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EDITOR: F. J. CAMM

NOVEMBER 1951

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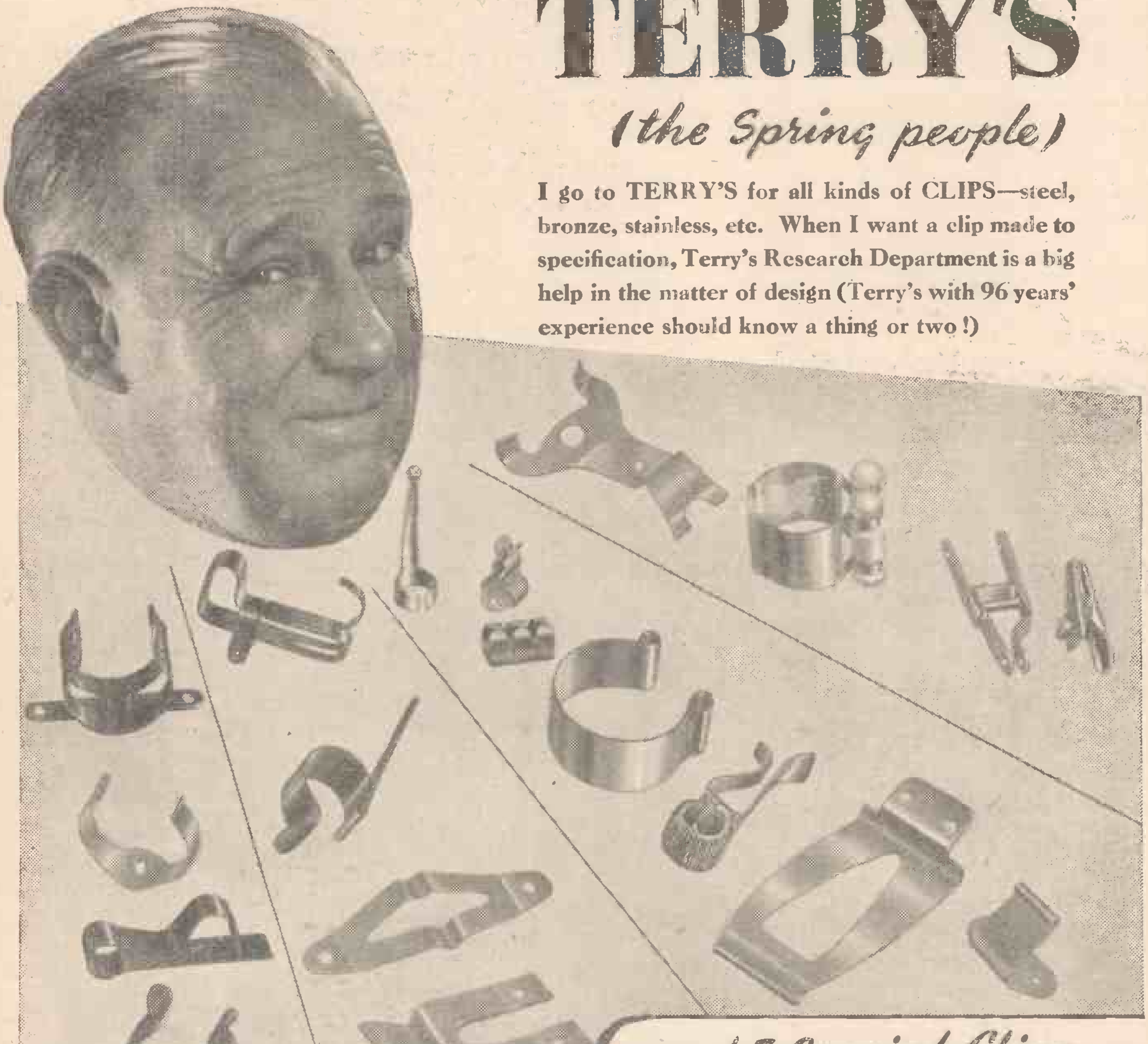

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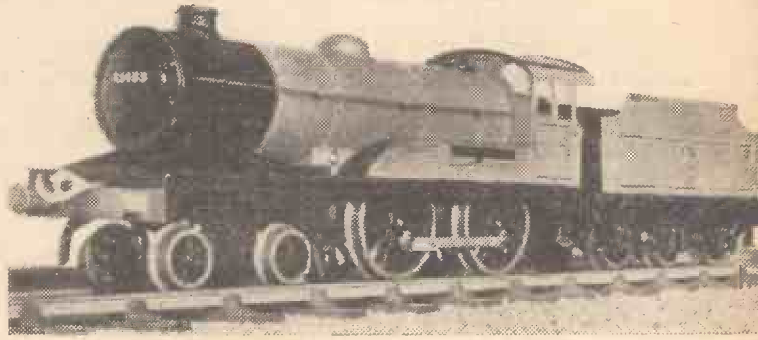

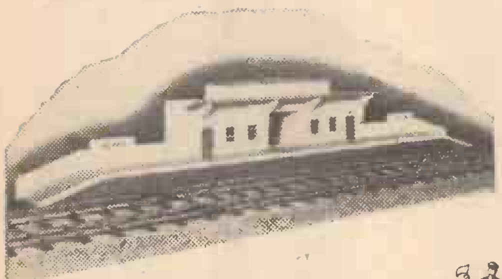

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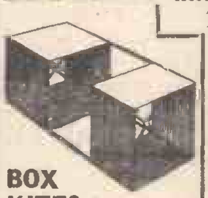

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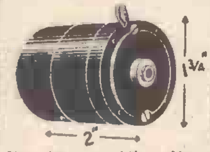

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PRACTICAL MECHANICS

EDITOR F. J. CAMM

NOVEMBER, 1951
VOL. XIX. No. 215

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

FAIR COMMENT By The Editor

A College of Technologists?

THE position of Great Britain as a leading industrial nation is being endangered by failure to secure the fullest possible application of science to industry, and this failure is partly due to deficiencies in education. Those are not my words, but those of the Percy Report published in 1945.

The Government heeded those warning words to some extent and the number of students taking technological subjects at universities is double that for the year 1939. Some universities have started post-graduate courses in technology. Unfortunately these courses do not go far enough, and, after six years, industry is still perilously short of skilled men in the higher grades, and shorter still of skilled men in the practical crafts.

The universities are not well equipped to provide academic training in technology.

The Government recently published a White Paper on technological education in which it states its acceptance in general terms of the recommendation of the National Advisory Council on Education for Industry and Commerce which were made in a report issued by the latter body in November, 1950.

One of the suggestions in that report was that a Royal College of Technologists should be founded to encourage the development in suitable technical colleges of advanced courses at first-award and post-graduate standards.

The report also recommended that increased financial assistance should be given to the colleges and also that the new courses should be framed in close co-operation with industry. The Government has decided, however, that the title should be College of Technology, and that it should be established, at the first stage at any rate, without any responsibility other than the granting of an award and the approval of the courses.

It is my view that the result which it is intended to achieve would be more easily attained by starting a number of such colleges throughout the country, and which would in time achieve international reputation equivalent to those of similar colleges in other countries.

The Zurich Hochschule and the Massachusetts Institute are the type of college I have in mind. Until the college has attained status of this sort it cannot attract students of the highest calibre.

Six valuable years have gone by in which such colleges could have made progress towards international recognition.

In the report of the Council it is stated "an evolutionary method should be adopted in the development of higher work and research in the colleges, whereby advanced courses are concentrated, as speedily as building conditions permit, in colleges which are in a position to transfer elsewhere the whole or the greater part of their junior and less advanced work." Conditions in the colleges should be such as will attract good students and the right kind of staff.

The White Paper rejects the recommendation of the Percy Report for the setting up of technological universities, the reason given being the estimated cost of £6,000,000. This seems to suggest that the College of Technology will have to struggle along on a small Government grant. As there are 66 colleges in England, Scotland and Wales to share the grant it is obvious that we cannot expect rapid or spectacular results.

COAL BY PIPELINE?

THE experiences of the past 10 years in the supply and distribution of coal has drawn attention to a problem which seems insoluble. The National Coal Board's Central Research Station is giving attention to the possibilities of coal as a chemical and as a synthetic or reconstituted fuel. This, however, must remain a long-term project. For many years we shall continue to obtain coal by direct methods of hewing. No doubt in the future all coal will be ground to powder at the coal-face and be pumped to the surface in water. It may possibly be distributed to industrial areas by pipeline.

Coal dust and fine coal is already being mixed with a suitable binder or aggregate to produce briquettes which give more heat than lump coal and are cleaner, freer from dust, and uniform in size and quality. Already a press has been designed to make cobble briquettes weighing about 1½ lb. each. It has been installed at Cardiff and is producing five tons of such briquettes an hour. No doubt if this system was developed quickly it would help to solve our coal problem.

INTERPLANETARY TRAVEL

MY article last month (augmented this month in an article containing fuller information on pages 46 to 48) has aroused great interest in interplanetary travel. Readers have expressed surprise that developments in astronautics have gone so far.

The British Interplanetary Society, which was founded in 1933 to promote the development of interplanetary exploration and communication by the study of rocket engineering, astronomy and other associated sciences, now includes among its members many British and foreign workers prominent in these fields. The society organises meetings, lectures, exhibitions and film shows to spread technical knowledge and to bring home to the public the limitless possibilities of rocket propulsion and the ultimate implications to human society of the crossing of space. Membership is open to all interested in the subject, no technical or other qualifications being required. Fellowship is open to those who possess scientific, technical, or professional qualifications.

In America, where considerable progress has been made, the American Rocket Society performs a similar function.—F. J. C.

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The Present State of the Science and the Latest Ideas in Astronautics Reviewed

By F. J. CAMM

ASTRONAUTICS refers to the new science of flight beyond the atmosphere, and travel to other worlds. Because it has been the subject of fiction by scientific authors such as H. G. Wells it is still regarded by some as a fantasy which will never fructify.

Similar views were held concerning the sister science of aeronautics, about radio, and certainly about television. Yet television is a far more remarkable achievement than the construction of a device for travelling to other worlds. There is no scientific reason why after a process of gradual development and evolution a space ship should not be successful.

We know a great deal to-day about travelling through the air, into the Heavyside Layer, the troposphere and the regions beyond. As with every other scientific development, such as the motor-car and the aeroplane, the invention is forecast many years before it reaches practical development.

Often it is because of some missing link; in the case of the motor-car it was the internal-combustion engine. The past 50 years have been most remarkable in scientific developments. Each new discovery or invention improves existing devices. Thus radar, radio and television have made flying safe.

With all this knowledge in a number of unrelated directions at our command it only requires a co-ordinating effort to apply it in new directions. The raw materials for space travel have been produced, and they now require unification. Space travel is no longer Vernesque. Its evolution will be a gradual affair. The space ship will not be a sudden invention. The Wright brothers did not invent the aeroplane although they were the first to try a power-driven machine. They made use of and co-ordinated the knowledge which had been gained by dozens of individual experimenters.

The subject is now being studied very closely, as was apparent from the recent International Congress on Astronautics which took place in London during September, and at which a number of scientists of international repute gave their ideas as to how the space ship should be constructed.

Rocket Propulsion

It was generally agreed that the rocket affords the means, the only one so far known of realising the dreams of Jules Verne and H. G. Wells. It is now well known that a rocket is more efficient in the vacuum of outer space and at high flight speeds than it is within the atmosphere. Another great advantage is that it can generate enormous power for little weight and size of engine. The power/weight ratio cannot be equalled by any other form of motive power.

The V2 used by the Germans during the war, for example, was four times as powerful as the "*Queen Elizabeth*." Some of the early pioneers of astronautics were Goddard in America, Oberth in Germany, Esnault-Pelterie in France, Tsiolkovsky in Russia, and small amateur societies, mainly in Germany and America, endeavour to carry on the work.

In World War Two Germany made great use of rocket engineering. To-day it is being actively developed all over the world for assisting the take-off of aircraft, for the propulsion of aircraft at extreme speed and heights (the American Bell XI rocket plane was the first to fly faster than sound, and its successors are intended to fly at several thousand m.p.h. and at altitudes of hundreds of thousands of feet); for offensive and defensive missiles, likely eventually to supersede military aircraft as we know it to-day; and for high-altitude research by instrument-carrying projectiles.

Atomic Energy

An American example of the latter has already climbed to a height of 250 miles at a speed of 5,000 m.p.h. This experimental work, although unrelated to interplanetary flight, is contributing data for its eventual achievement, as is current research on atomic energy.

The space ship of the future will undoubtedly make use of the latter. It is more than probable that within the next 20 years rocket engineering will have advanced to a stage where it is possible to establish an Earth-satellite-vehicle in a stable close orbit around the Earth, and this will be the first step to the stars.

Once the Earth-satellite-vehicle has been established flights by piloted rockets several thousands of miles into space will follow. There will be flights circumnavigating the Moon without landing on its surface, first by robot projectiles carrying television and later by piloted craft, flights to the Moon by piloted space ships landing tail first on its airless surface using the braking effect of their rocket jets, then taking off again and returning to Earth, where a safe landing may be made by using wind within the atmosphere.

There will also be flights to other planets of the Sun's family. First to Mars and Venus because they are nearest. A century or more hence no doubt the planets of other suns—the distant stars—will be visited.

Many involved technical problems, however, need to be solved before that is possible. When the Great Adventure commences depends entirely on the funds and the facilities made available for the task. But astronautical engineers expect the first piloted return flight to the Moon to take place before the end of the present century. After all it is 42 years ago since Blériot crossed the Channel. It could happen sooner if a concerted attack were made on the problem, such as the effort which is being made in connection with the atomic bomb.

The "Earth-satellite-vehicle"

The theme of the technical sessions of the Second International Congress on Astronautics was the Earth-satellite-vehicle, or orbital rocket, because this represents the first great objective on the way to interplanetary flight.

The American Government has already announced that it is seriously studying the Earth-satellite-vehicle, which has many practical uses, both for military and civil purposes. (Ref. statement by J. V. Forrestal, U.S. Defence Secretary, in Report to Congress, Dec., 1948.) The first artificial satellite to be established will undoubtedly be nothing more than a small radio-controlled rocket carrying automatic instruments for research purposes, capable of sending its readings back to earth by radio.

Piloted rocket craft will follow later; they could leave their circular orbits at will; by reducing speed with rocket jets firing in the direction of motion, and land back on Earth using wings like normal aircraft.

The principle of the Earth satellite is very simple. A good analogy may be obtained by tying a stone to a piece of string and whirling it round in a circle. The stone keeps travelling in the circle because the inward tension in the string balances the *outward* centrifugal force produced by the stone's motion.

In exactly the same way a body circling the Earth at the right speed would remain at a constant distance, in a state of equilibrium. This time the outward centrifugal force would be balanced by the invisible, but very powerful, pull of gravity.

The nearer the satellite to the Earth, the more rapidly it would have to move to maintain itself. Just outside the atmosphere, a few hundred miles up, the required speed is about 18,000 m.p.h.

Moreover, once the satellite had been given its initial speed it could never lose it again, since there is no air-resistance in power, and could never fall down—any more than does the Moon, which stays in its orbit for exactly the same reason.

It is important to realise that the satellite would *not* stay up because it is "beyond the pull of gravity" as is sometimes stated. The pull of gravity (like the tension of the string in the analogy given earlier) is essential to prevent it from flying off into space.

Thus a rocket guided into the correct circular path around the Earth could shut off its motors once it had reached the required speed and remain orbiting the Earth for ever in perfect safety. The satellite could be established at any distance, but for technical reasons it would be easier to place it as near the Earth as possible—as long, of course, as it was outside the atmosphere and thus immune to air-resistance.

The value of such orbital rockets would be:

(a) as research observatories beyond the atmosphere, for physicists and astronomers. (Study of cosmic ray primaries, and astronomical observation without hindrance from our semi-opaque atmosphere, etc.)

(b) as observatories for meteorologists, who could "see" the Earth's weather system developing, and thus make more accurate forecasts—a use probably of particular interest to the British!

(c) as radio relay stations, capable of receiving short-wave signals from the Earth's surface and rebroadcasting them to reach round the curvature of the surface, so removing the limitation on range which the horizon normally imposes for ultra-short-wave transmission. This would permit world-wide reception of television, or "frequency-modulated" radio (free from atmospherics), also the radio guidance of military missiles over longer ranges.

(d) as military bases for reconnaissance, or even for launching projectiles.

The Space-station

Eventually, a large manned "space-station" might be constructed from components ferried out to the required orbit by rocket craft. Space ships might also be refuelled, while waiting in such orbits, from tanker rockets climbing up from the Earth's surface to meet them. Both these seemingly fantastic developments would be practicable, because any object, once established in the orbit, would have the effects on it of both gravity and velocity balanced out; it would have no apparent weight, and would "float" in space. Connection between one rocket and another, in a circular orbit in which both were "Earth-satellites," would also be entirely feasible. Although both would be moving at tremendous speeds, their *relative* velocity would be zero.

It is the value of these orbital techniques in connection with refuelling future space ships which makes them so interesting and important for interplanetary flight, apart from the fact that the practical uses of orbital rockets, in themselves, afford a powerful reason for obtaining support for astronautics in the early stages of the subject.

Men who will build a space-station from which the moon can be reached, will take off in a winged rocket like this, poised ready for launching.

The floating platform under construction. Parts are ferried in freighter rockets. The artificial planet is balanced against gravity like the moon.

Mr. L. R. Shepherd, Ph.D., in his lecture before the British Interplanetary Society, said that it is now generally agreed that the requirements of a vehicle, making a non-refuelling return-flight to the Moon or other planets, are too severe to be met by existing methods of propulsion. However, if one could accumulate sufficient fuel and materials in a close orbit about the Earth, it would be possible to proceed from there to the surface of the Moon and back.

The attainment of a circular orbit at a height of 500 kilometres above the Earth's surface would not prove too difficult. A three-step rocket with an exhaust velocity of 3 km/sec., an effective mass-ratio of <50, and a ratio of initial mass to payload of *c*300 should be capable of achieving this orbit.

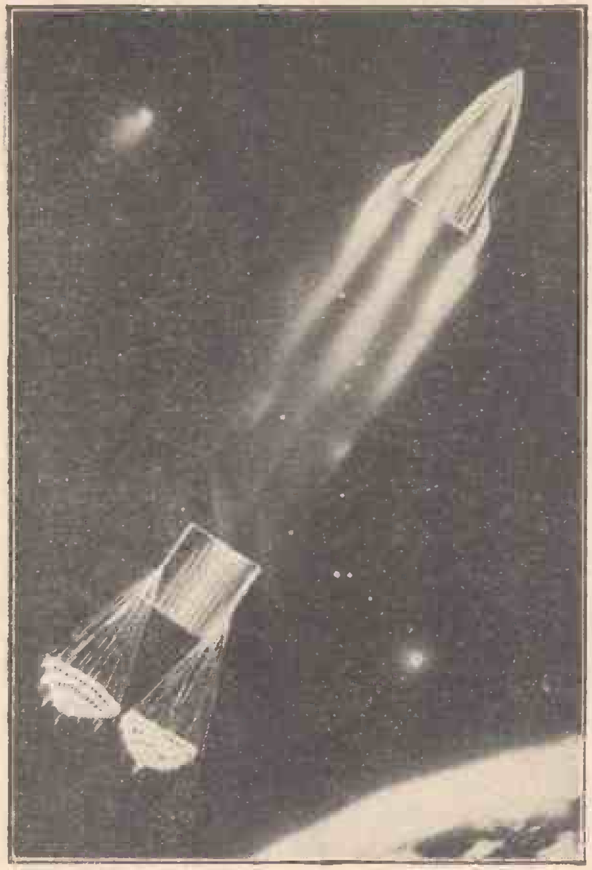
This performance is not outside the range of present techniques. However, we should need to do better before proceeding on to the next stage of interplanetary flight, otherwise we should be forced to carry out a "lift" involving hundreds of flights by satellite vehicles before we had accumulated sufficient materials in the orbit. Improvements would be required, both in the performance of the satellite vehicle and in the subsequent interplanetary vessel in order to bring the project down to a reasonable economic level.

Improvements in the satellite vehicle might be achieved with chemical propellants or might lie in the application of nuclear energy. In the case of the inter-orbital vehicle, however, one might go to a new principle, making use of very high exhaust velocities ($\sim$ 100 km/sec.) at very low accelerations ($\sim 10^{-3}$g). This could be done in an "ion-rocket," employing a propulsive jet consisting of a beam of electrically-accelerated ions. Such a vehicle would not be capable of landing on the surfaces of planets, but would be capable of executing large velocity changes with low mass-ratios, operating exclusively between satellite stations—for example, between an Earth-satellite and the tiny Martian moons, Deimos and Phobos.

Space-flight might therefore be carried out in two types of vehicle, viz., satellite vehicles having low exhaust velocity and high thrust operating from surface to orbit, and interplanetary space ships having very high exhaust velocity but very low acceleration operating between orbits. Permanent orbiting space-stations might be included in this scheme to act as the junctions between the two types of vehicle, but they would not be essential to the scheme. Space-stations and ion-rockets might draw propellants and other massive materials from bases on small satellites or the asteroids to avoid having to lift these through large gravitational potentials.

The Four Regions

The aerodynamics of a space rocket must take into consideration the fact that during



Booster step—portion of a freighter rocket that assists propulsion—falls away in mid-air. Braking parachutes reduce speed before landing.

its operation flight in four different regions is necessary—the subsonic, the transonic, the supersonic, and the condition encountered at great heights. Different laws of flow apply to each of these four regions, which complicates the aerodynamic design.

For the subsonic the drag is largely determined by the body fineness ratio and smoothness; as the transonic is entered, there is a sharp rise in drag coefficient (up to 10 × the low-speed value), and accurate lift calculations can be made by the Ackeret-Busemann method. Bodies with ogival nose shape and thin, wedge-shaped aerofoils are best. Swept-back wings are advantageous between $M=0.8$ and 1.2, but the rocket will not operate long in this region. Straight wings should therefore probably be used, unless the landing glide dictates otherwise, which is doubtful.

In the supersonic, Newton's laws, derived from the collision of particles with an inelastic body, govern the lift and drag. Flat-plate aerofoils are theoretically best, though for constructional reasons wedge-sections should again be used; aerodynamically, this regime is not far removed from the transonic.

At great heights drag coefficients rise again, but the dynamic pressure will be negligible in practice, hence the aerodynamic forces will be so very small that they are even considered useless for initial braking prior to landing.

Below 50 kilometres, however, lift/drag ratios of 6 to 8 are considered attainable for landing manœuvres using aerodynamic braking. It is thought that fears of excessive aerodynamic heating are groundless.

During take-off, the maximum total resistance will occur at a height of 8 to 10 kilometres, where the flight Mach No. is about 1.5.

It is important to repeat that the satellite vehicle would not stay up because it is "beyond the pull of gravity," as is frequently stated. The pull of gravity is essential to prevent it from flying off into space.

The Value of Orbital Rockets

Summarising the foregoing it will be seen that a rocket guided into the correct circular part around the earth could shut off its motors once it had reached the required speed, and remain orbiting the Earth forever in perfect safety. The orbit could be established at any distance, but for technical reasons it would be easier to place it as near the Earth as possible, as long as it was outside the atmosphere and thus immune to air resistance. The value of such orbital rockets would be:

1. As research observations beyond the atmosphere, for physicists and astronomers. (Study of cosmic ray primaries, and astronomical observation without hindrance from our semi-opaque atmosphere, etc.)

2. As observatories for meteorologists, who could "see" the Earth's weather system developing, and thus make more accurate forecasts—a use probably of particular interest to the British!

3. As radio relay stations, capable of receiving short-wave signals from the Earth's surface and re-broadcasting them to reach round the curvature of the surface, so removing the limitation on range which the horizon normally imposes for ultra-short-wave transmission. This would permit world-wide reception of television, or "frequency-modulated" radio (free from atmospherics), also the radio guidance of military missiles over longer ranges.

4. As military bases for reconnaissance, or even for launching projectiles.

Eventually, a large manned space-station might be constructed from components ferried out to the required orbit by rocket craft. Space ships might be refuelled, while waiting in such orbits, from tanker rockets climbing up from the Earth's surface to meet them.

You may feel that these suggestions are fantastic, but they are quite practicable, because any object once established in the orbit would have the effect on it of both gravity and velocity balanced out. It would have no apparent weight and would float in space. Connection between one rocket and another in a circular orbit in which both were earth satellites are also entirely feasible. Although both would be moving at tremendous speeds their relative velocity would be zero.

It is the value of these orbital techniques in connection with refuelling future space ships which makes them so important for interplanetary flight, apart from the fact that the practical usage of orbital rockets in themselves afford a powerful reason for obtaining support for astronautics in the present early stages of its development.

