in the air" as science is to-day, and the whole course of industry was being altered. Many new inventions such as the bicycle, steam trams, steamships, telephones, motor-cars, wireless and X-ray, were being brought into the public eye, and, therefore, perhaps it is not so surprising to know that models helped to formulate some of the ideas of this famous family. Bewdley people particularly owe very much to the influence of this famous engineer as he was either directly or indirectly responsible for their water supply, the first bathroom in the district, the best gas in the county, and many other small benefits to the local community.

A Fine Scale Model

One of the most interesting commercial models recently produced by Messrs. Bassett-Lowke, Ltd., for Messrs. John Brown & Co., Ltd., of Clydebank, consists of a section through the hull of the *Queen Elizabeth*, showing her boilers, steam turbines and auxiliary machinery connected with the running of this Queen of the Seas. This model was made to a scale of ¼in. to the foot and was constructed specially for the Institution of Mechanical Engineers Centenary Exhibition, at the Science Museum, South Kensington. This is a very interesting and unusual model and it presents to the public the vital working part of a ship, which many passengers, who enjoy the luxury of the passenger accommodation and public rooms of this magnificent ship, hardly ever see.

"The Bathing-pool Express"

The first of many new attractions for children in that popular seaside resort of St. Leonards, Hastings, is "The Bathing-pool Express," recently opened by the Mayor, Mr. C. F. Chambers. The railway is being operated in conjunction with the Corporation by the Romney, Hythe and Dymchurch Railway Co., who are famous for their layout along the Kent Coast. The locomotive now being used is the 10¼in. gauge "Royal Scot," No. 6,100, which was originally built for the Marquis of Downshire for his line at Easthamstead Park, Berkshire, by Messrs. Bassett-Lowke, Ltd., Northampton. One of the largest models ever built, it has cast iron cylinders and wheels, also steel headed cast iron buffers; gun metal castings include motion and weigh bar brackets, main frame angle plates, steam brake cylinders, main frame bogie stretchers and hornblocks.

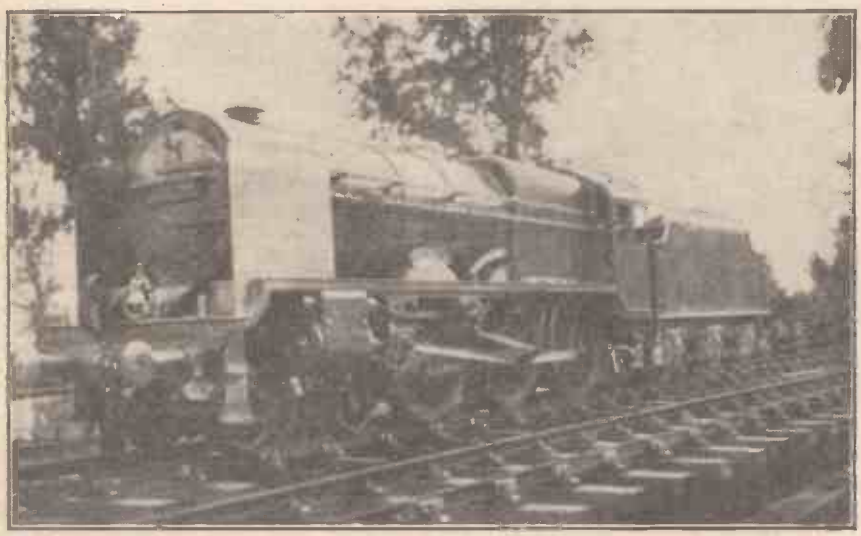
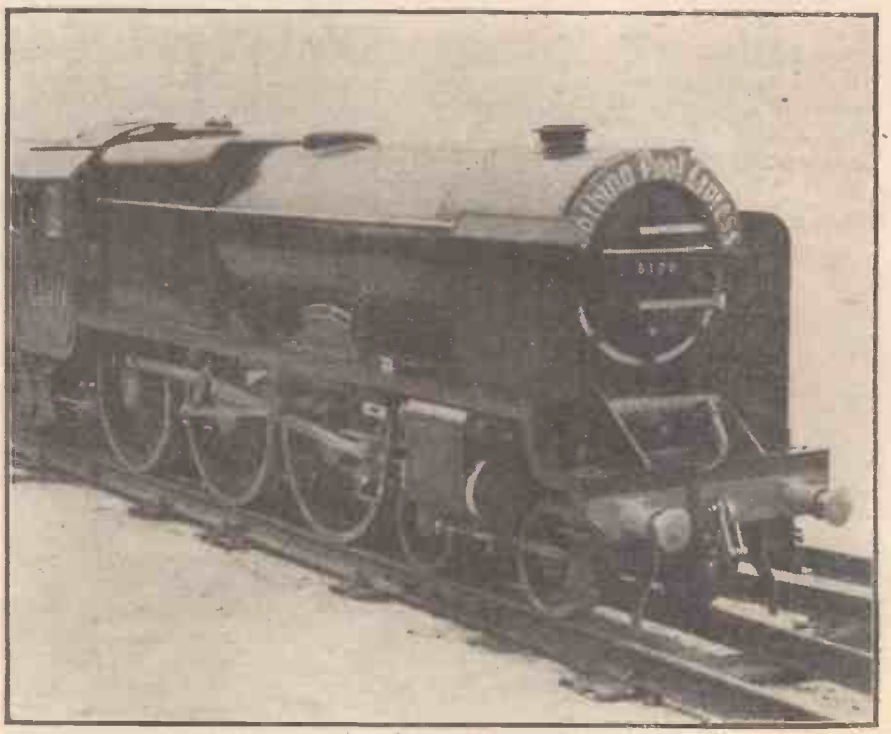


Fig. 5.—The Bassett-Lowke 10¼in. gauge "Royal Scot" locomotive now in use at West St. Leonards on the line operated by the Romney, Hythe and Dymchurch Railway Co. in conjunction with the Corporation. The photograph shows the locomotive during its trials on the line of Mr. H. F. R. Franklin, at Radwell, Bedfordshire.

Fig. 4.—An early model steam engine built about 1870 by Sir Joseph Tangye, the famous engineer.

Connecting and coupling rods, as well as details of the Walschaerts valve motion are hand finished steel forgings. The three cylinders are 1½in. diameter, and the boiler is of steel with a pressure of 120lb. to the square inch. Overall the engine and tender measure 12ft. and the engine weighs a ton, being capable of drawing 15 open coaches, each with articulated bogies for smooth and silent running.

The railway is now open seven days a week since the first Sunday, when several hundreds of holiday makers with their children stormed the railway when they found it closed. Such a disturbance was made that this has convinced the Corporation of the advisability of Sunday opening, and now the visitors and residents of St. Leonards are able to enjoy model railwaying every day of the week.



A close-up view of the front of the scale model L.M.S. "Royal Scot," used on the new miniature railway at West St. Leonards.

Letters from Readers

A Vertical Enlarger

SIR,—It was with great interest that I read the articles on a vertical enlarger in the March and April issues of PRACTICAL MECHANICS. I have been using successfully a similar piece of apparatus, designed and constructed when I became a miniature camera convert. While enlargers remain at current astronomical price levels, I feel that many readers may be compelled similarly to improvise, and the accompanying details of my enlarger may be of interest to those wishing to make an enlarger capable of first-class work at little cost.

The principle of using an entire camera as part of an enlarger is, of course, old, but this simple adaptation to the vertical type is, as far as I am aware, novel. The main point in its favour is that a lens of good definition and of covering power suited to the negative is available at no extra cost. An image of first-class quality is projected, image size being limited only by negative quality and the length of the supporting column (Fig. 1).

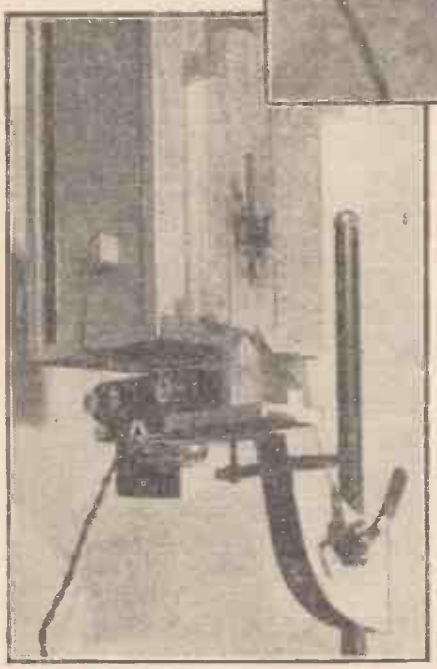


Fig. 1. (Left). Part of the enlarger with camera in position. Fig. 2. Close-up view of the camera bracket.

The negative is held firmly against the lower face of the condenser by a polished brass, spring-loaded pressure plate. Below this, the camera shelf is cut out to suit the model in use, in this case a Retina. This supporting bracket is rigidly held by a slotted strip of wood running between guide blocks on the lamp house, and is secured in any desired position by a wing nut. Focusing may thus be done approximately by raising or lowering the camera slightly, and finally by the focusing movement provided on the camera.

The close-up view, Fig. 2, shows the camera shelf and a rotating orange lens cap, an invaluable addition. In order to show details more clearly the two photographs were made before the instrument had its coat of dead black. Owing to the short focal length of the lens used, the whole instrument is very compact, but for other than miniature cameras, the set up would become rather heavy and unwieldy.—GEO. W. TULLOCH (Shetland).

Porcelain Elements for Electric Fires

SIR,—The reply to R. J. Marr given in PRACTICAL MECHANICS (July, 1947, p. 319), while no doubt practicable to an experienced and well-equipped ceramist, is not likely to be applicable to his case. A more workable method would be to employ a sillimanite-ethyl silicate cement, and fire only at 500 to 600 deg. C. The firing at over 1,000 deg. C. though an improvement, is not necessary for this purpose.

This mixture, moreover, is free from a fault inherent in all commercial refractories used for this job, as well as the clay mix suggested in the reply referred to—that is, of becoming a conductor at elevated temperatures. I have seen dozens of commercial refractories in which a short circuit has occurred through the ceramic due to this effect, coupled with absorption of oxide from the element wire.

Full details of the sillimanite technique can be obtained from Messrs. Smith and Shaw, Silicon Organic Developments, Ltd., 11, Cavendish Place, London, W.1, who also have a most helpful advisory staff to deal with any individual queries.—A. STEPHENS (London, W.2).

A Simple "Epidiascope"

SIR,—The simple "epidiascope," described by your contributor R. L. G., appears to be a quite efficient instrument except that it is *not* an epidiascope.

The epidiascope is a dual-purpose instrument, combining the diascope, which projects an image from a film-strip or lantern-slide, and the episcope, which projects the brightly lit surface of a picture or flat object. R. L. G.'s instrument is obviously an episcope.

