MAKING A DUPLEX FIRE PUMP

NEWNES

PRACTICAL MECHANICS

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PRACTICAL MECHANICS

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Editor: F. J. CAMM

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FAIR COMMENT——BY THE EDITOR

A Scheme for Apprentices

DURING the past nine years I have on many occasions commented on the failure of our apprenticeship system, and drawn attention to the great shortage of skilled men which resulted. The facts by now are well known. The apprenticeship system as we knew it 30 years ago was a serious affair. To become indentured you visited a solicitor's office with your parents, when the solicitor read over to you a frightening document setting forth the terms of the apprenticeship, the pocket money to be received per week, the premium your parents were to pay, the hours of work, and the penalties for breaches of the clauses. When the solicitor had finished reading the document you placed your finger on a seal and said "This is my act and deed," and you then signed it. The document pledged you "to absent yourself from your master neither night nor day for the full period of seven years, not to suffer damage to his goods, and to report others who may damage or steal them."

The period of apprenticeship was usually seven years, and for the first year you received 4s. a week, with a penny per hour stopped for all time lost. The only holidays you could claim were Good Friday and Christmas Day. Each year you received a rise of 2s. until the full period of seven years had been served, when your wages reached the large sum of 16s. a week. From that point you were expected to spend a further two years as an improver at one pound a week. You became a journeyman, gaining experience, spending a few months in one factory and a few months in another, when you qualified to earn the full rate of a couple of pounds or so! As soon as the contract finished you were sacked and were on your travels again looking for work. Little wonder then that parents decided that apprenticeship was not worthwhile. Boys were put to the more lucrative jobs, such as salesmanship, or entered the Civil Service, which provided security and a settled income, as well as a pension upon retirement. Engineering provided no such prospects, and an engineer had to work until he was too old to totter to it, and then rely upon his friends until Lloyd George introduced the Old Age Pension.

This war, however, soon revealed the weakness of our production position; there were not enough skilled men, and the country has had to introduce training schemes for unskilled men and women, whilst the trade unions relaxed their rules to permit these dilutees to work side by side with skilled men in the factories. I am glad to know that my consistent advocacy of the need to return to the apprenticeship system in an improved form is meeting with success. I have communicated my views on the subject to various organisations and Government Departments, and have found complete accord on my opinion that the status of engineering must be raised and the conditions made more attractive. I have already dealt with the scheme in practice now for selecting suitable apprentices for engineering according to their adaptability and aptitude. Now the Trade Unions are taking a hand. I have received, and am asked to pass on to readers of this journal, a memorandum from the Manchester District of the Amalgamated Engineering Union on the subject of training apprentices. The committee has given a great deal of thought to the technical education of apprentices. It is of the opinion that the time has arrived for a new outlook in the engineering industry on this matter. Having in mind the probability that in the post-war period the school-leaving age will be raised to 15 or 16, and wider opportunities for secondary school education provided, the way is open for a much needed advance in the technical training of the future craftsmen of the industry.

Technical Education of Apprentices

The union has an interest in the education of its future craftsmen equal with its interest in the conditions of their employment in industry. The tendency to employ youths on repetition work, whilst denying them the opportunity of sound theoretical and practical education, is bound, in the long run, to have a detrimental effect on the personnel as well as on the product of the industry.

A New York engineer suggests "that the purpose of apprenticeship in any industrial establishment is to develop a group of journeymen mechanics thoroughly skilled in all phases of their respective trades." This, in the opinion of the committee, is too limited a conception. They suggest that apprentice education should be soundly conceived and adequately planned, so as to enable those capable of using the opportunity to become equipped for the highest possible positions in industry, science or technical education itself. The aim should be to provide for those who desire merely to become better craftsmen, as well as for those who aspire to the highest possible positions in the industry.

The measures suggested to achieve such an aim are a national scheme of technical Education under Government control; the separation of apprentice training from industry proper; the adaptation and extension of the present Ministry of Labour centres for practical training in association with the technical colleges; two years' practical and two years' theoretical training as the full course; and the colleges, as well as the training centres, to be staffed by teachers with practical as well as theoretical qualifications.

The cost of training, including expenses for books, travelling, etc., to be borne half by the Government and half by the industry, so that the apprentice does not suffer any financial loss during training.

The point made regarding separation of training from industry is the crux of these proposals. The paramount concern of managements in the industry is production, and the attention given to training occupies quite a subordinate place. Further, an apprentice who is learning, and creating his own picture of the industry, should not have his attention distracted by piecework difficulties or any of the other irritations attendant on production.

Technical training should be open to all who by preliminary tests prove that they would profit by it. It should be graded to suit the limitations of each individual student. Where an apprentice would not respond to the full course of training he would be returned to industry in accordance with his grade.

Apprentices who complete the full course successfully should be given a qualifying certificate which would be a recognised standard of competence.

To give effect to the above proposals it is suggested that the proposed conference of interested parties should recommend that each organisation represented at the conference should submit the agreed proposals to their parent body, with a view to calling a national conference designed to formulate a national policy for submission to the Government.

Schools should include a certain amount of practical training in the various crafts in their curriculum. At school-leaving age they should be presented with a card indicating the degree of merit they have reached in their education and training. School examinations should be overhauled, so that a boy who obtains high marks in geography but no marks, say, in physics and mathematics, is not graded higher than a boy who obtains a reasonable average in all subjects, but lower total marks. In other words, total marks are no index of a boy's ability. A boy with a memory for dates is not necessarily better than one who cannot remember them. The present schoolmaster's reports are often misleading, and they should be issued by some independent examiner who will not colour the report according to whether a boy is popular or unpopular, or whether he happens to be good at sport, and has brought honour to the school in football or cricket.

The Central Telegraph Office

Behind the Scenes—Ingenious Telegraph Apparatus Described

By W. T. LOWE

The centre gallery of the Central Telegraph Office. Here the instruments are working to the Midlands, Scotland, Ireland, etc. (By the courtesy of the Postmaster-General.)

FOR about ten years previous to the end of 1940, practically the whole of the inland telegraph apparatus was accommodated on the third floor of the C.T.O. But this, it would appear, was simply a reversion to a former state, when the office moved from Little Bell Alley, Moorgate, in 1874. The instrument room occupied the same space, but business became so brisk that another floor had to be added to cope with the rapidly increasing number of telegrams.

To facilitate the expeditious treatment of the messages in such a large organisation some ingenious systems were introduced. One of these systems often came nearer to members of the public than they actually knew. From behind a curtained portion of many a small post office attached to grocers' and other shops, the clicking of morse sounders could often be heard. In fact, whilst waiting for stamps, you could sometimes see the telegraphist operating.

In those days all London offices were interconnected through a huge switchboard at the Central Telegraph Office. A number was allotted to each office. If, say, Wood Green had a telegram for Forest Hill, the telegraphist at the former office would call the latter in abbreviated morse figures. Suppose Forest Hill's number to have been 125, Wood Green would continuously signal "A U E" until Forest Hill answered with "A U E—G" ("G" signifying proceed).

All Metropolitan offices being connected to this board, it really was a spectacular display when in operation. When one of them called with their abbreviated morse numbers, a light flashed and the board operator inserted a plug in the corresponding hole, thereby connecting the morse speaker at her elbow to the transmitting station. Consequently she would pick up the plug marked "125" (or whatever it was) and insert it in the hole relative to Wood Green's light, and so connect the two stations. This system saved much time, staff and stationery.

Automatic Machines

With the demise of morse in the Central Telegraph Office, automatic machines for timing telegrams were introduced. But a morse operator had to refer to the clock every minute of his or her duty. Here, then, was another system which had to be ingeniously organised.

All post office clocks are corrected at least once in every twenty-four hours, and wherever one looked in the C.T.O. a clock was visible. It has, of course, always been essential that the timing of telegrams should conform to a controlled system. So, to the present day, at certain hours, Greenwich mean time (received from the Observatory by electrical current) is distributed either automatically, or by hand, to offices in direct touch, who, in turn, transmit the signal to smaller offices. Principal offices, however, receive the signal direct through a chronopher. The numerous clocks were electrically corrected every hour, and a bell struck to denote the hour.

Time Signal

During the days of morse, at two minutes to ten (later nine) a.m., the warning "Time, Time, Time," would be signalled by hand. The overseers would indulge in a little humour, not so much in what they said, but how they said it. Their expression was quite official. "Time, Gentlemen, please," they would call. But 9.58 a.m. and 10 a.m. must have been the only moments when hundreds of telegraphists sent the same signal almost at the same time.

A tale is told that, on one occasion a young telegraphist from a small provincial town visited us. As is usual, at the end of the tour the guide asked our colleague from the distant station what, in his opinion, was the most striking feature of the office. "Well," the young fellow replied, "it's all bosses and clocks!"

With the change over from morse to teleprinter, however, the clocks remained, and as far as possible all instruments were still geographically grouped. In one division we found circuits maintaining touch with Southampton, Portsmouth, Brighton, Bournemouth and other places in Sussex, Kent, Dorset and Hampshire. Welsh cities and towns and places in the west were nearer to each other than they actually are in fact. Another division gave its total attention to places in the metropolis. Hackney, Holloway, Wood Green, Putney, and every district in London came through here on teleprinter. Scotland, Ireland, and the Midlands had their connecting instruments installed as family acquaintances—so to speak.

The Baudot instrument room at the C.T.O. (By the courtesy of the Postmaster-General.)

Immediately a teleprinter was suspected of giving trouble it was removed to "hospital" and another substituted on the line—"at the double." Everything was done quickly to maintain 100 per cent. service. Shut off from the rest, test panels and controls occupied the south end of the gallery. Here was a sight that would have pleased the eye of many a wireless "fan."

The Intelligence Duty had nothing to do with crime, as its name might perhaps imply. No other branch of the Post Office is perhaps so closely associated with the Press as the telegraphs. Day and night press messages come into the C.T.O. from all parts of the British Isles, and the world in general. With printed addressed envelopes ready to hand, the Intelligence Duty deals with work for editorial sanctums. This branch is reminiscent of the days when the Post Office dealt with practically the whole distribution of telegraphed news. But the cry of "wheels" (to wind perforated Wheatstone slips upon), the pneumatic hiss and tapping of perforators, and the hum of Wheatstone apparatus have all disappeared, possibly never to reappear. Because, if it wasn't all so modern it was certainly picturesque.

Pneumatic Tubes

For short-distance communication pneumatic tubes gave, and still give, very useful service. A large system links up post offices situated in the vicinity of the City and surrounding areas. One tube runs as far as Haymarket. Another goes to the South-Western District Office, near Victoria. The telegrams are placed inside a small carrier. At the rate of 20 miles per hour this is drawn through a tube by suction. Thousands of telegrams are conveyed through many miles of tube daily.

Do you know what happened when a subscriber wished to telephone a wire to the Central Telegraph Office and asked for "Telegrams"? Can you imagine the scene! Neatly arranged telephone switchboard panels spanned tables laden with gadgets of engineering ingenuity. Coloured lights for various signals flashed silent messages to those who superintended. This phonogram division, the largest in the world, was divided into two sections. The lines from the switchboards in the smaller section connected post offices in London and the Home Counties which did not do sufficient telegraph work to warrant the installation of a teleprinter. The larger section dealt almost exclusively and directly with the public. At one time the operators' activities were controlled from a switchboard similar to that seen in telephone exchanges, and the operating positions were nothing more or less than switchboard extensions. Later, the operator manipulated his or her own cords and controlled a number of lines. He or she used two pegs—one for calling, the other for answering. A dial was also fixed to every circuit. On the board a small electric lamp lighted up. The operator took a peg labelled "A," inserted it into a relative hole, said "Telegrams," requested the subscriber's telephone number and then proceeded with the message. Perhaps the subscriber's voice was rather faint. An attempt was made to improve reception by using an amplifier in which thermionic valves played an important part. Improvement could sometimes be effected by cutting out the transmitter while the subscriber was speaking. This was done by bringing a foot, lever device into play, leaving the operator's hands free to continue typing the message.

Testing lines at the C.T.O.
(By the courtesy of the Postmaster-General.)

The conveyor band system, showing the chain-guarded drop, and slow-moving band. Note the pneumatic tubes overhead.
(By the courtesy of the Postmaster-General.)

It must be remembered that the subscriber's period of contact with a telephone – telegram operator is of much longer duration than with a telephonist at a telephone exchange. Moreover, the former must pay great attention to articulation, for everything which he or she hears, and has to record on a telegraph form, is greatly varied. The enormous number of telegrams telephoned to and from subscribers' residences and offices to-day justifies the assumption that those who conceived the idea "way back in the 'nineties" were gifted with remarkable foresight.

Conveyor Bands

Conveyor bands are used in the larger post offices not only for carrying letters and parcels, but also for carrying telegrams to and from instrument tables. In the old C.T.O. there was an elaborate structure through which thousands of telegrams passed daily. Within chromium-plated bars or rails which formed a sort of barrier from the operating positions, men and women were seated at long tables. Each one had a book in which the name of every telegraph office in the United Kingdom was printed. They sorted telegrams, coming

The cable room at the C.T.O. Morse-key transmission of telegrams which are relayed to ships on the high seas.
(By the courtesy of the Postmaster-General.)

from all points of the reorganised Central Telegraph Office, for their respective destinations. Bands of webbing travelled at arm's length inside a frame. You had to be quick to follow the progress of any particular message. Slow-moving bands brought packets of telegrams, or, as they are officially known, circulators, to the sorting clerks, who placed each telegram on one of the appropriate bands, which, running inside the frame, carried it away to an instrument table; the phonogram room; and other parts of the building.

Messages received on teleprinters and in the phonogram room were also carried to these sorting tables by conveyor bands. The telegraphist dropped the telegrams into a V-shaped trough at the back of the instrument table. At the bottom of the trough a moving band took the traffic to a parent band, and thence onward to a chain-guarded drop. Tumbling down this drop, the message alighted upon the slow-moving band, to be picked up by a sorter and circulated to a re-transmitting circuit, or to its destination. Up through the ceiling it took the telegrams for the phonogram room. Down through the ceiling it brought them straight from the telephone-telegram operator to the slow-moving band. This contrivance was really a wonderful piece of work, and in a modified form it may also be seen in other large telegraph stations in the British Isles.

Such were the surroundings in which the staff of the Central Telegraph Office worked until December, 1940.

The Cable Room

There was, however, one branch of the C.T.O. which modernisation had not affected quite so much. Considered to be the most important section, both publicly and diplomatically, the cable room stood apart from the inland telegraph galleries—as the huge rooms were officially called. Cable operators were really unofficial miniature ambassadors. Working direct to many places on the Continent, a knowledge of at least French and German was essential. And they had to use tact, of course. Up to the eves of August 4th, 1914, and September 3rd, 1939, they worked on German lines as if nothing had happened, or was likely to happen. They plodded on until the fatal moments, and nobody can say that any one of those fellows contributed to a diplomatic difference of opinion. Since 1889, morse and many other systems have assisted to make the cable room an imposing spectacle. From here, also, messages were, and, of course, still are, transmitted direct by remote control, through wireless stations, to ships sailing the seven seas and places thousands of miles away.

The most spectacular branch of the C.T.O. which has come under the control of cable room men is the "Picture Telegraph," an article on which appeared in PRACTICAL MECHANICS for November, 1942.

Combating Explosive Incendiary Bombs

The Anti-personnel Incendiary Bomb, Now Used by the Germans, Loses Much of its "Sting" if Dealt With in the Proper Manner

By JOHN TOWERS

THE use of fire-creating devices in war dates back to the earliest days of which we have record. From the distant days when the blazing pine torch and faggot were used as weapons of destruction, the terrifying power of fire has been developed through the stages of the fire-ball, the flaming arrow, red-hot cannon balls and the fire-ship, to its present devastating form.

Although the methods employed now differ from those used by our ancestors, the objects prompting their use (namely, to cause conflagrations in the enemy's territory, with the possible disruption of the defence and normal services, and to create a state of chaos, panic and demoralisation among both defenders and civilians), are unchanged. During this war, the fire "blitz" air raids have been striking examples of how far the development of fire-creating devices has progressed, but in spite of the weight of the attacks and the effectiveness of the modern incendiary bomb, the enemy failed utterly in achieving his real object. The fire-ship of the past has now been superseded by the large airborne "bombers" of to-day. In place of a single source of fire, we now have to contend with the possibility of each enemy raider carrying several thousands of incendiaries; yet, in all of our "blitzed" cities and towns the enemy has failed to create the chaos, panic and demoralisation on which he had backed to complete the destructive power of his raid. The frustration of the enemy's hopes was due not only to the fortitude of the public, but to the way it put into practice the instruction it had received, through classes, pamphlets, the press and radio, on how to deal with incendiary bombs. Experience has shown that a modern fire "blitz" can be on such a scale that the N.F.S. could not cope with it, but experience has also shown that properly instructed civilian fire fighters can, by safeguarding their areas and thus relieving the pressure on the other Services, make a valuable contribution to the frustration of the enemy's hopes. Proof of this is provided by the fact that belligerents, in efforts to defeat the fire-watchers, endeavour to alter the type of attack by the introduction of new types of bomb. Thanks to the prompt action by the Ministry of Home Security and the local Civil Defence authorities, instruction in the form of leaflets, lectures and demonstrations was soon available to all fire fighters concerning the most effective methods of combating the new devices produced by the enemy.

Types of Incendiary Bombs

Until quite recently, the chief fire-creating devices used by the enemy have been the 1 kilo magnesium bomb (known as the "Elektron" bomb) and, to a much lesser extent, the 110 kilo oil bomb. The "Elektron" bomb is 9in. long by 2in. in diameter. The whole construction, except the fins, is of incendiary metal and burns for about 10-15 minutes after throwing off pieces of molten magnesium in all directions for, approximately, the first two minutes. It falls with a velocity of 350ft. per second, and can penetrate most types of domestic roofs.

A variation of the above is known as the 1 kilo magnesium with tail explosive charge. This is simply the same bomb as mentioned above, with the addition of an explosive charge fitted under the fins. It functions the same as the "Elektron" up to approximately two minutes after impact, when the explosive charge is set off which causes molten and solid metal to be projected, therefore, some form of cover—a shield, an upturned table or chair or other reasonable protection—is advisable when tackling it.

Anti-personnel Incendiary Bomb

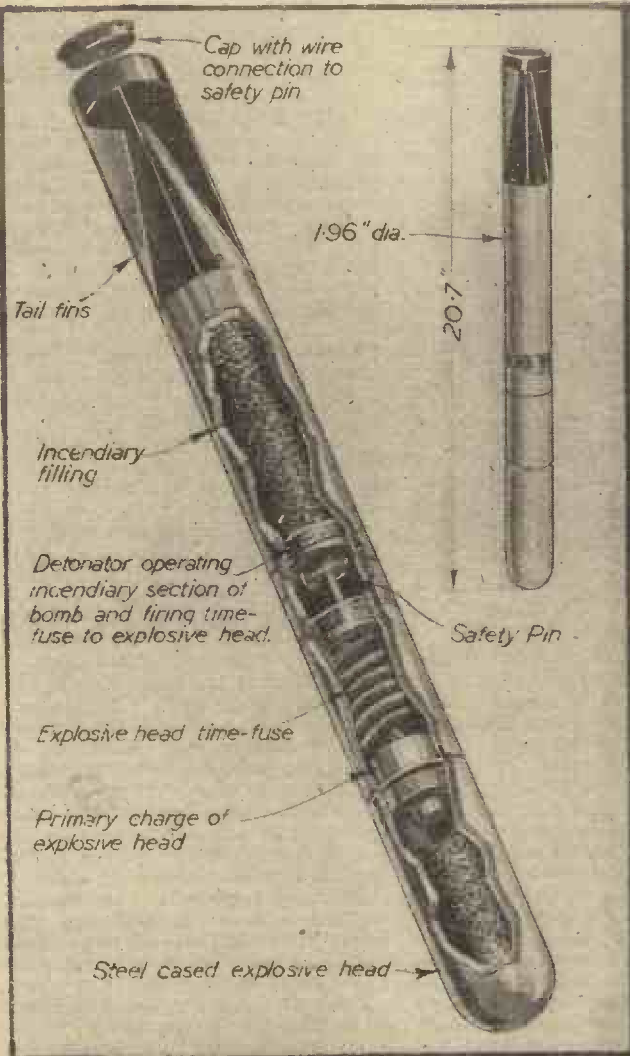
As the name implies, this incendiary is an effort on the part of the enemy to prevent fire fighters reaching the spot where the bomb has dropped, until it has been able to set up a serious fire.

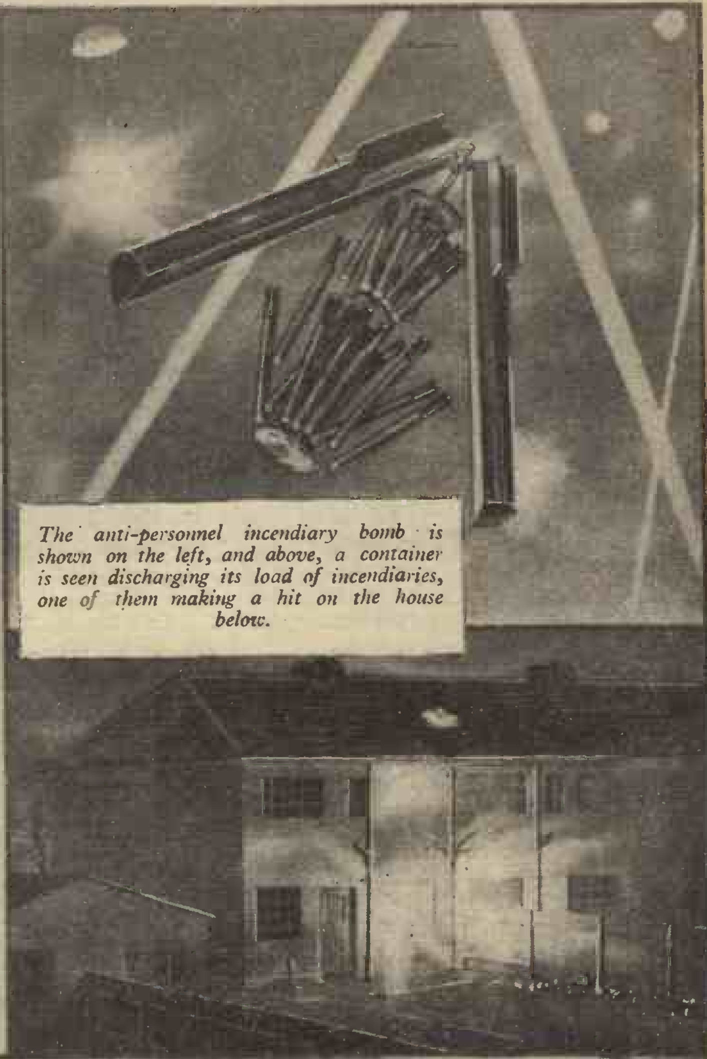
The bomb itself is the ordinary "Elektron" fitted with a 7½in. nose at its base. This addition houses a time fuse and 3½ ozs. of T.N.T. which is capable of producing an explosion comparable with the Mills hand grenade. On impact, the incendiary portion comes into operation in the normal manner, but, at the same time, the slow fuse for the explosive content is brought into action. The delay on this fuse varies from 1 minute 20 seconds to seven minutes, therefore, until the explosion takes place, it is essential to make the utmost use of cover while tackling the incendiary portion which is already doing its work. What forms effective cover greatly depends on the scene of the incident; a 4½in. brick wall is considered desirable, but the main thing to bear in mind is to keep well down and take advantage of every bit of cover available until the explosion has taken place, when the fire can be attacked more effectively. The construction of the bomb is shown on the opposite page, together with an artist's impression of an incident in which he shows the first sign of the incendiary portion in action, and—at the bottom of the page—the fire fighters attempting to check the fire from behind an outside wall, thus getting maximum protection from the explosion which is also shown. A lath-and-plaster or breeze partitioning wall does not offer safe cover, and to emphasise this, the artist gives us a view of one of the partitioning walls of the room in which the incident is taking place.

Points to be remembered about the anti-personnel incendiary are: The explosive content is rendered effective by the removal of a wire—shown in the illustration—which follows the contour of the bomb, and one end of which holds in position a safety pin, while the other end terminates at a small metal disc which normally rests on the top end of the fins. The passage through the air causes the disc and wire to be removed, thus releasing the safety pin; one should listen for the wires falling slightly after the bombs, as this will give an indication of their type.

It is possible for the 7½in. explosive portion of the bomb to become separated—by the force of impact—from the incendiary section, so keen observation is necessary. The weight of the complete bomb is 5 lb., thus the force of impact will be greater than the ordinary "Elektron" and the bomb will penetrate an additional floor, but as it is nose heavy, it is not likely to fall inside windows, etc.

The Explosive Incendiary Bomb





The anti-personnel incendiary bomb is shown on the left, and above, a container is seen discharging its load of incendiaries, one of them making a hit on the house below.

The fire-fighters attack the fire from outside the house thus securing the protection of a 9in. brick wall. Note the effect on the breeze partitioning wall.

Studying

Particulars of a New Cloud Energies and Properties

By ANDREW R. BOONE

Measuring the energies and other properties up to fifty billion electron volts is the function of this cloud chamber apparatus at the California Institute of Technology. On the right, scientists are installing camera apparatus.

SUSPENDED, in total darkness, between the pole faces of an electro-magnet setting up a force 10,000 times more powerful than the earth's magnetic field, a cloud-making chamber awaits the onslaught of a charged particle from outer space. Suddenly, far too tiny for the strongest microscope to bring it within human view, a particle flashes through the chamber, hurtling earthward 150,000 miles a second with an energy, weight for weight, 400,000 times greater than that of a one-ounce rifle bullet zipping 3,000ft. a second toward the enemy.

Yet, with this new cloud chamber, whose 24in. diameter and the magnet with which it is virtually surrounded, make the cosmic-ray trapping device, Dr. Carl D. Anderson, California Institute of Technology physicist, hopes to measure the mass behaviour of the little-known mesotron, and the energies and properties of other cosmic ray particles whose energy touches the stupendous figure of 50,000,000,000 electron volts. When you remember a lighting flash discharges at the rate of one to two million electron volts, you get an idea of the energy raining down from outer space upon the new cloud chamber.

Though completely invisible themselves, in this ingenious device the rays set off a train of events that leave a temporary visible record of their path and dual motion picture cameras snap stereoscope pictures of the trails of wreckage left in the wake of these cosmic jots. By measuring the curvature of these trails later, Dr. Anderson and his associates take an important step toward solving the secrets of the universe.

How does science photograph invisible cosmic projectiles passing lenses at 9,000,000 miles a minute? Where do cosmic rays come from, and what are they? What's the practical value of such studies? Physicists can answer these questions only in part. From the studies eventually will come information which will advance our knowledge in biology, meteorology, geology and astrophysics.

Details of the Cloud Chamber

Let's look in on the cloud chamber, housed in a light-proof cabinet, for an intimate view of this scientific legerdemain. We see the huge magnet, lying horizontal on two concrete beds. Enclosed within its frame are the field coil, the cloud chamber, cameras, fast-action illumination lights, a pair of trigger devices, an air exhaust system, and a complicated array of wires, switches and relays.

It so happens that the cosmic rays strike the apparatus about once every minute. When a particle passes through a pair of Geiger Counters, one placed above and the other below the cloud chamber, setting both off simultaneously, a picture is taken. This procedure is not simple; as a charged particle approaches the cloud chamber, it passes through the first counter, which is simply a gas-filled metal cylinder through which is stretched a fine wire, and rushes on through the chamber and the lower counter. When both are hit simultaneously, rapid discharges of electricity occur between the wires and cylinders, and these discharges are amplified to operate relays and other devices.

During the incredibly swift passage through the chamber, the particle collides with a large number of gas atoms along its path, tearing off electrical charges from some, and turning them into electrically charged ions. This procedure occurs before your eyes constantly, and you never witness the transformation. But in the chamber the stage is set.

On the floor of the chamber is placed a small quantity of ethyl alcohol. Shortly the space becomes saturated by evaporation. Now all is ready. A charged particle passes through, leaving 4,800 to 7,200 pairs of ions along its two-foot path. As the counters trigger-off the apparatus, the black velvet-covered metal back is pulled out a bare half-inch, expanding the atmosphere 10 per cent., causing it to cool 25 deg. F., in a flash. As a result of the cooling, the moisture condenses and comes out as a gentle rain. No dust being present, the droplets grow on the shattered ions, and for a moment leave a string of droplets resembling miniature beads—beads of such substance they can be readily photographed.

Photographing the Ions

The instant the beads form, two lamps—quartz tubes fitted with electrodes and filled with argon gas, through which a charge of electricity is caused to pass—flash. Their beams, focused through auxiliary lenses, flood the chamber for 1/100,000 of a second with a brilliant blue light equivalent in intensity to that produced from a pair of medium size flash bulbs.

With that flash, the picture is taken. Now two electric motors, started by the impulse in the "trigger-off" tubes, move the 35 mm. film one frame, and the cameras, shutters open, are ready for the next atom-blasting arrival of some as yet unidentified particle.

No human eye ever will see directly the particles speeding through the cloud chamber. Yet by measuring the curvature of their paths and making other complicated determinations, physicists have learned much about the building blocks going to make up the universe.

Let's tear the cover from one of the larger building blocks. This is a molecule, of which all matter is composed. The molecule is the smallest block having definable properties. Could you isolate a molecule of sugar from one of the grains now so precious, you would find it sweet to the taste.

Small though it be, the molecule is subdivided into two or more of the 92 elements thus far discovered. The sugar molecule contains atoms of carbon hydrogen and oxygen. We're only part way on the road to discovery

Camera is hoisted to top of magnet, and lowered into place against cloud chamber.

Cosmic Rays

Chamber for Measuring the of Cosmic Ray Particles

of ultimate units when we reach the atom. Break an atom apart, and you find it made of a solar system of electrons, which are infinitely tinier particles, each carrying a negative charge of electricity. The centre core carries a positive charge of electricity equal to the total charge of all its surrounding electrons.

Protons and Neutrons

We must subdivide the core into its parts before the picture is complete. This nucleus is composed of two kinds of particles, protons and neutrons. The protons weigh 1,840 times more than the electrons, mass for mass; and for each electron in the outer fringes, there is an equivalent proton in the core. If the atom contains six electrons, there also are six protons. Filling the intermediate space inside the core are heavy particles called neutrons. These carry no electrical charge.

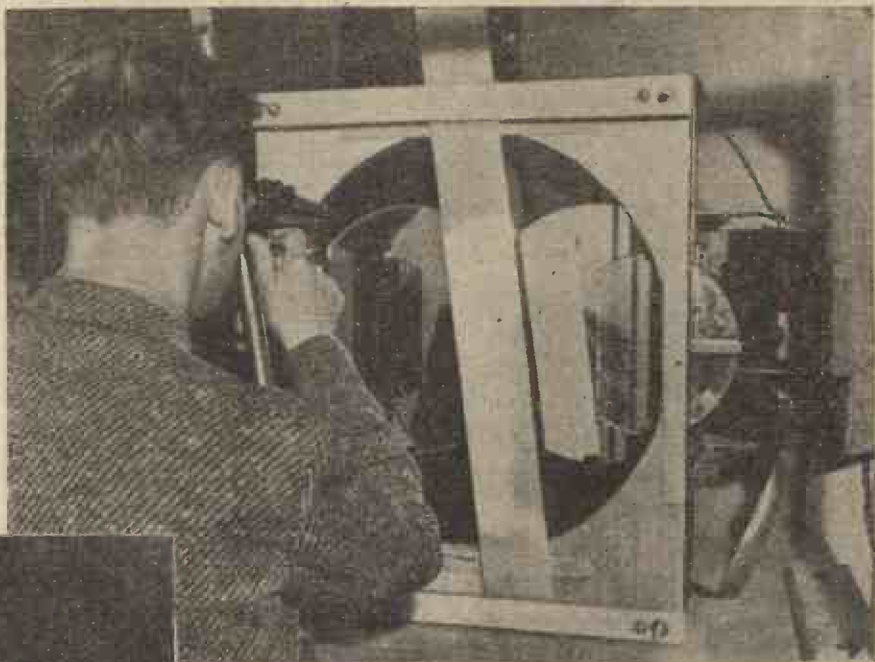
You must add to this list, for sake of

Interior of cloud chamber is illuminated by two special lamps focused through lenses. Each lamp, filled with argon gas, gives flash lasting 1/100,000-second, equivalent in intensity to medium size flash bulb (half of Wabash No. 2).

completeness, the positive electron, or positron, a very light and unstable particle; the mesotron or meson, which may be either positive, negative or neutral, and weighs 200-250 times more than the electron; and particles of no mass and no charge—the gamma or X-ray, now called photons. In 1932, Dr. Anderson snapped the first picture ever made of a positive electron, and for this outstanding feat received the Noble prize. That epochal picture caught the positron with an energy of 10,000,000 electron volts, only 1/5,000 the energy of other particles whose secrets he hopes to trap with the new apparatus.

Mesotrons

The first evidence for the existence of the particles, now known as mesotrons, was announced in 1936 by Drs. Anderson and Seth H. Neddermeyer. This announcement was based largely on data they had gathered while making experiments on the summit of Pike's Peak at an altitude of 14,000ft. above sea-level.



At intervals, following a series of photographs, a projector unit is attached to each camera, and the pictures projected through the same optical system on to an opal glass for study and measurement of curvatures. By this means, mass of mesotrons and energies of other cosmic ray particles is determined.