Thus it will be seen that the development of rocket propulsion and the application in the near future of atomic power to rockets has transformed the whole subject of astronautics from a scientific dream to an imminent reality. Anyone who attended the second four-day International Congress of Astronautics which took place in London in September of this year, where eminent scientists expressed the views which I have summarised here, could not have been left in any doubt about that.

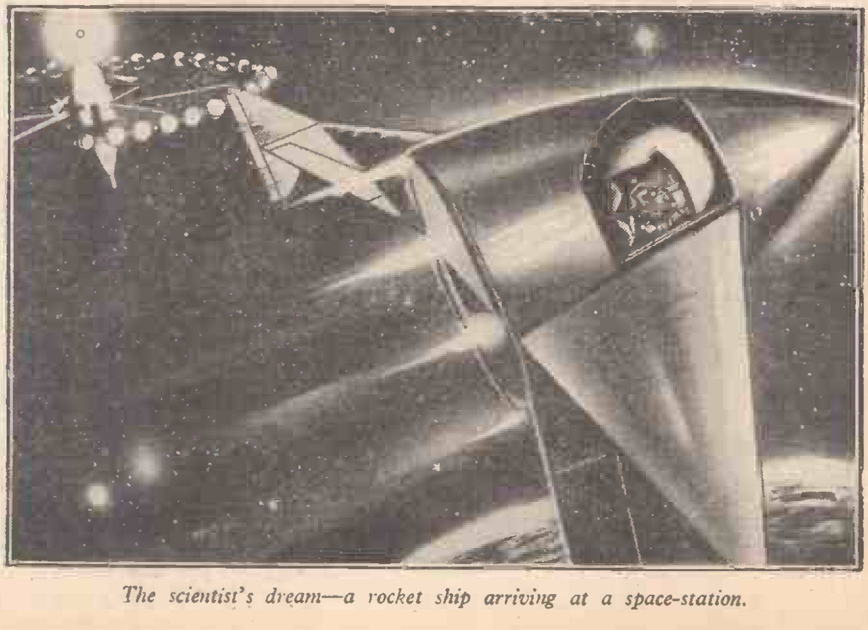
Increased Speed of Flight

Since the Wrights first flew on the 17th December, 1903, we have seen the speed of flight advance from 30 miles an hour to those well in excess of the speed of sound, and astronautics is at the present time in a state comparable to that of aviation in the days of the pioneers. There is now little doubt that space travel will be realised before the century closes.

The increasing membership of the British Interplanetary Society is an indication of the growing interest. Like all new industries and sciences, lack of finance is the retarding force which prevents more rapid development. Experiments are costly, and they have to be financed privately. Perhaps a Carnegie or a Nuffield will arrive and fund a project to build the first experimental space ship.

This journal, more perhaps than any other in the world, has in the 20 years of its existence done a very great deal to draw attention to this new field of scientific endeavour.

We have regularly published articles on the subject including one long series which gathered together all of the available knowledge. It is to be feared, however, that there are many, as was the case with the early days of the aeroplane, radio, and television, who regard the subject with an amused twist of the lip.



The scientist's dream—a rocket ship arriving at a space-station.

Making a Light Forge

A Self-contained Unit for the Home Workshop

By R. G. ILSTON

The completed forge, with footpump.

THIS forge is designed for the home mechanic who has no mechanical air supply available, and with the exception of control valve, screws, nuts and fireclay it is built from scrap materials. The sizes and materials can be modified if necessary, and when finished the forge (Fig. 1) is a serviceable piece of equipment.

Constructional Details

First of all, a hearth casing is made. This is a 15in. outside diameter band of 1/8in. M/S, 6in. wide, with two cutouts 6in. wide by 1in. deep (Fig. 2) positioned opposite each other so that when in use long bars can be laid across the hearth beneath the surface of the fire if desired. A bottom of 1/8in. M/S is fixed in place by 3/8in. × 1/4in. B.S.W. screws and nuts through four cleats cut from 1in. × 1in. × 1/8in. angle. Four holes 13/32in. diameter are drilled for the legs, while a 9/16in. hole is drilled for the air pipe.

Legs and Brackets

Legs are next made from 3/8in. gas-pipe (Fig. 3) and fixed to the casing by 1in. × 3/8in. B.S.W. screws and nuts. Two brackets "A" (Fig. 4) are made of 1in. × 1/8in. M/S strip, which are fixed near the bottom of the legs by 1 1/4in. × 5/16in. B.S.W. screws and nuts, so that the inside faces of the brackets are 7in. apart. Two angles "B" are cut from 1in. × 1in. × 1/8in. M/S angle and drilled as indicated.

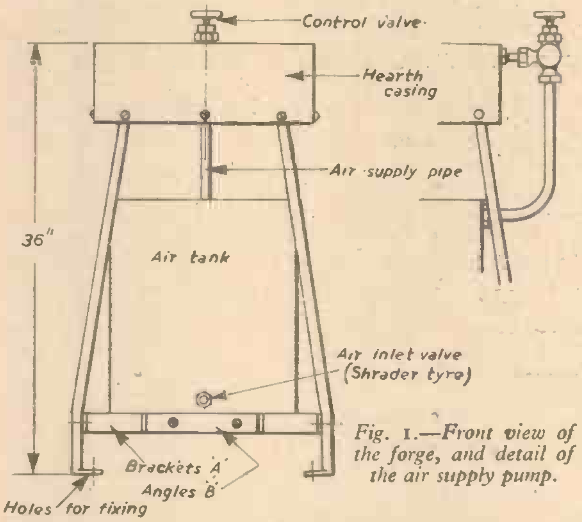


Fig. 1.—Front view of the forge, and detail of the air supply pump.

A small oil drum is brought into use as an air tank. The angles "B" are soldered to the bottom of the drum parallel to each other at a distance of 7 1/4in., and a Schrader valve is soldered in position, where shown in Fig. 1, while a 9/16in. hole is drilled in the top rear of the tank for the air pipe.

The tank is placed so that the angles beneath clip over the brackets "A," the angles then being fixed by 3/8in. × 1/4in. B.S.W. screws and nuts.

A screw-down control valve is obtained and a length of 1/4in. gas-pipe is bent and one end fixed into the air tank, as shown in Fig. 1, the other end being screwed into the valve. Another piece of 1/4in. gas-pipe 5in. long connects the valve to the hearth case by means of two locknuts; the pipe, as shown in Fig. 2, projects 3in. into the casing.

The Hearth

The hearth itself is formed of fireclay, which is shaped as required by a small trowel. The bottom of the hearth is covered to a depth of 1in. and the sides built up to the top of the casing and conforming to the shape of the cutouts in the sides. At the front the walls are 2in. thick and at the back they widen to 3in. to cover the air pipe.

When construction is completed the forge is given a coat of heat-resistant black paint and then is ready for fixing to the floor. An automobile pump connected to the Schrader valve provides the air supply, which is controlled by the valve at the rear of the hearth.

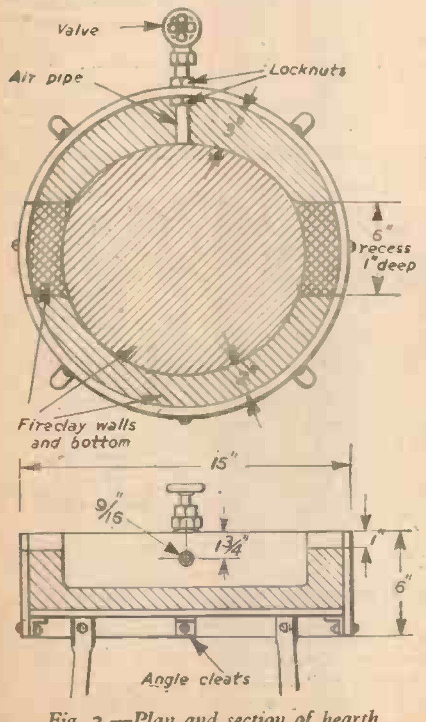


Fig. 2.—Plan and section of hearth.

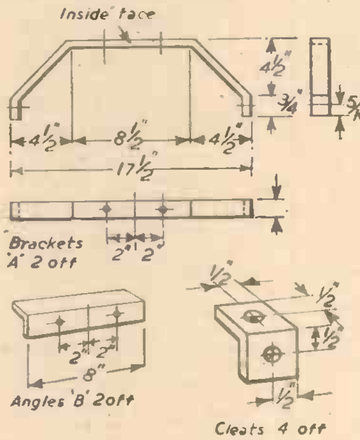


Fig. 4.—Details of brackets and cleats.

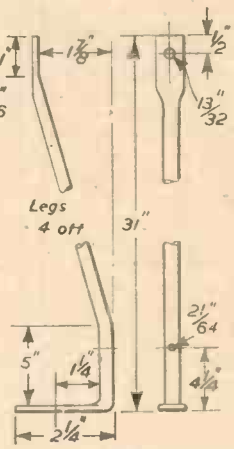
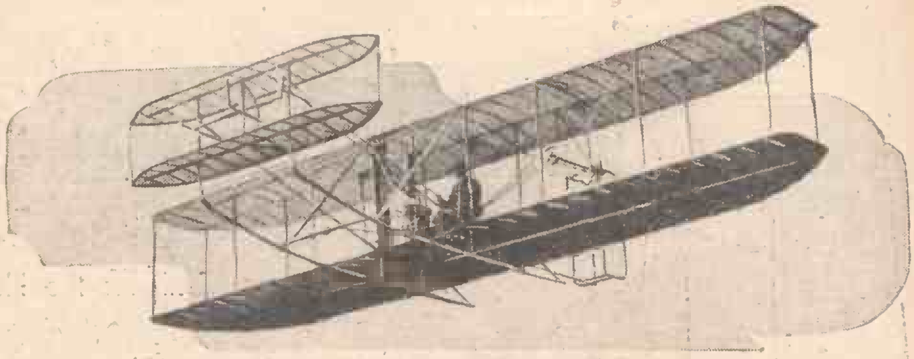


Fig. 3.—Details of the legs.

THE BEGINNING OF *Flying*



The Wright aeroplane in flight—August 1908.

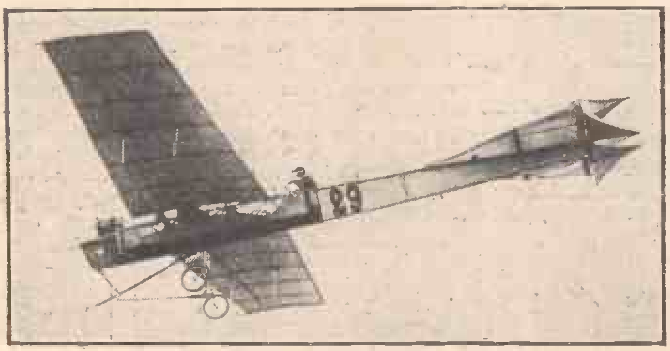
The Story of the Early Pioneers from Clément Ader and the Wright Brothers to the Pioneer-founders of the British Aircraft Industry in the First World War

By C. G. GREY

(Concluded from page 11, October issue.)

HE borrowed the field from them and Paulhan's *Farman* was put together thereon on April 27th. Paulhan started at 5.31 p.m. the same day and landed at Lichfield for the night. He got to Manchester at 5.32 a.m. next morning, and won the £10,000.

Grahame-White, who was caught napping, started on his rebuilt machine an hour or two later, but was stopped at Roade by darkness. He started at 2.30 a.m., but was forced down by the wind and was on the ground when Paulhan's victory was announced. But—and here comes the joke—G.W. went to call on Paulhan at Hendon while their machines were being assembled. He cast an eye over the land between the field and the Midland Railway, and saw that it was fair and suitable for flying. And that was the beginning of the history-making Hendon Aerodrome.



Hubert Latham on his Antoinette monoplane.

Grahame-White and his able assistant, Dick Gates, somehow acquired the land from a whole series of farmers, each of whom was like Naboth and his vineyard, and they started a flying school. You will notice that Holt Thomas was thus responsible for starting both Brooklands and Hendon as aerodromes. Furthermore, he rented a row of sheds at Hendon and there started The Aircraft Manufacturing Company, Ltd., where Geoffrey de Havilland built the D.H.1 and D.H.2 right up to the D.H.10 series of aeroplane, which were continued after 1919 by the de Havilland Aircraft Company, Ltd., whose D.H.106 (the four-jet Comet) and D.H. 113 night fighter Vampire, are two of the most famous aeroplanes in the world to-day.

On May 29th, Glenn Curtiss flew from Albany to New York, 130 miles, in 2hrs. 32mins., and won a $10,000 (or in those days £2,000) prize from the *New York World*. But he was the only builder of aircraft in the U.S.A. who was making progress.

Race Round Britain

Lord Northcliffe announced another £10,000 prize on June 28th, 1910. This was for a race round Britain—London, Harrogate, Newcastle, Edinburgh, Stirling, Glasgow, Carlisle, Manchester, Bristol, Exeter, Isle of Wight, Brighton, Tunbridge Wells, London. So you see that so long ago we had ideas of flying across country. And in 1911 it really happened.

In 1910 we had a flying meeting at Wolverhampton, which woke up the Black Country, and at Bournemouth, where the Hon. Charles Rolls, the originator of the Rolls-Royce car, was killed on a Wright biplane. The performance figures at Bournemouth give an idea of the progress since Reims: *Height*, Morane (Blériot), 4,107ft.; *longest flight*, Grahame-White (Farman) 91 miles in 2hrs. 34mins.; *speed*, Morane (Blériot), 56.64 m.p.h. Also there was another successful meeting at Blackpool.

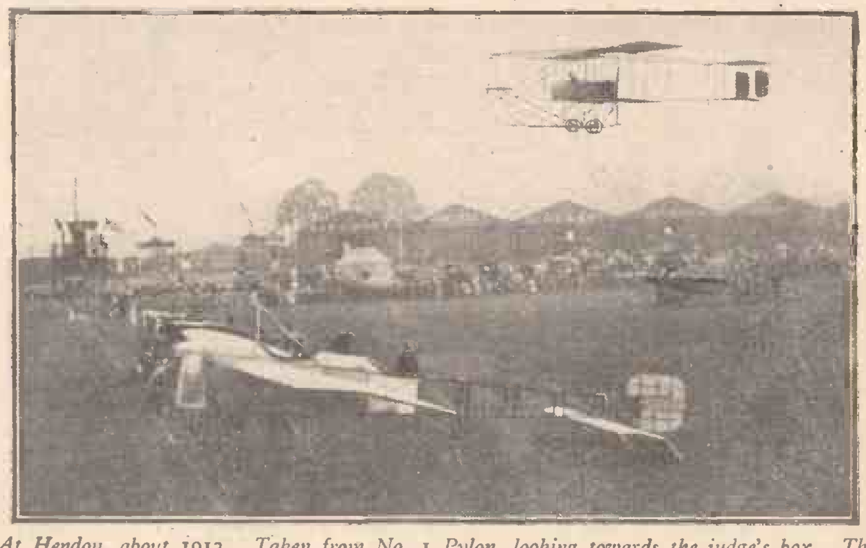
Naturally there were many meetings on the Continent, at Reims (again), at Nice, at Tours, at Rouen, at Lyons. There were others in Germany and Italy.

In this country A. V. Roe was carrying passengers on his triplane at Brooklands, and his rival, Cody, was flying at Laffans Plain, Aldershot, and at Bournemouth.

We also had Scotland's first meeting, at Lanark, where I was part of Scotland's first crash, when Capt. Bertram Dickson and I, in a weight-lifting competition, smashed up his perfectly good Farman. The performances were much as at Bournemouth, only that Anthony ("Chips") Drexel pushed his Blériot up to 6,750ft. (world's record), and James Radley, also on a Blériot, put up a speed of 58.32 m.p.h. Also Ireland had its first meeting, at Dublin.

Now we must get on to 1911, the year of the great cross-country races, neglecting Paris-Brussels and other inter-capital flights in 1910, and a great Paris Aero Show in October, and the winning of the Gordon-Bennett Race in the U.S.A. by Grahame-White. Also right at the end of 1910, on December 21st, Maurice Tableau on a Maurice Farman (Renault engine) won the International Michelin Cup by flying 365 miles non-stop in 7hrs. 48mins. And on December 31st, S. F. Cody, on his own biplane with a 60 h.p. Green engine, won the British Michelin Cup with 189 miles non-stop in 4hrs. 46mins.

The first of the big races was "The European Circuit"—Paris, Reims, Liége (Belgium), Venloo, Utrecht (Holland), Brussels (Belgium), Calais, Dover, Brighton,



At Hendon, about 1913. Taken from No. 1 Pylon, looking towards the judge's box. The sheds of Holt Thomas's "Aircraft Manufacturing Company, Ltd." in the background. A tandem Blériot is seen in the foreground, and a "Longhorn" Maurice Farman in the air.

London (Hendon), Dover, Calais and Paris. The winner was Lieut. de Conneau, of the French Navy, who flew as "M. Beaumont," on a Blériot; the second was Garros, also on a Blériot; the third was Vidart, on a Deperdussin.

Gordon-Bennett Race

The 1911 Gordon-Bennett Race, held at the Royal Aero Club aerodrome, at Eastchurch, was won for the U.S.A. by Charles Weymann, a part-French native of Haiti, but a U.S. citizen. He flew a Nieuport (French) monoplane with a 14-cylinder Gnôme, and his speed was 79 m.p.h. Downwind on the straight he must have been doing 100 m.p.h.—pretty good for those days, although motor-cars were doing more than 100 m.p.h. at Brooklands.

A Grahame-White biplane, commonly known as a "box-kite," built at Hendon, and largely used for elementary training.

The big event was the Circuit of Britain, aforementioned. It started from Brooklands on a red-hot day in July. Inside the circuit of the track the air was excessively hot and some machines could not lift. There were several crashes in test flights before the start, and several in starting, but 21 machines actually got away. First stop was Hendon, 20 miles, for the night. Thence the competitors went on the course indicated, stopping the night as convenient.

The finish was at Brooklands four days later. "Beaumont," on his Blériot, won by an hour or two from Védrines, a typical excitable French *méccano*, who was flying a Morane monoplane. James Valentine was third, a few days later. Cody, a day or so later still, was fourth. All the rest fell out by the way. And the miracle was that nobody was killed.

An important part of aviation history in 1911 was the permission given by the Admiralty to four officers—Lieuts. Samson, Gregory and Longmore, R.N., and Lieut. Gerrard, R.M.L.I., to draw full pay while being taught to fly at the expense of Mr. (now Sir) Frank McClean at the aerodrome that he had bought at Eastchurch (Isle of Sheppey) for the Royal Aero Club. That was the start of all our Naval aviation and of the Royal Naval Air Service.

Start of the R.F.C.

Also in 1911 the War Office bought some aeroplanes and formed the Aeroplane Company of the Air Battalion R.E., which included balloons and kites. All the first batch of officers had learned to fly at their own expense. That was the start of the Royal Flying Corps. The R.F.C. and the R.N.A.S. were amalgamated in 1918 to form the R.A.F., as we now know it. The year 1912 brought rapid development. The Central Flying School, to train Navy and Army pilots, was organised on Salisbury Plain. And while it was being built, a military aeroplane competition was held, also on the Plain. Makers from several nations competed, but S. F. Cody won on the tests, although his type of machine, like the Wright, was useless for Service flying and was a "dead-end" design.

Mr. (now Sir) Geoffrey de Havilland beat all the competitors on marks, with a tractor biplane which he had designed and built at the Royal Aircraft Factory (now the R.A.E.) at Farnborough. And as it was Government-built it was not in the competition, so he flew *hors concours*, as the French say.

At the Reims meeting that summer a Deperdussin monoplane covered a little more than 120 miles in an hour. This was the first time a human being (the pilot, Prévost) had travelled at two miles a minute for an hour on end.

Competition Flying at Hendon

At Hendon we had regular competition flying every week-end, round "pylons" built on the aerodrome. There were regular railed enclosures at varying prices and car parks. In 1912, 1913 and 1914 we thought that it was a poor week-end if 15,000 to 20,000 spectators did not pay for admission, not counting some thousands in the fields on Hendon Hill overlooking the aerodrome where the farmer charged sixpence a head for admission. We called it "the Aberdeen grandstand."

There were six or eight flying schools at work all the week, and Grahame-White set up a factory outside the aerodrome where he built aeroplanes before and during the war. I always reckoned that he made vastly more money by losing the London-Manchester contest in 1910 and winning Hendon, which Holt Thomas had discovered, than did Paulhan, who won the *Daily Mail* £10,000.

Hendon also started, in 1912, the "Aerial Derby" over a course all round London, starting and finishing at Hendon. Several millions of people used to turn out to see the competitors pass the turning-points. And we also had the annual "King's Cup" Race.

Sopwith Aviation Company

Another great beginning, in 1912, was that of the Sopwith Aviation Co., when young T. O. M. Sopwith started to design and make aeroplanes in the roller-skating rink at Kingston. That was the foundation of what is now the great Hawker-Siddeley combine, the biggest thing in British aviation, with T. O. M. Sopwith as chairman. They made the Hurricane which did most towards winning the Battle of Britain.

In 1913 the British Aircraft Industry consisted of the early efforts of Sopwith, Handley Page, Short Brothers (with whom was Richard Fairey), Bob Blackburn, A. V. Roe, and his brother Humphrey, Holt Thomas's firm, the Aircraft Manufacturing Company, Ltd. (to whom came de Havilland), and the young men, Sidney and Henry Smith and Herbert Thomas, who were building up the Bristol Company for Sir George White. When war began in 1914 they were all under 30 years of age, and by 1918 the aircraft industry was the biggest in the country. The only pre-war exceptions were the two Army officers, Major Herbert Wood and Capt. Peter Acland, who built up the Vickers Aviation Dept., which now owns Brooklands, and Pemberton Billing, who started the Supermarine Aviation Co. They were a little over 30. They were all practical mechanics. There was no such thing as aeronautical science in those days.

The First Seaplanes

Yet another event of 1912 was the beginning of waterplanes, or seaplanes. Shorts made aeroplanes with floats; so did Avros. The first school for flying off water was started on Windermere. Glenn Curtiss, in the U.S.A., made a real flying boat and brought it over here. With Lieut. Porte, R.N., he started to build a trans-Atlantic boat. Then the war began, and from it he developed the North Sea patrol boats, from which Porte developed the "F" (for Felixstowe) boats, from which Shorts developed the all-metal boats of Imperial Airways, and so the Sunderlands of to-day, and from them descend the Saro (Saunders Roe) "Princesses" of to-morrow—all a legitimate genealogy.

In 1913 and 1914 things just went on developing and improving—better aeroplanes, better engines and better flying. Just a month before the war a German pilot flew for 24 hours and some minutes non-stop. Another German flew to a height of 22,000ft., and another German flew, with a passenger, more than 1,000 miles non-stop in a straight line, across country. And yet we beat them.

British Aviation Still Leads

So you see lots of things had happened in aviation between 35 and 40 years ago. To-day, with our gas turbines and jet-propelled aircraft, we are still keeping "our light so shining a little ahead of the rest" (as Rudyard Kipling enjoined us to do); and it has all been done by practical mechanics, while the scientists have been working and giving explanations of why and how the things work.

TWIST DRILL MAINTENANCE

With Constructional Details of a Drill-sharpening Clamp

By C. W. TINSON

NO tool is more difficult to grind accurately without proper equipment than a twist drill and although many have the knack of hand-grinding and getting a satisfactory result, it is not given to all to of us to do this with complete confidence.

Anyone who has thought of trying to make up a fixture or a machine for the purpose will have first closely studied a new twist drill and must have profoundly admired the beauty of its form, the elegant curl of its flutes, the glints of light by which the relief along the length of them is revealed, the scroll-like formation of its head, which certainly deserves a polish to equal the lustre of its skirts, and the classic contour of its trailing edges which contrast with the austere straightness of its cutting edges, all combining to make it a most efficient tool in the workshop. Where should we be if this superb tool had not yet been invented? Drilling holes would, indeed, be a very laborious process.

Some handymen, not content with the primitive method of sharpening worn drills by hand, may have attempted to design a fixture by means of which their drills might be restored exactly to the perfection of their original profile and will then have come up against the geometrical intricacy of what I might term—to coin a phrase—the spiralated appearance of its head, which, of course, is not a true cone.

I have made three machines intended to reproduce the required shape, but each of them has been a failure. Apart from any question of the geometry being right or not, there were several reasons for my disappointment, of which lack of rigidity was probably the chief one: it is extremely difficult with an apparatus having the nature of a "trial installation" to avoid backlash, distortion, and, worse still, deflection of the drill under the load imposed by the grinder, particularly in the case of small drills.

In some designs it is not easy to set up a small drill so that the cutting edge is precisely in its corect relationship to a chosen diameter of the grinding wheel, and any design which does not allow for dressing both sides of the head of the drill at one setting without adjustment—needing rotation of the drill through 180 deg. to reset it for grinding the opposite side—should be rejected. It is difficult enough to keep the drill point precisely coincident with its longitudinal axis without complications of that sort.