Some years ago I made one very similar, and found that in the absence of an expensive lens a 4in. diameter reading glass worked quite well. Picture intensity was increased by placing curved tin-plate reflectors behind the lamps.

I hope these remarks might be of interest to readers thinking of making an episcope. —R. H. LAMB (London, N.W.).

Books Received

"Model Petrol Engines." By Edgar T. Westbury. Published by Percival Marshall and Co., Ltd. 226 pages. Price, 7s. 6d. net.

THIS book deals with the design and construction of model petrol engines from the model engineer's point of view. In addition to general information on the design of engines and their necessary appurtenances, the book also contains a number of complete designs of widely diverse types of engines for model power boats, aircraft and racing cars. The care, maintenance and testing of engines for high performance is also fully dealt with in this practical and informative book, which is enhanced by many fine half-tone illustrations and line diagrams.

"Railway Modelling in Miniature." By Edward Beal. Published by Percival Marshall and Co., Ltd. 176 pages. Price, 10s. 6d. net.

NOW issued in an enlarged and revised edition, this book is an acknowledged guide for all those interested in gauge "00" modelling. The author deals not only with the layout and building of the track, but also instructs the reader in the importance of scenic background. The miniature railway enthusiast who, for reasons of restricted space, is unable to put down a layout in one of the larger gauges, will find much in this book to interest him. A perusal of the many scale drawings in this book should prove an inspiration both to newcomers to the hobby and to owners of existing systems to add to the realism of their layouts.

Model Racing Car Competition Cup

THE Wico-Pacy Model Racing Car Competition Cup, presented by The Wico-Pacy Sales Corporation, Ltd., of Bletchley, was competed for at the Pioneer Model Racing Car Club Competition at the Royal Horticultural Hall, London, on July 19th, and was won by B. P. Winter, 71, Oakington Avenue, Wembley Park, Middlesex. His model achieved a speed of 47.6 m.p.h. The runner-up was J. Cruickshank, 105, Salusbury Road, N.W.6, whose speed was 46.6 m.p.h.

QUERIES and ENQUIRIES

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

Treatment of Oak Door

YOUR advice on the following point would be much appreciated: My front door is of good quality oak. It faces due south and french polishing does not last very long. I have therefore stripped it down to the bare wood and wish to obtain artificially the silver grey colour to which oak matures if exposed to the weather for a long period. Is there a dye which would produce the tint? Or is it done with a chemical? If possible, I should like to avoid the white grain which lime produces.

Further, would it be satisfactory to apply a coat or two of egg-shell varnish after treating for colour?—H. J. Pack (Epsom).

ORDINARY wood stains are useless for giving the effect which you require on your oak door. The effect can be obtained by very lightly burning the wood surface with a blowlamp and then by carefully sandpapering the surface and finally by rubbing linseed oil into it. However, the blowlamp treatment has to be well carried out in order to get an even effect.

Another method is to rub the bare wood over with a strong solution of potassium permanganate, preferably used hot. This will give a brown colouration which will gradually weather to a greyish appearance. Still another method is to brush strong ammonia over the bare wood. A further method consists in brushing a paste of soda ash and ammonia over the wood, allowing it to dry on, and then swilling it off with water. This tends to bleach the wood, but it subsequently becomes grey in appearance, particularly in the presence of atmospheric dirt.

A somewhat similar effect can be produced by brushing the whitened wood over with a dilute solution of a black dye in methylated spirit, but in this case the dye fades or otherwise changes colour on exposure to light, so that this method is not really to be recommended.

When the desired colour has been attained the wood should be treated with raw linseed oil and after this has dried in the coating of egg-shell varnish, such as you suggest, should be applied.

Fluorescent Paint

CAN you tell me the ingredients used in the making of fluorescent paint and in what proportion they are mixed? Also, where can the ingredients be obtained?—H. Irvine (Edinburgh).

ANY oil paint may be made fluorescent by incorporating with it from 3 to 5 per cent. of xylidine, anthracene or primuline base. Even the incorporation of vaseline will render a paint fluorescent, but the vaseline must be very small in amount, otherwise the paint will remain permanently tacky.

The above materials may be obtained from any chemical supply house, such as Messrs. W. and J. George and Becker, Ltd., 17-29, Hatton Wall, London, E.C.1, or Messrs. Baird and Tatlock (London), Ltd., 14-17, St. Cross Street, Hatton Garden, London, E.C.1, or, doubtless, from some local supplier in your city.

We do not know of any firm which is yet producing fluorescent paints, but, no doubt, if you will write to the Director, Research Association of British Paint, Colour and Varnish Manufacturers, Waldegrave Road, Teddington, Middlesex, you may be able to gain information as to whether any experimental manufacture of this type is now being effected.

Oilskin Dressing

COULD you please inform me how I can make a good oilskin glaze or dressing for black and yellow waterproofs? I want it to dry quickly and give a glossy, non-sticky surface.—R. Hughes, (Lerwick).

IT is not easy to make oilskins on the home scale, the difficulty being to get the impregnating material to dry rapidly and completely. Factory-made oilskins are produced by means of secret processes and formulae, in addition to which they are smoothed by means of hot rollers.

However, for small scale use, there are one or two formulae which are promising. The following has been recommended:

Dissolve 1 oz. of soap in 1½ pints of boiling water. Then stir in 1 quart of boiled linseed oil. When cold, add ½ pint gold size. This liquid is worked into the fabric.

Another formula is:

Soak calico in bullock's blood, and then dry it. Next give the stretched cloth two or three coats of boiled linseed oil to which a little litharge has been added. The third coat of linseed oil may, with advantage, have had added to it 1 oz. of gold size to every pint of the oil.

A third formula for the same purpose advises the use of a solution of beeswax (2 ozs.), resin (2 ozs.), in boiled linseed oil (1 pint).

All of the above liquids require to be spread thinly on both sides of the fabric, the latter being in a stretched condition. The drying time is usually a matter of three or four weeks, even in a warm room.

Transformer Details

I WISH to build a transformer with secondaries 200-0-200 v. 50 m.a.; 2 v. 3a.; 4v. 6a, for use with a valve rectifier. The mains supply is 230 v. 50 cycles.

Could you please advise me as to the size of laminations and where they can be obtained, also the number of turns and gauge of wire to use.

I understand that there is an equation concerning transformers which takes into account the frequency of the supply and the permeability of the iron. Could you please supply this formula and indicate how it is used?

Does the resistance (A.C.) of the secondary coil account for the "lost volts" on closed circuit as does the internal resistance of a cell, or is some other factor involved?—P. H. Belsey (Dover).

THE output required from your transformer on the 50 m.a. range is 400 x 0.05/2 = 10 volt amps., 6 volt amps. on the 2 volt range, and 24 volt amps. on the 4 volt range. Total 40 va. The cross sectional area of

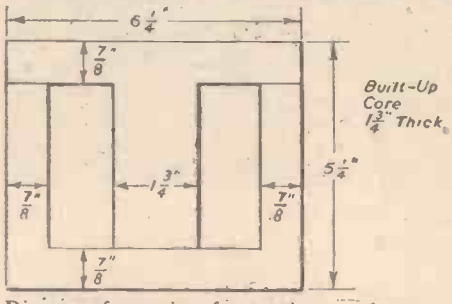


Diagram of stampings for a mains transformer—(P. H. Belsey.)

the transformer core could be found by the formula $A = \frac{\sqrt{W}}{5.58}$, taking W as the volt amp. output. The area could thus be 2.65 sq. in. You could use core stampings of the dimensions given in the diagram, the Stalloy stampings being 0.014in. thick and lightly insulated on one side.

The formula connecting the turns (S) maximum total magnetic flux in the core (ϕ) and the voltage V is $V = 4.44 \times f \times S \times \phi \times 10$, where f is the frequency in cycles per second. A flux density of about 55,000 lines per square inch is suggested. For the core in question you could thus use 3.1 turns per volt for the primary. The efficiency of the transformer may be taken as about 85 per cent., so the input would be 47 volt amps. Dividing this by the supply voltage gives the primary current as 0.205 amp., 29 s.w.g. will carry 0.22 amp. at 1,500 amps. per square inch, so the primary could have 713 turns of 29 s.w.g. On the secondary it is advisable to allow an extra 5 per cent. turns to provide for the volt drop on load. The volt drop is due to the resistance of the windings, and also due to inductance resulting from leakage of magnetic flux which is not linked with both windings. To minimise the latter the primary and secondary should be wound as close together as practical considerations permit.

The 50 m.a. winding could thus have 1,300 turns of 36 or 40 s.w.g. enamelled wire with a centre tap or loop; the 3 amp. winding could have 7 turns of 17 s.w.g.; and the 6 amp. winding 13 turns of 15 s.w.g. Single silk covered enamelled wire is probably the best to use, but you may have difficulty in obtaining supplies of this. As an alternative, enamelled wire is permissible, in which case we advise a layer of thin paper between each of the layers of wire. The stampings could be obtained from Messrs. Geo. L. Scott and Co., Ltd., of Hawarden Bridge Steelworks, Shotton, Chester. When assembling the core, the insulated sides of the stampings should all face the same way, adjacent layers of stampings being reversed so the joints in one layer are covered by the next layer.

Infra-red Light Filter

I SHALL be obliged if you will please answer the following queries:

(1) Where can I obtain an infra-red ray filter of one-sixtyfourth inch sheet ebonite (which I believe can be used as a filter)?

(2) Is there any method of treating clear glass electric light bulbs to reduce glare and give the frosted glass effect?

(3) Can an 80 watt fluorescent lamp be used on a rotary converter (12 v. D.C. input type), and what wattage rating would be required?—R. G. Waters (Farnborough).

(1) INFRA-RED light filters (of varying grades and intensities) may be had, in gelatine film form, from either Ilford, Ltd., Ilford, London, or from Kodak, Ltd. (Wratten Division), Kingsway, London, W.C.2, the price being about 1s. per square inch. We do not think that the extra thin sheet ebonite mentioned is yet commercially available.

(2) Rub the electric light bulbs over with a paste of fine carborundum powder and oil. This will scratch the glass and render it opaque.

Another way is to make a smooth paste of waterglass (sodium silicate) and slaked lime. This is spread thinly on the glass bulbs and allowed to dry slowly.

(3) The ordinary type of 80 watt fluorescent "discharge" lighting tube cannot be used in conjunction with a rotary converter. They necessitate special transformers and chokes as supplied by the manufacturers. For particulars of these, write to the General Electric Company, Ltd., Wembley, Middlesex.

Fluorescent Powders

COULD you please supply me with a list of powders which fluoresce? Also a fixative for fixing these powders to glass? Could you also give me the address of a firm where I can purchase these powders?—W. Kirby (Cambridge).