Now Dr. Anderson's cameras are beginning to trace the paths of protons, electrons and mesotrons. How he identifies one from another involves observations and calculations too complicated for review here. He gets no pictures of neutron and photon paths because they do not ionise and shatter the atoms enough to be caught in their headlong flight from outer space. The proton, however, being very heavy, not only shatters more atoms than other particles; its very mass resists the magnetic field, causing it to dash through the chamber with less curvature.

Early cosmic-ray researchers thought photons and electrons gave the rays their great penetrating power, carrying them through hundreds of feet of rock, and deep into the sea to recording instruments. Whether they were protons, electrons or photons was a question unsolved for several years. Now the particles penetrating the atmosphere and reaching the earth are known to be mainly mesotrons, most of which are produced in the upper atmosphere. How they are created is a deep mystery, yet a few facts about their brief life have been developed. The mesotron is born, flashes through the atmosphere and dies—in one millionth of a second. That is, carrying either a positive or negative charge, and sometimes being wholly neutral, the mesotron disintegrates, experiments indicate, into other particles.

Dual 35mm. movie cameras photograph track of cosmic-ray particles through two aluminised mirrors. Coating is applied to front surface of glass, ground optically flat. Mirrors are used to increase focal distance, on account of restricted space.

Progress

Despite the war, cosmic ray research is moving forward. From the Caltech cloud chamber, most powerful in its ability to measure the tremendous energies of the cosmic jots yet developed, probably will come information applicable to everyday living and open new horizons to scientists generally.

Jet Propulsion

The Possibilities of a New Method of Propulsion for Aircraft

By S. J. GARRETT

NOW that flight speeds have reached such high figures, limitations lie close ahead regarding the capabilities of the airscrew in converting engine power into thrust. Scientists and engineers are therefore seeking alternative methods of propulsion in which such limitations are avoided, the general trend of such research being towards jet propulsion.

In any aircraft a continuous forward thrust is obtained by reaction against the column of air swept back by the airscrew, i.e., a mass of air is thrown backwards and the force applied for this purpose to the air reacts on the aircraft with a forward thrust. The essential difference between jet and airscrew propulsion is that the latter deals with a large mass of air at a low velocity (Fig. 1), while the jet uses a smaller mass of air and imparts a higher velocity to it.

Slipstream Speed

In the normal fighter type of aeroplane with a speed of, say, 380 miles per hour, a forward thrust of about 1,000lb. is necessary, and to give this an engine of about 1,250 h.p. is required, throwing back by means of its airscrew about 50 tons of air per minute with a velocity of about 12 miles per hour. This velocity appears quite low at first sight, but it should be remembered that it is added to the forward speed of the aeroplane, so that relative to the aeroplane fuselage the slipstream speed is getting on for 400 miles per hour. Also, the slipstream velocity varies with the speed of flight; it is perhaps ten times this speed with the aeroplane standing stationary on the ground, and it falls off as the forward speed of the aeroplane increases. This is one of the factors restricting the performance of an airscrew at high speeds. The use of variable pitch greatly extends the utility of the airscrew, but it only postpones the limitations without removing them.

It will be seen from the above that the airscrew deals with very large quantities of air at high aeroplane speeds, but that a comparatively small velocity is imparted to it. The same thrust can be obtained by throwing back a smaller mass of air at a higher velocity. For instance, if 5 tons of air per minute is pushed backwards at 120 miles per hour, or 0.5 tons per minute at 1,200 miles per hour, the same thrust will be obtained; this alternative offers certain advantages, which is just what is aimed at by jet propulsion.

Multi-stage Blower

An obvious step towards obtaining the required small, high velocity slipstream is that illustrated in Fig. 2, where the engine drives a multi-stage centrifugal blower delivering compressed air to a jet pointing to the rear of the aeroplane, from which the air escapes at a velocity of several hundred miles per hour, the reaction producing the required forward thrust. There is no doubt that such a system would work, but the overall efficiency would probably be less than with the usual airscrew system.

If, however, the air is heated after leaving the blower, and before reaching the jet, its internal energy can be greatly increased, and it is capable of doing much more work, and producing a bigger thrust. A convenient method of doing this is shown by Fig. 3. The engine drives a multi-stage centrifugal blower as before, but the air is delivered into a combustion chamber, into which a spray of petrol (or other fuel) is injected and kept burning. The air is thus heated to a high temperature, which will increase the pressure in the combustion chamber. Both the jet and the blower must be suitably proportioned to obtain the required pressure. If the jet is small the blower must be capable of maintaining a high pressure, the velocity from the jet will then be high, but the mass flow will be small. On the other hand, a large jet will result in lower pressure and lower jet velocity, but the mass of air dealt with will be greater. The proportioning of these parts is a matter of ascertaining the optimum conditions in order to reach the highest attainable efficiency.

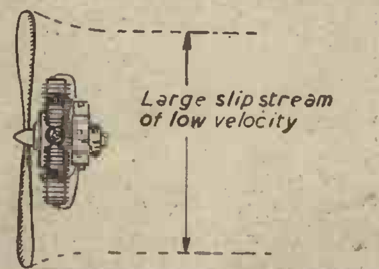


Fig. 1.—Diagram illustrating the slipstream of an airscrew.

Gas Turbine

Up to this stage the usual aero engine has been assumed to be supplying the power necessary to drive the blower, but so much energy can be made available in the combustion chamber that it is possible to use part of it to do the work of the engine. The next step, then, is to dispense with the engine entirely and to drive the blower by means of a direct coupled turbine driven by the heated gases, as illustrated in Fig. 4. A proportion of the contents of the combustion chamber is led off to the turbine inlet, the exhaust being directed to the rear to assist the propulsive effort; the amount of thrust obtainable from the turbine exhaust depends upon the design of the turbine, and the amount of energy it is found possible or desirable to extract from the gases. This then is an outline of the principles underlying jet propulsion.

It will be observed that the complete system becomes a form of internal combustion engine working on a continuous instead of the usual intermittent cycle. Suction and compression are carried out continuously by the blower, combustion is a continuous process in the combustion chamber, while the continuous flow from the jet is, of course, the exhaust.

Many practical difficulties have to be overcome before success is achieved, not the least perhaps being the construction of a turbine wheel, and nozzles, to stand up to the erosion, etc., due to the high temperatures and velocities. The progress of aviation at high speeds and high altitudes demands some such development, and the scientist will no doubt see that the demand is met in due course.

Jet versus Rocket Propulsion

Jet propulsion should be clearly distinguished from rocket propulsion, which is sometimes referred to in discussions on interplanetary communication. In jet propulsion as already described the mass thrown backwards is drawn from the surrounding air, so that it would be quite impossible to consider using such a device for a journey, say, to the moon. But in the case of a rocket the whole of the matter ejected is carried in the rocket itself which is therefore entirely independent of the atmosphere, except that the latter causes resistance and obstructs free travel. The combustion process in the rocket necessarily requires oxygen, but this also is carried (in chemical combination) and not obtained from the air. Although various fantastic (but not necessarily quite impossible) suggestions are sometimes put forward it is improbable that rocket propulsion will be used as the main source of power for terrestrial air travel.

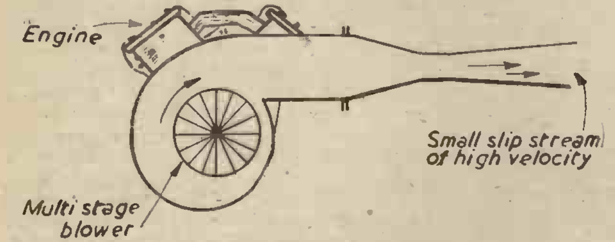


Fig. 2 (left).—Diagram showing how a high-velocity slipstream is obtained.

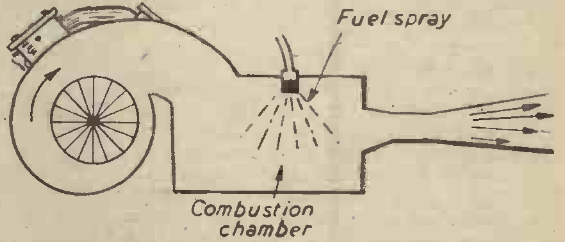


Fig. 3 (right).—Method of using a combustion chamber in conjunction with a blower.

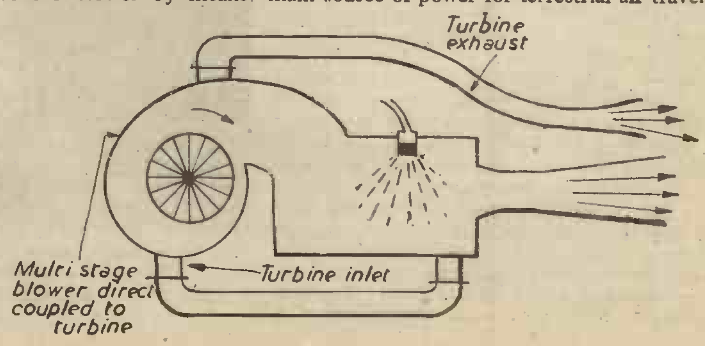


Fig. 4.—Using a blower driven by a direct-coupled turbine for producing a high-velocity slipstream.

Artificial Light Photography

How to Obtain Successful Results With Ordinary Cameras

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

THE previous article was devoted to flashlight work and explained how it was possible for a beginner with any make of camera, and without any special apparatus, except one carton of Johnson's flashpowder, costing 1s. 3d., to make eight or 10 exposures. While flashlight is obviously "artificial light," yet it is usually considered as a class by itself, and is not always included under the above heading.

Artificial lighting is by no means new, for professional photographers have used it for many years in their studios, and it has become a very important item in their studies; in fact, much of their work would be impossible if they were not able to fit up nests of, or single special lights, for obtaining certain effects quite unobtainable by natural lighting. These installations are often a most expensive item in the equipment of a studio, and therefore not one of consideration for the great majority of amateurs; but in these days of high-watt and photo flash-bulbs, flood and spot lights and power plugs, it is possible for an amateur with a moderate amount of pocket money to acquire much skill, together with a considerable amount of pleasure, in this branch of the hobby.

Selection of Apparatus

The selection of the apparatus must be left to the individual. I am only going to try to interest those of you who wish to try your hand at the work in a small way, and who have to be content with the use of the dining-room, or a small darkroom.

In describing the use of flashpowder I limited it to the taking of portraits, and those hints are equally applicable to the use of all other artificial lighting apparatus. In just the same way the subjects to which I refer in this article can be taken by means of flashpowder.

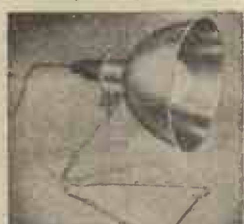
One piece of apparatus which came into my possession a few years ago and which I have found very useful, consists of a deep, bowl-shaped reflector, plated inside with chromium, and fixed to a short stand which is adjustable to almost any angle; attached to it is a fairly long lead fitted with an adjustable holder for use with an ordinary lamp bracket or power plug; the actual bulb supplied with it is a 250-watt Nitrophot. I believe the lamp is of foreign manufacture, but at the time it was purchased in London. The light which such a lamp gives enables me to take a portrait or a table-top subject with an exposure of half a second, using a fast film, such as a Selo H.P.3, and a lens aperture of F8. This lamp gives plenty of scope, as for instance, if I want to overcome heavy shadows, when taking a portrait or a still life study, then by stopping down my lens to F16 or 22, I can, while the exposure is being made, hold the lamp for part of the time on the right hand side of the camera, then change to the left, and still have time for a short top light by raising the lamp above the camera.

While on the question of lamps and lights it should be understood that it is not necessary to have high-power lights for this work; I have seen a portrait taken on an Ilford Hypersensitive Panchromatic plate with the lens set at F3.5, and the only illumination was that given by a couple of matches held by the sitter and kept alight for a matter of 15 seconds. Ordinary electric lights of 60 watts can be used quite successfully with open stop and a fast film, the time required being about half to one second. A nest of three 60-watt lamps makes a very useful help for practically any subject, but, when fitting this set, care must be taken to see that the circuit is not being overcharged and, where it is on the ordinary household installation, warning should be given to the other members of the family to switch other lights off while you are using the nest.

An untouched portrait taken with a Nitrophot 250-watt lamp. Exposure ½ sec. F6.5 Selochrome film.

Photoflood Lamps

The very excellent Photoflood lamps that in normal times are obtainable, usually are of 150 watts, and give a candle power of approximately 1,000; they have a fairly long life. A Nitrophot of 500 watts also has a candle power of about 1,000, and a life of about 1,000 hours; extra care is required with this type, and it is inadvisable to use more than one at a time, because it takes about 2½ amps. Those readers who are familiar with electric lighting and its peculiarities, will be able to counteract any risks of fusing, overcharging, etc.



(Below) The Holborn Multi-flood outfit, consisting of aluminium reflector with wire stand jointed to be employed at any angle.

(Above) Holborn Photo-spot, a portable spotlight, operated from any circuit.

If I were fitting my room for much artificial light work, I should install single lights instead of nests, and have plenty of lead so that each lamp could be moved to any position required; also, I should certainly use the rubber-covered flex.

Sometimes it is possible to get very beautiful lighting effects by combining daylight with one lamp, the results will usually be very soft without any hard shadow or lines.

Those who use both orthochromatic and panchromatic films must remember that the pan. variety, although it might be the same speed, will require less exposure than the ortho. films, because they are much more sensitive to the red rays which are given off by the lamp.

Exposure Times

Dark walls increase exposure times just as much as dark clothes on the sitter; in fact, the general surroundings are an important factor because it is the light reflected from the subject, and decoration of the room, which acts on the emulsion, and therefore must be considered when calculating the exposure.

There is still one other factor which must be given some thought and I must, for the benefit of any reader who has not experimented with indoor photography, explain this fairly fully; it deals with the actual power of the lighting, and the distance from the subject. If the light at a distance of 4 feet from the person you are photographing requires 1 second, then at 8 feet it would want 4 seconds, and at 12 feet no less than 9 seconds, the reason for this increase being that the value of the light reaching the subject falls off inversely as the square of the distance. I will show how this can be calculated by figures. Take the square of 4 feet, $4 \times 4 = 16$ which requires 1 second. 8 feet would be $8 \times 8 = 64$. 64 divided by $16 = 4$. $12 \times 12 = 144$ which divided by 16 gives 9 seconds as the exposure required at 12 feet from this particular light. I am, of course, only assuming 1 second for the 4 feet for my example, but this rule of increasing the time stands for any close-up when the distance has to be changed; the only modification which can be allowed is when the general decoration of the room is lighter and therefore gives greater reflection. Many amateurs fail to get successful results at their first attempts because they are not aware of the great difference distances can make to the power of the light.

Reflectors

With regard to the use of reflectors and diffusing screens, they are unquestionably a great help with artificial lighting and I think more so than with flashlight work, because the exposures are longer and therefore under control. It is a mistake to allow the full effect of the light to fall on the sitter, the table-top study, or any other subject, excepting actual copying of plans, drawings and such like, which require full lighting. The use of a diffusing screen made of nainsook, japanese silk or similar material will, if placed between the light and the sitter, prevent hardness, and if this can be employed so as to throw most of the light on to a reflecting screen—which should be placed at an angle to receive the light, and at the same time reflect it on to the sitter—then a soft lighting result of a pleasing character will be assured if the exposure is correct.

A large piece of white paper carefully stretched on a light frame of wood or a child's wooden hoop makes a very good reflector.

Care must always be taken to prevent the light falling on the lens.

Exposure Factors

You will have noted that there are four important factors in artificial lighting which must be considered when estimating the exposure, and these apply to practically every type of subject: portraits, studies of the family pets, copying paintings, photographing models or postage stamps, or table-top and still life subjects. They are:

(1) Power of light and the amount of light reflected from the surroundings.

(2) The speed of the film.

(3) The stop of the lens.

(4) The distance between the lens and the sitter or object.

Usually after the first two or three attempts you will find that you have gained quite a lot of useful information, and that it is easy to calculate the exposure successfully; especially if you try to standardise the work, by using always the same make of film and the same stop.

Correct developing is very necessary with all artificial lighting; hardness is a feature of most first efforts, but this can be overcome to a great extent by the use of a developer known to give "soft" negatives. Such a developer is Azol, and if the tables are followed then correct development is assured. The selection of printing paper is one which cannot be dealt with in this article, except to advise a matt surface, normal grade bromide paper.

Finally, I do not want anyone to think that this branch of photography calls for expensive cameras; obviously you would expect better results from such, but it can be done with ordinary folding types, and even with the box form of camera, but with these latter care must be taken to measure the distances, if it is not possible to focus with them.

A bomb train arriving alongside a Stirling bomber with its "cargo for to-night." This aircraft's full load is eight tons of bombs.

The World of Aviation

The Mosquito : German 45-ton 'Plane : Long-range Fighters' Successes

The Mosquito

BUILT by the de Havilland Aircraft Co., the Mosquito is probably one of the best aeroplanes of its class yet constructed. A twin-engined monoplane, it has a span of 54ft. 2in., length overall of 40ft. 9½in., and a height over propeller tip of 15ft. 3in. Its speed brings it into the top fighter class, while the duration of flight is considerable. The Air Ministry describe the machine as a reconnaissance bomber, and it can carry a useful load of bombs over long ranges. Its armament is stated to consist of four 20 mm. cannon, and four .303in. machine guns. Another interesting feature is the fact that the Mosquito is the first all-wood operational machine of this war. The power unit are two Rolls-Royce engines.

German 45-ton 'Plane

THE German transport plane, the Bloehm and Voss 222, recently shot down in the Mediterranean, is probably the largest aircraft of its kind in the world. It has six engines and is capable of carrying 80 fully armed men. It is much larger than the Halifax and the Flying Fortress. The B.V.222 is powered by B.M.W. radial nine-cylinder D.C. air-cooled engines, and is stated to have been designed before the war by Dr. Vogt for the Lufthanse world air routes. Fully loaded the machine weighs about 45 tons. Its cruising speed is 150 m.p.h., with a top speed of 190 m.p.h. at 10,000ft.

A.T.C. is Now World-wide

FOLLOWING Britain's lead, air training organisations are now firmly established in several Dominions, and many thousands of young Australians, Canadians, New Zealanders, West Indians and Rhodesians, are hard at work training to enter their own air forces or the R.A.F. The U.S.A., too, has recently started the A.T.C. of America.

Long-range Fighters' Successes

ONE of the outstanding features of our intense air activity preceding and during the present offensive in the Middle East has been the success of our long-range fighters.

These aircraft have recently operated mainly behind the enemy lines in North Africa, and particularly along the important coastal zone from Alamein to beyond Tobruk. One squadron, the first to be established in the Middle East Command, completed well over 300 flying hours in the month preceding the offensive and, in the course of widespread activities, came through without the loss of a single aircraft. During the month pilots of the squadron destroyed three Heinkel 111s, one Ju. 88, one Savoia 81, one Fieseler Storch and one Macchi 202, in addition to severely damaging a number of Ju. 87s.

Germany's Four-engined Bomber

THE Heinkel 177 is the first German aeroplane built as a four-engined bomber to fly over this country. Outwardly it appears to be a twin-engined monoplane, but each of the engine nacelles contains two Mercedes-Benz 601 engines of 1,150 h.p. The two engines, placed side by side, are geared to drive one airscrew. The Heinkel firm patented this form of engine installation in 1936, but the first aircraft built on these lines did not appear until after the war began.

Recently one was shot down over the Bristol area and others have been reported over various parts of Britain. This machine is a heavy bomber in the class of the Lancasters, Stirlings and Halifaxes. It is claimed that it can carry a bomb-load of something over six tons. Maximum range is phenomenal—just over 7,000 miles.

The "sting in the tail."

MASTERS OF MECHANICS

No. 81—Sir Samuel Morland, an Early Inventor of Romantic Renown

KING CHARLES II, the Merry Monarch, had many good traits in his character. Among them was his enthusiastic and sincere encouragement and patronage of science, invention and mechanics.

Charles, indeed, became so interested in mechanical invention and its possibilities that he went so far as to create a royal appointment which he named "Master of Mechanics." The holder of this post was supposed to be not only a mechanician of note and a proved inventor, but also a general scientist of the new and progressive school which was then arising.

The first holder of the appointment of "Master of Mechanics" which Charles II brought into being immediately after the restoration of the Monarchy in 1660 was Sir Samuel Morland. As a mechanic and an all-round inventor, Morland undoubtedly possessed considerable ability. Indeed, he figures as one of our earliest mechanicians and as a pioneer of steam power in Britain.

Old Samuel Pepys, the celebrated diarist, who was a contemporary, declared that Morland "was looked upon by all men as a knave." And Pepys, despite his violent likes and dislikes, was, above all things, a pretty shrewd judge of character.

Much of Morland's history is obscure, and, in particular, the precise circumstances in which he evolved his various inventions. So far as can be ascertained, he was definitely an original inventor.

Political Appointments

The earlier life of Samuel Morland was taken up with political affairs. He seems to have been born about the year 1625, the son of a Berkshire clergyman. He was educated at Winchester School and at Cambridge University, after which he embarked upon a period of continental travel. During the Protectorate of Oliver Cromwell (1653–1658) Morland formed one of the embassy to Sweden. Afterwards he was appointed to the office of assistant to Cromwell's secretary. After a time he began to feel dissatisfaction with the treatment he received in this office. Resentments arose rapidly in his mind, and when, ultimately, he accidentally became aware of a plot against the life of Charles II (who was then living in exile), it did not take him long to inform the King's friends of the machinations of the Cromwellian party.

It was in this manner that Morland came into favour with Charles. When the latter entered triumphantly into London in 1660, after the death of Cromwell, and was restored to the English throne, he awarded Morland a baronetcy, and a pension, in addition to making him the first occupant of the newly-created post of "Master of Mechanics."

He now gave himself up to mechanical invention, it being from this point in his career that Morland's main inventions date.

As time went by he gained a good deal of national celebrity on account of his mechanical pursuits and his scientific studies. His house in London, which, if we are to believe contemporary statements, was packed with mechanical models and apparatus of all descriptions, was a resort of all who made pretensions to an interest in scientific achievement.

Early Inventions

Among the earliest of Sir Samuel Morland's inventions is that of the speaking-tube, or *Tuba stentorphornica*, as he called it.

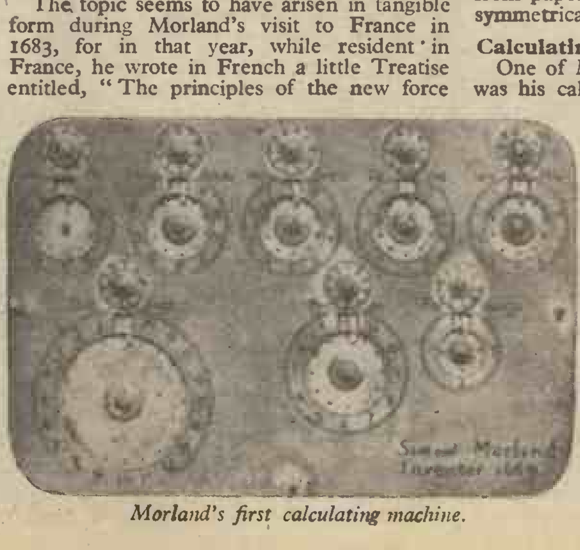
Scientific historians have long disputed Morland's claim to the invention of the principle of speaking-tube and sound-conduit construction, since the German Jesuit, Athanasius Kircher (1601-1680) undoubtedly described the principle and construction of speaking tubes in his scientific writings. The claims of Morland and Kircher in this respect are fairly equally divided. Perhaps Kircher was first in the field with his description of the principles of sound conduction through tubes, but Morland certainly seems to have brought the principle to a more practical conclusion.

Sir Samuel Morland.

Morland invented several types of water pumps and machines actuated by water power. In 1684, he was sent to France to execute some waterworks for the French King, Louis XIV, a project which he carried out with distinction. It has been claimed that Morland was the original inventor of the force-pump. Certainly, he devised water pumps of high efficiency. One of them was operated by eight powerful men, and it pumped up water from the Thames at Blackmoor Park and threw it up to the top of Windsor Castle.

To a man of Morland's restless and imaginative mind, the question of steam power would inevitably arise out of his hand-pump inventions.

The topic seems to have arisen in tangible form during Morland's visit to France in 1683, for in that year, while resident in France, he wrote in French a little Treatise entitled, "The principles of the new force of fire invented by Chevalier Morland in 1682, and presented to his Most Christian Majesty in 1683."



Morland's first calculating machine.

This document was never published. It is now preserved in the British Museum. It is written on vellum and consists of thirty-eight pages only. The bulk of the essay concerns itself with the weights of columns of water, the thickness of lead for water-pipes, tables of measures, etc., but the final chapter deals with the subject of steam power.

Morland definitely employed a cylinder and a piston in his engines, although he was not the actual inventor of these devices. He even went so far as to design and construct a primitive form of stuffing box in order to inhibit the escape of steam past his piston rods.

Patented Inventions

But Morland, apart from employing a vacuum created by the condensation of steam, appears, also, to have at least considered the usefulness of steam pressure. His earliest ideas concerning this subject comprised notions for utilising the explosive force of gunpowder to drive a piston up a large cylinder. In the Calendar of State Papers there is the following entry under the date, December 11th, 1691:

> WARRANT for a GRANT to Sir Samuel Morland of the sole use for 14 years of his invention for raising water out of pits, etc., to a reasonable height, by the force of powder and air conjointly.

Under the same date, we find, also, the following entry in the Calendar of State Papers:—

> WARRANT for a GRANT to Sir S. Morland of the sole making of an engine invented by him for raising water in mines or pits, draining marshes or supplying buildings with water.

For all his grants and patents, however, Morland never constructed a true steam-pressure engine. Nevertheless, it was he who first began a quantitative study of the properties of steam and, bearing in mind the poor facilities which existed in his day for exact experiment, he obtained some surprisingly accurate results in his patient studies of the relationship between the pressure and the volume of steam.

Other interesting inventions with which Morland's name is associated comprised a method of secret writing, a form of pentagraph whereby writing could be copied mechanically, a mode of removing writing from paper, and an apparatus for producing symmetrical designs by mechanical means.

Calculating Machines

One of Morland's more serious inventions was his calculating machine, which was first devised in 1666. The Frenchman, Blaise Pascal, had previously constructed an adding machine, but Morland had no knowledge of this device. Hence, his own mechanical calculator was certainly an original one. The machine was made of metal and measured 4ins. by 3ins. by about ¼in. in thickness. It had eight dials on its front plate for the counting of farthings, pence, shillings, units, tens, hundreds, thousands and ten-thousands pounds. Behind the dials were fixed notched discs which engaged adjacent discs and so enabled straightforward additions to be made. In this instrument, however, there was no automatic provision for carrying amounts of one denomination to another, as, for example, converting shillings into pounds. This had to be done mentally by the operator of the machine.

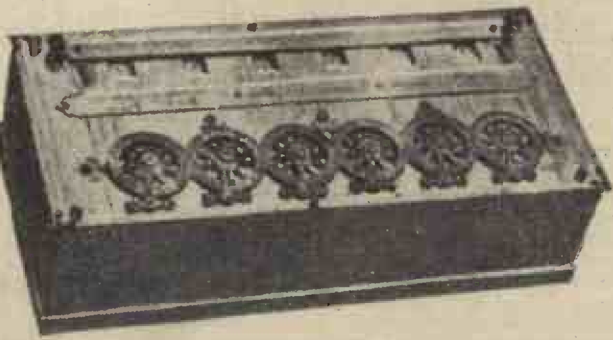
Another calculating machine devised by Sir Samuel Morland multiplied instead of added. It could also be employed for the extraction of roots. A further machine of Morland's essayed to give solutions of triangles and to evaluate trigonometrical functions. The first two of Morland's calculating machines were described in detail in his book, "The Description and Uses of Two Arithmetick Instruments," which was published in London in 1673. But for all their originality and their crude ingenuities of construction, Morland's "arithmetick instruments" served, at that time, no utilitarian purpose. They were curiosities only, and, as mechanical curios, they soon descended into the all-embracing limbo of worldly oblivion.

Experimental Barometer

Other technical experiments conducted by Sir Samuel Morland were concerned with atmospheric pressure. He made a special form of barometer having a sloping or inclined tube so that a slight change in atmospheric pressure produced an enhanced movement of the mercury within the tube. The device was hardly practicable, however, and it soon succumbed to better inventions.

Sir Samuel Morland was of too roving and too temperamental a disposition to succeed well with any mechanical project. He showed his originality and his inventiveness in many directions, but few of his machines (apart from his pumps) had any lasting success. After the death of Charles II, his fortunes progressively deteriorated. In his later years he lived on and even below the abject poverty line, and, to make his distress still more acute, he was stricken with permanent blindness. Yet, in spite of all this misfortune, Morland still cherished and nurtured his inborn interest in mechanics; and, seemingly, he kept his eccentricities to the end.

Morland died in the December of 1695, having just attained the allotted span of seventy years. Few noticed his passing, for the fame of Sir Samuel Morland was spent. But the birth of steam power was now nigh, and only ten years were to elapse before Thomas Newcomen demonstrated his famous "atmospheric" engine, the first practical means of obtaining continuous motive power from the use of steam. But in those ten years the memory of Morland completely disappeared. It has only been revived in detail within comparatively recent times in consequence of the new historical light which is now being turned upon mechanical inventions.



Another early calculating machine, constructed by the Frenchman, Pascal.

The Steam Car

The Present and Future Prospects of Steam Propulsion for Cars

By W. J. ROBERTS

Fig. 6.—An experimental steam car on trial.

STEAM as a motive power for private cars and light delivery vans has always been a possibility and, from the early days of the White and Stanley cars, has been the ultimate aim of a small body of enthusiasts throughout the country.

The object of this article is not to give detailed instructions as to how to build a steam vehicle, or even to convert an existing petrol vehicle, but rather to lay before the reader a résumé of what has been done, and what is still being done in the hope of providing, for the happier times ahead, a reliable and cheaply produced means of transport which would be independent of imported fuels. There is no doubt whatever that such a vehicle, using home-produced fuel, would, providing it was reliable, be an asset to the country and open up a new era of motoring history.

Earlier Objections to Steam

It has frequently been said that the unreliability of the earlier attempts killed the prospects of the steam car, but on looking into the matter this does not seem to be quite the case, as a matter of fact *all* the drawbacks raised by the objectors applied equally to the petrol car of the same period, they were: Clumsiness and ugliness, the bewildering confusion of taps, levels, pressure gauges, etc., and the dirt associated with the whole business.

Stanley Engine

When we come to examine these objections, however, they are not so real; compare, for example, the Stanley engine, shown in Fig. 1, with any petrol engine of its time, the balance goes to the steam engine even on the score of simplicity alone, and talking of simplicity, consider the White boiler and burner (Fig. 2), a model of simple efficiency.

Space, however, will not permit more than

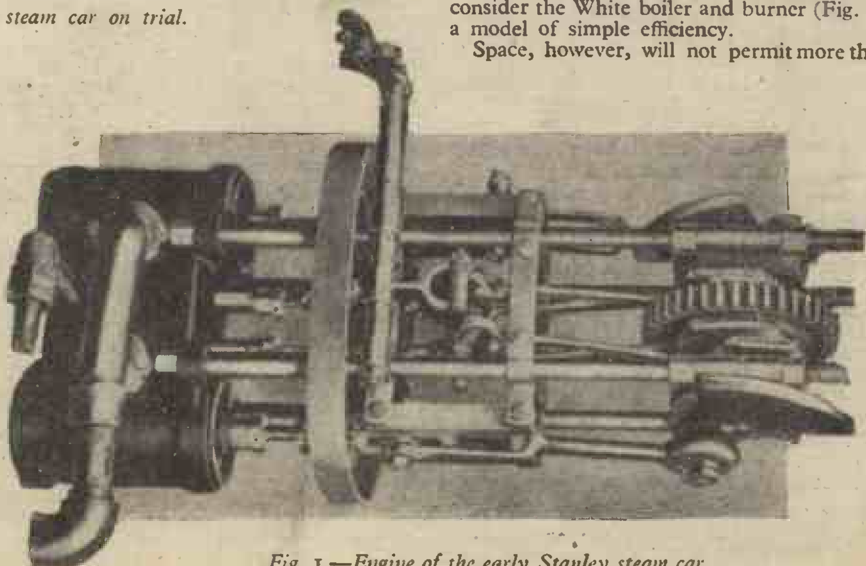


Fig. 1.—Engine of the early Stanley steam car.

Fig. 2.—The White steam generator.

a passing glance at these "old-timers," interesting though they may be.

The next attempts at steam vehicles came just after the close of the last century with the introduction of two famous names in the heavy vehicle world: Sentinel and Foden. The fallacy of the "unreliability" of steam was exposed by the consistent performance of these familiar vehicles; their decline was not due to their own characteristics but was brought about by the excessive taxation they were subjected to. During the same period the American designers produced a moderately successful job in the Doble car, one of which was purchased and run by a woman film star!

Recent Developments

During the last decade, however, the petrol car has developed almost to perfection, and, whilst it would not be right to belittle the success of the mass-produced light cars of recent years, there comes a phase, however, in the development of any machine, built to certain principles, when perfection is approached, and that period seems to be almost with us as regards the modern petrol car; thus the time is ripe for the further development of the steam car.

From the mass of data and facts available, provided by many steam car enthusiasts, it is only possible to mention the most interesting; accordingly, the first recent development of note is the work of the Bolsover Bros., two Yorkshire engineers who have been interested in the matter over a very long period. Their earlier work consisted of the design of steam engines and boilers to adapt the existing cars to steam propulsion, and two outstanding engines were produced. One, a radial, designed to bolt direct to the clutch housing after removal of the I.C. type engine, thus utilising the existing transmission system and other details of the original car. In each case they had the intention of utilising the present radiator as a condenser, the petrol tank for carrying water, and the installation of a boiler under the existing bonnet in place of the original engine.

