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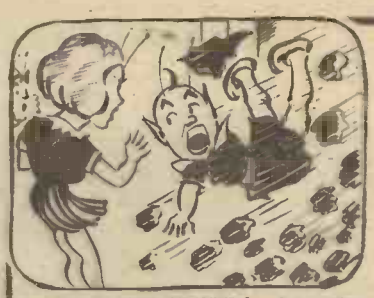

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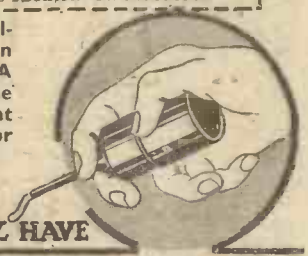

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Editor : F. J. CAMM

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FAIR COMMENT —BY THE EDITOR

Invention and Post-war Stability

WE want more aggressive methods in our Economic Organisation, both to maintain our export trade during the war and to prepare for the sudden and drastic change which is inevitable on the declaration of peace, says Sir Arrol Moir.

This problem should be given full consideration in the administration of our trade both within the country and the Empire and through our export trade with foreign countries. It is true we are at war, but we learnt our lesson through the slump after the last war, which was created by the stagnation and change of trade during the war period.

Stagnation showed itself in many branches of our trades which prosper in peace time when the present war was under a year old, and it is, therefore, our national duty now, in spite of war pressure, to find new stimulus for our export trade and to eliminate the growth of this stagnation by the introduction of new ideas into our national industry. This could be greatly assisted by the encouragement of every source of inventive talent in all classes of the community and placing it before the many manufacturers and producers of all sizes throughout Great Britain through an unbiased body. The Institute of Patentees exists for this purpose.

For Post-war Trade

THE production need not be put in hand now, while the war lasts, but contracts can be signed and arrangements made that can be put into force as soon as peace is established, so that this country and the British Empire can start the fight for post-war trade supremacy with advantage and established initiative. This has proved to be possible in America by a public body known as the Mellon Institute, which, after development through financial support since 1913, has carried out investigation work for the inventor and put, through practical experiment, over 400 inventions right that started in commerce wrong. They now work in a building larger than Buckingham Palace.

Such an organisation could be established in this country without interfering with existing associations and institutions, but which would prove to be an asset to them after its initial development, as well as to all types of trades and professions. It could be formed from the older brains of the country who do not wish to take an active part in the conduct of the war, but who, through their past experience, would be eminently suitable for such an important part and would be pleased to put their activities to the development of an organisation, the benefit of which could be world wide when peace has been finally established.

Exhibitions

ITS members would consist of inventors and commercial firms whom the institute could bring together through correspondence and exhibitions, established in various industrial centres throughout the country, to the extent of about four per annum, giving each an exhibition once in three or four years, thus creating a sense of competition for the inventor, which would give him greater power of introduction into the world of commerce than he possesses at present and would allow all classes of inventors to be treated on the same footing.

Such exhibitions have already been held during the last twenty years, both in London and other industrial towns, and in spite of the poor standard of exhibit available, have all proved a financial success and created interest. One held in Sheffield attracted an attendance of 30,000 in ten days and ran at a profit of over £600.

It is true that over 90 per cent. of the ideas submitted would not be worth development, but if one or two of the remainder are worth investigation, a new industry may be started or an old one revived that will provide employment for several thousand in a few years' time and become an asset to the country, and to the world in general at a later date, thus making the remaining 90 odd per cent. worth investigating to the full.

It is only when the bulk of the world is plunged into war, such as now, and in 1914, that the true value of inventive talent is realised to the full and demanded. Encourage it also in peace time as well as in war for the benefit of trade and national health and comfort.

Preparing for the last war the Germans knew the value and strength of inventive talent, as was shown by the Key Industries Exhibition held in Westminster afterwards. There were shown some of the essential items needed in war-time, such as magnetos for aeroplanes and lorries, heat-resisting glass for miners' lamps, optical glass for ranging instruments, tungsten steel powder for armour plating, etc., which were sold at a false value through secret government subsidy to the rest of Europe for years before the commencement of hostilities, so that when the latter was launched, their opponents would not be able to supply themselves with the additional quantities suddenly brought into demand by the expansion of war equipment without initial experiment and design carried out by the inventive brains of their countrymen.

Once our inventors' talent was fully under way and encouraged and investigated by the Special Inventions Branch of the Ministry of Munitions, the absolute necessities were produced on a more efficient standard than the German and have remained so since, as is shown already in this war.

New Ideas

IN addition to the provision of existing needs, new ideas, such as the tank and Stokes' trench mortar, were introduced into the army equipment through the Ministry's activities, which proved themselves to be of invaluable use to our Army; and it has been already shown in the new war that the tank has been included in the main attack on the Western Front to the extent of over 1,000 a side, with many more of various sizes and designs to take their place as hostilities proceed.

This war was started with the necessary talent attached to the various governmental production departments for our fighting services, but greater assistance might be provided and the necessary work expedited if liaison was established between these and the inventive brains throughout the country, guiding and encouraging the latter on what lines to produce designs and suggestions as well as investigating ideas submitted for acceptance or refusal as at present. Every idea need not be submitted in secret, and those that must can be put forward by each side in a special way to avoid disclosure.

When once started, it could establish an experimental station for the investigation of new inventions and for the research work of inventors which would carry out work under contract for individuals and firms, and when established commercially, would do certain experimental work free of charge, acting under discretion for members who had little finance, but whose ideas showed chance of success if further developed on the right lines. It would also form a technical committee to consider the commercial possibilities of ideas put forward, who would seek the assistance of our other institutions.

Economic Stages

THE whole scheme could be set up to develop in economic stages, each stage proving itself before the next was undertaken. This was the system adopted by the Mellon Institute, and similar lines could be set up in this country, the inventions exploited under an unbiased technical supervision, being mutually profitable both to the inventor and the institute. Thus the latter could gain funds to extend itself on an economic basis and become a national asset in the advancement of trade, defence and other developments of national importance, thereby reducing unemployment by the creation of new and the revival of old industries.

Gliders as War Weapons

The Function of the Glider, with Particular Reference to the Hotspur

A line up of Hotspur gliders and one in actual flight.

Below : Immediately on landing the crew get in touch with headquarters by means of radio

AT the time of writing no British gliders or glider troops have gone into action. When the new front is opened up it is certain that glider troops will be used if the potential value of the air as a transport medium is not to be neglected.

Some time ago we asked ourselves the ultimate value of the small-scale commando raids. Later we asked why we should lock up in this country vast forces of bombers and fighters when it seemed that they would be of more value in the Middle East. When the first "1,000-plus" raids were carried out an answer of a sort was provided. But bombing without a deeper significance than mere destruction means that the tactical possibilities of the bomber are not being fully realised.

If we regard the commando raids as practice raids, and the "1,000-plus" raids as preliminary bombardment testing out the effects of large mass raiding, then the so-called "second front" proposals take on a new aspect.

We can assess roughly the magnitude of the offensive.

In the pattern of large-scale attack, gliders must be an important piece. The glider is the lorry of the air. The glider can put down in one spot fully equipped men, who have been transported at altitude and speed. Released at heights of 10,000 feet the glider can travel 30 miles, and come into its objective silently and at hedge height. Once the glider is down a compact body of fighting men is assembled.

The glider, made for the most part of wood, is not easily destructible. It has no engine to be disabled, no bombs to be touched off, no fuel to be ignited. It can absorb an amount of fire without going out of control. Once released it must be detected by sight or radiolocation.

A class of glider pilots with their instructor.

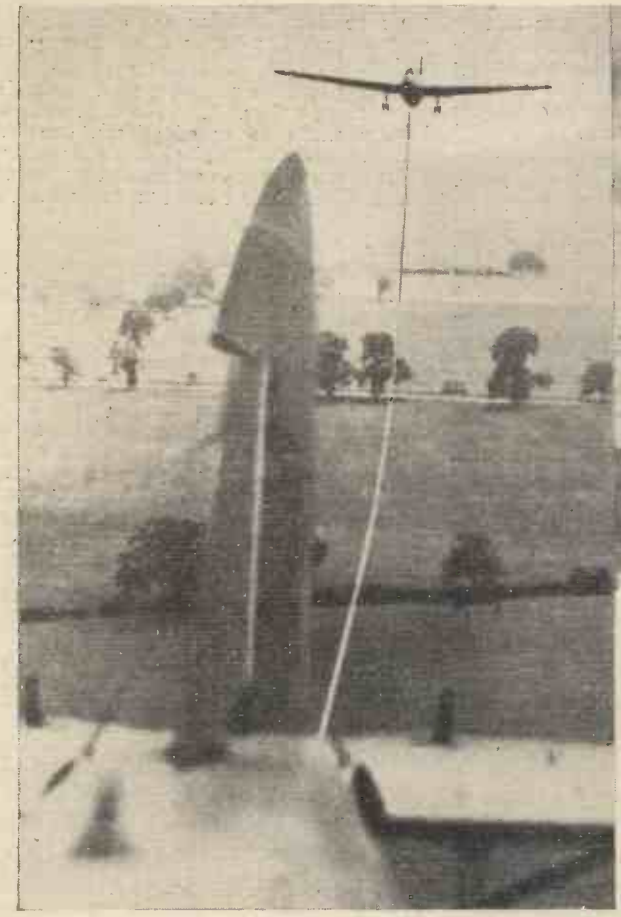
Troop Movements

The purpose of the glider is to move troops quickly and efficiently to where they will do the most damage. The glider is not a highly finished weapon : in all probability it will make but one operational journey. It can therefore be made cheaply, and in great numbers without detracting from its value.

The glider can be put down in a small space. Once down its use is over, and only if there are ample men to spare would it be profitable to recover used gliders during operational service.

Tug-machines and gliders need fighter escort when used on active service. The bomber-tug-machine when towing cannot be so manœuvrable—any evasive action it might take makes the glider pilot's job difficult. But it is possible for tug-machine and glider to dive without harm. It must be remembered always that the airborne troops must feel like fighting when they get down, and violent banks and dives are not helpful in ensuring this.

The speed of the tug-machine is only reduced slightly by the addition of the glider. It has been estimated that the Junkers Ju 52,



A glider in mid-air, being towed by the tractor aircraft.

Showing how a glider can land in a restricted space.

towing a 10,000 lb. glider, has its speed reduced by about 15 miles an hour. It has also been estimated that towing a 7,000 lb. glider with a wing loading of 10 lb./sq. ft. causes only 11½ miles an hour reduction in the speed of the tug-machine. And all the British gliders known at present have an undercarriage which may be dropped after the take-off. The dropping of the undercarriage—in no case of retractable type—decreases drag considerably. Also, wheels require a flatter landing ground and the skid stops the glider in a shorter space when the undercarriage is not attached.

Paratroops are invaluable for small-scale raids, but in a gigantic attack wave after wave of gliders are required. Glider for paratroop transport, the glider will always carry the more men. The size of the glider is limited only by the power of the tug-machine. It is said that the Germans employ tank-carrying gliders. The weight of an armoured fighting vehicle can be compared with the weight of 50 fully equipped men.

Methods of Employment

Let us sketch briefly the manner in which gliders could be employed in the event of an overseas attack. We will assume that the "second front" is being opened up.

First, aircraft carrying paratroops go over. Under air escort invasion barges with commando troops go forward. Light bombers and naval guns screen their landing. The naval units retire to port under air escort to pick up more men. Standing by are supply ships carrying artillery and mechanised vehicles.

As the landing positions are consolidated gliders are brought into action. They are put down in a broad line forward of the landing parties, and up by the paratroops.

It is now that forces of bombers go out and bomb targets forward of the glider troops. Under cover of fighters, ships must land their supplies of field artillery and armoured vehicles. As soon as the mechanised divisions are landed they must be rushed up to assist the glider troops and paratroops.

The glider troops and the paratroops are the mobile force. Their chief weapon is suddenness in striking. They must be reinforced by heavy artillery and mechanised units with all speed. Their sole job is to maintain a broad fan forward of the landing area.

Troopships must reinforce the landing party by night, and destroyer screens must be set out to guard those troopships.

Losses among glider troops will be heavy. Their job is to hold this forward line for as long as possible without mechanised support. They must have the power to direct the subsequent landings of gliders, so that glider troops will arrive where the need is most urgent.

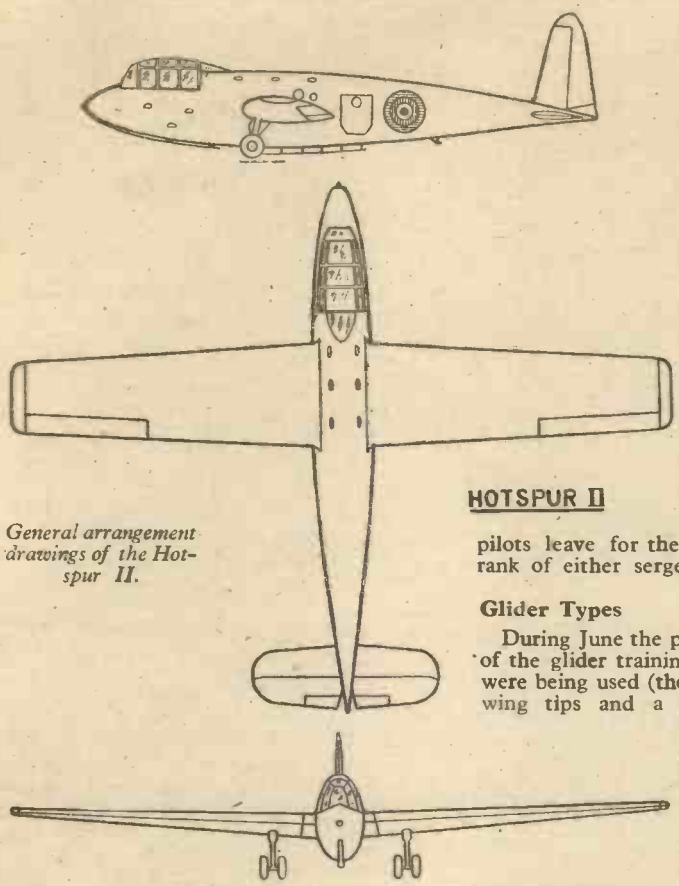
Landing Heavy Weapons

In the opening up of an overseas front the most crucial hours are those during the landing of the heavy weapons. Fighter support in large numbers is indispensable and vital. At the moment of landing no invasion is immediately mobile. Thus, as with the glider troops, the landing parties must be in touch with fighter stations. The men on the ground know where they need air support most. They must be allowed to say so.

Troops are equipped to fight in two dimensions. The air adds a third dimension. Therefore, the best answer to the aeroplane is the aeroplane. It will not do all the time for fighters to be away bombing the enemy supply lines and enemy troops advancing. Troops are equipped to deal with troops. The fight between ground troops and aeroplanes is unequal. And there is never any point in fighting unequal battles, however heroic, if such battles are avoidable.

It would be possible by means of the glider to put down fully-equipped men wherever needed. Once the landing of troops, heavy artillery, tanks, armoured cars, and anti-tank units behind them has been accomplished, the first job of the glider troops has been

The front part of a Hotspur glider. Note the three footholds which help the pilots to enter the cockpit.



General arrangement drawings of the Hotspur II.

effected. They should then be withdrawn and re-formed.

As the invasion army, now firmly established, advances, so the glider troops come into use again. They can be sent over beyond the immediate enemy forces. They could ward off the first blows of the approaching enemy. For the capture of enemy aerodromes and airfields they would be ideal. Dropping silently out of the clouds gliders can dive, and, building up speed to nearly 170 miles an hour, come in hedge-hopping.

Glider troops are mobile. They can deliver rapier-like thrusts. They can weaken attacks by taking the first blows. They are compact and dangerous. They are the cutting edge of attack.

Here is something of the history of these glider pilots:

Glider Pilot Training

All glider pilots are volunteers from the Army. And glider pilots at present flying come from nearly all the units in the Army. If the volunteer is accepted he is transferred from his unit to an airborne division. He does a course at airborne division headquarters on the theory of flight, and other subjects that will be of use to him later. He is then transferred to an elementary training school where, in a course of some weeks, he learns to pilot a light aeroplane. Here he does a few hours' night flying.

He then goes on to a glider training school. Here he is put on to a troop-carrying glider. He flies on tow, and learns to land and the right moment to cast off the tow rope. The troop-carrying glider he uses has ballast instead of live load.

When he is sent to the glider operational training unit he does a course, and here he carries live load. At the glider training school he carried a parachute, but at his operational training unit he does not. Lectures are also continued meanwhile.

He is released at great heights, and has to find his way back; he is released at low heights, and must again find his way back; also, he does some night flying, so that by the time he rejoins the Army he is a fully qualified glider pilot. It is then that he gets his wings.

Glider troops wear a plum-coloured beret, a shoulder flash with the word "Airborne," and a plum and blue badge showing Bellerophon mounting the winged horse Pegasus. Glider pilots wear the same, and, in addition, they have their "wings." During training they wear their khaki uniforms. Their instructors are drawn from the Royal Air Force. Glider pilots leave for the Army usually with the rank of either sergeant or corporal.

Glider Types

During June the present writer visited one of the glider training schools. Hotspur IIs were being used (the Hotspur I has rounded wing tips and a greater span than the Hotspur II), and it was reckoned that pupils did between 8 and 11 trips before they go solo.

The Hotspur II, which was designed by General Aircraft, Ltd., is a midwing troop-carrying glider, of wood construction, plywood covered. Makers of the Hotspur differ—many are furniture makers. The only fabric used is on the control surfaces.

The instruments include turn and bank indicator, altimeter, compass, air speed indicator, and rise and fall indicator. Dimensions are: length, 39ft. 3½in.; span, 45ft. 11in.; height, 10ft. 10in. An estimated cost for the Hotspur II is £1,500.

The Hotspur has dual tandem control, and during training sand bags are strapped to the seats at the back as ballast.

There are three ways into the Hotspur. The first and second pilots can get in (by three footholds in the fuselage) through the cockpit covering, which opens back like a lid. The third and fourth crew can get in through a door on the starboard side, opposite No. 4 seat. And the other members of the crew have a door on the port side. All the seats are numbered, and men would be allotted to a definite position. The Hotspur has the yellow and black stripes on its belly and underside of its wings, which denote the trainer.

If manilla is used for the tow rope, it is 2¼ in.; if hemp, 2 in. is used. The ropes are used for some 30 launches, and then a new one is spliced on. A cable maintenance gang checks the ropes after every launch. To lessen wear, the rope has attached to it, at the glider end, a small drogue.

When the glider casts off the tug-machine the tug comes down fairly low over the landing field and releases the rope. The end which the tug drops falls to the ground first and the drogue keeps the rope from buckling and crinkling as it goes down. The drogue also guards against whipping before the rope is dropped.

During training not more than one glider is towed at a time. The idea that you can have a whole string of gliders, one tied behind the other, doesn't work out in practice. A lot of complications set in, and a "wave" makes life in the last one next to impossible.

Towing Speeds

The maximum towing speed for the Hotspur is about 160 miles an hour. Landing speed is somewhere in the region of 80 miles an hour. At the training school visited, Hawker Hectors were being used as tug-machines. They are very good for the job.

The best position taught at this school for the glider when on tow is above the tug's slip-stream—other schools favour below the slip-stream. Close formation flying is not easy, either on tow or off tow, but it can be done.

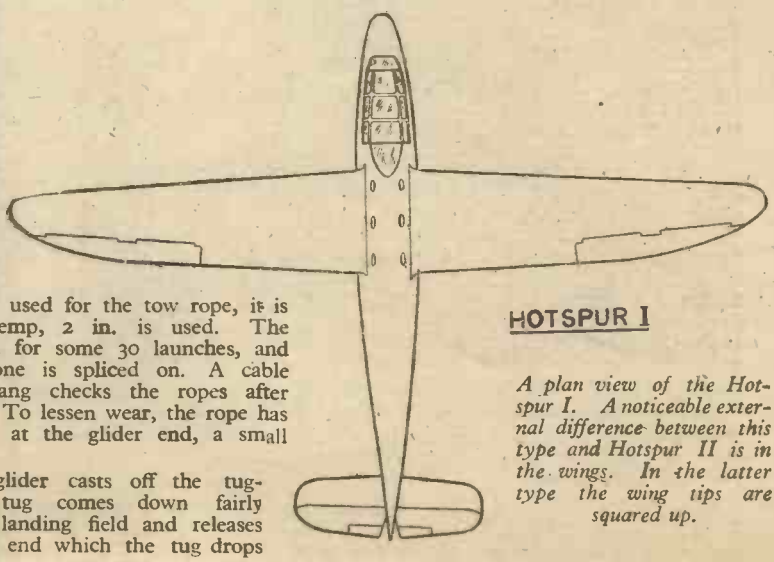
An army marches on its stomach. It now flies on it. In other words, the well-feeling of the airborne troops is essential. The first thing that is required is that there shall be air, the second that there shall be light. Head cold, feet warm, is the ideal as far as ventilation is concerned.