THE following materials are fluorescent under ultra-violet ray illumination: Zinc silicate, zinc borate, cadmium borate, calcium tungstate, salicylic acid. Frequently, a "mixed" fluorescent powder is used, such as:

Zinc silicate	.. 10-12 per cent.
Calcium tungstate ..	.. 40-50 per cent.
Zinc or cadmium borate	.. 40-45 per cent.

A clear celluloid varnish (made by dissolving scrap celluloid in a mixture of equal parts of acetone and amyl acetate) makes a good medium for cementing such powder down to glass or other surfaces. Frequently such a solution can be obtained ready made from large paint stores. The fluorescent materials are available at most chemical laboratory supply firms, as, for example, Messrs. Harrington Brothers, Ltd., 4, Oliver's Yard, 53a, City Road, London, E.C.1, or Messrs. J. W. Towers and Co., Ltd., Victoria House, Widnes.

It might also be of interest to you to note that ordinary yellow vaseline when thinly smeared over glass gives an excellent greenish fluorescence under ultra-violet illumination. If you can make use of this simple means of fluorescence, it may save you trouble and expense.

Deposition of Metals on Glass

I AM interested in the deposition of metals on glass. At present I am only able to deposit silver and copper, but I believe it is possible to deposit gold. Could you supply me with the formula for depositing gold, and also give me the following information? Is it possible to deposit any of the following metals, cadnium, tin, zinc, brass, nickle, chromium, lead, mercury. If so could you supply me with the necessary formulæ?—F. Holmes (Liverpool).

IN order to gild glass chemically, prepare a solution of gold chloride of the strength 100 grains to one pint of water. Mix four parts of this solution with one part of a solution made by dissolving 600 grains of caustic soda in one pint of water and filter the mixed liquids.

Immediately before gilding add to the gold solution a few drops of the following solution and then at once pour the liquid on to the glass surface to be gilded :

Dissolve 300 grains of glucose in seven drachms of water and then add an equal bulk of rectified spirit or 90 per cent. alcohol.

The process of chemical gilding is not easy to carry out. It is expensive and necessitates the most scrupulous cleanliness of all materials.

An alternative method of gilding is to pour on to the glass a solution of gold resinate in ether, the solution containing about three to five per cent. of metallic gold. The glass is then heated strongly in an oven. This gives a dull gold deposit rather than a mirror.

Gold salts and materials for the purpose are obtainable from Messrs. Johnson, Matthey and Co., Ltd., Hatton Garden, London, E.C.

Metallic chromium can be deposited on glass in lustrous form in the following manner :

Immerse the glass in a weak solution of stanntous sulphate. Wash superficially. Then pour on to the glass surface simultaneously a solution of 10z. of silver nitrate and 10z. 28 per cent. ammonia in one quart of water, together with a solution of commercial formalin of strength one vol. formalin solution to four vol. of water.

Rinse the glass thus treated and submerge it in a solution of copper sulphate (one in four), to which a current of five amps is applied, the glass sheet being made the cathode of the cell. After a film of copper has been deposited on the glass, give the sheet of glass a similar treatment in a bath of nickel sulphate (one in four).

Now wash the sheet, dry and polish it. Finally plate it in a solution of chromic acid (one in three) for about five to 10 minutes, using a current-density of about 100 amps.

The method is a difficult one. It needs practice and a good practical knowledge of electro plating.

The other metals which you mention can be deposited on the glass in a similar manner after the glass surface has been electrolytically coppered, using, of course, the necessary electrolyte in each case. Brass, being an alloy, cannot be deposited in this manner.

Developer for Blackline Printing Paoer

WOULD you please let me have the formula of the developer used for blackline printing paper for copying drawings and which is applied to the paper with a sponge or cloth ?—J. Gallivan (Killarney).

THE developer for positive printing papers such as you name varies according to the make and composition of the paper. Usually (but not always) it consists of a weak solution of ammonia (say one part of ammonia in five of water), which is simply sponged over the paper. At other times, the developer contains complex organic chemicals and "coupling agents."

You would be best advised to write for such material to Ozalid, Ltd., 62, London Wall, London, E.C.2, who are specialists in these printing papers, as well as in "dry development" papers.

Producing Ozone

CAN you please inform me of a simple method of producing ozone and the voltage required ? Also, what is the effect of feeding ozone into a flame ; would it cause an explosion ? —L. J. Coles (Alton).

A SIMPLE way of producing ozone is to provide a glass tube about 1ft. long and ¾in. diameter. A straight length of wire is passed down the inside of the tube and allowed to pierce the wall of the tube near one end, being sealed to the glass at that spot. A second length of similar wire is coiled round the outside of the tube. The two wires are then connected to the secondary terminals of an induction coil. On passing a slow stream of air or oxygen (better the latter) through the tube, a portion of it will be transformed into ozone, owing to the action of the silent electric discharge from the induction coil. The percentage conversion of the oxygen into ozone is about 14 or 15 per cent. It is never more than 20 per cent., even in the best of circumstances. The voltage required depends upon the capacity of the induction coil. A six-volt accumulator ought to be ample for any small type of ozoniser.

There would be no danger of explosion if ozone were fed into a flame. It would merely make the flame burn more vividly, just like oxygen does. Remember that the ozone obtained from any type of ozone apparatus is never pure; it is always diluted with a large bulk of air or oxygen. Pure ozone has to be obtained at low temperatures by the freezing out of ozone at a temperature of minus 182 deg. C. by means of boiling liquid oxygen. Liquid ozone boils at minus 119 deg. C., and in the liquid state it is explosive.

Cementing Wood to Glass

I WISH to repair a china cabinet ; the door of same is barred and glazed. The tracery of wood is extremely fragile by itself, strength being given by the glass and cement.

It is here that I would like your advice on a suitable cement.

Is there a proprietary compound and, if so, what is its name ?—C. F. Blame (London, W.).

SO far as we have been able to trace, there is no proprietary cement of the type which you require. Ordinary fish glue or cold glue is commonly employed for the purpose of sticking wooden strips down to glass, but this method is inefficient. The cement sometimes used for the purpose consists of ordinary hard plaster darkened by admixture of a black pigment. You can make a similar hard composition by slaking powdered calcined magnesite with a solution consisting of 40 parts magnesium chloride in 60 parts of water, adding a little drop black to the mixture and allowing the mixture some 30 hours in which to set.

In our opinion, however, a better composition can be made up on a wax-pitch basis. Melt together four parts of pitch, one part paraffin wax (or beeswax) and one part of resin. When melted, stir in four parts of fine brickdust or stone dust, chalk or some other inert "filler." This cement is solid when cold and it has to be warmed before it can be applied to the glass. It should be applied thinly to both contacting surfaces, which are then brought together and, if possible, retained under a little firm pressure for an hour.

You should note, also, that any good cellulose or celluloid cement (such as those which are now sold in small tubes), makes excellent cement for wood to glass adhesion. The requirements are that both contacting surfaces should be cleaned and lightly smeared with the cement and then brought into contact under firm pressure for a few hours.

If you cannot get celluloid cement, you can make it for yourself by dissolving scrap celluloid in a mixture of approximately equal volumes of acetone and amyl acetate. Do not use heat for dissolving the celluloid. Shake the celluloid scraps in the mixture of liquids until a thick solution has been obtained.

Reversing an A.C. Motor

I HAVE a 20-volt A.C. motor and I wish to reverse it. Will you please explain how this can be done ? The armature has three coils.—A. Clark (Bristol).

PRESUMABLY the motor is a series machine and it may have one or two field coils. Such a motor can be reversed by reversing the current through the armature, which may be done by means of a double-

Connections for a double-pole two-way switch for reversing an A.C. motor.—(A. Clark.)

pole two-way switch as indicated in the diagram. You may find the motor runs better in one direction than the other; if so, this indicates the brushes have been fixed a little back from the neutral position, and you may be able to obtain equal running in both directions by moving the whole of the brushes about 16 degrees forward in the original direction of rotation.

Photographic Reversal

I HAVE recently been given a "print"—which is a negative, taken on a 120 film in the tropics. This one negative only shows reversal, the other seven pictures being normal.

Why does this happen ?—J. R. Bates (Hove).

THERE are two types of photographic "reversal." The one is due to the action of a developer containing traces of oxidising agents and sulphur compounds (such as thiocarbimide) on an over-exposed emulsion, but its exact mode of action is not understood.

The other and, perhaps, the truer type of reversal is similar to the phenomenon which used to be called "solarisation." It comprises an actual destruction of the latent image on the emulsion. This type of reversal, also, is not yet completely understood as regards its mechanism. There is no doubt, however, that it involves an actual destruction of the latent image.

On available evidence, its effect seems to proceed on these lines :

When a silver-containing photographic emulsion is given a normal exposure a certain amount of electron-energy is liberated in the emulsion. The freed electron wander throughout the emulsion and form "silver complexes," which are developable up to metallic silver by means of a chemical process. Up to a certain point, the stronger or the more prolonged the light action, the greater the number of these silver complexes which are formed. When, however, all the available silver atoms in a given emulsion area have been made into developable complexes no further exposure can possibly add to their number. It is after this point that the peculiar phenomenon of reversal or solarisation is reached, and the result is that, at this stage, the silver complexes (which form the latent image), apparently become undevelopable. That is to say, the latent image gradually "fades" or becomes destroyed with ever-increasing light exposure. It is, indeed, a veritable reversal of exposure, and is due not to any faulty action of the developer, but, rather, to the fact that there is nothing there to develop ! The latent image has been (partially or completely) destroyed. Hence it cannot be developed up.

Fixing Microscope Objects

COULD you please explain the method of fixing "specimens" to microscope slides ? Where can the necessary substance be obtained ?—G. McDougall (Rosyth).

MICROSCOPE objects are fixed to slides in very many different ways, the precise method of fixing being determined by the nature of the specimen, its size, its degree of flatness, its moisture content and other factors. The larger objects and the more permanent ones are usually mounted "dry," that is to say without any surrounding medium at all, these being kept in position by means of the cover glass which is ringed with a marine varnish cement.

Other objects, particularly the flat, transparent ones, are mounted in a solution of Canada balsam in benzene or naphtha. Other objects are mounted in gelatine, or are fixed "wet" in gelatine solution and/or in various other specialised solutions.

For the various cements and other preparations for microscope mounting, a good source of supply is Messrs. Flatters and Garnet, Ltd., Oxford Road, Manchester, 13.

Cellulose Lacquer

I AM making certain ornaments and utensils in brass and gunmetal. Can you please let me have the formulæ for a lacquer to prevent discoloration ? Also, are there any firms selling proprietary brands of this lacquer ?—C. Maude (Silsden).