Utilising Existing Petrol Engines

The system finally evolved by the Bolsover Bros. was recently patented, and represents a real step forward. In its essentials it consists of the conversion of a standard 4-cylinder car engine to steam by substituting for the standard cylinder head a pair of cylinders designed for steam operation, and thus the advantages of the existing engine and transmission system are retained. The only alteration is the modification of the valve camshaft drive and re-shaping of the cams to suit steam power, no reversing gear is fitted as the existing gearbox provides this. The diagram, Fig. 3, gives a sectional view of the engine, which is quieter, has greater flexibility, and possesses a stronger pull at low speeds, cannot be stalled and, most important of all, runs at a fraction of the original cost.

Self-contained Engines

As an alternative to the above conversion system the same firm has produced a useful "V" twin compound engine suitable for the light car or van, rated as 20 h.p. at 2,000 r.p.m. with a steam inlet pressure of 1,500lb. per sq. in. Sectional views of the engine are given in Figs. 4 and 5, Fig. 4 being front and Fig. 5 a side view of the completed unit. It is supplied as a set of castings for the purchaser to machine and assemble, as also is their four-cylinder radial design. As a matter of interest the photographs Figs. 6 and 7 will repay study; they are photographs of a standard petrol car chassis converted to steam, utilising an engine from a Stanley 10 h.p. steam car, and a 15 h.p. White semi-flash boiler of about 35 sq. ft. heating surface. Fig. 6 shows the car on the road under test.

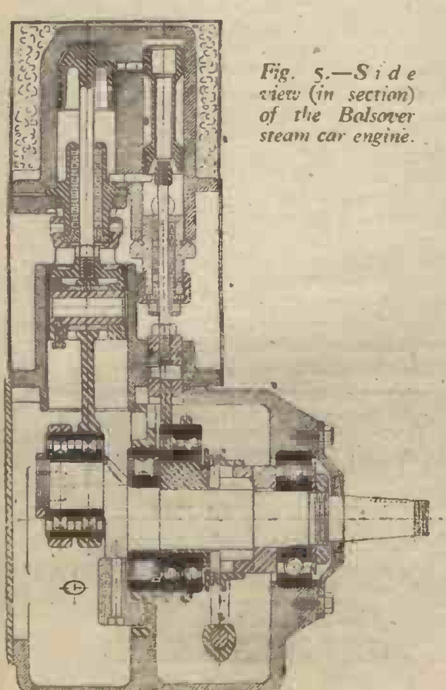


Fig. 5.—Side view (in section) of the Bolsover steam car engine.

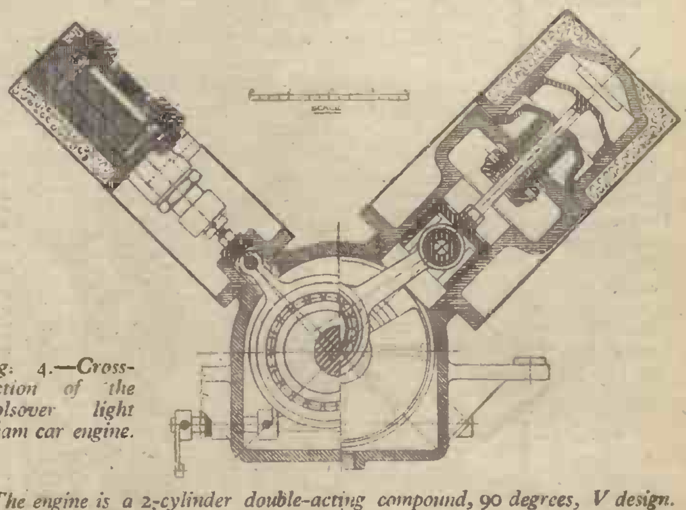


Fig. 4.—Cross-section of the Bolsover light steam car engine.

The engine is a 2-cylinder double-acting compound, 90 degrees, V design. Size of cylinders: H.P. 1¼in. bore; L.P. 2¼in. bore, by 1½in. stroke. Engine is rated to develop 20 h.p. at 2,000 r.p.m. with a steam pressure of 1,500lb. per sq. in.

The Steam Generator

The unit which has given most trouble in steam car design and construction is the steam generator, or boiler. The earlier boilers suffered from the disadvantage of slow steam raising and fuel problems. Several types have been designed and tried out and Bolsover Bros. have at last given us an answer to the problem in the Bolsover-Rogers boiler.

Originally two types of boiler were designed, one to burn solid fuel and the other to burn

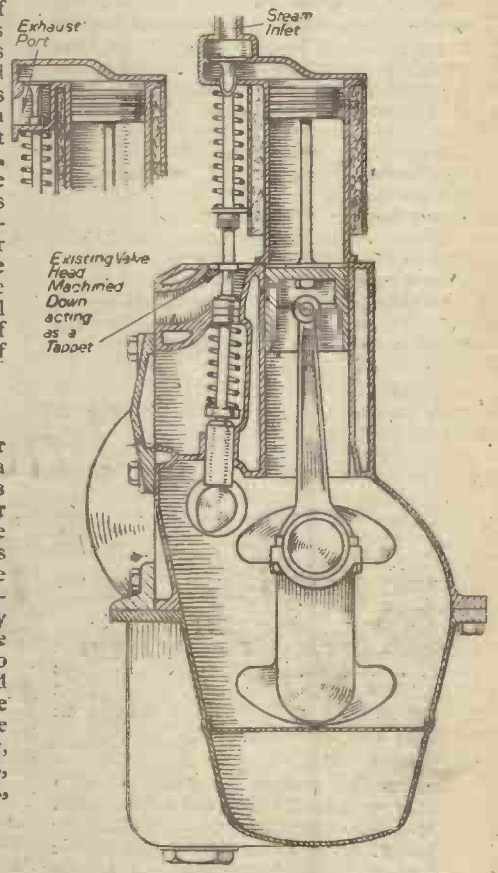


Fig. 3.—The "Bolsover" conversion system.

liquid fuel; the latter, a very ingenious arrangement, was capable of raising steam sufficient for moving away in a matter of minutes by simply turning the ignition key. However, in view of the shortage of liquid fuel and necessity to conserve it, this one is likely to be shelved for some considerable time. The boiler for solid fuel, however, is illustrated in Fig. 8, and the details given here are those kindly supplied by the designers.

Under the Bolsover-Rogers patents a clever system of hydraulic damper control has been perfected. That is, when the temperature of steam reaches a predetermined point, round about 750 deg. F., water under pressure is made to flow from a small pressure storage vessel and to act upon a piston which operates the damper, very positively closing the latter. This causes the steam temperature to fall below 750 deg. F., the water pressure is then released from the damper piston by the action of the control valve, and the damper is opened again by means of a spring. This control, which is very sensitive, is governed by a master thermostat, which, in turn, is influenced by the average temperature of the steam within the boiler, thus effectually preventing any over-heating of the boiler coils. The control is positive and reliable, and it will function with certainty without any attention. The temperature of steam is thus kept at the desired point, and the thermostat can be set, at will, to give steam temperatures at any point between 500 and 800 deg. F.

The flow of feed-water to the boiler, and, consequently, the steam pressure maintained therein, is regulated by a spring-loaded control valve, which keeps the boiler pressure constant within close limits.

The boiler is of the "Monotube" forced circulation type. The tube assembly consists of a series of flat spiral coils in the upper part of the boiler. The feed water enters the top coil, it is forced down by the action of the feed pump through the series, and then passes into a large helical coil which surrounds the fire zone. Steam is generated in the helical coil, and is then superheated by passing it through several flat spiral coils, which are placed on top of it. Coke fuel is fed into the fire zone through a firing-chute located on the top plate of the boiler casing.

Final Notes

Owing to the need to conserve fuel, even the coal or coke fired boiler will have its fuel problem, but a suggestion has been made for a method of firing steam car boilers of the flash type, utilising heavy oil obtained from the sumps of petrol cars. Every filling station has quantities of this which would gladly be given away; the problem of filtering and burning it should not prove insurmountable, and although the calorific value is low, the quantity available is sufficient to merit consideration.

The foregoing is briefly the story of the steam car in England. That there is a future for it is the firm belief of many. If its development is carried on with the energy and persistence devoted to its petrol counterpart there seems no logical reason why British brains and British initiative should not eventually get a steam car into the production stage.

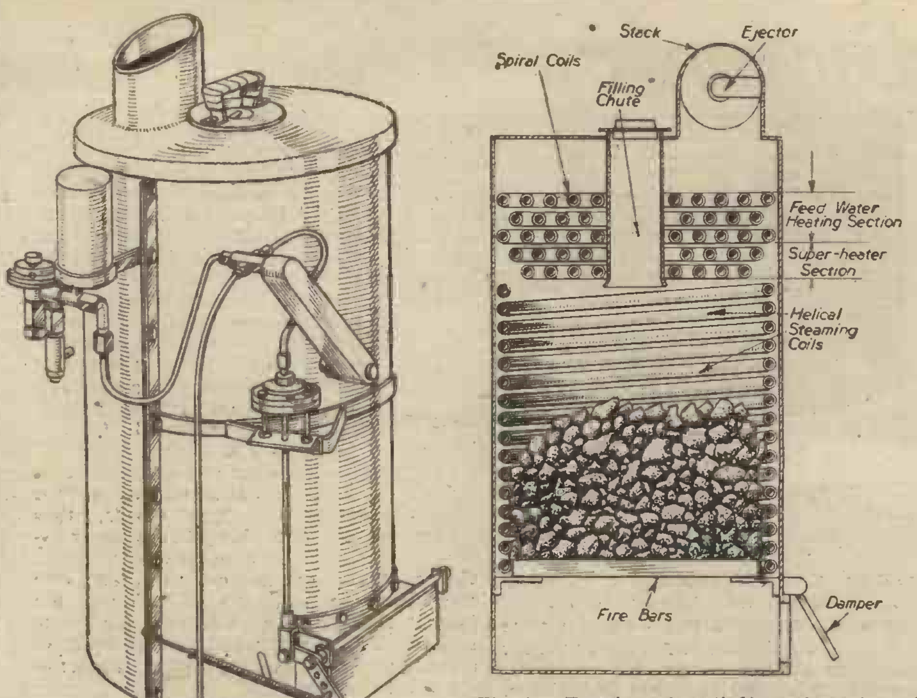


Fig. 8.—Exterior view (left) and section of the Bolsover-Rogers steam plant.

A leading feature of the Bolsover-Rogers steam plant is its use of coal or coke for fuel, which is burned within the steam coils of the boiler, as indicated in the illustration.

Fig. 7—A steam car enthusiast at work on a converted car.

British Flying Schools in U.S.

ALTHOUGH R.A.F. cadets are no longer being received in United States Army Air Corps schools owing to the expansion of the Corps, the flying training schools built by the R.A.F. in America are carrying on with undiminished vigour.

These British schools are six in number. They were built on virgin sites, some in the desert, taking from 40 to 60 days from start to occupation. The staffs consist of American civilians, with the exception of an R.A.F. chief instructor, who is also C.O., an administrative officer, a chief ground instructor squadron leader and two armament N.C.O.s. The nucleus of the staff was found among the instructors of the American civil flying schools belonging to the big air corporations.

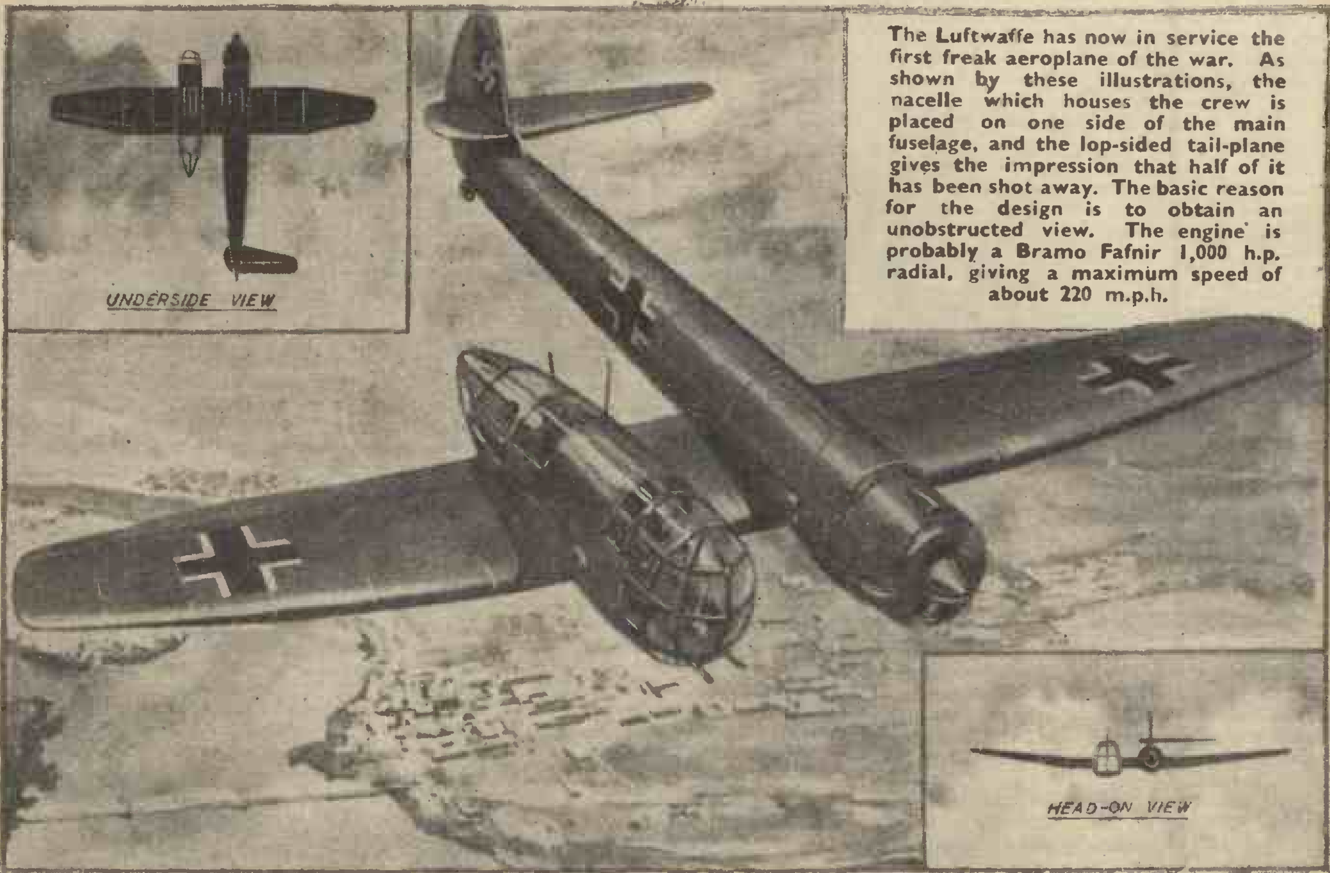
America is rich in vast level regions where rainfall is low and visibility high. Perfect flying weather is enjoyed almost all the year round. One school is at Terrell, 30 miles from Dallas, Texas. Here the surroundings are fields of rice and maize. The Miami, Oklahoma, School is set among rolling grasslands where cattle are raised and zinc is mined. In Arizona there is a school near Phoenix. Beyond the orange groves which surround the school buildings are cactus and sage brush, with a background of mountains. A river irrigates the orchards. Perhaps the cadets at Clewiston, Florida, are the most fortunate, for they can enjoy perfect bathing all the year round, both in the Gulf of Mexico and in the Atlantic. The climate is almost tropical.

R.A.F. Standard

The cadets at these schools are trained on the R.A.F. standard syllabus. Primary, basic and advance flying training is given during the course, which includes night and cross-country flying. A great deal of attention is given to instruments. R.A.F. trainees are also received at United States Naval training establishments at Grosse Ile, Detroit, and Pensacola, Florida.

As some return for the hospitality shown to R.A.F. cadets by American authorities, the British schools there are being expanded to take in American cadets. An interesting comparison of methods has resulted from these experiments in co-training. R.A.F. officers who have taken part express the liveliest gratitude to the Americans for their spirit of helpfulness, and the keenness with which they have put all available accommodation and experience at our disposal. It is pleasant to record that our cadets have made friends everywhere, and have proved themselves the best of ambassadors. The welcome given to them by local inhabitants is described as marvellous, especially so in what was formerly regarded as an isolationist stronghold in the Middle West.

Blohm and Voss 141 Monoplane



The Luftwaffe has now in service the first freak aeroplane of the war. As shown by these illustrations, the nacelle which houses the crew is placed on one side of the main fuselage, and the lop-sided tail-plane gives the impression that half of it has been shot away. The basic reason for the design is to obtain an unobstructed view. The engine is probably a Bramo Fafnir 1,000 h.p. radial, giving a maximum speed of about 220 m.p.h.

Merchant Navy Scholarships

SCHOLARSHIPS for boys who intend to become Deck Officers in the Merchant Navy are now available as follows:

The Nautical College, Pangbourne, Berks. £70 per annum for three years.

H.M.S. *Conway*, Tower Buildings, 22, Water Street, Liverpool, 3. £70 per annum for two years.

H.M.S. *Worcester*, Greenhithe, Kent. £70 per annum for two years.

T.S. *Mercury*, Hamble, Southampton. £45 *per annum* for two years.

University College, Southampton. £60 per annum for one year.

These have been made possible by the generosity of Mr. H. P. Drewry, and successful applicants will take up their studies next autumn.

Candidates must be sons of Navigating or Engineer Officers of the Merchant Navy or R.N.R. who have been killed or seriously disabled by enemy action during the war, or who have died during the war while still in service, but not as the result of enemy action.

Candidates should be 14-15 years of age and should make their application to the Principal of any of the establishments named above not later than February 6th, 1943.

A sum of £10,000 has been given by Mr. H. P. Drewry, a British merchant and shipbroker, formerly resident in Paris, to provide the above-mentioned scholarships.

Mr. Drewry, when making the gift, expressed a wish to help the Merchant Navy with which his family had been closely connected for many years. As a merchant and shipbroker, extensively engaged in international shipping trade up to the outbreak of war, he is fully aware of the need for a strong Merchant Navy.

New Insulating Tubing System

"PLASDUCT" is the name given to a new insulating tubing system recently introduced by The General Electric Co., Ltd. It has been produced primarily for use in buildings of various types—Nissen huts, emergency hospitals, hostels and camps where close-joint tubing or cleat wiring has hitherto been specified.

Plasduct tubing is constructed of bakelised paper and, in addition to being an effective insulator, possesses the following properties: (a) good mechanical strength; (b) strong resistance to delamination; (c) resists corrosion by many chemicals; (d) highly resistant to moisture; (e) light weight.

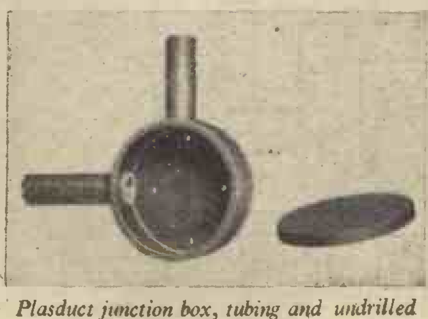
There are only five component parts in the Plasduct system, namely, the tubing, a tubing coupler, a circular junction box and two covers. Each unit is matt finished so that, if desired, a completed installation can be painted to tone with surrounding decorations.

The tubing is available in 5ft. lengths, and in the following sizes: $\frac{5}{8}$in., $\frac{3}{4}$in. and 1in. diameter. The junction box is $1\frac{1}{4}$in. deep inside, $2\frac{5}{8}$in. outside diameter, $2\frac{3}{8}$in. inside diameter, and is fitted with a fibre base $\frac{3}{16}$in. thick, drilled $1\frac{7}{8}$in. and 2in. centres. The box is so designed that it may be used for mounting switches, batten-holders, ceiling-roses, or any similar B.E.S.A. fitting.

Easy Fixing

To make a firm, tight joint between junction box and tubing it is only necessary to drill a hole of appropriate size with a carpenter's brace and steel bit.

Thus, it will be appreciated that by using the junction box in place of the fitting normally employed with metal conduit, a complete tubing system can be easily and quickly devised with an absolute minimum of parts. These features, coupled with the extreme simplicity of installation and, consequently, the comparatively low labour charges involved, make the Plasduct system particularly suitable for present-day emergencies.

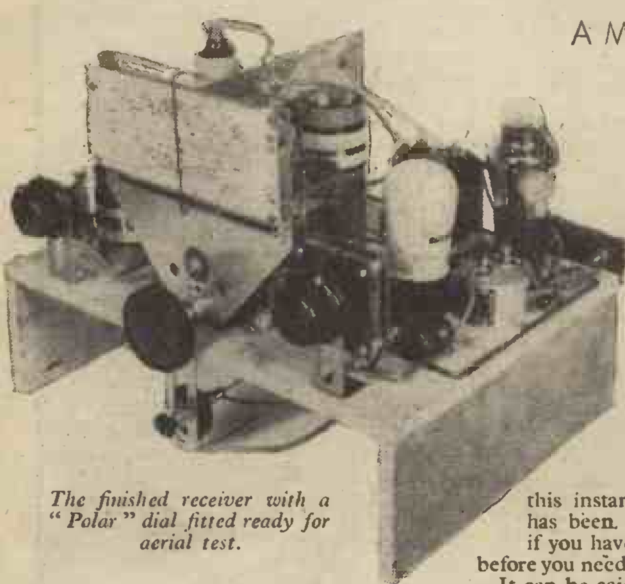


Plasduct junction box, tubing and undrilled fibre cover.

The junction box used as a mounting for switch and batten-type holder; and (underneath) tubing and fibre coupler.

War-time Battery Three

A Medium-wave Receiver of High Efficiency, Using Coils Which Can be Made by the Constructor



The finished receiver with a "Polar" dial fitted ready for aerial test.

TO satisfy the many demands from our readers for a receiver capable of putting up a good performance on medium waves, and having a component specification of such latitude that the minimum of difficulty would be experienced in obtaining the parts, we have produced the design described in detail below.

The conditions imposed naturally limit the valve arrangement and circuit refinements, so after giving all considerations our careful thought, we decided that three valves would be the most satisfactory number to make the set as universal as possible and, to cater for reception in all areas, under average conditions, one T.R.F. stage would be necessary. The circuit, therefore, is as shown below, where it will be seen that it is perfectly straightforward, and shorn of those refinements which would normally have been incorporated in times when components were easily and quickly obtainable. The question of valve supply has not been overlooked, and we think that the valves required, namely 1 S.G. or H.F. pen., 1 medium impedance triode and an economy L.F. pentode, are those most likely to be to hand in the majority of constructors' dens, or obtainable from those firms who deal in surplus or second-hand components, etc.

Although we give the complete list of the components used in our test receiver, we do not make it a "solus" specification, thus allowing the constructor every latitude in that direction, provided, of course, that such parts as are finally used are capable of carrying out the work for which they were originally designed.

For those who have a well-stocked spares-box, the circuit shown could be used as a basis for one having a more ambitious specification, but that depends on requirements.

The Coils

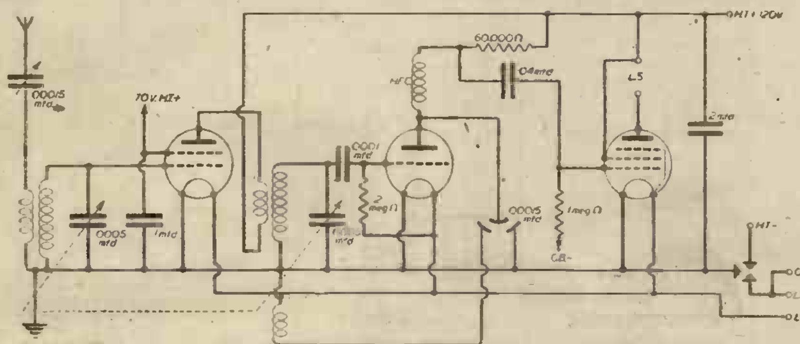
Coil construction can be a very interesting subject, particularly so when the completed components are incorporated in a receiver and experiments carried out to secure the highest efficiency. In this instance, the experimental work has been completed; therefore, even if you have not attempted coil winding before you need not fear lack of efficiency.

It can be said that these components form the king-pin of the design, so we advise every builder of this receiver to go about the coil winding and construction in a careful manner, and endeavour to make a thoroughly sound and neat job. A little extra care and time devoted to the process will be amply repaid by the improved results obtained.

Two coils have to be made, one for the aerial circuit and the other for the R.F. coupling. To simplify matters, and bearing in mind the absence of long-wave transmissions, the windings are designed to cover only the medium-wave band, so even the veriest beginner should not experience any difficulty in carrying out the necessary work.

For the coil formers a length of tubing having an external diameter of 1¼ins. will be required. We used Paxolin tubing, but ebonite, fibre, or even well-dried and shellacked cardboard postal tubes can be used, provided their walls are stiff enough to allow them to retain their circular shape. The better the insulating properties of the formers the better will be the coils.

For the aerial section, cut off a length of 2½ins., and for the R.F. transformer 4ins. will be required. Finish off the ends, and then drill three pin-holes, parallel with and ⅛in. from one edge of the formers.

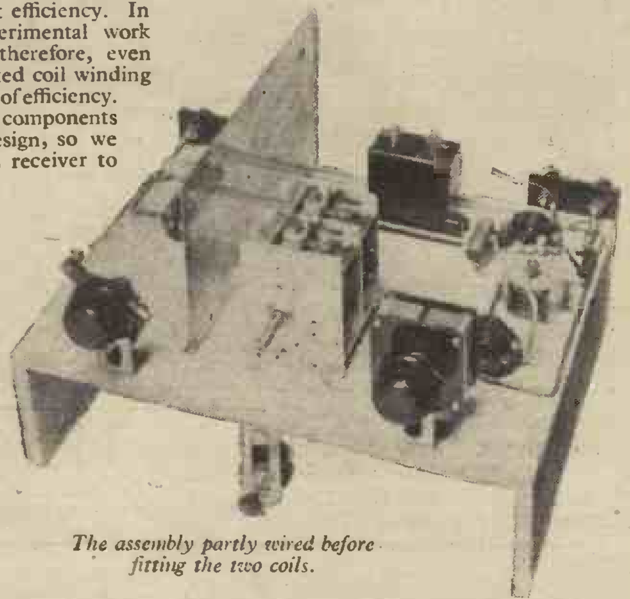


The theoretical circuit, which shows that the design is as simple as possible consistent with high efficiency.

These form the anchoring holes for the start of the grid windings, the wire being threaded through them two or three times to make a firm anchoring.

Using 26 S.W.G. enamelled wire, wind on—and this applies to each coil—63 (sixty-three) turns, keeping the wire taut, free from kinks and with each turn tight up against the previous one. When making the first turn see that it is parallel, all the way round, with the edge of the former.

Count the turns carefully, and when the winding is complete, drill three more pin-holes through which the end of the wire is then fastened, leaving a length of 4ins. for connections. Now, the start of the winding forms, on each coil, the *grid* connection, and the finish the *earth* connection, so these can be marked if so desired.



The assembly partly wired before fitting the two coils.

Primary Winding

It will be seen in the theoretical circuit that a primary winding is required for each coil. In the aerial circuit it is connected to form an aerial coupling coil, but on the R.F. coupling it is used as a normal primary connected in the anode circuit of the S.G. valve.

Taking the four-inch length of former first, proceed in the following manner. Cut a strip of Empire cloth or, failing this, smooth-finish stout brown paper, 1in. wide and 8ins. in length. Wind this firmly round the centre of the winding just completed, and, starting approximately ¼in. from the edge of the Empire cloth, wind on—in the *same* direction as the other winding—15 turns of 34 S.W.G., enamelled wire. This calls for a little care, especially the anchoring of the ends of the winding. There are various ways of doing this, and it is possible that the constructor might devise a better scheme than that given below, but do make sure that the ends are anchored securely. Before commencing the winding cut two strips of Empire cloth ⅜in. wide and 2ins. in length. Fold them in half, and through the fold of one thread round a couple of times the 34 S.W.G. wire, leaving four or five inches free. Place the folded strip flat on the wide band of Empire cloth, so that the wire rests ¼in. in from the edge. Alongside it, but with the fold pointing the other way, place the other narrow strip, then, holding both in position with one hand, wind on a complete turn of wire so that it holds them down. It will now be found that the rest of the winding can be completed, taking care not to exert *too* much tension on the wire, and to see that all turns are adjacent. When the winding is finished, cut off the wire, leaving a free end of four or five inches, and repeat the method of anchoring the wire through and round the loop formed by the second folded strip of Empire cloth. After this, grip the ends of the strip and gently pull them until the loop and wire are tight up against the winding. To complete, cut off the spare ends of cloth.

For the aerial coil—i.e., the short former—repeat the whole procedure but, instead of only 15 turns, *wind on 25 turns* of 34 S.W.G.

When the above instructions have been carried out, the third and last winding can be put on the R.F. transformer, this being to form the reaction circuit.

Reaction Winding

This winding is started half an inch from the earth end of the grid coil, the wire being anchored by the three-hole method already described. The turns are put on in the same direction as the other windings, and the wire used has the same gauge as the primaries, namely, 34 S.W.G. enamelled. For this section only 19 turns are required.

The R.F. transformer in completed form, and before adding primary and reaction windings.

This now completes all the winding work, so the finishing details can be attended to.

On the aerial coil the bottom end of the primary and secondary (or grid coil) have to be connected to earth, therefore these wires can be made common to each other on the coil, thus leaving only one connection to be made to earth when wiring the coil into the set. Where the end of the grid winding leaves its anchoring holes, strip off its enamel for a half inch; cut the wire from the bottom end of the primary so that it is long enough to reach that point, then, after cleaning it, solder the two together, making sure that there is no strain on the finer wire, and that the joint is perfectly sound. For fixing this coil in position, cut off a length of half-inch square wood so that it just fits inside the bottom end of the coil former, to which it is anchored by means of a screw on each side passing through the walls of the tubing. This completes the *aerial* coil.

Finishing the R.F. Coil

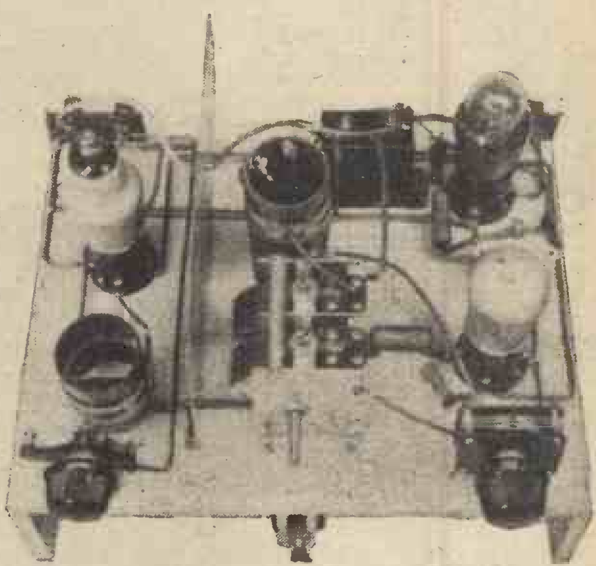
After anchoring the bottom end of the grid winding, take the free end down through the inside of the former and make another anchoring point—two holes will be sufficient for this—finishing with the end outside the former. The *top* end of the reaction winding can also be passed down through the inside of the tube and brought out through the same bottom anchoring holes as the end of the grid winding. These two wires are common to earth, so they can be soldered together as described for the aerial coil.

To allow clearance of the wooden fixing block, these lower anchoring holes must be at least ⅜in. from bottom end of coil former.

The ends of the primary winding should be taken to auxiliary anchoring holes at the *top* of the former, an inch being allowed between the two fixings. For strength, it is best to terminate these connections by short lengths of insulated flexible wire, these being passed inside the former, through holes adjacent to anchoring points of the fine wires, and, after making a single small knot in them (to take any strain), they can be soldered to the ends of the primary winding. This method is visible in the illustration showing the top view of the completed set and the plan drawing. When this, and the fixing of the wooden block in the bottom of the former has been done, the R.F. coil is completed.

Constructing the Set

Unlike our normal designs, we have used for this receiver a baseboard, thus simplifying assembly and wiring from the point of view of visibility and, of course, the beginner. In case this statement appears to contradict the illustrations, which show what might be classified as a chassis, let us make it quite clear that all components (bar the on-off switch) are mounted on the baseboard, and all the wiring, except the leads to the switch, are above the baseboard. The two side runners are purely optional. The switch could be located elsewhere, and then the runners dispensed with, but we used them to allow an H.T. battery to be housed under the set, and to give clearance to the control knob of the particular slow-motion drive we used. Details like this depend solely on individual requirements.



Showing the coils in position and all wiring completed. Note anchoring knots of R.F. transformer primary leads.