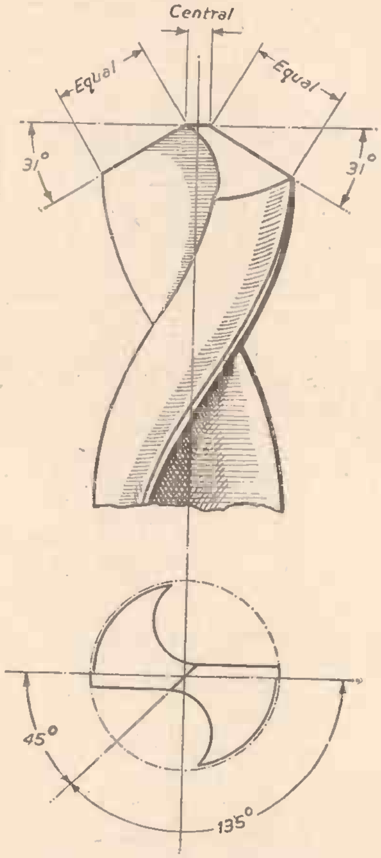
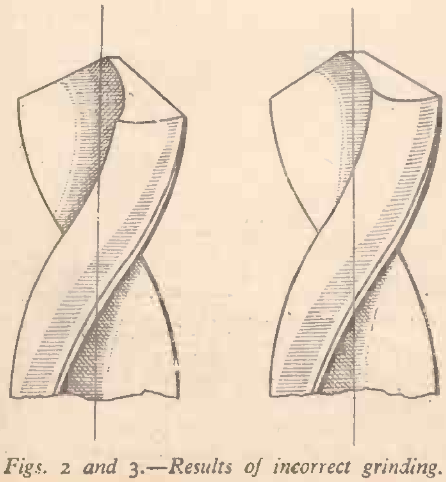


Fig. 1.—Cutting edge angles.

It is to be understood that the emphasis in this article is on the maintenance of small twist drills such as are normally to be found in the average man's equipment. The difficulties will tend to diminish, of course, as the drill diameter increases.

It is possible to resharpen and reset small drills, from the very tiny ones up to $\frac{1}{4}$in. diameter or so, to a standard which is entirely satisfactory, without a machine of any kind, and the design of a clamp fitting, simple to make, is the subject of this article. It is advisable, however, as a preliminary, to make clear the basic requirements in respect of the angles, reliefs and other features, the importance of which cannot be overlooked if one wants one's drills to perform effectively and efficiently.



Figs. 2 and 3.—Results of incorrect grinding.

Cutting Edge

There are three cutting edges to a twist-drill, as can be seen in Fig. 1: the two radial edges and the edge at the apex. The edge at the apex is generally at an angle of 45 deg., as indicated in that figure. If the drill is ground correctly, its head will look exactly as shown, but there are plenty of ways in which one can go wrong, and Figs. 2 and 3 illustrate two of the more common results of incorrect grinding—results which, unfortunately, are so easily obtained when grinding by hand, especially when the drills are small ones.

In Fig. 2 the point is not central and the cutting edge angle on the right is more acute than that on the opposite side—two faults, while in Fig. 3 these faults do not appear, but the clearance behind the cutting edge is non-existent: this drill would, therefore, ride on its trailing points.

Fig. 4 illustrates the result of grinding the point so that the central cutting edge is at right angles instead of at 45 deg. to the side edges. This formation will be found to be noticeably less efficient in cutting speed.

The drill shown in Fig. 2 will not drill a hole true to size, because its point is offset. The drill in Fig. 4 will not cut as rapidly as it should, while the form shown in Fig. 3 will not cut at all. The shape shown in Fig. 1 is most important and to produce it by hand-grinding requires not only considerable skill but not a small measure of luck as well, if the drill is a small one.

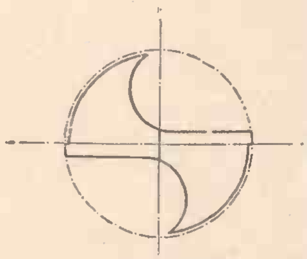
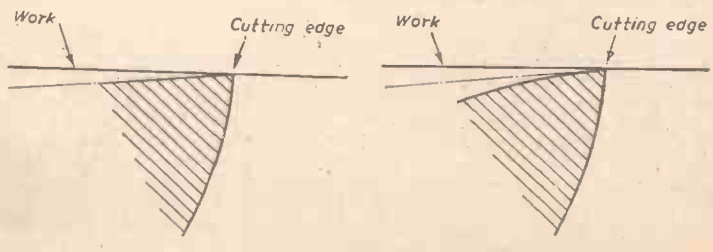


Fig. 4.—Cutting edge at right angles.

Angle of Incidence

It will be clear from Fig. 1 that the direction of grind should produce an angle of 45 deg. at the centre. In side elevation, looking along the length of either of the side cutting edges, it is obvious that the head must make an angle of incidence to the work, as a plane-iron or a chisel does, as



Figs. 5 and 6.—Diagrams showing angles of incidence.

shown in Fig. 5. If the cutter were flat on the work it would only skid across it, but if the angle is too great the leading edge will be weakened.

Many more points will occur to the reader who studies the matter, and he will probably reach the conclusion that only a lucky chance could give the perfect form when grinding by hand: the requirements seem to be so exacting. The question is, then, what simple appliance could be made up to help to control the operation? It must be of a kind which supports the drill properly to eliminate all deflection, and its design should allow both sides of the head to be dressed at one setting, by alternate grinding strokes to one side and then to the other.

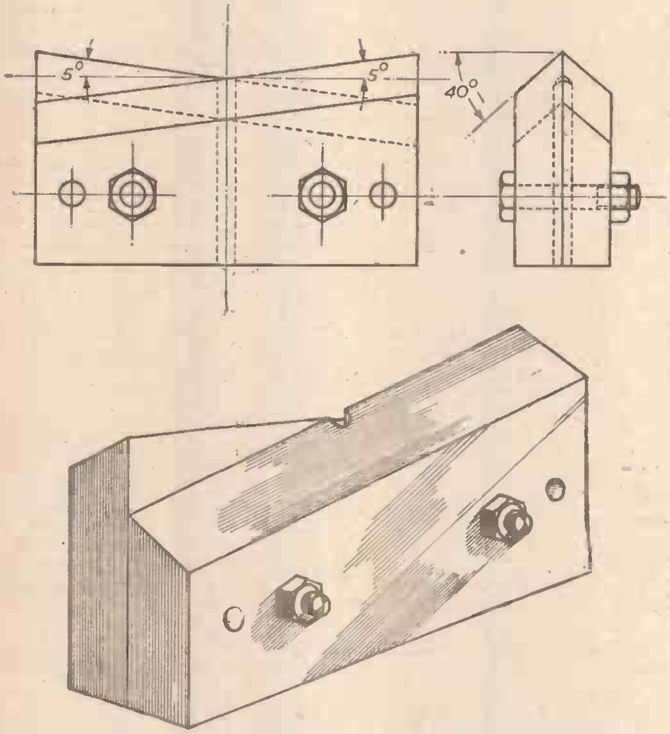


Fig. 7.—Simple two-piece clamp for holding twist drills for sharpening.

Drill-sharpening Clamp

Now, for small drills it is permissible to grind at a tangent, giving the bevelled form of edge which is shown in Fig 5. This is because the smaller drills are not strong enough as struts to accept a heavy feeding load, whereas a larger one can withstand greater pressure. In the latter case, the cutter bites into the work with a deeper indentation, and the relief behind the leading edge must, in consequence, increase progressively, as shown in Fig. 6, otherwise the torque increases undesirably. So much more contact would be made with the combination of a deep feed and a plain bevelled edge. The reduced penetration, due to the comparatively light feed, is therefore the justification for using a bevelled grind on small drills. It is then permissible to make use of the very simple type of clamp illustrated in Fig. 7.

It consists of two pieces of steel, suitably bevelled, dowelled and bolted together. A hole is drilled vertically to receive the drill to be sharpened. The important surfaces should be ground flat, and it is very desirable, of course, that they should be hardened. It is a requirement that the drill be firmly fixed in the joint, and so a piece of paper is sandwiched between when drilling through the clamp. A new drill should be used for this operation to ensure that the hole in the clamp is of the correct diameter. On removing the paper there will be the required grip so that the drill to be sharpened will be held quite firmly in the clamp.

The clamp has a bevel of 40 deg. in end view; this will produce the required angle of 31 deg. for the slope of the leading edges of the drill. In front elevation, the clamp is bevelled at an angle of 5 deg., which produces a clearance of about 3½ deg. measured normal to the cutting edge, because the drill is mounted in the clamp at 45 deg., as shown in Fig. 8.

The drill to be sharpened is set up so that its point is slightly proud, and is then dressed by rubbing a No. 149 carborundum pocket hone over each surface alternately. This stone is 3in. x ⅞in. x ⅜in. thick, by the way, so the stock out of which the clamp is made is preferably ⅜in. or more in thickness so as to give adequate land for the stone: then the stone will be under proper control as it rides up and down the slopes. It is best to use a new stone so that you know its faces are truly flat: an old one has generally worn a bit concave.

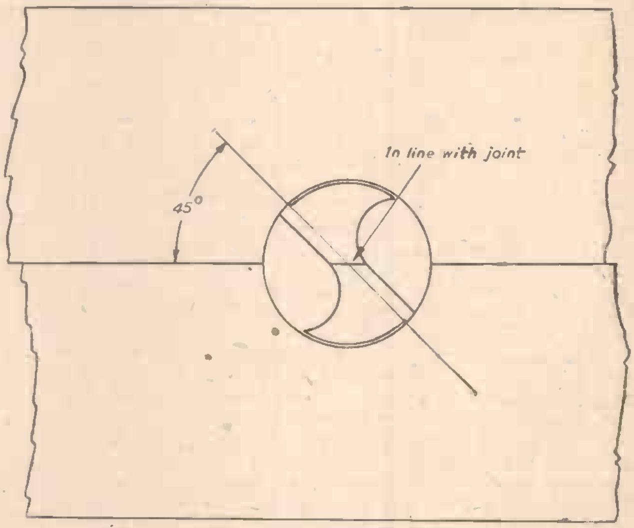


Fig. 8.—Showing the angle for mounting a drill in the clamp.

Always provided that you have drilled the hole in the clamp quite centrally, there is nothing that can go wrong with your sharpening operation. The angles will be the same on each side, the point will be in the middle, and the relief will be equal on each side, for with this device there can be no distortion of the drill due to the bite of the stone.

Another advantage is that the drill can be set up in the clamp correctly without much trouble, because one can see quite easily to line up the centre cutting edge with the division of the clamp: even very small drills can be set up accurately if a magnifying glass is used. Furthermore, the work, in this case the head of the drill, is in full view all the time, which can hardly be said of it when using some machines having articulated headstocks.

For Larger Drills

When dealing with larger drills it may be necessary to provide the additional clearance demanded by heavier feed loads,

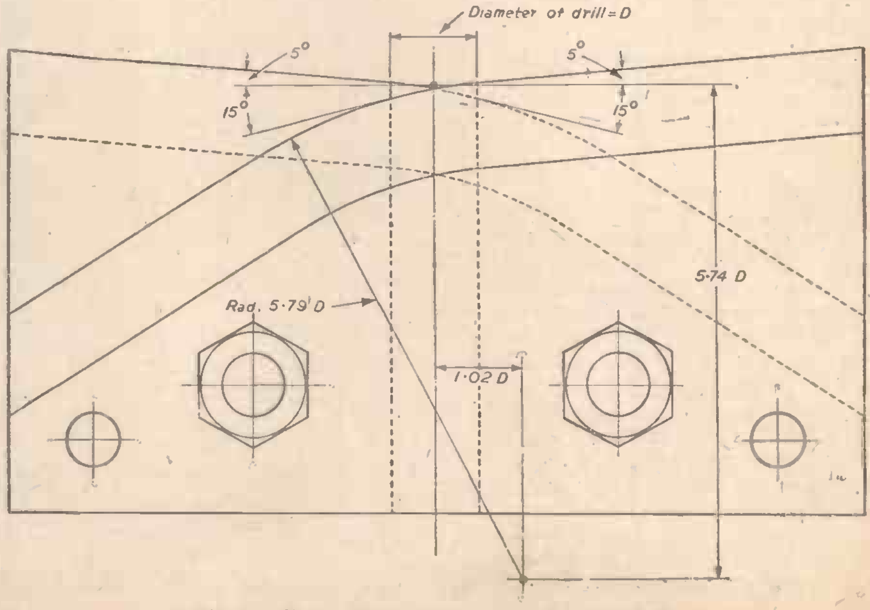


Fig. 9.—Type of clamp for use with larger drills.

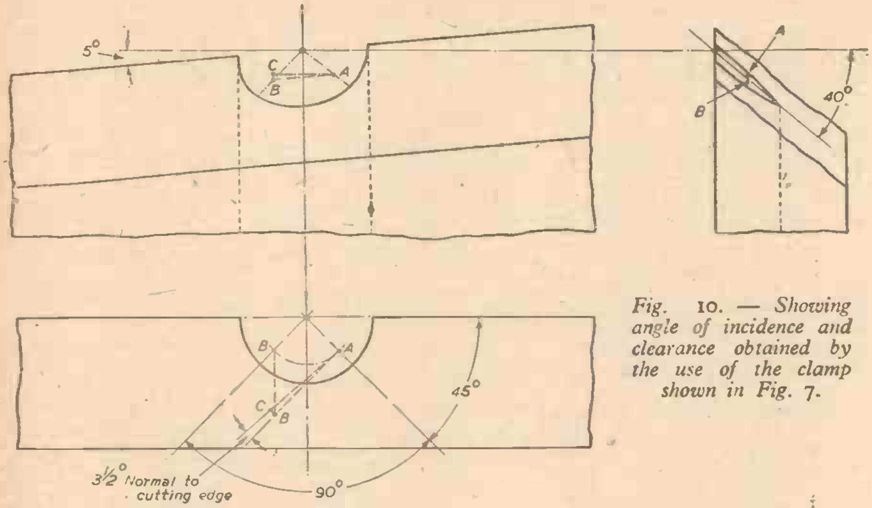


Fig. 10. — Showing angle of incidence and clearance obtained by the use of the clamp shown in Fig. 7.

and Fig. 9 illustrates the type of clamp which is then required. The radius shown provides a tangent at 5 deg. at the front and at 15 deg. at the back, the dimensions for the arc being given in terms of the diameter of the drill.

It will be agreed that it is hardly practicable to form this arc precisely for drills less than about ⅛in. diameter: a good compromise is to make the clamps with the two angles joining at the centre line of the hole and then carefully rub off the corner at their intersection to the approximate radius required.

Figs. 10 and 11 compare the relief actually obtained with clamps made to Figs. 7 and 9 respectively, and show the advantage of the arc. In both figures, A is any point on the cutting edge. At a station 90 deg. behind is another spot, B, on the same radius. In Fig. 10 the point B is 5 deg. lower than the point A, and if the angle made by the line AB and the horizontal (i.e., the work) is projected, it is found that the cutting edge makes an angle of incidence to the work of 3½ deg. while the tailing point of the drill, which is in the vicinity of B, has a clearance of 5 deg.

In Fig 11 a similar projection shows the angle of incidence to be 3½ deg. as before, but the clearance at B is now 11 deg.

For Model Makers

Model makers are likely to be interested in the very tiny drills down to No. 68, or even smaller: for these the clamp shown in Fig. 7 will be found entirely satisfactory.

The main disadvantage of the method described is that a separate clamp is required for each diameter of drill—that is if one wishes to be really exact, but, on the other hand, these clamps can be made up relatively quickly, and it is not long before one has accumulated a number of them sufficient to deal with the range of sizes which need reconditioning most frequently.

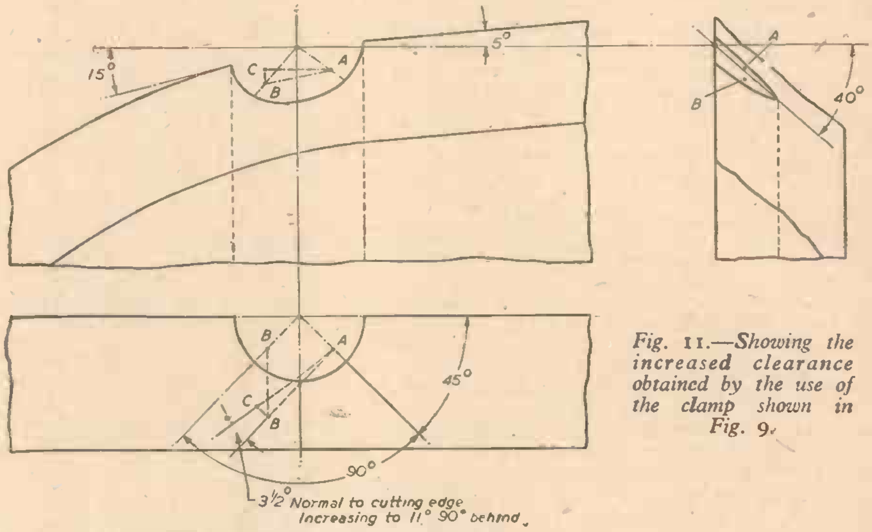


Fig. 11.—Showing the increased clearance obtained by the use of the clamp shown in Fig. 9.

Items of Interest

Gas Turbine Launch

TWO small craft, the Royal Navy's contribution to the Festival of Britain Gas Turbine Week on the Thames, were on view at Westminster recently. They were a 52ft. harbour launch, and an M.T.B., both of which are conversions. The launch has been modified by the installation of a Rover gas turbine weighing 600lb. in place of a 2½ ton diesel engine. In the accompanying illustration the harbour launch is seen arriving at Westminster.

High-power Transformers

IT is reported that the Aluminium Company of Canada have placed a contract with Ferranti, Ltd., Hollinwood, Lancashire, for power transformers totalling 400,000 kVA. to operate at 300,000 and 275,000 volts. These transformers are to be installed at their new hydro stations, Kemano and Kitimat, in British Columbia.

The Latest Aircraft on View

MORE than 50 types of aircraft, among them the latest jet and delta-wing research machines, and gas-turbine driven aircraft, were on view at the twelfth annual flying display and exhibition organised by the Society of British Aircraft Constructors, which was held at the Royal Aircraft Establishment's airfield at Farnborough, Hampshire, in September last. Noticeable among the larger aircraft was the latest British long-range jet bomber, the Vickers Valiant, which is still on the partial secret list. The machine is powered by four Rolls-Royce Avon turbo-jet engines.

A close-up view of the gas-turbine driven harbour launch.

A Passenger-hauling Model Locomotive

Constructional Details of a 3½in.-gauge Locomotive and Tender

By E. W. TWINING

(Continued from page 24, October issue)

As the reader whose interests lie in locomotive work already knows, it is necessary when cylinders are controlled by piston valves to provide against condensed steam being trapped in the cylinder by the piston at each end of its stroke. This is done by fitting relief valves which, being spring loaded, remain closed against normal and maximum steam pressures, but open under the force of water pressed upon them by the piston. In some model locomotives fitted with piston valves this trapping of condensate is ignored and only the ordinary blow-off cocks operated from the cab are fitted. This, I think, is not the best arrangement. It would be better to cut out the hand-operated cocks and provide the spring-loaded automatic valves.

In the present 0-6-0 type model I have devised a simple type of valve and spring loading. The idea is clearly shown in Fig. 6. It consists of countersunk valve seatings in little brass blocks soldered against the cylinder flanges, two 3/16in.-diameter stainless steel balls (from Bassett-Lowke Ltd.) and a piece of clock spring drilled at, or near, the centre for two holding screws tapped into a central brass block. The only point which calls for some nicety of adjustment is the strength of the spring. This is, however, a matter which can be predetermined.

I have said nothing hitherto regarding working steam pressure. This, I think, need not be higher than 60lb. per square inch in the boiler, which means that the maximum in the cylinder will not be higher than 50lb.

Now the diameter of the holes at the seatings for the ball-valves will be ⅛in., therefore the actual pressure on each valve will be: $16 \text{ ozs.} \times 50 \times \frac{1}{8}^2 \times \cdot 7854 = 9 \cdot 8 \text{ ozs.}$ so that a light spring is all that is called for, although the spring must press the balls at something over the steam pressure. If we take that pressure to be, on each valve: 9.8 ounces, we may very well make the spring press to, say, 10 ounces, and this is an amount which can be measured and applied by weights from inside of the cylinder when the front and back covers are removed.

The pistons are deeply grooved, as shown in Fig 6, and they are made steamtight by being wound, not too tightly, with soft cotton wick impregnated with either grease or thick machine oil. Motor engine cylinder oil is excellent. The winding must be done as carefully and uniformly as possible, and the last turns should slightly exceed the diameter of the metal flanges so that the excess will need to be compressed in order to get the piston into the cylinder. The fit should be a fairly tight one, but not so tight that the piston cannot be moved by pushing and pulling with the fingers.

The Valve Gear

The Hackworth gear designed for this model is shown in full detail in Fig. 8. As most of my readers will know, it is a radial gear giving constant lead in all positions of the reversing lever. In this respect, as in many others, it resembles the gear of David Joy, the chief difference being that whereas the reciprocating motion of the die-block is, in Joy's gear, taken from the connecting rod, in Hackworth's it is derived from the crankshaft or axle. In the present case I have provided a short return-crank, something like the return-crank in Walschaerts's gear, but set dead in line with the crank and of such a length that the throw of the return-crank-pin is ⅜in.

It should be noted that the pin in the return-crank is on the same side of the axle centre as the main crankpin. That is because we are fitting cylinders with inside admission valves. If we were using the old flat, or D, valves the return-cranks would be longer and the pins would be ⅜in. on the opposite side of the axle. I mention this in case some reader decides to buy a pair of finished cylinders of a stock pattern which would almost certainly have outside admission flat valves.

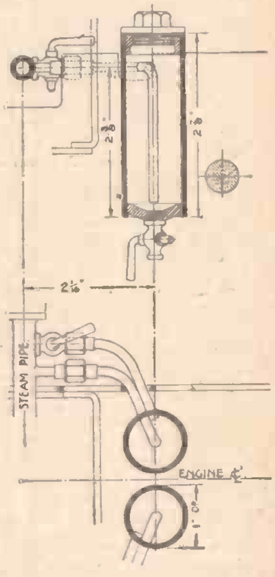


Fig. 10.—Section and plan of cylinder lubricators.

In only one respect have I departed from strict geometrical accuracy: the guides for the die-block ought, instead of being straight, to be curved to a radius equal to the length of the valve or radius rods, but as the rods are so long the difference in effect upon the valve events will be unappreciable.

All the parts of the motion and gear are of steel except the die-blocks and the reversing shaft bearings, which are of brass. The guides would be better in steel and they can be made from round steel rod, drilled out and the two parts of each guide saddled one on to the other and silver soldered together. Note that in order to attach the reversing shaft bearings to the engine frames small pieces of steel plate are required shaped as shown at the top right-hand corner of Fig. 8. These plates are riveted to the frames.

The reversing rod passes backward from the reversing shaft arm between the frame plate and the firebox side, and as the shaft is so near to the firebox throat plate there is no room to crank the forward end of the rod; therefore a slot must be cut in the frame to accommodate the head of the screw by which the rod is attached to the reversing arm. This slot, curved to 1⅛in. radius, is shown clearly in Fig. 8.

The reversing rod, reversing lever, with its sector plate, the auxiliary shaft and other details are, I think, all clearly shown in Fig. 9 and require no further comment nor explanation, beyond saying that, for the sake of simplicity, nearly all the parts are made from the same thickness of steel plate as that from which the frames were cut.