ANY transparent cellulose lacquer will suit your purpose. The lacquer should be flowed in a thin film over the metal and allowed to dry in a dustless, slightly-warm, dry atmosphere. Alternatively, the lacquer may be brushed or sprayed on.

Suitable clear cellulose lacquers are manufactured by Messrs. John Beard and Co., Ltd., Great Ancoats Street, Manchester.

You can make a suitable lacquer by dissolving clear scrap celluloid in a mixture of equal parts of amyl acetate and acetone.

Transfer Making

I HAVE been attempting to make a transfer of the type used for embroidery. As you know, they are a thin tissue paper having the outlines and necessary detail lined on them with a type of substance which can be transferred on to cloth at any time by the pressure of a warm flat iron.

My experimental mixtures have been no success; could you therefore please inform me as to the correct method ?—G. Le Huquet (Newhaven).

TRANSFER-MAKING is a difficult job to carry out on a small scale, since the best transfers are made mechanically by printing methods. However, you may proceed as follows :

Obtain some thin, strong paper and impregnate it with the following fluid :

Toluene	.. .. ..	6 parts (by volume).
White spirit or paraffin	..	2 parts
Neat's-foot Oil	.. ..	2 parts

To the above add a trace of carbolic acid.

The paper, after being impregnated with this liquid, is hung up in order to allow the volatile solvents to pass off. It is now printed or otherwise inscribed with the design required, a specially soft ink being used. Such an ink may be compounded in accordance with the formula as under :

Pigment	.. ..	3 parts (by weight).
Castor oil	.. ..	5 parts
Cumarone Resin	..	½ part
Ethylene glycol mono-methyl ether	.. ..	1½ parts

It may be possible for you to obtain a small quantity of a soft transfer ink from a local printer.

Ultra-Violet Rays

I SHOULD be very grateful for information concerning the following subjects :

(1) What is the type of film necessary for photographing objects illuminated by ultra-violet rays only, and the exposure necessary with a specified lamp ?

(2) Will you explain the process involved in viewing objects illuminated by ultra-violet rays using an apparatus resembling a pair of prismatic binoculars ? It is supposed that the reflected ultra-violet rays impinge on a ray sensitive screen, and are then viewed when reflected into the eye.—R. Dennis (B.A.O.R.).

(1) ANY film or plate will suffice for recording ultra-violet illumination, provided that the ultra-violet wave frequency is not too high. However, Ilford, Ltd., Ilford, London, manufacture a series of emulsions on plates or films specially designed for for ultra-violet work. So, also, do Kodak, Ltd., Kingsway, London, W.C.2. Both these firms issue literature on photographic work in the ultra-violet and, no doubt, would be pleased to send you copies on application.

Since the emulsion speeds of available plate and film material vary so greatly, we cannot possibly give you a correct figure for the exposure of such emulsions to any given light source. The exposure naturally depends upon the emulsion speed, the stop number and the type of object photographed. You will have to make your own trials and experiments in this direction.

(2) We are not familiar with the apparatus to which you refer, this most likely being a recent technical product of the war, details of which have not yet been published. From your description, however, we consider that the apparatus consists merely of an ordinary binocular or telescope-glass system in which is incorporated an ultra-violet "vision" light-filter, i.e. a colour filter which cuts out all but a small amount of visible violet light together with invisible ultra-violet light. Such filters are expensive, but they can (normally) be obtained from either the Ilford or the Kodak companies above mentioned.

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Comments of the Month

By F. J. C.

Roadfarers' Memorandum Accepted by M.O.T.

THE Council of the Roadfarers' Club recently prepared a memorandum on Obstruction of the Highway and submitted it to the Ministry of Transport, as well as other interested bodies including the Metropolitan Police and the Home Office. It has now been considered by the Minister of Transport, who, in a letter to the Secretary of the Council, states: "I am directed by the Minister of Transport to thank you for your Memorandum on the Obstruction of the Highway and to say that the suggestions contained therein have been noted, and will be used as and when they can be adopted conveniently."

The Memorandum dealt with the wide variety of causes of obstruction and methods of eliminating them. Here are some extracts from it:

"In view of the attitude of the police . . . and the savage penalties imposed by magistrates for the so-called offence of obstruction, it is necessary to draw the attention of the authorities to aspects of the matter which may have escaped their consideration. . . . As the law is at present there is no defence to a charge of causing obstruction by leaving vehicles for an 'unreasonable' time on the highway. If it is proved that a vehicle has not caused obstruction to other vehicle or vehicles, the police rely on the old unreasonable phrase 'causing obstruction to vehicles on the road or which might reasonably have been expected to be there.'

"The police sought and obtained powers to remove from the highway any vehicle causing obstruction, and we maintain that the onus is upon the police to prove obstruction and not merely to give evidence as to the time the vehicle has been left unattended. Dozens of cases are brought every year against those who leave their vehicles in culs-de-sac.

"Discrimination should be made between those who are merely using their cars for pleasure purposes and those who are compelled to use them (and are granted petrol units for that purpose) in the execution of their duty.

"We think payment of overtime to the police whilst they are in Court is wrong in principle. It is a direct invitation to the police to 'make' cases.

"Many millions of pounds have been contributed to the State, and this could have been used partly for the construction of adequate parking places. Until that is done we fail to see how the problem can be solved by prosecution, which is merely another form of taxation.

"We suggest that parking in certain streets should be permitted until such time as parking places are provided by the State. The London squares and parks lend themselves to parking. Even though adequate garage space were available, it is entirely unreasonable to expect business drivers to put cars into a garage, taking them out several times in a day.

"It is interesting to trace some of the causes of obstruction. There are far too many traffic lights which, being insensitive to the needs of the moment, needlessly hold up traffic at crossings when other traffic does not wish to proceed at right-angles to the stream so held up. Many of these could be usefully abolished without introducing the need for police control. Some of the lights are so badly timed that they render ineffective traffic lights hundreds of yards to the rear.

"Where police do control traffic they will quite often hold up a file of 50 or more vehicles in order to allow one vehicle to cross.

"Horse-drawn traffic in the streets of London should be abolished during certain hours.

"The unilateral parking of vehicles has been successfully adopted in the provinces, and we see no reason why it should not be adopted in certain streets in London.

"We maintain that when cases of obstruction are brought the police should give evidence that they have had the vehicle under continuous observation for the whole of the time alleged.

"The abolition of all road islands which merely bottleneck the road would help to relieve the congestion. It is noted that most of the measures for road safety have failed in their objects. As they were experimental and are now merely obstructive devices which have reduced traffic in busy towns and cities to a farce, they should be removed.

"The fixing of the stopping places of public service vehicles at traffic lights, or at points where opposing lines of public service vehicles stop and completely obstruct the road was a mistake. The stopping places should now be readjusted.

"It is not so much a maximum speed limit as a minimum, which is required in busy towns and cities.

"The methods at present adopted are repressive, out of step with the developments of road transport, and amount to handing over the road for the exclusive use of public service vehicles."

No White Patch This Winter

AS a result of representations made by the Cycle Manufacturers' Union and the National Committee on Cycling, the Minister of Transport has decided not to bring into operation this winter those provisions of the Road Transport Lighting (Cycles) Act, 1945, which would compel the cyclist to carry a white patch and reflector as well as a red light.

"The information which has been given to the Minister of Transport," says Mr. H. R. Watling, the Union Director, "clearly indicates that it would be futile to attempt to enforce the law in this respect for some time yet as none of the materials which are required to equip the 12,000,000 bicycles in use are available to the industry, and indeed the industry is very embarrassed by the recent decision of the Minister of Supply to reduce the quantity of steel for the manufacture of replacement parts of bicycles. In these circumstances it is hopeless for the Ministry to consider the provision of additional equipment such as would be required by the Act. The position will be further examined in the autumn."

Highway Maintenance

THE Minister of Transport recently received a deputation from the British Road Federation on the question of Highway Maintenance.

The deputation represented that the recent limitation of grants from the Road Fund for Highway Maintenance would have unfortunate effects and urged that there should be an implementation of the first stages of the Ten Year Plan announced by the Minister in May, 1946.

In his reply the Minister said that the representation had his sympathy, but it would be too much to hope that the roads could escape altogether from the effects of the general economic situation. He had not gone back on the Ten Year Plan, and looked upon the present period rather as an interruption. When the circumstances were appropriate he would do all he could to overtake arrears in the operation of the plan, and he reminded them that several major schemes such as the Severn Bridge and the Jarrow Tunnel projects were going forward.

We think that this is false economy in view of the accident statistics issued by the Minister from time to time. If the Ten Year Plan were put into immediate effect many causes of accidents would vanish, for, of course, accidents are not always due to carelessness but to an ever-growing volume of road vehicles of all types endeavouring to use roads never made for such volume.

During the war little or no road maintenance has been carried out, yet our highways had been subjected to unprecedented weight and traffic. Such repairs as had been carried out were of a temporary nature. Arrears of repairs must eventually be made up and undue delay will only lead to an eventual increase in cost. Exceptional conditions last winter have aggravated a situation which is already serious.

In May, 1946, the Minister stated that in the first year of his plan he proposed to spend £80,000,000, and that arrears of road maintenance had approximated to £45,000,000. Little evidence is available that any progress has been made with regard to road construction and maintenance.

The announcement that a reduction of 39 per cent. was being imposed in respect of road maintenance (a drop from £22,000,000 to £13,500,000) during the coming year is a matter of great concern to trade and industry, and in view of the shortage in the supply of vehicles, depreciation due to bad road conditions was a serious economic factor. Many old vehicles will not stand up to the battering they get on bad roads.

Paragrams

Suspicious Circumstances

THE strange sight of a tradesman's delivery cycle being ridden through the streets of Loughborough, Leics, at night made a local policeman rather suspicious as his wife, in common with most wives, cannot get her goods delivered even in the daytime. So he gave chase, and when the rider of the cycle was caught he was found to be an R.A.F. warrant officer, who said to the policeman: "Anyone would think I had stolen the Crown Jewels instead of a bicycle." The magistrates, at the subsequent hearing of the summons, imposed a fine of £1, as they said they thought defendant only "borrowed" the cycle in order to return to camp.

Invented Improvements for Cycles

MR. GEORGE KILBORN, of 34, High Street, Rothwell, Northants, who recently celebrated his golden wedding anniversary, started his business life as an apprentice to a cycle-engineer, and was at one time the proud rider of a "penny-farthing." He took out several patents for improvements to cycles, including a new type of brake which was much more efficient than the hit-or-miss type then in use, a tube-expander and a valve reseater, and, although he later left his original trade and became water engineer to Rothwell Urban Council, he always retained his interest in cycling.

Owner, Please Come Forward!