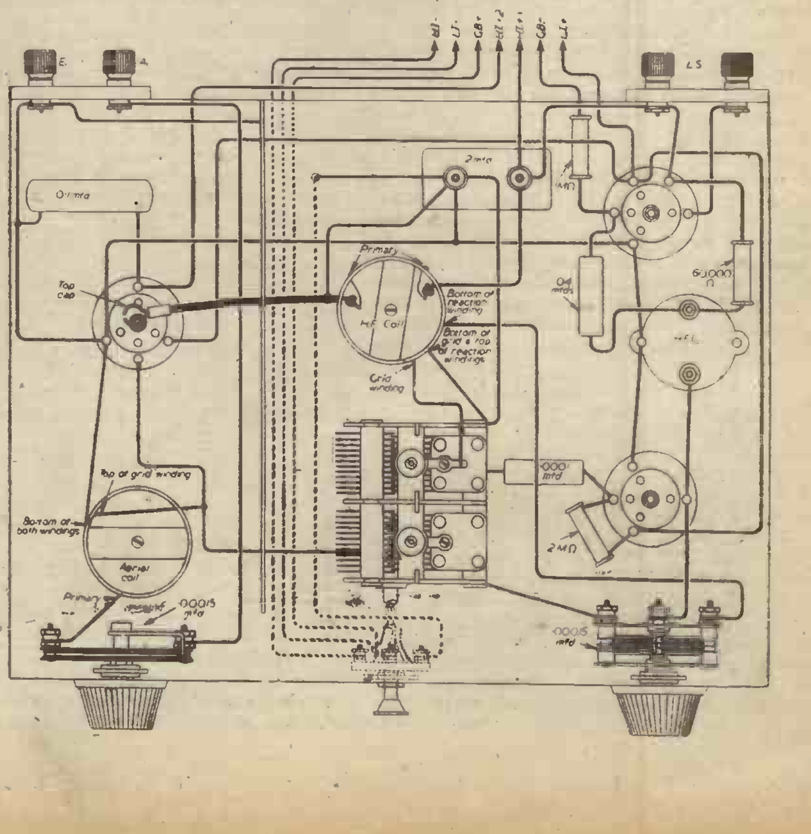
The baseboard is 12in. by 9in., and was cut from a piece of 5-ply wood. The metal screen, which is essential, is 7⅞in. by 4½in.,

(*Continued on page* 135)

LIST OF COMPONENTS

- Two medium wave coils (see text).
- One two-gang .0005 mfd. condenser.
- One .00015 mfd. variable differential condenser.
- One .00015 mfd. variable condenser.
- One slow-motion dial.
- Three component mounting brackets (if panel is not used).
- One 0,1 mfd. fixed condenser.
- One .0001 mfd. fixed condenser.
- One .04 mfd. fixed condenser.
- One 2.0 mfd. fixed condenser.
- One 2 megohm resistor, ½ watt.
- One 1 megohm resistor, ½ watt.
- One 60,000 ohm resistor, ½ watt.
- One screened H.F. choke.
- One three-point on-off switch.
- Two four-pin baseboard valve-holders.
- One five-pin baseboard valve-holder.
- Two terminal strips.
- Four terminals, A, E, and L.S. positive and negative.
- One baseboard 12 x 9ins.
- One metal screen 7⅞ x 4½ ins.
- One Cossor 210 S.P.T. (metallised).
- One Cossor 210 H.F. (metallised).
- One Cossor 220 H.P.T.
- One Exide 2-volt accumulator.
- One 120-volt H.T.
- One 9-volt G.B.
- Flexible wire, screws, tinned copper wire, soldering tags, Systoflex.

WIRING DIAGRAM OF WAR-TIME BATTERY THREE



The Electrogravitic World

The Scientific Discoveries of a Century Ago Heralded the Dawn of a New Age. Here are Presented Reasons for Thinking That Again a New Age is Dawning

By W. D. VERSCHOYLE

BY the slight movement of a compass needle, Oersted first demonstrated in 1820 a relation between electricity and magnetism, thereby inaugurating the electromagnetic world in which we live. In the subsequent development of electromagnetism many great pioneers took part, and these, working with unstinted co-operation and resources, after little more than a century of intensive work, have established electromagnetism as the greatest achievement of the human mind.

In the progressive development of Oersted's discovery we now seem to approach finality, for it is hard to imagine any field left to be explored of greater potential practical significance than those already traversed.

Nevertheless, there is such a field, which we may call the "Electrogravitic," and its successful exploration will mean to mankind probably quite as much as any of the great electromagnetic discoveries made since 1820.

Faraday's Work

Nearly a century ago Faraday attempted to enter this field, but after considerable work gave up the attempt for various reasons, ill-health being one of them. About 1850 he closed a memorandum concerning this effort with these words:

"Here end my trials for the present. The results are negative. They do not shake my strong feeling of the existence of a relation between gravity and electricity, though they give no proof that such a relation exists."

Believing that the inspirations of genius are worth following up, this "strong feeling" of Faraday's moved me in 1908 to do some work on this, the most obscure problem in the whole of physics. Great advances had been made in electrical science since Faraday's time, and I felt that in his failure was no element of finality. It now appears that he could not possibly have succeeded, for in 1850 enough was not yet known about electricity, and is now known only because of Faraday's work.

How to attack the problem was the primary difficulty, and innumerable failures were recorded at first. But a form of radiation was at length found, which quite certainly slightly affected weight, even at a distance of 10ft. from the radiator. But to deal with gravity on a large scale it was felt would make large power demands, and the methods primarily employed were deemed unsuitable to meet the requirements. Hence, keeping in mind the efficacy of a certain form of radiation, other methods of generation admitting of the use of unlimited power had to be devised. Again, after innumerable experiments, this also was found.

But at once another difficulty arose. A small variation of weight (L) could now be produced at will, but all attempts to increase L failed so consistently that this problem assumed proportions hardly smaller than the first.

Validity of First Step

During the solar eclipse of 1919 scientists proved the truth of Einstein's mathematical prediction that a ray of light would be found to be deflected in a strong gravity field.

Now we know that electromagnetic effects are often reversible, and it thus seemed a justifiable inference that, if gravity can so affect electromagnetic radiation, we should be able to find some extremely energetic form of radiation capable of affecting gravity.

The fact already discovered that radiation was implicated in L thus received inferential support, but no light was thrown thereby on the operative factors. Increase of voltage, and hence of power, certainly made a small difference, but only to a point where further increase met with no response from L. Some vital factor still awaited discovery, and my working theory gave no guidance as to its nature.

Basis of Extended Working Theory

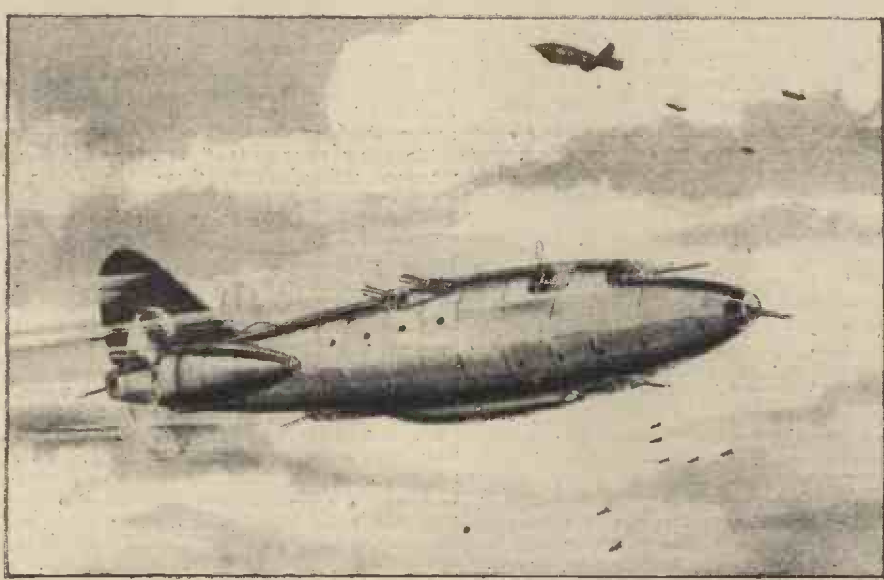
In a monthly notice of the R.A.S., dated December, 1923, dealing with "Internal Motions in Spiral Nebulæ," Sir James Jeans wrote:

"It is at least conceivable that a slight step from a gravitational force M/r^2 in the direction of a force v^2/r might be found to provide explanations of some of the unsolved enigmas of the solar system, such as the moon's motion in longitude, Bode's law, and the circularity of planetary orbits."

Now this is a pregnant suggestion, for whilst a v^2/r gravity will produce but small differentiation in the internal motions of a spiral nebula, at intra-atomic velocities and distances of the order of 10^{-13} cm. this force becomes of tremendous importance, provided that we can agree that the term *portion of matter*, as used in Newton's law of gravitation, is applicable to every particle entering into atomic constitution.

But, even so, it was felt that a v^2/r force could not act at all, in a nebula or anywhere else, without a fundamental change in our ideas regarding the elementary particle and gravity itself; and, in 1930, what were deemed suitable changes were incorporated in my working theory, together with a dependent heuristic concept of the missing factor, and to bring this into operation alterations were made in my apparatus.

The effect on L was immediate. Its value rose as the new factor value was increased, following a straight-line relation, verging doubtless towards an upper limit still a long way off. With the apparatus available an increase of nearly 2,500 per cent. was observed, as a first small step towards what was theoretically possible. The ultimate limit of gravitic response is an unknown quantity, and is certainly not reached in terrestrial experience. One sentence in Eddington's "The Nature of the Physical World" shows this: ". . . in the Companion of Sirius the density is about a ton to the cubic inch." This is usually attributed to a superionisation process; but with the new ideas may also be explained as an actual increase of gravity output from a small body, at what we might call a compound logarithmic rate, under the conditions obtaining in White Dwarf stars.



An artist's impression of a heavily-armed aerial tank of the future. Note the absence of wings and elevator.

Validity of New Ideas

In 1936 came some welcome evidence as to the validity of the basic changes on which this progress was founded.

In the Physical Review (U.S.A.) of November, 1936, is announced the discovery, at the Carnegie Institution of Washington, D.C., of "a new attractive force overpowering the Coulomb repulsion" between the ultimate particles whereof the atomic nucleus is composed, when the distance between these particles is of the order of 10^{-13}cm. The announcement concludes:

"It thus appears that a real beginning has been made towards an accurate and intimate knowledge of the forces which bind together the 'primary particles' into the heavier nuclei so important in the structure and energetics of the material universe."

Now to make this "new attractive force" operative and explicable requires exactly the same changes in our basic ideas as does Jeans' v^2/r gravity, and also the increment of L in my experiments, and it thus seems certain that the same force is implicated in each and, furthermore, that the changes may be found generally useful, both where the constitution of matter is under consideration, and where gravitic effects are suspected to be abnormal.

In the progress towards its far-distant theoretic limit, electrogravitism enters the world of practical things in the manner briefly outlined on page 138 of the February issue of PRACTICAL MECHANICS.

An electrogravitic age is surely dawning, its foundation such as I adumbrated in 1932 (*The Soul of an Atom*):

"The structural plans of the atom and the solar system are identical; each is held together by the same universal force; the same mechanical principle modulates and sensitises their physical relations; and thus, at different ends of the scale of nature, they exemplify the uniformity of physical processes which have entered into the construction alike of the great and the small things of the universe."

Academic

Against this structural plan and electrogravitism generally comes the whole force of Relativity Theory. Inertial and gravitational mass are inseparable. The first is certainly there, and must be incorporated in the theory, but it simplifies matters to drop gravity. Hence, there is no such force as gravity; there is only a geometric curvature of space-time.

Again, in Einstein's space-time continuum, Reimannian geometry or Weyl's extension of it, is no very secure place for electromagnetic phenomena, even though these unquestionably form a most important part of world experience.

Thus, at two points the fundamental concepts of electrogravitism differ from Relatival—it must have gravity, and is itself an extension or refinement of electromagnetism. Also, it embodies the belief that through the electrical theory of material constitution no enduring picture of our world can be obtained. It stresses the importance of structural detail, no less for the electron, than for the atom, the solar system, or the universe; and then through defining tentatively an electronic structure, it finds a real physical difference between inertial and gravitic mass, gives Sir James Jeans his v^2/r gravity, accounts for, and even anticipates, the Washington new attractive force, offers a new explanation of the "Coulomb repulsion," and hopes to build on a strictly experimental L-foundation a new and inspiring world, a world of new experience—the Electrogravitic World.

The Electrogravitic World

World conditions are subject to no influence more productive of change than rapid transportation, and in the electrogravitic world this influence will reach the limiting possibility of speed. What will it be? 800 m.p.h.—1,000 m.p.h., who can say? A day-return ticket to New York or other equidistant centre will be bought at the ticket office with the same unconcern as at present to Brighton. A long-distance move of a ton of freight by aeromotor will cost about the same as on a railway at present. More power will have to be applied, but it will be for a much shorter time. Ease of departure and landing will cause to vanish the inaccessibility of the poles, the mountain top, and the jungle fastnesses of the equator. International boundaries will have no more than geographical significance, and freer intercourse will lead to better understanding, and to a less barbaric adjustment of international differences than the present totalitarian call to arms.

And from the slight movement of a compass needle, observed by Oersted in 1820, all this follows.

It is worth mentioning that work on this problem was by no means continuous between 1908 and the present. The heavy cost of the experiments had to be financed, and this was done quite largely by development and sale of sundry inventions. This and other business involved about twenty trips across the Atlantic, and two round the world during that time.

Practical Engineering in Bygone Days

Some of the Difficulties Which Had to be Overcome

By T. R. HARRIS

THE lot of the inventor has often been hard, in that the successful application of inventions depended on better material and more accurate workmanship than that available at the time. Thus, practical improvements have often lagged behind the ideas of forward-looking men. The history of the steam engine illustrates this theme. The introduction of the compound engine was premature in that not until many years after could boilers be constructed to withstand the higher pressure steam necessary for the successful application of the idea of compounding. The early engines of Newcomen and Watt were very dependent upon the crude facilities available in those days. The earliest of the Newcomen engines had brass cylinders as it was impossible to procure cylinders of cast iron, the state of the foundry industry being very backward. Whilst foundry work was in its infancy, machining was unknown! The first cylinders that were successfully cast were often out of truth with regard to the bore, and it is recorded that Mathew Boulton, when making the early Watt engines at Soho, wrote to James Watt who was still in Edinburgh, "My dear friend, congratulate me, I have just succeeded in making a cylinder nowhere more than a quarter of an inch out of truth."

Cylinder Boring Difficulties

The cylinders for the early Newcomen engines would not be machined in a boring mill or lathe, but were cast as near round as possible, and finished by the following method. The cylinder was laid on its side in the yard and a block of lead, about two to three hundredweights, was cast inside it; to this was added about a bucketful of emery and oil. Then two gangs of men pulled the block backwards and forwards, by means of chains, until they had scoured the cylinder smooth. The cylinder was then turned round a little on the ground, and another portion was scoured smooth. When it is considered by what means the early engineers produced their cylinders—often four feet in diameter and ten feet long—it is a wonder that their engines were as good as they were. Necessity, always the mother of invention, soon demanded some better way for preparing cylinders, and the boring mill followed. But here again perfection was difficult to obtain. The Coalbrookdale Works were pioneers in the casting and boring of cylinders, and as these increased in size difficulty began to be experienced from the frequent breakage of the boring bars. It was desired in 1734 by the managing partner, Richard Ford, to have for this purpose "a wrought iron spindle, 12ft. long and full 3in. in diameter; one end to be left square for 18in. and ye other end to be left square for 6in., and the remaining 10ft. be left round, but to be as true as may be, and to be made of right tuff iron and right sound." This was ordered from an anchor smith in Bristol, and supplied at a cost of £26 10s. od. in September, 1734. Another was obtained in 1745, 15 cwt. 3 qr. 15 lb. at 8d. per lb., £21 19s. 4d. From 1755 to 1765 James Brindley, the famous engineer, was frequently at Coalbrookdale, and superintended the manufacture of a large engine sent to Newcastle-on-Tyne for the Walker Coal Co. in 1763. The cylinder was 10ft. long and 74in. in diameter, and was said to be the largest that had been sent to that district. It was also stated that the "bore was turned perfectly round and well polished" and "the whole a complete and noble piece of work."

Introduction of the Boring Bar

The accurate boring of large cylinders was however still a source of anxiety. In 1751 it was stated, "The 54in. cylinder for Lord Ward having been examined, was found to be true and exactly bored, viz., within 1/16in. in all the working parts." In 1776 James Watt wrote to James Smeaton, "Mr. Wilkinson has improved the art of boring cylinders, so that I promise upon a 72in. cylinder being not further distant from absolute truth than the thickness of a thin sixpence in the worst part." This reference is to John Wilkinson of Bersham, near Wrexham, who in 1775 contrived a new machine for more accurately boring the inside of cylinders. A straight bar was fixed in the axis of the cylinder which was made to revolve slowly around it, while a sliding cutter was caused to travel along the central stationary bar. On the expiration of Watt's patent in 1800 other engineers commenced the manufacture of engines. Among these was Mathew Murray of Leeds, who became a serious rival to the Soho firm of Boulton and Watt. A letter written by James Watt, Jun., from Leeds on June 15th, 1802, describes Murray's Works. In the course of this letter occurs the following: "His (Murray's) cutter block is pushed forward upon the boring rod by an endless screw, which, or some similar contrivance, we must adopt, both to guard against the negligence of the borer and to save part of his wages."

"Casting Brass Burrs"

Thus the early engineers not only designed and built their engines but had to devise and construct their own tools and overcome numerous difficulties. Not only were endless screws difficult to make—being hand cut—but the nuts or, as they were called, "burrs" in which the screw worked also presented difficulties. These were mostly of brass and cast around the screw. A quotation from a publication of 1835 is a further illustration. "Casting Brass Burrs. The usual method of accomplishing this object, is to place the screw in a mould of the required form, and to cast the brass about it, by which means a very perfect burr may be produced, but there is frequently great difficulty in removing it from the screw. To avoid this a lead burr is cast in the usual way (which may be easily taken off) and used as a box for the formation of a sand core. After the box is filled, it is subjected for some hours to the heat of the drying stove, and when its contents are found to be perfectly free from moisture, the whole is plunged into the melted lead, which robs the core of its casing, and renders the sand copy fit for use instead of the original."

Making a Duplex

Constructional Details for a A.R.P. Work and

By A. J. BUDD

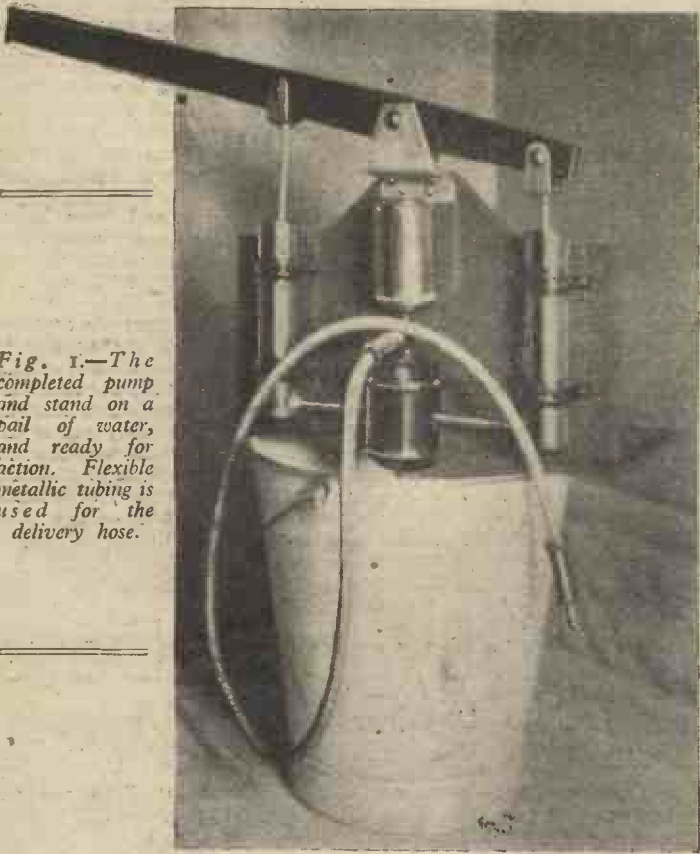


Fig. 1.—The completed pump and stand on a pail of water, and ready for action. Flexible metallic tubing is used for the delivery hose.

IN designing the pump shown in the accompanying illustrations, the writer had in mind an inexpensive and light appliance, which could be constructed in a small home workshop, and which would be a satisfactory substitute for a stirrup pump.

Using a plain nozzle, the finished pump can, with little effort, project a 3/16in. jet of water a distance of 20ft., and will empty a pail of water (2 gallons) in three minutes.

It will be seen, with reference to Fig. 1, and the illustration on the cover of this issue, that the pump is mounted on a wooden stand which conveniently rests on an ordinary household pail. When using the pump the left foot of the operator rests on the baseboard, the right hand working the pump lever, and the left hand manipulating the nozzle. When dealing with explosive incendiary bombs two men would, of course, be required to handle the pump and nozzle.

General Considerations

There are several novel features embodied in the pump. For instance, an ordinary brass garden syringe sawn in half provided the two pump barrels. Hard red rubber tap washers are used for the pump valves, and parts of a brass cycle-pump barrel are used for the cylindrical valve chambers. A copper screening can taken off an old wireless coil forms the body of the air vessel.

Constructional Details

The first parts taken in hand were the two valve chambers which, together with the valves, form the "heart" of the pump.

Two 1¼in. lengths of 1in. outside diameter brass tubing were cut from an old cycle pump barrel, and the ends filed up square. In one side of each tube, midway from the ends, a 3/16in. hole is drilled. In each hole is soldered a brass bush with a ⅜in. internal thread. Next, two discs of 1/16in. thick sheet brass were cut out as shown in Fig. 3, after being marked out with compasses. The two 1in. holes were made with the aid of a carpenter's bit. The holes were made slightly under size, and filed so that the tubes were a push fit. After pressing these in place so that the ends projected 3/32in. the joints were well soldered. Fig. 4 shows this part of the work completed.

Valve Seatings

For making the valve seatings, a strip of 16 gauge hard flat sheet brass 1in. wide was taken, and on the centre line four circles were scribed (Fig. 5) of the same diameter as the inside of the valve chambers. From the same centres four more circles were scribed having a diameter of 7/16in. These smaller circles were then divided into six equal parts by scribing light lines through the centres, and the points of intersection were centre-punched and ⅛in. holes drilled through. A 3/32in. diameter hole is drilled through each of the four centres and tapped with a ⅛in. thread.

The brass strip is then divided into four parts by cutting through with a cold chisel on the lines marked "a," using an old domestic flat iron as an anvil (this method is much quicker than using a hacksaw). After cutting off the corners with the cold chisel, each piece in turn is placed between lead clams in a vice, and carefully filed down to the scribed circle. Each disc is then rubbed over the face of a smooth-cut file to remove all burrs, and each disc finally filed round the edge till it was a push fit in the end of the valve chamber.

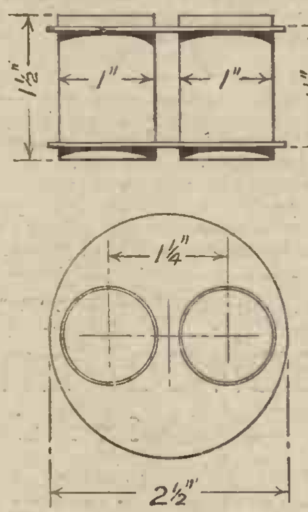


Fig. 3.—Details of valve chambers and supporting plate.

Valves and Guides

As previously mentioned the valves consist of rubber tap washers, and they should be ¾in. diameter and at least 3/16in. thick. When purchased these will be found to have a central hole a little over ⅛in. diameter which is just right for the purpose.

The valve guides consist of the shanks of plated screw-hooks, of the pattern shown in Fig. 6. Make sure when obtaining these

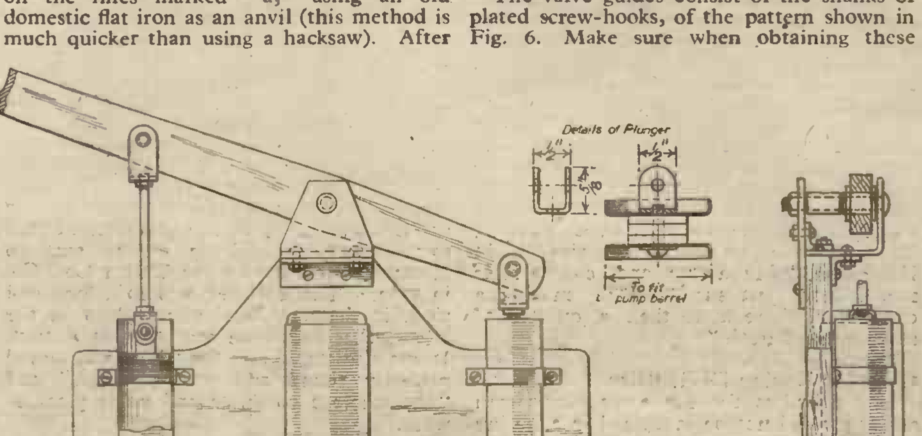


Fig. 2.—Front, and part-sectioned side elevations of pump. A section of one of the pump plungers is shown in the inset.

Fire Pump

Small Hand-pump Suitable for Other Purposes

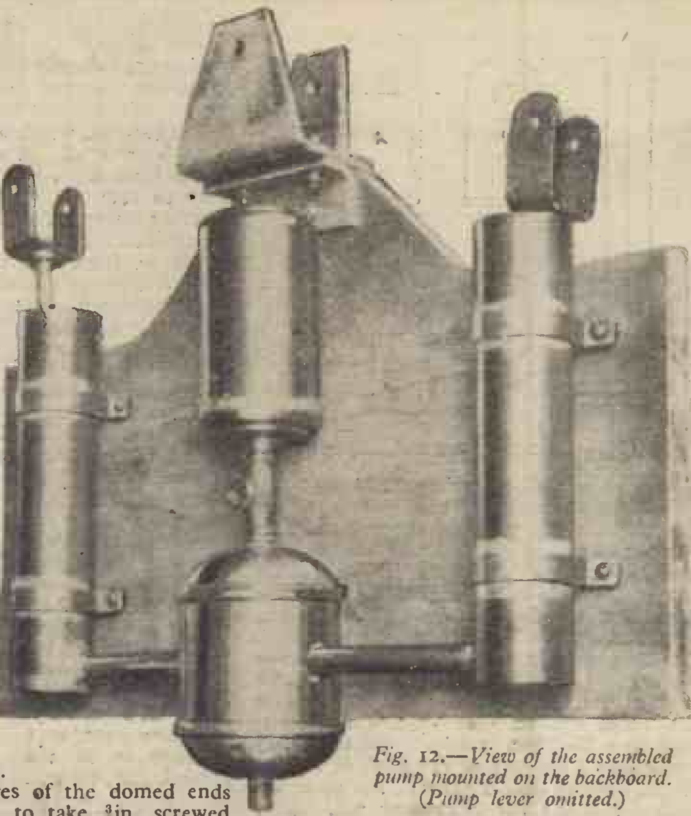


Fig. 12.—View of the assembled pump mounted on the backboard. (Pump lever omitted.)

hooks that the shanks are ⅛in. diameter. Hold the screwed end of each hook in turn, in a vice (between lead clams, of course) and with a hacksaw cut off the turned-up end. File the end square and then, with a screw-plate, cut a ⅛in. thread on the end for a distance of about ⅛in. Now reverse the shank in the vice, and cut off the screwed portion to within ¼in. of the flange, as indicated in the sketch. File the end square, and then file two flats on opposite sides of the projecting piece.

As the two suction valves are inside the valve-chambers, the former, with their guides, have to be placed in position before their seatings are soldered in place. After placing the valves on the guides, screw the ends into the central holes of the two seatings by

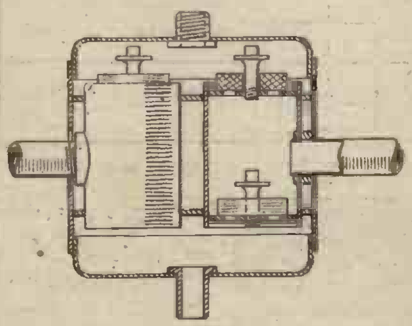


Fig. 7.—Part sectional view of valve chambers and outer casing.

gripping the squared ends in a vice. Fig. 4 shows the finished seatings and guides, one of the rubber valves being shown in position.

Press the two suction valve seatings in place to within 1/16in. of the ends of the valve chambers, and then solder in place. This must be carefully done so as not to allow any solder to run into the holes in the valve seating. The seatings for the delivery valves can now be soldered in place, and the guides, with the valves in place, screwed in. After soldering in each valve seating it would be as well to cool the part in cold water before allowing the rubber valves to come in contact with them.

Valve Chamber Casing

It will be seen, with reference to Figs. 7 and 8, that the valve chamber casing consists of three parts—the body and two ends. In the model illustrated, the body is made from a potted meat tin, while the domed ends are of dished block tin. The body is 2¾in. inside diameter and 2in. deep. As an alternative, flat dished brass stampings could, with advantage, be used for these ends, as shown in the drawings, Figs. 2 and 7.

Two 1/16in. diameter holes, diametrically opposite each other, are bored through the sides of the body to allow the ends of the connecting tubes to be screwed into the valve chambers, when these are assembled.

Through the centres of the domed ends ⅜in. holes are bored to take ⅜in. screwed bushes, which form the suction and delivery connections. These bushes are well soldered to the ends on the inside.

Before assembling the valve chambers and casing, well clean the inside edges of the latter with fine emery cloth, and also the

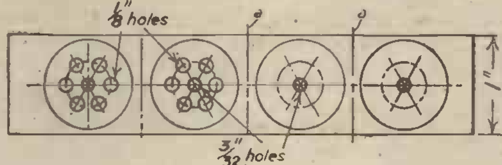


Fig. 5.—Marking out brass strip for making valve seatings.

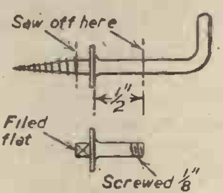


Fig. 6 (left).—Details of valve guides.

edges of the circular plates which support the valve chambers. Press the valve chambers in place inside the casing so that the circular plates are equidistant from the ends of the former, and also make sure that the screwed bushes coincide with the holes in the side of the casing. When any necessary adjustments have been made the joints between the circular supporting discs and the inside of the casing can be soldered.

The next step is to well solder the dished ends in position, removing any superfluous solder after cooling in cold water.

Pump Barrels

The two pump barrels, which are of brass, 6¼in. long and 1½in. outside diameter, were cut from a disused garden syringe, and the ends filed square. At a distance of ⅜in. from one end of each barrel ⅜in. holes are drilled, into which the ends of the brass connecting tubes are soldered. These tubes, which are 3¼in. long, have a thread cut on the other ends for screwing into the bushes in the valve chambers. The bottom ends of the pump barrels are closed with discs of sheet brass 1/16in. thick, soldered in place.

Fig. 4.—Valve chambers, supporting plates, and valve seatings and guides.

Fig. 8.—The body and ends of the valve chamber casing.

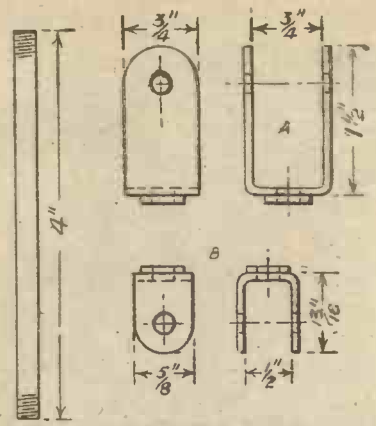


Fig. 9.—Connecting-rod and end pieces.

Plungers and Connecting Rods

The plunger taken from the garden syringe was used for one pump barrel, and a similar plunger to match it was made as shown in the detail sketch in Fig. 2. Two stout tin lids were obtained, a good sliding fit in the pump barrel, and a 3/16in. hole drilled in the centre of each. Three brass washers, 7/8in. diameter and ⅛in. thick, are placed between the tin lids and the whole clamped together with a 3/16in. brass bolt, 1¼in. long, under the head. A strip of 1/16in. sheet brass, bent to a U-shape, is drilled and tapped to screw on to the end of the bolt, as shown. A ⅛in. hole is drilled through the upturned ends for taking the connecting pin. After screwing it on tightly, the U-shaped piece is soldered to the bolt and to the top of the plunger. Details of one of the plungers are given in the inset in Fig. 2.

The two connecting rods are of bright mild steel, 4in. long and screwed at each end for a distance of 5/16in. On one end of each connecting rod is screwed a U-shaped piece, A (Fig. 9), which is attached to the pump handle, the other end of each rod being screwed into smaller U-shaped pieces (B), which are attached to the plungers.

The larger parts (A) are bent to shape from pieces of 1/16in. sheet brass, ¾in. wide and 4in. long, after marking out and drilling the holes. A brass disc, 1/16in. thick, is soldered to the underside of each U-piece, and the central holes continued through and then tapped to receive the screwed ends of the connecting rods, which should be a tight fit. The smaller parts (B) are made in the same way, and discs soldered on for thickening purposes. These ends are attached to the plunger lugs with 3/32in. bolts and nuts.

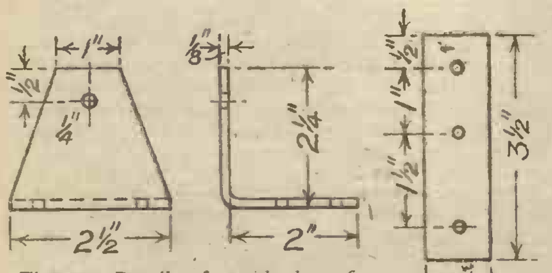


Fig. 13.—Details of metal plates for forming the trunnion bearings for the pump lever.

Backboard and Footrest

At this stage it is as well to prepare the backboard on which the pump parts are fixed. For this purpose a piece of deal will be required 14in. long, 9in. wide, and ¾in. thick. Plane this on both sides, mark the centre line, and pencil in the outline of the top edge (see Fig. 11). With a hand-saw and coping saw cut this edge to the required contour, and smooth over with a rasp and glass-paper. A part has to be cut away in the bottom centre of the board, as at C, to accommodate the back of the valve-chamber casing. A shallow concave recess, D, is also made to allow for the back of the air vessel.