It is a fact that the morale of the soldier is not high after a long flight in a glider, which has little light and poor ventilation. This must be remedied. Glider troops must alight with the urge to do battle. If they spend most of their time being sick they cannot be expected to feel like giving battle. It is essential that alterations which give plenty of light and air in a glider should be made.

To return for a moment to the tactical use of gliders, we can see that there is a very vital use for them in the broad strategy of invasion. Used in vast quantities, they would prove a deadly and fast-striking weapon.

There is great scope for the development of the glider. The first, and most obvious way, is in size. The German DFS 230A1 is a 10-seat troop-carrying glider with a wing span of 69ft. 11in., and a length of 37ft. Empty, it weighs 1,700 lb., loaded 4,500 lb. It has an armament of one machine-gun. This is a small transport glider, which was first used over Crete.

The Gotha Go 242, illustrated on next page, carries 23 men, including two pilots. It is towed by the Junkers Ju 52, and has been used in Libya. Armament is four machine-guns. The undercarriage is jettisonable. The nacelle is hinged at the rear to facilitate loading.



HOTSPUR I

A plan view of the Hotspur I. A noticeable external difference between this type and Hotspur II is in the wings. In the latter type the wing tips are squared up.

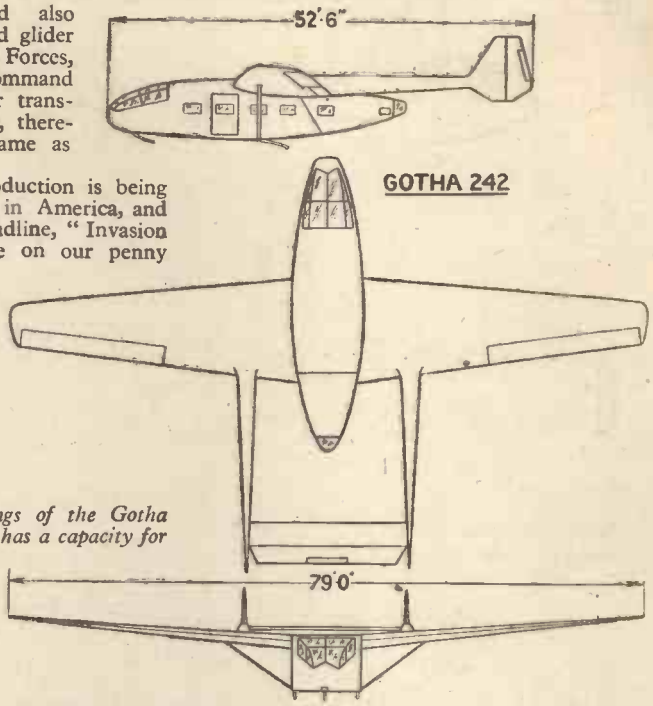
The DFS 230 A1 is classed as small, the Gotha Go 242 as medium. What the capacity of the large troop-carrying gliders is can only be guessed, but already reports have come through which state that the Germans have gliders capable of transporting 100 men.

Mobility Developments

Apart from sheer size, there is room for development in the mobility of the glider. Experiments have been carried out in the United States whereby the glider, once landed and its load taken off, is picked up by a tug-machine which remains in the air. At the moment it is not generally assumed to be practical for gliders, once down, to be retrieved and used again within a short space of time. If the American experiments prove sufficiently successful to be put into operational use it means that the number of gliders needed is lessened. It also means, and more important, that the tug-machine can circle until the glider is emptied of its troops and then come down low and pick up the glider which, except, of course, for the glider pilot, is empty. Thus the tug-machine serves a useful purpose on the return trip.

The United States Airborne Command, which is under the direction of Colonel William C. Lee (he commanded the Provisional Parachute Group before), has, as its programme, the formation of regiments of parachute units and also airborne infantry units. And glider units, drawn from the Air Forces, are to be attached to the Command for training troops in glider transport. The scheme appears, therefore, to be much the same as our own.

We learn that glider production is being pushed ahead in Germany, in America, and in Britain. The thriller headline, "Invasion by Air!" we used to see on our penny dreadfuls is no longer schoolboyish fantasy. Speed is the essential. Gliders confer speed on any airborne army. There will come the time when such an army will go into action.—[*By the courtesy of the Editor of "Aeronautics."*]



General arrangement drawings of the Gotha Go 242. This German glider has a capacity for 23 fully equipped troops. The glider empty weighs 2,300lb. and loaded 8,500lb. The central nacelle is 37ft. long.

Aero Notes

"If at First . . ."

A LITTLE episode . . . it might be called "devotion to duty": in the R.A.F. squadron records it is entered without comment. Yet everybody, from the squadron commander downwards, knows what it represented. An aircraft, having just taken off from a Coastal Command aerodrome, caught fire in one engine. It was heavy with bombs, fuel and ammunition.

The pilot—a 21-year-old flight lieutenant—headed for the sea. There he got rid of his embarrassing load of bombs, and landed again without mishap. It was an inky dark night and the landing was in itself something of a feat. Though the fire was now extinguished the aircraft was unserviceable. But the pilot and the crew had a job to do. If they had received a shaking they did not show it. They clambered into the stand-by aircraft and took off again, all well within the hour from their first attempt.

(Above). Briefing the crews of bombers before taking part in a raid.

(Right). The sting in the tail of a Wellington bomber.

Lancaster and Lightning Shock

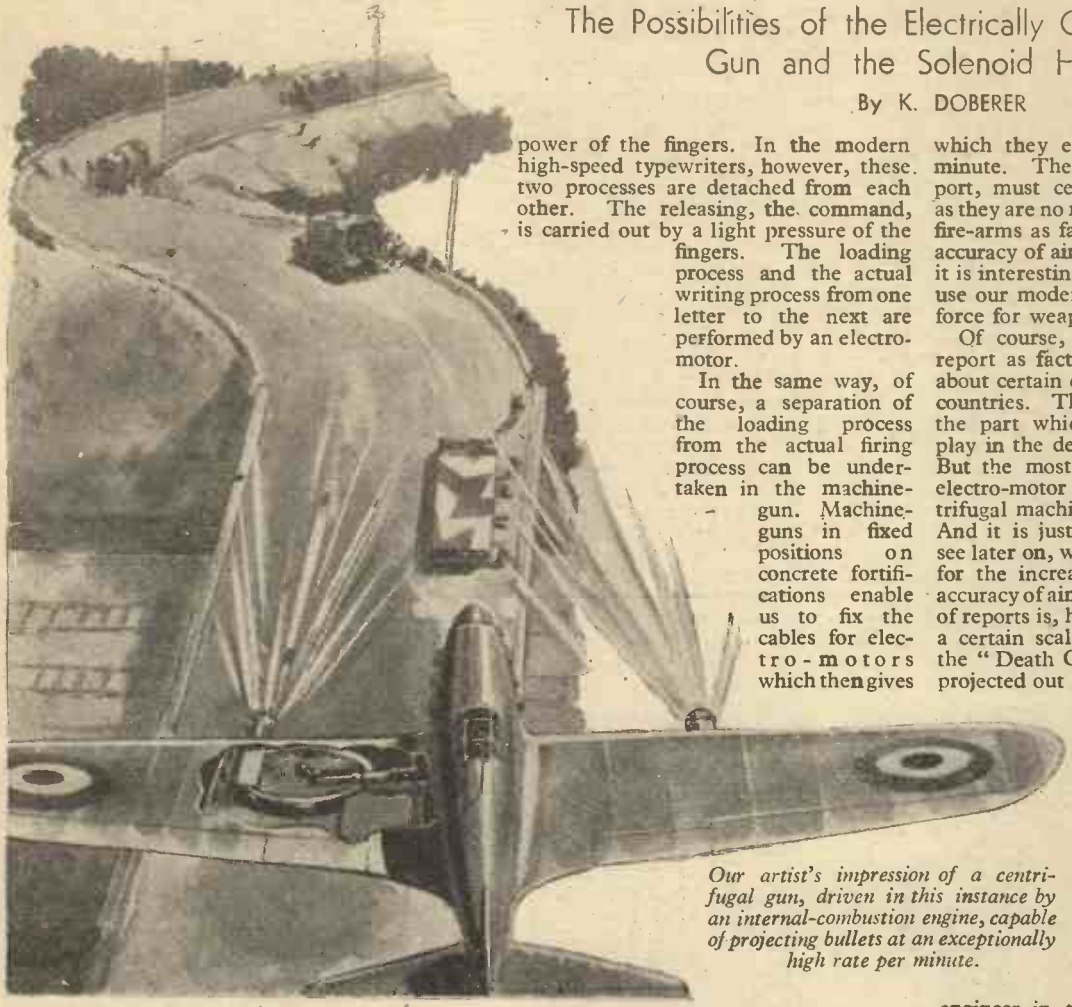
FLYING through an electric storm over the North Sea, a Lancaster bomber was suddenly wrapped in a flash of blue light and tossed out of control. All four engines cut out, and the bomber nose-dived for 6,000ft. at more than 400 miles an hour. The captain tugged at the control column and his second pilot tugged too.

The gunner then struggled out of his turret, and climbed up to the cockpit, where he worked the wheel controlling the elevator trimming tabs. Between them the three men brought the Lancaster out of its dive when it was only about 400ft. above the water. The engines started again, and the crew finished their journey home.

Electric Fire-arms

The Possibilities of the Electrically Operated Centrifugal Gun and the Solenoid Howitzer

By K. DOBERER



Our artist's impression of a centrifugal gun, driven in this instance by an internal-combustion engine, capable of projecting bullets at an exceptionally high rate per minute.

THE very effective light machine-gun—model M 26 of the Brno Zbrojovka—called the Bren gun in the British Army, possesses a theoretical rate of fire of 600 per minute. This amounts to an ammunition consumption of two and a half times of its own weight for this short period.

This rate of firing is multiplied in special models, used in aerial defence and aerial attack, by the method of coupling the barrels. For this purpose, an extremely high rate of fire is necessary in a comparatively short period. This problem has been solved by simply coupling together the machine-gun barrels and their loading mechanism. By coupling of five barrels, theoretically and for a short time—for a few important seconds—also actually, a rate of fire of five times 600, that is, 3,000 shots per minute are possible.

But in spite of all these decisive constructive improvements, the primitive fundamental principle has remained unaltered—the utilisation of the explosive power of the charge. Not only is this explosive power used to hurl away the projectiles, it must also operate the whole complicated loading process. Recoil loaders, in which the recoil of the cartridge is used to operate the loading mechanism, are just as primitive as the gas-engine loaders, in which the gas, generated in the barrel, passes into a cylinder and actuates the breech mechanism.

We can best compare this process with one we are well acquainted with in our everyday life. When we use a typewriter, the fingers must not only release the type bars, they must also simultaneously perform the process of writing by exerting the muscle power of the fingers. In the modern high-speed typewriters, however, these two processes are detached from each other. The releasing, the command, is carried out by a light pressure of the fingers. The loading process and the actual writing process from one letter to the next are performed by an electro-motor.

In the same way, of course, a separation of the loading process from the actual firing process can be undertaken in the machine-gun. Machine-guns in fixed positions on concrete fortifications enable us to fix the cables for electro-motors which then gives us the opportunity to use the electro-loader system where the charge only performs the actual forcible firing process. All loading movements are carried out by the electro-motor. The result is a much smoother functioning of the whole loading process, and possibilities for new constructional work are created which may lead up to a considerable increase in the rate of fire. Decisive improvements of this description may be attained especially for multiple machine-guns to ward off enemy air attacks on places of strategical importance and on ships; on places, therefore, in which the supply of ammunition is safeguarded at the same time.

In how far electro fire-arms will also be employed in the trenches, and in position warfare, only depends upon one question—in how far the big problem is solved of the steady supply of current for an army by the use of steel-plated cables or by employing wireless transmission of power.

Long-range Centrifugal Gun

A German patent describes a control contrivance of the loading mechanism for the steel projectiles of mechanical sling weapons, fitted with a centrifugal rotor, specially designed for use in fighter airplanes.

A few years ago it was reported that a Japanese had also constructed a machine-gun, driven by an internal combustion engine, and worked by means of a revolving disc, possessing an aperture on its face, which fires no less than 9,900 shots per minute. The Americans were also said to be carrying out similar experiments, and to have made an invention of the same nature as the Japanese gun with which they even can fire 33,000 shots per minute. These bullet-slingers, says the report, must certainly not be over-estimated, as they are no match for the customary modern fire-arms as far as the hitting power and the accuracy of aim are concerned. Nevertheless, it is interesting that efforts are being made to use our modern machines also as the motive force for weapons.

Of course, we must not take the whole report as fact, but it gives us an indication about certain experiments going on in several countries. There is a hint in the report on the part which our modern machines will play in the development of the new weapon. But the most modern of our machines, the electro-motor as motive power for the centrifugal machine-gun is not even mentioned. And it is just the electro-motor, as we shall see later on, which offers the best possibilities for the increase of the so much distrusted accuracy of aim. The actual result of this series of reports is, however, that public opinion, on a certain scale, has become acquainted with the "Death Centrifuge"—it has now been projected out of the hazy distance of Utopia into the sphere of reality.

Utopia already had seized upon this weapon a few years ago. In the year 1932, a novel by Ilja Ehrenburg, the Russian writer, "Trust for the Destruction of Europe," was published. In this book a bombardment by 28 electric centrifugal guns—the system was named "Centrifuge Divoire Excelsior"—is described. These bullet-slingers were, so the novel goes, constructed by a French engineer in the year 1928, and consisted of two large steel discs, running at a speed of 2,000 revolutions per minute.

Let us briefly allude to the fact that this idea, which has now become reality, is not the only possibility of discarding the powder-recoil weapons. The air-gun was already mentioned in the cited report. To-day it is generally only used as a sporting gun. But many efforts have been made to make this type of weapon a requisite of war. The Military Historical Collection in Prague, for instance, possesses a repeating air-gun, constructed by Girardoni somewhere about the year 1770. The gun was 12-chambered. The necessary compressed air was pumped into a reservoir in the gun stock with a hand pump. The first of the 12 shots carried as far as 200 paces, whilst the last ones had practically expended their force when they left the barrel. By the use of motor-driven compresses a far more rapid series of shots or larger bores in connection with a considerably increased range would be attained. Owing to the noiselessness of its operation, the employment of this principle for hand grenades seems to be quite feasible. But this gun, and also all the patented gas-guns with their excellent electrical ignition, will always remain insufficient where projectiles are to have a certain piercing power when they reach their mark. Contrary to the air- and gas-propelled fire-arms, the centrifugal gun possesses this property, as it is based on the theoretically unlimited power of centrifugal force. After a certain probationary period it will certainly be able to compete with our powder-recoil weapons in the most instances.

The Rotating Bullet

Let us consider the terrific speed with which every ounce of steel on the periphery of the large wheels of modern turbines revolves. If from one of the turbines of a giant liner a particle of steel was hurled away it would travel at a speed of 300 yds. per second. It would penetrate a human body like a bullet, as the velocity of a bullet fired from an ordinary revolver, when it leaves the muzzle, reaches a speed of 280 yds. per second. Only the projectiles from modern army pistols with an initial muzzle velocity of 350 yds. per second would overtake the particle of steel hurled off by the turbine. Using nickel steel blades for the turbine we can, however, go up to peripheral speeds of 400 metres per second. It is therefore possible to construct a centrifugal machine able to hurl steel particles from its outer rim at speeds much higher than the initial velocity of projectiles from army pistols.

In the United States of America separators with duralumin rotors were built for scientific research with which peripheral speeds of 725 yds. per second were registered. The physicists Beans and Weed, of Virginia University, succeeded in reaching 500,000 revolutions per minute with their super centrifuge, which, however, has a correspondingly smaller diameter of the rotor disc. During experiments which Professor Beans was carrying out, a rotor of 3½in. diameter burst whilst doing 132,000 revolutions per minute. This works out a "muzzle velocity" of 650 yds. per second for the outer parts on breaking away.

It may be assumed that, if suitable new light metal alloys are used, peripheral speeds —and these, and not the number of revolutions are the chief thing—of about 1,000 yds. per second could be secured without straining the material to the breaking point.

The achievement of serviceable peripheral speeds, which here means firing velocity, can, therefore, hardly be doubtful for the centrifugal machine-gun.

Compared with the old types of fire-arms the centrifugal machine-gun will be greatly superior in its rate of fire. The first centrifugal machine-gun, constructed in the year 1918 by the American, W. Lombard, in Boston, theoretically fired no less than 33,000 shots in one single minute. This large number of shots was a logical result of the construction of the Death Centrifuge. Thirty-three thousand shots per minute means that 550 projectiles are hurled out every second. Five hundred and fifty is—at the same time—the number of revolutions of the two flat steel discs running together closely. After every revolution these discs throw, from a slit in the rim, a steel bullet out of the discharge aperture. The number of revolutions is necessary, if, with a disc diameter of 20in., an initial velocity of nearly 800 yds. per second is to be achieved by the bullets. This initial velocity, which is increased by the radial action of the centrifugal power, imparts more energy to the round steel bullets of the centrifugal machine-gun, although they only possess one-quarter of the weight of the heavy lead-filled pistol bullets. The steel bullets in the Death Centrifuge roll in a steady stream into the machine through the axis. Then they are carried to the rim, moving up to top speed, by a fluted spiral curve—the fluting being stronger and stronger towards the outside. By this system it is possible to increase the speed of the bullet from nought up to 800 yds. per second in a comparatively short period.

Is this the howitzer of the future? An impression of an electric solenoid gun.

Huge projectiles, perfectly streamlined, are hurled through space by means of powerful electro-magnetic fields.

The Water-hose Method

In keeping with the uncommon character of the recoilless shot, it must be assumed that the accuracy of aim of the Death Centrifuge within a certain range can be increased without any difficulty compared with the results obtainable with powder recoil weapons, so that the very contrary of superficial predictions comes to pass. It is not an actual disadvantage of the centrifugal weapons that it is not possible to simply take direct aim over the straight barrel of the gun with them. By an anticipated method of calculation, the aiming contrivance and the distance adjusting apparatus are so coupled that if they are properly regulated, there is the same guarantee for the exactitude of aim of the projectiles as with the powder recoil weapon. It will then be a matter of indifference to the marksman which curves his bullets may take before they hit their mark.

As the actual power of every weapon is dependent upon the proper limitation of its use, it stands to reason that this principle also applies to the centrifugal machine-gun. It is a typical hand-to-hand fighting weapon like the tommy gun. Its confines lay in the impossibility to increase the initial velocity over a certain point, owing to the limited qualities of the materials used for its construction, which even the most up-to-date alloy combinations cannot overcome. A further limit is given in the aerodynamically disadvantageous form of the bullet compared with the long stream-lined projectile used in modern fire-arms. The steel bullet from the centrifugal gun is not an armour piercer, although it is asserted that during tests an armour plate, ¾in., was penetrated by a shot fired at a distance of fifty paces from a centrifugal gun.

The proper utilisation of an ultra quick-firing gun can be demonstrated by the water-hose method introduced during the English army manœuvres. During machine-gun operations so many tracer bullets were interposed in the ordinary ammunition of the belts that there was a line of fire from the mouth of the gun to the target of these sheaves of bullets. Similar to the functioning of a fire hose, the gunner no longer adjusts his aim by means of the sight, but simply by the line of light. By employing this method, hits were scored in the shortest time, even against such difficult targets as low flying battle 'planes. The ultra-high rate of fire of the centrifugal machine-gun is an indication for its use in a similar manner.