ON the road from Helpston to Maxey, near Peterborough, which usually carries quite a fair amount of traffic, there was a bridge, until the floods washed it away. Now there is no bridge the road is impassable, and the Soke of Peterborough County Council seem to be having a good deal of trouble in finding out the owner of the bridge. It does not belong to the local authority but to some private landowner, and until the owner is discovered the road looks like remaining impassable.

Road Safety Rally

A CYCLISTS' rally, in which members of local youth organisations were invited to take part, was recently held at Kettering under the auspices of the local Road Safety Committee. Prizes of £3, £2 and £1 were won by the three entrants who showed the best knowledge of road safety as they cycled along a special course. There were 73 competitors who rode from Burton Latimer, near Kettering, and rallied at Rockingham Road Park, Kettering, where a 16-year-old rider was found to be the winner. Another boy was second, and a boy and a girl shared third prize.

Gave Them a Choice

A MAN who pleaded guilty at Towcester (Northants) Police Court to the theft of a cycle valued at £3 was stated to have given six explanations to the police of the way in which the cycle got into his possession. One of these explanations was the right one, but the police suggested to the man that they were not particularly keen on competitions during working hours and he had better tell them which version was correct. For the theft of the cycle he was fined £5 and told that if there was a next time he would find himself in prison.

Prizes Were Appropriate

PRIZES of cycle accessories were given to the winning competitors in a Road Safety Quiz held for schoolchildren at the Assembly Rooms, Boston, as part of a local move to educate children in road-safety. Members of the winning team each received a front lamp, those in the second team were given cycle pumps, and those in the third team rear lamps. The Mayor of Boston, who presented the prizes, referred to the considerable results that had already been obtained in the local road safety campaign, and said he hoped this good work would continue.

Just Right for Beginners

SO that a learner-cyclist or a person suffering from some physical disability may have confidence when getting on and off, an American cyclist has invented a device consisting of two additional wheels which are attached to the rear wheel of any cycle. The wheels, which are retractable by means of a lever on the handlebars, are about the size of push-chair wheels and support the cycle so that a disabled rider can mount without fear of falling, and then let the wheels down again when he wishes to alight.

Fighting Back

AFTER Boston Magistrates' Court had spent nearly half an hour hearing a summons against a local woman cyclist for failing to observe a Halt sign, they decided there was some doubt, having regard to the conflicting evidence of the defendant and a police witness, and dismissed the summons. When she was told that the case was dismissed, defendant told the magistrates that she had been considerably inconvenienced by the police-court proceedings and asked for costs to recompense her. The magistrates refused to make any order for costs.

Reg. Harris, of the Manchester Wheelers, who recently won the world's amateur sprint championship in Paris.

Cycle Dealer's Death

THE death has occurred at the age of 70 at his home, 12, Station Road, Chesterfield, of Mr. Joseph Warner Armistead, who for many years carried on business as a cycle agent and repairer in Corporation Street, Chesterfield. He first went into business in partnership with his brother, the late Mr. Harry Armistead, and subsequently continued on his own account until his retirement 18 years ago, when his son, Mr. Joseph F. Armistead, took over the business. Mr. Armistead was a keen cyclist from the early days and was one of the first members of the original Chesterfield Cycling Club.

Road Time Trials Criticised

WHEN returning a verdict of "accidental death" at the inquest at Grantham on Gordon Parkin, 22-year-old Colsterworth member of the Grantham Road Club who was fatally injured while riding in a 10-mile event on the Great North Road, the jury expressed the view that this road is not a proper place for the holding of speed trials, having regard to the amount of traffic. According to the evidence, the cyclist collided with the cab door of a lorry which the driver opened, having first, as he stated, looked into his mirror. Immediately the door was opened the cyclist struck it. The club have decided to hold their events on another stretch of road.

Not So Wizard

"THEY must be reminded of the film 'The Wizard of Oz' and the road that leads to nowhere," said the surveyor to St. Ives (Hunts) Council during a discussion on the lack of direction signs in the town, and the difficulty travellers had of leaving the town once they had found their way into it. The signs were all removed during the war and now that the news of the end of the war has at last filtered through to St. Ives they will, no doubt, soon be put back again.

Battle of Britain Memorial

AMONG the names of members of aircrews who died in the Battle of Britain inscribed on the parchment roll of honour which rests on the lectern in the Battle of Britain memorial chapel in Westminster Abbey is that of a former Leicestershire racing cyclist, Sydney Eric Riddington, whose home was at Humberstone Lane, Thurmaston. At the time of his death he was flying with 53 Squadron, Coastal Command, as a pilot. He failed to return from an operation.

Missed No Chances

THREE speedy riders from Notts Castle B.C. who took part in events at the sports meeting organised by the Peterborough engineering works of Messrs. Peter Brotherhood, Ltd., practically swept the board. Between them they won three first prizes, four seconds and three thirds in five races, and when they went back home they took with them an assortment of prizes to the total value of £36.

Killed During "Safety Week"

WHILE prizes were being distributed at East Grinstead to the winners of a children's safe cycling competition, organised as part of the town's "Safety Week" programme, a 13-year-old boy cyclist fell from his machine and was killed under a motor-coach. Hanging across the road a short distance from the spot where the accident happened was a large banner with the words "Sussex by the Sea. Keep our Roads Safe."

Cleared the Field

DURING the final of a one-mile cycle race held at Winterton (Lincs) Midsummer Sports before a crowd of some 8,000 spectators, the leading rider suddenly fell, bringing down the four riders behind him and leaving the solitary remaining competitor, G. Place, of Mexborough, Yorks, to carry on and win at his own speed. Two of the other riders got themselves fresh machines and carried on to come in second and third.

Remembered Too Late!

WHEN a 27-year-old Dersingham (Norfolk) labourer was remanded in custody for six days after the hearing of a charge against him at Boston Police Court for stealing a lady's cycle, he complained: "It's rather a long spell, isn't it? I'm under the doctor's care, you know." The clerk to the magistrates explained that while the accused was in custody, pending investigations into further charges, his health would receive every attention.

Swedish Cyclists' Impressions

HAVING regard to the marked and general deterioration of good manners in this country of late years it was interesting to hear two Swedish travellers, on a cycling tour of the country, comment at Boston, Lincs, on "English good manners." They were also pleased with "the excellent roads in the country," but they were not so pleased with the "peculiar climate." To those who spend their lives in the English climate it seems more than peculiar sometimes.

Coming of Age

DONCASTER Wheelers Cycling Club members are making plans for their twenty-first anniversary celebrations, to be held this year. Mr. Harry Aspinall of 29, Kings Road, Doncaster, is anxious to get in touch with all founder and first-year members of the club, being those members who joined in 1926-27.

Bicycles Made for Four

THE two girls and two boys who won a cycle trial organised by the local Road Safety Committee were later taken to a cycle dealer to make sure that the cycle which each had won as a prize would be exactly right for them and tailored to fit the rider. The trial comprised a ride over a four-mile course, the cyclists to observe all the road signs and give the correct signals, followed by a series of questions on the Highway Code at the end of the course.

Cycle for Long Life

THE fact that he took up cycling in the days when the penny-farthing was the most modern machine on the road and continued up to three years ago to be a keen cyclist may have had something to do with the long and healthy life of Mr. Richard Joseph Whittingham, who has died at his home at Cusworth, near Doncaster, at the age of 87. He was one of the very first cyclists to be seen in the streets of Doncaster.

Around the Wheelworld

By ICARUS

Claud Butler, Junr.

CONGRATULATIONS to Claud Butler, whose wife recently presented him with a son. Claud now has two sons and a daughter.

B.L.R.C. and U.C.I.

SO the U.C.I. has refused to recognise the B.L.R.C. for the present. The time must come, however, when it will be forced to do so, because the inevitable development of cycling in this country on any scale commensurate with our brotherhood of 12,000,000 is on the lines laid down by the B.L.R.C. This refusal will not, of course, have any effect on the policy nor the ambition of the B.L.R.C.

I do not know what jockeyings went on before the meeting of the U.C.I., but the fact that they refused to let the representative of the B.L.R.C. have a hearing suggests that they did not approach the matter with an open mind, and he was confined therefore to a protest.

Thus, the position in this country remains unchanged, and there will continue to be the so-called split, although how there can be a split between two bodies which were never united and have always had a separate existence I do not know. It would be inimical to the best interests of the sport for these two bodies to amalgamate on the basis of a compromise, although there is every reason why the N.C.U. should now submerge its identity in favour of a more live and up-to-date body. However, we must await events.

Cycle Parks in Brighton

THE new cycle parks in Brighton are fitted with metal racks to take 375 bicycles, and visitors to Brighton may leave their bicycles there at a charge of 1s. for the day or portion of the day. Attendants are provided and the ticket is in two parts, both numbered correspondingly to prevent persons claiming a bicycle which does not belong to them. This is a very modern adaptation of the cycle store which was in existence in Brighton before the war, and which used improvised racks.

The cycle park is built underneath the promenade on the south side of the Aquarium, and as soon as they are supplied its position will be denoted by the display of two blue flags bearing the words "Cycle Park."

I hope that this idea will be copied throughout the country.

Parking on the Highway

UNDER the Public Health Act, 1925, highway authorities are prohibited from granting parking facilities on the highway. The recent attempt of the Southend and the Worthing Corporation to impose a parking fee has been successfully opposed by visitors who have refused to pay the fee. The Corporation found that it had no power to prosecute. The conditions under which vehicles were left made the charging of a fee a farce in that they undertook no responsibility for loss or damage.

The Southend Corporation recently sought to obtain from Parliament the right to make charges for the parking of vehicles on the public highway, but it was successfully opposed by various organisations.

The Act of 1925 specifically forbids the imposition of such charges, but daily complaints are received that motorists and cyclists are being asked for payment. The normal practice is for an attendant, not always in uniform, to approach the visitor, issue a printed ticket, and demand the sum of 6d., 1s., or whatever the charge may be. If challenged on the score of legality the attendant admits that the payment is voluntary. This fact, however, is not clear from the wording on the ticket, which is merely a receipt for the attendant's "services." All responsibility for the safety of the vehicle is disclaimed on the ticket by the authority which issues it.

May I warn my readers, therefore, that no one has the right to charge for parking on the highway, and I urge them to refuse payment no matter under what guise it may be demanded. Only when all motorists and cyclists decline to pay will the present practices vanish. They are merely forms of extortion, and I am wondering whether prosecutions will be brought against these Councils for breach of an Act they are expected to administer. Many of the members of these Councils are also magistrates who should know the law, and undoubtedly inflict fines on road users who break that law.