The footrest, which is 15in. long, and 7in. wide, is made of ½in. wood. In the centre of the front edge, a semicircular part is cut away to take the lower end of the valve-chamber casing. The footrest is fixed to the backboard with four brass countersunk screws, driven in from underneath, as shown in Fig. 2. Two iron brackets are also screwed to the backboard and footrest, at a distance of 1½in. from the ends of the backboard. Before finally fixing the footrest and backboard together it would be advisable to assemble the pump parts and screw the pump barrels to the backboard. Four clamping strips, each 4½in. long, are cut from ⅜in. by 1/16in. sheet brass, and holes drilled in the ends to take ⅛in. coppered wood-screws ⅝in. long. These strips are then bent to a U-shape to fit the pump barrel, the end of the strips being also bent at right angles to form feet for screwing to the backboard, as shown in Figs. 2 and 12.

Bearings for Pump Lever

The next parts to claim attention are the metal plates for forming trunnion bearings for the pump lever. Aluminium sheet ⅛in. thick is used for these parts, which are marked out and finished to the dimensions given in Fig. 13. The right-angled plate is bent to shape by holding it in a vice and hammering the projecting part over till the correct angle is formed. Holes 3/16in. diameter are drilled where indicated for the fixing bolts and screws, the ¼in. holes in the top ends being for the pump lever shaft.

In assembling these parts the right-angled piece is first screwed to the top of the backboard with two ¾in. round-headed wood-screws. It is also bolted to another angle piece, 2½in. long, which in turn is screwed to the backboard. The 1in. strip is fixed to the back of the board with a single screw, and is also bolted to a small angle-piece, 1in. long, which, in turn, is bolted to the base of the main angle bracket. The head of this bolt is countersunk. This method of building up the bearing brackets for the pump lever results in a very strong and rigid fitment. The drawings, Fig. 2, show clearly how the parts are positioned, and screwed and bolted together.

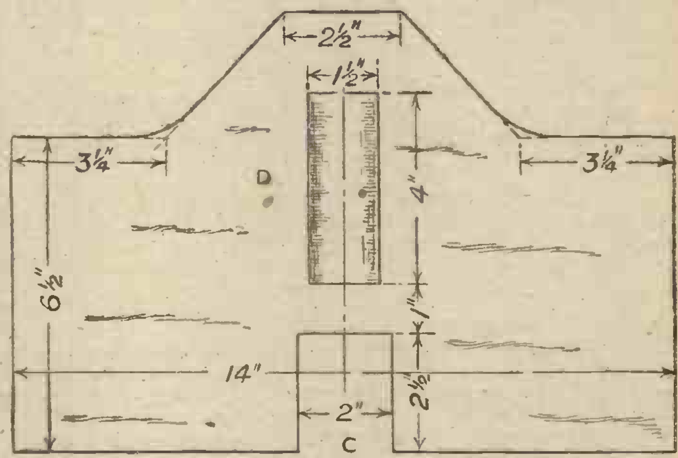


Fig. 11.—Front view of backboard, giving dimensions.

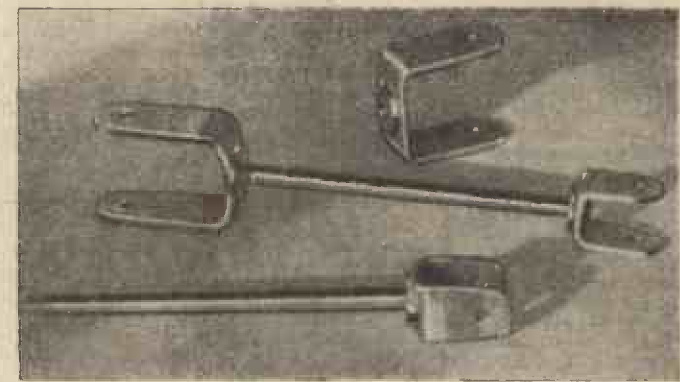


Fig. 10.—The finished connecting-rods and U-shaped ends.

Pump Lever

The pump lever, shown in Fig. 14, is planed to the shape required, from a piece of hardwood, 2ft. 4in. long, 1½in. wide, and ⅞in. thick. Three holes are drilled through on the centre line, the centre hole being 7/16in. in diameter and the other two each ¼in. diameter. A threaded brass bush, 1in. long, and with a 5/16in. central hole, is screwed into the hole in the lever, and a thin nut is screwed up tightly on the projecting end. The two smaller holes are bushed with pieces of thick brass tube, a bare ⅞in. long, having an inside diameter of 5/16in.

The corners of the lever at the handle end are chamfered for a distance of 4in., as indicated, to make it more comfortable for the hand.

Air Vessel

As previously mentioned, the air vessel is made from a copper screening can, 2¾in. diameter, taken from a disused wireless coil. The bottom of the vessel consists of part of another screening can of slightly smaller diameter, and this is well soldered in place, after having a central hole drilled through it, and a ⅜in. threaded brass nipple soldered in

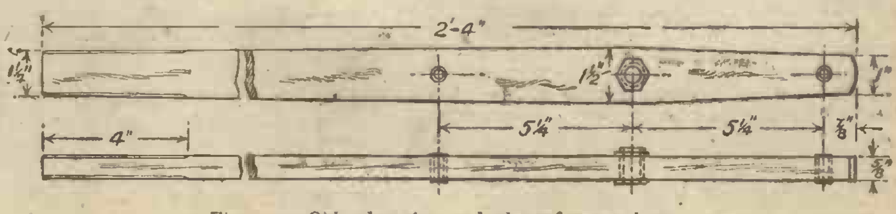


Fig. 14.—Side elevation and plan of pump lever.

This nipple screws into one end of a ⅜in. brass T-piece, the other end of which is connected to the threaded nipple on top of the valve-chamber casing. The centre part of the T-piece forms the delivery connection of the pump, and to this is connected one end of a length of flexible metallic hose, to the other end of which a brass nozzle, having a $\frac{3}{16}$in. bore, is connected.

The suction pipe consists of a piece of red rubber tubing, one end of which is bound to the suction nipple of the pump by means of a few turns of enamelled copper wire.

Testing and Finishing

When finally assembling the pump parts, a little red lead or paint should be smeared on all the threaded connections to ensure air- and water-tight joints when these parts are screwed together. After screwing down the pump barrels, and making any necessary adjustments, fit the pump lever in position, tighten up the nuts, and apply a little lubricating oil to the pivot bolts, and also to the plungers. The pump is then ready for testing.

Finally, wipe the pump and stand with a clean rag, and unscrew the pump barrels. When quite dry, the backboard and footrest can be given two coats of hard-gloss paint, allowing the first coat to dry thoroughly before applying the second coat. The pump lever, valve-chamber casing, and the bands round the pump barrels are painted with bakelite paint —pillar-box red. The backboard and footrest are painted in dark green.

After the painted parts are allowed to dry, the pump can be assembled again and it is then ready for use.

Give the pump a try-out occasionally to ensure the valves being in good working condition.

Aero-engine Starting Equipment

The Various Systems Used on Modern Aircraft

By T. E. G. BOWDEN, M.I.E.T.

DUE to the high horsepower developed by modern aero-engines the problem of starting has been greatly increased. The force required to turn high-powered engines renders the use of some form of auxiliary starting mechanism essential. Engines of up to approximately 200 horsepower may be started by hand swinging the propeller, but power units developing more than this figure are impossible to start without mechanical assistance. The main disadvantage incurred by fitting a self-starter is the fact that the engine weight is increased, and thus the amount of payload that may be carried by the aircraft is decreased. The size of the starter is limited by the space available and this factor affects their design to a considerable degree. The various methods of starting and the equipment required will now be described.

Hand Swinging

The propeller hand swinging method is as follows: The carburettor is flooded and the engine primed with the magneto switches in the *off* position. The engine is then turned over with the throttle slightly open, followed by switching on the hand-starting magneto, opening the throttle, pulling the airscrew over compression as quickly as possible and at the same time turning the hand magneto. When the engine fires, switch off the starting magneto and switch on the main magnetos. The function of the auxiliary magneto is as follows: The main magnetos do not operate efficiently at low turning speeds and poor sparks are produced. By fitting a hand turned magneto a satisfactory stream of sparks may be obtained, the current being distributed to the correct sparking plugs by means of the main magnetos' distributor.

Hucks Starter

An improvement on the hand swinging method is the Hucks starter. This consists of an adjustable shaft mounted on a framework attached to a standard motor-car chassis. The shaft is driven by the car engine and may be connected to the propeller boss by means of a dog, thus revolving the crankshaft until the engine fires. The dogs are designed so as to automatically disengage when the engine starts. The disadvantages of this system, which is not used very much at the present time, are the facts that it is impracticable for large aircraft whose engines are mounted high above ground level, and that the starter may not be available at every landing ground.

Modern starters may be divided into four classes:

1. Hand driven starters.
2. Electrically driven starters.
3. Gas starters.
4. Cartridge starters.

Hand-operated Starter

Taking the first of these various types, i.e., the hand-operated starter, two alternative designs are available, each with their own advantages and disadvantages, the inertia type, and the direct turning type. The hand-driven inertia starter, illustrated in Fig. 1, consists of a small but heavy flywheel which is rotated by means of a handle and gear wheels. The energy stored when the flywheel

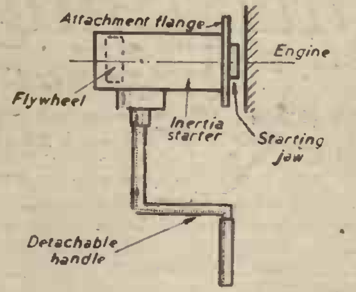


Fig. 1.—Diagram of the hand-driven inertia starter.

is rotating rapidly is transferred to the engine crankshaft by a system of gears and a clutch. When the rate of rotation is approximately 12,000 r.p.m. the clutch is engaged and the engine turned at approximately 80 r.p.m. The time taken to gain the required revolutions is approximately 30 seconds and the number of revolutions turned through by the engine is one or two. A safety ratchet to prevent damage should the engine backfire, and a slipping clutch which automatically disengages the starter when the engine fires, are incorporated. The clutch is usually of the spring loaded type. The speed of the flywheel may be judged by the sound caused by its high rate of rotation. A drive to the booster magneto is usually incorporated to facilitate starting.

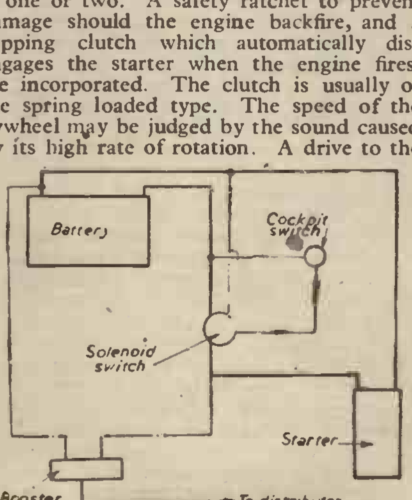


Fig. 2.—A typical circuit for an electrically-operated starter.

The direct turning starter consists of a handle connected to the engine crankshaft by means of a worm and gear wheel mechanism. The gear ratio must be sufficiently low to allow the engine to be turned over by a mechanic of ordinary strength. A typical ratio is 10 to 1. As in the case of the inertia starter, a clutch and ratchet is incorporated.

Electrically-operated Starters

Electric starters may be either of the direct cranking or the inertia type and operate in a similar manner to the hand-operated starter described above. The electric motor takes the place of the manually operated handle, thus saving much physical labour. Should the batteries run down and thus render the electric motor useless it is usual to provide the alternative hand turning mechanism to be used in case of emergency or to conserve the batteries. The disadvantage is of course the increased weight involved. The time taken to reach the required revolutions in the inertia type is reduced to approximately 7 seconds by using an electric starter.

In order to save weight which would be incurred by running heavy cables (capable of taking the current) to the pilot's cockpit from the starter and battery, a solenoid switch is installed requiring only light cable to complete the circuit when the starter is required. A diagram illustrating a typical circuit is shown in Fig. 2. The solenoid requires only approximately 50 watts and eliminates the danger of transmitting a high amperage through considerable distances. The switch that closes the solenoid circuit is generally of the push-pull type, i.e., the switch is pushed in to start the electric motor and pulled to engage the starter to the engine when the required speed has been attained.

The main disadvantage of the electrically-operated starter is the limited capacity of the battery. The size and weight must be kept as small as possible, and thus great care is necessary to avoid running the battery down, especially in cold weather. A common method used to partly overcome this disadvantage is to employ an external battery for starting the engines. The battery is mounted on a trolley and plugged into the aircraft at a convenient position, and thus the drain on the aircraft's batteries is reduced. By using a special plug the aircraft's circuit is automatically broken when the external socket is plugged into the connection.

The batteries used are generally of the 40 or 25 ampere hours type, and are mounted so that inspection or replacement is as easy as possible. Both 12 and 24 volt systems are in use at the present time and various types of generators are mounted on the engine to charge the batteries. A typical generator running at 5,000 r.p.m. develops 1,000 watts at 24 volts. If the aircraft is of the aerobatic type non-spillable batteries must be used.

A booster coil is fitted which is brought into operation when the electric motor is switched on, and is automatically switched off when the engine fires and the starter is disengaged.

Electrically driven starters require very little maintenance. The brushes should be examined and the battery kept charged. The level of electrolyte must be checked and if necessary the battery topped up with distilled water. It is important that the cable connections should be satisfactory. Practically no lubrication is required and care is necessary when applying oil or grease, as damage may be caused if the manufacturer's instructions are not adhered to.

Gas-starter System

A gas-starter system is illustrated diagrammatically in Fig. 3. The method of operation is as follows. Air passes from a storage bottle, is mixed with petrol and distributed to the cylinders in their correct firing order. The combustible mixture is fired by means of a hand starter magneto and thus the crankshaft is turned until the engine runs on its own ignition and induction systems.

The air is stored in a steel bottle at a pressure of 200lb. per square inch. An engine-driven air compressor is often used, but alternative sources of supply are hand or foot pumps. One filling will normally be sufficient for five or six starts. A small motor-driven compressor mounted on a trolley is usually available for charging the bottle at all main airports.

The compressed air flows from the container, through the control cock, via a press cock to the atomiser. The press cock may be operated by the pilot's hand or foot,

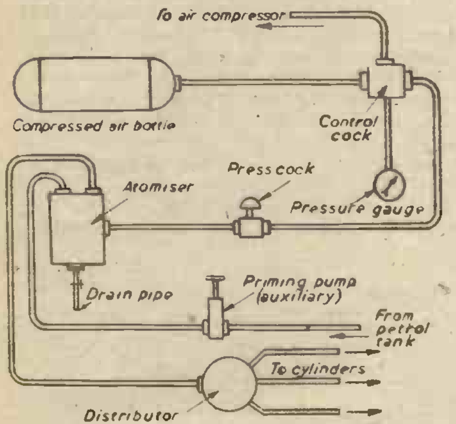


Fig. 3.—The gas-starter system.

whichever is the most convenient, and its purpose is to control the amount of air passed to the cylinders. The atomiser's function is similar to that of a carburettor, i.e., the supplying of a combustible mixture. Petrol is supplied to the atomiser by means of a priming pump or, if the supply tank is situated at a higher level, by gravity. Excess petrol is drained by means of the cock fitted at the lower end of the atomiser. The compressed air flowing past the jet, which is situated in a venturi, draws petrol from the atomiser in the form of a spray which passes along the pipe line to the distributor.

The distributor, as its name implies, distributes the combustible mixture to the various cylinders in the correct sequence. Non-return valves are installed in the pipe lines leading to the cylinders to prevent the mixture flowing back.

The actual procedure when starting is as follows. The drain cock fitted to the atomiser is opened and the reservoir filled with petrol by means of the priming pump until petrol flows from the drain pipe. The cock is then closed and the main fuel supply cock turned to the *on* position. Following these operations the induction system is primed in the usual manner and the cock controlling the flow of compressed air placed in the *on* position. The hand-starter magneto is then rotated and the press cock depressed. When the engine starts up the cock is released and the main ignition switched on.

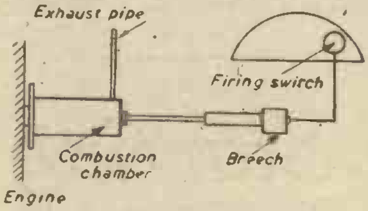


Fig. 4.—The cartridge starter.

A very efficient form of starter is the cartridge starter, which is illustrated in Fig. 4. An explosive cartridge is placed in a breech and fired (usually electrically). The gases produced travel along a pipe to a cylinder containing a piston. When the piston is forced along the cylinder by the pressure resulting from the expanding gas the linear motion is transformed into rotary motion by means of a screwed sleeve. This rotary motion is utilised to turn the engine over several times. An exhaust valve opens when the piston has travelled a certain distance and the gas discharged. Due to the high pressures reached, a safety disc is fitted which collapses when the safe pressure is exceeded.

A magazine is usually fitted so that approximately half a dozen cartridges are available. Different cartridges with varying quantities of explosive are available for starting up various engines in varying climates.

A variation of the above system is that in which the gases produced when the cartridge is fired are led direct to the cylinders, thus forcing the crankshaft to rotate.

Summing up the methods of starting which have been described, it will be seen that there are eight methods, i.e., hand swinging, Hucks starter, hand inertia, hand direct, electric inertia, electric direct, gas, and cartridge starters. Each one of these systems has its own disadvantages and advantages, and when deciding which one to employ several factors should be considered. For low-powered engines an auxiliary starter is not generally required. The advantages of the inertia starter are as follows: the engine is rotated fairly rapidly, the weight is reasonably low and starting in cold weather is not affected by the stiffness of the engine.

This Enlightened Age

By LESLIE MADEN

DURING the past 50 years there has taken place one of the most remarkable and rapid changes in history. Science, from being a strange new cult, still groping and struggling to clear away the cobwebs of ignorance and superstition that clogged and biased men's minds, has striven forward surely and confidently, transforming on its way almost every sphere of life, and opening up new and undreamt-of vistas.

Education, too, has made great progress, and now, more than ever before, ordinary men and women have ample opportunity to form intelligent opinions of their own. Surely then, this twentieth century of ours must be a very prosperous and happy period in which to live? There is so much to find out; so much to perfect and improve; so much that lies ahead of us. A golden age, indeed!

Yet, within the same short space of years there has taken place a strange and ghastly paradox, for while we have progressed, we have also regressed. Side by side with all the scientific wonders of the age, there has marched an extraordinary chaos of savagery and bloodshed unparalleled since the Dark Ages. Civilisation has cracked, and the crack has broadened into an ever-widening chasm that threatens to engulf us.

How did it happen? How has this madness come about? In large measure, surely, it must be attributed to our financial system. When money was regarded merely as a convenient medium of exchange, it did no harm, but, unfortunately, it soon became the predominating factor in all business transactions, its original purpose, which was to facilitate the exchange of goods, being reversed by the practice of using goods to facilitate the amassing of money.

This false financial development did immeasurable harm to the economic and social system of this country, and to many others. The marvellous inventions of science began to be exploited for purposes which were warlike and horrible, and the thoughts of many people became correspondingly warlike and horrible. They shut their eyes to the obvious imperfections of the existing social system. Anyone possessed of sufficient moral courage to question harmful and frequently treacherous activities was invariably shouted down by cries of "Red!" "Bolshie!" or "Don't interfere with the man at the helm!" The fact that there was more than one man at the helm, and more than one helm, and that everyone was steering full steam ahead for a head-on crash appeared to be generally ignored.

Well, now the crash has come. The past lies behind us—a black record of greed and graft, and utter irresponsibility of outlook by the common people towards their own much-boosted "self-government." We shelved the responsibility of that government on to anybody who cared to take it, and the present indications of the disintegration of the civilised world are the bitter fruits of our folly. The future stretches before us—grim, dark and uncertain. No one seems eager to tackle the vast problem of post-war reconstruction. Instead, we are given smooth assurances that it can quite safely be deferred until "this Hitler business is finished."

But wouldn't it be better to face it now? Wouldn't it give us more zest for the struggle to know, once and for all, what we are fighting for, what are our common aims? At the moment different people seem to be fighting for different things, some for the perpetuation of the old regime, and some for an improved social system which has, as yet, no practical foundations. Wouldn't it be better to lay those foundations now, firmly and securely? After the war we shall all be so confused and exhausted that no one will have the energy or enthusiasm to apply to the working-out of a new social order, and it will no doubt be an easy matter to convince us that the old system, with all its miserable weaknesses and injustices, will be the most convenient. "After all," the politicians will tell us, "it is established, it has been tried before." They will, however, neglect to add "—and failed."

Reclaiming Porous Castings

How Defective Castings are Made Good with Special Sealing Solutions

IT is well known in engineering circles that in spite of the utmost care in manufacture, metal castings often show porosity, although the defect is generally slight. This porosity, however, may be sufficient to cause rejection of the castings with consequent loss of money, time and labour. In the case of large objects, this return to the melting pot is much to be deplored, especially as an efficient and simple remedy can be found. A British product has been introduced in this country by Bakelite Limited, of London and Birmingham. For overcoming porosity, sealing solutions are used, namely, Bakelite V.1845 and N.2106. The former is a clear solution of a special resin and is used in cases of fine porosity, whereas the latter is a solution containing a finely divided mineral filler and is employed when the porosity is of a grosser nature. These solutions may be used for both ferrous and non-ferrous metals, and factory trials have demonstrated conclusively that the results produced are highly satisfactory.

Sealing Solution

There are two main methods, one, for small castings, by which the sealing solution is forced into the casting by external pressure, and the other, for large hollow castings, by which the solution inside the casting is subjected to pressure, thereby forcing the solution through the walls from the interior. The small castings can be treated by the well-known vacuum-pressure process, in which the castings are placed in a strong container from which the air can be evacuated. When a suitable vacuum has been attained, the sealing solution is allowed to run in from the storage vessel until the castings are covered, after which pressure is exerted for a convenient time. The solution is thus squeezed into the body walls of the casting, filling the pores. After removal from the vacuum-pressure chamber, the castings are submitted to a baking operation to be described later.

For Large Castings

In the case of larger hollow castings an example may be taken of one having several outlets. All but one of these apertures are closed, the open one being used as a port for filling the casting with the sealing solution and as an opening through which pressure may be exerted. The casting may be either in the trimmed or untrimmed condition, since final machining can be carried out after sealing, if desired. When the remaining exits of the casting are effectively plugged and the hollow casting is filled with the sealing solution, air pressure is applied at the open port so that the solution is forced from the interior into the pores of the metal. Any available pressure from 50 up to 250 lb. per sq. in. may be used. If any porosity exists, the solution is forced through so that sweating occurs on the outside surface of the casting; although in the case of gross defects the solution emerges as a spray. While it is probable that a casting showing such leaks would be returned to the foundry, it may be stated that even severe porosity can be cured by two impregnations of the solution N.2106, followed by intermediate stoving.

Polymerisation

By this impregnation process, which is carried out at normal atmospheric temperature, some of the sealing solution remains within the walls of the casting; the next step is to "fix" it therein. The solution consists chiefly of a Bakelite synthetic resin which, by the application of heat, is converted from a soluble and fusible substance into a solid which is no longer soluble or fusible, and which is highly resistant to nearly all forms of attack. This transformation is known as polymerisation, and Bakelite in this cured condition has no known solvent. The first stage of the baking process removes the solvent, and further heating leaves the pores of the casting filled with a chemically inert solid which cannot be removed by any pressures applicable to the casting in service or on test.

In order to effect this polymerisation, the following procedure is adopted, although much latitude is permissible:

1. After the pressure has been exerted for some time as is considered necessary, the casting is drained and lightly wiped with a cloth moistened with a thinning solution (also supplied by Bakelite Limited) in order to remove the excess of material adhering to the surfaces of the casting.
2. The casting is now placed in a suitable oven, well ventilated, at ordinary atmospheric temperature. Heat is applied so that during the first hour the casting is brought to a temperature of about 85 deg. C.
3. After the solvents are removed, the temperature is raised to about 110 deg. C. for an hour and finally raised to 135 deg. C. for a similar period.

When the stoving cycle is complete the casting is sometimes refilled with sealing solution and again subjected to pressure. This second impregnation will test whether all the pores are filled; if any sweating can be observed the casting is ready for a second stoving, which, however, is seldom required.

Hydraulic Tests

It will be noted that the castings have not been subjected to the usual hydraulic test; nor is this necessary, since the sealing solution itself acts as a pressure test medium which will detect any porosity and at the same time will charge the metal with the filling fluid, thus effecting a great saving of time. In fact, water must not be used; or if it were used as a test liquid, the casting must be dried thoroughly before the solution is placed therein. Of course, after the process of impregnation and stoving has been completed, the usual hydraulic tests may be carried out.

This method of salvaging porous castings should be especially welcome under war conditions when time is so valuable and when every porous casting thus salvaged can be put into service, instead of beng returned as scrap to the melting pot. The material is stated to be inexpensive, and little is actually consumed by any casting, since any solution which has not entered the metal wall is returned to the storage vessel for use upon subsequent occasions.—*Machinery*.

WAR-TIME BATTERY THREE

(*Continued from page 127.*)

plus ⅜in. turn up for fixing. We were able to use a piece of thin aluminium, and this is to be recommended if available, but failing this, zinc—plain or perforated—or a piece of tinplate could be used.

Little can be said about locating the components, as their relative positions are clearly indicated on the plan drawing. A word about the screen and coils is, perhaps, advisable, as it is essential for these to be fixed in the positions shown otherwise instability might be produced, due to the fact that the coils themselves are not enclosed in screening cans.

After the valve holders, H.F. choke, two-gang condenser, terminal strips, and component brackets have been fitted, the screen can be screwed in position, but only after the four holes have been drilled in it to allow the filament wires, the anode connection, and one lead to the fixed vanes of the front section of the two-gang condenser, to pass through. The fixing and wiring of the coils should be left to last, otherwise there will always be present the danger of damaging them. Their connections are shown quite clearly on the wiring plan.

It is essential to see that all connections, especially those to earth, are electrically sound, and we strongly advise soldering. A poor or intermittent connection can ruin the efficiency of any circuit, therefore, if terminals are used see that their contacting surfaces are bright and clean, and that the head is firmly screwed down.

Variable Factors

It will have been noted that the primary windings of the aerial and R.F. coils are not the same. This is due to the fact that the turns on the R.F. transformer were adjusted to give a degree of coupling satisfactory for a certain measure of selectivity and transference of energy.

The turns on the aerial coupling coil were likewise governed by selectivity, bearing in mind the varying types of aerial with which the set is likely to be used, and the widely differing locations. If, therefore, in any particular district a greater degree of selectivity is required, a few turns can be removed from the coupling coil, but it must be remembered that signal strength will also be reduced.

Two separate .0005 mfds. tuning condensers can be used in place of the two-gang component, but if this is done then they must be located so that the screen comes between them.

Operation

After completing all wiring, have a final visual examination and, if possible, apply a simple continuity test to satisfy yourself that no short-circuit exists between the H.T. positive lines and the L.T. or earth, before connecting batteries, etc.

For H.T. positive 1 use 120 volts H.T., for H.T. positive 2, 60 to 70 volts, and with the output valve specified 4½ volts grid bias. After connecting aerial and earth, accumulator and speaker, set the reaction control (the right-hand variable condenser) to minimum setting and switch on by means of the push-pull switch.

Rotate the two-gang condenser control until a transmission is heard; open the aerial series condenser to reduce volume, and then adjust the trimmers on the ganged condenser until the best result is obtained. Now close aerial condenser, and bringing up reaction until the circuit is *just below point* of oscillation, search for a signal towards the upper end of the tuning scale, i.e., ganged condenser closing. After making sure that no oscillation is present, again adjust trimmers to see if results can be improved. Repeat the procedure on a transmission at the lower end of the tuning scale, the idea being to obtain the most satisfactory trimming adjustment for the whole medium-waveband.

The Story of Chemical Discovery

No. 18—The Study of Solutions, or Matter in its Dissolved State

THE earliest races of mankind must inevitably have been aware of the fact that some materials dissolve in water whilst others obstinately refuse to behave in this manner.

Common salt is an example of the first category of materials; sand is typical of the second group of substances.

Possibly, too, our remote ancestors were cognisant of the fact that soluble substances dissolve more readily in hot water than they do in cold, but, so far as we can tell, they do not appear to have had any clear notions as to what happens to a substance when it enters the dissolved state.

Modern chemistry, when it was first founded in the 18th century, was far too busy with other matters to look into the question of the dissolved state. That remained a topic which was only taken up and scientifically examined at a comparatively late stage in the development of chemical science. Even at the present time, the subject of solvents and the true nature of solution has by no means been thrashed out to its ultimate extent.

Gases in Solution

Ordinarily speaking, we are all apt to regard a solution as a liquid containing a solid which has dissolved in it. There are other solutions, however. A gas can dissolve in a liquid to form a very strong solution. An example of this is the "ammonia" of the druggists' shops and household stores. This is a solution of the gas, ammonia, NH_3, in water. Perhaps, as some chemists maintain, some of the ammonia gas may have actually combined with the water to form a definite chemical compound, ammonium hydroxide, $NH_4.OH$, but that probable fact does not invalidate the argument that this "liquor ammoniæ" contains a large proportion of ammonia gas which has actually dissolved in the water.

Hydrochloric acid, HCl, is another similar case, for here we are confronted with a solution of hydrochloric-acid gas in water.

It is also a fact that one solid can dissolve in another solid. Molten glass, for instance, can dissolve certain metallic oxides which impart to it characteristic colorations. Rocks, too, can contain metallic compounds in the dissolved condition, and there are examples, also, of solids containing dissolved gases, although in the majority of cases a liquid tends to expel its dissolved gases before it congeals or solidifies.

We see, however, that the peculiar nature of solution is not one which is confined solely to solids and liquids. Given suitable conditions, any form of matter can enter into that peculiar state of union with another form of matter to which we apply the term "solution."

Salt and Water

In modern chemical science, the substance which exerts the dissolving action is called the *solvent*. The material which is dissolved by the solvent is known as the *solute*, and the substance or medium which results is termed the *solution*. Thus, in the case of salt and water, the salt (sodium chloride) is the solute, the water is the solvent and the resulting liquid is the solution.

Let us now consider this common example of salt and water a little more closely. Everyone knows that if you stir a small quantity of common salt into a basin or a tumblerful of water the salt will disappear from sight. If it cannot be said to "vanish into thin air," it can certainly, and with all truth, be maintained to have "vanished into thin water."

What has become of the salt during this common yet mysterious process? Obviously,

Svante Arrhenius.

the salt has, in some way, mingled with the water, because it imparts its own characteristic salty taste to the water. And, furthermore, if we evaporate the water by boiling, the salt remains behind after all the water has been driven off.

Still more, the salt is not in any way destroyed by the strange disappearing trick which it performs during the act of solution, for if we dissolve an ounce of salt in a pint of water and then carefully boil the water off we shall get back exactly one ounce of the same salt. Solution, therefore, is most clearly and emphatically not a destructive process.

Suppose, now, that to our basin or tumblerful of water we keep adding salt in small amounts at a time, stirring the liquid well after each addition of salt to ensure that all the salt has dissolved before a fresh quantity is added. We shall find, in this instance, that we can only go on making fresh additions of salt for a limited time, because, after a certain quantity of salt has been dissolved in the water, the latter will resolutely refuse to dissolve any more of the salt.

If, now, we take the solution of salt in water which refuses to dissolve any further amounts of salt, and if we warm that solution, we shall find that it will again dissolve more salt. But, if, afterwards, we allow that solution to cool, the extra amount of salt which it has dissolved at the higher temperature will again appear in the liquid as the latter cools, the salt, in this case, being "thrown out" of the solution.

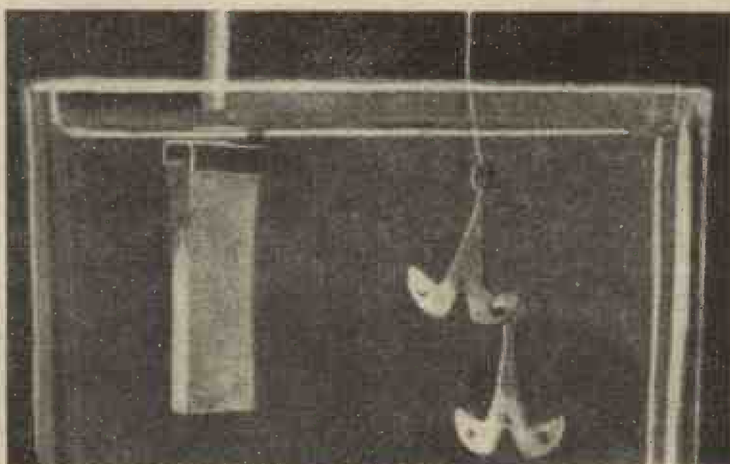
"Saturated" Solutions

Liquids, therefore, can only dissolve a limited amount of solid material at any one degree of temperature. A solution which contains the maximum amount of dissolved substance or "solute" is known as a "saturated solution." The precise strengths of all saturated solutions depend upon the temperature of the solution, its chemical nature and, also, upon the chemical nature of the "solute" or dissolved substance.

Such facts are fairly well-known ones, and they are facts which any seriously minded experimental amateur can easily confirm for himself. They do not, however, take us directly to an understanding of the real nature of the act of solution. In other words, they do not afford us a clear indication of what the fate of a teaspoonful of salt or sugar may be when it is stirred into and dissolved in a vessel of hot or cold water.