But even for this purpose, the rate of fire used by the first mentioned inventor is too high. Even if one takes into consideration that copper and lead are not required for this type of gun, the consumption of steel by a rate of fire of 33,000 shots per minute is too high. In Japanese tests the rate of fire has been reduced to 9,000 shots per minute.

To attain this number of shots, the number of revolutions of the rotating disc was reduced to 150 per second. Of course, the diameter of the disc had to be accordingly enlarged, so as to ensure the necessary bullet velocity of 800 yds. per second.

A smaller number of shots is possible, if after every shot the next bullet enters the feed only after several revolutions of the whirling discs have taken place. To enable this, an electro-magnet, coupled with the rotor between the bullet magazine and the firing groove, is provided (according to a German patent) which releases the steel bullets in a certain rhythm. This rhythm can, of course, be made variable, so that different rates of fire result, similar to the English Lewis machine-gun.

The Solenoid Howitzer

A steel shell, thrust by the force of huge magnet fields through a barrel-long system of rings of solenoid coils, and leaving then the mouth of the solenoid howitzer noiselessly, but with incredible speed—that is the scientifically ideal application of the electro-gun. Although in all big guns the aiming contrivances are already electrically operated and even the initiative to the propelling force, the charge explosion, is given by electricity, this primeval force of nature so far was only a servant of the great force of the explosive which ultimately flung the projectile, weighing many tons, out of the barrel with a rumbling detonation.

Now the same work is to be performed by a series of enormous electro-magnets, out of which American engineers have constructed the barrel of an amazing howitzer. One after another, each of the series of strong coils pull the heavy steel shell up to the centre of its ring. At the same moment, however, the circuit is broken, and only the long row of the coil rings higher up in the barrel attract the shell. This makes it impossible for the rings already passed to develop counter forces, and the shell is drawn through the barrel at a speed increasing from coil to coil.

It may be added that this method may supply the propelling power for several other types of war machines. We may mention the torpedo release and the throwing of mines. These ballistical contrivances may offer better opportunities at once and then prove useful for the further development of the idea right up to the ideal solenoid howitzer. The dominant advantages of this new method to throw projectiles are quite obvious. Instead of a heavy gun, weighing hundreds of tons, a steel-ribbed construction suffices, perhaps only weighing the tenth part of the weight of a "Dicke Berta." The cost per shot of about £200 can be reduced considerably if, instead of an explosive charge of many hundred kilograms, the high tension from the electro-power station is able to supply the energy direct. Deformations of the ordinary gun barrel, making it unserviceable after a small number of shots, are impossible with the solenoid howitzer, as the projectile is forced to keep exactly to the centre line of the barrel by the magnetic field and, therefore, does not even touch the walls of the barrel. There will be an economisation of metal, as the copper driving bands, which must produce the spinning of the projectile, are, with the electric gun, superfluous—and copper is an important metal in war-time. The rotation of the projectile on its own axis during flight, so necessary for stability and always a source of the greatest difficulties with heavy guns, can be achieved by magneto-electric effects with the solenoid gun. Sound, smoke and flash of discharge—a constant worry to military experts—are entirely done away with in the electro-gun. Even the slight report of a pneumatic shot, the shot by air pressure when the compressed air is released, does not obtain with the solenoid gun. Whilst the shot is being fired, the air can have free access to the steel frame behind the projectile, or it can even be pressed in at the moment of firing to avoid drag—the resistance of air. Projectiles for the solenoid gun do not, of course, possess the imperfect aerodynamic form still necessary for those of the powder gun, with its flat base, exposed to air reaction, which tends to reduce the motion. They are constructed in streamline contour in perfect accordance with aerodynamical principles and taper to a point at the tail. Consequently, the decrease in velocity is much smaller and to cover the same trajectory they can start with a lower initial velocity.

Should we have any doubt about gaining the initial velocity of the powder recoil guns —the 210 millimetre (8.26in.) long-distance guns, firing into Paris during the Great War from a distance of 130 kilometres, possessed an initial velocity of 1,600 metres per second—we must remember that the normal velocity at which electricity responds is 300,000 kilometres per second. During a lecture Nicola Tesla once stressed this point, referring to the incredibly short time which suffices to build up big forces in electro-technics. Tesla said :

"Such results are easily achieved, as the condenser can discharge the accumulated energy in an inconceivably short time. Nothing known in physics can equal this property.

"As far as its effect is concerned, a powerful explosive like dynamite can best be compared with a charged condenser. But even the tremendous explosive powers of dynamite cannot be compared with those of a discharge or an explosion of a condenser. The pressure produced by the detonation of chemical compounds can be determined by dozens of tons per square inch, whilst a condenser discharge will amount to thousands of tons per square inch. If one could produce a chemical preparation able to explode with the same velocity as a condenser charge, one ounce of it would be enough to put the most powerful battleship out of action."

Thus the possibilities existing in the exploitation of electric percussive forces were clearly stated. Therefore the problem is reduced to the question of the mastery of such forces. Many large laboratories devote their work to the study of finding a solution.

A Shot Out of the Earth

To reduce the budget expenses connected with such special investigations as much as possible, other possibilities for the application of the driving power of the solenoid coils are being searched for and technically perfected in various laboratories.

As we have already pointed out, the decisive difference between the driving power of the solenoid coils and that of gaseous substances is that the former do not exert any pressure on the walls of the tubes, so that, in the work proceeding in Moscow, the brass tubes, which otherwise would have been necessary, can be substituted by simple papier maché tubes.

The small steel projectiles, containing the goods about to be transported, are hurled forward through the electro-magnetic fields of the solenoid coils placed along the papier maché tubes. In view of this properly functioning plant, we can understand how the solenoid howitzers, with their big, closely packed magnet coils, will convert mighty current impulses into extreme accelerating power. A standard work on ballistics, edited by a number of leading artillery experts and published in 1939, gives the following data about an electro-magnetic gun :

Length of the tube ..	27.5 metres
Calibre of the projectiles	47.5 centimetres
Weight of the projectiles	3,000 kilograms
Initial velocity of the projectiles	1,000 metres per second

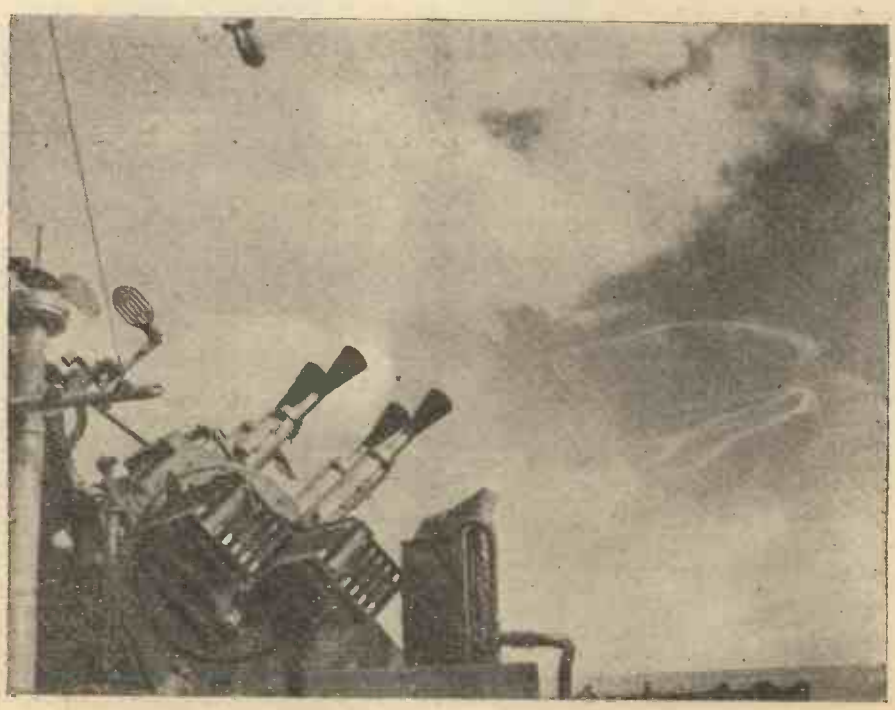
In addition, unbelievable figures relating to the rate of fire are given.

In Russia, designs for a gun of this kind have been made by Professor A. A. Koroljkoff, who demonstrates that such guns can be operated both by direct current as well as by alternating current. Of course, it is not possible simply to connect up such guns with the next point—the heavier ones require quite a fair-size power station for themselves.

In his design for a gun of this type, Professor Koroljkoff bases his calculation on energies available from a power station which has a capacity of 100,000 kilowatts. His gun is only to fire projectiles with a calibre of six inches, weighing approximately 40 kilograms, but these projectiles are to leave the tube with an initial velocity of 900 yds. per second and with a rate of fire of 200 shells per minute.

These figures are, it is true, theoretical, but there is no doubt that such guns are already under construction.

Objections raised by experts, that the barrels of the solenoid guns have to be too long to be practical, are unfounded. The tubes of the electro-magnetic quick-firing howitzers can be run into the ground in pits, and the range can partly be regulated by the strength of the current. Guns of this kind can be excellently employed for the purpose of directing the most rapid and continuous fire on certain predetermined objectives, or points which the enemy has to pass under all circumstances.



Modern pom-pom anti-aircraft guns on board a destroyer.

Aircraft Detectors

Aeroplane "Spotting" by Electro-acoustical Methods

By D. W. ALDOUS, M.Inst.E.

Fig. 1.—The aircraft detector in position for operation.

SINCE the outbreak of war many devices for the location of aircraft in flight have been studied and developed. One electro-acoustic method, which has been produced in commercial form in this country by Benjamin Electric, Ltd., comprises an accurate metal parabolic reflector, with a diameter of 3ft., mounted on a massive turntable which is placed on the roof of a building. The turntable enables the complete reflector to be turned through 360 degrees, while another control permits the angle of elevation to be adjusted to any degree. Located precisely at the focal point of the parabolic reflector is a microphone (piezo crystal or a special dynamic type) and surrounding the outer periphery of the reflector is an acoustic tube adjusted in length so that it acts as a Helmholtz resonator. This resonator not only increases the sound magnification but it also markedly reduces wind noises and pick-up due to mechanical vibration.

Signal Output

The signal output from the microphone is fed into a high-gain amplifier incorporating a special filter network, so that it acts as an acoustic band-pass filter. By means of a selector control, different bands of audio-frequencies can be accepted and all other signals attenuated. The output from the amplifier is applied to a pair of headphones and/or to the "Y" plates of a cathode-ray tube. In operation, by rotating the reflector unit, which resembles a searchlight in appearance, in the direction of the aircraft a low audio-frequency signal will be heard in the headphones, and as the reflector is adjusted carefully the intensity of the sound will increase or decrease, dependent on the direction of flight.

Crystal Microphone

Employing the same method, but in a less elaborate form, the Department of Physics at Rensselaer Polytechnic Institute, Troy, New York, has developed an aircraft detector for use by observers in the smaller towns and villages in rural areas of the U.S.A. outside the audible range of air-raid sirens installed in the bigger towns, and themselves lacking adequate warning of the approach of enemy aircraft.

This detector consists of a crystal microphone, with a large loudspeaker horn acting as a sound collector, plus a battery-operated amplifier feeding earphones. The microphone mounting is shown in Fig. 3, and it should be noted that the function of the loudspeaker horn, admittedly not designed for the present purpose, is to act as a sound collector and is not intended to resonate at any particular frequency.

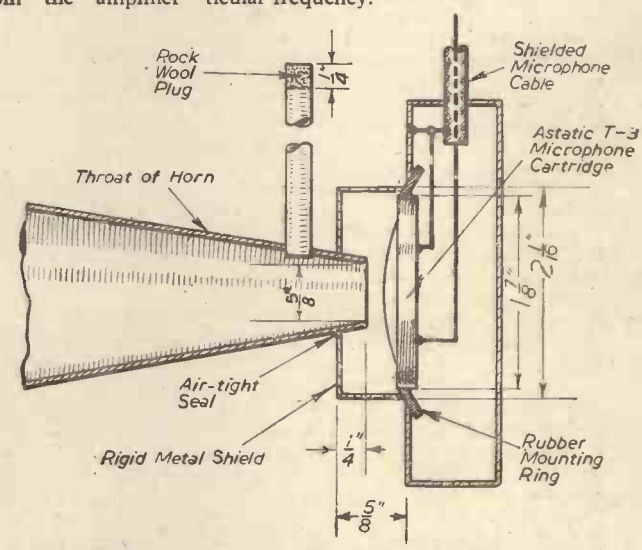


Fig. 3.—The crystal microphone mounting.

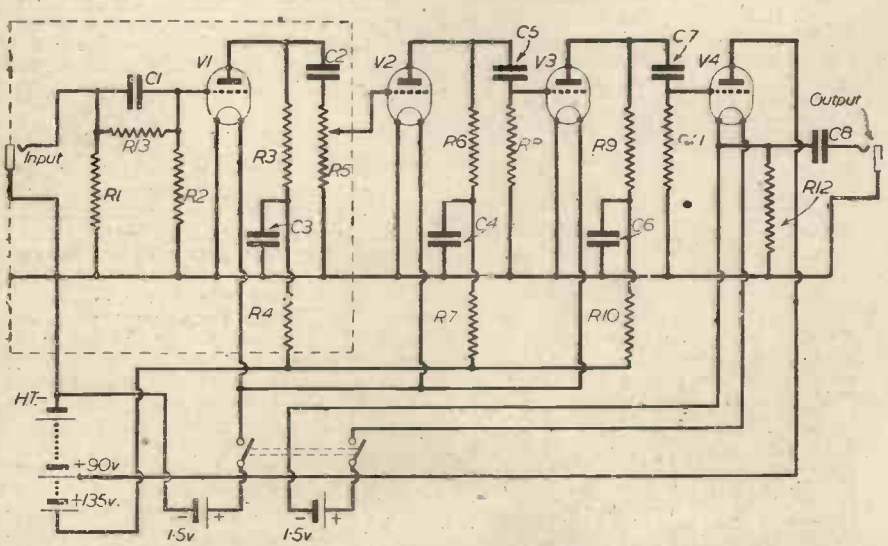


Fig. 2.—The amplifier circuit. Values of the various components are: R1, R2, R4, R7, R10, 100,000 ohms; R3, R6, R9, 300,000 ohms; R8, R11, R13, 500,000 ohms; R12, 3,000 ohms; R5, 500,000 ohms; all resistances rated at 0.5 watt. C1 is .00025 mfd.; C4, C6, C8, 0.1 mfd.; and C3, 8 mfd. electrolytic.

Amplifier Circuit

The amplifier circuit is shown in Fig. 2, and any high impedance L.F. amplifier valves are suggested as being suitable for V_1, V_2, V_3, with a low impedance output valve for V_4. One feature of it is deserving of special mention. The keynote of the complete detector is simplicity combined with cheapness, and in attaining this end a novel form of output circuit, which dispenses with the conventional choke or transformer, is used. The output is taken, via a 0.1 mfd. condenser, from the cathode (filament) circuit of valve V_4. Although a low impedance output valve is recommended, its anode resistance is specified as 3,000 ohms, and so when used with a pair of high-resistance earphones, say 2,000 ohms, an optimum circuit of average value is obtained. Also, even if R_{12} should fail a tolerable performance could still be effected by the earphones resistance alone. The possibility of shock to the operator from the H.T. supply, in the event of failure of the output condenser C_8, is removed owing to the valve action in not passing reverse current.

Cost of Equipment

The equipment seen in Fig. 1 is said to cost the equivalent of £10, and its range of sensitivity is sufficient to give the "spotter" enough time to prepare for recognition.

A Beaufort torpedo-bomber. These machines are now operating against enemy ships in the Mediterranean.

The World of Aviation

The Whirlwind : Germany's New Bomber : The Typhoon : A Backyard 'Plane : All-metal Amphibian 'Plane : New Russian 'Planes : Jet-propelled 'Planes

The Whirlwind

AN announcement stated that the Whirlwind, one of our newest fighters, has recently been in action. It is a single-seat twin-engined 'plane, powered by two Rolls-Royce Peregrine engines, each of 350 h.p. Its armament consists of four 20mm. cannon, and the Whirlwind has a speed of nearly 400 m.p.h. The range of the fighter is fairly extensive. The Whirlwind was taken off the secret list last March.

Germany's New Bomber

THE Heinkel 177, Germany's new bomber, is an unusual aircraft with a maximum range of over 7,000 miles, with a 15 per cent. overload, and carrying 1,000lb. It has four Mercedes-Benz engines, each of 1,460 h.p., but appears to have only two, for each pair is built into one nacelle, and geared to drive a single propeller. With a wing span of 103ft. and a length of 67ft., this giant of the air, strange as it may seem, is fitted for dive-bombing, having dive brakes beneath each wing. When loaded for a maximum range flight, the Heinkel 177 can carry under half a ton of bombs, but for what the Nazis call normal range, between 2,000 and 3,000 miles, its load is about that of our Lancaster. It has a top speed of just over 300 m.p.h., a cruising speed of 180 m.p.h. and a ceiling of 25,000ft. The machine is well armed, having among other armament features a gun turret underneath the fuselage both fore and aft of the wings. It has a crew of seven. So far, the Heinkel 177 has not carried out any operational flights.

The Typhoon

SINCE the Typhoon came into existence, as far back as February, 1940, it has been test-flown by Flight-Lieuts. P. W. S. Bulman and Lucas, until to-day it is turned out as the fastest interceptor fighter in the R.A.F. It is similar in appearance to the Hurricane, but there the similarity ends. The Typhoon is much faster (its speed is said to be well over 400 m.p.h.), and it climbs with amazing speed. Two men, Sydney Camm, who designed the machine, and Frank Halford, designer of the engine, are responsible for the Typhoon. Naturally the specification of this fighter is a close secret, but it can be said that the engine develops 2,400 h.p. and its short length adds considerably to the manœuvrability of the Typhoon and may account for the statement that it can stand on its tail and still go on climbing. It is a fitting reply to the Focke-Wulf 190.

A Backyard 'Plane

AN American aircraft firm have during the past year been carrying out experiments with a 'plane which can be flown with absolute safety from suburban gardens. It can be built for as little as £150. During tests the machine has shown its ability to rise and descend vertically regardless of wind or calm. It has hovered motionless above the ground while men on the ground have changed one of its tyres, and hovered a few inches above the head of a man on the ground for half an hour. The machine can fly backward, forward and sideways. An amphibian model taxies forward, sideways or backward, against any current of wind, and turns round and round on the same spot. It will land on sea or grass without any adjustment. The machine has a top speed of about 90 m.p.h. and is said to be practically fool-proof. It can be mass-produced.

New Aircraft Engine Plants

A NEW aircraft engine plant, so huge that it will house its own indoor road, highways and villages, is being rushed to completion by a large aeroplane company in America. The Chrysler Corporation is also building a huge plant at Detroit, where air engines of tremendous power will be built.

500 Flying Ships

HOWARD R. HUGHES and Henry J. Kaiser, the civil engineer who revolutionised American shipbuilding, are joining forces to build a fleet of 500 huge cargo flying-boats to carry war supplies to the front. The 'planes will be designed by Mr. Hughes and made by Mr. Kaiser. Mr. Kaiser's idea to build these huge machines was based on the 70-ton Mars carrier aeroplane built by the Glenn L. Martin Company. The Mars can carry 150 troops with full equipment.

New U.S. Fighter

"A NEW American fighter which is in the 400 m.p.h. class will be delivered on all fronts," said Major-Gen. Brett, commander of the United Nations air forces in the South-west Pacific, in Philadelphia recently. "It flies fastest above 25,000ft., weighs 5,000lb. more than the ordinary fighter, and possesses fire-power equivalent to a five-ton lorry smashing into a stone wall at 60 m.p.h."

All-metal Amphibian 'Plane

AN amphibian machine which has been giving a good account of itself recently is the Grumman "Goose," an all-metal 'plane which is heavily armed for both offensive and defensive work. Powered by two 450 h.p. engines, the "Goose" has a maximum speed of 201 m.p.h., a ceiling of 22,000ft., and carries a crew of three or four. Armament features include a fixed machine-gun in the nose and a free one at the back. Bombs can be carried under each wing.