There are two items shown in Fig. 4 which have not yet been referred to, both connected with the chassis of the engine. One of these is the pair of displacement lubricators for the cylinders and the other the feed-water pump. The latter is a Bassett-Lowke horizontal type having a ½in. plunger and coupled up by 5/32in. diameter pipe from the flexible connection at the back and

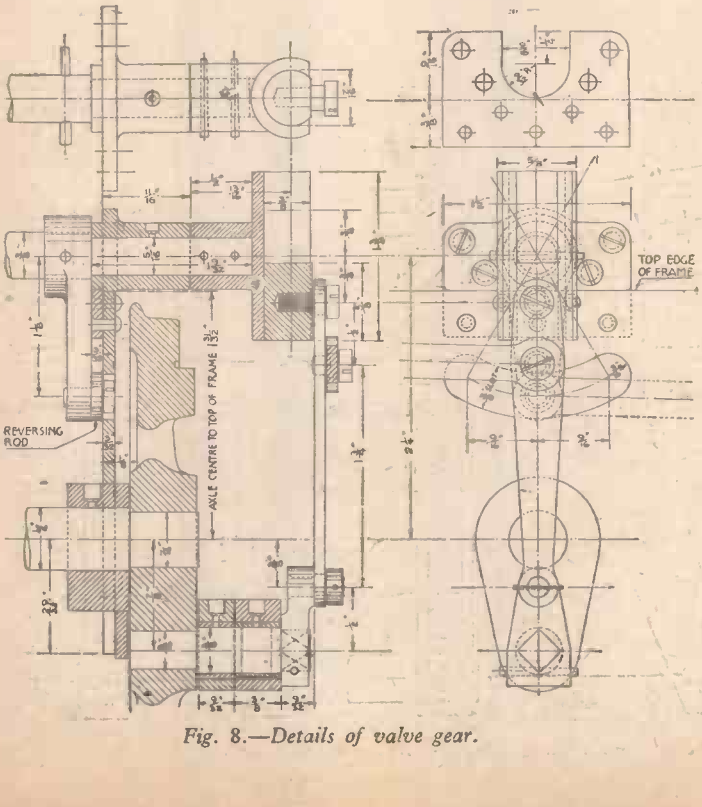


Fig. 8.—Details of valve gear.

to the check valve on the right-hand side of the boiler barrel.

There are two lubricators so that each cylinder shall have its own independent oil supply. The steam-condensing pipes must be taken to the lowest points of the containers and the oil delivery pipes must lead out near the tops—on a level with the steampipes to the valve chests.

The plain taps at the bottoms of the containers are for draining away the water which has condensed and the taps on the delivery pipes are for adjusting the oil feed. I should like to have had screw-down needle-valves here because a much finer adjustment can be made, but I am afraid that there is no suitable fitting ready-made for a straight-through pipe. Fig. 10 shows a vertical section through one and the plan view of both lubricators.

The Boiler

The general arrangement of the steam generator is, I think, fully set out in Figs. 4 and 5 and details are sufficiently complete to render—with just two exceptions—further drawings unnecessary. One of these is shown in Fig. 11: the foundation ring, which is actually, of course, a part of the boiler. The other is the regulator, but I will refer to this later.

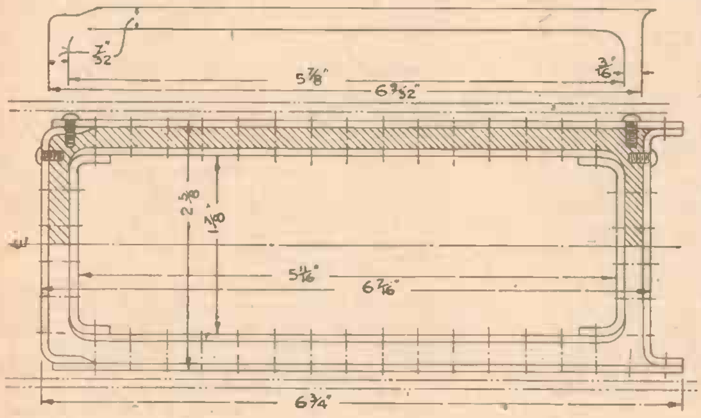


Fig. 11.—Details of firebox bottom and foundation ring.

Of the practical construction of the boiler I shall say little for it would require a whole textbook in order to teach how to flange plates, anneal and bend them and rivet them together.

The boiler for this locomotive is to be built of copper throughout, with the exception of the two cast parts: the foundation and firehole rings, which, as previously mentioned, will be in gunmetal. The barrel will be a seamless copper tube 3¾in. diameter outside, by 8in. long. This will be of No. 16 gauge. All the sheet metal for the rest of the boiler will be of No. 14 gauge excepting the firebox and smokebox tube plates which ought to be a little thicker, say No. 13 if obtainable or even No. 12, although the latter will be rather difficult to flange over to sharp angles, especially at the top corners of the firebox. If No. 13 cannot be got I should make the tube plates of the same thickness as the rest of the boiler, viz. No. 14. The tubes are going to be beaded, and soldered as well, so No. 14 should be heavy enough.

Not only will the tubes be soldered but also the whole of the riveted joints, so use rivets of 3/32in. diameter, snap heads, and pitch them at ⅜in. intervals. The overlap of the plates should be a full 5/16in.

Before the first rivet is put in the constructor must decide what kind of soldering he is going to do—whether he will use silver or soft. Some people advocate the former for the whole boiler whilst others claim that there is such risk of burning, and so weakening the copper, that you lose ultimate strength instead of increasing it. Now my view of the matter is this: that if a boiler is properly riveted up nothing more is wanted other than something which will seal all the seams and prevent leakage. Model seams cannot be caulked as are those on big boilers so the most sensible seal to use is soft solder, and this, besides sealing, does add a little to the strength. But—and this is an important "but"—if the inner firebox is soft soldered and, when steam is up, the water level in the boiler should drop below the crown of the box, the solder will melt and be blown out of the seam. This means, very nearly, writing off the whole boiler and building another. To provide against such a contingency as this I recommend that the inner firebox only be silver soldered. It is small compared with the whole boiler shell and the temperature of the plates will not need to be raised so high nor be so long sustained. Before assembling, thoroughly clean with emery cloth all the steams where the silver solder will have to flow and then rivet up in the usual way.

The foundation ring must be silver soldered to the inner box. All joints in the boiler shell should be thoroughly cleaned bright, including the outer surface of the foundation ring and firehole ring and carefully tinned so that the surfaces after they are riveted together will take the sealing solder readily. Tin also the holes in the front tube plate to receive the flue tubes.

The Backplate

The reader may wonder why I have, in Fig. 4, shown the backplate flanged outward instead of inward in the usual way. Well, it is done in order that the inner firebox may be passed into place from the back and the backplate riveted up as the final assembly. The inner box is too large to be passed up from the bottom; making it larger than the bottom opening enables us to get in two more flue tubes and adds a little more firebox plate as well to the heating surface. For identically the same reason flanging of the backplate outward has been sometimes done in full-size locomotive practice.

Attention is drawn to the three annular rings which are to be placed around the openings in the front tube plate and backplate where the steampipe passes through these and around the opening at the dome, in the barrel. These will be soft soldered to the plates before the boiler is assembled. The purpose they serve is to restrengthen the plate where it has been weakened by piercing and to provide additional metal to take the screws which hold the regulator, the stuffing-box and the dome respectively.

Both the stuffing box and the gland on the regulator rod will best be made from pieces of brass rod with brass plates silver soldered on, or in, them; the safety valve seating will be made in the same way.

Before finally introducing the steampipe into the boiler a round hole must be cut in it to come under the dome and over this hole another piece of pipe will be saddled, as shown in Fig. 4, but not soldered. The soldering must be done after the steampipe is in position, by the flame of a small blowpipe playing downwards on to the joint.

Regulator and Boiler Fittings

The regulator box and valve are built up in exactly the same way as the cylinders, of brass tube and sheet; both the body and valve being cylindrical with the valve carefully lapped in. I venture to think that the drawing, Fig. 12, is so fully detailed that no further explanation is necessary beyond saying that all joints must be silver and not soft soldered. This applies to the attachment of steampipes to the regulator and, of course, to all joints in pipes in the smokebox.

It will have been noticed that two check valves are shown on the boiler barrel; the

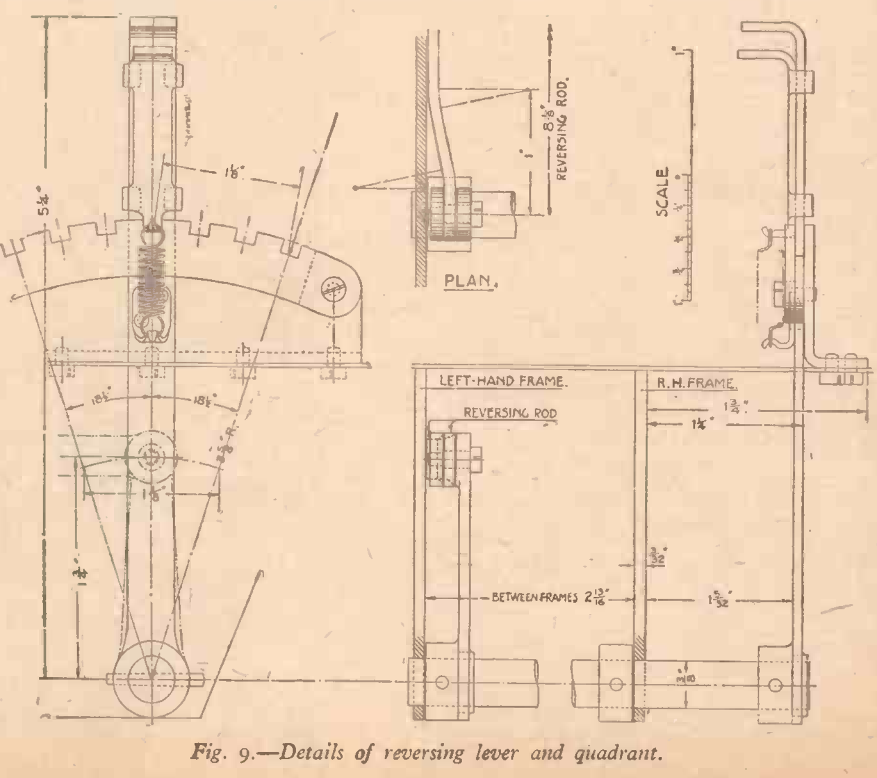


Fig. 9.—Details of reversing lever and quadrant.

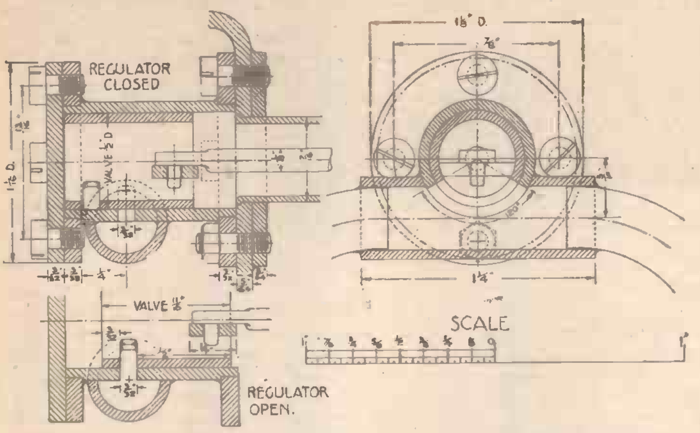


Fig. 12.—Details of the regulator valve and steam branch pipe.

right-hand one taking the water delivered by the axle-driven pump. The one on the left will have its pipe terminating under the rear buffer beam, at the footplate, in a union for connection to a pipe under the tender, which pipe will be led from a hand-operated pump of the same pattern as that on the engine but larger, and fitted with a lever for working. It will be immersed in the water in the tender tank. The purpose of this is mainly to feed the boiler when the engine is standing, but it is useful also to top up the water level should the boiler be generating steam at a greater rate than the water delivery by the axle pump can compensate for.

The driver's fittings on the firebox back are only four in number: the water gauge, the pressure gauge (1in. in diameter, reading to 80lb. or perhaps higher). The blower cock and pipe, and a pet-cock placed, as a check on the water gauge, level with the firebox crown.

The form and arrangement of the firehole door are clearly shown in Figs. 3 and 4. It is pivoted at the footplate, upon which it rests when open. I have found doors opening downwards more convenient than those hinged to open sideways.

It may be noticed that no brakes are shown on the engine; the constructor can add dummy brakes if he wishes, but for simplicity's sake I have omitted them. Brakes worked by steam, or otherwise, are of little use on a small locomotive which will be used for hauling passengers. The weight of the driver alone so greatly exceeds that of the engine that it is very much more effective to put hand- or foot-operated brakes on the truck on which the driver is to ride.

(To be continued)

Facts About Centrifugal Force

With Particular Reference to the "Rotor" at the Festival Gardens

By P. BOWN

THROUGHOUT the ages centrifugal force has been used in the arts and industries in a variety of ways—and even in war.

Early man whirled the sling rapidly around him so as to give added impetus to the stone, and the Roman siege-catapult—at least in part—used this same principle. In our time we find the effect in use as a cream-separator or as a flocculent spinning device for certain synthetic products; and there is the centrifuge of the laundries and dye-works. The promotors and planners of the Festival of Britain have said that "the accent is on 'Youth,'" but a glance around discloses that much emphasis has also been placed on "Innovation."

The "Rotor"

Those of us who are in the fifties will remember the joy-wheel, a polished, rapidly rotating horizontal disc, seen in the fun-fairs of those days. The newcomer, the "Rotor," could well be a close cousin. The device takes the form of a square-bottomed bowl like the lower part of a regular cylinder.

The participants enter and stand up against the circular wall. If they stand anywhere else it matters little, for as the bowl turns they become aware of a mysterious force which urges them incontinently outwards, and to such effect that finally the subsidence of the floor leaves them stuck on the wall "like flies on fly-papers."

Speed and Weight

It will be apparent to the philosophical mind that there must be a relationship between the bowl-speed and the human weight: and there is the added factor of frictional values between clothes and wall material. It is hoped in this article to make the linkage clear. The novice may be inclined to approach the matter with some trepidation for fear of complicated mathematics, but actually the algebra and mechanical theory involved are of the simplest.

If we were shown 10 equal cubes of some common metal or substance and were asked the total weight, we could readily give it provided we knew something of the specific gravity or relative density of the substance, but in default of any information on its identity we could only weigh a cube and multiply by 10.

An Experiment in Friction

In our case we must go further. We require an accurate value for friction and for this

Fig. 1.—Sliding friction test.

purpose must carry out what is called "an appeal to Nature." Our aim would be amply served by a dummy or a made-up bale of cloth, but at this juncture a willing victim appears, and so we proceed.

He is first weighed and turns the scale at, say, 168 lbs.

A sample of the circular wall material is obtained and set up horizontally. Our

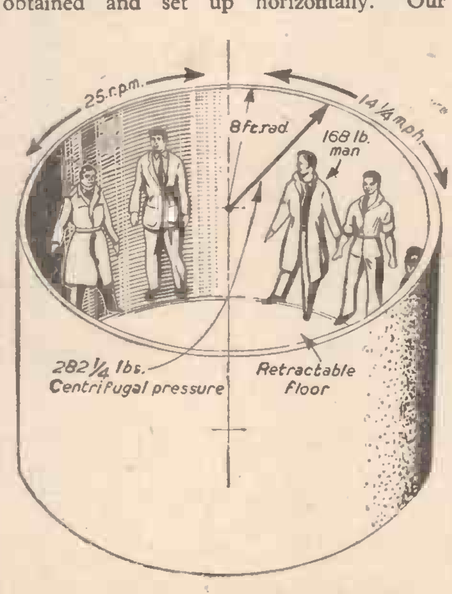


Fig. 2.—Diagram illustrating the effect of weight, speed and pressure.

subject is invited to lay down on this, relaxed, and with head back (Fig. 1). His ankles are now tied together with a strong cord and a spring balance connected, as shown: the pull must be absolutely horizontal and care is taken not to break friction by lifting his legs. The cord is slowly pulled and he begins to slide at, say, 100 lbs.

Adhesive Pressure

Now, when our subject is in the bowl the pulling force, which has then to break the adhesion, is obviously 168 lbs.—the man's own weight. Here we see the beginning of a sum in simple proportion. If a 100 lb. pull can unstick a contact due to a pressure of 168 lbs., what kind of adhesion can be broken up by a *pull* of 168 lbs.?

Calling this adhesive pressure x, $x : 168 :: 168 : 100$, $\therefore x = \frac{168}{1} \times \frac{168}{1} \times \frac{1}{100}$.

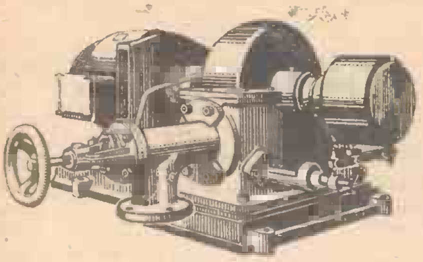
This is 282¼ lbs. We now inquire into the necessary bowl-speed to set up this pressure, knowing that gravity (limited to 168 lbs.) will be defeated when the speed is attained. The engineer's rule for determining this quantity tells us that $N = \sqrt{\frac{50{,}000F}{17RM}}$ where N is the required r.p.m., F the pressure, M the moving mass and R the radius of action. Putting our bowl's diameter at 16ft.,

$$N = \sqrt{\frac{50{,}000 \times 1{,}129}{17 \times 8 \times 168 \times 4}},$$

which is very close to 25 r.p.m. (the $\frac{50{,}000}{17}$ is a constant quantity which always appears in this formula). This figure of 25 r.p.m. is the critical speed (Fig. 2).

Gravity Versus Friction

Bring it below 25 and the man begins to slip down; restore it to 25 and he "stays put." It is a tug-of-war between gravity and friction; below 25 gravity wins; above 25 friction has it. And if we could abolish friction? It is curious with what insistence we can believe that there is still some speed which will make him hold, but this is wholly illusory as well as being self-contradictory, for the machine could be revved to destruction without effecting any adhesion. In an actual case the speed would be put rather higher than 25 to cover adequately the various frictional values obtained from the clothes of the participants. The speed of these joy-riders can be obtained by a kind of rule-of-thumb. In one revolution they go $3^1/_7 \times 16$ft., so at 25 r.p.m. they travel $3^1/_7 \times 16 \times 25$ f.p. min., which is 14¼ m.p.h.



Small WATER-POWER PLANTS

Notes on Installations Suitable for High Falls

By J. H. RAPLEY

THIS article is intended to help those wishing to build a small water-power plant, and who have available a stream with a fall of at least 30ft. within a reasonable distance. This is about the lowest head on which an impulse turbine can be used with satisfactory results. The impulse turbine offers the advantages of simpler construction and better governing, and lends itself better to home construction than the reaction turbine needed on lower heads. Certain of the statements following result from practical experience with small turbines, and are not necessarily true of larger installations.

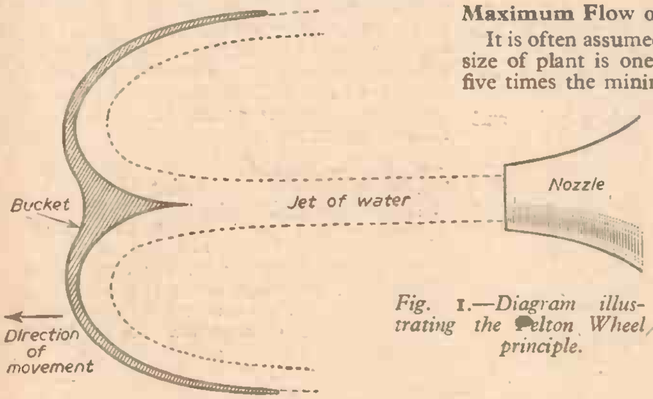


Fig. 1.—Diagram illustrating the Pelton Wheel principle.

Similarly, the theory and formulæ are simplified, but give sufficiently accurate results for all practical purposes.

Levelling the Site

The first step in investigating a possible site is to level as accurately as possible between the points where the water enters the pipeline and where the turbine will be placed. Since with an impulse turbine the casing is open to the atmosphere, the head below the turbine cannot be used, and the effective head must be measured to the nozzle. It is occasionally possible to obtain rough levels from a large-scale map, but only on very high heads of several hundred feet can any degree of accuracy be obtained. A careful survey with a dumpy level is always to be preferred. The exact location of the point where the water is taken into the headrace or pipeline is usually governed by the lie of the land, which must allow a solid foundation for a weir, or dam if storage is contemplated, and which will allow the pipeline to be carried on a steadily falling gradient towards the turbine. In general, open trenches or leats are to be avoided as they require a certain amount of maintenance and are easily blocked by leaves or drifting snow. Where the head is small, socketed, glazed, earthenware pipes or concrete pipes can be used. It is usually found that a point is reached above which any increase in head calls for an uneconomically long pipeline. At the lower end there must be a clear run for the tailrace and firm ground for the foundations.

The working head in practice is less than the head found from the survey due to the effects of pipe friction. Before this can be found it is necessary to find the flow of water and select a suitable size of pipe. The use of a weir for measuring flow, which is probably the best method for small streams, has been described in a previous article. In this country there are usually a few weeks every year when the flow becomes very much reduced, and a plant small enough to use this may be impracticable and would, in any case, be far too small for the greater part of the year. Some of the problems of water storage will be mentioned later, but it should be realised that it is rarely possible to store more than enough for a few hours' run.

Maximum Flow of Water

It is often assumed that the largest economic size of plant is one requiring a maximum of five times the minimum flow, but in the case of a private plant, where the owner is willing to manage with little or no power for a week or two in an average year, a considerably higher ratio is justified. In certain cases, where an uninterrupted supply is essential, an engine-driven stand-by plant is necessary and in most cases more economical than any means of water storage. It should also be remembered that frost in winter can severely affect the flow of any stream depending on surface water, and it is then that the power may be most wanted. Once these points have been considered, the maximum flow of water can be found. If this is measured in cubic feet per second ($6\frac{1}{4}$ gallons $=1$ cubic foot) the losses due to pipe friction can be found from the table given here, which covers pipes up to 9in. diameter, and allows for a proportion of bends and pipe corrosion. On a high head scheme it is best to keep the friction losses down to 10 per cent. of the total head, but where the head is ample the saving in cost due to using a smaller pipeline may outweigh the serious loss in efficiency. Choosing too small a size of pipe is one of the commonest mistakes in designing a plant. It will be seen clearly from the accompanying table how rapidly the friction losses increase compared with the quantity flowing through a given size of pipe.

Suitable Pipes

It is impossible here to discuss piping in great detail, but the following notes may be of some assistance. Earthenware and concrete pipes are only suitable for heads of a few feet. Cast-iron pipes are very heavy to handle, and expensive; they tend to become blocked in time by internal corrosion, and jointing is usually rather complicated. Steel pipes are essential on heads of over 400ft., but are expensive and tend to develop small leaks after 20 years or less due to rusting. Many types of joint are available, and the pipes are not unduly heavy to handle. Asbestos cement pipes are available for heads up to 400 feet; they are non-corroding, have a low friction loss, and compare favourably in price with all other types. Jointing is quick and easy. Messrs. Turners Asbestos Cement Co. Ltd., of Trafford Park, Manchester, 17, are the manufacturers of these pipes, but owing to the immense demand delivery is rather slow.

The Pelton Wheel

The commonest impulse turbine is the Pelton Wheel, the modern version of the old "hurdy-gurdy" of Californian Gold Rush days. The principle of the Pelton Wheel is that the kinetic energy of a jet of water travelling at high speed is absorbed and converted into mechanical energy, the water losing the greater part of its velocity in the process. This is illustrated in Fig. 1 where a jet of water is shown striking a double cup or bucket. The jet is split, each half travelling round the bucket, and finally leaving in almost the opposite direction to that in which it entered. If the bucket is stationary, the water will leave at the same speed as it enters; if the bucket is moving at the speed of the jet the water retains its velocity, and again no work is done. If, however, the bucket is moving at half the speed of the jet, the water leaving the bucket will have zero velocity and merely fall under the influence of gravity. Under these conditions the whole energy of the water has been transferred to the bucket, which must either accelerate or the energy be absorbed externally. If the bucket is mounted

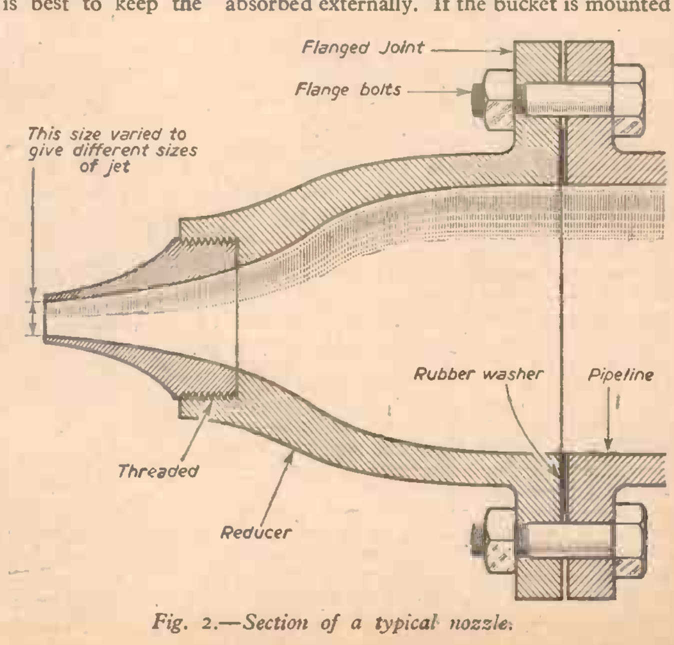


Fig. 2.—Section of a typical nozzle.