The clue to our present-day explanation of the problem of solution came in a very roundabout way. In or about the year 1877, a German scientific worker, W. Pfeffer by name, a botanist, made a careful study of the curious phenomenon which occurs when a piece of parchment or skin is interposed between a solution of a salt and some plain water.

If we tie or cement a piece of skin (such as bladder skin) across the wide end of a glass funnel we shall have what is called in chemical science a "membrane" through which water can freely pass; but one which prevents the passage through it of a dissolved substance. Such a device is known as a "semi-permeable membrane."



A typical electro-plating bath for small objects. The theory of electrolytical dissociation explains the phenomenon of electro-plating by assuming that the electric potential applied to the bath gives direction to the ions into which the dissolved substance is split up.

Osmotic Pressure

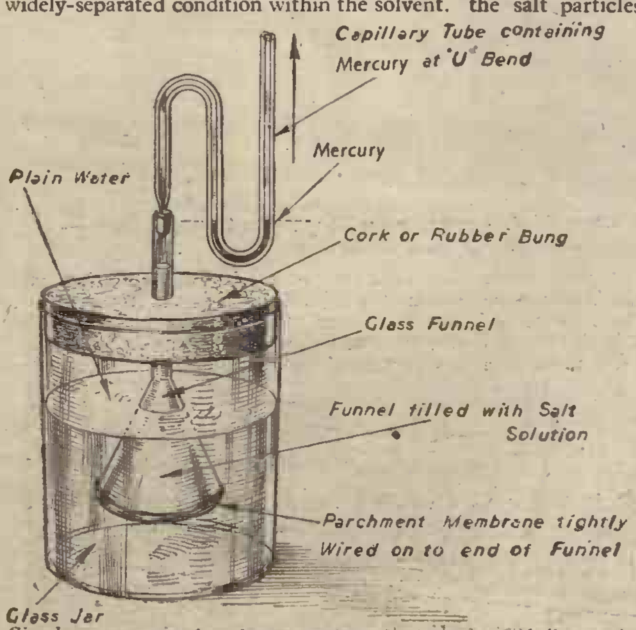
Now, if we secure the funnel membrane downwards in a jar of plain water, as indicated in the illustration, pour into the funnel a solution of salt, and finally secure to the upper end of the funnel stem a bent tube containing a little mercury, we shall find that after the funnel has remained in this position for some hours the mercury in the open column has been forced upwards, thus indicating the fact that a definite pressure has been generated within the apparatus. This degree of pressure is now spoken of as "the *osmotic pressure* of the salt solution" (Greek: *osmos*, "a push.").

Whence can this clearly-demonstrable pressure have arisen? Investigation in all such circumstances reveals a very curious action to have taken place. The parchment or skin membrane passes water freely in either direction, but it will not pass the dissolved salt. If the membrane had permitted the water and the dissolved salt to pass freely in either direction the net result, after a time, would have been that some of the dissolved salt on one side of the membrane would have passed through the membrane and would have diffused into the plain water. Under these circumstances, this process would have continued until the balance of salt and water had equalised itself on both sides of the membrane.

In the case of a semi-permeable membrane such as we have just described, however, a rather extraordinary thing takes place. Since, owing to the presence of the semi-permeable membrane, the dissolved salt cannot get to the plain water, the plain water actually goes to the dissolved salt. Because of the water which passes through the semi-permeable membrane to the dissolved salt, an extra pressure is generated on the solution side of the membrane, and it is this pressure which is indicated by the pushing up of the mercury in the bent glass tube.

Since this pressure (*osmotic pressure*) is clearly demonstrable without the least shadow of doubt, it is obvious that it must be caused by something. What this mysterious "something" is was, for a long time, undecided, but the modern theory is that the pressure is actually the result of the mass-bombardment of the particles of dissolved salt against the membrane.

Consideration of this and of similar experiments led a number of physical chemists to come to the conclusion that the molecules or particles of a dissolved substance exist in a widely-separated condition within the solvent.



Simple apparatus for demonstrating the existence of "osmotic pressure," or "solution pressure."

In its solid state, the constituent particles of common salt cohere together in consequence of their own mutual attractions. But when the salt is "dissolved" in the water what happens is that the salt particles are relatively widely separated. Each salt particle becomes, as it were, a particle of its own, an independent unit, and, as such, it celebrates its newly-acquired liberty by skeltering hither and thither throughout the liquid in much the same way as a particle of a gas scurries here, there and everywhere within a confined space.

In the act of solution, the particles of liquid have, as it were, interposed themselves or infiltrated between the salt particles. Whereas, in the solid state, one particle of salt was adjacent to another salt particle, in the dissolved condition hundreds of millions of liquid particles may exist between one salt particle and the next one.

Illustrating the nature of a saturated solution. A beaker containing water and crystals of a chemical salt. The water has dissolved a maximum amount of the crystals, and it will not dissolve more. The resulting clear solution is therefore "saturated."

The liquid particles are more mobile than the salt particles. Consequently, when all the particles of liquid are driven off by heat all that the salt particles can do is to fall together again and to assume their original state. They have been violently careering through the mass of liquid particles, but now that the latter have forsaken them they must necessarily return once again to their old state of mutual captivity.

Electrolytic Dissociation

The modern theory of the dissolved state and of the nature of solution is, for the most part, due to a celebrated Swedish chemist named Svante Arrhenius. He was born in 1859 and was, from the early days of his studentship at Upsala and Stockholm, particularly interested in theoretical and physical chemistry. Like many others, he pondered long and earnestly over the inner and the real nature of solution. It seemed to be a problem so close at hand, so intimate and yet so difficult of elucidation.

In his own words, Svante Arrhenius tells the tale of his now famous "theory of electrolytic dissociation":

> "I got the idea on the night of the 17th of May, 1883, and I could not sleep that night until I had worked through the whole problem. I had deduced a rather great number of different properties of solutions which had not been explained before, but I must say that this circumstance made no very great impression upon my professor at Upsala. I came to my professor, Cleve, whom I admire very much, and I said, 'I have a new theory of electrical conductivity as a cause of chemical reactions.' He said, 'This is very interesting.' Then he said, 'Good-bye.' He explained to me later—when I was presented with the Nobel Prize for Chemistry—that he knew very well that there are so many different theories formed, and that they are all almost certain to be wrong, for, after a short time, they disappear; and, therefore, by using the same statistical manner of forming his ideas, he concluded that my theory, also, would not exist for long!"

Arrhenius's theory of solution has, however, lived down most of its opposition. Briefly, Arrhenius pictured a particle of common salt (sodium chloride) splitting up into two particles immediately it enters into dissolving union with the water. In the dissolved state, the particle of salt (sodium chloride, NaCl) automatically divides up into a particle of sodium and a particle of chlorine. These particles are termed *ions*, an ion being an electrically charged particle.

Thus, according to Arrhenius, when common salt dissolves in water, it undergoes a process of "electrolytical dissociation" or electrical separation. It splits up into *ions* of sodium which are positively charged and *ions* of chlorine which are negatively charged.

The electric charges which appear on the ions come from the actual molecules of the salt (sodium chloride), the molecules being electrically neutral in the whole or unseparated condition but developing polarity in their components when they are split up.

When we pass an electric current through a solution of salt in water, we give systematic direction to the ions contained in the solution. The positive ions (of sodium) stream towards the negative electrode, whilst the negative ions (of chlorine) flow towards the positive electrode. Thus it is that if we electrolyse a solution of salt in water, we obtain the liberation of chlorine gas at the anode and metallic sodium at the cathode. (In this latter instance, the liberated sodium instantly reacts with the water, forming sodium hydroxide or caustic soda.)

Arrhenius has thus given us what is more or less the present-day accepted theory of solution.

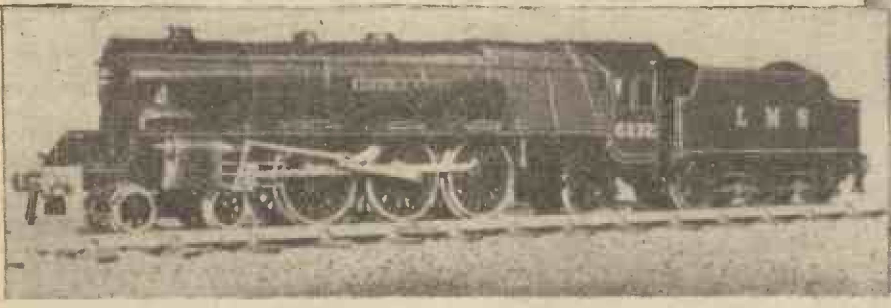
Prof. Ostwald

Svante Arrhenius was quite an unknown man at the time of his introduction of his theory of solutions. Like Cleve, his professor at Upsala, most of the famous chemists of the day gave him and his theory little encouragement. There was one celebrated chemist, however, who saw the germ of genius in Arrhenius's notions concerning solution, and this was Ostwald, one of the "fathers of physical chemistry," who was then professor in the University of Leipzig.

Ostwald championed Arrhenius's ideas on the difficult and abstruse, yet none the less highly important, subject of solutions and, to a large extent, it was due to the Leipzig professor that they gradually became accepted.

Arrhenius died in 1926 at the not very advanced age of 66.

THE WORLD OF MODELS By "MOTILUS"



Gauge "o" "Duchess of Montrose" locomotive—1938, and "Ajax" model locomotive—1892.

Fifty Years of Model Locomotive Progress

THERE is a line in a verse of one of the lesser known poets—"We dwell unjustly in the past."

I suppose all those who have passed the age of 60 do dwell—but not always unjustly—in the past. Henry Ford has said that we learn nothing from history except that we learn nothing, but, however true this may be of political history, it is certainly not true when applied to science and engineering.

In the development of model making as a hobby or craft I would say there has been no improvement for hundreds of years in real craftsmanship. In fact, some of the work of the Chinese of a thousand years ago is finer than any work done by the western civilisations to-day. It is in the commercially made model that progress has been so rapid during the past 50 years, in the making of publicity and museum models, but more in the adaptation of new processes and inventions and methods of production, which has enabled firms to place within the public reach, at reasonable prices, fine models, equal to many of the hand-made ones.

"Ajax" and "Zulu"

For the purpose of this article I would like to devote myself to just one aspect of progress in models, and that is the model locomotive. When I was a boy, about 50 years ago, the only model locomotives available for purchase in the shops were those early steam models with green boilers and brass wheels, which bore little resemblance even to the locomotives of their day. The "Ajax" and "Zulu" were cheaper models, and one of the more elaborate ones is illustrated here. They were not in the slightest way scientific in their design and, although they would probably work for a short time, the boiler was never powerful enough to generate sufficient steam to supply the cylinders continuously.

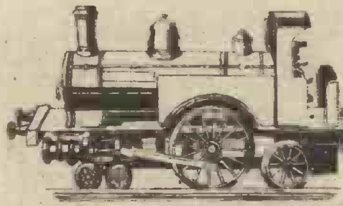


Fig. 1.—A Birmingham-made model locomotive—date about 1895.

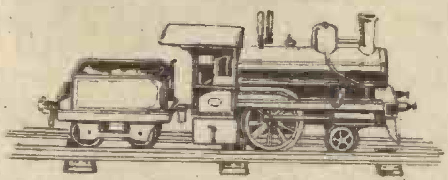


Fig. 2.—An oscillating cylinder steam locomotive of 1898 (continental made).

The early clockwork locomotives of the same period were mostly French and German make, were very flimsy and light in weight, and represented for the most part crude replicas of continental types. There were some excellent scale model locomotives of that period made by skilled engineers and amateurs, many of which are still to be seen in the museums of several cities of England.

About this period there were some very good commercially made model fittings and parts on the market for the use of model makers. Firms in Birmingham, too, were improving to a small extent the design and construction of model locomotives, which were sold mostly by opticians in those days. Fig. 1 shows an illustration of a Birmingham model of the 1895 period.

Foreign Models

At the Paris Exhibition of 1900 the continental toy makers, especially the Germans, made a very fine display of clockwork and working steam model locomotives, and Fig. 2 shows an oscillating cylinder steam locomotive for the continental gauge of 35 m.m. (known as gauge "o" (1¼in.) in this country). This and several similar locomotives, including an American type passenger train which comprised 4-4-0 locomotive and tender, two 4-wheel coaches, a bogie saloon coach and an American pattern brake van, were made by the firm of Carette & Co., of Nuremberg. M. Georges Carette was a Paris-born Frenchman, and established a factory in Nuremberg with a German partner, Paul Josepthal (both of whom, incidentally, are now in retirement, the latter in Palestine and the former near Paris). Another Nuremberg firm—Gebrüder Bing—were also showing a fine collection of mechanical, electrical and steam toys, including steam locomotives. About the year 1901 they introduced a special piston-valve cylinder reversing by means of a steam block operated from the cab or the

Fig. 3.—A continental steam model locomotive with piston valve cylinders—1901.

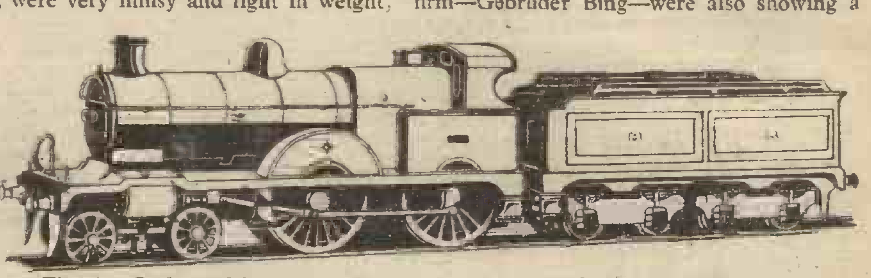


Fig. 6.—Scale model steam M.R. locomotive by Bassett-Lowke—3¼in. gauge—built mainly from castings.

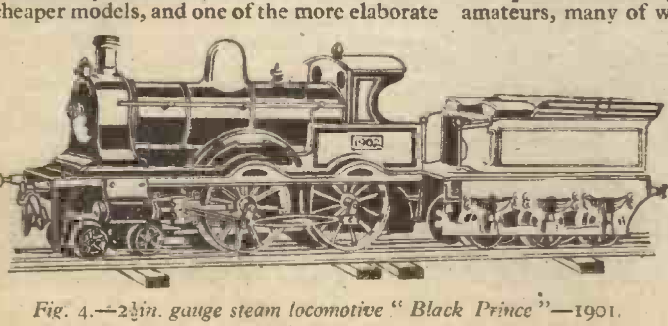


Fig. 4.—2½in. gauge steam locomotive "Black Prince"—1901.

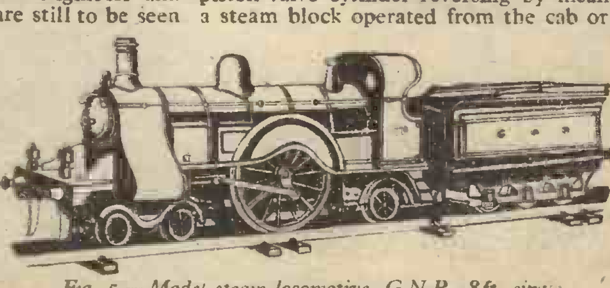


Fig. 5.—Model steam locomotive, G.N.R., 8ft. single locomotive, 2½in. gauge (1902).

rail, which reversed the steam inlets from steam to exhaust, and Fig. 3 shows one of the first of these models sold in this country. Messrs. Bassett-Lowke, of Northampton, who had previously confined themselves to hand-made models, fittings and parts, now turned their attention to the production of inexpensive model locomotives, and the first one—made in 1900—was a 4–4–0 L. and Y. locomotive, driven by two inside oscillating cylinders placed between the frames.

The "Black Prince"

Later they made use of the continental piston-valve cylinders, and the first model of this type was the 2½in. gauge "Black Prince," Fig. 4, which caused quite a sensation in the model-making world.

A model engineering journal in 1901 referred to this model in the following terms:

". . . a really creditable representation of the 'Black Prince' L. & N.W.R. locomotive and tender, with piston-valve cylinders and reversing motion, which is deserving of great praise as a genuine step in the direction of more realistic models than have often been supplied by professional model makers. After a practical trial of a sample engine, we were able to commend its good running ability. One of the happy purchasers of a similar engine writes: 'With only four burners going, and running light with tender only, it ran without a stop for 40 minutes, and covered over 3,000 yards . . . " From that point progress increased. The gauges for commercial models at that time most in use were 2in. and 2½in., except on the continent, where smaller gauges were in vogue.

The construction of the "Black Prince" was practically all sheet metal, the only castings being for the wheels. These were not to scale but light in weight and construction.

The model introduced from the continent by Messrs. Carette was a G.N. 8ft. Single, No. 776 (Fig. 5), and here castings play a larger part in the construction. The side-frames, the splashers and front buffer beams were fine iron castings, but the model was not a great success from the working point of view because it was too heavy for the low working pressure of about 40lb. All these steam models had a plain cylindrical boiler and were fired by wick methylated spirit lamps.

In the year 1903 Mr. Bassett-Lowke helped in an effort to satisfy the taste of those who built their own locomotives and required a full set of working drawings and castings for a well-known type of British model. The Midland Compound of that time was decided upon. Patterns were made and it was certainly a milestone in the production of complete sets of castings and parts for the amateur. The gauge was 3¼in. and the scale was ⅝in. to the foot, and the model when completed and used with scale model permanent way, made one of the finest scale model outfits that it was possible for the amateur to make, and placed the building of a model locomotive within the reach of many new enthusiasts. (Fig. 6.)

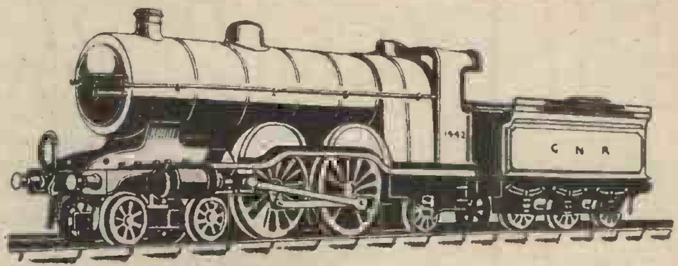


Fig. 7.—G.N.R. Atlantic type locomotive in clockwork (gauge 1).

Progress was very rapid between this period and the outbreak of war in 1914 and many fine models were introduced, both in clockwork and steam, including a G.N.R. Atlantic (Fig. 7) in clockwork and electric, a G.W.R. County class in steam and the Midland Compound in gauge 1, also the L.N.W.R. "Sir Gilbert Claughton" and rolling stock in tinplate in the various companies' style and colours. The outbreak of the last Great War brought the production of all articles of this description to a standstill, as it has done in the present hostilities.

Fig. 9.—An inexpensive 4–4–0 clockwork locomotive—gauge "0"—introduced in 1926.

"All-British" Models

In 1918, soon after the termination of the last war, Messrs. Bassett-Lowke put down plant to enable them to produce "all British" made model locomotives, in clockwork, steam and electric, and made themselves virtually independent of continental parts. (Fig. 8.)

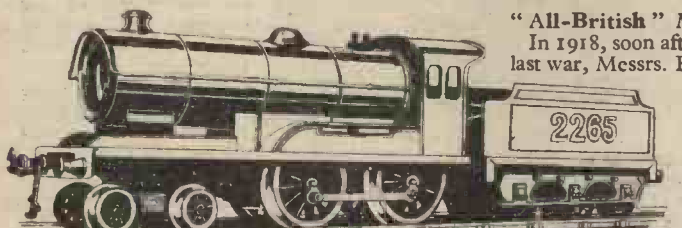


Fig. 8.—Peckett tank locomotive in gauge "0" and 1—clockwork.

Scale Model Permanent Way

The chief track in use at this time was the well-known tinplate track, but in the year 1902 Mr. George Winteringham introduced scale model permanent way to a scale of ¾in. to the foot, which was afterwards also produced in ⅛in. scale and is also used to this day for gauge "0" and upwards.

There was a great revival in the interest in model railways and this was well catered for by the introduction of many famous and inexpensive model locomotives, among which may be mentioned the 4-4-0 clockwork locomotive (Fig. 9). Another interesting model was the 2-6-0 Mogul produced in L.M.S., L.N.E.R. and G.W.R. types (Fig. 10), which was made up as a set of parts at a later period, having for its predecessor the set of parts for building the gauge 1 Midland Compound. Another type which contributed to the popularity of scale models in gauge "0" was the clockwork driven "Princess Elizabeth" which was also made in A.C. and D.C. electric. (Fig. 11.)

Fig. 10.—L.M.S. Mogul locomotive in gauge "0"—produced in 1925.

Introduction of "00" Gauge

In the year 1926 there was introduced from the continent "00" gauge, which was another milestone in model railway history, its size and gauge being 4 mm. to the foot and ⅝in. gauge (half "0" gauge). This was later developed into the famous Twin Trix railway, which before the war had an enormous following.

At the introduction of streamlining of our main line railways replicas in gauge "0" were introduced both in L.M.S. and L.N.E.R. livery. In fact the L.M.S. "Coronation Scot" model (Fig. 12) was on sale in London the day the locomotive itself made its first public journey from Euston to the North. Following shortly on this was the appearance of the model L.M.S. "Duchess of Montrose," last pre-war all-British model, recognised by all connoisseurs of model locomotive production as the finest commercial article then produced—at a reasonable price! (See illustration in heading.)

A High-class Scale Model

This brief survey of model locomotive progress would not be complete without a reference to the fine 2½in. gauge model of the "Flying Scotsman," constructional details of which were given in PRACTICAL MECHANICS during the early part of 1940. The first completed model was constructed at the Northampton works of Messrs. Bassett-Lowke, who also supplied the castings and all materials for making the model. The finished locomotive was an example of the finest model engineering craftmanship.

At this high spot we conclude the story, hoping that we may come back ere long to those happy days of peace, when the makers of commercial models may go full speed ahead with the experience they have gained, sadly interrupted by two major wars, to give us even better productions and refinements that have yet been thought of in the world of model railway operation.

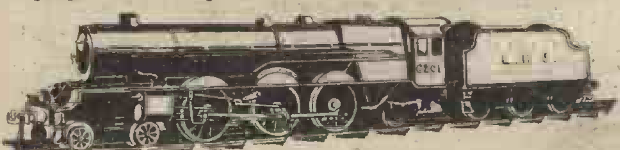


Fig. 11.—L.M.S. "Princess Elizabeth," gauge "0"—1936.

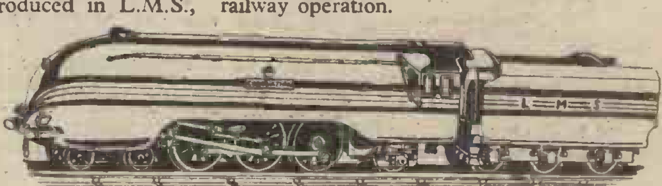


Fig. 12.—Model streamlined locomotive "Coronation Scot"—clockwork and electric—1937.

Our Busy Inventors

By "Dynamo"

Device for De-icing

JACK FROST is a fifth columnist, so far as the propeller blades of aircraft are concerned. The de-icing of these blades is the subject of a recently accepted application for a patent in this country.

The invention consists of a propeller blade which has conduits for de-icing fluid. These conduits are built into the structure of the blade.

A New Dress Form

AN inventor has been devoting his attention to the production of an effective dress form in order to assist the dressmaker to fit her customers. It appears that many attempts have been made to produce from a living model a dummy which is an exact replica of the feminine human form. For example, it has been proposed to mould the dress form by using plaster of Paris, wet papier mâché, glued paper tape and other materials. But it seems that none of these substances is entirely satisfactory. When exposed to damp, they become distorted and, being fragile, they are easily damaged. Also, when made from the living model, they cause discomfort to the person upon whom they are shaped.

Another idea for forming lay figures from living models has been moulds constructed in sections. These may be made of modelling compound such as is used by dentists for taking impressions of their patients' mouths, or of any other soft substance which, when heated, is plastic and, upon cooling, becomes rigid.

In this instance, each section is encased in a close-fitting cover of pliable material such as Jersey cloth. And the sections, after being heated to render them soft and plastic, are then connected by spring clips. Lastly, the flexible mould is placed on the model, the sections are fitted and the mould, when completed, remains on the model until it becomes cold and hard.

Good Form

THE inventor of this improved device maintains that it obviates the drawbacks associated with previous methods and he affirms that he has produced a light, tough, resilient form shaped accurately and without inconvenience to the living model.

His process consists in providing the model with a protective vest. Upon this vest he assembles and moulds to the contour of the model a number of stretchable sections of thermo-plastic sheet material. This has a fabric base impregnated with a composition of vegetable wax, rubber, beeswax and resin, which has been heated and rendered plastic and adhesive. While plastic, the sheet material is conformed to the living model, and the shell, thus shaped, is allowed to cool to room temperature and thereby stiffen into a form which may be removed in sections without distortion.

By means of this invention a woman might have made for her a kind of last in the shape of her complete form. And, as a consequence, it would ensure a perfect fit with a minimum of visits to her dressmaker.

Glider Release

TO-DAY in the theatre of war the glider plays an important part, and a recent invention relates to mechanism for the towing and release of these engineless aircraft.

The device comprises mechanism not only for towing and releasing gliders, but also for supporting and releasing bombs.

According to this invention, an attachment plate has a recess into which a plug fits. The plug has an eye for connection to the load or towing cable. It also possesses a hook-shaped head or projection engaging with a pivoted hook mounted in a socket at the back of the attachment plate. The pivoted hook is associated with a locking and release mechanism, by means of which the hook can be held securely locked in one position, and turned to release the plug when required.

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

Air Mine

AS a defence against air-raids, it has already been proposed to suspend a high explosive charge by a wire from a free balloon. The charge is designed to be exploded by enemy aircraft coming in contact with it. In one such proposal the device has been furnished with an external slow-burning time fuse, whereby the mine is exploded after some time has elapsed, if it has not been contacted by a hostile 'plane.

A model of a tank shown to the National Inventors Council in Washington, which, according to the inventor, is more powerful for quick thrusts into all kinds of terrain than anything now being turned out. It is also equipped with a bridge inside, which can be let out in front when the tank reaches a narrow stream, allowing it to go over instead of through the water.

An application relating to an aerial barrier against enemy aircraft has just been accepted by the British Patent Office. The invention provides means to control the period of the action of what is termed an air mine.

The contrivance includes a light container having within it a high explosive charge which is attached by a long wire to a hydrogen-filled coloured fabric balloon. This balloon is fitted with an adjustable automatic internal pressure-operated gas valve to release a certain amount of gas, when the device reaches the various heights required.

The gas valves of a series of balloons can thus be so adjusted that the air mines will ascend to different relative heights. The object is to constitute a curtain of defence in the aerial path of the enemy.

Fitted to the container are external fins. And in the event of the balloon being destroyed, the air mine automatically explodes with safety, before it reaches the ground. This is caused by one of two methods or a combination of both. The increased air resistance, when the air mine drops, is used to force a propeller and screw in contact with a percussion cap. Or the air velocity exerts a pressure on a diaphragm at the base of the mine and detonates the explosive.

The inventor states that the approach of aircraft will not disturb these mines prematurely; but contact with one of them or a wire will cause complete destruction.

Siamese-twin Shells

IT is claimed for a new form of projectile that, while it can be fired from a gun of ordinary construction, it possesses a wide area of striking power. It comprises two portions adapted to be separated while in the air but to remain connected by a chain or cable. The two portions each contain a bursting charge. One of them has a chamber containing the chain or cable. These two portions are separated by the action of heat and a delay-action fuse, and their charges are exploded by impact with their target or by a separate delay-action fuse.

Sealing Broken Gas Mains

IN an air raid the fracture of gas mains is an ever-present peril. To protect against this danger, an inventor has devised a means for stopping, or "bagging off," gas mains broken in air raids.

Broadly speaking, the device consists of an expansible bag or balloon which can be inserted in a fractured main. This is self-inflated by the evolution of a gas generated by the interaction of suitable chemicals brought into contact by the insertion of the bag.

Easy Shaving

AMONG recent applications for a patent in this country is one relating to dry shavers having free or floating blades which rotate in contact with a shear plate. The new invention includes a support for a blade of this character. In all its operations the edge of the blade is in intimate wiping contact with the shear plate. Not only does the blade act as an efficient cutter, but, in addition, the edge is continually sharpened by a sort of lapping action which prevents shaving from dulling the blade.

The device comprises a blade loosely mounted in a rotatable support arranged so that when the support begins to rotate the blade tilts backwards, while the cutting edge takes up an effective position with respect to a shear plate, behind which the support and blade rotate.

QUERIES and ENQUIRIES

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

Condensation Trouble

I HAVE a sheet steel garage which, in cold weather, has much condensation of moisture on its ceiling. I shall be grateful if you could recommend a remedy to prevent this.—L. Crapper (Liverpool).

THE condensation trouble which you describe is a very common one. It is also a very difficult condition to remedy. The condensation is caused by the atmospheric moisture condensing upon the cold surface of the sheet steel. Hence, anything which you can do to stop the conduction of heat through the metal will, wholly or partially, remedy the condensation. For example, the steel sheets might possibly be protected on their outsides with tiles or asbestos sheet in order to prevent or to inhibit the escape of heat from the interior of the garage. This would go far to lessen the condensation trouble. Some individuals have tried painting the troublesome surfaces with paints containing fine asbestos, the idea here being to produce a non-conducting film on the condensation-laden surfaces. In some instances, this notion has worked fairly satisfactorily; but in others it has failed.

We feel, therefore, that the most fundamental advice which we can offer you is to the effect that you should make all possible endeavour to heat-insulate the surfaces on which condensation appears. If you can effect this, the trouble will disappear, since condensation cannot make its appearance on a surface which is as warm as the air making contact with it.

Wire for Spark Coil

I HAVE on hand a quantity of No. 30G enamelled wire, about 1¼lb. in weight. Would that amount of wire be suitable for making the secondary for a 1in. spark coil? If so, what size of core and amount of wire, and gauge, will be required for the primary?—Robert Dunting (Rochdale).

THE quantity of wire you mention for the secondary of a 1in. spark coil is sufficient in weight, but would hardly give a spark 1in. long as its diameter is rather larger than usual, and would, consequently, give insufficient number of turns. You may, however, get a ¾in. spark, and the relatively heavy gauge will ensure a heavy current discharge, resulting in a "fat" spark. The size of iron core recommended is ½in. diameter by 7½in. overall length, composed of soft iron wire No. 22 gauge. For connection to a 4-volt accumulator the primary should be wound with two layers of No. 14 s.w.g. d.s.c. copper wire, and the condenser may consist of 60 sheets of tinfoil 6in. by 4in., interleaved with waxed paper.

Removing Ink Splashes

I SHOULD be grateful if you could tell me how to remove ink splashes from a much valued book without defacing the page.—H. A. Burrough (Bristol).

WE might have been of more detailed assistance to you if you had told us what type of paper the ink splashes have been made on; whether they are large or small splashes, and whether they are made in ordinary ink or with any special type of ink. However, assuming that the splashes are of ordinary writing ink on reasonably good paper you can eliminate them by saturating a piece of pure white blotting paper with a solution of sodium hypochlorite (ordinary "Milton" will do). The blotting paper is then laid down on the ink splash and pressed firmly into contact with it for a moment or two. After this, take a clean piece of cotton-wool, dip it into a weak solution (say, 5 per cent. solution) of hydrochloric acid (spirits of salt), and wipe it lightly over the ink splash. The latter will disappear almost instantly. The area of paper where the splash has been should now be carefully wiped over with another piece of cotton-wool which has been dipped into hot water, and then wiped over a piece of soap. This final treatment removes

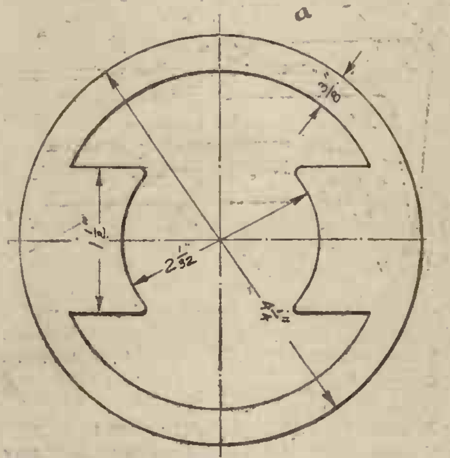


Diagram of two-pole field magnet of the iron-clad type for a synchronous motor.

the trace of acid from the paper, which acid, if it were not removed, would slowly disintegrate the paper.

The above two solutions (i.e., sodium hypochlorite or "Milton" and 5 per cent. hydrochloric acid) should be procurable from your local druggist. Or, if you prefer, this highly efficient two-solution ink-eradicator can usually be obtained from manufacturing stationers and dealers in office supplies.

We must again stress the fact that, after you have removed the ink stain, you *must* treat the paper gently with soap and water in order to remove all traces of acid.

When performing the operation of ink-stain removal always take the precaution of having one or two sheets of waxed paper under the sheet undergoing treatment in order to keep the solutions from making contact with the underlying papers. Use all solutions as sparingly as possible and *do not* attempt to dry the paper by ironing or by heat. Allow it to dry spontaneously. Then, when it is dry, you may iron it in order to flatten it and to smooth it off.

Commutator-type Rectifier

I AM thinking of constructing a small synchronous motor to drive a commutator type rectifier, and I should be obliged if you could help me by clearing up a few points.

I want this motor to run off a 12-20 v. 50 cycles supply at a speed of 3,000 r.p.m., and to develop enough power to drive this rectifier, which has four brushes. It will have to be a two-pole job, and I want to make it self-starting if possible.

(1) What size and shape should I make the laminated field magnet?

(2) Will one coil be sufficient for the windings, and how many turns, and what s.w.g. wire will be necessary?

(3) How wide and what length should the rotor be?

(4) Of what material should the rotor be constructed?