The Japanese Zero Fighter

WE have heard quite a lot about the Zero fighter which the Japanese are using in the Far East, and although the American and British fighters are superior in both speed and armament, the Zero fighter cannot be dismissed lightly as a second-rate machine. Early models had only two machine-guns synchronised to fire through the propeller, but the aeroplane was so light and compactly built that it had amazing manœuvrability. If an opponent got on its tail the Zero would go into an amazingly steep climb and then flop over backwards on top of its pursuer. This sensational loop was made in about 300ft. Most other fighters would need 1,000ft. to do the same thing.

It is now rumoured that the Zero fighter has now been equipped with special robot-pilot devices. If in a dog-fight the Japanese pilot finds himself at a disadvantage, he merely hands over to the robot pilot, which then hurls the aeroplane around in the sky in a manner with which no human can cope.

Britain's finest bomber—the Lancaster—in flight.

New Russian Machines

WE hear that Russia is developing several types of heavily armoured high-speed fighters, but she is very secretive about their capabilities.

The Focke-Wulf 190

IT is now learned that Kurt Tank, the designer of Germany's No. 1 fighter, the Focke-Wulf 190, has succeeded in concentrating the major weight, engine, tanks and pilot tightly around the centre of gravity so that the machine has exceptional manœuvrability. It will also be able to be fitted with a more powerful engine when one becomes available.

Jet-propelled 'Planes

ITALY are still experimenting with their jet-propelled planes, but what results have been achieved in this field are not yet known. A descriptive article on this type of aeroplane appeared in a recent issue of PRACTICAL MECHANICS. Instead of an airscrew, air is sucked through the nose, expanded by heat, and shot out of a narrow hole in the tail in such a way as to provide a powerful forward thrust for the aeroplane.

Giant Aircraft

IN reply to a further question in the House of Commons recently about cargo-carrying aircraft, the Minister of Aircraft Production, Colonel Llewellin, stated that orders had been placed in this country and a suitable production programme arranged. The Minister added that, with the assistance we hoped to get from the United States, a substantial number of these aircraft should be available.

Picking Up Gliders

RECOVERY of a glider once it has reached its objective and discharged its load has been an hitherto unsolved problem in military aviation. The U.S. Army Air Force are experimenting with what may be the answer. As will be seen from the illustration on this page, the gadget consists of two poles from which is suspended a rope which runs along the ground to the glider. The towing 'plane drags a hook over the rope in a low swoop, and the glider is hooked just like a mail bag. The glider then becomes airborne once more, as shown in the illustration.

The Spitfire V

THE Spitfire V, which has recently been taking part in a number of fighter sweeps across the Channel is now fitted with an improved engine, and is armed with two cannon and four machine guns. As an all-round 'plane it compares favourably with the Hurricane, being swift, high-flying, easy to manœuvre in the sky and deadly in fire-power.

Target-towing Aircraft

A NEW aircraft, the Miles Martinet 1, built by Phillips and Powis Aircraft, Ltd., has been introduced into the R.A.F. for towing targets for firing practice. It is a two-seat, low-wing monoplane of wooden construction, and is powered by a Mercury XX or Mercury XXX air-cooled radial engine. Transmitting and receiving radio units are fitted. Provision is made for fitting desert equipment. It is possible to tow either sleeve or flag-type targets.

Seagull Scout 'Planes

CURTISS WRIGHT'S versatile Seagull scout 'planes are now serving with the U.S. Fleet. A two-seat monoplane for land-based or catapult operation, the Seagull's long cruising range and its ability to carry light bombs make it a menace to submarines.

The Carter Trainer

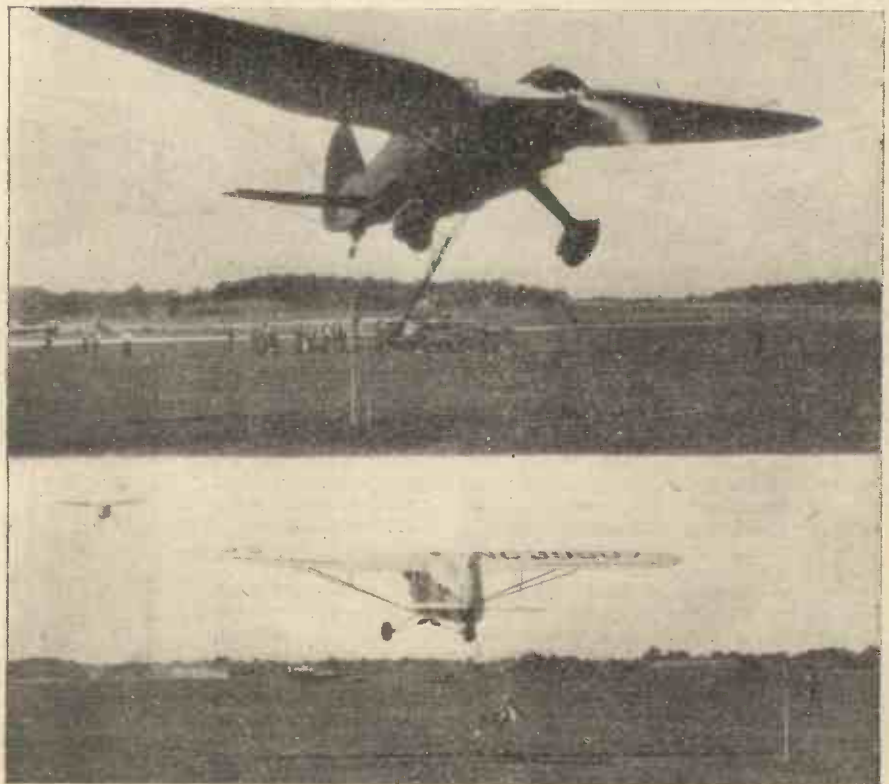
BY an ingenious device known as the Carter trainer, the A.T.C. lads of Wood Green, London, get useful practice in dummy bombing. It was built by the boys under the supervision of their commander, and all the instruments work as accurately as those of a real 'plane.

The Mustang

MUCH has been said about the Mustang, the American one-seat single-engined fighter. It is an all-metal monoplane of the low wing cantilever type. It is not unlike the German Me. 109E in appearance with its square-cut wing-tips. This is due to the straight lines of the Mustang's wings, tail-planes, and rudder, but it lacks the rather ungainly body lines of the German machine. The Mustang is powered by a liquid-cooled Allison 1,150 h.p. engine, and has a wing span of 37ft. 3in. and is 31ft. 3in. long.

Lockheed and Thunderbolt

MR. EDWARD RICHENBACKER, American flying expert, has told Army radio technicians that the two American fighter 'planes, the twin-engined Lockheed and the Thunderbolt, have both proved superior " in actual tests " to the Focke-Wulf 190. The Lockheed, he says, climbs as high as a Spitfire, and flies faster, and the Thunderbolt will go higher.



Method of picking up gliders after they have discharged their load. (*See paragraph on this page.*)

Odd Jobs in House and Garden

8.—Making Briquettes : A Cinder Sifter : Using Fire-bricks

By "HANDYMAN"

Fig. 2.—Mixing the coal dust and cement in an old bowl.

IN order to economise to the utmost in the use of coal, it is necessary to burn up all the coal dust. A good method of doing this without causing a lot of smoke is to form the coal dust into briquettes; these can be burned in the same manner as ordinary coal blocks, which are obtainable ready-made.

The dust for making the briquettes should only contain fine particles of coal, and pieces of appreciable size must be burned in the ordinary way. The reason for this is that the fine dust binds more uniformly.

One of the simplest binding agents for holding the dust together in the form of briquette is Portland cement, a seven pound bag of which will be sufficient for making several dozen briquettes.

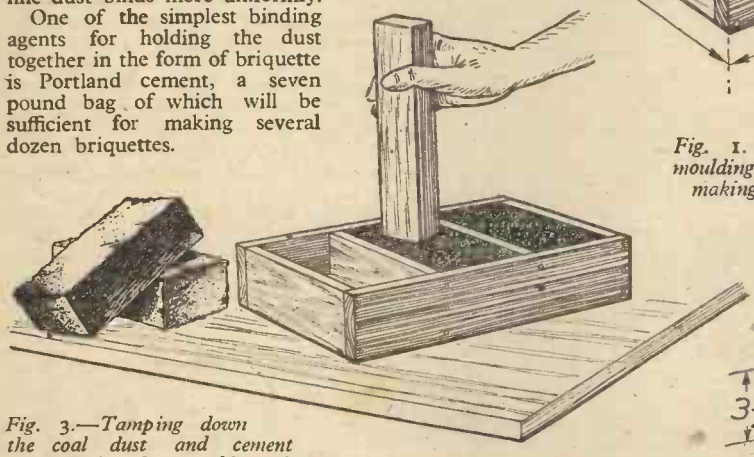


Fig. 3.—Tamping down the coal dust and cement mixture in the moulding box.

First of all a simple moulding box will be required, and this can be made with pieces of wood ½in. thick, to the dimensions given in Fig. 1. Nail the parts together as shown, so that spaces between the partitions measure roughly 6in. by 3in. by 2in.

Next, an old bowl or similar receptacle, of fairly large size, will be required, in which to mix the coal dust and cement, in the proportion of 16 parts of coal dust to 1 part of cement; add water, a little at a time, and mix the ingredients well, until a stiff, mortar-like consistency is obtained. A handy tool for the mixing process is a small garden trowel, as shown in Fig. 2.

When the mixture is ready place the moulding box on a flat board, fill the spaces with the mixture and tamp it down with a thick square piece of wood, as indicated in Fig. 3. After the blocks have been formed they can be pressed out from the moulding box and put on one side to dry for about 24 hours before being used. Although the briquettes will not burn exactly like solid coal, when put on a hot fire they will burn away slowly, thus saving coal.

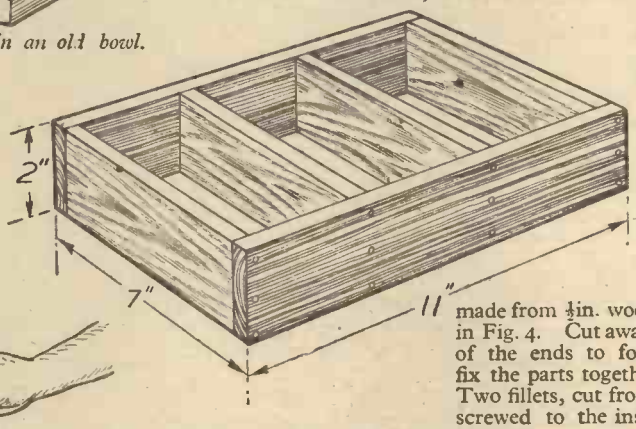


Fig. 1.—A simple moulding box for making briquettes.

Clay as a Binding Agent

Instead of using cement, ordinary garden clay can be used as a binding agent. The clay should be moistened till it forms a thick pasty mass, the coal dust being added and mixed thoroughly with the clay, and then form the mixture into balls, by hand, or press the mixture into wooden moulds to form briquettes, as previously described. Small flower pots can also be used for moulds. After being formed the briquettes should be placed on a shelf in a dry shed to dry and harden before being placed on a fire.

The Paper Bag Method

Another simple method of utilising coal dust is to sprinkle it with water thoroughly to dampen it, and then place it into small bags roughly made of pieces of soiled thick brown paper. If brown paper is not available, any old piece of newspaper will answer the purpose. Use two or three thicknesses of paper for each bag, and pack the dampened coal dust in as tightly as possible, without bursting the bag. Tie the bags round with a piece of wire in two or three directions and they are then ready for use. If the bags are placed one at a time on an open fire, the contents will burn away slowly like an ordinary coal block.

A Cinder Sifter

An old method of economising in the use of coal is to burn the cinders over again. This, however, usually proves to be rather a dusty job, but with the easily made sifter illustrated herewith, cinders can be collected without any mess or dust flying about. The sifter consists of an outer container, in the top part of which is a sieve, covered by a loosely fitting lid. Two handles are also provided.

The container can be made from ½in. wood, to the dimensions given in Fig. 4. Cut away part of the bottom edges of the ends to form feet, as indicated, and fix the parts together with 1½in. French nails. Two fillets, cut from 1½in. by ¾in. batten, are screwed to the inside of the container 4in. from the top edge to form supports for the sieve. A piece of ⅜in. plywood cut to the size required and screwed in place forms the bottom of the container.

The sides of the sieve can be cut from ½in. wood, the parts being either screwed or nailed together. Cut a piece of ½in.-mesh wire

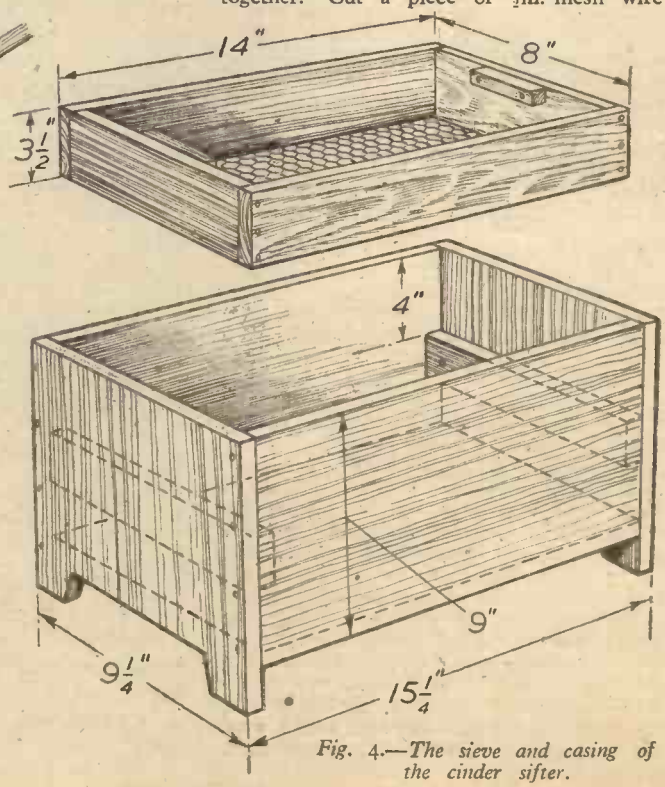


Fig. 4.—The sieve and casing of the cinder sifter.

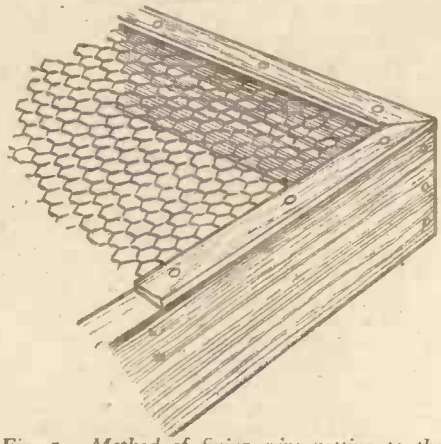


Fig. 5.—Method of fixing wire netting to the bottom of the sieve tray.

netting to correspond with the overall dimensions of the sieve frame and fix it in place with a few wire staples. Clamp down the edges of the wire netting with strips of wooden lath nailed in place, as shown in Fig. 5. Small pieces of wood can be screwed to the ends of the sieve tray, on the inside, to form finger grips to facilitate the removal of the sieve (Fig. 4).

A shallow, loose-fitting lid with sides about 2in. deep can be made with ¼in. plywood, or pieces of packing-case wood. The lid covers the container while the sifting is being done and prevents the spreading of dust. To hold the sifter firmly whilst shaking to and fro, either a metal or wooden handle can be screwed to each end of the sifter, as shown in Fig. 6.

Using Fire Bricks

Considerable economy can be effected in the use of coal or coke by the use of firebricks, especially in open grates. These bricks are obtainable in various shapes and sizes, and the best method is to place one, specially shaped for the purpose, at the back of the grate, or one on each side. By this means up to 50 per cent. of the total grate space can be taken up by firebricks which become red hot and give off a considerable amount of heat, after the fire has been alight for some time.

An Improvised Heater

In cases where a small room or shed has to be warmed, a simple improvised heater can be made with two garden flower pots and a tallow nightlight. Select the clean pots, one 6in. diameter, and the other about 5in. Place the larger pot where it is required to stand, put in the lighted nightlight, and then place the other pot (inverted) so that it rests in the top part of the larger pot. After an hour or two, a pleasant warmth will be noticeable.

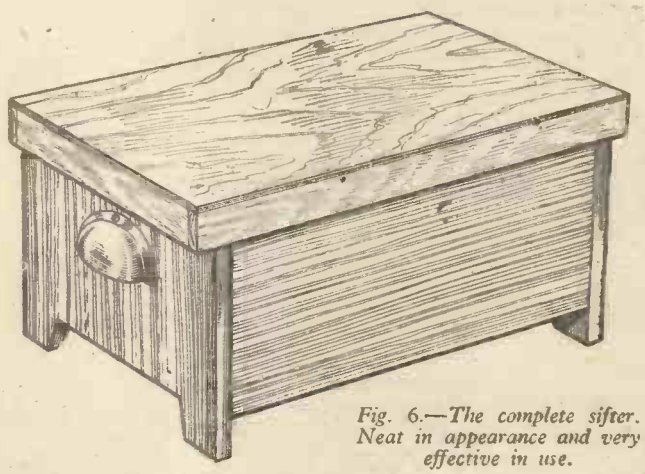


Fig. 6.—The complete sifter. Neat in appearance and very effective in use.

Tank Progress

Three columns of "Churchill" heavy infantry tanks lined up prior to taking part in exercises.

"Churchill" Tanks

SINCE the Dieppe raid, in which some of the "Churchill" tanks taking part were unfortunately left in the enemy's hands, some interesting illustrations and particulars of these formidable machines have been released.

There are several types of this machine, but the principal difference is in the armament carried. The latest type, the "Sprintern," has a 6-pounder gun mounted in the turret, and also a coaxial machine gun which is trained with the 6-pounder, but can be fired independently. Some of the tanks are fitted with a 2-in. gun in the turret, and a 3-in. howitzer below it. All the types have similar tank bodies, and nine carrying wheels, or "bogies," on each side. The engines, transmission gear, and tracks are also common to all types. The turrets and tank bodies are made of specially hardened armour plating. The "bogie" wheels are carried on short radius arms, provided with helical compression springs. At the rear, on the side of the tank shown in the right-hand illustration, is seen the air intake louvres for cooling the radiators, which are just behind it. At the extreme rear is an auxiliary petrol tank which can be jettisoned, when necessary, from inside the tank. The "Churchill" has a surprising speed, but on account of its heavy armour and formidable fire power it can also be used as a pill-box.

Welded Construction

Considerable progress has been made in the United States in fabricating tanks by arc welding. Two problems in connection with this process, that of welding armour plate, and the provision of welding shops with equipment for permitting large tank sub-assemblies to be rotated into different positions for flat welding the joints, have been successfully overcome. Two types of these welded tanks are now in service, the "M3" and the "M4," and both have a heavy armament.

One of the new "Churchill" tanks travelling at speed on manœuvres, somewhere in this country.

MASTERS OF MECHANICS

No. 79.—The Rev. William Lee, and His Invention of the Stocking Frame

IT is a rather curious fact that mechanised knitting, despite its greater complexity, was first attempted at least a century and a half before mechanised weaving. Knitting, of course, differs from weaving in that it consists of the art of entwining a single thread in such a manner as to produce a fabrie, whereas weaving comprises the combining of two or more threads for the production of cloth or textile fabric.

Weaving is older in history than knitting, but in chronological sequence knitting comes first, for, seemingly, inventors tried to devise a machine which would knit automatically before they brought into being the nowadays commonplace loom of weaving machine.

There is a good deal of mystery, to say nothing of romance, surrounding the first crude attempts to devise a knitting machine. It is recorded that the art of knitting stockings arose in Scotland at about the beginning of the sixteenth century, whence the technique passed to France, in which country a considerable industry was founded upon it.

As the sixteenth century progressed the practice of knitting became more and more widespread and popular. Knitwear stockings were worn both by royalty and the nobles and by the poorest of people. Stocking-knitting became as important an industry as hand-loom weaving.

First Mechanical Knitter

The creation of the first mechanical knitter towards the end of the sixteenth century is of much interest in view of the fact that apart, of course, from the invention of the spinning wheel and the early weaving loom, both of which devices are older than recorded history, it comprises the first of the long and highly ingenious series of inventions which, in the eighteenth and nineteenth centuries, so greatly revolutionised the textile industries.