Pipe Friction Tables

V = velocity of water in pipe in feet per second.
Q = quantity of water flowing in cubic feet per second, usually known as "cusecs."
L = loss of head in feet per hundred feet of pipeline.

Diameter of pipe in inches

V	4		5		6		7		8		9	
	Q	L	Q	L	Q	L	Q	L	Q	L	Q	L
2	.17	.73	.27	.50	.39	.40	.53	.33	.70	.28	.88	.27
2.5	.22	1.04	.38	.80	.48	.66	.67	.53	.87	.47	1.10	.40
3	.26	1.33	.41	1.00	.59	.90	.80	.80	1.04	.65	1.33	.53
3.5	.31	1.93	.48	1.40	.69	1.13	.94	1.00	1.22	.83	1.55	.75
4	.35	2.20	.55	1.90	.78	1.60	1.07	1.27	1.39	1.05	1.77	.87
4.5			.61	2.20	.88	1.90	1.20	1.60	1.57	1.30	1.98	1.05
5					.98	2.20	1.34	2.00	1.70	1.60	2.20	1.40
6					1.18	3.00	1.60	2.60	2.09	2.10	2.65	1.90

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on the circumference of a wheel, the energy can be transmitted through the wheel and shaft and used to turn some other machine. Of course, only during a small part of each revolution is the bucket in contact with the jet, therefore a number of buckets are mounted on the wheel, one entering the jet as the preceding one leaves. In practice, to reduce splashing, a small part of the lip of each bucket is cut away.

Power Output

The theoretical power of a Pelton Wheel or other turbine is found from the flow and working head. In practice, an efficiency of 70 per cent. to 80 per cent. may be expected with careful design, so taking the flow as Q cusecs, the working head H feet, and the efficiency 75 per cent., the horse power is given by the formula:

$$\text{Power output} = .085QH \text{ h.p.}$$

With plants under 10 h.p. driving electric generators, it can be taken that 1 h.p. = .5 kW. though this depends on the generator efficiency. Small alternators are generally lower in efficiency than D.C. generators. As the speed of the buckets should be half that of the jet for maximum efficiency, it follows that the speed of a given size of wheel depends on the speed of the jet and, hence, on the head. The velocity of the jet can be taken as $8\sqrt{H}$ ft. per sec., thus the speed of the wheel is proportional to the square root of the head.

Points of Design

There are certain practical points of design to be considered if a high efficiency is to be obtained. The diameter of the wheel to the centre line of the buckets (the bucket pitch circle diameter) should not be less than ten times the diameter of the jet, nor the width of the buckets less than five times the jet diameter. Consequently, in designing a wheel for driving an electric generator where a high speed is desirable, to allow a smaller and cheaper machine, the minimum wheel diameter should be chosen by first finding the size of jet. This is given by:

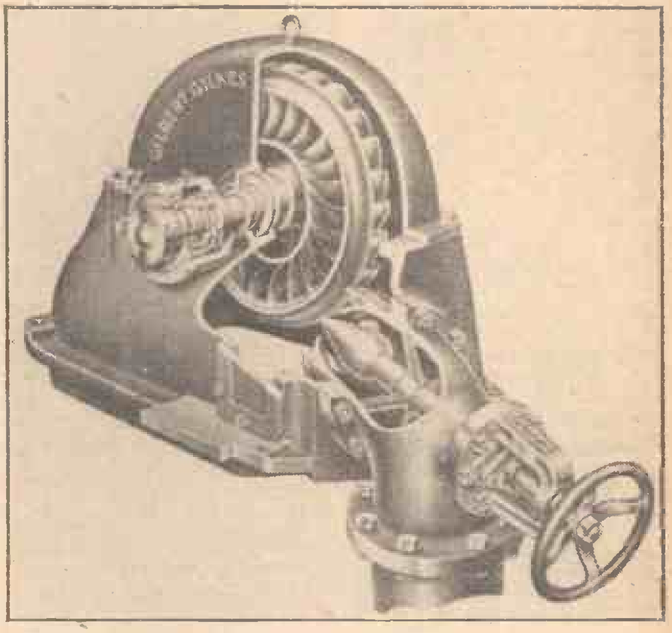
$$\text{Jet diameter} = \sqrt{\frac{23Q}{\sqrt{H}}} \text{ in.}$$

Using the minimum wheel diameter, the wheel speed then becomes:

$76.4D\sqrt{H}$ r.p.m. where D is the wheel diameter in ft.

Constructional Details

The actual construction of a Pelton Wheel consists of the wheel and buckets, usually cast in one piece, and made of bronze or other non-corroding metal, mounted on a shaft running in ball or roller bearings and enclosed in a watertight casing. Two discs mounted on the shaft close to the casing throw the water clear and prevent leakages. The buckets should be designed with a sharp centre edge to divide the jet smoothly, and rounded so that the jet leaves the bucket at about 170 deg. to the direction in which it enters. Any closer approach to the ideal 180 deg. will result in interference between the two jets. Although the preferable construction for a small wheel is to have the buckets cast solid, for amateur construction a cast or welded bucket bolted to the wheel saves expensive patterns. It is usual to use a roller bearing at the driving end and a combined journal and thrust ball bearing on the other side to locate the shaft endways, but for small machines double row self-aligning plummer blocks are satisfactory. Care should be taken to exclude water from the bearings by packing well with grease, but too much grease causes heating and is undesirable. A good-quality ball-bearing grease of the consistency of Vaseline should be used; cheap car and tractor greases soon give trouble. Plain bearings are not suitable for small machines as the high friction losses give a very low efficiency on part load.



Section of a Turgo impulse wheel. (By courtesy of Messrs. Gilbert Gilkes and Gordon, Ltd.)

Variable Nozzle

The simplest form of nozzle is that shown in Fig. 2, which consists of a reducing portion with a threaded end on to which can be screwed several sizes of nozzle to suit the quantity of water available. The more usual means of varying the size of jet is a spear valve as shown in Fig. 3. This is fitted with a handwheel and screw mechanism, allowing it to be moved in and out of the jet. This can be done by automatic means as will be shown later, but this is a refinement usually only to be found on professional machines. Fig. 3 also shows how the speed can be governed by a deflector which throws more or less of the jet clear of the wheel to suit the load. This is controlled by a pendulum governor either mounted on the shaft or driven by a belt. The latter is perhaps simpler to adjust, but a belt failure can result in a runaway, under which conditions the wheel tends to run up to twice its normal speed, though friction losses and windage usually restrict this to about 70 per cent. above normal. It is well to remember that the turbine and all associated equipment should be able to stand this runaway speed. This method of governing can give a small speed variation, but calls for very accurate workmanship and minimum friction in the moving parts.

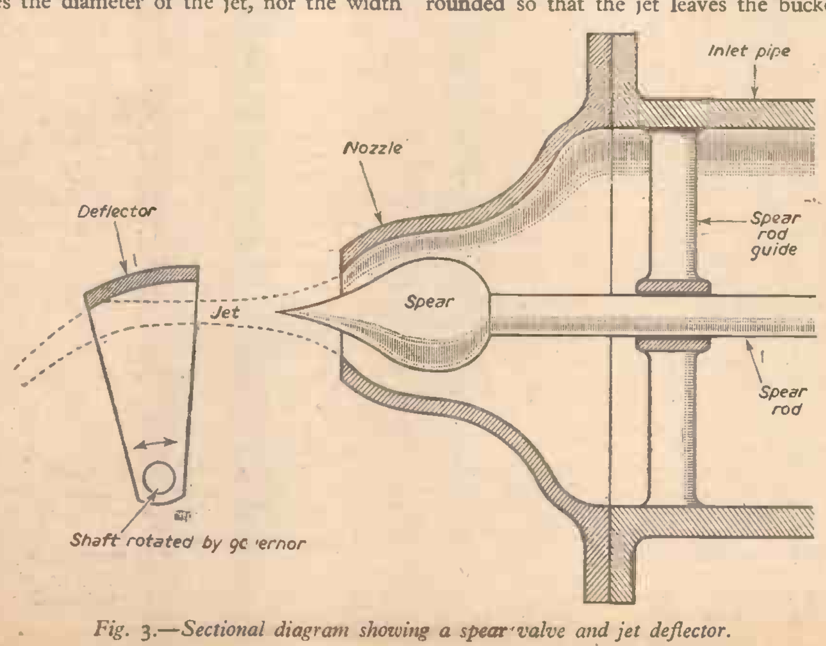


Fig. 3.—Sectional diagram showing a spear valve and jet deflector.

(To be continued)

Earth Fault Risks

The Effects of Faulty Installation in Electrical Plant, and the Methods Used for Minimising the Risk of Electric Shock

By J. L. WATTS

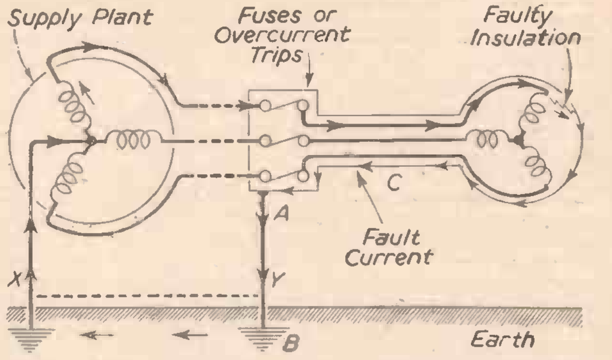


Fig. 2.—Path of earth fault current on an earthed three-phase motor.

ONE of the most common causes of electric shock, and sometimes of fire, is the failure of insulation between live conductors and the metallic casing of apparatus or the metallic sheathing of cables. There are very many possible causes of such a failure of which may be mentioned deterioration of insulation due to old age; loss of insulating power due to moisture, oil, or acid; chafing of insulation due to vibration or rubbing of parts, or rough handling of apparatus and such causes as an accumulation of carbon or metal dust on the insulation.

At parts such as switchgear, terminals, brushgear, plugs, etc., where the conductors are exposed, a deposit of conducting matter on the insulation may allow slight leakage of current. In some cases this leakage may burn away the conducting matter, but the leakage current is also very liable to burn or carbonise the surface of certain synthetic insulating materials, after which they become conducting and allow currents of considerable value to pass between the live conductors and the frame or casing of the apparatus.

Effect of Insulation Failure

The effect of faulty insulation between conductors and case depends on the nature of the supply and the conditions under which the plant is used. Taking first the case of a motor, the frame of which is not connected to earth, and being fed from a supply system which is completely insulated from earth at all points. If the insulation were perfect, no voltage would then exist between any of the conductors and earth, and no electric shock would be received by a person touching any one conductor whilst in contact with earth. It must, however, be emphasised that no insulation is perfect, and actually there would be some current leakage through the insulation, which would result in a difference of voltage between certain conductors and earth. An electric shock would be quite likely under these conditions although it may or may not be severe. Such an insulated system, however, is quite practicable and useful in the case of a small D.C. or single-phase A.C. generating plant.

The majority of electric supplies, however, are derived from larger generating plants of the D.C. three-wire or polyphase A.C. type, and it is usual to connect the neutral point of such systems to earth at the generating plant or transformer. This limits the maximum voltage between any conductor and earth to that existing between the "live" or "phase" conductors and neutral, which is much less than the voltage between the phase lines, this voltage difference existing at all times. Consequently, some degree of shock is likely if a person touches one of these conductors whilst "earthed." The same result occurs if an earthed person touches metallic casing or sheathing of electrical apparatus which is in contact with the conductors due to an insulation defect, termed an "earth fault," if the framework or sheathing is not effectively connected to earth. Fig. 1 shows that the full phase to neutral voltage will then exist between the framework of the apparatus and earth.

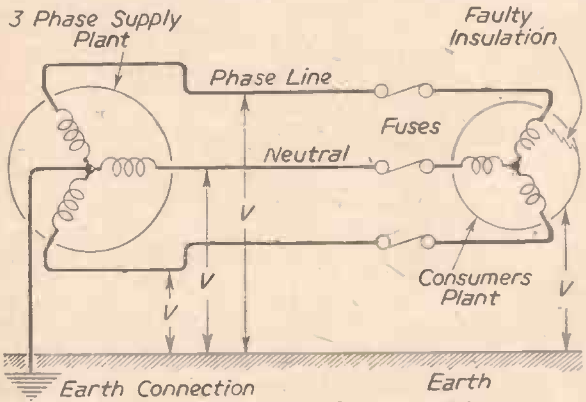


Fig. 1.—Effect of an earth fault on unearthed plant.

Methods of Protection

Six methods can be considered with a view to avoiding or minimising the risk of electric shock arising out of earth-fault insulation failures.

Method No. 1 is to use an insulated supply system. As mentioned above, this is quite practicable for a small, private generating system, but special converting plant or transformers would have to be used by a consumer to obtain the same conditions if the supply was derived from most public supply authorities. The method also is somewhat unreliable because, as explained above, perfect insulation is unobtainable; and an insulation defect would be liable to convert the system from an insulated one to one with an earthed point. Such a defect may not be disclosed until trouble occurs and a shock is received.

Method No. 2 is to arrange matters so that it is impossible for a person to be in contact with the framework of electrical apparatus or cable sheathing whilst in contact with any earthed material. This method is useful in some cases, where there is little or no machinery and wooden floors are fitted; but it is almost impossible to achieve more than a limited success in the average industrial premises in view of the very large number of conducting materials which ultimately make contact with earth.

Method No. 3 is to use electrical apparatus which has an insulated casing instead of a metal one. Obviously this method of protection is limited to little more than lighting apparatus. Even so, moisture can make the outer surfaces of the insulation alive.

Method No. 4 is to connect the metallic framework of the plant and apparatus, and the metallic sheathing of the cables, to earth through a low-resistance conductor. In this way any leakage current from a live conductor to the metallic casing, on a system having an earthed point, will flow to earth as indicated in Fig. 2. This practical method will be dealt with in more detail later.

Method No. 5, which can be used to reduce the severity of an electric shock, is to supply the plant at rather a low voltage between the mains and between the mains and earth. This method is useful in the case of private generating plant, but suffers from the disadvantage that non-standard electrical apparatus may be required and, in addition, large and expensive cables may be required to carry a given amount of power at a given efficiency. This is due to the fact that the current required to transmit a given power is inversely proportional to the voltage. A very low voltage, of the order of about 40 volts, would be necessary to ensure that there was no possible risk of a fatal electric shock under any conditions. Special converting apparatus (such as a motor-generator for D.C. or a transformer for A.C.) would be necessary for plant fed from public supply mains. A modification of this method, the Butcher-Black and Decker system, is, however, very useful for such items as portable apparatus, and will be described later.

Method No. 6 of reducing the risk of electric shock is to maintain the insulation of the installation in good condition. Whilst accidents cannot be avoided every effort should be made to do this, in conjunction with other methods of protection. Maintenance of the insulation involves the periodical testing of the insulation resistance between the conductors and their metallic casing, or sheathing, by means of an insulation testing set such as a "Megger." This test should be repeated every few months. It is suggested that in the event of the insulation resistance being below about 0.5 megohm the circuit should be split up for individual tests as may be necessary in order to localise the part which is responsible for the defect. A careful inspection of the section will then often reveal the cause, which can usually be remedied by the cleaning or renewal of a small piece of insulation, or wrapping an exposed conductor with insulating tape. In addition to minimising the risk of electric shock, such periodical attention can do much to avoid expensive breakdowns which might involve considerable consequential losses.

Precautions with Portable Apparatus

On account of the risk that persons handling portable apparatus may be unable to relax their grip should the casing or handle become alive due to faulty insulation, such apparatus needs special consideration, especially when used in a place where there is earthed metalwork or a concrete floor. The framework of the plant should be connected to earth through one core of the flexible cable and a suitable plug; it should be noted that a lampholder adaptor is not intended for earthing. Periodical tests of the earthing conductor of this flexible cable should be carried out by passing through it a current at least equal to the melting current of the protective fuses. Simple testing apparatus is available which can be used by unskilled labour to test the cable in a few seconds, these tests should preferably be carried out every few days.

The Butcher-Black and Decker system, which is indicated in Fig. 3 is a modification of method No. 5, and is a method of supplying A.C. apparatus, particularly small portable gear, with a high degree of safety. It has the following advantages. (1) Single-phase motors of normal voltage may be used, or lower voltage if required, these being connected between the outers A and C of a transformer. The maximum voltage between any point of the circuit and earth is limited to half the output voltage of the transformer by the connection of the mid point B of the transformer secondary winding to earth. Alternatively, or preferably in addition, the mid point of the secondary winding can be connected to the trip coil by the connection X-Y shown in Fig. 3.

(2) Any leakage current arising from failure of the insulation between a conductor and the metallic sheathing then flows through the trip coil and results in the switch cutting off the supply to the faulty apparatus. Only a very small leakage current is required to cause the trip to operate, whereas with the normal direct earthing method the defective apparatus is not swtiched off until the leakage current has risen sufficiently above the normal full load current to operate the excess current protective device.

(3) One transformer can be used to supply several portable or non-portable items if required.

(4) Unlike direct earthing systems, the continuity or completeness of the earthing circuit can be tested quite simply by merely pressing a push-button switch. It is only necessary for continuity of the earthing circuit to be maintained on the output side of the transformer.

Direct Earthing Protection

Direct earthing, or the connection of the framework of the plant to the general mass of earth, is the most common method of protection against the effect of earth faults. The object of this earth connection is primarily to limit the voltage difference between the framework of the plant and earth under fault conditions. This voltage is equal to the product of the earth fault current, or leakage current, and the impedance between the framework of the defective plant and earth. Thus the impedance of the earthing circuit must be maintained at a low value. In practice this impedance is mainly due to the resistance of the earthing conductors, and the resistance of the connection between the conductor and the earth, usually called the earth electrode.

Fig. 2 shows that the consumer's earthing circuit consists of the actual connection to earth B and the earthing conductors A and C. The conductors may consist of metallic cable sheathing and/or separate earth wires. Conduits and cable sheathings will provide a low-resistance circuit provided all connections are carefully cleaned before being made, and are kept tight. Part of the earthing circuit may consist of copper or bronze wire or strip. The cross-sectional area of such a conductor should be not less than half that of the largest conductor protected, subject to a minimum size of 0.0045 square inch and a maximum size of 0.1 square inch. The earth wire in a flexible conductor should be the same size as the circuit conductors. Fixed earth wires should be bare and exposed for inspection throughout their length.

The greater part of the resistance of the consumer's earthing circuit is often that of the actual connection to earth, the earth electrode B. The Institution of Electrical Engineers' Regulations suggest that, for a circuit having a rating of up to 100 amps, a suitable connection to earth can be made by connecting the framework of the plant to the point of entry into the building of the metallic water pipe from an urban water supply carried in underground metallic pipes which have metal-to-metal joints. In other cases the earthing connection may be made by means of buried plates or strips of metal or by several metal pipes or tubes driven vertically several feet into the ground. In cases where the earthed point of the system is available to the consumer, as when the supply is derived from a generating plant or transformer on the consumer's premises, it is wise to connect the framework of the plant to that point in addition to earth. With this connection, as shown by X-Y in Fig. 2, earth fault current from metallic sheathed conductors does not have to flow through the earth and earth electrode.

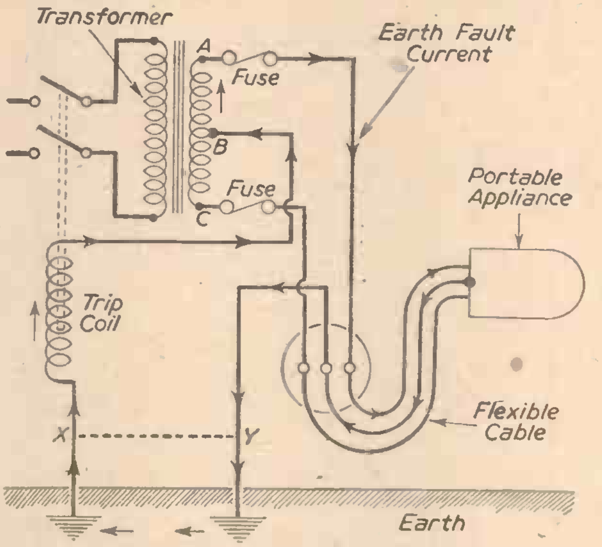


Fig. 3.—Butcher-Black and Decker earth fault protection scheme for portable apparatus.

Resistance of Earthing Circuit

There is another reason why the earthing circuit of the consumer's plant must have a low resistance if direct earthing is to be effective. This is to enable the earth fault leakage current to reach a value which is high enough to melt the protective fuses or to operate the excess current protective trips through which this current flows. This faulty current is equal to the voltage difference between the faulty conductor and earth divided by the resistance of the earthing circuit to earth from that point. A 15 h.p. 400 volt three-phase motor will have a full load current of about 38 amps and may be protected by excess current trips in the starter which are set at about 50 amps. If the neutral point of the system is earthed, as is usual, the maximum voltage difference between any point of the conductors and earth will be 230 volts. In order to allow 50 amps earth leakage current under fault conditions the maximum resistance of the earthing circuit must be limited to 230 ÷ 50 = 4.6 ohms. For larger motors a lower earthing resistance would be required.

In order to allow for the resistance of other parts of the earth fault current circuit which may be outside the control of the consumer, and to allow for variation of resistance of the earth electrode which may occur under varying weather conditions, the maximum resistance to earth of any part of the framework of the plant to the earth electrode should be limited to 1 ohm. This will limit the volt drop along the earthing conductors when fault current flows. It should be noted that if the earthing circuit has a high resistance the current may not be cut off the faulty apparatus and, in consequence, the framework of the defective apparatus, and possibly other connected apparatus, may remain alive at a dangerous voltage.

The earthing circuit should be inspected periodically to ensure that all earth wires are firmly connected and that all conduits and cable sheaths are tightly secured to the apparatus. The resistance of the earthing circuit and the earth electrode should be tested about once a year. It is also important to inspect the fuses and excess current trips to ensure they will operate at a reasonably low current and also to test the control gear to make sure that it is not too stiff to be tripped when the excess current trips function on earth fault currents.

Mention may also be made of protective systems employing leakage trip coils which are connected in series with the earthing conductor or else are operated by unbalanced currents in the supply lines. These trips, however, are outside the scope of this article.

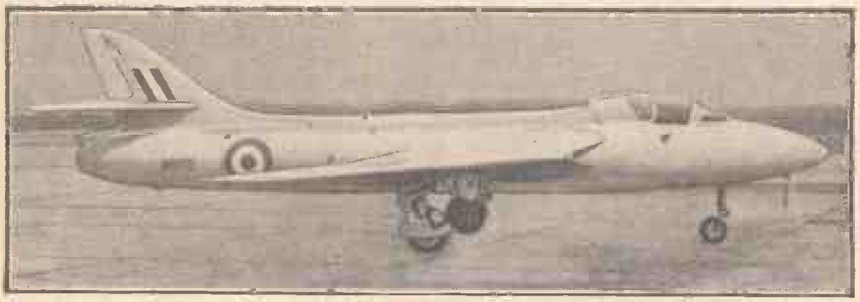
Farnborough Marches On

An Account of the Recent S.B.A.C. Flying Display

By THE MARQUIS OF DONEGALL

LOOKING through my voluminous notes about the recent Society of British Aircraft Constructors' show at Farnborough, several basic facts emerge.

The S.B.A.C. Flying Display and Exhibition is not only the most important annual event in British aviation, but this year's show from September 11th to 16th inclusive, displayed more obvious yearly progress over its predecessor than any of the former displays that it has been my privilege to report.



Straight from drawing board to production—the new P.1067 Hawker jet fighter. Whilst this follows the lines of the P.1040, P.1052 and P.1081 which were fitted with Rolls-Royce Nene engines, the P.1067 has the Rolls-Royce Avon of much greater power.

Old hands were temporarily misled by the fact that although the general layout of the aircraft was similar to that of last year, the newest types of military aircraft were located in a separate holy-of-holies, only to be gaped at with reverence from a respectably non-technical distance.

The Valiant and the Hawker P.1067

It was, of course, only reasonable that our newest treasures, such as the Valiant and the Swift and Hawker P.1067, should not be scrutinised too closely by the experts of some seventy countries, and it surprised me that the Ministry of Supply allowed these, and even newer types ordered for service in the R.A.F., to take their place in the flying display.

The whole vast set-up divided itself, as usual, into flying and static, the main static show being, as before, in a single enormous marquee with some 200 individual stands.

The Ministry of Civil Aviation stand could be seen very much the same as it was at the Paris Exhibition earlier in the year. Among the models, the greatest interest was shown for the Armstrong Siddeley snarler rocket-engine and the Napier Nomad compound unit.

Front view of the new Hawker jet fighter P.1067. It was designed by Sydney Camm, C.B.E.