(5) Will "shading" opposite halves of each pole face with a copper band make the rotor self-starting?—J. Burnell (Barnstaple).

IF the 4-brush rectifying commutator runs freely without a great deal of frictional resistance from the brush pressure an armature of the H-type, 2in. diameter by 1½in. long, should suffice for the synchronous motor. Both field magnet and armature must be laminated, the former being of the 2-pole ironclad pattern to the dimensions of accompanying sketch, the two field coils being wound each with 45 turns of No. 18 s.w.g. d.c.c. copper, for operation on a 20 volts A.C. circuit. As regards self-starting this presents too many difficulties to be practicable on such a small scale, and is hardly necessary, as a spin of the shaft with the fingers in either direction should cause the rotor to run up to synchronous speed if the brush pressure is relieved momentarily. The starting torque derived from "shaded" pole-tips by means of copper loops is negligible for such small dimensions.

Chemical Cigarette Lighter

CAN you please give me any information about the chemical (non-electric) cigarette lighters, as used by quite a large number of American soldiers? I understand that to light a cigarette one has merely to insert tip of cigarette into a special opening provided, and to draw in; the chemical composition inside lights the cigarette, due to the air passing over it.—F. Peover (Macclesfield).

QUITE a number of "chemical" cigarette lighters have been attempted from time to time, but none of them have ever been very successful for the reasons that, so far, their action has been, to say the least, highly erratic. They often manage to contaminate the cigarette with the taste or flavour of traces of chemical, and none of them is without danger.

You do not state the actual make of lighter which you refer to, but, from your description, we should judge that the gadget comprises a metal case enclosing asbestos packing which has been impregnated with red phosphorus in a finely-divided state. When the end of the cigarette is inserted into the container, it picks up a trace of the phosphorus, which latter, due to the friction created by the withdrawal of the cigarette, ignites momentarily and so lights the cigarette, this action being aided by inhaling a current of air through the cigarette when it is in position in the lighter.

None of these lighters is manufactured or marketed in this country, so that we have not available the precise details of the lighter construction which you require.

Noisy Gas Fire

HOW can I make a five-element portable gas fire burn without noise? Gas fires supplied by the companies burn silently. Why?—W. J. Welchman (Harrow).

THE cause of noise with your gas fire is probably due to one or more of the following faults:

(1) Single-hole gas discharge orifice in the injector. For silence this orifice should have several (10–12) small holes in the form of a double cross.

(2) The gas discharge orifice in the injector has a short channel compared with its diameter. A thin-walled orifice is generally noisy.

(3) The gas discharge orifice is not concentric with the mixing tube.

(4) The mixing tube has been left rough-cast; it should be reasonably smooth inside.

(5) The aeration is too keen. The blue cones at the burner ports should be ½in. to ¾in. long. Adjust the air shutter to obtain this result.

(6) The burner ports should preferably be made of fireclay, and be divided into several small holes.

(7) Excessive gas rate. When cones are half to three-quarters of an inch long the flame should reach three-quarters of the length of the radiants.

First check points 5 and 7. When correct, this condition will give the quietest possible operation without making alterations to the fire.

Concrete Filler

CAN you give me any information regarding the new concrete which can be sawn and nailed like wood? I know that sawdust and cement is used, but do not know in what ratio. Is there any chemical used to treat the sawdust? If so, what is it, and where can it be obtained?—Geo. Thomson (Leven).

THE special form of concrete to which you refer is probably that made with a "filler" consisting of a mixture of sawdust and asbestos. You can make such a concrete in the following manner:—

Asbestos powder	58 parts
Dried clay	42 parts
Sawdust	100 parts

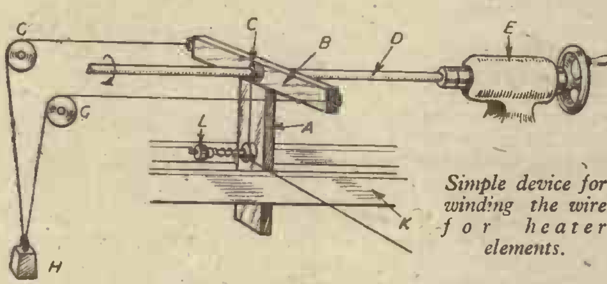
Intimately mix the above ingredients in the dry state. Then add four parts of the above mixture to one part of dry Portland cement. Mix well and slake with cold water to form a sloppy paste.

If you have any difficulty in obtaining supplies, or if you are in need of further technical information, we would suggest that you communicate your requirements to The Associated Portland Cement Manufacturers, Ltd., Portland House, Tothill Street, Westminster, London, S.W.1.

Re-plating Accumulator Plates

I HAVE re-plated a number of lead acid batteries, and find that the compound is gradually coming off the plates although it has only been on for a short time. I use the 40-60 formula, but I may add that the litharge and red lead is the ordinary commercial type, and not the special battery quality. Could I improve my compounding when making the next batch of plates—if so, could you give me directions?—Patrick O'Neill (Clare).

THE cause of the paste failing to hold in the lead grids is usually attributable to its being applied in too moist a condition. A very stiff paste is essential, and if it can be applied under pressure so much the better. Use brimstone acid only for mixing the paste, not commercial oil of vitriol. A lengthy experience in such work is essential to obtain entirely successful results. Many useful hints will be found in the handbook "Electric Accumulators," by A. H. Avery (Cassell & Co.).



Simple device for winding the wire for heater elements.

Winding Heating Elements

I SHOULD be very grateful for any information you can give me regarding a machine for the winding of spirals for electric hot-plates, fires, etc.

The sizes of wire I intend to use are .0148, .0201 and .0179.

I have constructed a machine, but am not satisfied with the method adopted for feeding the wire on the mandrel, and I feel sure there must be some way to prevent it running back.—C. Shaw (Penarth).

A METHOD of winding small spirals on the lathe in gauges between Nos. 26 and 36 s.w.g., which answers very well in workshop practice, is shown in the accompanying rough sketch. A hardwood or fibre T-piece A is provided with a metal bush at C of the same size as the silver-steel mandrel D on which the spiral is to be formed. The cross piece B carries two eyes from which a cord runs over two pulleys conveniently fixed at centre height to some stationary article, the cord carrying a weight H at the lower end which gives a steady tension endwise on the spiral as it is wound. Tension on the wire is provided by a double washer and compression spring L. The tail end of the T-piece slides easily between the two sides of the lathe bed to prevent it from rotating. Close-wound spirals up to nearly 18in. overall length can be wound by this device, with ease and certainty, and afterwards pulled out, either hot or cold, according to gauge of wire and spacing required.

Moulding Plastics

I WISH to carry out some experiments on the moulding of plastics. I intend to use steam or gas heated moulds of dental plaster of Paris, and would therefore require low-pressure and temperature thermosetting, or thermoplastic moulding powders. Is it possible to obtain such moulding powders, and if so, where can I obtain them?

Do you think I could obtain sufficient detail, such as printing, and thin lines, by using cellulose acetate in either sheet or powder form?—J. Lloyd (Keighley).

PLASTER moulds are not at all satisfactory for compression moulding. Such moulds crack under heat and may only be used for sample or pattern making. If the idea is to cast these moulds, then lead may be used, but still such material is not satisfactory for production purposes. Such moulds are used only for casting either resins or cold moulding compounds. If experiments are required to be carried out a plaster cast can be used for casting back both male and female in aluminium alloy.

Re-purifying French Chalk

I HAVE about 6lbs. of French chalk (talc) that is not quite clean. Will you please inform me as to how I could re-purify it?—F. G. Harding (Churchdown).

WE cannot give you specific advice regarding the cleaning of your French chalk, unless we know exactly what type of contamination it is affected with. Is the chalk greasy, or contaminated with colour pigment, soot, carbon, dust or grit.

You say that the chalk is "not quite clean," and, therefore, we assume that it has undergone some sort of dust or dirt contamination. In this case, your best plan, first of all, will be to rub the chalk through some coarse-mesh fabric, and afterwards through some finer fabric. In all probability this may completely remove the impurities. If this treatment fails, try bringing the chalk to red-heat in a suitable earthenware (not a metal) vessel. This may serve to burn out the impurities (which may be combustible), after which treatment the chalk should be sieved as before.

It may also be possible to "wash out" the impurities by stirring the chalk into a large volume of water and then allowing it to settle. With this treatment, the impurities will most probably rise to the surface of the water and will thus be readily swilled away. If you adopt this treatment you will, no doubt, have to repeat it several times before all the impurities have been washed away.

Slow-speed Generator

I HAVE a Rotax dynamo (12 v. 10 amp.) and I wish to use it as a wind-charger. Can I have it re-wound as a slow speed dynamo (about 450 to 800 r.p.m.) to give 10 amp. output?—C. Kemp (Enfield).

YOU cannot rewind any dynamo to give its normal full output at only a fraction of its normal speed, even by specially rewinding. If you reduce the speed of the present car dynamo from, say, 1,200 r.p.m. to 600 r.p.m., as suggested, the result will be either half normal volts, namely 6 volts 10 amperes, or half the current output, namely 12 volts 5 amperes. You can slightly lower the usual speed by specially rewinding the fields with a larger gauge of wire, but it would reduce the efficiency and call for considerably more driving power, which is a disadvantage in the case of wind-driven generators. By rewinding the armature with more conductors and leaving the fields unchanged you can obtain the 12-volt output at a lower speed, but at the expense of output in current, since the armature wire will necessarily be of smaller size than originally, in order to get the extra turns per slot.

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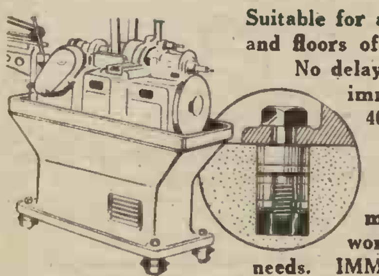

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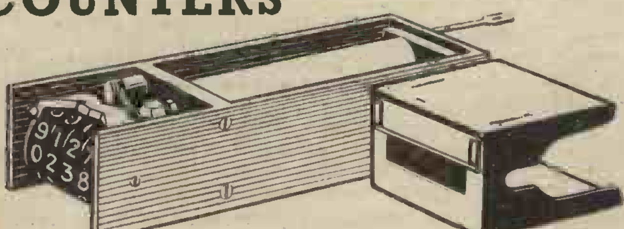

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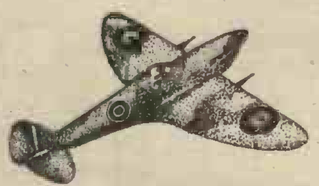

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1 K.W. TRANSFORMER, input 100 volts at 100 cycles, single phase, output 10,500 volts, centre tapped to earth. Price £4/10/-, carriage forward.

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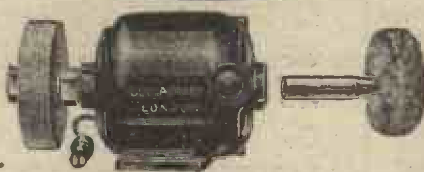

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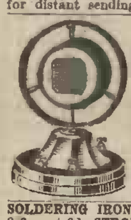

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What do you suppose would happen if a person who was putting himself into mental, moral, and physical bankruptcy by worrying, were to convert all this worry energy into constructive action? In no time at all he would have accomplished so much that 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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Editor: F. J. CAMM
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Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

Comments of the Month — By F. J. C.

The Roadfarers' Debate on Road Surfaces

NEARLY 50 members of the Roadfarers' Club were present at the Clarendon Hotel, on Saturday, November 21st, for debate on road surfaces, which was preceded by a luncheon. Lord Kenilworth was in the chair, and other important members included Mr. C. G. Grey, Major Frank Bale, O.B.E., A. Logette, A. H. Bentley, A. H. Burgess, W. G. James, Capt. F. C. Day, J. Dudley Daymond (chairman), C. A. Smith, W. J. Mills, Maurice Newnham, Dudley Noble, H. Boon, T. D. Osborn, R. A. West (secretary), V. S. Bowman, J. L. Callway, E. Coles-Webb, E. P. Richford, J. E. Rawlinson, and J. A. Masters. Sir Henry Maybury, who was to have opened the debate, was ill and therefore unable to attend.

Lord Brabazon, the president of the Roadfarers' Club, had prepared a paper which Lord Kenilworth read in opening the debate. In the course of this paper he said: "I suppose there are more different road surfaces here than anywhere else in the world. No one seems decided as to the best. When I was at the Ministry of Transport, I discovered that in the north of London they were pulling up wood blocks and putting down granite sets, and in the south of London they were pulling up granite sets and putting down wood blocks. But why wood blocks? Originally to prevent the noise of horses' hoofs, but if that is the basis, then I wonder we don't put straw down everywhere as we used to do for invalids.

"Starting from London as you come on to the Kingston by-pass there are patches of bitumen mixtures, each bit about 300 yds. long, which merit the attention of road users. As far as I remember, the fourth stretch is the best, but they all show that bitumen with its proper mixtures need not be slippery. Straight asphalt is a death trap, however, and is self lubricating. Some roads remain dry looking even in rain, others are always wet and seem to sweat under certain conditions. The construction of such should be avoided.

"The change when motoring from one surface to another without notice is sometimes very dangerous, as what is a perfectly safe speed on one surface may be unsafe on another.

"One word as to the 'hard' or plain concrete road. Is the alternate Bay form of construction essential, as it gives a poor ride and often gets in tune with the natural up and down spring period of a car, when the most extraordinary results occur. Surely, as even on railway lines they are starting to do without breaks for expansion, longer stretches of concrete roads could be indulged in.

"As to camber. Could instruction be given as to which is the right way to 'bank' a road, or super-elevate it, as they call it, as I know of some examples of severe banking which, under icy conditions, are exceedingly unpleasant.

"Finally, why elevate kerbs? Is this for ornament, to keep the water on the road, or just to keep the accident rate up?"

Lord Kenilworth expressed the view with which many will agree, that the roads of this country are, generally speaking, good, and he disagreed with one of the speakers who thought that borough surveyors were responsible for some of the bad road surfaces. Lord Kenilworth displayed great knowledge of road matters and road policy, and very ably conducted the meeting.

Another famous road authority expressed pleasure that the Roadfarers' Club has in the very early stages of its existence realised that road surfaces are one of the most important aspects of our difficult road problems. "As a member of this very important organisation, which I am certain will perform valuable work, I believe that if we can make the roads safe for all, and consider the especial needs of each section of roadfarer, another great object of the club will be achieved, namely an improvement in the friendliness with which each will use the roads. Bitterness results when one particular section uses roads to the detriment of the other.

"There can be no doubt that our road policy must be brought into line with modern traffic needs. It is useless to plan new roads unless great care is expended on the nature of their surfaces, with intelligent anticipation as to future developments of road policy. The Kingston by-pass is a good example of what I mean. Originally built as the last word in roads, it had to be reconstructed and widened a few years later.

"The Government has realised a long time ago that road surfaces are not all that is desired, for they formed the Road Research Board, with an experimental stretch of road at Harmondsworth, and a laboratory close by. It has investigated a large number of problems connected with different types of road surfaces, the causes of skidding, and the durability of road surfaces, all inter-related problems, for not only must the surface be reasonably skid-proof, but it must remain so under heavy traffic conditions and the rapid wear which that brings, and under a variety of weather conditions.

"These experiments and the conclusions drawn from them are made known to borough surveyors, but unfortunately the Ministry of Transport has not the power to compel their adoption, except in so far as the main roads are concerned.

"The colour of the surfaces has a very marked effect upon road safety. We cannot say that money has been lacking to bring about many obvious reforms. The Road Fund has produced millions every year, but the money has gone in other directions, although when the Road Fund was introduced by Lloyd George he said that it would be used for no other purpose than the making and upkeep of roads.

"Whether the Fund after the war will revert entirely to that purpose no one can say. But whatever reforms on road surfaces are proved to be necessary money will be required in abundance to carry them out. It will also take years to bring them into effect."

Other views expressed concerned the colour of roads, whilst Mr. J. A. Masters thought that a surface which may be good for motorists, such as a rough macadamised surface, was not necessarily the best for cyclists.

Mr. V. S. Bowman thought that the problem should be attacked from the tyre point of view, and he mentioned that one company had produced a method of treating tyres which made them absolutely skid-proof.

It is not possible here to report all the remarks and opinions expressed, but they are being submitted as a memorandum to the Minister of Road Transport.

The toast of the Club was proposed by Mr. A. Logette, with a reply by Mr. C. G. Grey; the Visitors and Press were toasted by Mr. F. J. Camm, with a response by Mr. W. J. Mills; whilst the toast of the Chairman was proposed by Mr. J. Lindsay Callway.

New members of the club include the Marquess of Donegall; Mr. H. G. Wells (writer of the famous cycling novel, "The Wheels of Chance," which was serialised in this journal just before the war); Lt.-Col. Charles Jarrott, O.B.E. (founder of the Automobile Association); Leonard Ellis (Secretary of the R.R.A.); Prince Birabonga (famous racing motorist under the name of B. Bira); Col. J. A. A. Pickard, O.B.E. (Secretary of the Royal Society for Prevention of Accidents); H. Samuelson (Secretary of the R.A.C.); Major Frank Bale, O.B.E. (one of the founder members of the Order of the Road); H. Morgan (Junior Car Club); H. Boon (Chloride and Electrical Storage Co., Ltd.); W. J. Bassett-Lowke; The Marquess of Queensberry; Sydney Camm (Designer of the Hurricane, Typhoon, etc.); and Trevor T. Laker.

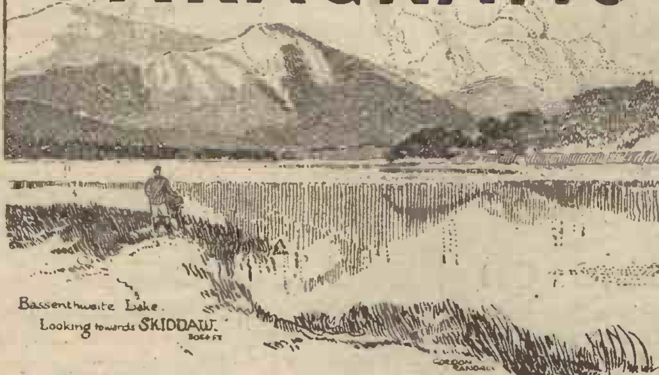
The club already has made considerable progress, and is representative of all sections of road users. It hopes to play an important part in post-war road policy and to avoid the clashes which occurred before the war between rival road interests. From time to time, the club will issue memoranda on various topics affecting the roads and road users, and it will submit them to the Ministry of Transport.

The club does not intend to work in opposition to existing organisations but to adopt an independent and helpful policy in its efforts to find solutions to pressing road problems.

When the war is over we cannot go back to the old system, and it is a wise move to found the club during the war when the roads are comparatively free from traffic, and to hammer out a policy which will make road travel a pleasanter thing than it has ever been. As a national body the Roadfarers' Club will take its place as the only Roadfarers' Parliament representative of all road users, fair to all, and not favouring any particular section.

The next meeting of this Roadfarers' Parliament takes place on Saturday, February 6th, when there is to be a debate on Road and Vehicle Lighting. Membership of the club is by invitation only. The secretary is R. A. West, 32, Elm Bank Gardens, Barnes, S.W.13.

PARAGRAMS



Lights Out at York

THE city of York has decided to put out all its automatic traffic signals. Other towns and cities please copy!

Cutlery and Crockery

USERS of hostels in North Wales must now carry their own cutlery and crockery.

Map Re-issued

THE youth hostel map of England and Wales has been re-issued in a revised edition.

New Channel-Paris Road

IT has been reported that the Germans are making a new 130ft. road from Paris to the Channel.

Ordnance Maps Again

ORDNANCE Survey maps, which have been in short supply, are now available in greater quantities.

To Wales by Bridge?

AT a meeting of caterers in North Wales, a road bridge from the Wirral across the Dee estuary into Wales was advocated.

Surfacing New Roads

TO avoid the use of imported bitumen, experiments are being made with quick-drying compressed concrete for surfacing new roads.

Regular Hostel Week-ends

THE Scottish Y.H.A. is asking cycling clubs to organise regular youth hostel week-ends as a means of keeping hostels open during the winter.

Surcharges Go

SURCHARGES for the use of fuel are being abolished at youth hostels. The latest areas to drop surcharges are the South Coast and the West Riding.

More Hostel Users

DURING 1942 a total of 31,158 visitors stayed at the hostels of the Y.H.A., Manchester Regional Group, compared with 24,656 in the previous year.

Cyclists and New Tyne Tunnel

ENGINEERS planning a new tunnel under the Tyne between Howdon and South Shields are giving consideration to a scheme for escalators for cyclists using the tunnel.

More London Hostelers

MEMBERSHIP of the Y.H.A. in the London Region was 22,760 at the end of the financial year, compared with 30,875 in 1939, 16,896 in 1940, and 16,199 in 1941.

Stole Vicar's Bicycle

A MAN who stole the Vicar of Newnham's bicycle was sent to prison for fourteen days at Hitchin. He was said to have sold the stolen machine to an American soldier.

New Youth Hostels

TWO new youth hostels are to be opened in the Manchester area shortly. They are situated at Whitehough Grange, near Barley, close to the famous Lancashire landmark, Pendle Hill, and at The Hall, Castleton, the Derbyshire resort.

Better Bicycle Facilities

THE L.N.E. Railway is to fit bicycle stands at suburban and country stations to accommodate the machines used by passengers travelling to and from stations. Existing facilities have become inadequate.

French Prices Controlled

VICHY radio recently stated that the prices of bicycles in France are to be controlled. The control applies to both new and second-hand machines, and to wholesale as well as retail prices. Second-hand machines must not be sold at prices which exceed those for new ones of the same type.

New High Record

A NEW high membership record has been made by the Scottish Y.H.A. During 1942 a total of 29,032 members was enrolled. Previous figures were: 1939, 18,720 (highest pre-war membership); 1940, 15,870; and 1941, 21,594. Most of the newcomers are young cyclists.

Bicycle v Tram

A BOY who stole the bicycle of a Glasgow insurance collector was spotted riding the machine next day while its owner was on his rounds. The collector seized the bicycle and the boy, but the latter made off on a tram, only to be followed and caught by the owner.

Rail Vouchers Cancelled

THE Ministry of Transport has cancelled the point-to-point rail vouchers issued to cyclists by the national cycling bodies, and the youth hostels associations. Members using these vouchers were permitted to travel by rail to one station and return from another.

"Bitterly Ashamed"

AT a meeting of the Town and Country Planning Association in London, Mr. W. H. Ansell, president of the Royal Institute of British Architects, said: "The ordinary citizen is bitterly ashamed of the slaughter on our roads, particularly of children, and demands that the new planning shall devote itself seriously to dealing with this blot on our national life."

Most Popular Scots Hostel

ONCE again, Loch Eck youth hostel, in Argyllshire, is the most popular youth hostel in Scotland. During 1942 it had 10,349 overnight visitors. Other hostels with good attendances were: Creag Dhu (9,466), Glen Loin (9,208), Strone (7,979), Edinburgh (7,745), Fintry (7,330), and Ledard (7,090). All these hostels, except Edinburgh, are in the popular Loch-Lomond-Trossachs area.

Round the Top of the World

SENDING his congratulations on the opening of the new Alaskan-Canadian military highway, Mr. Henry Wallace, vice-president of the U.S.A., predicted that the new road would be "part of an eventual highway serving the New World from the south of South America to Siberia," and went on to say that in the not too distant future it will be possible to travel overland from Buenos Aires to Moscow.

Famous Hostel Closed

DERWENT HALL youth hostel, opened by the Prince of Wales in 1932, has been closed. Its site is to be covered by a new reservoir. The week-end the hostel closed, some 160 cyclists and hikers held a party, and next day helped to dismantle and pack the hostel's equipment.

Increase at Manchester

AT the annual general meeting of the Youth Hostels Association, Manchester Regional Group, it was reported that during 1942 the total membership had grown to 10,448, an increase of 34 per cent. over the preceding year.

Famous Pilgrimage Recalled

ONE of the most famous pilgrimages by bicycle is recalled by the death of Lady Elspeth Campbell. In 1895 she led a party of Campbells into Glencoe in an effort to overcome the hatred which had been felt between the Macdonalds and the Campbells since the Massacre in 1692. Lady Elspeth rode through Glencoe on a bicycle, one of the first women riders to do this. Forty years later she was a passenger in the first vehicle to traverse the new Glencoe road.

Deserter Steals Bicycle

A DESERTER who stole a bicycle from a Falkirk works was fined £1 recently at a local court. It was stated that the man rode the machine to Glasgow, where he tried to sell it, but the man to whom it was offered was suspicious and notified the police.

Vice-president's Golden Anniversary

FOUNDER member and first secretary of the Finsbury Park C.C., of which he is now a vice-president, Mr. A. C. Crane has celebrated the golden anniversary of his wedding. He is president of the North Middx. and Herts C.A., and a member of the F.O.T.C.

A Clubman's Death in Action

ROBERT ATTEWELL, Nottingham Wheelers, lost his life when the submarine on which he was serving was sunk by enemy action. He was only 21 and was winning prizes in road time trials when he was 17.

Their Century

OVER 100 Sheffield Phœnix members are serving with the Forces.

Zenith Wheelers' Loss

DAVID BURNESS, Zenith Wheelers and West of Scotland road and track champion, has died of wounds in Libya. He served with the H.L.I.

A Good Record

FORTY members of the Fulham and Kensington section of the National Clarion C.C. are in the Forces. Two are prisoners of war.

Lion Road Club Re-forms

A FORMER fairly prominent North London club, the Lion Road Club, has re-formed. It ceased activities two years ago owing to dearth of active members.

Clubs Combine

PYRAMID ROAD CLUB and Abbotsford Park Road Club—both of Sheffield—are combining to provide open sporting events during the winter.

Smith Parker's "Tour"

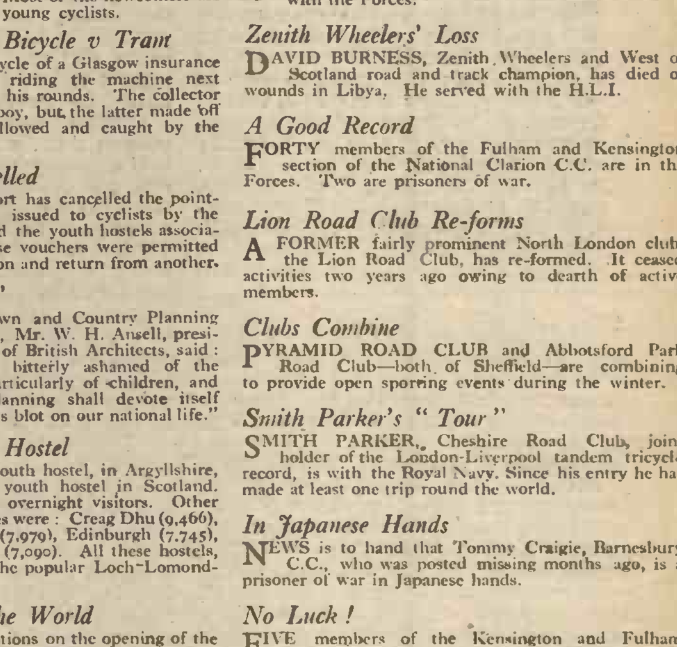
SMITH PARKER, Cheshire Road Club, joint holder of the London-Liverpool tandem tricycle record, is with the Royal Navy. Since his entry he has made at least one trip round the world.

In Japanese Hands

NEWS is to hand that Tommy Craigie, Barnesbury C.C., who was posted missing months ago, is a prisoner of war in Japanese hands.

No Luck!

FIVE members of the Kensington and Fulham Section of the National Clarion C.C., made an attempt on their club's London-Guildford-London record. Only two finished and both failed.



Seen by the wayside: The Telford Memorial seat, at Westerkirk, near Langholm, close to the famous roadmaker's birthplace at Glendinning.

A Novel Club

BRITISH prisoners of war in an Italian camp have formed a cycling club which has become affiliated to the National Cyclists' Union.

D.F.M. for Leeds Clubman

SERGEANT-PILOT FRANK ALLISON, Leeds Clarion C.C., has been awarded the Distinguished Flying Medal.

Cumnock Rally

NATIONAL conditions permitting, the famous Cumnock Rally will be held this year during the week-end June 26-27.

Around the Wheelworld

By ICARUS

Lord Kenilworth speaking at the Roadfarers' Club lunch reported on page 25.

B.S.A. and Cut Chain Wheels

C. A. (BATH ROAD) SMITH, who for many years has been advocating correct tooth form for chain wheels, and has taken the matter up with many manufacturers, writes:

"After all these years of my claiming the superiority of gear 'cut' wheels, B.S.A. Cycles, Ltd. write me that I have their full permission to inform the Press that their chain wheels are now gear cut to B.S.I. specification. With such a lead there is no doubt that the trade will forsake the idea of stamping out gear wheels. It may be a little cheaper, but look at all the trouble from replacement of gears, chains breaking, and discontent generally. The B.S.I. (British Standards Institution), formed in 1901 as the Engineering Standards Committee, gave the cycle trade all information *re* 'Steel Roller Chains and Chain Wheels,' and recommended the trade to cut the chain wheels. What did the trade do? They ignored the blessings of free advice and said cutting chain wheels was too expensive. And yet they spent no end of money on B.S.I. services, to which I have called attention before. The chairman of a big company recently wrote me how he enjoyed his cycle trips and how his friends joined in them, and all remarked how nicely the machines ran! In the July number of THE CYCLIST diagrams were given of these remarkable gears showing how they differed from the correct form of tooth form!

"I hope that the other large concerns will go into the matter, and, as I have said before, the small firms here have a chance of introducing 'cut' gears to the enthusiastic cyclists who support them. Start on these club riders and it will not be long before the word 'cut' gears will be on everyone's tongue. I believe 'cut' gears to be as big an improvement as the pneumatic tyre was to the bicycle 40 years ago. (I started to cycle on solid tyres in 1883!)"

The New Lamp Masks

FRANK URRY tells me that the new lamp mask for cycle headlamps, which is supposed to be designed to give more light, is a complete failure. He finds it gives less, much less. This funnel-shape design is the best the combined Ministries of War Transport and Supplies can do, apparently.

Road Accidents

THE number of fatal road accidents occurring on the roads of Great Britain during the black-out in October, 1942, has greatly increased.

Figures show that out of a total of 697 persons killed, 285 lost their lives in the hours of darkness. In the previous month the total was 553, of which deaths during the black-out numbered only 158.

The figures point to the need for greater caution on the part of all road users. Pedestrians are again reminded that it is not safe to rely on drivers seeing them. They should act rather on the assumption that drivers cannot see them. They can also help to protect themselves by wearing or carrying something light in colour.

Drivers are urged to regulate their speed so that they can pull up within the range of their vision, and to see that their lamps are properly adjusted.

The increase of fatal accidents to pedal cyclists in the blackout from 14 in September to 38 in October should underline the importance of seeing that lights and brakes are in proper working order.

The figures for October contain a warning—but they also contain a message of encouragement. Deaths in the black-out in this month since the beginning of the war have steadily decreased. They are as follows:

October, 1939—561
" 1940—501
" 1941—378
" 1942—285

Record Passed

LEONARD ELLIS, secretary of the R.R.A., informs me that the record claimed by R. Morford, of the South Western Road Club, and G. E. Lawrie, of the Viking Road Club, for the tandem tricycle four-hour record, in respect of their ride of 232¾ miles on July 26th, 1942, has been passed by the R.R.A. Committee.

The Cycle and Motor Cycle Trades and the Red Cross

WORKERS throughout the country are contributing £50,000 a week to the Red Cross through the Penny-a-Week Fund. A great effort is now being made by industry to secure at least similar regular support from employers.

H.R.H. The Duke of Gloucester, president of the Red Cross and St. John Fund, a short while ago asked Sir Harold Bowden, Bart., G.B.E., to make an appeal to the cycle and motor-cycle trades; and Sir Harold gladly consented to do so. Immediate and enthusiastic support was forthcoming from the British Cycle and Motor Cycle Manufacturers and Traders' Union. An extremely strong committee was formed under Sir Harold Bowden's chairmanship, consisting of Mr. Gilbert Smith, Major Frank Smith, Mr. Herbert Goodwin, Mr. C. E. Wallis and Major H. R. Watling. The committee thus includes the president and director of the Union and the two surviving immediate past presidents.

Sir Harold Bowden has sent a letter to a large number of those engaged in the two industries concerned, asking for their generous support for "The Cycle and Motor Cycle Trades Red Cross Fund."

It is recognised that many firms and individuals are already supporting the Red Cross, and indeed some have contributed handsomely to the Red Cross Sports Appeal recently directed to those interested in cycling as a sport. The committee feels, however, that in spite of this fact the cause is so deserving and the need so urgent that the response to this further appeal will be immediate and generous.

Most of the activities of the Red Cross in war-time are common knowledge. What is not so well known is that the Red Cross is the only agency through which parcels, including food parcels, can be sent to prisoners of war. *In this service alone the annual expenditure is £4,500,000—a figure which cannot diminish, and may be expected to increase as major operations develop.* On the basis of its current expenditure and commitments the Duke of Gloucester's Fund can only just make both ends meet.

A feature of Sir Harold Bowden's appeal is that subscribers are being urged to contribute annually, under covenant, for the duration of the war. The Red Cross, which is exempt from income tax, thus obtains double benefit from each subscription without extra cost to the contributor. This Fund is exclusive to the cycle and motor-cycle trades. It constitutes more than an opportunity to assist a great cause—it is a challenge to these industries.

Subscriptions or inquiries should be addressed to The Cycle and Motor Cycle Trades Red Cross Fund at St. James's Palace, S.W.1. Lists of subscribers will be published each week in the cycling and motor-cycling press.