Precise details concerning the construction and mechanism of the first mechanical knitter, or "stocking frame," as it was called, have not survived the passage of time. There is, as we have previously mentioned, an atmosphere of mystery about the entire circumstances of this pioneering and immensely noteworthy invention.

It is tolerably certain, however, that the mechanical knitting frame, the first of the textile inventions, was the outcome of experiments made by one William Lee, a clergyman, who was, for a time, curate of Calverton, then a village about five miles distant from Nottingham. Lee, although supposed to have been born at Calverton, was, so far as can be ascertained, actually a native of Woodborough, another Nottinghamshire village. The date of his birth is unknown, nor are we aware of any of the circumstances of his early career apart from the facts that he became an Arts graduate of St. John's College, Cambridge, and that he ultimately took Holy Orders.

Lee must have been a fairly young man when he first devised his stocking frame in or about the year 1589. Shakespeare was living at that time, and Queen Elizabeth was on the throne of England. British trade was increasing throughout the world, making our country rich and prosperous. Yet, strangely, the invention of the stocking frame brought to William Lee no lasting pecuniary rewards or fame. On the contrary, it enshrouded him in miseries and vexations and, in the end, it led him to a condition of almost abject poverty.

Pioneer Inventor

The Rev. William Lee, one of Britain's first if not *the* pioneer mechanical inventor, was an inventor who failed. Perhaps his mechanised stocking frame may not have been

The first means of supplying power for textile mills in England—the water-wheel.

a very efficient one, for we have few details of it. Rather, however, Lee was an inventor who was before his time, for all forms of mechanism in the days of Elizabeth and, indeed, for long after the close of her reign, were regarded with ineradicable prejudice and suspicion. Steam power, of course, had not yet come. Any crude mechanisms, therefore, which happened to be built up by an ingenious craftsman or inventor had still to be powered by hand or, at the most, by means of mechanical energy derived from a water-wheel or similar device.

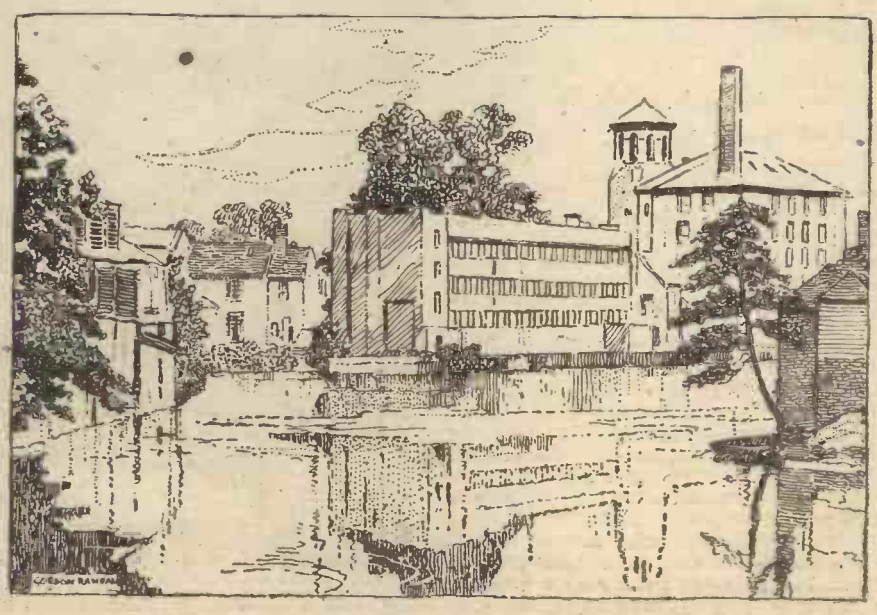
There are several stories relating to the Rey. William Lee and his invention of the stocking frame. The most reliable one has it that Lee was expelled from Cambridge University for marrying contrary to the statutes of his College. His wife, the story runs, was compelled to practise stocking knitting in order to contribute to the slender family funds, and it was in consequence of witnessing her continually active fingers that Lee conceived the idea of his stocking frame, thereby lightening his wife's burden in this respect.

Whatever truth there may be in this story, it is evident that William Lee actually did invent some kind of a mechanical knitting machine, probably a hand-turned multi-needle affair, which he set up and operated successfully for a time in Nottinghamshire.

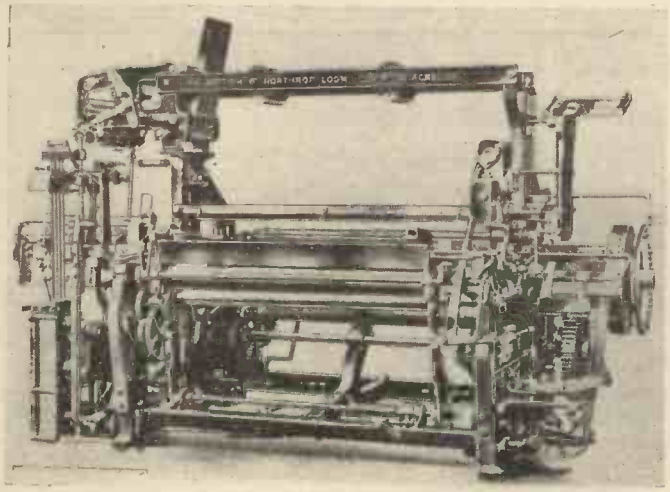
But Lee was a man of ambition. He wanted more than merely local renown for his stocking frame. He took the device to London with him, set it up in his apartments in Bunhill Fields, on the outskirts of that city, and eventually prevailed upon no less a personage than the Queen herself to do him the honour of witnessing the performance of his invention.

Queen Elizabeth Refuses Patent

There is a tradition that Queen Elizabeth was accompanied by Lord Hunsdon when she visited Lee. The stocking frame, to Lee's delight, worked perfectly and even amazed the Queen. Whereupon my Lord Hunsdon urged the monarch to favour the struggling clergyman by granting him a patent for his remarkable invention. To which appeal the Queen is reported to have made the following reply:



The first mechanised silk mill in England. Situated at Derby, on the River Derwent.



A modern automatic loom for cloth weaving. The outcome of two centuries of evolutionary effort in the textile industry.

"My lord, I have too much love for my poor people, who obtain their bread by the employment of knitting, to give my assent to the forwarding of an invention that will tend to their ruin by depriving them of employment, and thus make them beggars. Had Mr. Lee made a machine that would have made *silk* stocking, I should, I think, have been somewhat justified in granting him a patent for that monopoly, which would have affected only a small number of my subjects, but to enjoy the exclusive privilege of making stocking for the whole of my subjects is too important to grant to any individual."

Lee Settles in London

If the English Queen really did make this pronouncement to Lee she failed to discourage this inventor, for, obtaining ample encouragement from Lord Hunsdon, who in consideration of a share in the proceeds of the expected future patent, advanced sufficient funds for carrying on further inventive work. Lee at once settled down in London, not only to improve his original stocking frame (which would only knit coarse hose), but also to contrive a machine having twice the number of needles which would knit stockings in silk.

In these activities Lee seems to have had the assistance of Sir William Carey, son of Lord Hunsdon, who was actually bound as apprentice to Lee.

Little or nothing came of Lee's efforts in conjunction with Sir William Carey, but, at a subsequent date, Lee, in association with his brother, James, contrived, after many long and tedious trials, to build up an arrangement of needles soldered into brass combs whereby plain silk stocking could be produced from what was then termed "twenty gauge silk" thread.

Hosiery Industry

During this period, Lee had endeavoured to keep a small hosiery industry running in Nottinghamshire. He also erected nearly a dozen of his new "silk frames" in London in anticipation of Queen Elizabeth's finally granting him the much-desired patent for his invention.

In all these activities, Lee had worked principally with a small staff composed of his own relatives together with a few trusted apprentices.

In 1596, Lee had erected his ninth "frame" in London and was hopeful of obtaining Queen Elizabeth's coveted patent protection for his invention. Unfortunately, at this juncture Lord Hunsdon, who was virtually a partner in the enterprise, died. To make matters worse, Hunsdon's son, Sir William Carey, Lee's apprentice, also died at about the same time.

Queen Elizabeth, then at the zenith of her dictatorial power, refused to encourage Lee any further with his inventions. She declined to grant him any patent for either a woollen or a silk-knitting "frame." On all sides, the unfortunate clergyman-inventor met not only with discouragements, but, in addition, with, at times, active hostility. Like many an inventor, he was accused of taking the bread out of the mouths of the workers. His "frame" was decried by the many, although the few took to constructing copies of it for themselves, and so defrauding the inventor of the legitimate proceeds of his ingenuity.

Lee Leaves England

At last, worn, weary and despairing of any further encouragement, Lee determined to leave England. The news of his intention reached the ears of the French Ambassador in London. The ambassador showed himself interested in Lee's stocking frame. He offered the hospitality and good feeling of his countrymen to Lee and to his brother if they would remove themselves, together with a selected number of their workmen, to France for the purpose of erecting "frames" and operating the latter in that country.

Lee gratefully received this offer. At once he made plans for the setting up of his mechanised industry in Rouen. But all sorts of vexatious delays and mishaps intervened to prevent his prompt removal of men, machines and material to that noted city. Several years, in fact, elapsed before Lee and his brother had set up their "frames" in Rouen. And when eventually Lee announced his readiness to start off in Rouen with his mechanised knitting, the news of the tragic assassination of the French king, Henry IV, resounded throughout the whole of France.

Henry IV of France, through his ambassador and other officials, had encouraged Lee in his creative efforts. But with the untimely demise of the king Lee seemed to have a presentiment that all was lost for him.

At any rate, his former cheerfulness, fortitude and determination in the face of active discouragement completely deserted him at this stage. He fell into a condition of melancholy from which he never recovered.

His Death

It is said that the Rev. William Lee died in a garret in Paris in 1610, the year of the French king's assassination. Certain it is that William Lee was never heard of again, and, for this reason alone, the story of his death in Paris is probably an accurate one.

After Lee's death, his brother, James Lee, together with the diminutive band of workers who went over to France from England, decided to return to their native shores. Together, they endeavoured to operate the stocking frame secretly in one or more obscure Nottinghamshire villages. Had they been able to do so, the Lee "stocking frame" might never have been made public.

As matters were, however, a miller of Thoroton, in Nottinghamshire, managed to obtain the secret of the construction of Lee's "frame." This man, whose name was Aston, subsequently set up on his own account, and, seemingly, he was the only man who ever made anything out of the project. Aston must undoubtedly have had innate mechanical ability, for he appears continually to have improved the stocking frame, and to have gone far to found a stocking and knitwear industry which not only sufficed for our country's needs alone, but also for the beginnings of an export trade to other nations.

In the 17th century English-made stockings attained a degree of celebrity on the Continent. English knitted silk stockings were exported to Italy in unusually large amounts.

Thus was created a prosperous English industry by the invention of a single mechanical principle.

A Lancashire landscape which depicts an industrial vista far removed from any of which the Rev. William Lee may have dreamed.

Aircraft Pneumatic Equipment

Details of the System as Used on Military Aircraft

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

COMPRESSED air is used mainly to operate the wheel brakes, but is also employed in military aircraft to operate the armament and in certain cases as an undercarriage emergency lowering system. Flaps and landing lamps are also sometimes operated by means of compressed air. The flying instruments are frequently driven by a vacuum pump and the auto-pilot and de-icing systems by low-pressure air.

The advantages of using pneumatic power are as follow. No return pipes are required as the air is discharged to the atmosphere after the required operation has been completed. A pneumatic system is light in weight, the operating fluid does not cost anything and compressed air can be conveniently stored in high-pressure bottles.

Disadvantages

The disadvantages are, first, the compressed-air bottle is extremely vulnerable (especially in military aircraft), as if it is hit and punctured the bottle is liable to break loose from its mounting and cause a great deal of damage; secondly, leaks are more difficult to trace than when hydraulic power is used, thus increasing the maintenance difficulties; and thirdly, it cannot be used for operating the retracting mechanism for undercarriages due to the very high pressures required.

A typical compressed-air system is illustrated in Fig. 1, in which the main components are shown in their relative positions.

The compressor is mounted on and driven by the engine of the aircraft. The piston type is generally used and absorbs, as a rule, less than 1 h.p. when operating at normal delivery pressures. It is important that the compressor be mounted so that maximum cooling is obtained, as excessive temperatures may be reached if adequate cooling is not provided. A duct is often fitted to the engine cowling to direct a cooling stream of air on to the compressor fins. Very little maintenance is required, and beyond an occasional lubrication a well-designed compressor should function for a considerable period before an overhaul is necessary. An automatic relief valve is fitted so that when the required pressure has been attained the air passing through the compressor is circulated back to the crankcase. It is important that the oil supply in the compressor is maintained at the correct level, otherwise the pressure will drop.

The Oil Seal

The next item of equipment is the oil seal. This consists of a metal container with from half to one and a half pints of oil through which the air supplied by the compressor passes to the delivery pipe at the top of the oil seal. A cock is also fitted to allow surplus oil to be drained away. The oil seal prevents the air escaping back to the compressor when the required pressure is reached.

An oil trap is fitted immediately following the oil seal to drain off any oil which has been forced past the baffle in the oil seal. This is necessary owing to the effects of oil upon any rubber tubing which may be fitted. The compressed-air bottle stores the air at approximately 200 to 400lb. per sq. in. A connection is usually fitted to allow the bottle to be charged from an external source when the aircraft is on the ground, i.e., the engine need not be run to charge the bottle to the correct pressure.

The air flows from the storage bottle through an air filter to a pressure reducing valve. The function of this valve is to reduce the air pressure to the figure required to operate the service. The operating pressure varies from 50 to 200lb. per sq. in., according to the force required.

Triple Reading Gauge

If the brakes are operated pneumatically, a triple reading gauge is fitted as shown in Fig. 1, to indicate the pressure in the circuit before passing through the reducing valve

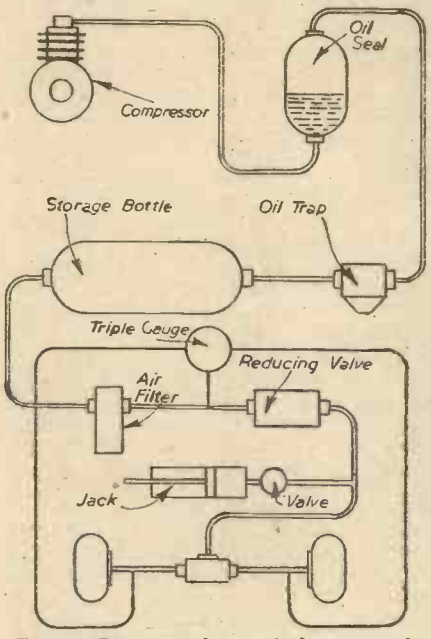


Fig. 1.—Diagram of a typical compressed-air system as used on modern aircraft.

and the pressures in each of the pipe lines connected to the brakes.

Control valves are fitted to allow the air to flow to the appropriate service. When it is required to operate the brakes a lever, usually positioned on the control column, is depressed, permitting air to flow through the brake pipe lines. To allow adequate manœuvrability whilst taxi-ing on the ground, a special valve is connected to the rudder bar. When the pilot pushes his right foot forward, i.e., when he wishes to turn to the right, the valve allows air to flow to the right wheel brake only, thus leaving the left wheel unbraked and causing the aircraft to turn to the right. When the rudder bar is in the neutral position for straight movement, air is admitted to both brakes if the control lever is operated. The amount of movement of the rudder bar also controls the amount of air admitted to the brakes, thus controlling the degree of braking. The brake shoes are forced against the brake drum by the air expanding the tube to which the shoes are attached. Pneumatic brakes allow more sensitive control than when hydraulic power is used owing to the fact that air is compressible and hydraulic fluid is not.

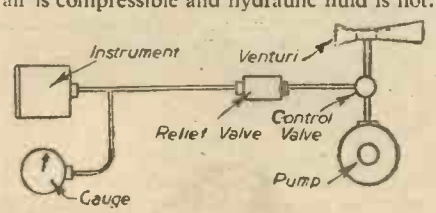


Fig. 2.—Diagram illustrating a typical vacuum system.

If a jack is incorporated in a pneumatic system, the air forces the piston down the cylinder in a similar manner to the way in which a hydraulic jack operates.

The piping usually consists of aluminium tubing, and where flexibility is required armoured rubber hose is used. Rubber sealing rings are fitted to the pipe connections to prevent leakage. Leaks may be traced by brushing the pipes with soapy water, the puncture being indicated by air bubbles.

De-icing Equipment

When pneumatic power is used to operate de-icing equipment, the compressor supplies air to a distributing valve which allows the air to flow into rubber tubes fitted along the wing leading edge. The tubes are inflated and deflated by means of the air pressure, thus preventing ice forming or cracking ice which has formed before the de-icer is put into operation. The leading edges of the fin, tail plane or aerial masts may also be protected by this method.

Vacuum pumps are fitted to drive the blind flying instruments. A vacuum of approximately 4in. of mercury is required. Venturi tubes were originally fitted to obtain a suction, but are now being superseded by vacuum pumps, which are more reliable. Other advantages possessed by the pump are freedom from icing (the Venturi is liable to choking by ice), and the fact that the vacuum is maintained at low airspeeds or when taxi-ing along the ground prior to taking off. The instruments indicate the attitude of the aircraft by means of a gyroscope and the suction pump draws air into the instrument case through a jet which is directed on to the gyro vanes, thus operating in a similar manner to a turbine. The rate of revolution is fairly high, being approximately 10,000 revolutions per minute. The pumps are usually of the rotary sliding vane type and as well as supplying a vacuum may also supply air under pressure from the exhaust. This latter supply may be used for inflating the wing de-icers mentioned in a previous paragraph, as only a low pressure is required.

Vacuum System

A typical vacuum system is illustrated diagrammatically in Fig. 2. In this layout both a Venturi tube and a vacuum pump are fitted. Should the engine fail, the pump would not function and the Venturi tube is fitted to operate the instruments in the event of any such emergency.

It is necessary to install a vacuum relief valve in the system so as to prevent excessive values of vacuum which will be caused by high air or engine speeds. If the Venturi is located in the slipstream of the propeller, the air velocity will be greater than that of the aircraft itself.

A vacuum gauge may be fitted to indicate the height of vacuum being supplied, or if the gauge itself is not installed a coupling is provided so that a gauge may be attached for checking purposes on the ground.

In conclusion, from the above short description of the use of pneumatic power in aircraft, it will be seen that its use is confined chiefly to operating brakes, wing de-icers and instruments. It is likely that hydraulic power will supersede pneumatic power for the operation of brakes in order to reduce the number of systems installed in the aircraft, but the gyro-operated instruments will remain pneumatically driven.

THE MONTH IN THE WORLD OF

Science and Invention

A new American war medal being examined under a magnifying-glass after it has left the press. 2,000 of these medals are to be struck for distinguished service in the U.S. Army and Navy.

Warships Without Funnels

TO provide more space for guns and aircraft equipment (including catapults), naval architects are planning battleships without funnels.

Huge Electric Stator

THE largest electric stator ever to be transported in Britain has recently completed a successful journey from the north-east to the Midlands. It travelled on an L.N.E.R. transformer wagon set running on 40 wheels. Weighing 130 tons and capable of generating 50,000 kilowatts, the huge bulk of this power-unit monopolised the track, completely blocking traffic on the opposite or adjoining lines.

It is to light and heat a big town, and to turn the lathes of war.

Grass Eaters

MR. GUSTAV J. MARTIN, of New York, has devised a plan to feed paratroops and other "isolated forces" on grass, leaves and wood. He told a New York meeting of chemists that men would have to be "conditioned" to the diet by a course of harmless bacteria, taken in the form of a liquid "tasting like chocolate syrup."

A Balloon Rescue Marker

MEMBERS of the U.S. Naval Air Base at Lloyd Bennet Field, Brooklyn, N.Y., are conducting experiments with a balloon type rescue marker which could be carried in compact form by Navy pilots engaged in over-water manœuvres. The deflated balloon is attached to a cartridge in which is contained helium under pressure. This is attached to a band around the pilot's arm. In a forced landing the pilot pulls the cartridge trigger, shooting the balloon aloft.