But we are wandering away from the flying display. During the operative period, the weather could rightly be described as largely "touch and go," and I think we were lucky that "birds walking" only occurred on the Saturday morning, first period of the two days when the general public had a look in. This possibly accounted for the record public attendance on Sunday, September 16th.

Delta-wing Jets

As far as public interest is concerned the stars of the show were undoubtedly the Vickers Valiant and the Hawker P.1067, even though the Short four-jet S.A.4 bomber and Vickers Supermarine Swift were close runners-up; and the manœuvrability of the little delta wing jets, the Avro 707B, and the Boulton Paul P.111, as they flashed past the stands produced that indescribable noise that a crowd makes when its breath has been taken away.

There were various descriptions of them, from the Ministry of Supply's "maybe the most important factor in aeronautics" to a non-technical bystander's "just like the things I used to make out of blotting-paper and threw around the schoolroom." That is really not a bad description of the shape of these fascinating little aircraft.

The latest British jet bomber, the Vickers Valiant, powered by four Rolls-Royce Avon turbo-jet engines.

Circus Formation

Let us take the machines in the order laid down, ignoring last-minute alterations in the schedule. In the circus formation, we have first the Vickers-Armstrongs Viscount 700, which Brian Trubshaw demonstrated with particular stress on its remarkable take-off. It will go to B.E.A. and to Air France. Next the de Havilland Comet, which was furnished as for delivery to B.O.A.C. and was inspected by many of the public, shown over by a uniformed steward and stewardess, who let us look at the normal meals supplied to passengers by the company.

Next, a military type, the A. V. Roe Ashton Mark II. The only spottable difference from last year's Mark I was that measures had been taken to deal with conditioning problems for crew or passengers at heights of the 40,000-ft. level. The Ministry of Supply has ordered six of these.

Back in civilian life we come to the Handley Page Hermes V with Squadron-Leader L. H. G. Hazelden at the throttle. This aircraft in the Proteus version should knock-off some 400 m.p.h. and has already given good service to B.O.A.C. in its Theseus version. Its pay-load is about 13,000 lb., and it has, with the Dunlop anti-skid device, an impressively short landing.

Not to be confused, we now have in the circus formation, Bristol's Proteus-Lincoln. This is a turbo-powered transport, also manufactured for B.O.A.C. Take-off and landing are excellent and its pay-load is about 25,000 lb. for 4,000 miles.

Next came the military Napier Nomad-Lincoln. Few details are available and what there are, except that the fuselage has been substantially reinforced, are too technical for this article.

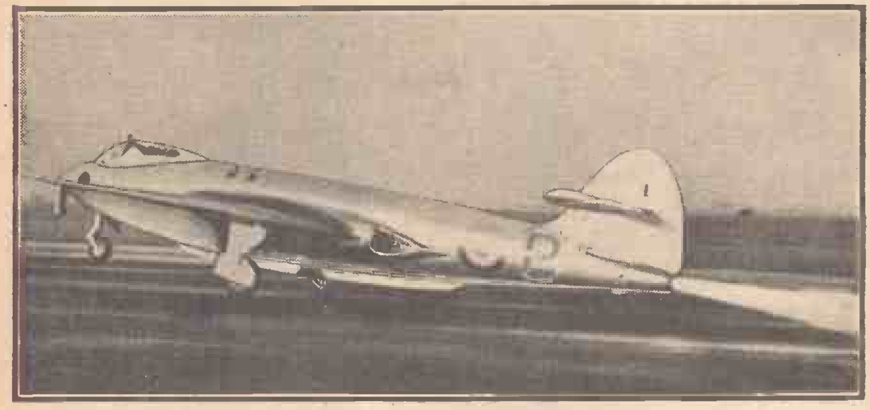
the Naval staff of the Joint Services Mission at Washington, D.C.

de Havilland Dove

Then, our old friend, the de Havilland Dove. Having had personal experience of flying this machine, I regard its commercial popularity in many countries as fully justified. To my mind the Dove is the ideal medium-sized, all-purpose, civil aircraft.

The de Havilland Heron is the Dove's heir-apparent. It did its best work under B.E.A. colours and, unlike the Dove, is powered by four Gipsy Queen 30s.

The Short Sealand Amphibian is said to handle very well and is certainly beautiful as to landing; it is powered by two Gipsy Queen 70s and reversible-pitch propellers.



The P.1072 at the point of take-off, being assisted by the "snarler."

The Avro Shackleton was displayed by "Johnny" Baker, who showed how quickly a Shackleton can get out of an unhealthy situation.

Lastly in the "circus," de Havilland's Mamba-Marathon, powered by four Gipsy Queen 70s, showed its feeder-line paces. The West African Airways Corporation, among many other far-flung experimentalists, have been operating this reliable and useful all-purposes aircraft for some time.

Helicopters

Time out for the helicopters. We had first the Bristol 171 which flew in undefinable skating patterns and there was a model of Bristol's twin-rotor 173.

There were five Westland helicopters on their stand. As far as flying is concerned, it was the Westland S.51 which all interested readers know as an old friend.

Next came the light aircraft demonstrations, first, individually, and afterwards, in circus formation. The Percival Provost piloted by R. G. Wheldon, a Leonides-powered R.A.F. trainer showing the aircraft's manœuvrability and Mr. Wheldon's skill.

Another trainer seen at Farnborough for the first time was the Gipsy Major I Auster Aiglet.

This was followed quickly by the Auster S. This is a military liaison craft, shown for the first time, powered by Cirrus-Bombardier with Hordern - Richmond variable - pitch propeller.

Coming again to circus formation, T.O.B. Evans had brake-seizure but managed the resulting burst tyre, on landing, almost as though nothing had happened.

The Westland Wyvern with R. S. Bradley did credit to this Python-powered strike-fighter, and particularly to its rate of climb from take-off.

The Fairey A.S.7. "Fire-Fly" three-seater had no guns during Mr. Matthews' flying but carried instead radar housing and auxiliary tank and sonobuoys—small transmitters.

Percival's Sea Prince, with its twin-wheel undercarriage has been much praised in the U.S.A. At least one has been sent to

Individual Demonstrations

"Tim" Wood managed to halt the Blackburn universal freighter in 200 yards from landing. He used reverse-pitch from touch-down, which definitely fulfils a gap in the gamut of military supply aircraft.

The Fairey Gannet lacked its conventional wing "fences." Considering the bulk, it did loops, rolls and aileron manœuvres with surprising ease.

With the Short S.A., Brooke-Smith had restrictions put upon him in the demonstration of this four-Avon long-range bomber. He did not fly very fast but he made several low-speed trips over our heads and it was obvious that British military aircraft, if resonance tests prove satisfactory, can well do with this addition.

We now pass on to de Havilland's Sea Venom F.20. The Sea Venom is scheduled for Britain, France and Australia. It has the latest in navigational air-aids, and these should make an operational ground-fog machine. For the rest, all is strictly hush.

We must mention de Havilland's Venom reheat-fighter-bomber in relation to its Ghost turbo-jet. By the pressure of a button the pilot can ignite extra fuel and with resulting noise to be expected from half-a-million blow-lamps—but surprisingly little flame.

We saw the Hawkers P.1052 and P.1067 in flight. The former devolves from the famous Sea Hawk, as adopted by the U.S. Navy for deck-landing qualities which their Sabre did not possess.

U.S. experts remarked on the graceful lines of the Hawker P.1067 and I must say that as flown by Neville Duke on low-speed runs, this Avon-powered transonic will undoubtedly beat the Sabre's 680 m.p.h. world record of a year or two ago. The prototype was not armed.

Gloster Meteor

The Gloster Meteor flown by Squadron-Leader Zurakowski provided a private enterprise ground attack in view of the fact that Zurakowski did most of the development and experimental flying. Considering that the Meteor carried 24 rockets, "Zura's" aerobatics looked to the tyro like "a piece of cake."

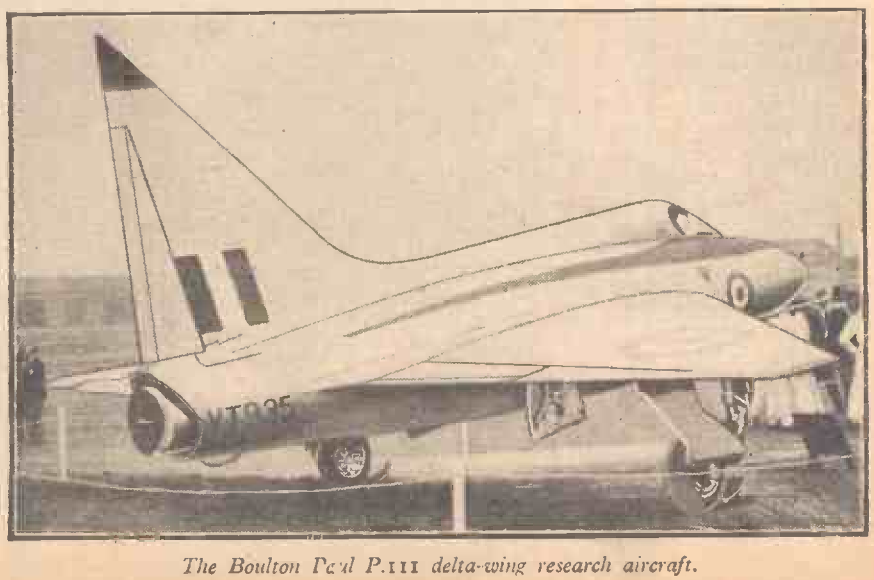
We come on to the Vickers Supermarine 508; and again into secrecy. It is a twin Avon Naval fighter and Lt.-Commander Lithgow was able to persuade everybody that it has excellent take-off and climb—not to mention good roll.

Boulton Paul's P.111 was flown by Lt. J. Elliot of Aerodynamics Flight A.R.E. This aircraft makes little noise and seems to be able to retain air speeds uncommonly low for a fighter.

The Avro 707

Lastly, the Avro 707 was flown by "Roly" Falk at what I timed as less than 90 m.p.h. "Roly" got on the air and told the assembled company more in a couple of minutes about his mount than I could attempt in another article. There emerged the facts that the 707 has surprised its own makers and that the Chiefs of Bomber Command have their fingers itching to get their hands on a model B as soon as it has completed the whole of its testing.

As a postcript we might add that the record public attendance on Sunday, September 16th, was over 140,000—a great tribute to the enterprise of the Society of British Aircraft Constructors and to the increased air-mindedness of the great British public.



The Boulton Paul P.111 delta-wing research aircraft.

THE WORLD OF MODELS

The Model Engineer Exhibition By "MOTILUS"

ALL those interested in models look forward to the annual Model Engineer Exhibition held in London at the New Royal Horticultural Hall. One's first impression of the Hall this year was of good display arrangements, leaving plenty of room for visitors to move freely. A noticeable change at the far end of the Hall was a marine tank, erected in place of the former arena for working model cars, aircraft, traction engines and power boats. The new large tank was raised so that the water surface was at normal eye level, a platform being provided for the children to use when watching operations with power boats, radio controlled boats, model seaplanes, etc. Landlubbers who preferred their hobby dry could repair to the dais where they could watch model Grand-Prix racing, with true-to-scale models of well-known prototype racing cars competing, three at a time. Meanwhile, railway fans probably gave these a cursory glance and then turned to give critical attention to the interesting and comprehensive 00 gauge model railway layout exhibited by the Ilford and West Essex Model Railway Club. This layout has been considerably altered of late, and, as readers probably know, is the combined effort of all members of the Club. Several new locomotives and rolling-stock pieces had been specially built ready for the 1951 Model Engineer Exhibition for operation on the improved layout.

Once more this year visitors could watch demonstrations of model building in many phases, given by experts who could also answer questions about their work put by fellow model-makers. Several model societies assisted in giving these demonstrations, which proved most popular.

Model "Churchill" Tank

Opening ceremony at the Exhibition was unique this year; a working model "Churchill" tank paraded before the audience, tore its way through a *Model Engineer* poster and, halting on its display platform, fired its gun in salute.

The majority of the amateur competition models were ranged in the centre of the hall, on either side of the working demonstration area. The proportion of high-quality workmanship seems to grow every year, and has now reached a remarkable level. Other competition models, those in the aircraft sections, were displayed at the far end of the Hall, although entries of aircraft models seemed to be less than usual.

Locomotive models entered for competition did not hold any outstanding surprises. Standards were high, although some modellers who did promising work fell into error with insufficient attention to correct details and good finish. The Championship Cup for steam locomotives went to Mr. T. A. Bott, of Headington, for a fine 3½in. gauge model 4-6-2 L.M.S. "Duchess" class locomotive. Mr. P. B. Denny exhibited some model buildings from his Buckingham branch line railway to a scale of 4mm. to 1ft. Many model railway enthusiasts will be familiar with this excellent small scale layout, and these buildings had been well chosen to represent a country market town. A well-executed steam locomotive worthy of mention was Mr. J. P. Jones's 3½in. gauge 4-6-0 L.M.S. model of the "Royal Scot" class, which was unpainted and an example of well-finished, precise model-making.

Fig. 1 (Above).—A view showing central section of this year's Model Engineer Exhibition in London. The new specially-built marine tank for aquatic demonstrations can be seen at the far end of the hall. Down the centre of the hall is The Model Engineer Workshop, where demonstrations of model-building took place.

Ship Models

The competition ship models looked very impressive when viewed *en masse* and on closer inspection revealed several beautiful models of different sizes and types. An attractive selection of working model yachts and sailing ships made a spectacular display here, but many of the beauties to be found were less obvious, although no less striking to the close observer. An exceptionally good model of the famous clipper, *Cutty Sark*, with a copper-plated hull, won for Mr. A. E. Field, of Walsall, the championship award in the sailing ship class. Dr. F. Machanik, of Whitton, entered an attractive and unusual model of a Viking ship discovered at Gokstad, Norway, in 1880, the model being to a scale of ½in. to 1ft. and carefully executed.

Mr. D. McNarry's entries in the miniature marine models section were, as usual, quite outstanding. One was a dockyard model of H.M.S. *Prince*, first rate 1670. Built to a scale of 1in. to 50ft., the model represented 1,000 hours of painstaking work, resulting in a beautiful miniature replica. The second model, scarcely more than 3in. long, was of a 12-gun brig-of-war of about 1840, also to a scale of 1in. to 50ft. This model was fully-rigged and a triumph in the art of miniature modelling. Another neat, well-finished miniature was that of an Arab "Baghala," or deep-sea dhow, built by Mr. W. C. Gay of Hayes. This model, to a scale of about 1in. to 10ft., seemed to have caught something of the "regardless of time" atmosphere of the Middle East.

An excellent model in the non-working steam and motor ships class was that of H.M. Frigate *Mermaid*, shown as she was in 1943 at anchor. This was built to a scale of 1in. to 16ft. by Mr. F. W. Crudass, of Wimbledon. The model was remarkable for fine detail and finish, execution of detail work being exceptionally good. Working model steamers included many interesting exhibits and several unusually large models.

Fig. 2 (Right).—Part of the display of locomotives in the competition section of the Model Engineer Exhibition. On the left is Mr. J. P. Jones's 3½in. gauge, 4-6-0 L.M.S. locomotive.

Two-masted Schooner Yacht

SIR,—During the long evenings of last winter I made a sailing boat, as illustrated in the book edited by you entitled "Model Boat Building." It is the two-masted schooner yacht, and it turned out a great success and sails well. The accompanying photograph gives a good idea of the smart appearance of the finished boat.

During the coming winter nights I hope to make another one, using the same type of hull but finishing with a Bermuda rig.—A. V. ANSLEY (Carshalton).

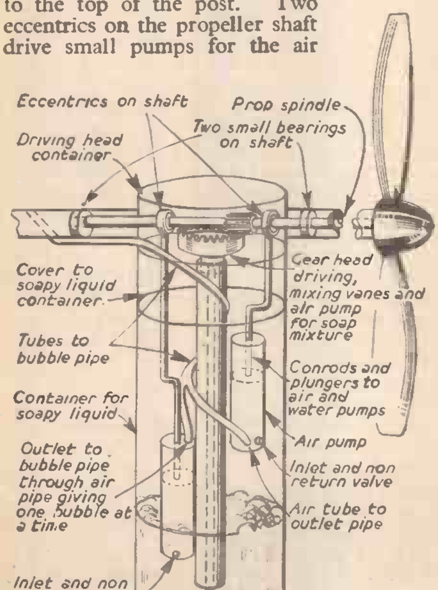
[*We would be pleased to receive from readers photographs of model boats constructed from this book.*—ED.]

Mr. A. V. Ansley with his model schooner yacht.

Bubble Weather Vane

SIR,—In the August issue of PRACTICAL MECHANICS Mr. W. E. Brown (Devizes) asks for suggestions for a bubble weather vane. He does not mention the height or size it is proposed to be, but here is a rough layout which may help him. As I am away from home I am unable to give facts and figures, but the accompanying sketch will no doubt give him some idea of the lines to work on.

A container for the soapy solution is fixed to the top of the post. Two eccentrics on the propeller shaft drive small pumps for the air supply and bubble solution respectively. Mixing vanes for the solution are driven by a vertical shaft geared to the propeller shaft, as shown.—G. E. RUXTON (Rainham).



Mr. G. E. Ruxton's suggestion for a bubble weather vane mechanism.

Steam Buses

SIR,—Your "Fair Comment" in the September issue, "Will the Steam Car Return?" brings back to my mind the National Steam Omnibus Co.'s buses that used to run through the City nearly 40 years ago. I have often wondered why this form of transport died out. I consider that at the time they were the fastest and most comfortable public vehicles on the road; you doubtless remember them. I have seen them go up Ludgate Hill, leaving the old "Generals" almost standing still!—E. O. GROSSB (Sydenham).

Experiment with a Compass

SIR,—I have read with interest the views and ideas expressed on "Perpetual Motion" and would like to submit the following.

Unfortunately, I have not much time for experimenting these days, but as a small boy I used to amuse myself with all sorts of junk that used to come into my possession, among which was a field-compass (used in World War I) and a permanent magnet.

To cut a long story short, I found that by placing the magnet in a certain position the compass needle revolved at about 60 r.p.m. Both the compass and the magnet were laid flat on the table and did not have to be manipulated in any way, and once in position the motion continued indefinitely.

The opposite pull was supplied by the magnetic pole of the earth, and I have often wondered if it is possible that there is a pulsating movement of the magnetic field of the earth.—PHILIP MOUNT (Greystones, Co. Wicklow).

Perpetual Motion Clock

SIR,—I was very interested in the perpetual motion devices described in the September issue.

A short while ago a friend of mine received a journal from the U.S.A. In it there was an advertisement with a good photo of a clock made there. It was called a "Perpetual Motion Clock." You simply place the clock on your mantelpiece, unlock its balance-wheel, and it will run *indefinitely*—without hand-winding or electricity.

The clock is powered by variations in the temperature of the atmosphere alone. I have the name and address of the makers of the clock.

With regard to the new cycle-frame design described in PRACTICAL MECHANICS, over 62 years ago I had a safety cycle having very thin tyres and a frame almost the same as the one illustrated in the September issue. If my memory does not fail me, it was made by the Coventry Machinists Co., Ltd.—S. H. MILES (Porthill).

[*The clock is the "Atmos," of Swiss manufacture.*—ED.]

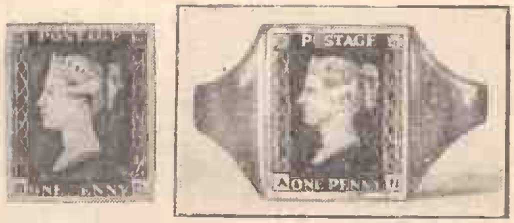
BOOK RECEIVED

Fractional Horse Power Motors. By Stuart F. Philpott. Published by Chapman and Hall, Ltd. 366 pages. Price 30s. net.

MOST electric motors used in domestic appliances, and an increasing proportion of those used for commercial purposes, are of less than one horse-power and, consequently, are known as fractional horse-power motors. There is now a large field of application and a great variety of types of these small motors, and it is the object of this book to describe the principles, construction, operating characteristics, use and maintenance of each type. Following a short introductory chapter, the book goes on to deal with practical considerations of the principal types of electric motors. Later chapters deal with the choice of motors for various uses, constructional details, testing, and radio interference suppression. The book is profusely illustrated in half-tone and line.

A Piece of Craftsmanship

ON the right is a full-size illustration of the first British Postage Stamp—the penny black—which was used to inaugurate the first "Penny Post," originated in 1840 by Sir Rowland Hill. On the far right is an enlarged view of a gold signet ring, with a vitreous enamelled replica of the stamp. The ring is owned by Mr. H. V. Howard, of the famous philatelic firm of Stanley Gibbons, Ltd. The actual ring panel is half stamp size.

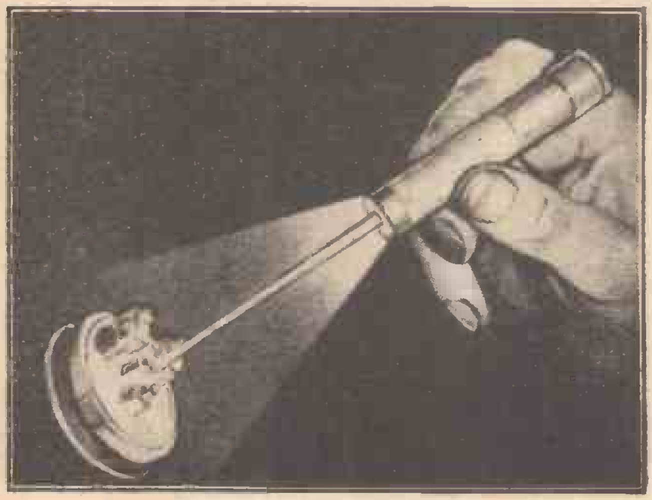


Trade Notes

A Review of the Latest Appliances, Tools and Accessories

The Spotlight Screwdriver

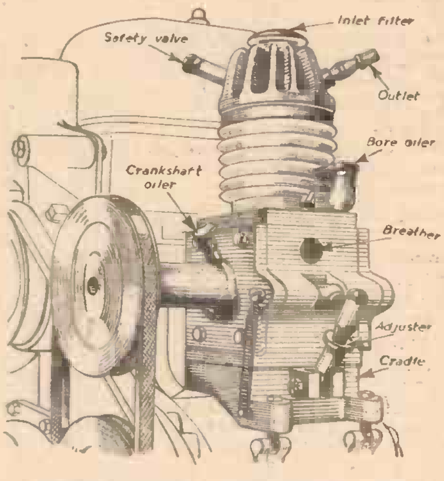
JOHN E. BUCK AND COMPANY, 47, Brewer Street, Piccadilly, London, W.1, have just placed on the market a very handy little tool known as the Spotlight Screwdriver "Minor." It is shockproof, and the ⅛in. by 2⅞in. blade, firmly set in a lens of transparent Diakon plastic, is designed so that work may be done inside radio sets or in dark corners with maximum efficiency. The light, supplied by a 1.25v. bulb, is operated simply by screwing and unscrewing the end cap. The handle houses an ordinary standard size torch cell. The overall length of the tool is 6¾in., and it retails in the U.K. at 6s. 9d. complete. All inquiries should be addressed to the firm at the address given.



The Spotlight screwdriver in use.

Mopal MO4 Compressor

THIS "heavy duty" unit, when fitted to the engine of a commercial vehicle, provides a mobile compressed-air supply for inflating tyres, spraying paint, and driving small pneumatic tools. Fitting this compressor to the dynamo takes about half-an-hour. It is belt-driven from an additional pulley in front of the existing dynamo pulley, and can be engaged and disengaged at will. The unit includes the Mopal compressor, producing 2½ c.f.m. at 1,000 r.p.m.; 30ft. of airline complete with pressure gauge; additional pulley for fitting to dynamo; and tyre valve adaptor for single and twin wheels. Total weight is 11lb. Further particulars can be obtained from the manufacturers, Overseas Engineering Co., Ltd., 194-200, Bishopsgate, London, E.C.2.



The Mopal MO4 heavy duty compressor.

"Cymota" Distribution Rights

BY mutual agreement with Blue Star Garages Ltd., Messrs. Cymo Ltd. have taken over the sole distribution rights in the United Kingdom for the sale of the "Cymota" Bicycle Engine.

To facilitate sales and service Messrs. Cymo Ltd. will in future operate from Leamington Road, Erdington, Birmingham, 23, where all correspondence and inquiries should be sent.

Club Reports

Aylesbury and District Society of Model Engineers

THE September meeting, held again at Hampden Buildings, Temple Square, was this time devoted to a model night. A good cross-section of members' work was on view, and many models showed the progress made since the last time they were shown.

We were pleased to welcome the secretary of the Luton S.M.E. with a number of his members. A pleasant time was had by all.