Radio-equipped Police Patrol

TRAFFIC jams and bad accidents are now being specially handled by the Metropolitan Police. Eight traffic accident groups, each consisting of a car with an escort of two motor cycles, have already been given areas to patrol, and any police officer on duty who has trouble with the traffic, or with any smash of more than a minor nature, telephones Scotland Yard who, in turn, send on the nearest patrol to help him. The patrol car has a two-way radio transmitter to keep in constant touch with headquarters. The intention is to raise the number of patrols from eight to 32.

Eventually each motor cyclist in the Metropolitan Police is also to have a two-way radio transmitter with military valves, a handlebar flick-switch and an upright aerial at the back of his machine. The rider will not wear head-phones and, to leave his hands free for control, he will have a mouthpiece fitted round the neck. It is hoped that each machine will carry a loudspeaker to allow the rider to address the general public when on the move.

The work of the 76 cycles now on patrol in London has been so satisfactory that the number is being doubled. Apart from these new traffic accident groups, their main job is to patrol a beat in order to keep an eye on erring traffic and to assist in traffic control. Motor cycles are also used, mainly in outlying districts in London, to take a police officer from one beat to another. He does one beat on foot, gets his machine, and rides off to his next beat.

Reg. Harris, World Champion

OUR congratulations to Reg. Harris upon winning the World Amateur Sprint Championship. This is the first really important event since the war won by an Englishman. No thanks are due to the N.C.U., nor to any other body, for the success of Harris. He has ploughed his lonely furrow as an amateur and ridden to the top by his own efforts. This is a sign after our series of defeats abroad that the tide is turning, and let us hope that at the next Olympic games a fair proportion of the honours will come to England.

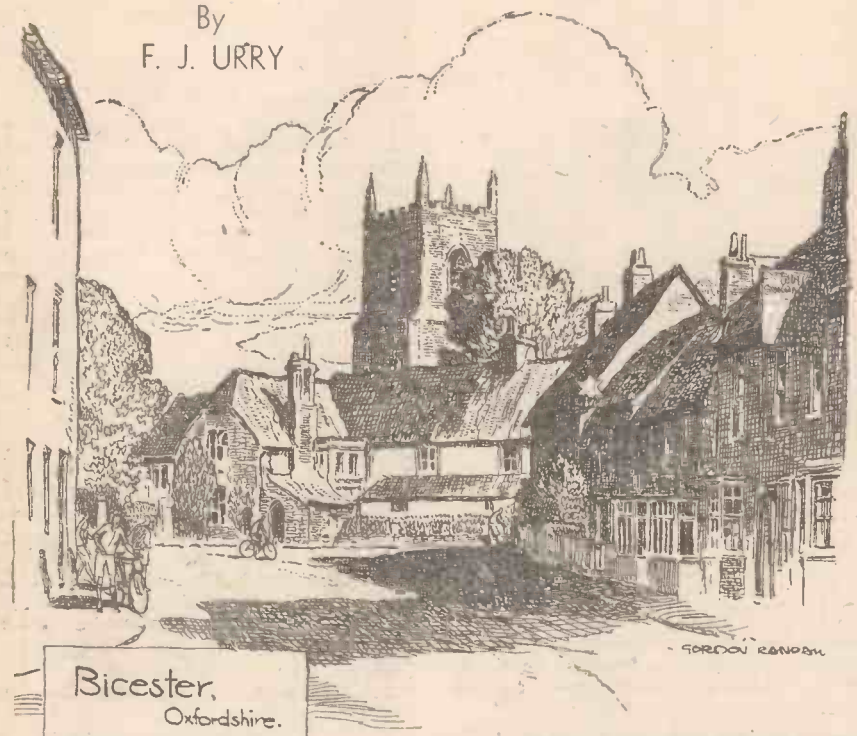
With riders such as Harris and Fleming (the latter was inside two hours for 50 miles two week-ends running, recently), there are lively prospects in international sport; but, of course, selection committees do funny things!

French Cycle Tourists Over Here

A PARTY of 27 French cycle tourists visited Britain during August, and they were welcomed by members of the C.T.C. The visitors were members of the Touring Club De France, which is co-operating with English bodies in the development of international cycle touring. Their route, after a day in London, from whence they travelled to Edinburgh, included Lochness (the monster was on holiday)! Loch Lomond and Glen Coe. They cycled by way of Stirling, Pitlochry, Kingussie, Inverness, Fort Augustus, Fort William and Balmaha. They camped at selected sites of the Camping Club of Great Britain.

Wayside Thoughts

By
F. J. URRY



Bicester,
Oxfordshire.

Picturesque cottages grouped around the old church.

The Coming Event

WHEN we were told we should not have a show in October it was bad news, for it will surely mean that we shall not see in material form some of the much boosted improvements in bicycles and their equipment that the manufacturers so generously promised us during the war period. When those promises were made no one appeared to realise how great would be the call from every quarter of the world for bicycles and the need for exports. This demand being imperative, the question of novel introductions and improvements had to be postponed in the main to await the moment when the urgency for anything on two wheels had died down a trifle. I doubt if that time has arrived so far as the export trade is concerned, but there are more bicycles in the home depots, or were a few weeks ago, and talking to dealers I sense the real need for the type of machine equipped and finished to a higher standard than the basic models. It is in this connection that the show would have been good for the pastime and the industry. We are a trifle weary of the plain bicycle, and particularly of the awful quality of equipment, such as lamps and bags. Cycling, to be fully worth while in the pleasure sense, needs top quality goods and, except in rare instances, we have not seen that desideratum for eight long years. Therefore, I predict a disappointment among keen cyclists, who will still have to wait the fulfilment of their desire for the best products. There is money to spend and a great awakening of interest on the sporting and touring side of the game which would surprise some of the people who have a bias for standardisation.

Time for All Things

THE other Sunday morning I went a lonely ride to think over a knotty business problem; a silly thing to do, for in the first mile I became aware of the beauty of the morning, the scent of the wind and, more than any other single thing, the song of the birds. That is just what cycling is for, to create a forgetfulness of your little troubles, and looking at them—as I did—through such lovely surroundings realise how tiny they are. I sat on a bank above a pool whose mirror was continually shattered by scurrying coots, and high in the blue a lark was dropping liquid music into the atmosphere. That was a pipe of peace in the middle of a 10 leagues jaunt, and if the resolution "to think things over" completely disappeared what did it matter, for I was happy? There are times when it is just silly—no less—to try to mix business with pleasure, and the older I grow the more sure I become that cycling on a spring morning of radiant sunshine is one of them. I am sorry for the folk who can never get away from the shop; it may lead them to great success in life, measured by finance, I admit, but also it may confine them to a prison from which they can never escape. It is easy to concentrate on business matters in the right surroundings, but I can't do it when the road is before me and spring is touching all nature with green and fairy fingers. Nor, I imagine, can anyone concentrate on pleasure; it just happens, as it did to me that morning, and to deny its delicate delight would be sheer madness.

Not All Roses

ALL cycling is not ease, and sometimes only grows into fun when the adventure is over. If this were not so, then the game would severely lack character, and so would the rider. Sometimes, as when we go pass-storming, we impose our own little difficulties, and at other times they are imposed for us by the weather and the road in combination, almost as if the natural elements disliked us for the time being and the artificial one had been made purposely to annoy us. In such circumstances, if you are not hungry and are decently fit, I say you can enjoy such ventures, and they certainly remain a victorious memory long after the days of ease, undecorated with incident, have faded into nothingness. Not so many years ago I rode with a friend 80 miles to Peterboro' into an easterly gale of driving rain, several thunderstorms and a touch of sleet in the valley of the Nene, and, as it would happen on such a day, we had a couple of punctures. My companion wanted to return after 10 miles and one perforation. That was while we were getting thoroughly wet, always the worst travel period on a stormy day, but I persuaded him to carry on, on the promise of a glorious run home with the gale on the morrow. To this hour that man talks about the high enjoyment of the fight, the food we ate on the way and one comfortable inn where a log fire roared its welcome on that grim April day. That journey was glorious in so far that the triumph of muscle over matter made me feel supremely young and gave me a fuller confidence that there were years of good cycling in me still, and that thought alone was a solace. No—to say cycling is all blue skies and fair winds is not true, and the fine physical excellence of it would be lacking were it so. But it is a great game for the fit and stout-hearted.

Warm Blooded

ONE rather cool week-end when the wind had a cutting edge, my companion said to me as a group of youngsters swung past us: "Tell me, how do those people keep comfortably warm in such weather and in such scanty clothing?" I don't know, never having tried bare legs while riding into an east wind. That they do, as the record of their health and fitness proves, is certainly true although I have seen, on occasion, shivering specimens waiting on windy corners for their club comrades, and, let me admit it, felt a little superior in the judgment of my raiment. Sketchy clothing I can understand when summer is really at work and the air is warmly caressing; but on a day like the one in question, it seems to me rather a doubtful design for comfort. But then, as I say, I'm not competent to speak on this matter from experience, and should not have raised the question except for my friend's query and numerous notes on the same subject that have reached me from time to time. Actually, I suppose one can enjoy cycling in almost any everyday garb, but the compromise between the all-out sketchiness of shorts and jersey is, to my mind, the ordinary cycling suit, with a pull-over for cool days, a waistcoat for the moderate temperatures of spring and autumn, and the unlined sports jacket for summer touring, minus waistcoat, and if it is really hot the outer garment can be packed away for the zephyrs to crinkle your shirt. But each to his own notion on these matters, my point being that extravagant equipment does not necessarily mean the competent cyclist, for I know many a fine rider and keen tourist prefers his grey slacks to any sartorial cycling garb. No doubt if my years were yet to run into the thirties my choice of raiment would follow the fashion, but being pretty happy as I am I've no intention of changing habits.

State Them Frankly

I WONDER if, in the settling-down processes now in operation, the hardening of opinions and the discoveries of new foundations for living, the rising generation will seize the chances to voice its convictions. Amid the present turmoil of interests most of us seem to fly from one opinion to another without giving much thought to the values of work or leisure; we air our prejudices, but seem to remain silent on the matter of our convictions—if we have any. That convictions will come to the younger people I am certain, if the older ones will only state their own with the good temper that conviction should always carry, a character in temper so seldom associated with the sheer prejudice that nearly always raves and even then fails to make its point. My love of cycling as a way of leisure is a conviction that I have tried to put over to my fellow countrymen for many years not, I'm afraid, very successfully, but at least honestly. I find that in some quarters my opinions on travel happiness are construed as an exaggeration amounting to prejudice, simply because the other fellow will not give himself a chance to learn cycling. I've played most games and enjoyed them, and still find fun in the few left to me, which do not entail a too serious sense of competition. But for unalloyed pleasure—and here is my conviction on cycling—give me the freedom of the road and a bicycle and I ask no greater boon with which to fill my leisure. The variety of cycling, its exercise, its healthiness, its awareness and its life, are the elements that keep simple humanity fit and contented, and bring to that type a thousand happy memories to fill a million unwritten pages. Nor is cycling all sunshine and fair breezes, and if it were half its adventure would disappear and stale by the very fact that its marvellous variability would be curtailed. Never in this world has mankind yet obtained something for nothing, but I verily believe the nearest approach to that elysium of the holiday spirit is cycling. Whether you grow rich and important or remain of the crowd, here is a levelling pleasure that puts all equal, gives to all a reliance on the personal, and is indeed a triumph of mind and muscle pleasantly used over all the gradations of life. I say that no one can be a true cyclist without becoming a better and more likable individual to his friends and himself.