Device for Hose-pipes

MR. FRED MOORHOUSE, of Huddersfield, has recently patented an invention that will be of interest to all firemen. It is an apparatus for supporting a hose-pipe. The hose-pipe is arranged in such a way that on being run out it is laid quite straight. The time taken to run out a 65ft. length is from four to five seconds. As the usual time is from 15 to 20 seconds the worth of the invention can be appreciated. In fire-fighting speed is all important. Usually three men are required to run out a hose-pipe, but this new method requires only two—one to turn on the water and one to run out the hose-pipe.

Seeing Through Steel

IT is reported from New York that science, discontented because it cannot X-ray steel plates over 8in. thick, is building a new gigantic machine to determine deeper secrets as part of the war production effort. The principal parts of this super-detective, a huge electro-magnet, will weigh 125 tons, and be composed of more than 100,000 pieces of silicon steel.

Its hollow glass core will toss electrons about 800 miles, whirling them around a quarter of a million times in $^1/_{240}$ of a second. The giant machine will be housed in a building with 3ft. concrete walls. The operator will stay outside in a control room and peer at the machine through a periscope. The whirling electrons will strike a target to generate a beam of highly penetrating X-rays. The beam will emerge from the machine together with scattered high-speed electrons capable of penetrating 2in. of steel. The capabilities of the new tool are not yet known.

Cargo Submarines

ACCORDING to Senator Lee, the American Army and Navy have proved "receptive" to proposals to combat the U-boat menace by sending Allied cargoes under water by huge submarines. The cargo submarine proposal comes from the veteran inventor, Mr. Simon Lake, whose work in developing submarines is known throughout the world. He put forward the design which he completed in its essentials years ago for a 7,500-ton cargo-carrying model, the first of which he claimed could be completed within six months, after which shipyards anywhere could turn them out.

Gas-driven Ships

ENGINEERS in Britain are interested in the progress made in Scandinavian countries with gas engines for tramp steamers. The gas is produced on board from ordinary bunker coal, and is preferable to oil for British tramps. The latest gas engines occupy less space and consume 20 per cent. less coal.

New Welding Process

MR. C. W. BRETT, a well-known authority on welding, announces a new welding process which consists of welding together totally dissimilar metals. He states that it is too early as yet to predict the full extent of application. He promises surprises, however. "At first it was possible to weld only cast and malleable iron to steel, but now any commercially applied metals can be united in this way," he asserts.

Machine for Copying Templates

THE Eastman Kodak Co., in collaboration with the North American Aviation Co., have produced an X-ray machine for duplicating templates. Its purpose is to make photographic reproductions of templates, both accurately and quickly, and the size of the machine is 10ft. long by 5ft. high. The operation may take as little as half an hour, while the print of the template can be used a quarter of an hour after developing. The original template is coated with a fluorescent lacquer (that is a lacquer which glows when excited with light of a particular wavelength), and an Eastman Matte film is then applied to the surface of the template, on top of the lacquer. X-rays are then allowed to fall on the film, which is deposited in a large chest-like compartment, which is similar to a radiogram in appearance. The film is then stripped off and "cured," after which it is stored. Both positives and negatives may be made in the apparatus.

Portable Sound Locator

THE Army Signal Corps of the U.S. have approved a small portable sound locator for aircraft, which can be slung like a camera, being not much larger. The spotter wears headphones to which is attached a parabolic condenser or sound collector. This collector is coupled with the amplifying circuit housed in the container slung from the spotter, and leads run from the container to his headphones. The approaching aircraft is heard as a faint hum in the earphones, and the spotter turns slowly until the noise is at a maximum, when he should be facing the direction from which the aircraft is approaching. This enables him to put up his binoculars to the right area of sky, instead of searching widely.

Defying Gravity

SOMEWHERE in New Jersey the Wright Aeronautical Corporation are erecting a newly developed type of concrete building which can be set up more rapidly than the usual structures of steel and wood. This remarkable factory is being built—impossible as it seems—from the roof down, with the floors as the final units to be completed.

Inside the pressure chamber at a submarine training school.

America's New Tank

THE feature of the new American heavy tank, Mark IV, is its revolutionary fire power. It mounts a 75mm. cannon in a revolving turret which turns the full circle.

New System of Road Dressing

A NEW system of road dressing is now being used in Sheffield which is entirely automatic. A high-viscosity tar is applied hot to the road surface by means of mechanical brushing, and is followed by a dressing of granite chippings applied direct from a gritting machine, which carries five tons of materials. The chippings are then rolled well into the surface. That the new process is speedy is proved by the fact that 9,000 square yards were dressed in six hours. In addition two gangs of 12 men did the work in less time than it took four gangs, composed of larger numbers, in pre-war days.

"Jack-in-the-Box" Mine

IN order to beat enemy engineers' mine detectors, the Allied Forces are now successfully using a "jack-in-the-box" mine which springs up out of the ground and explodes. The working of the mine is a secret and so far German technicians have failed to discover it. The only information available regarding them is that they are laid for various purposes. Some mines explode when run over by a tank and others when touched by a soldier's feet. Both British and Nazi engineers have been using the "broomstick" detector, but the new mine counters electrical detection. As the engineers explore minefields with their detectors, the new mine explodes up out of the ground with one detonation, then bursts and kills the engineers.

Sugar from Potatoes

A CONSULTANT scientist attached to a big international sugar manufacturing firm has for the past two or three years been working on a hunch of his own. He knew that sugar could in some way be extracted from the starch contained by potatoes. He has now discovered how it can be done. The new sugar—practically indistinguishable from the cane sugar—is to be put into production shortly. It should be available very early next year, as no new machinery is required. The potato sugar is to be made in lump, granulated and liquid form, and will be cheap.

Coal from "Slurry"

A PROCESS is now being examined by the Coal Industry Fuel Efficiency Committee for utilising "slurry"—the part of coal left over after it has been washed—as solid fuel. At present most of this slurry is merely dumped, or is washed down to the sea in rivers as coal dust. It is estimated that approximately 1,000,000 tons of solid fuel could be recovered if the process should prove efficient. Slurry is not a first class fuel, but can be used for many purposes.

Torpedo-proof Ship

IT was recently revealed by President Roosevelt that American shipbuilding engineers have designed a shallow-draught cargo ship which it is hoped will be virtually torpedo-proof. It is understood that the new vessel, riding high out of the water, will use petrol engines, is cheap to build, and can be mass produced. It will be a small type of ship suitable principally for coastal work. But it is hoped that larger ships will thus be set free for deep-sea work. Washington officials are cautious in their claims and point out that the new type of ship may be followed by new types of torpedoes to deal with it.

The Combined Harvester

Details of a Machine Which Cuts, Threshes, and Delivers the Grain in One Operation

IN order to speed up the gathering of the corn harvests this year, the Ministry of Agriculture state that over 1,200 reaper-threshers, or combine-harvesters were used in this gigantic task. The combine harvester is really several machines in one, and as a tractor draws it round a field it cuts, threshes and delivers the grain in one operation. The modern machine shown on this page however, propels itself.

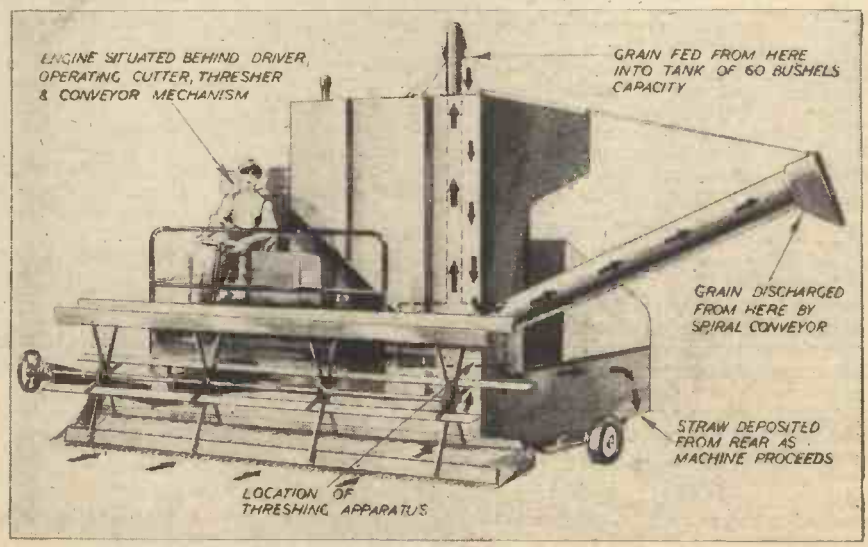
Dry weather is essential to get the most effective use from these machines, though a little dampness in the crop is obviated by the use of a drying machine which works in conjunction with the harvester.

Progress over 100 Years

That we have made tremendous strides in the harvesting of corn during the past 100 years is evident from the fact that whereas in the days of the scythe and flail it took nearly fifty days to harvest and thresh an acre of grain, it is now possible to do the job in less than an hour with the combined harvester.

These machines can deal with 12 to 15 acres a day provided the weather is good, and consume a gallon of petrol per acre.

The self-propelled machine illustrated, which is one of the largest types, has a cutting sweep of 16ft. The machine pours the threshed grain into a 60 bushel tank, which then transfers it into a truck which takes it off the field to be dried.



A diagrammatic drawing showing the working of the combined harvester.

Black-out Control of Lighting

Details of a Simple Switching Arrangement

By G. F. BROWNE

THE necessity of maintaining a strict black-out during hours of darkness is a source of much inconvenience to the average householder. The present period of shortening days and longer nights is, perhaps, a suitable time to discuss methods for minimising this inconvenience, in preparation for the coming winter.

The greatest difficulty is experienced in preventing light spillage from entrances and doorways and, no doubt, the reader is only too familiar with the awkward and unwieldy light traps which have become part of our

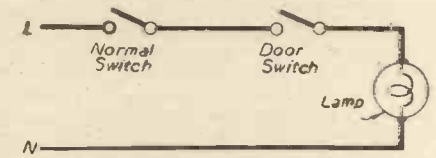


Fig. 1.—Complete black-out is obtained with this system. It is not recommended.

daily life. The only alternative has been the manual switching of the lighting before an external door is opened.

For normal household use, and for use in many other premises, the easiest and most convenient way of preventing light spillage is by means of a door-operated switch, so arranged as to extinguish the lighting, or

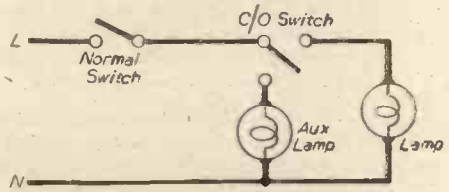


Fig. 2.—A better arrangement, but wiring is slightly more complicated.

reduce it to a safe level upon the door being opened. The difficulty and inconvenience of negotiating a light trap, or of manually switching off the light every time a door is opened is thus disposed of.

There are three ways in which the desired effect can be achieved:

1. Complete Black-out

The automatic door switch can be arranged to completely black-out the lighting upon every occasion that the door, to which the switch is fitted, is opened. This is the simplest method, requiring a plain "on–off" switch in series with the normal switch (Fig. 1). But the shock to the nervous system of a person in a room which is suddenly blacked out is very great, and many accidents have resulted from this cause. For this reason, the simple "on–off" automatic door switch is not recommended, and should not be used.

2. Subdued Auxiliary Lighting

The disadvantage of the previously mentioned system can be disposed of by arranging the door switch as a change-over switch (Fig. 2). When the door is opened the main lighting is switched off, and a suitably shaded low-power lamp is switched on. By this means the room is never completely blacked out, a very low value of illumination being maintained even while the door is open.

The disadvantage of this system is, of course, that it increases the amount of wiring that has to be installed, with the consequent increased difficulty in arranging to conceal it, or at least make it unobtrusive.

3. Dimming

Partial extinction, or dimming, of the main lighting appears to be the most useful method, possessing all the advantages of the other methods without their disadvantages. It can be effected by means of a simple "on–off" door switch with a resistance, or choke, connected across its terminals (Fig. 3). When the door is closed the resistance is short circuited by the switch contacts, allowing the lamp to receive its full working voltage. The opening of the door, and consequent opening of the switch, places the resistance in series with the lamp, so reducing the voltage available at the lamp. By suitable choice of the value of the resistance or choke the degree of illumination can be reduced to any desired level.

If A.C. mains are available it is desirable to use a choke rather than a resistance, because the heat generated by a resistance may cause damage to furnishings, or if not properly protected it may constitute a fire risk.

Another advantage possessed by this system is that at all times some current is flowing through the lamp, maintaining the filament above ambient temperature. The current surges which occur at switching on, due to the lower resistance of the filament when cold, are thus minimised, and the life of the lamp is prolonged.

A variation of this system is to connect a neon lamp, such as the Osglim, across the switch contacts instead of the choke (Fig. 4). As the resistance of the filament lamp is very much less than that of the neon lamp, the latter will glow at almost its full brightness when the door is open.

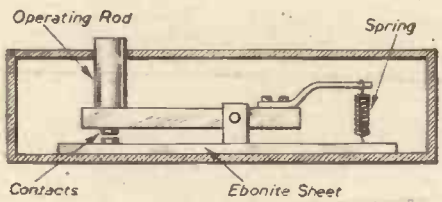


Fig. 5.—A simple and effective type of door operated switch.

Door Switches

The construction of suitable door switches is described in detail, as the problem presents little difficulty for the average amateur mechanic.

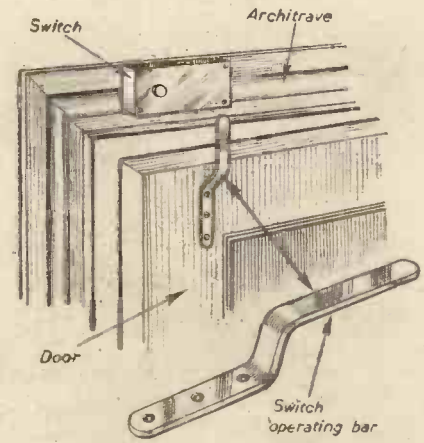


Fig. 6.—Mounting the switch and its operating bar. The whole assembly can be neat and unobtrusive

A simple type of switch is illustrated in Fig. 5. It consists of a pivoted brass bar about 3in. long carrying a contact at one end, and is spring loaded at the other, so that the switch is normally open. The assembly is mounted on a sheet of paxolin or ebonite to which a further contact is secured in alignment with the moving contact. The switch is enclosed in a metal box, operation being effected by means of a short rod of ebonite, or other insulating material, fastened

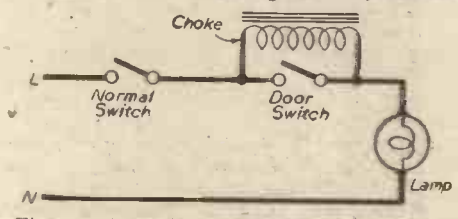


Fig. 3.—A satisfactory dimming circuit for use on A.C. supplies.

to the brass bar and projecting through an aperture in the container.

The completed unit is mounted on the top jamb of the door and the switch is closed, when the door is shut, by a piece of iron bar, about ¾in. by ¼in., fastened to the door, and in line with the operating rod (Fig. 6).

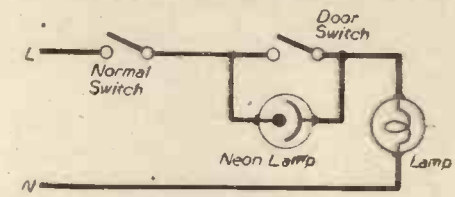


Fig. 4.—An alternative to Fig. 3. The neon lamp replacing the L.F. choke.

There are several commercial types of switch which are suitable for the purpose, and among them is the Burgess micro-switch, which is useful when concealment is important, as it is so small that it can be recessed into the jamb of a door and remain almost unnoticeable.

Resistance or Choke

The resistance used should be of a high enough value to reduce the illumination to a satisfactory level, without allowing any light to show outside the premises. A value of about 1,300 ohms with a rating of 25 watts is suitable for use with a 230-volt 60-watt lamp, or 800 ohms rated at 40 watts for a 230-volt 100-watt lamp.

The resistance need not be mounted directly alongside the switch, but can be mounted in some unobtrusive position, if so desired, and connected by leads being taken from it to the switch contacts.

Where A.C. mains are available, a choke is preferable, as previously mentioned. This should have an inductance of 4 henries and be capable of carrying .1 amp for use with a 230-volt 60-watt lamp, or 2.5 henries and .2 amp in the case of a 230-volt 100-watt lamp.

Installation

When installing a device of this nature it is important to ensure that the switch is connected in the live, or unearthed, lead. If the necessary wiring alterations are carried out from the wall switch, this condition will be automatically met with, provided that the original installation has been properly carried out.

Picture Telegraphy

How Photographs and Drawings are Transmitted Over Great Distances by Means of Electricity

By W. T. LOWE and E. PHILLIPS

A photograph of the interior of St. Stephen's, Vienna, telegraphed from Munich to London. Note the wealth of detail. (By the courtesy of the Postmaster-General.)

ALMOST every day you can see telegraphed pictures in the press. They are mostly war pictures. You will notice by the accompanying photographic illustrations (which have not been retouched) that the clarity is remarkable.

Bakewell's Facsimile Telegraph

It was to be expected that when Messrs. Cook and Wheatstone invented the electric telegraph, in 1838, someone would not be far behind in trying to send and receive the actual writing, and also drawings, known as facsimile. It is therefore notable that in 1850 an Englishman, F. C. Bakewell, invented a facsimile telegraph.

In this system, the design to be transmitted was drawn upon the surface of a metal cylinder with a fluid of insulating character.

The cylinder was connected to one pole of an electric battery, and was continuously revolved by a weight-driven motor. A wheel-shaped stylus rested upon the surface of the cylinder. The stylus was fitted on an arm the other end of which engaged in a worm-gear, geared to the cylinder driving motor.

Connected to the line circuit by means of the worm-gearing, the stylus was enabled to explore the whole surface of the cylinder in a spiral of a certain pitch. While the stylus rested on the metal of the cylinder a current passed to the line, but when the stylus passed over a portion of the cylinder on which the design was drawn, the circuit was interrupted and no current passed.

At the receiving end a cylinder revolved synchronously with the sending cylinder. An ink-stylo was mounted on worm gearing similar to the sending stylo. Normally held away from the surface of the drum, which was covered with paper, the line current passed through electro-magnets fixed under the outer end of the ink-stylo arm.

When the current was interrupted, the ink-stylo fell on the surface of the paper, being weighted for the purpose, and made a mark. Resumption of the current flow attracted the free end of the ink-stylo arm and raised it from the paper. A copy of the design thus appeared on the paper.

This system failed owing to the difficulty of keeping synchronisation, and the lack of an efficient relay.

D'Arlincourt's Apparatus

Twelve years later, however, the Abbe Caselli, an Italian, produced an apparatus on similar lines. It transmitted drawings and diagrams, and worked on the Paris-Amiens wire for some years. Then D'Arlincourt, in France, came upon the scene with his facsimile telegraph in 1878, which was actually tried in London at the Central Telegraph Office. The designs were reproduced on the receiver in black on a white ground. Seven minutes to deal with a picture 12in. by 2¾in. was considered too long. By the way, synchronisation of the sending and receiving instruments in picture telegraphy is absolutely essential. D'Arlincourt's apparatus was found lacking in this respect, that being another reason why it did not find favour at St. Martin's-le-Grand. The French Telegraph authorities also cast it out, but after a longer trial.

To obtain perfect reproduction the sender and receiver must run at the same speed. And until many years later (in 1919, to be exact, when the tuning fork was adapted for the purpose of synchronisation) there were no means of obtaining absolute precision of movement.

Five years before d'Arlincourt, however, the light-sensitive properties of selenium were discovered. Thorne Baker, of England, and Prof. Korn, of Germany, used selenium in an apparatus which they each invented for translating the light and shade of a picture into electric current. That is the principle upon which pictures are telegraphed, and which will be explained later.

In those days there were no efficient means of increasing small values of current, and the lines used for transmission were, technically, not good.

A national English newspaper experimented with the Korn system on their Manchester-London private telegraph line, but owing to the difficulties already mentioned, it was not used to any great extent.