The meeting also decided to allow £20 to the "O" Gauge section, so that they could start building a test track as the beginnings of a lay-out. Mr. Stevens said that fine scale would be used, so that both coarse and fine scale locos and stock could be run.—Hon. secretary, E. H. SMITH, Mulberry Tree Cottage, Devonshire Ave., Amersham, Bucks.

Shrewsbury and District Society of Model and Experimental Engineers

THE annual exhibition of the above Society will be held on Friday, November 9th, 7 p.m.-9 p.m., and Saturday, November 10th, 10.30 a.m.-9 p.m. The Saturday morning opening is an innovation asked for by many visitors last year. A much increased display of working models is expected this year, and they will be situated in an additional large room.

Owing to the number of classes in the College it will not be possible to run the passenger-hauling locomotives on the Friday evening but they will be in operation all day Saturday. A further improvement on past exhibitions is that the track will be in a position where it can be seen much more easily.

Any "lone hands" who have any exhibits of interest and wish to show them are asked to inform the secretary.—W. T. HOWARD, Technical College, Shrewsbury.

Harrow and Wembley Society of Model Engineers

THE above Society held a very successful exhibition at Victoria Hall, Station Road, Harrow, on Saturday, September 22nd.

About 170 models were displayed, some from neighbouring clubs to whom thanks are due for their support, together with some excellent work by members' ladies in the handicraft section.

The standard of the exhibits was, in fact, higher than on previous occasions, and great interest was shown in the models displayed in all sections. Added interest was given by Mr. F. Cottam's dock shunting loco working under steam.

Judging took place Saturday morning and prizes were distributed in the evening by the chairman's wife, Mrs. Sedcole. Thanks were extended by Mr. Sedcole to all who had contributed to the success of the exhibition and, in particular, to Mr. S. R. Emery, the navigator of the show.

The number of inquiries made during the day would suggest that our membership will be increased in the near future. To the potential new members we offer a cordial welcome.

On Wednesday, September 26th, at Heathfield Schools, College Road, Harrow, members and guests of the Society were given a most interesting talk by Mr. Millard, chief foreman of the loco erecting shop at Swindon Works. Messrs. Millard, Jarvis and Reeves came all the way from Swindon for the occasion.

The subject was the "Building of the Castle Engines" and with the aid of many slides and a film members were able to follow the construction of this well-known class of loco from the drawing office, foundry, machine shops and final erecting shop. It was interesting to note that by careful planning, standardisation of parts, modern machines and workshop layout, the construction time had been considerably reduced. It was now possible to count this time in days rather than in weeks, as in latter years. The accuracy demanded and obtained by the use of the latest type of precision optical aligning gauges was viewed with interest.

The meeting, which was very well attended, closed with a vote of thanks to Mr. Millard and his party for the trouble they had taken to make a thoroughly enjoyable evening.—Hon. secretary, C. E. SALMON, 11, Brook Drive, Harrow.

TAKE UP PELMANISM

And Overcome Worry

WORRY uses an immense amount of vital force. People who worry not only use up their energy during the day by worrying but they rob themselves of that greatest of all restoratives, sleep. People who worry can't sleep. They lose their appetite. They often end up by getting really ill. How often have you heard it said, "I am worried to death"?

What do you suppose would happen if a person who was putting himself into mental, moral, and physical bankruptcy by worrying, were to convert all this worry energy into constructive action? In no time at all he would have accomplished so much that he would have nothing to worry about.

Nothing is more discouraging to a worrying person than to have someone say, "Oh, don't worry, it will all come out right"!

This is not reassuring at all. The worrying one can't see how it is going to come out all right. But if the men and women who worry could be shown how to overcome the troubles and difficulties that cause worry, they soon would cease wasting their very life-blood in worrying. Instead, they would begin devoting their energies to a constructive effort that would gain them freedom from worry for the rest of their lives.

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People to-day are all too prone to complain that they just have to worry. But once they become Pelmanists they cease this negative form of thought.

Remember—Everything you do is preceded by your attitude of mind.

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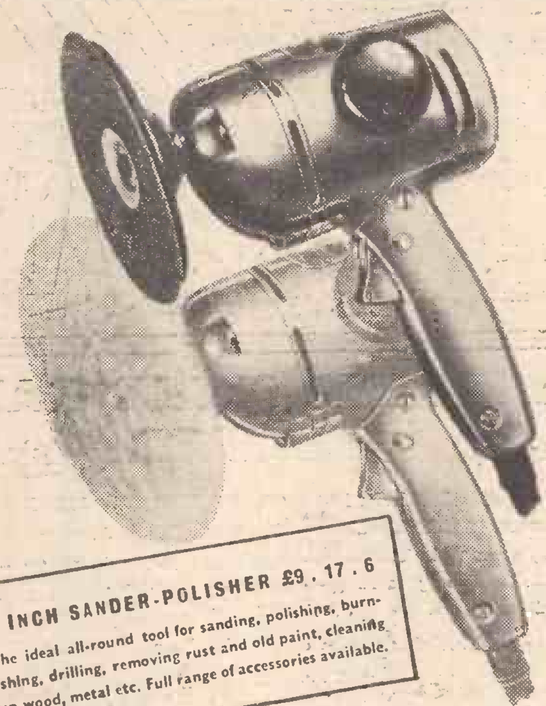

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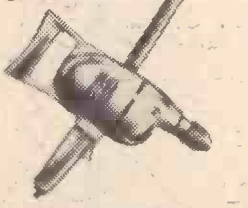
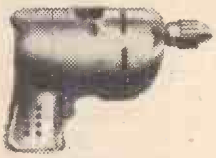
The ideal all-round tool for sanding, polishing, burnishing, drilling, removing rust and old paint, cleaning up wood, metal etc. Full range of accessories available.



½ INCH DRILL £11 . 7 . 6

Capacity in steel, ½" (up to 3" in sheet metals, using a HOLE SAW); in hardwood, 1". Bench Stand available for assembly as Drill Press.



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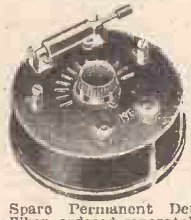

Crystal Sets. Our latest Model is a real radio receiver, which is fitted with a permanent crystal detector. Why not have a set in your own room? 10/6, post 6d. De Luxe Receiver in polished oak cabinet, 18/6, post 1/-. Sparo Permanent Detectors, 2/- each. When ordered separately, 2/6. With clips and screws, 2/10, post 3d. Headphones, brand new, S. G. Brown, G.E.C., etc., 15/-, 23/-, and super-sensitive, 30/- a pair, post 8d.

New Headphones, 10/- a pair. Balanced armature type (very sensitive), 12/6 a pair. Both post 8d. New **Single Earpieces,** 3/6. Bal. armature type, 4/6; ex-R.A.F. earpiece, 2/-, post 4d. **Headphones,** in good order, 5/6 (better quality, 7/6), all post 8d. **Headphones** with moving coil mike, 15/-. Similar phones with throat mikes, 12/6, post 8d. **Headphone Cords,** 1/3 a pair, post 3d. **Replacement Bands,** 1/3, post 4d. **Wire Bands,** 6d. **(All Headphones listed are suitable for use with our Crystal Sets.)**

Bell Transformers. These guaranteed transformers work from any A.C. Mains, giving 3, 5, or 8 volts output at 1 amp., operate bulb, buzzer or bell. Will supply light in bedroom or larder, etc. PRICE 8/9, post 8d. BELLS for use with either the above or batteries, 6/6, post 6d. **"Big Ben" Chimes.** Housed in Cream Plastic Case. Easily connected to give Two-Note Chime from Front Door, and Single Note from Rear. Operates from 6-9 volt Batteries or Transformer (shown above). 19/3, post 10d.

Ex-R.A.F. 2-valve (2-volt) Microphone Amplifiers as used in 'plane inter-com., in self-contained metal case; can be used to make up a deaf-aid outfit, intercommunication system, or with crystal set; complete with valves and fitting instructions, 20/-, post 1/8. Useful wooden box with partitions to hold amplifier, 2/- extra. Ditto, less valves, 10/-. One-valve amplifier, complete with valve, 10/6, post 1/-.

Hand Microphones, with switch in handle and lead, 4/-. Similar instrument, moving coil, 7/6, post 6d.

Sparking Plug Neon Testers with vest-pocket clip, 3/3, and with gauge, 3/6, post 3d. **S.B.C. Neon Indicator Lamps,** for use on mains, showing "live" side of switches, etc., 3/6, post 4d.

Soldering Irons. Our new streamlined iron is fitted with Curved Pencil Bit, 200/250 v, 50 watts, 10/-, post 6d. **Standard Iron** with adjustable bit, 200/250 v., 60 watts, 11/-, post 6d. **Heavy Duty Iron,** 150 watts, 14/-, post 8d. All parts replaceable and fully guaranteed. **Small Soldering Irons,** for use on gas, 1/4, post 4d. Resin-cored solder for easy soldering 6d. packets, or 1lb. reels, 6/-, postage extra.

Microphones.—Just the thing for impromptu concerts, room-to-room communication, etc. Bakelite table model, 6/9; Suspension type, 8/6. Post 6d. **Mike Buttons** (carbon), 2/-. **Moving Coil,** 4/6; **Transformers,** 5/-. All post 4d. each.

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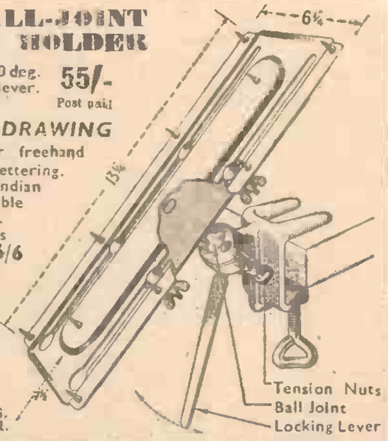

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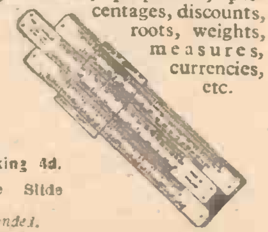

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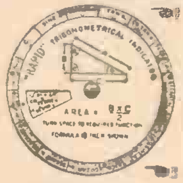

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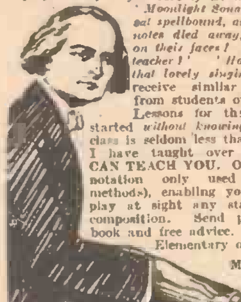

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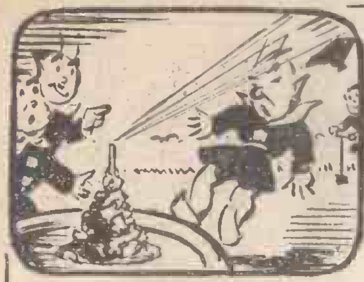

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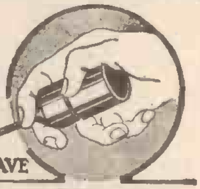

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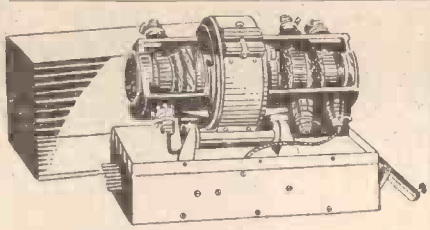

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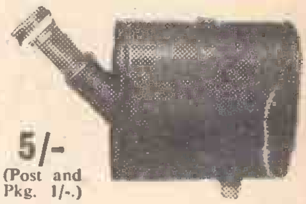

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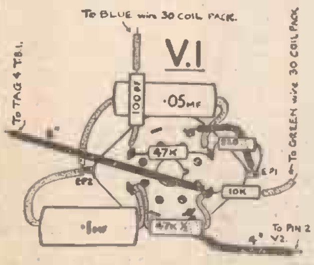

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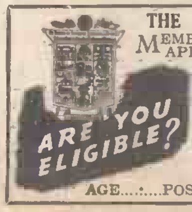

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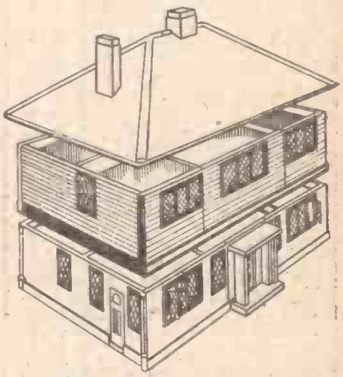

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THE Cyclist
Editor: F. J. CAMM
VOL. XX NOVEMBER, 1951 No. 354

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

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Comments of the Month

N.C.U. COMMITTEE FAVOURS MASSED START!

Our Policy Vindicated!

By F. J. C.

FOR ten years we have supported massed start racing against the opposition of the N.C.U. and the R.T.T.C., both of whom have been relentless in their efforts to get it stopped. We have suggested (what we know to be a fact) that the real motive behind their opposition has not been that massed start racing is dangerous, nor that the M.O.T. might abolish all road racing, including time trials, but that this form of racing would eventually oust time trials and track racing.

If we can judge from recent events our forecast has been very accurate. We must refrain from commenting on the recent R.T.T.C. Bulletin because we understand that it may form the subject of litigation.

We do know, however, that the membership of the N.C.U. during the past year is down by several thousands and that the membership of the British League of Racing Cyclists has increased. If any justification were needed for the rectitude of our policy it is provided by the N.C.U. itself. **After ten years of propaganda against the B.L.R.C. its diminishing membership has forced the National Council to accept a report on road racing submitted by one of its own committees. This report is indeed a surprising document because the case against the B.L.R.C. has been centred around the danger of this form of racing and defiance of Government authority.**

The two most cogent parts of this N.C.U. Committee's report are as follow:

"*The very departments (N.C.U. departments) that in the past have issued statements and directives relating to such events, and have expressed views against them, appear to have no hesitation whatever in endorsing the action of the various police authorities in rendering every facility to the promoters.*"

"SECONDLY, WE HAVE YET TO RECEIVE EVIDENCE THAT SUCH EVENTS CONSTITUTE ANY DANGER TO EITHER RIDERS OR PUBLIC."

The National Committee has accepted this report and an interesting situation arises, as is disclosed by the following letter which we have addressed, at present without reply, to the Secretary of the National Committee on Cycling.

"Is your committee going to consider the new situation created by the report of the N.C.U. committee that there is no evidence to support the oft-repeated charge that mass start racing is dangerous? This committee repudiates previous N.C.U. policy on mass start racing. The N.C.U. is represented on your committee and which has on many occasions expressed views against mass start, and recently turned down the League's application to be represented on the National Committee of Cycling.

You will agree that the position of the N.C.U. in this matter is farcical and the proper course is for it to resign from the National Committee of Cycling."

Now the suggestion is being made that the N.C.U. should run its own massed start racing and ignore the League altogether, hoping by this means to kill the League, and after a short spell of promotions, massed start itself.

The N.C.U. has in a letter to all centres advocated road racing on open roads in diametrical opposition to all their previous statements, and in spite of all their previous efforts to have League activities proscribed for doing just that. It will be interesting to see where we go from here.

That all is not well within the ranks of the N.C.U. is obvious from the fact that a meeting between the B.L.R.C. and the N.C.U. recently took place at the N.C.U. offices with the object of endeavouring to find a formula acceptable to both sides which would establish unity. The meeting was highly confidential. *Yet the N.C.U. Committee was guilty of breach of faith in publishing the agreed confidential report.* This is what the B.L.R.C. said in reply:

"The B.L.R.C. Committee view with concern the fact that the report emanating from the N.C.U. Committee relating to the recent N.C.U.-B.L.R.C. meeting to discuss unity, has, as one of its signatories, Mr. Edward Anderson, who, in fact, was not at the meeting. The B.L.R.C. Committee consider that a definite breach of faith has been brought about by the publication of this report, and that further the minutes of the meeting in question should be published; these minutes were jointly compiled by Messrs. R. P. Itter, N.C.U., and W. C. Rains, B.L.R.C. The B.L.R.C. Committee state that in the interest of the sport nationally, and to safeguard road sport as a whole, the control of road racing should remain in the hands of the B.L.R.C., who have proved during the past 10 years that with the "know how" and a competent organisation built around rules developed during this period, road racing in this country is possible as is proved by the undoubted success of the recent 'Tour of Britain.' The *Daily Express* have confirmed their intention of sponsoring the 1952 'Tour of Britain,' which will again be organised by the B.L.R.C. The B.L.R.C. Committee are of the confirmed opinion that the solution to the troubles confronting N.C.U., B.L.R.C. and R.T.T.C. can best be found in true unity, by the mutual recognition of each other; the N.C.U. to control Track and Circuit Racing, the B.L.R.C. Road Racing, and the R.T.T.C. Time Trials."

What chance is there of achieving unity when confidence in the early stages of discussion is so flagrantly set aside? The N.C.U. finds itself between Scylla and Charybdis. It is rapidly going down the hill to self-destruction, and it has only itself to blame. Its methods in the present case are typical of those which it has adopted for the past 50 years and which has earned for it the title of "The Apostle of Lost Causes." In view of the charge which the League has levelled against it, we cannot see that any useful purpose would be served in a continuation of the discussion.

The N.C.U. is obviously a body in which confidence cannot be placed.

This pleasant little town is an ideal centre for tours of the lovely Dove and Manifold Valleys

BENT CRANKS AND PEDALS

Hints on How to Straighten Them

If a cycle skids and throws the rider, or if a pedal catches the kerb or a hard bank or other obstruction, there is a probability that a pedal spindle may be bent or a crank bent or twisted. However small the amount each is put out of alignment the rider will feel it at once when commencing to ride again.

Knocking at pedals or cranks with such heavy stones as may be available is likely to cause trouble. In the case of a bent crank, it may well lead to broken balls in the bracket bearing—and even to broken cups—since attempting to hammer or bend a crank while attached to the axle puts a dangerous strain on the bearings.

It is possible, in this case, to remove the crank, and if the bend is very much it will often be found that the crank can be put on the bracket axle wrong way round and the bend will then be outwards; the chain or stay will be cleared and the machine can be ridden. The boss of the crank will overhang the end of the axle, so the rider will have to avoid getting his ankle near it, and the pedal will " wobble " and be uncomfortable, but the machine can be ridden, and that is the essential thing for the time being.

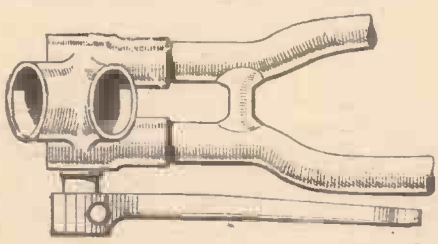


Fig. 1.—The bent crank in its new position after reversing.

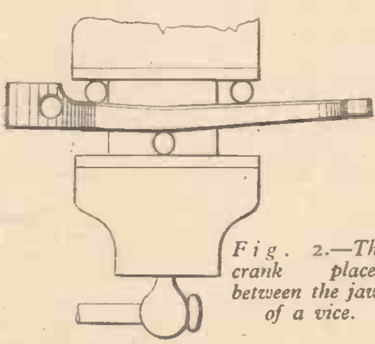


Fig. 2.—The crank placed between the jaws of a vice.

Fig. 3.—Testing the crank for straightness.

Fig. 1 shows the bent crank in its new position. It looks bad but it is rideable.

A vice should be used to straighten the crank when the facilities are available. The crank should not be hammered back with a hammer, as it will spoil the plating and make a "bodged up" job of the repair.

Lay the bent crank between the jaws of a good strong vice as shown in Fig. 2. Three pieces of soft iron bar (even a big nail will do if a piece of bar is not handy) should be placed as shown. Those on the face of the crank may have a small piece of brass strip (even a worn halfpenny will do) placed between the crank and the nail or bar. This will prevent the nails or bars indenting the plating, and the vice should then be tightened up.

It may require a piece of gas barrel on the vice tommy bar or handle to give sufficient leverage to bend a tough crank, and if this is found to be the case, the crank should be heated at the bend with a blowlamp. A heat below red will be enough and will not cause the plating to be damaged, although good plating will stand a red heat and polish up again well after cooling. But plating varies, and it is well to be on the safe side. On the other hand, if the bend is pronounced it may be unsafe to try to bend it cold, since some toughened cranks once bent are a little brittle at the bent part and may snap.

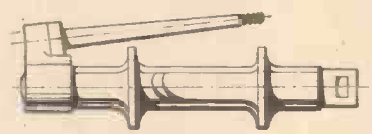


Fig. 4.—The pedal spindle screwed in from the back.

Do not grip the crank by the small end in the vice and try to hammer it back to the straight position. It will bend in the wrong place, and the ends of the thread for the pedal spindle may be damaged. To test as to where the bend really is—and it is not always easy to see it exactly—lay a straightedge (steel rule) along the face of the crank as in Fig. 3, and the position of maximum curvature becomes at once apparent, as shown.

The impact of a fall is generally taken by the pedal. In such cases the crank will be twisted as well as bent. Fit the bracket axle in the big end of the crank, and screw the pedal spindle in from the back, as in Fig. 4, and sight down along the crank. The twist will be at once apparent as seen in the sketch. Notice where the twist is and hold the small end of the crank in the vice (in brass clamps, A, to avoid plating damage) and with a bar, B, fitting the axle hole in the big end of the crank, pull it round as shown by the arrow in Fig. 5, heating the part at the twist, C, with a blowlamp. This can best be done after the bend in the crank has been taken out.

A bent pedal spindle is somewhat difficult to straighten successfully on account of its being tapered in section. Take off the pedal by releasing the end cone, and screw the spindle in the crank, which should be taken off the bracket axle to act as a lever. Then,

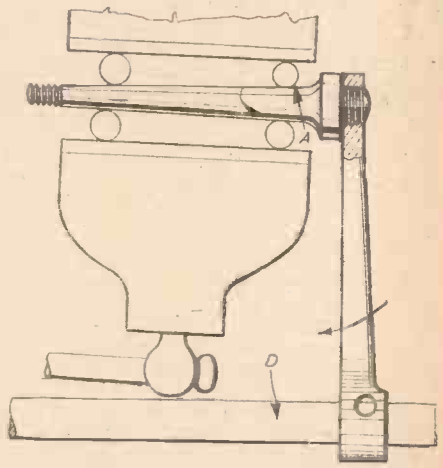


Fig. 6.—Straightening a bent pedal spindle in a vice.

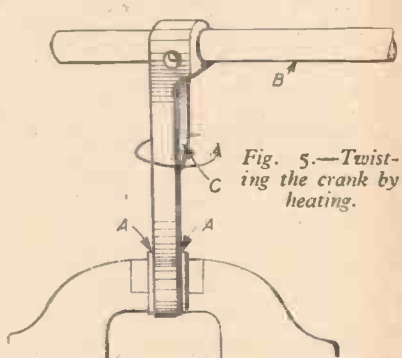


Fig. 5.—Twisting the crank by heating.

Fig. 7.—A bent pedal spindle.

using nails or iron bar (½in. bar is the most suitable) hold the spindle in the vice as shown in Fig. 6, and pull on the crank in the direction shown. To get a good leverage a bar, D, can be put through the axle hole in the crank. There is no great risk of bending the crank if the pedal spindle is heated with a blowpipe at the place where it is bent. But it is well to ascertain the exact spot, or a bad running pedal will result if bent anywhere else. To do this use a small straightedge laid along as shown in Fig. 7. A longer straightedge would not be suitable because the parallel screwed end of the spindle would lift it out of contact with the taper part as shown in Fig. 7, and no indication of the position of the bend could be obtained.

If a pedal spindle is bent right in the ball race at A, Figs. 6 and 7, it is almost impossible to bend it straight enough to ensure the ball bearings being parallel with each other, and if heated on the ball race, the latter will be softened and the bearings wear badly. By far the best way, in such a case, is to buy a new pedal spindle.

Some Points to Consider

By "PEDRO"

WHEN making a decision regarding a cycle frame size remember that the smaller the better. A small frame is not only stronger and more rigid, but naturally a little lighter. Many cyclists think that they should have as large a frame as they can manage, but this idea is wrong.

I remember a man ordering a 23in. machine, eventually receiving a 22in. in mistake. He took it back after a few days, and all the explaining in the world could not convince him that he could obtain identically the same position on the 22in. as the 23in. It is sometimes erroneously thought, especially by beginners, that a small frame makes it easier for the rider to reach the ground, but it is simply the distance the saddle is from the ground that makes that possible or not, irrespective of anything that comes between them. Large frames have their advantages, one being that a few extra inches on the seat tube make the same increase on the head, and a long head makes for easier steering.

I do not want readers to think that I recommend a 19in. frame for any-sized rider; as a matter of fact, I do not advocate the use of 19in. frames at all, but I do say the "smaller the better," taking into consideration the fact that the seat pin should not extend much more than 5in. or 6in. otherwise the advantage gained by the more rigid small frame is lost in the whippiness of the seat pin and handlebar stem.