Many Difficulties

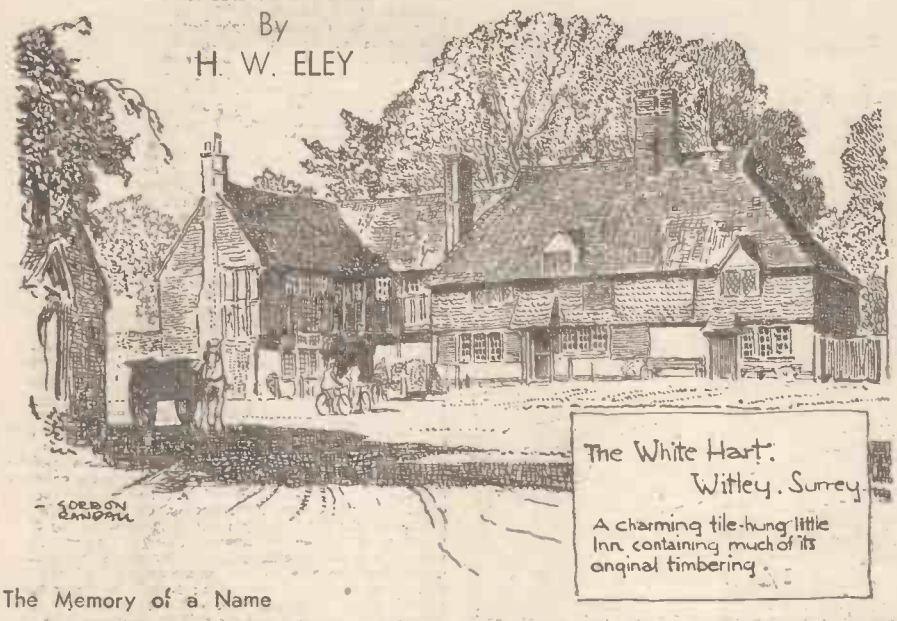
I GET a lot of letters asking me for particulars of accommodation, and in these times find them most difficult to answer for the simple reason that six years of war and seven of rationing have completely destroyed the value of my own private list. During my own journeys I have frequently been greatly disappointed with the receptions at my old haunts, from Scotland to Cornwall, for some have changed hands, and many have been attacked by the desire to make money while the going is good and let the future take care of itself. Indeed, I have found that the best hotels are very little more expensive than what we should once have termed moderate places, for at least you do obtain decent comfort, and the food is perhaps as good as you can expect. That catering will improve in the not too distant future I do not doubt—indeed, it must if we desire to make touring one of our real industries—but until the food situation improves the joy and delight of the pre-war welcomes may be limited for all of us who roam. The recommendation of to-day based on a pre-war experience is not worth much, and even the places one visited last year and found satisfaction then may easily have changed with a new owner installed, or suffered the fate of labour shortage which is undoubtedly the trouble at many establishments. Yet it is always worth taking a chance; it is part of the adventure of travel to-day and is the main reason why my touring bag holds as much provender as the home larder can spare when I go a-holidaying.

A Question

I SUPPOSE we shall have to wait a little longer for the better bicycle and its equipment. It's a pity, but exports must come first, and, according to the economists, we shall fail in our standard of living if we do not take heed. So I'll carry on with what I have as well as I can and be thankful. Yet I do hope our standard of bicycles will not decline and that our foreign customers will continue to bank on the quality of the British-built bicycle. That is specially important, considered as a long-term view. And the subject brings to mind the undoubted fact that while U.S.A. can build cars cheaper than we do here, they cannot compete with us in the oveseas market with bicycles. I wonder why? Both vehicles are mass-produced articles. It would almost seem as if our big manufacturers of bicycles could teach the motor-car people the way of the thing. This situation has always been a curiosity to me and I have never heard a satisfactory explanation.

CYCLORAMA

By H. W. ELEY



The White Hart. Witley. Surrey.
A charming tile-hung little Inn containing much of its original timbering.

The Memory of a Name

ONE day recently I was conducted over an old house in the country. A big house . . . with many attics, out-houses, and "cubby-holes," such as abound in houses which were built in the spacious days when folks kept many servants, and there was no such thing as a "kitchenette." And, in one store-room, I came across an old cycle. Dusty, tyres deflated, handle-bars rusty; a sorry sight, but it was the name of the machine which gave me the surprise, and sent my memory racing back over the years. The "Mead"—that American invader which came over to this country about (I suppose) 1907, and secured a certain measure of popularity. But I had never seen a "Mead" bike for years. Have you?

Mrs. Jean McClintock—Daughter of J. B. Dunlop

FOR many years I have kept in touch with Mrs. McClintock, and I was pleased to receive a letter from her the other day—from Eastbourne, where she has now returned after a wartime stay in Scotland. And her letter brought memories to me of my earlier Dunlop days, when J. B. Dunlop was alive, and when his bearded face was a more familiar feature of Dunlop advertising than it is to-day. From my office bookshelf I took down J. B. D.'s book, published by Thom of Dublin somewhere about 1920. And it recalled all the old exciting days when litigation about tyre patents was the order of the day. The industry seemed to thrive on lawsuits and the atmosphere of the Courts!

Nature Near to London

MORE than once in these notes I have referred to the fact that the enthusiastic naturalist has no need to journey many miles from the heart of London to see country sights and hear country sounds. I was reminded of this the other day when I was walking in Highgate Woods—having entered them near to Cranley Gardens station. Right by the path, where children played, two gaudy-hued jays popped from tree stump to fence and peered cheekily at me as I paused to admire their rich plumage. And—a few moments later—I was interested in the antics of a squirrel, climbing nimbly up the trunk of a silver-birch tree. Thrushes and blackbirds abounded, and although it is late in the season to expect bird song there were one or two snatches of song from a robin and a few happy notes from a linnet. All so near to London!

Summer Touring

AT this time of the year I always get a few welcome and cheery postcards from friends who are indulging in cycling holidays, and early last month I received a card from a good cycling pal—quite an old hand at touring—and I noticed the postmark was Rhayader; and it brought back to me good memories of rides I had years ago in that pleasant country on the Radnor and Montgomery borders. . . . I recalled that I used to stop at Rhayader on occasion, and I remembered the inn—"The Lamb and Flag." My friend reported good weather, the deep joy of unspoiled countryside, absence of smoke and grime . . . and an appetite that was rather difficult to satisfy, even in the heart of the country where it is popularly supposed that food is much more plentiful than in the towns and cities. How I love that Welsh border countryside! The rowan trees will be heavy with the ruby-like berries, which will glisten gloriously in the sunshine slanting across the hillsides. I envied my touring friend!

The British Bicycle

THAT was a fine tribute to the quality and performance of British cycles which was paid by a member of the Cabinet recently, on the occasion of the opening of a new factory in Coventry. It is getting quite the fashion for Cabinet Ministers to visit factories and demonstrate their interest in industry and their belief in the quality of British products. And, in the case of the bicycle, how true it is that the old traditions of quality and good value have been maintained. The British cycle is supreme, holding its own in the face of all competition and in spite of all our manifold manufacturing difficulties. It is good that the fact is blazoned forth to the world.

I Visit the "Hanningfields"

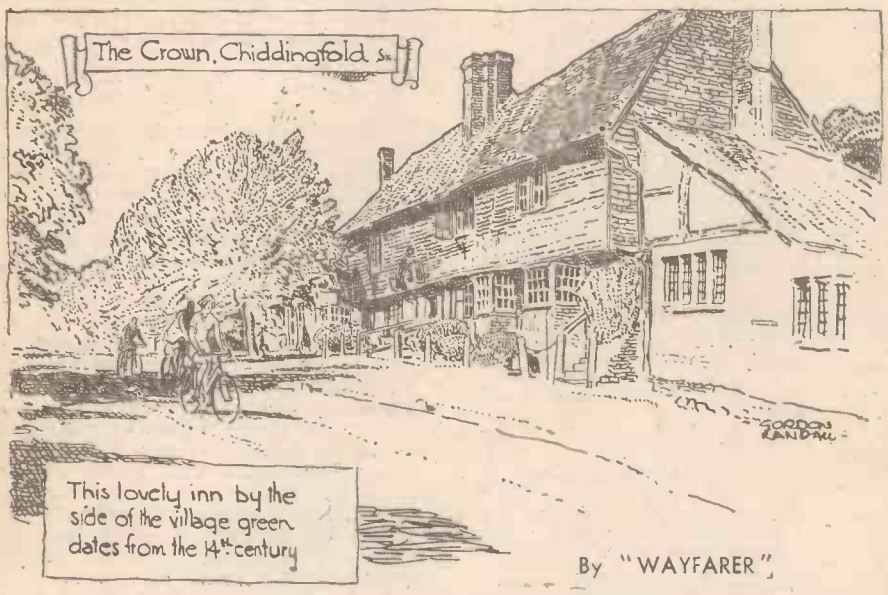
SOME readers may know these little Essex villages—not so far from ancient Chelmsford. I spent a few days in West Hanningfield, which is old, unspoiled, and possesses a good inn, an ancient church, and has traditions which go back into the dim past. There is an old house there named "Helmans," and, from what I gathered from certain old records which I was privileged to look at, it dates back to the year 1381. Of course, there have been several restorations, the last one of any note being in the reign of Queen Anne. I saw the house first in May, when it was embowered in lilac . . . and the whole place drenched in springtime beauty. Wood-pigeons cooed lazily from the trees and there was a moorhen's nest at the edge of the pool in front of the rambling house. The inn, "The Compasses," was cool and inviting, with a cheery landlord having good ale to sell. Now, you cyclists who have never sojourned in the heart of Essex, there is a tip for a tour—to the Hanningfields, which have been spared the ravages of "modern progress" and where there is peace and serenity in a world of clamour and chaos. . . .