Now, the same discovery which was responsible for broadcasting as we know it to-day, provided the solution of increasing the values of current. It is known as amplification.

As is well known, Sir Ambrose Fleming discovered the principle of the thermionic valve in 1912. The modern form of this valve amplifies weak currents enormously.

The Photo-electric Cell

Then came the re-discovery after World War No. 1 of the photo-electric cell, which added yet another contribution, in that it gave inventors the means for which they had long sought, that of turning the light and shade of a photograph into electric currents which could be sent along a wire. The last obstacle to real picture telegraphy was thus

The Picture Telegraphy Department of the Central Telegraph Office. The power switch-board is on the left, and the control panel on the right. (By the courtesy of the Postmaster-General.)

removed when, in addition to actual transmission and reception, great improvements were made in photographic materials.

Three systems of picture telegraphy were working by 1926, the Siemens-Karolus Telefunken in Germany, the Belin in France, and the Bell in America. Great Britain, with its comparatively small distances between large towns, did not offer much inducement for work on this method of communication. The distances between the cities of the Continent and in the U.S.A., however, invited some means for the speedy transference of pictures, and consequently the use of picture telegraph apparatus was an advantage.

The Post Office installed a set in the Central Telegraph Office, London, for working to the Continent, and the first public picture telegraph service to Berlin opened in January, 1930. To-day, pictures are mostly flashed by radio, but a detailed description of one of the line systems will be interesting.

In these systems telegraphed pictures are transmitted over telephone circuits, and picture transmission does not in any way resemble ordinary telegraphy.

Sending of a picture is performed by means of a light-sensitive apparatus called a "photo-electric cell." This is a glass bulb, which has part of its inner surface coated with a material which is sensitive to light. The material first in use was potassium; but this has now given place to caesium, which gives a better response to light. The metal is deposited as a very thin film on the glass. Placed just in front of the metallised surface, and also inside the bulb, is a wire mesh or grid.

Under the influence of light a stream of "electrons" flows from the caesium to the grid. This, in effect, is an electric current generated by the light. The current is very small, being of the order of 4 micro-amperes ($\frac{4}{1{,}000{,}000}$ ampere). This small current is passed to a valve amplifier and so increased to the amount necessary for line transmission.

The picture or other matter to be telegraphed is clipped on a metal cylinder which, by means of an electric motor, is arranged to revolve continuously in front of the photo-electric cell.

A beam of light from a spot-light lamp is directed upon the surface of the picture by prisms and focused by a lens. A disc with a toothed edge rotates between the light and the picture. The light is interrupted by this means and reaches the picture in a series of pulsations. The number of these pulsations is determined by the characteristics of the line used for transmission.

For continental working it is 1,424 pulsations per second. Pulsations of current are thus caused through the photo-electric cell, and when passed through the amplifying system these cause a carrier wave of the same frequency.

Siemens-Karolus Telegraph

The photo-electric cell used in the Siemens-Karolus picture telegraph (which system before the war was used in the Post Office), is made in the form of a ring, the light passing to the picture through the central hole. The lens for focusing the light on the picture is mounted just behind the cell which, together with the lens system, is mounted on a screw axle which is turned by gearing with the driving motor.

Close to the cylinder on which the picture is clipped the photo-electric cell is placed. Now the picture cylinder is revolving continuously on its axis, and the photo-electric cell and lens are gradually moving downwards. As a consequence the whole of the picture comes before the light-spot, point by point, and the picture is "explored" or "scanned" in this way by a spiral of light from top to bottom. As the light strikes the picture it is reflected into the photo-electric cell, and as the value of the light reflected varies with the light and shade of the picture (a bright patch reflecting all the light, and darker patches reflecting less light), a varying current passes across the photo-electric cell from the sensitive surface to the mesh.

From the mesh the current passes to the amplifier and so to the line, where it can now be detected by any electric means, and, if desired, can be connected to headphones and the picture "heard." This picture tone is heard as a burbling note similar to that which we hear on the wireless when television signals are being broadcast.

Photographic Details

As photographic materials are used for reception, a fully equipped photographic dark room is essential. Photographic film or paper of suitable size is clipped round a metal cylinder in the dark room, and enclosed in a light-tight case, which has a shutter. When the case is placed in the apparatus for reception the shutter is opened automatically. The cylinder is revolved by a motor at the same speed as the picture cylinder at the sending end, and light from a spot-light lamp is focused on the film by means of a lens. The method of modulating this light according to the variation of the current being received from the sending apparatus varies in the system employed. The Siemens-Karolus and Belin systems use an oscillator. This is a small mirror attached to a wire which passes between the close-set poles of an electro-magnet. When electric currents pass along this wire, it is twisted against the pull of the magnet, and the amount of this twist is proportional to the strength of the current. So a small current will cause the wire to waver, so to speak, but a strong current may cause a twist almost to right angles. As a beam of light is focused on the mirror itself, these vibrations will cause the reflection of this beam to move rapidly from side to side. This reflection, which is rectangular in shape, is arranged to pass through an opening in a mask, and then is focused as a spot of light on the receiving cylinder. The picture may be received either as a positive or a negative; the former is now usual. Special bromide paper is used for this. For the high lights of the picture no light is allowed to fall upon the paper, but for the varying tones of the shadows, the vibrations of the mirror will cause the necessary amount of light to fall on the paper, bit by bit. As the cylinder and paper are continually revolving in front of the light, and the light is gradually moving downwards, it records point by point and in the form of a fine spiral, the variations of light and shade of the picture being sent. After reception is completed, which takes about 12 minutes, the cylinder with the paper is taken to the darkroom and quickly developed, fixed, washed and dried and then delivered to the addressee in a short time.

A fine specimen picture telegraphed from Copenhagen to London. (By the courtesy of the Postmaster-General.)

A close-up view of the control panel. The picture transmitting apparatus is seen on the right. (By the courtesy of the Postmaster-General.)

Bell System

Other systems differ from the foregoing in the method of transforming the received currents into terms of light. The Bell system, used mainly in the United States, has a metal ribbon vibrating in front of a small hole through which the light shines. The rate of vibration is affected by the varying values of the received current, and so more or less light is permitted to pass on to the photographic paper or film.

Used largely for wireless reception, the Wright system has substantial differences. The receiving apparatus comprises a metal cylinder which is divided into two lengths by a fine slit. Sensitive paper is clipped round this, sensitive side inwards, and is held by a clip which moves along the cylinder, under the influence of a worm screw driven by a motor. Ingenious optical means, known as Kerr cell, and Nicol prisms, are used for transmuting the received electric currents into corresponding terms of light. The resultant light is caused to revolve and shine through the slit in the cylinder on to the sensitised paper, which, under the influence of the worm screw, is slowly moving along the cylinder, and so continually exposing fresh surface to the beam.

Picture Sizes

Size of the pictures and rate of scanning (or number of lines per millimetre) are the subject of international arrangement. The Wright system has a picture size approximately 10ins. by 8ins., and the rate of scan is four lines per millimetre. Other systems produce a picture about 8½ins. by 6½ins., and the rate of scan is 5⅛ lines per millimetre. With picture telegraphy over wires the larger number of lines gives the finer result; but for wireless transmission four lines per millimetre is satisfactory.

Marconi-Wright System

A modification of the Wright system, the Marconi-Wright, is useful for the transmission of actual messages. It is possible to transmit two messages, each measuring 8in. by 10in., in less than 20 minutes. Messages 10in. by 4in. have been received in 4½ minutes. Of course, it is difficult to give up-to-date information at the moment, but we do know that in operation this apparatus ran continuously. It was therefore not necessary to stop the machinery whilst working, the pictures being dealt with in immediate succession. Naturally this saved a lot of time—a valuable asset in all forms of communication.

Used for telegraphing pictures over Atlantic cables, the "Bart-Lane" system differed greatly from any other. The results showed a good range of tones, but had a rather heavy "grain." This system has now fallen into disuse as the newer systems described are superior in every way. The system, however, was used on July 25th, 1920, for telegraphing pictures of the American yacht race from America to England for the daily press. Copies of the pictures were also sent by post, and on receipt of these the telegraphed pictures were reprinted side by side with the posted copies for the purpose of comparison, which was favourable.

Public Picture Telegraph Service

On the introduction of the public picture telegraph service in 1930 newspapers and news agencies were quick to recognise its value. The first service, to Berlin, was opened by the Postmaster-General on January 7th, 1930. This was followed by services to Frankfurt - on - Main (Germany) on January 21st, Copenhagen (Denmark) on February 20th, Munich (Germany) on April 25th, Vienna (Austria) on May 20th, Stockholm (Sweden) on September 4th; Rome (Italy) on September 3rd, 1931, Oslo (Norway) on November 1st, 1931; Amsterdam (Holland) on February 1st, 1933, and Paris (France) in June, 1933.

These services have been extensively used for press purposes, and also for commercial and private purposes.

Tabulated trade returns, letters in extenso; engineering plans, designs for fashions and advertisements, and seasonal and festive greetings have been telegraphed to and from the Continent.

In the United States a wide use is made of the picture and facsimile telegraph for commercial and legal purposes, and items transmitted through London from the U.S.A. to Europe and vice versa have included legal documents, signed statements, and similar matter, as well as news pictures.

For some years before the war practically every event of importance on the Continent had been illustrated in the daily papers by means of a "telegraphed picture." A large number of news items have also been telegraphed from London to Continental cities. Royal weddings and political events of all kinds, railway and other accidents, and the arrivals of transatlantic fliers are among the subjects where the picture telegraph served the requirement of speedy transmission.

On one occasion a photograph of an event which happened on the Continent at midnight was telegraphed to London and appeared in the early morning edition of a London paper.

Wireless Photogram Service

Cable and Wireless, Ltd., send pictures across the Atlantic by wireless. The company has coined the word "photogram," and the system is known as "The Wireless Photogram Service." Some interesting information has been presented in a picturesque manner by means of an illustrated brochure. It is pointed out that, in sending pictures and facsimile matter across the "Pond," at least a week is saved.

The value of this time-saving device is stressed particularly for the press, fashion artists, motor-car dealers, advertisers, architects, engineers, photographers, etc. One particular photogram, the largest ever transmitted across the Atlantic, covered practically the whole of a newspaper page. It was an advertisement of an £8,000,000 financial prospectus.

Broadcast transmission of photographs by wireless was attempted by Knudsen in 1908, but only crude results were at first obtained. Later, a simple form of apparatus, invented by Thorne-Baker in 1933, picked up broadcast pictures with a two-valve receiver. The interest of this, however, is limited.

Other systems are the "Nippon" and the "Standard," but these differ very little from those already described. It is interesting to note that facsimile telegraphy has been used for some years past between Moscow and various cities in the U.S.S.R.—that is, instead of employing a mechanical conveyance, actual sheets of printed matter have been "transported" by means of picture telegraphy, and by radio at that! The U.S.S.R. has found picture and facsimile telegraphy of great value in its immense territories.

(Above) Placing the cylinder, with photograph, in the transmitting apparatus.

(Right) Clipping the picture to be transmitted on to the drum, or cylinder. (By the courtesy of the Postmaster-General.)

Battery-electric Bicycles

Further Notes on Their Construction and Operation

By P. G. BOYD, B.Sc.

(*Concluded from p. 14, October issue.*)

The electrically-driven bicycle described by the author.

Charging Details

A GOOD battery giving its full rated capacity is essential. The specific gravity of the acid should be kept up to, but not above, the maximum value permitted by the particular battery manufacturer, and the level of the acid should be kept higher than normal—slightly above the bottom of the filling tubes. Overcharging of the battery, particularly at excessive amps. when the battery is more than half charged, should be avoided. On the other hand, trickle charging is also to be avoided as it tends to "form" the grids. Best results will be obtained if the battery is charged at the maker's recommended rates, which generally are about 4 amps. for 60 amp.-hour, and 7 amps for 100 amp.-hour sizes, etc. To avoid damage by overcharging it is best to ordinarily stop charging just before the specific gravity ceases to rise further, say when it reads 1.275, and about once a month to overcharge at normal or slightly below normal amps. for about 5 hours after the specific gravity has reached its maximum of, say, 1.280.

The writer's battery (12 volts 57 amp.-hr.) has up to date done over 600 miles, and, so far, shows no signs of deteriorating—in fact, the reverse is the case—it having on test at 418 miles given an output of 65 amp.-hours when discharged in 9 hours. From data which the battery manufacturers have provided it is estimated that the battery would give a mileage of over 3,000 with the present inefficient motor on the bicycle before its capacity falls below 45 amp.-hours. This is a very good life for a battery not intended for this type of work. It may be added that car starter batteries of the lead-acid type are, for weight, space and efficiency, better suited to a bicycle than any other type known to the writer. It is necessary however to maintain them properly for this rather severe type of working.

Two points of interest are, first, it is unnecessary to fully discharge a car-starter (pasted plates) type battery occasionally in order to maintain it properly, and, secondly, it is impossible to state the extent to which a battery has been discharged from the readings of the specific gravity alone. This is because of the fact that the fall in specific gravity is proportional to the amp.-hours taken out of the battery regardless of the rate at which they were taken out.

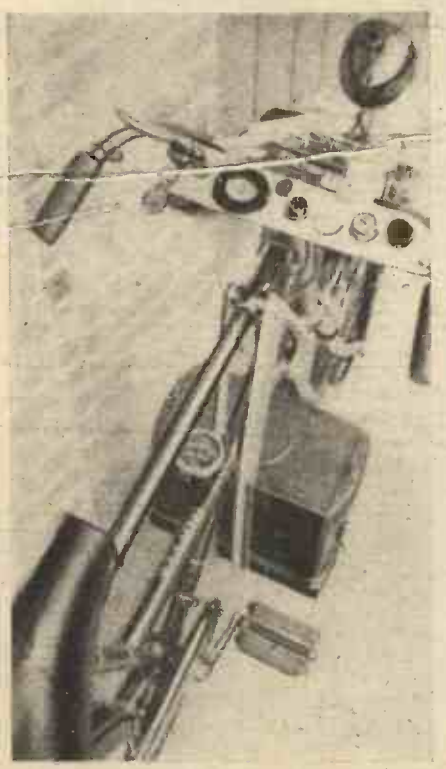
General Constructional Hints

Fig. 6 shows that in the case of the writer's bicycle the full battery voltage is switched straight on to the motor when starting, but, usually, in order to reduce the starting current, and also to reduce the stress on the free-wheel and chain, the starting switch is not closed until a speed of about 3 m.p.h. is attained by pedalling. If starting from rest is required it would be better to use a starting resistance rather than tap the battery.

An old motor-car starter switch is used for switching on the motor. It is operated by a lever as direct operation is tiresome on a long journey. For safety it is recommended that it should be of the free-release or "dead-man" type, and it should be operated by the left hand. A locking device should be provided to prevent the switch being closed when the machine is parked.

Heavy Leads Necessary

It is very essential to use heavy low resistance leads and good tight connections, soldered where possible, in order to reduce voltage drop. This applies particularly if a 6-volt system is used.



A view of the machine as seen from the saddle. The three-speed switch is in front of the handlebars.

If an earth return is used for one of the connections between the battery and the motor, a heavy copper connection, which need not be insulated, should also be used between the motor frame and the "earthed" battery terminal, as a frame "earth" lead is liable to have a high resistance. The voltage drop on the separate leads, etc., may easily be tested with a voltmeter with, say 2 or 4 volts from the battery, and the motor's armature locked. In connection with this question of voltage drop, the ammeter which the writer uses, as shown in Fig. 6, is of interest. It has no terminals—the insulated lead is looped through an iron ring. There is, therefore, no voltage drop in the meter, and it is short-circuit-proof. This interesting ammeter, which is surprisingly accurate, is of the centre zero type, and was obtained from an old Ford V8 motor-car. As it was calibrated only up to 30 amps., only half the total current is put through it, and its reading is approximately doubled to ascertain the total current.

In the case of the writer's bicycle 3 lb. of battery stores sufficient electricity for one mile. It may be taken, therefore, that if 3 lb. of useless dead weight is replaced by useful battery weight slightly more than one mile extra per battery charge will be obtained.

Pedalling Gear and Motor Drive

For many reasons the writer decided to retain the use of the ordinary pedalling gear. This prevents the conversion of an ordinary motor-cycle to electric drive, but certain models of the light auto-cycle type could be converted. A free-wheel in the power drive is worth while, both for easier starting from rest when pedalling, and for longer free-wheeling going down hill and when coming to rest. In order that full advantage of the free-wheel can be obtained the free-wheel should be in the final driven sprocket, that is on the road wheel hub. Both the motor and chain will then be at rest when free-wheeling.

On the writer's machine a heavy duty $\frac{3}{16}$in. free-wheel is used, and to it is bolted the large $\frac{1}{2}$in. sprocket. The driving chain is a standard light $\frac{1}{2}$in. by $\frac{1}{4}$in. cycle chain, and this is found to be amply strong in view of the even torque and relatively high chain speed. Incidentally, the chain drive has proved to be very efficient—there is only a friction loss of 6 watts in it at full speed. It is also very silent. The driving and driven sprockets have 12 and 48 teeth respectively. It is essential to arrange the motor mounting in such a way that the chain may be perfectly aligned. As the chain very seldom requires adjustment it is simpler and better to use packing pieces under the motor than to provide a jockey pulley. Effective mud-guarding for the chain is essential.

It has been suggested that a three-speed gear should be put in the motor drive, but the writer prefers to obtain any speed variations required electrically. It may be added that a three-speed gear with correct ratios would be of some advantage in the pedal drive.

Limitations of Battery-electric Bicycles

The writer's experimental bicycle is reasonably satisfactory for his purpose, but would not be satisfactory for daily use in inexperienced hands. More than 50 people, both male and female, have driven it and they have all expressed satisfaction with its performance, particularly its silence and simplicity, but they have complained about its excessive weight. With a suitable efficient motor designed specially for the job and weighing about 12 lb., and a suitable cycle frame, a cheap and reliable machine for short

distance transport could be manufactured. Its limitations in speed and range of about 20 m.p.h. and 40 miles per battery charge should, however, be fully understood.

Unlike a petrol driven vehicle, when petrol was available on the roadside in unlimited quantities at about 1s. 6d. a gallon, and when inefficiency did not therefore much matter, a battery-electric vehicle, because of the strictly limited amount of energy which can be stored in the battery, must be very efficiently designed in the first instance, and carefully maintained in efficient condition afterwards. Fortunately the maintenance of a good electric vehicle should be very small and their greatest disadvantage, namely, a run-down battery on the road, is largely overcome by the electric bicycle where one may always pedal home.

Operating Data

Finally, it is thought that other experimenters will be interested in comparing their results with the following data which was obtained on the writer's machine before removing the 33 lb. motor. (Other data was given in PRACTICAL MECHANICS, June, 1942.)

In Fig. 5, the speed curve shows the speed, both in r.p.m. of the motor, and in road speed in m.p.h. for various outputs from the battery. The various speeds were obtained by braking on the level or going up hills. If a speedometer is not available the speed may be calculated accurately by counting the revolutions of the road wheels for a period of, say, 10 sec.

With the motor as finally altered the steepest gradient which could be climbed without pedal assistance and with a 12-stone rider was 1 in 10.

On a level, dry concrete road three tests, which will be of interest to cycle tandem enthusiasts also, were made. Wind direction may be neglected as runs in two directions were made and the averages taken. The results of these tests are shown in the table.

Test No.	Watts at Start	Steady Watts	Steady Speed m.p.h.	Time to reach Steady Watts and Speed
1	560	330	19	26 seconds
2	690	360	16	36 "
3	700	420	14	40 "

Test No. 1 was made with only the 12-stone rider on the machine.

Test No. 2 was made with the 12-stone rider and a 12½-stone pillion passenger.

Test No. 3 was made with the 12-stone rider on the machine and pulling another rider on another bicycle weighing a further 15 stone total.

The speed at start in all tests was 4 m.p.h. and the watts quoted are the watts output from the battery—not the input to the motor.

Both the latter and also the h.p. output from the motor may be calculated from the curves in Fig. 5, if required, for each of the three tests.

Of final interest might be the fact that the only repairs, breakages or adjustments required during 600 miles on the writer's machine was twice tightening the motor chain. This reliability is attributed to the absence of reciprocating parts.