"Whip"

This question of "whip" (flexibility—give—call it what you may) is an important one, for it is not nice to know that the energy you put into the machine to propel it is being partly absorbed by the frame. Laterally the frame must be rigid.

If you put your weight on one pedal with the crank in a downward vertical position, you will probably notice, at least "feel," the bracket portion of the frame give towards the opposite side and it can be easily understood that if this swaying to and fro occurs every time pressure is placed on the cranks, no matter how consistently steady this pressure may be, a certain amount of energy is consumed—therefore part of the energy expended by you to drive the cycle forward is used for a futile purpose.

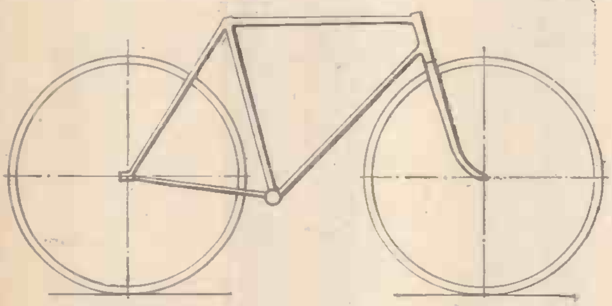
The same thing may happen in the rear triangle of the frame, every thrust will spring the rear stays over towards the right-hand side, and besides driving power being lost in this flexibility the rear wheel is momentarily out of line, causing a still further wastage of power.

Chain Stay Design

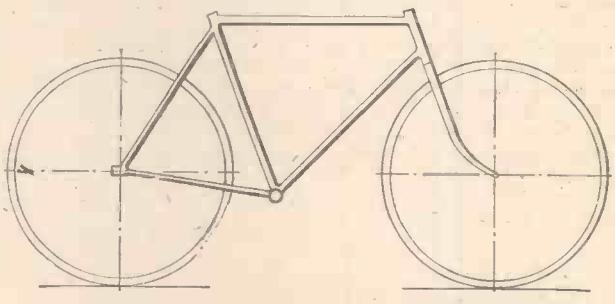
Makers have overcome this "whip" to a certain degree by using straight chain stays instead of cranked, round section instead of D-shaped or oval. One maker uses square section stays; another markets a frame that has pressed-steel of channel section tapering in width and being larger at the bottom bracket end; while still another uses round tubes that taper; and recently a fourth manufacturer of lightweight machines has designed a tube that is increased in diameter half-way along its length.

The designing of a perfect laterally rigid frame is far from an easy task, for the designer knows that vertical resiliency is an attribute to perfection.

The wheelbase of a frame is the distance from the centre of the front hub axle to the centre of the rear (when the axle is in the centre of the rear fork-end slot). The measurement from the front fork-end centre to the centre of the bracket axle should not be less than 24in. for an ordinary road machine with 26in. wheels, mudguards and 6½in. cranks, otherwise there would be insufficient clearance between pedal and mudguard when the pedal is in a position nearest the guard. Naturally, if 27in. wheels are used this distance must be increased by 1in., and it can be reduced by 1in. if guards are going to be permanently dispensed with, increased if the machine is to be fitted with 7in. cranks, and so on. If 13in. is allowed for the radius of the front wheel, 1in. clearance for the mudguard, 6½in. for crank and 1¾in. for pedal, 24in. will only leave 2¾in. for the toe to extend over the pedal, only just about sufficient for a rider with a normal-sized foot to enable unhindered steering.



(Left) An upright short wheelbase model of the same frame height as the machine shown on the right and measuring 40in. between wheel centres.



(Right) A normal model with a 20 degrees rake and 42½in. wheelbase.

Seat Tube Angles

When we come to the length of the rear chain stays, the question of seat tube angles arises, for the more upright this is, the shorter the back can be. If we take a frame with a 71 degree seat tube, the chain stays cannot be less than 16½in. (measured bracket centre to centre of rear fork-end slot), allowing for mudguard clearance and 26in. wheels, otherwise there will not be sufficient clearance for the mudguard between tyre and seat tube. From these dimensions it will be seen that 40½in. is the minimum safe wheelbase (but not necessarily the best). In reality it would be slightly less than 40½in., as this total was obtained by measuring from the front fork centre down to the bracket, and up again to the rear fork-end centre, whereas, as already explained, wheel-base is correctly measured in a straight line.

Short wheelbases may be faster on hills or perhaps we should say machines with short backs make hill climbing easier, they may add in a very small measure to the rigidity of the machine, and make it "lively," but comfort must be considered, and as the disadvantages of an extraordinary long base are obvious, the happy medium must be obtained. A clubman's lightweight mount suitable for all-round usage—touring, club riding, racing, etc.—should have a wheelbase of about 41½in., a machine solely for road racing about 40in., while a roadster for town and business riding can be anything round about 44in.

Frame angles have been the subject of some experimenting and alterations have taken place during recent years. The head and seat tube have become more upright—a step, I consider, in the right direction, and I see little reason why seat tubes should not become more upright still, so that when a straight seat pin is used the saddle is in the correct position—the peak a few inches behind the bracket centre.

A head of about 74 degrees can be regarded as suitable, and although a little more upright may slightly improve steering, it will also tend to increase the amount of vibration that reaches the rider, and I do not think we have much to complain about with regard to steering, anyway.

Steering

It might be borne in mind that an upright head needs a resilient fork, in order to absorb some of the road shock, for the difference in riding a cycle with 74 degrees head and then one with 68 degrees both with the same design forks is apparent. The recent change in frame design calls for the designer's attention to front forks.

A bracket height at 10½in. is fairly standard with the usual type of machines, and this gives about 3¾in. clearance between pedal and ground (with 6½in. cranks), and allows the machine to lie over at an approximate angle of 64 degrees (with ordinary rat-trap racing pedals) before the pedal touches the ground, and it might be mentioned as a warning, that with an obstruction such as a kerb or roadside verge of 3in. the machine will only lie over at approximately 85 degrees (only five degrees from upright).

Around the Wheelworld

By ICARUS

C.T.C. Presidency

I HAVE received the following letter from W. M. Robinson (my old colleague, "Wayfarer"):—

"What is wrong with the Cyclists' Touring Club? It is known to a small circle of people outside the Council and Headquarters officials that Mr. Frank Urry, who was elected C.T.C. President at the beginning of 1951, suddenly resigned that office a few months ago. More than that Mr. Urry simultaneously broke his long connection with the club by relinquishing his membership and returning the gold badge which was presented to him on the occasion of his election as an honorary life member. Further, he sent back to Craven Hill the medallion (the Alfred Bird Memorial Prize) awarded to him for 'the most signal service' to the club. I have been told the reason for this most drastic action on the part of Mr. Urry, and I applaud him for his courage. I understand his attitude, but I do *not* understand the attitude of the C.T.C. Council in deciding that these facts are not the concern of the membership, from whom they have therefore been carefully concealed. Is this policy of secrecy fair and just? I do not think so."

I believe I have the facts of this case, and I feel that it is in the best interests of the C.T.C. membership that they should be known. I know that my old friend Frank Urry would prefer to be self-effacing on the subject, so I invite the C.T.C. to tell the facts to its members, rather than it should go to them through a statement in the Press. If they have nothing to hide or hush up there is no reason why this should not be done.

It surely must be a matter of vital interest to members to know why a president, with a life-long service in the interests of the C.T.C., should resign in this way.

A Legal Point

IF a club is unincorporated, that is to say it is not registered as a company like the North Road Club, Limited, or the Bath Road Club Limited, it cannot sue or be sued as a club because it is not a legal entity. This does not stop anyone, of course, who is a member of the club from bringing an action nor does it stop individuals of the club being sued. Damages awarded in any such action would be against the individual or individuals. Of course, threats of litigation are rare in cycling circles, but it is conceivable that circumstances might arise where writs could be issued. That is why I strongly advise large clubs to become incorporated. The B.L.R.C. should certainly do so.

A New Bicycle Frame

MR. G. E. W. HICKS, of Cyprus, who has had over 55 years of experience as a cyclist, writes to say that he thinks the standard type frame is quite unsuitable for modern road conditions, where it is imperative that all types of rider, male and female, should be able to put one foot on the road in a traffic stop without risk of trouble or dismounting. With the present pattern frame, he says, there is a tendency for one's toes to foul the front wheel mudguard when steering in awkward or bumpy situations. This, he says, could be avoided by the fitting of a smaller front wheel of about 20in. diameter which would permit a large size carrier to be fitted to the handlebars!

He says the shaft drive is a good idea, but wants to dispense with the rotary chain wheel drive entirely, and fit a lever drive with direct up and down leg movements, as in some of the early machines.

I am sorry that I do not agree. The smaller front wheel would follow the smallest depressions in the road and result in a very bumpy ride. I should dislike my machine to resemble a tradesmen's carrier. Also, the direct up and down movement of the leg is not an improvement on the rotary motion.

I agree about shaft drive, but the chain and chainwheel has the essence of simplicity, and after over 50 years of testing has proved entirely satisfactory and nothing has replaced it. F.N. some years ago marketed a shaft driven bicycle, but it was not popular, although it was better than the chain and chainwheel on hills. One had a feeling that every ounce of effort was being used.

Tax on Touring Bags

THE President of the Board of Trade, at the moment of going to press, has promised to give sympathetic consideration to the request of the National Committee on Cycling to reduce the purchase tax on cyclists' touring bags from 66⅔ per cent. to 33⅓ per cent., pointing out that the touring bag cannot be regarded as a luxury, that it is, in fact, in the same category as the brief cases and school bags from which purchase tax has recently been wholly removed.

Touring bags are largely used by workers carrying their lunch to work, and they cannot, therefore, be regarded as luxury articles. Current increases in the price of raw materials have affected the incidence of the purchase tax. For example, the retail price of 14s. for a touring bag last December had increased by 1s. 6d. in January, sending up the purchase tax from 5s. 11½d. to 6s. 7d., or a total increase to the user of 2s. 1½d.

At the same time it should be remembered that purchase tax is not decided by whether goods are luxuries or not. Many necessities carry purchase tax, such as ordinary clothes.

The Cycle Show

MR. ANTHONY EDEN will open the Cycle and Motor Cycle Show on Saturday, November 10th. All the space at Earls Court has now been booked by 28 manufacturers of bicycles, 33 of motor cycles, 120 of components and accessories, and 7 of tyres.

A Demonstration of British Superiority

A TRIUMPHANT achievement—4,000 miles actually cycled in eight weeks has proved beyond any possible doubt the outstanding superiority of a new all-British cycle tyre and a new British cycle of all-welded construction. Approximately half of this great mileage to Lapland and back was through country where cycling is generally deemed to be impossible.

Why the ride took place is interesting. Feeling that the age-old reputation for supremacy in quality of British goods is in danger of becoming seriously diminished by the apparently growing tendency for the public to demand cheaper and ever cheaper products, the John Bull Rubber Co., Ltd., of Leicester, decided to design an entirely new cycle tyre (the New Service) embodying in its make-up the very best ingredients that money can buy as well as the finest degree of British craftsmanship. This with the idea of teaching the British public that it genuinely pays to disburse that "little extra" in price which provides that "great deal more" in the way of reliability and good service, making the dearer product by far the most economical investment. When the first specimens of this new tyre came off the production line, it was felt that here was a product in which implicit faith could be placed, and this faith resulted in the makers inaugurating the trip to Lapland and back, they being assured in their own minds that the tyre would withstand the greatest gruelling which could be devised—and certainly the route selected has provided the most arduous conditions possible.

The Enfield Cycle Co. Ltd., of Redditch, having recently produced a new bicycle of all-welded construction, felt that the Lapland and back ride afforded an excellent opportunity of subjecting their new product (the Enfield "Bullet") to a test which would speedily reveal any weaknesses both of construction or design, and thus that firm joined up with the John Bull Company's venture.

The riders left Leicester on Saturday, July 21st, and returned on September 15th to Northolt Airport, after having travelled by air from Brussels.

John Howard Davies, boy star of the British film, "Tom Brown's Schooldays," gets his new B.S.A. Gold Vase from Mr. S. P. Digby, B.S.A. Sales Director, at the B.S.A. London depot.

Wayside Thoughts

By F. J. URRY

The lane to Plaish.

An evening scene by the main road near Newport, Isle of Wight; milk waiting to be collected from the farm.

Personal Adventure As Proof

PROBABLY before these notes appear we shall have had news of the riders making a Lapland journey on behalf of the John Bull "New Service" tyre, the Enfield welded frame bicycle and the Cyclo Gear Co.'s products. The three riders are Wally Summers, the well-known professional; Richard Cockburn, of the Beckenham Cycle Works, and Stephen Smith, of the Balham Cycling Club, none of them youngsters, but each competent tourists, and they need to be, for the trip has certainly entailed some vigorous riding over the roughest of tracks. What a chance for the adventurous, and how I wish the years had not excluded me from participation in such a round of 4,000 miles. It will be useful to get the full story of this trip, for to-day there are not enough trials of this nature to emphasise the quality of the bicycle and its components. Primarily, I suppose, the idea is to test the values of the "New Service" cover just marketed by the John Bull Company. It looks a good tyre, and seems to fill a need of something between the light cover and the generally named roadster type. It is light for its build, resilient, and, as far as I have tested it to date, speedy, and if it stands up to rough usage then I feel it will find a place of favour among touring riders, and fellows like me who want a cover that will stand up to town work and granite setts without sacrificing the liveliness of the open-sided breed. The Enfield welded frame will surely have something to put up with, as will the Cyclo gear with the ultra-low range in operation over very many miles of the trip. Personally, I shall be interested in the report, knowing the tyres, the gears and the bicycles, as well as a couple of the riders. It is refreshing to feel that here is a touring test quite apart from speed; far too much emphasis has been laid on the latter and too little on the former. After all we are mostly utilitarian and touring cyclists, and the purely racing machine and its equipment must always be modified for our comfort if we are to enjoy the pastime thoroughly.

How Folk Think

SOME people need a lot of convincing. My daughter was telling friends of her Irish experiences of June last, how we fared, and all the little adventures of wheel travel, and when I arrived on the scene one of the party was voicing the evident thoughts of other folk present by saying: "But you didn't really enjoy it in the same manner as if you had gone by car?" My companion was quite dominant in her rebuttal of the suggestion, saying the satisfaction of "doing something" was not the only thing that mattered, because you went slowly enough to really see and hear and smell, and it was never any difficulty to stop and stare. And therein I think she epitomised the telling difference between cycling and motoring. The latter had lost its adventure by becoming almost impervious to incident in its performance, you just change the gears; but the bicycle has never become so routine a thing because it still responds to the mood of the rider, the joy of the long glide, the satisfaction of the long climb, the comfortable feeling that you can always take a wayside rest, linger as long as you like without imposing impatience on anyone, and remember there is always another day to come and possibly another chance to travel this way again if there are corners left unexplored. You can, of course, do all these things when motoring, but curiously enough you don't; it always seems that the introduction of manufactured speed performs some operation on the brain to make the whole body "want to get on with the job." I've noticed it time and again in my own case and rather marvelled it should be so. A holiday, especially a touring holiday, ought not, it seems to me, to be run to a schedule, it savours too much of work and output. Have an outline of travelling intention by all means, but to follow slavishly a detailed route irrespective of weather, wind or mood is partly destroying the very freedom of cycling. I know my motoring friends won't agree, but then I don't expect them to, so few of them to-day have any experience of cycle touring in the kindly leisurely fashion of getting anywhere anytime. My companion was right in her diagnosis, there is much more in it than merely riding; that is the physical part of it, but the atmosphere of the pastime is something inexplicable, and each of us must create our own and learn to be worthy of it.

Can They Return?

I'VE been riding to work now for over fifty years, most days and changing my route occasionally as the mood dictates. And I suppose the habit is now so fixed and comfortable that I shall go on to the end of the story. The fact that I need not do this daily ride merely makes me conscious of how good it is for me, this morning and evening exercise of seven miles, fresh in the beginning of the day, and a real refreshment of the mind and spirit when working hours are over. To-day it is not fashionable for men to ride to work if they can afford other means of travel, and from my daily observation, very few do. And that is a pity, for verily I believe if more folk made the effort into a habit we should be a happier, sunnier and more healthy people. It used to be so before the coming of the car. The carriage folk, as they were called in those days of long ago, rode bicycles to their offices and never gave a thought of doing otherwise unless the weather was abominable. But if you mention such things to-day to folk in similar positions, saying how good it would be for them, they look horrified and wonder what kind of a fanatic they have happened against. Personally, I take it all in good part, and because people have become used to me, am accepted for what I am and represent, and sometimes shyly and almost secretly told I am the wise one among them with courage to back conviction. That, I think, is the trouble in these times. There exist certain people who still think the bicycle is sort of exclusive to the poorer among us, and therefore you ride one at your social peril. It is a curious slant of mind—if indeed mind has anything to do with the matter—but it exists and persists, often on the ground that a car is indispensable which, of course, is nonsense, but very easy and comfortable to believe. I can do my business with the aid of a bicycle and enjoy both better; people have become used to my method and as many praise as blame it. What a fine thing it would be if more folk practised the economy of which they prate (to other people) by riding a bicycle.

Reasons Why

MAYBE that is a harsh judgment, and in any case it is wishful thinking, not so much because I want to see it happen as the values it would give to the folk sound enough in body and mind to break modern convention. Far too many people look upon cycling as a game for the young —and impecunious; a man is a fool to ride a bicycle if he can afford a car. It is all a matter of opinion, and the latter notion is voiced often enough without any slightest proof of the health values of cycling, but the easy way wins by the supposed superior status of the motorist. I am not trying to be cynical, but because I fit into the category of the fellows who can afford motoring, it is as well to give the other side of the picture and to make it as positive as I can. The man who is rising to the three score years is the very type who, physically, needs cycling to preserve his youth, his activity and—very importantly—his relationship with simplicity. It is a time of life when folk are apt to coddle themselves, wrap themselves in their years and say in effect, "all that is behind me." So it may be if the object of retaining a modicum of activity was related to the really strenuous games, but in this case it isn't, for that is one of the blessings of cycling, you can make it fit into your fitness and still retain all the joy of it except speed. Indeed, I think my kind of riding to-day is the very epitome of travel freedom, for I don't *have* to get anywhere in a given time, I just use the measure of minutes to enjoy the travel thoroughly, chew the cud of its delights and come to my inn wherever it be with a full sense of satisfaction, and a desire for many more such journeys. It is a way to make life linger pleasantly along the road of easy activity, and you can go on doing it a very long time without breaking down the marvellous machinery of the human body. That is my experience and, believe me, it has been and is a very pleasant one. It is just a case of nursing a mood and using the right type of bicycle, the rest is a matter for your own experiment.

CYCLORAMA

By H. W. ELEY

GORDON RANDALL

Buttermere

The lovely setting of the old Victoria Inn nestling between the mountains at the head of the lake. Written over the doorway of a room on the ground floor is the following " The name of the Bridge Inn was changed to the Victoria in compliment to her late Majesty and the Prince Consort when they were being entertained in this room.

November Days

NOT many writers sing the praises of November; most folk associate the month with fogs, and drear days, and sodden fields and gardens. But the sun *does* shine in November, and there are November days when it is good to dig in the garden, and listen to the cheery song of the robin . . . that cheeky, friendly bird which will almost perch on your spade as you leave it in the good earth, while you stretch your back, and light a pipe, and sniff the goodly aroma of the bonfire you have lit on the rubbish heap. And November has its picturesque patches . . . the month ushers in all the panoply of the hunt, and one morning, as I potter in my garden, I see the hounds streaking across Fradley Bottom, and catch a glimpse of pink coats by the ridge of trees at Knighton End. Also . . . November brings a special joy to the youngsters, for is it not the month of crackers, and Roman candles, and " silver cascades " and streaking rockets, and Catherine wheels? Here in my village, no small boys trundle around with a rag-effigy, and ask " Penny for the Guy, sir ? " But " the Fifth " lives on, and the village shop has its quota of fireworks in its small bow window. . . .

A Very Fair Policeman

I HAVE not in mind a " blonde bobby," but a " man in blue " I know in this pleasant countryside, and with whom in off-duty hours, I sometimes sip a tankard of ale, and discuss all sorts of topics, ranging from apple-stealing by small boys, to the merits of Ayrshire cattle as against Shorthorns, to the quality of the Vicar's last sermon . . . and the other day, we got on to the subject of road accidents. Now, everyone knows that the poor cyclist gets more than his fair share of blame for accidents, and it was refreshing to me, therefore, to hear my policeman-pal defend the cyclist vigorously, and give it as his firm opinion that cyclists were good and careful road users. " Some folks have nothing but bouquets for the motorist, and brick-bats for the cyclist," said my friend. " I speak as I find, and round here, cyclists know how to ride, and they know the rules of the road." How good it sounded! A champion of the cyclist at last!

King Winter—and the Bike

MUDDY roads, the little lanes rutted, snow threatening from the grey skies . . . and it is high time to give the old bike its winter overhaul; to attend to all the little matters which affect one's pleasure and comfort in winter riding. But how sadly some machines are neglected! How hard riding is made when regular cleaning and oiling are not the order of the day! When it rained all morning recently, I devoted the time to a " clean-up," and am repaid by sweeter running, and a new pride in my bike. And bearing in mind the flinty Derbyshire roads and lanes, I have fitted new tyres. So when the winter sun shines through the bare trees, and the winds have dried that mud away for a November ride to the Weaver Hills, where Staffordshire shows her happiest smile, and proves that, like Durham, she is not a shire of nothing but pit-banks and the ugliness which comes from the presence of King Coal.

Which Town Has Most Cycles?

IN all the analyses and returns which are produced to-day, and in spite of the prevailing passion for statistics, I never seem to have seen any figures indicating which town in England, in relation to its population, has the most cycles. I discussed this question with some cyclists the other day, and one gave it as his opinion that Cambridge would " top the list." I wonder ? One does get the impression, when in Cambridge, that it is indeed a town of bicycles, but then, the bike is in much evidence when the colleges are in term, and I think one might get a false impression.

" Stately Homes "

HERE in Derbyshire, one is near to some of the finest and most impressive of the old " stately homes of England," and a few weeks ago, I visited Chatsworth, when it was possible to wander through the grounds, and tour the house. What splendour is there, and what treasures of art, and sculpture, and period furniture! The corridors and spacious rooms speak of a glorious past and of ducal magnificence! No " great house " I have ever seen compares with Chatsworth for size, beauty, and treasures not even near-by Haddon, still basking in the romance of Dorothy Vernon and her elopement; not Hatfield, where the epic story of the Cecils lives on. Chatsworth is unique, and as I wandered over its velvet lawns, and gazed at portraits of bygone Dukes of Devonshire, and mused upon all that the great mansion had witnessed through the years, I felt that there was something to be said for the magnificence of the old days —something to be defended in wealth and privilege—for this wonder house gives its grace and beauty to all. I felt glad that the toilers from the Potteries, and from the " satanic mill towns " of Lancashire, could bask in the loveliness of Chatsworth, see its treasures, even if the big red and cream coach would soon whisk the sight-seers back to Stoke, or Wigan, or Ancoats, or Burslem. I cycled home through the dusk, with the owls haunting the air with their mournful calls, and many a scared rabbit dodging across the road, bemused in the beam of my lamp. And, abed early, it was not of Chatsworth and ducal splendour that I dreamed, but of bread and cheese and beer at a wayside inn called " The Dog and Pheasant."

Delights of Durham

I RECENTLY received an interesting letter from an ardent cyclist living in County Durham (at Tow Law to be precise) and he is sad because never, in these rambling notes, have I referred to his " native heath." As he rightly points out, Durham is not a land of " pit-heaps and dust," but, in parts, a land abounding in glorious views and unspoilt beauty. Actually, I never did regard Durham as black and forbidding, and I do recall that many years ago, on my return from a Scottish tour, I saw glimpses of some of the beauty of Durham. It is evident that my correspondent from the north has " an eye to see and a heart to understand " and I like his intimate descriptions of some of the scenery which is, so to speak, on his doorstep. He quotes the goodly scenery which there is from Witton-le-Wear, through Wolsingham, Stanhope, and St. John's Chapel . . . to Wearhead. Green and golden fields . . . purple moors . . . graceful pines and silver birches. He refers to the three " burns " which feed the Wear . . . Killhope, Wellhope, and Burnhope. He dips into the dim past, and mentions that the river was known to the Ancient Britons as " The Swift Waters." And . . . luring me to visit Durham, he talks of the legends, the folklore of the dales, and the friendliness of the dalesman. Well . . . he has painted a " Durham cameo " for me, far removed from coal and grime and pit-heads, and right now I vow that one fine day, I will tour in Durham . . . and maybe meet my enthusiastic correspondent who, so obviously, has the love of beauty in his heart. . . .

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