Long-life Tyres

CLEANING and generally overhauling my mount the other week-end, I made a careful examination of the tyres, and I was very gratified to find that the covers at present giving me service were in excellent condition—wearing evenly and with a good and effective tread pattern left. Now, having an inclination for making notes, I have always recorded tyre purchases; it is not a bad notion, and I looked up my last notes about the purchase of tyres. I found that the rear cover had been in use for over four years! I have, unfortunately, no accurate records of mileage, but I do know that this cover has done yeoman work, and it speaks volumes for good craftsmanship.

Chipping Campden, Gloucestershire.
The broad main street and the market hall. (16th century).

My Point of View



By "WAYFARER"

Faulty Signalling

I FEEL that there may be some justification for the complaints which are made from time to time regarding the inadequacy of cyclists' signals—though I fiercely resent these endless attempts to blame cyclists for nearly everything that happens. Certainly the signalling method too frequently employed before making a right turn leaves a lot to the imagination, creating danger for the cyclist and inconvenience for overtaking traffic. My own preference is for no signalling. I prefer to look round in order to see "what's cooking," and then to go right when it is both safe and convenient to do so. After all, the act of signalling does not confer any privilege on the signaller to carry out his (or her) "threat" immediately. You cannot proceed with the process until a fitting moment arrives.

The other day I saw a girl cyclist look over her right shoulder, throw out her right arm, and then make her turn. She must have seen a heavily-laden milk lorry right on her tail, and this should have warned her to wait. It had the reverse effect, and she went on her way to the accompaniment of the not unexpected and not undeserved objurgations of the justifiably incensed driver. This sort of conduct gets a bad name for all cyclists, and we cannot afford it.

Explained

DURING my many Irish tours I have often been intrigued by the inability of the populace to say "Yes" or "No" to questions they are asked. You inquire whether "this is the road to Galway," and the reply is either "It is, sorr" or "It is not, sorr"—with, occasionally, an implied affirmative in the shape of "Nine miles, sorr." Never a plain yea or nay! A little light was thrown on this matter by means of a letter in a recent issue of the *Radio Times*, where the writer stated that there are no words for "Yes" and "No" in Welsh. He added: "If asked in Welsh 'Are you going to the cinema?' you reply either 'I am' or 'I am not.'" I imagine that what "goes" for Wales also "goes" for Ireland, having regard to the shared Celtic origin of people and language.

Welcome Sign

I REJOICE to observe that the large maps provided, with commendable enterprise, by one of the cider-manufacturing firms, are now making their re-appearance on the hoardings. This may be said to represent another step on the road towards normality—which is still a very long way off! Some cyclists who claim to be in the "real" class (as I myself do, though the correct interpretation of the word eludes me) may be inclined to sniff at such maps, but I view them with interest, and it must be admitted that on more than one occasion, when I have "run off my maps," they have proved their utility.

Traffic Riding

OWING to circumstances beyond my control I do very little traffic riding nowadays, whereas at one time I was constantly in the thick of things. But recently there came a fugitive return to a cycling phase of which I was always very fond, and I rediscovered the old thrill in full measure. It was a joy to be again weaving in and out of the vehicles forming a temporary "jam," to be slipping through a hole here, to be coming to a full-stop there. The whole process calls for quick thinking and for intelligent action—indeed, for intelligent anticipation, if one may quote an ancient political phrase. I recognise no danger (for a cyclist of mature experience, anyhow) and I delight in traffic riding. Owing to my position on the bicycle it is never necessary for me to dismount, and with one foot on the ground when a halt is demanded, I am pretty quick off the mark as soon as the embargo is raised and the traffic stream is ready to go ahead. The bicycle remains about the fastest unit in city streets when congestion prevails.

Worth Saying Right

WHEN people talk about cycling "backwards and forwards to work" it is obvious that they have not given much thought to what they are saying. Of course, one knows what is meant, but it seems to me that the statement is worth saying right. "To and from work" is the way to put it. I mention the matter at this juncture because the *Radio Times* was recently guilty of the bloomer of asserting that a certain Count "flew backwards and forwards from Sweden." It would be a thrill to see anybody flying backwards!

Old Heads—Or No Heads

FROM time immemorial the difficulty of fitting old heads on young shoulders has been realised, but it appears to me that if something is not done about it in connection with road usage there will be no heads—with the alternative of bashed heads—on young shoulders. This remark is prompted through my having just witnessed a boy cyclist swing round a left-hand turn at speed, taking so full a sweep that he nearly touched the right-hand kerb of the road he entered. The scene was a suburban one where traffic was to be expected, but fortunately nothing was about and the lad "got away with it." No doubt the performance looked a lot more risky than it actually was—such is usually the case—but I see grim possibilities about such behaviour. Acts of that sort were fairly safe, if undesirable, some 50 years ago; they are highly dangerous to-day.

Good Hearing

EXACTLY a year ago a leading article in the principal daily newspaper published in the great city where I dwell discussed the centenary of the bicycle and asserted that the inventor "conferred untold benefits on his fellow-men." It asked: "Who would deny that the bicycle has proved one of the most useful inventions given to humanity during this century of rapid and startling changes?" The writer then added that the bicycle "remains more than ever supreme as an article of utility as well as the means of giving wholesome, invigorating pleasure to people of all ages." These quotations have lost nothing by being kept in cold storage for 12 months, nor have the truths they contain altered in any way. When next we hear people speak with contempt of the bicycle let us bear in mind the nice things said about it by a staid Birmingham newspaper.

Exasperating Delays

NEARLY always, when taking part in a club run, do I find the apparently inevitable delays exasperating. I can loiter with anyone. I (nearly) possess a row of medals for my readiness to linger in the presence of a sublime view, while my prowess in leaning on gates for indefinite periods is of world-wide fame. But when it comes to action, I am a veritable go-getter. Is the run timed to start at three o'clock? Then at three o'clock I want to move off, always believing that the people who are on the spot deserve much more consideration than the laggards. When tea is over and a decent break has been allowed for digestive purposes, and the skipper has ordained that we shall get back on the job, then I want to be in the saddle. I hate the "messing about" which characterises so many club runs. On the arrival of the time to move I prefer to be on the move, and I have never competed for the honour of being last at the meet or last away after tea. The fun of actual cycling makes a much greater appeal to me than mooning round, and time—yes! even leisure time—is far too precious to be wasted.

The minutes so frequently lost at the beginning of a journey in connection with the normal organised run could be conserved if the policy of my principal club were adopted. The actual fixture is tea at a certain hour at a specified place. You start when you like, travel by any route you fancy and go at your own pace. You ride alone or with one (or more) of your club-mates whose arrangements and riding powers match yours. Incidentally, this system fits in better with traffic conditions on main roads near densely populated centres and makes for easier progress. The system may not cover the question of the resumption of the ride after tea, though in practice it usually does, the various groups moving off as soon as they are ready, leaving the laggards to take care of themselves.

Yes, delays can be exasperating, as I found after tea on a recent club run where the lads (of all ages) were mighty slow in the uptake. I moved off according to schedule, whilst they dawdled, afterwards walking the first few hundred yards. In the end I, too, had to share in the time-wasting process by waiting for the laggards.

It Didn't Happen to Me

DURING the war period, when supplies were difficult to obtain, when many cycle shops and garages were closed down, when the shutters on existing business were put up early, when public transport was limited, and when innumerable caterers indulged in the "cease fire" act, this lurid thought often occurred to me: Supposing, on my way home next Saturday or Sunday something goes wrong with my bike. A milk-bottle inconsiderately left on the highway puts paid to the tyres or my chain breaks, or something else of a radical nature occurs. What do I do? I can't get replacements; I can't get transport; I can't get accommodation. It's 15 miles to walk home—and there's a bad air raid in progress. In the words of the old gag: "What does Mr. X do?"

Probably it was just as well to visualise the difficulties which a breakdown would bring into being, but in practice none of these things happened to me—except that I *did* finish a number of my rides to the accompaniment of overhead fireworks. Still, the grim possibilities had to be faced and, perhaps without altering one's cycling programme, they did impel one to see that, humanly speaking, one's bicycle was kept in perfect condition. Not that all the care in the world in this direction would have prevented a milk bottle from doing its stuff!

"The Track is to the West"

THE late W. F. Ball, who provided *The Birmingham Mail* with cycling notes over a long term of years (and was as graceful a rider as ever sat in a saddle), was wont to advise his readers in the Midlands to go "south or west" for their tours. I look upon this as sound—always provided that the existence of the north and east is not entirely overlooked. South or west from Birmingham gives you some marvellous stuff—the Cotswolds, the New Forest, Dorset, etc., and Mid and South Wales and so on. Not to make this note too local, however, is it not a fact that many of us naturally look west and south for our holiday enjoyment?

In Wales, for example, what cyclist does not aim for the west? In Scotland, do not most of us prefer Galloway and Argyle (and the Islands) to the east?

In Ireland it is the westerly areas which call so insistently. Thus, if in the words of Dr. Kenneth Macleod's spirited marching song, "The Road to the Isles," we find that "the track is to the west," we shall not go far wrong. But, as suggested above, we ought not to neglect the other points of the compass.

Hidden Village

ONE day in the late spring I came upon the hidden village of Hill Pool, in Worcestershire. It is a tiny and insignificant place, quite off the beaten track, and it consists of a handful of houses, a lot of fruit trees, two hills, a noisy stream, a bridge and a wall letterbox. The pool from which the village takes part of its name has been drained, but the first portion of the name is still justified—doubly so! A steepish and winding lane brings you to the village and you climb out of it by the same sort of thoroughfare, and then "you've had it." By the time this note appears it will be too late for you to see Hill Pool in its gorgeous spring garments of pink and white, but I commend to you the idea of making a visit to the place at the appropriate moment next year, if the opportunity comes your way. Though, to be sure, this quaint and hidden village is worth a visit at any time.

Bobbing Up and Down

TWICE within the memory of living man have I been gently chided for bobbing up and down on my bicycle—"dancing" they call it nowadays. On the first such occasion I unexpectedly met a brother-Anfielder near Ludlow just at the moment when I was "dancing" to get up a small hill, and he expressed surprise at my action. My reply was that what was good enough for the late W. P. Cook, the greatest exponent of pleasure cycling I have ever known, was good enough for me. On the second occasion, one who turned out to be an old-time cyclist—and very self-opinionated—sidled up alongside and volunteered the view that "that"—"dancing"—was never any good. A friendly discussion took place as we cycled onwards for a few miles, and I remained—as I remain—unconvinced that the bobbing up and down business is valueless. I believe, rightly or wrongly, that it serves a definite purpose.

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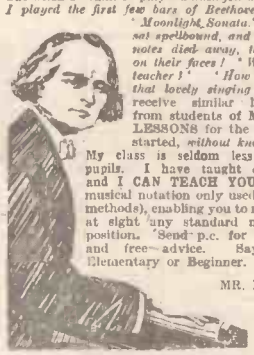

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