N.C.U. Diaries for Members Serving Abroad

CLUBS wishing to send a copy of the N.C.U. Diary to members serving abroad may purchase the diaries in lots of not less than one dozen at 2s. per copy instead of 2s. 6d.

In making application for this concession, a certificate must be sent to the Union, signed by the secretary, certifying that the diaries are definitely required for members *serving abroad only*.

Too Much Camouflage

THE N.C.U. has just settled an interesting case in favour of one of its members. In some part of England the roads were being camouflaged with an apparently sticky substance, and the N.C.U. member skidded and

(*Continued on page* 28)

AROUND THE WHEELWORLD

(*Continued from page 27.*)

sustained injuries. The defence of the contractors was that he had passed over this road more than a number of times and knew that these operations were taking place, and in consequence, therefore, the fault was his. The Union's submission was, however, that they had no look-out man and no warning notice, and that their member could not possibly be expected to conclude that the road was in a dangerous condition if no warning to that effect was given, and further, that the contractors were evidently saving the expense of a look-out man and in consequence the cyclist sustained injury. The Union's submission proved to be a good one, and damages were awarded to the member.

R.A.F. to Get 170,000 Bicycles

SIX bicycle manufacturers have now completed the delivery of 170,000 standard machines for use on airfields. Pilots, among others, now use them to cycle to and from their aircraft and so save petrol. A proportion of the new machines are painted white for safety in the black-out.

Bicycle Thefts in America

MR. J. EDGAR HOOVER, Chief of the Federal Bureau of Investigation, recently commented on the great increase of thefts in bicycles and accessories in America. As in this country, when the theft is reported the owners are unable to give a description of their machines. Very few are able to give the serial number. Many American municipalities have adopted licensing of bicycles, and this has resulted in a reduction in thefts.

Need or Shall?

THE Lighting Restrictions Order for 1940 states that it is illegal for any light to be displayed otherwise than in a roofed building, closed vehicle, or other covered enclosure, and states that in the case of a bicycle it shall display the lights required by the Road Transport Lighting Act, 1927, which says that only a single lamp showing a white light to the front instead of two such lamps *need* be carried. A cyclist was recently prosecuted and convicted because he carried two headlamps showing a white light. He was fined 5s. The case on appeal was heard in the King's Bench Division, and Lord Chief Justice of England Viscount Caldecote upheld the decision. Thus, the word *need* in the Act means *shall*. Yet the same Act states that a cyclist wheeling a bicycle after dark may do so provided he keeps to the left-hand side of the road and *need* not show a light. By inference, therefore, this must mean he *shall* not show a light.

Notts Centre Massed Start Meeting

THE affiliated clubs of the Notts Centre met on December 1st, 1942, in Nottinghamshire to discuss the Emergency Committee's massed start circular. The chair was taken by Mr. Jack Holdsworth, the late National Organiser for Cycling, and the secretary of the Union, A. P. Chamberlin, was present. After a meeting of considerable interest, any questions were the order of the day, but no proposition desiring an alteration of the present rules of the Union was submitted.

N.C.U. Centres and Massed Start Racing

UP to date, five centres have held special general meetings to discuss the Union's massed start circular. They are:

South Yorks and North Derby;
Birmingham and Midland;
London;
Devon and Cornwall;
Nottinghamshire.

The secretary of the Union, A. P. Chamberlin, has attended all of these meetings with the exception of the Devon and Cornwall Centre, where the date clashed.

All these centres have decided to uphold the present rules of the Union, and no resolution has found favour in which any alteration of rule has been suggested.

"Massed Start" Meeting

A SPECIAL general meeting of the Birmingham and Midland Centre was held at the Friends' Institute, Birmingham, at 5.30 p.m. on Saturday, November 28th. Mr. A. E. Taylor was in the chair, and was supported by the secretary of the Union, A. P. Chamberlin. At the outset of the meeting the chairman explained that every possible latitude would be given to delegates to thoroughly explore the matters referred to by the N.C.U. Emergency Committee's statement on massed start racing.

At the commencement of the meeting one delegate expressed the opinion that it was not necessary for the statement to be read again, because all the clubs should have had their instructions as to which way to vote. The chairman ruled, however, that the statement should be read paragraph by paragraph, and any questions arising therefrom would be answered by the secretary of the Union. This was done, and much lively discussion resulted.

Mr. Chamberlin was able to explain every detail of the controversy from the beginning to the present date to the meeting, and a resolution was moved by Mr. M. P. McCormack: "That the Birmingham and Midland Centre supported the Emergency Committee's statement on massed start racing, and agreed to abide by the rules of the Union." This was carried (delegates only voting) by 27 to 9.

What the Clubs are Doing

Roller Contest for Glasgow?

THE Douglas C.C. is making an effort to hold an open roller contest in the Glasgow area this spring.

Now C. S/M.

TIM ASHBURNER, a founder of the Crawick Wheelers, is now a Company Sergeant-Major in West Africa.

New Scots Promotions

FOR the first time since the club's inception, the St. Christopher's C.C., of Glasgow, will be holding two opens, at 25 and 50 miles, this season.

More Scots Events

GLASGOW'S new cycling body, the Belle Star Road Club, is to add to the 1943 list of open events by holding four time-trials, two for men and two for women.

Not so long ago this little machine was the toy of playboys on one of the beaches of America. To-day it serves a useful purpose in London, transporting parcels of hospital essentials.

Douglas Men in Forces

THREE well-known members of the Douglas C.C., of Glasgow, have just joined the Forces. They are James Renwick, Nelson Robertson, and Robert Gibson.

Briggs in Scotland

WALTER BRIGGS, former C.T.C. official in Yorkshire, has been stationed in Scotland recently, and has made good friends amongst the local cyclists.

Third Man's Promise

JAMES SCOTT, Crawick Wheelers, 17-year-old brother of Bill and David Scott, the South of Scotland cracks, has promised to take time-trialing seriously during the coming season.

More Record Attempts?

DUNCAN McCALLUM and Joe Macrae, Douglas C.C., holders of the Glasgow-Dundee-and-Back tandem record of the R.R.A., of Scotland, have designs on the Glasgow-Oban-and-Back record.

Scott in England

BILL SCOTT, Crawick Wheelers, holder of the Scottish 25, 30 and 50 records, is at present stationed in the North of England. Although he is a colliery worker, there seems no immediate prospect of his release from the Royal Engineers.

Shotts Riders Called Up

FIVE prominent members of the Shotts Wheelers, a Lanarkshire club, have been called up. They are J. D. White, S. Graham, G. Stewart, W. Corbett and A. Glen. Champion of the club is T. Tucker Brown, and novice champion W. Corbett.

Scots Star a Miner

JACK CONNER, the young St. Christopher's C.C., Glasgow, road star, is now working at a West of Scotland colliery. He registered for the Royal Marines, but later elected to become a miner. He is now time-trials secretary of his club.

Cyclists' Information Bureau

THE National Clarion C.C., Glasgow Section, has opened a Cyclists' Information Bureau at its clubrooms at 1, Northburn Street, Glasgow, C.4. Members will attend every Wednesday evening and answer questions relating to all aspects of cycling.

Hundred at Royal Albert Gathering

OVER 100 members and friends attended the annual prize-giving of the Royal Albert C.C. at Larkhall. "Lion" of the gathering was Alex. Gilchrist, 30-year-old rider who is the fastest man the club has produced. He won club championship, as well as the veteran's trophy and the club's open 25.

South Scotland Success

SUCCESS attended the annual prize-giving of the Upper Nithsdale C.C., of Kirkconnel, when over 100 members and friends were present. Mrs. Wilson, wife of Lieutenant-Colonel Wilson, presented the prizes, and principal recipients were Alex. Gilchrist (Royal Albert C.C.), David Scott (Crawick Wheelers), and A. Adams (Upper Nithsdale).

Meeting of Scots Cyclists

THE special general meeting of the Scottish Amateur C.A. to consider an executive proposal to revert to the 1939 constitution has been called for Sunday, January 17th, at 1 p.m., at Bo'ness, West Lothian. All affiliated associations and clubs are being circularised by the secretary, Harry Price. The S.A.C.A. is the controlling body of road sport in Scotland, and has a reciprocal agreement with the Road Time Trials Council.

Nelson Wheelers Dine

THE annual dinner of the Nelson Wheelers C.C., held on November 21st at Nelson, Lancs, was attended by 60 members and friends, who voted the affair the best of the series to date. Rex Coley ("Ragged Staff") travelled specially from London to be present, and congratulated the club on its wonderful achievements. Miss Gwendolen Stiff, the "Wheelers'" secretary, who organised the dinner, received a special cup for her performance in the Bon Amis "100" last season.

Fastest Mid-Scotland Rider

BEST Mid-Scotland cyclist of 1942 is Alex. Gilchrist, Royal Albert C.C., who broke club records at 25 and 50 miles, with times of 1 hr. 3 mins. 46 secs. and 2 hr. 18 mins. 5 secs. respectively.

I Ride in the Hardy Country

By PETER LINCOLN

The Town Hall, Newtown, Isle of Wight. Originally the old capital town, it is now just a quiet, almost forgotten corner of the island. Its old inn, The "Noah's Ark" (centre) is closed, and the Town Hall held in trust and used as a Y.H.A. centre.

WE often talk of "local atmosphere" when we are discussing novelists and the writers of books, and it is always interesting to the tourist, whether he covers the ground on foot, or on a cycle, to linger in a district where an author of renown has lived, and where places and place-names may be linked with books and episodes in books. Now, I wonder whether any author ever put so much strong and vivid "local atmosphere" into his works as Thomas Hardy? His Wessex novels abound in the "atmosphere" of real places in his beloved Dorset, and there is an added interest in touring around in an area which is so closely and wonderfully associated with a great writer. Dorchester, the county town of Dorset, is the "Casterbridge" of the Hardy novels, and the novelist lived in the town for some years. Now Dorchester is an ancient place indeed; in it, we may slip right back to Roman times, and we may see a Roman amphitheatre just outside the town. And if we feel that Roman times are too far back for our fancy, then let us take a peep at a quaint old building, still known as "Judge Jeffreys's Lodgings" on account of the fact that the house was used by that fierce and bloodthirsty judge at the period of the "Bloody Assize." Always make a point of looking at any statues in a town, and here in Dorchester see the one erected to the memory of the dialect-poet of Dorset—William Barnes, who died in 1886.

We have only to ride out to Upper Bockhampton to see the birthplace of Hardy—a grand old thatched house which seems a fitting place in which such a great interpreter of the village, and the life of rural people, should first have seen the light of day. By the way, if you are interested in earth-works, and things prehistoric, slip out some three miles from the town of Dorchester, and you will see the mighty prehistoric earth-work of Maiden Castle, crowning a hill.

Salisbury

We must think of Dorset and Wiltshire together if we are to get the essential atmosphere of Hardy and his work. And we just cannot be in the Wessex districts without journeying to Salisbury, where the great cathedral (unique because it is the only one of our English cathedrals built throughout in the one style) stands as a wondrous shrine, keeping watch, as it were, over the whole area. The "one style" is Early English, and the central spire rises like a finger pointing to Heaven—a marvellous landmark to the traveller crossing Salisbury Plain. I know of no English cathedral which has such a perfect setting as Salisbury—the Close is just as you would wish a Close to be—peaceful, dignified, with stately houses and an atmosphere which breathes beauty above all the sordidness, the clamour, and the cheapness of the world. The 15th-century "Poultry Cross" is something else which Salisbury offers to the traveller with seeing eyes and understanding heart—and if perchance you happen to visit the "George" Inn, in High Street, you may see some interesting 15th-century woodwork.

Blandford is a Dorset town which I love; it has Georgian dignity and an air of stateliness. There was a great and ruinous fire in Blandford in the year 1731, and much was destroyed, but the "Old House" in the Close survived the tragedy, and you may still admire its moulded chimneys, its red brick structure, and its spreading eaves. Blandford, in the olden days, was called Blandford Forum, and in the Hardy novels it becomes "Shottesford Forum."

Old "Shaston"

Let us to Shaftesbury, or to give its old name, "Shaston." It occupies a wonderful position on a hill—a hill overlooking the lovely Vale of Blackmore—of which Hardy gives a great and moving picture in his "Tess of the d'Urbervilles." It is surprising to think to-day that there was a time when sleepy old "Shaston" was a busy, thriving town, possessing a great abbey, a royal mint, and no less than a dozen churches. Only three of the latter survive, but there are still some remains of an ancient abbey.

My best memories of Wessex centre around old Wimborne, where the Minster is surely one of the very noblest shrines in our land. Unlike Salisbury Cathedral, one cannot say that Wimborne Minster offers us one pure style, for the central tower is Early Norman; the east end is Early English, while the west end shows 16th-century characteristics. But it is not a "muddle"—and one feels that in Wimborne Minster one is in a place of hallowed stones, of wondrous atmosphere, and there is a sense of awe associated with the place which is akin to that one experiences on a first visit to York Minster. In a niche of the south choir aisle, the visitor may see the stone coffin of one Anthony Etricke, a man who imagined that he knew exactly the year in which he would die. Evidently a man who believed in "having everything ready for any event" he had his coffin made, and even went to the length of having the date inscribed on it—the date 1691. But the great reaper was tardy in coming for Anthony, and he did not actually die until the year 1703. So the date had to be altered on his coffin, and you may quite clearly see the alteration to the figures to-day! Here in Wimborne Minster one may see one of those amazing astronomical clocks—similar to the one in Wells Cathedral. This one at Wimborne is said to have been made by Peter Lightfoot, in 1325. The clock is connected to a figure in the wall outside the church (like "Jack" at Wells) and appears to strike the quarters on bells, but I believe that the striking is really performed by hammers which are hidden from view.

"Sandbourne"

Thomas Hardy called Bournemouth "Sandbourne" and one can imagine that under the novelist's name the famous place would have been just as famous—and gay posters on our hoardings would have lured us to "Sandbourne" just as easily, and as surely, as they tempt us to take a "Southern express" to Bournemouth, there to bask in sunshine, and to derive benefit from the pine woods, and gaiety from all the amusements which an enterprising municipality provides. But we must not imagine that Bournemouth has nothing ancient and historic to offer us; one may seek the quietude and peace of a grey old Norman Priory, in a lovely setting between the Stour and the Avon at Christchurch. And Christchurch Priory is a great building; its architectural beauty is one of very high order; it stands as a wonderful tribute to Norman builders, and he who rides to Bournemouth, and fails to ride on to Christchurch, is foolish indeed. There is some particularly rich work outside the north transept, and the reconstructed choir, in the Perpendicular style, is wondrously light and beautiful. The chantry chapels are well worth time and attention, and there is one built by Margaret Pole, Countess of Salisbury, who was beheaded in 1541.

Weymouth

Our little tour of the Hardy country comes to a close, but if time permitted we would journey to Weymouth and look long at old Georgian houses; we would note the figure of King George III on horseback, cut in the turf off a hillside. We would go to Corfe Castle, between Wareham and Swanage. But we will not forget Sherborne, on the northern borders of the Hardy country—and named by the novelist "Sherton Abbas." And here we may see an Abbey Church in splendid preservation — showing various architectural styles, from Norman to Perpendicular.

WAYSIDE THOUGHTS

By F. J. URRY

The old church at Wisley, Surrey, in winter garb.

The Right Method

I HAVE always contested that the majority of bicycles are over-geared, with the result that cycling can be hard work when an autumn wind—or any other for that matter—goes prowling across the land from the direction in which you want to proceed. In October I wanted to spend a week-end with an old friend of mine who has turned farmer amid the delectable country that lies in the Clun Valley, amid the highlands of Salop. I gave myself just six hours of daylight to do the 60-odd miles, expecting, or at least hoping, for a mild day of mellow sunshine, when I knew the journey would be a joyful and easy passage. But though the day was mild enough, it was very much alive with a nor'wester that flung the leaves of wayside trees at me as I passed by, and made my passage a matter of circumspect pedalling on a 60in. gear into the gale, and taking the slope summits on a 45in. As far as Bridgnorth the wind was pressing my left shoulder, and the shelter of the hedges was gracious; but I knew that after an early tea in the "Loyal Town," when I turned into the funnel of Corve Vale, that wind would riot straight down the road over which I was bound. It did. But my little gears kept me going at a steady 10 m.p.h. without any feeling of weariness, and the few riders I passed by, struggling with their 70in. ratios, probably wondered why the grey-headed rider could make ground so easily. Just full use of the ankles combined with a low gear—only that and nothing more. It was one more lesson—if one were needed—of the value of very moderate gearing for ordinary touring purposes; 66 miles of windy riding through comely country, and an appetite of marvellous proportion at the end of the journey.

The Jolly Country

THAT was a glorious week—and spent in the congenial company of farmers, cattle dealers, auctioneers and men of the soil, hard as nails, and possessing thirsts which made my tea-drinking exploits seem completely feeble. Another friend of mine, who has recently bought a small estate adjacent to Clunbury, took us for a ride on a glorious Sunday morning over Titter Hill, at the foot of which stand the ruins of Hopton Castle, one of the Border strongholds. Up we went through the coloured woods, and out among the heather and bracken to the windy ridge, whence the visions of the land from this 1,300 foot eminence were sunny, misty pictures of loveliness. This man, who led the way on the most expensive of bicycles, said these were the roads he loved to roam, these upland ways over the top, for this was cycling with the flavour of real adventure. When he wanted to go fast in normal times, there was the car for the satisfaction of quickness; but it was a soulless business mopping up miles in a hurried phantasmagoria. And being a nationally noted photographer, he should know. Plums, apples, damsons, mushrooms, nuts—they all came within the menu of that week-end: in addition to jugged hare, roast partridges, and that speciality of the country, grilled ham and eggs. Surely these farmers are working hard in these urgent times, but at least they have the solace of good feeding, and the open air. Lucky you will count me, and lucky I am to claim such friends; but when you have been wandering this land on a bicycle for more than half a century, you would be but a poor individual if the spirit of comradeship had never strayed outside the immediate home circle. Those three days were good, and I will go again in the days to come.

From Over the Water

FOR some weeks now I have been riding an American bicycle, not the type you so frequently see illustrated in the press, but a machine built on English lines, and equipped with English saddle, tyres, brakes, and Cyclo gear. It came about like this. Some months ago Mr. Frank Schwinn, one of the big cycle manufacturers of Chicago, U.S.A., and an old friend of mine, sent me a pair of racing hubs and asked me to try them. I told him I could not get a bicycle worthy of these excellent hubs until the war was over, and his response was to send me a frame and fittings (chainwheel, forks, etc.) which, remarkable to relate, came to hand a few weeks ago, for to be quite candid I did not expect it would find travel room. It took me quite a long time to discover the needed oddments to make a complete bicycle, but my trade friends searched their stores and finally I was fixed up with an outfit, completed by a Cyclo gear giving 45in., 60in. and 68in., through the good offices of Mr. Louis Camillis of that Company. It is a beautiful machine, moderately light, very easy running, with most comfortable position and steering. The only special thing about it is that a steering lock is concealed in the column, and with the turning of a Yale key the steering is firmly locked. This is the neatest, lightest and most serviceable cycle lock I have seen, and I understand one of our big English makers has taken over the British rights of production. This type of safety lock will become very popular, for it is foolproof, cannot be tampered with, and is reasonable in cost to produce. The hubs, too, are a very fine job, built for six days' racing with dural flanges, using short spokes, and the set-out is on the highest plane. In its first 200 miles of travel the machine has charmed me.

The Short Answer

A MAN who passes me regularly on the way to work stopped his car and asked me why I seem to ride a bicycle so easily. In a way it was a compliment, but I am afraid my reply was terse and to the point, for I just said, "regularity, a low gear, and the best bicycle I can buy." But considering the matter at leisure, I am not sure that that immediate response to the query was not all that was necessary, for it does contain the secrets of easy riding, if secrets they be. How difficult it is to convince people that such is the case, and I am reminded of the ancient saying that "advice gratis seldom great is," yet in this case it is at least true that if an indivual wants to ride in ease and comfort he or she must have the right bicycle positioned correctly, and must be in practice—I won't say fit, because that word denotes some form of athleticism, and that is certainly not essential to easy riding. I have found from time to time when in the company of beginners, that they are too anxious to "get there," to push on with the fixed notion that achievement is the only thing, and often enough to ignore the need for feeding. If you would ride for the sheer joy of travel, achievement is the last thing to be considered, just because it will come all in due course without worrying about it; but feeding—sustenance—is important, and should not be ignored, because curiously enough one does not feel hungry when cycling, but when one does eat is frequently surprised at the quantity of food necessary to assuage appetite. If people will only grant themselves an intelligent approach to cycling, they will be most agreeably astonished how much cycling has to offer in return. It grows on you: its healthiness, its freedom, and its individualism.

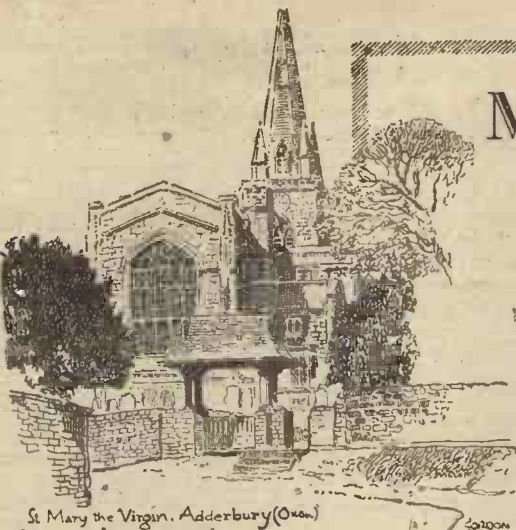
The Terse Response

THE pity is that to-day we cannot buy the very best type of bicycle, unless we are lucky enough to pick up a second-hand machine of our size and kind; and that indeed is the best way of bicycle buying now. But such machines are not easy to obtain, for owners know their worth as articles for their own pleasure and convenience, and are not keen to sell even if they themselves are unable to constantly use them. I know numerous lads in the Forces who could obtain extraordinary prices for their machines, but will not part with them because they want their service and pleasure when leave time comes round. I know, too, an old cycling acquaintance with a real love of the pastime and the possessor of several high-class machines, who is also a golfer, and a fellow member of his club asked him to sell one of his mounts. "Right," said he, "you can have one, but I'll choose it." "How much," the would-be cyclist asked. "Seventy pounds," was the staggering reply, "and remember I have not asked you to buy it. Three years ago I told you to buy a bicycle, the best you could get, and you laughed at me, and said I was a cycling crank. Perhaps I am, but at least I am travel free to-day, with the best possible piece of machinery of pre-war vintage under me." I cannot record what the other fellow said, and perhaps it is as well. If you are fortunate enough to have a decent machine, that true little tale is worth remembering, for until the war is over the best type of bicycle will not be obtainable, and, if I read the signs aright, even the war-time utility type are most difficult to get. Therefore, take care of your property; keep the tyres decently hard, the bearings adjusted and lubricated, and you have a jolly good servant with which to go roaming.

This Fine Thing

THERE is another thing I should like the world to know in reference to this cycling business, and it is just this: There are still among the public some people who think cycling is beneath their social dignity. Why, heaven knows, but there it is. I can understand people not liking cycling, but for the life of me I fail to realise why it should be considered *infra dig.* The simplest method of mechanical locomotion cannot be *infra dig.*; and to hold such an opinion seems to me a form of snobbery utterly unworthy. After all, let us consider the matter objectively. Certainly the bicycle was the great emancipator in the sphere of road travel for both men and women, and it did more to break down old-fashioned prejudice than any other single movement. It was the forerunner of modern transport, and linked country to town at a time when both were in danger of isolation, and were beginning to forget how dependent they were on each other. It opened wide the door to a deeper and truer sense of understanding and encouraged a love of country that no patriotic platform could ever hope to equal. Nor is the pastime in any whit diminished because it has lost its one-time domination in speed; for it is still the most silent and healthiest manner of travel, possessing a freedom that has no compeer. When you hear anyone traducing cycling with the unconscious snobbery of the thoughtless, tell him these things because they are true, and do not be afraid of his self-acquired superiority, for you can be quite sure he is a very ordinary mortal with no more sense than to see himself as he would wish others to see him.

An Egham greyhound owner gets over his transport difficulties. He used to take his dogs by car, but owing to petrol shortage he now takes them for a ride to the track in this cycle-drawn ambulance.



St Mary the Virgin, Adderbury (Oxon) "For Strength"

My Point of View

BY "WAYFARER"

Optical Delusion

A REAL live knight, in a letter to *The Times*, suggests that all military vehicles be fitted with rear reflectors, so that, when "standing stationary" (*sic*) without a rear light, their existence might be indicated to other drivers. But one always understood that these reflecting devices cannot be seen, despite the fact that they are extensively used on telegraph poles, kerb-stones, roadside signs, and advertisements. Possibly, however, it is only when fitted to cycles that reflectors become invisible—a sort of optical illusion—or delusion!

"Closed"

IT is a new and unpleasant experience for cyclists to be greeted with a notice-board bearing the word "Closed," when they roll up to a familiar tea-house in the country, with the confident hope of being able, as usual, to obtain a well-earned meal. In some instances the arrangement is only temporary, arising probably from the necessities of shopping—not an easy matter in these days, so I am told—and no doubt it is a case of "business as usual" in a few hours' time, when the caterer has returned from the ordeal of confronting rude shop assistants, and bearing a heavy burden of purchases. That circumstance, however, is small comfort to the hungry cyclist, whose first impulse is to gnash his teeth. (His second impulse—much more practical, this!—is to decide on the next step, so that the urgent requirements of the inner man can be dealt with.) On a bleak November Saturday, after doing a substantial mileage which had made me ready for tea, I drew two blanks from familiar houses of call, each of which displayed the forbidding message "Closed" at the front door. Fortunately, there was a town within two miles, and my hope of being successful there was quickly realised. Nevertheless, there are grim possibilities about war-time catering conditions, and, having these in view, I seldom venture far afield without arming myself with an iron ration, comprised of either chocolate or cheese.

More About Tyres

POSSIBLY another word or two may be profitably said on the subject of tyres. The need for adequate inflation is being strongly emphasised by the manufacturers, and I am in full agreement. It appears that a very high percentage of tyre troubles arises from under-inflation, but I do not think that much can be done about it, seeing that an equally high percentage of cyclists is quite unconcerned—and never sees the cycle press, where tyre advertisements are published. What I deem to be a typical case of under-inflation was brought to my notice the other day, when a friend arrived at my house for tea. She came per cycle, and, as I put her machine away, the flabbiness of the tyres attracted my attention. Permission to inflate them correctly was readily given—it would have been taken in the absence of assent!—and the visitor ultimately went home riding on hard tyres, thus gaining comfort and greater immunity from punctures, while my good samaritan action would help to prolong the life of the tyres.

Another point in connection with this matter is the need for a regular examination of tyres, not only in order that penetrating foreign bodies may be removed before damage is done, but also to watch for wear. Twice recently my system of examination has saved me from—well, there's no knowing, but I visualise a front-tyre burst at speed with disastrous results, or a catastrophe in either tyre occurring at a particularly awkward moment. When contemplating the purchase of renewals along the road—and it is well to recall that a burst tyre may mean the obtaining of a new tube as well as a new cover—one should bear in mind that the position of affairs is not nearly so favourable for cyclists as in pre-war days. For one thing, there is a shortage of tyres. For another thing, some of the garages, etc., on which we could depend for supplies have closed down "for the duration." Additionally, when trouble occurs in the black-out, the early suspension of business is a factor of vital importance. There is a fourth point which specially affects a cyclist of my type: I ride in outlandish places where a breakdown would be extremely annoying. Inability to use my bicycle; lack of public transport; absence of putting-up places—I would indeed be bunkered, and my reputation for punctuality (I usually travel without a time-margin) would be a thing of the past. So that there is a lot to be said in favour of giving periodical attention to one's tyres. It is a policy which pays.

Those Friendly Lights

ONE portion of Mrs. Roosevelt's recent B.B.C. talk was calculated to strike the imagination of cyclists. Referring to the black-out, which she described as "total," the speaker said that "the countryside loses all that friendly feeling which twinkling lights that shine out of a window give you as you walk along a country road in the dark. Here a country road is dense blackness. A passing car is a black object with two tiny lights. . . . This is a quality of blackness which no one who has not known it can possibly imagine." Mrs. Roosevelt was apparently lucky enough not to meet any of the motor-cars which are again carrying dazzling lights; and it is well to remember that the normal condition of a country road, *per se*, is velvet black. (I gather that there are actually people in this land who, in days of peace, would like to have bilious and other flood-lighting applied to all country roads. May mad dogs bite such people!)

We night-riding cyclists are conscious of having lost those friendly lights which shone out at us as we travelled through the darkened countryside in pre-war days—or, rather, nights. The lonely cottage with its square of light—sometimes unscreened, sometimes covered with red or white blind—always made a friendly signal to us; and, as we melted into the darkness, we might idly fancy the little family gathered round the fire, talking over the day's work, or reading the newspaper, or listening to the radio. Now and again, when the curtain was not drawn, we might catch a glimpse of the cottage interior, with the firelight dancing on the beamed ceiling, and a distant voice singing "Love's Old Sweet Song," or some other favourite that provoked memories. Friendly? Yes, very.

And then there was the little cottage which you were aiming to reach in the hope of being able to obtain accommodation for the night. You had not booked, and you had been delayed on the way. You recalled that they were early goers-to-bed at that cottage. If no light shone through the night as you approached, then the people of the house had retired, and you would have to seek elsewhere for supper, bed and breakfast. The problem would be to know where to try your luck, and—ah! thank Heaven! a friendly square of light glows through the darkness, and you know that all is well. Yes: we cyclists miss the greeting of the "twinkling lights that shine out of a window," with all the friendly feelings they appear to connote. But these days of gloom will pass, and, in happier times that are yet to be, we shall see the welcoming square of flame, and the firelight dancing on the beamed ceiling, as we speed by in the blackness of the night.

Return to Duty

WHAT a joy it has been recently to see some of our signposts back on the job, and "doing their stuff"! It is a sort of homecoming of old friends—friends to whom we invariably give a passing glance, notwithstanding the fact that we are travelling in familiar country. They are friends we have greatly missed, and it is good to know that a small selection of them have now returned to duty.

Explanation

NEWER readers may welcome a little word of explanation with regard to the picture which so often ornaments the heading of my contribution on this page. The matter is simple. On the borders of Northamptonshire and Oxfordshire are three fine churches which are said to have been built by three brothers. An ancient adage speaks of "Bloxham for length, Adderbury for strength, and King's Sutton for beauty." Incidentally, these churches, which are quite close together, are well worth inspection.

Notes of a Highwayman

By LEONARD ELLIS

Wherefores of White Horses

I OFTEN wonder why so many of the celebrated hill carvings of Britain are congregated in Wiltshire. Assuming that the necessity or the desirability of effecting these monuments has been established, it is obvious that certain characteristics are necessary in choosing the site. The slope of the ground must lend itself to the presentation of these pictures in semi-elevation. To carve them on the flat would be merely to present the birds with a fine view of man's handiwork, and there was no thought of aerial observation in those days. The ground therefore must offer smooth slopes of about 45 degrees; steeper than this would probably militate against the success of the project as screes would form and constantly obliterate the outline. The absolute vertical is of course ideal from a visibility point of view, but in the first place enormous expenditure would be necessary to erect the scaffolding in order to reach the job at all. The vertical would also be far easier from the point of view of plotting, and I suppose that few people have ever stopped to think of the difficulties in the way of laying out one of these giants. It is impossible to stand well back and draw the outline; the designer has to work at a spot that gives him no view at all of the rest of his work. He has also to bear in mind that the figure when carved will not be viewed from an angle of 90 degrees, but acutely, and as a consequence he must distort the outline so that the distant viewer will get a reasonably accurate picture of what he is trying to portray.

Further Considerations

SO much for the contour. It is obvious also that one other consideration must weigh heavily with the designer. He must choose a spot where, having removed the top layer of turf, he will expose a subsoil that will permanently offer a sharp contrast to the green grass. Chalk hills are therefore the obvious answer. We can see that Wiltshire is as suitable as anywhere in England, but it is by no means the only county. In fact, it is not the only place in which carvings are found, as there are instances in Bucks, Sussex, Dorset and Berks. There are probably others, and in all cases the same set of circumstances applies. But why so many in Wiltshire? I do not know the answer, and can only assume that the power of suggestion and imitation had something to do with it. We may find an answer in the reasons that led to these carvings, and in considering this we may divide our figures into three groups.

Genuine Antiquities and Others

THERE are first of all the real antiques, then the numerous memorials of 200-300 years ago, and lastly the efforts of our soldiers seeking relaxation during the 1914-18 war. The first class cannot be mistaken. It contains the oldest of them all, the one on the Berkshire downs overlooking Uffington. This is supposed to date back to the Iron Age, and the outline is so crude that, although called a horse, it might be anything from a snail to a whippet. By reason of its design we cannot doubt that the giant of Cerne Abbas is very old. Whiteleaf and Bledlow Crosses in Bucks go back to the days of King Alfred, and commemorate battles with the Danes. The Long Man of Wilmington, in Sussex, although outlined with white bricks in 1874, is generally supposed to be very ancient. The Wiltshire carvings are nearly all in the second class, except that the Bratton Horse, near Westbury, is the oldest and may go back to Alfred's days. The Cherhill White Horse was cut in 1780; Marlborough Horse was made by boys of the school about 100 years ago. The one at Alton Barnes was executed in 1812, and the figure near Broad Hinton is also comparatively recent. In this same class we may put the equestrian figure overlooking Weymouth, as this commemorates the visit of George III.

Cherhill White Horse, Wilts.

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