Electric Clock Chimes

Constructional Details of Mechanism for Operating Chimes from an Electrical Clock System

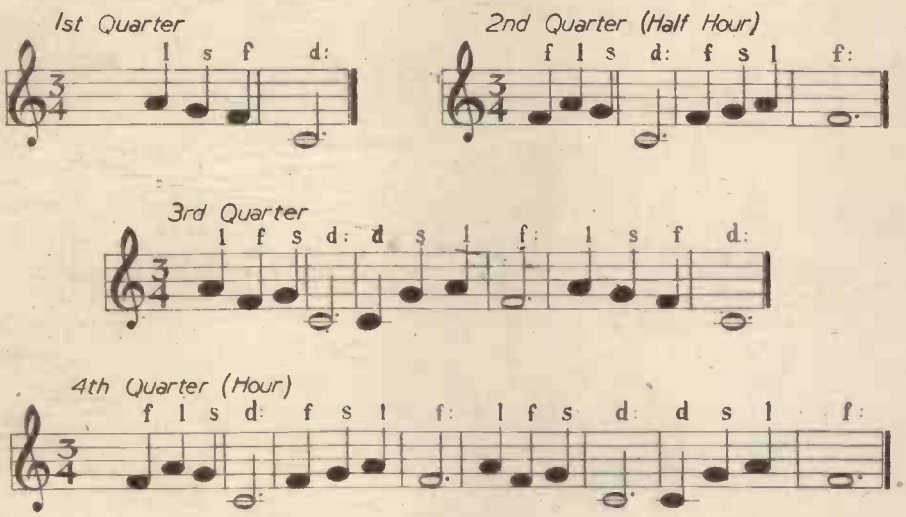


Fig. 1.—The popular Westminster Chimes.

WE recently reprinted the articles describing a Master and Slave clock system (see January, 1942, and October, 1942, issues) and in response to the requests of many readers we reprint the article on a suitable chiming mechanism, which was first published in the September, 1934, issue. This mechanism is not quite such a simple matter as would at first appear, owing to the fact that it is almost essential to call in the aid of clockwork in order to govern the strikers. The reason for this is that the only alternative is a motor which would turn the necessary governing roller, and apart from the power required for the motor, the necessity for self-starting arises. The master clock operates through the power of a three-volt dry cell, and it is almost impossible to find a satisfactory self-starting motor which would operate from this voltage, and this means that a separate supply would be required for the motor, with the added complication of some separate switching to be operated at the chiming periods. Before dealing with the construction of a suitable mechanism, the principles will first be described.

The Chimes

There are in use in England several musical sequences known as chimes, some of which are only popular in the district in which they are heard, whilst others are of almost universal popularity. The Westminster (or Big Ben) chimes are undoubtedly the most popular, and probably the simplest to construct from the amateur clockmaker's point of view. Residents of Portsmouth probably prefer to call this particular combination the Pompey chimes. There is also the Cambridge combination, and others which are less known. The Westminster consists of forty notes in all, divided up into ten separate peals or combinations, each of four notes. If the majority of people were asked to hum these chimes they would be found to offer different versions of the quarter, half and three-quarter intervals. They do not each commence in the same sequence, but are varied, and to any musical ear it is obvious after hearing each peal just what part of the hour is being rung, as there is a musical arrangement in the peal which gives each chime a completeness, somewhat after the manner of an ordinary sentence in English. Thus, when the first quarter is chimed it expresses finality with only four notes, and if the musical arrangement of the chimes in Fig. 1 is carefully studied it will be seen how the peals vary. It will be obvious that only four separate notes are required, and in most striking mechanisms these four

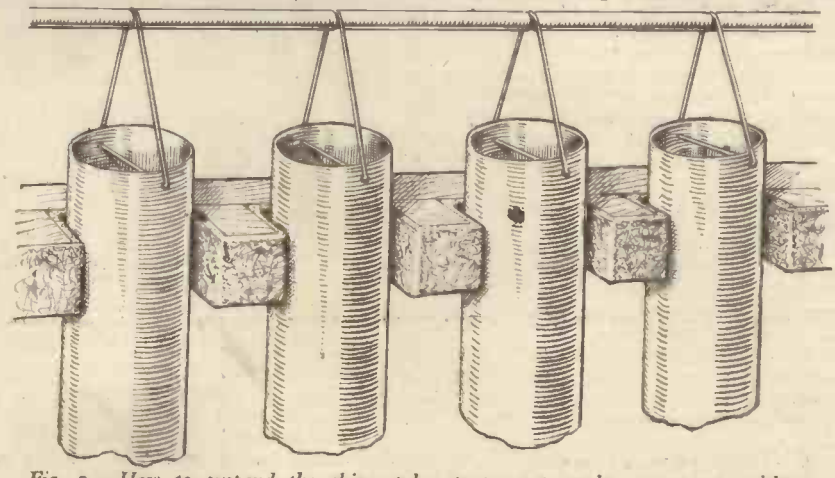


Fig. 2.—How to suspend the chime tubes to prevent undue movement without impairing the tone.

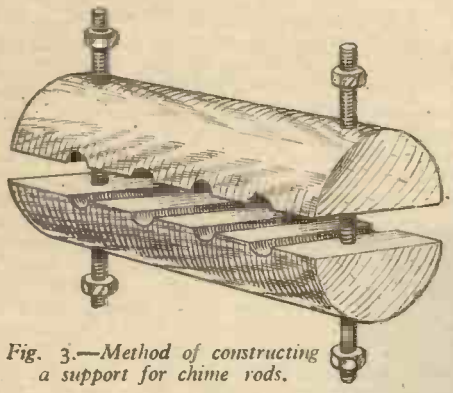


Fig. 3.—Method of constructing a support for chime rods.

notes are struck together to form the hour-striking note. In more elaborate mechanism a separate note is employed, as with the actual Big Ben system. This arrangement will necessitate a separate contact and other complications which may not be considered worth while.

Rods or Tubes

For the actual notes metal rods or tubes are usual; the rod enables a more compact arrangement to be constructed, but the tube gives a much more pleasing tune and enables deeper notes to be obtained. Brass will be found quite suitable, and if rod is to be employed it must be clamped at one end, a satisfactory arrangement being depicted in Fig. 3, where a piece of ordinary broom-handle is cut down the centre after four holes are drilled transversely to accommodate the rod. Tone will be improved if thin leather is placed between the wood and the rod, and the notes may be adjusted by sliding the rods through after tightening the nuts to hold the rod moderately firmly. A pencil or any piece of wood will enable the rods to be struck whilst adjusting the notes. For tubes a hole should be drilled slightly below one end and pieces of gut (a violin or banjo string will be found admirable), looped through, as shown in Fig. 2. It will be seen that in addition a strip of wood should be arranged a short distance below the suspension point, and a small block of wood should extend between the rods and be joined to a similar strip on the other side of the rods. Felt glued to the surface of these wooden pieces will prevent undue movement of the tubes, and will prevent movement due to vibration, without impairing the tone when the tubes are struck.

The Operating Hammers

The cleanest tone will be obtained from leather-tipped hammers, and one of the easiest methods of constructing these satisfactorily is to take a piece of brass rod ⅜in. in diameter. This is cut into ½in. lengths, and one end of each length is bored out to ¼in. diameter by ¼in. deep, and into this is forced a piece cut from a leather lathe belt (round section). This is hammered lightly into the recess in the brass hammer, and furnishes a most useful striker. A transverse hole to accommodate a piece of 20-gauge piano wire, and a tapped hole to take a locking screw, enables the hammer to be fitted to the striker and to be adjusted to provide the correct blow. Details of this are given in Fig. 4. When mounting the hammer the wire should be bent, so that in the position of rest the surface of the leather is slightly clear of the rod or tube, and when lifted the weight will be sufficient to enable the hammer to give the requisite blow to the rod or tube, and then jump clear. This adjustment may easily be made clear after assembly.

Direct or Remote Control

We now arrive at the point where we have to decide upon the method of operating the chimes. The advantage of the electric clock is that the master may be stowed away in a cellar or attic, and slaves operated at any desired position. In a similar manner the chimes may be placed in any desired position and operated from any slave. To preserve a neat appearance the chiming rods may be mounted in a small cabinet with electro-magnets for striking, and these may be controlled by the striking mechanism arranged in some other position. Alternatively, the striking mechanism may consist of ordinary clockwork gears with the hammers raised and released by pins on a drum, and this gearing may be set free by electrical means at a distance. Fig. 5 illustrates the two methods diagrammatically, and it will be seen that the second method offers the simplest solution and is by a great deal the cheaper. One magnet only is required, and this will release the rotating drum carrying the pins which raise the hammers.

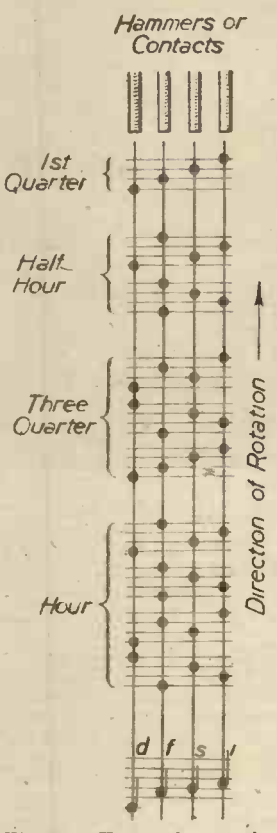


Fig. 6.—To mark out the chime-operating drum a strip should be marked off in this manner and then wrapped round the drum.

For both methods it is necessary to mark out the drum or cylinder which carries either pins to lift the hammers or pins to make the contacts to operate the magnets to lift the hammers. In general, a large diameter drum will be needed, as this not only facilitates the insertion of the operating contacts but reduces errors in setting out. For this it is necessary to mark out the surface of the cylinder in the 10 separate peals mentioned in the first section. A space must separate each peal, that between successive quarters being slightly greater than between the individual sections of each peal. A specimen marking-out strip is shown in Fig. 6, from which it will be seen that 40 pins have to be inserted to agree with the notes in Fig. 1. The strip should be of the same size as the

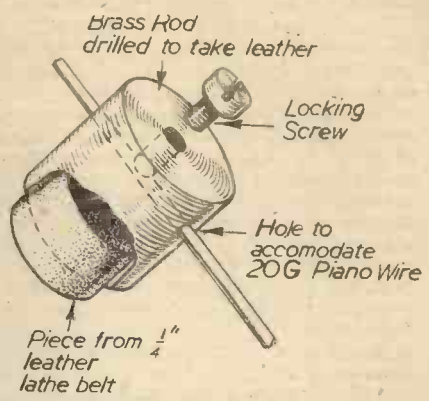


Fig. 4.—The simplest method of constructing a chime hammer.

circumference of the drum which is used, and it should be wrapped round the drum, and holes drilled at the points which are marked, or, alternatively, nails may be driven into the wood. For the direct operation of the hammers 1in. wire nails will be suitable, but for operating the contacts gramophone needles will be found more suitable on account of their shortness and rigidity.

Sufficient has been written to enable the amateur clockmaker to build a complete electric chiming mechanism, and further constructional details are purposely not included as it is possible that each constructor will desire to assemble the apparatus to suit his individual requirements. A word of advice may be given before closing, and that is, use at least an eight-day clock mechanism for the

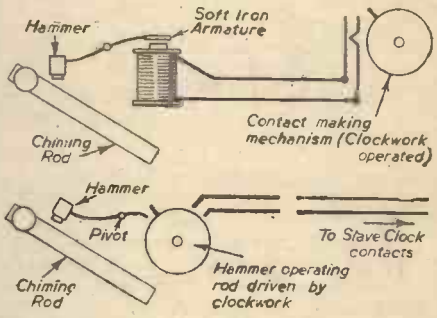


Fig. 5.—Two methods of arranging the chiming mechanism.

striking gear, or the continued rewinding of this part of the clock system will detract from the advantages of the electrically-operated timepieces.

Books Received

Hammer and Nails Carpentry. Published by Evans Brothers, Ltd. 54 pages. Price 3s. net.

THIS useful book is intended for the handyman or householder who likes making things in wood, but who has had little or no training in woodwork. The book explains, with the aid of numerous illustrations, how to make useful articles for house and garden without having to cut difficult joints. Simple constructional details of a wide range of domestic and garden fitments are given, including, amongst other things, fixing shelves, poultry pens, small greenhouse, tool shed, folding cot, light table, garden cart and a handy ladder. If you are one of the many householders who are handy with a hammer and nails this is just the book for you.

Problems in Radio Engineering. By E. T. A. Rapson, A.M.I.E.E. Published by Sir Isaac Pitman and Sons, Ltd. 150 pages. Price 5s. net.

THE problems given in this book, which is a fifth edition, were collected and classified to facilitate the class-work in radio engineering at Southall Technical College. They are drawn from past examination papers of the City and Guilds of London Institute and other Institutions, the problems embracing such subjects as electrical communications, radio communication, and telegraphy and telephony. Descriptive examples have been included as a guidance for private students.

The Story of Chemical Discovery

No. 16.—The Science of Synthetic Drugs. Chemistry's Contribution to the Medical Art

TO modern chemical science mankind owes, if not the complete and permanent conquest of pain, at least the efficient alleviation of that universally dreaded foe of humanity.

In ancient times, physical pain was, in some measure, successfully stifled by the use of certain herb decoctions, consisting mainly of opium and opium-like extracts. Right up to living memory, medicine depended, with one or two exceptions, for its pain-relieving methods upon the various root, bark and plant extracts which had been known for centuries. The first step in the elucidation of the active principle of a typical pain-deadening drug was taken in 1803 by the French chemist, Derosne. This worker obtained from opium (which is essentially the dried juice of a species of poppy) a crystalline substance which he termed *morphine* or *morphia* (from the Greek *Morpheus*, the god of dreams). This extracted material he found to possess the same properties as opium, but in an intensified degree.

Derosne's discovery was little heeded at the time, and so was a similar and independent discovery which was made a few years later by the German druggist, Sertürner.

In 1818, two French chemists separated the drug strychnine—one of the most deadly of poisons—from certain tropical seeds, and a year later they obtained another similar poison, brucine, from the same source.

Then followed the extraction of quinine from cinchona bark. Quinine, strychnine, brucine and similar extractive substances were termed *alkaloids* owing to their feebly alkaline character. At the present time, about two hundred of these plant alkaloids are known. Most of them are powerful poisons, but they are not all medicinally valuable.

Use of Alkaloids

With the coming of the alkaloids, medical science endeavoured to formulate a new system of controlling pain and disease. To a certain extent this system succeeded, and, with modifications, it has survived even at the present day. We use morphia to-day very extensively on account of its specific pain-killing propensities, yet we still rely upon the poppy plant for our supplies of this valuable drug. Quinine has never been synthesised or prepared artificially. It is one of the drugs which has so far defied the efforts of chemical science to produce it in the laboratory. Likewise, the mixture of alkaloids which occur in the foxglove plant and which go under the name of *digitalis* have not been made artificially. Yet digitalis is an indispensible drug for use by the medical practitioner in dealing with heart cases.

Chemical science seems first to have attacked the synthetic drug question by concentrating upon pain-killing substances. Probably the first artificially produced pain-reliever was the gas nitrous oxide (originally called "laughing gas"), which was discovered at the beginning of the last century by the British chemist and experimenter, Sir Humphry Davy. Davy found that when he breathed this gas it gave rise to excitement (hence the name "laughing gas"), followed by a transient insensibility. Nitrous oxide is readily made by heating ammonium nitrate, and to this day this medium, the pioneer of artificially produced pain-deadening agents, functions daily in countless dental surgeries as the "gas" which is administered for the more difficult and prolonged of dental extractions.

Then, towards the middle of the last century, came the use of chloroform and ether as anæsthetics. Ether seems to have been known for centuries, but it was apparently never used as an anæsthetic until it was introduced for this purpose in 1846 by Morton, an American doctor.

Adolph von Bayer, German chemist, who first synthesised many important drugs.

Chloroform

In the following year Sir James Simpson demonstrated the valuable anæsthetic property of chloroform. At that time chloroform was almost an unknown substance. It had first been made in 1831 by Baron Liebig, the German chemist and the introducer of our present-day meat extracts, Liebig obtaining impure chloroform by distilling bleaching powder with acetone.

To this day, enormous amounts of chloroform are manufactured on the large scale in the same way, or by distilling purified alcohol with bleaching powder (chloride of lime). Chloroform is one of the most valuable materials which chemistry has ever given to medicine. The coming of chloroform, which is a typical synthetic material, at once overcame for thousands the appalling terror of having to submit to a major operation.

It had long been known that the natives of Peru made a habit of chewing the leaves of a certain plant when they were about to undergo prolonged exertion. They employed decoctions of these leaves as pain-killers also.

Discovery of Cocaine

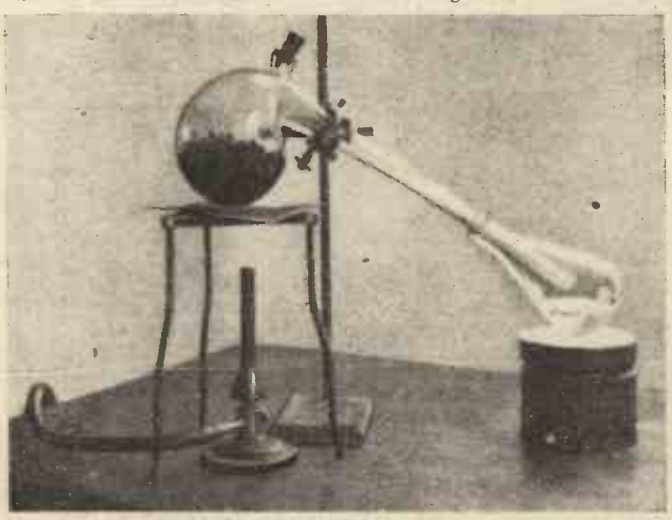
In 1860, Neumann, a German chemist, obtained a supply of the Peruvian leaves, and, after submitting them to chemical treatment, he extracted from them a white crystalline substance which he called *cocaine*. Now this substance, cocaine, was found to have the very remarkable effect of paralysing the nerve-endings in any region of the body to which it might be applied. It was found to be exceptionally poisonous but, when taken in small amounts, it was shown to be capable of producing a remarkably exhilarating effect upon the human system, mental and physical alike.

With cocaine came the conception of what we now term a "local anæsthetic." Cocaine, it was found, could be applied to any part of the skin for the purpose of rendering that area completely insensitive to pain. It could also be injected into the bodily tissues in order to render the immediately surrounding area painless.

Despite its highly toxic or poisonous nature, the value of cocaine for minor operations, such as teeth extraction and the superficial cutting of body tissues was at once recognised. The new drug was made the subject of intensive chemical study. If it were possible to find out how the molecule of cocaine was built up by Nature, it might then be possible not only to manufacture cocaine artificially but, better still, to improve on Nature's drug and to formulate and build up more powerful and, perhaps, less toxic local anæsthetics.

Composition of Cocaine

At last, after much research work had been done on the problem, the composition of cocaine was finally elucidated. Natural cocaine was found to have the following chemical formula:



Acetic acid being produced as a laboratory experiment. Such an acid underlies the formation of many drugs of the "aspirin" type.

$$H_2C—CH—CH.\ CH.CO.\ OCH_3^*$$
$$\quad\ |\quad\ |\quad\ |$$
$$\quad\ |\quad NCH_3CH.\ O.\ COC_6H_5$$
$$\quad\ |\quad\ |\quad\ |$$
$$H_2C—CH—CH_2$$

The chemically minded reader will be familiar with the interpretation of chemical formulæ similar to the above, complicated though they may be. The above formula represents a sort of atomic pattern made up of carbon, hydrogen, nitrogen and oxygen atoms. Careful study elucidated the fact that the anæsthetic action of cocaine in some strange way was connected with the CH_3 group of atoms, which is marked with an asterisk in the foregoing formula. If this group of atoms were replaced by a hydrogen atom only, then the whole of the anæsthetic and physiological action of cocaine vanished completely.

Much research has shown that Nature has, in cocaine, built up a needlessly complicated compound to obtain anæsthetic action. Decades of chemical work have demonstrated the fact that it is possible to get anæsthetic action which is even more powerful than that of cocaine by creating chemical substances of much simpler composition.

In a way, modern chemistry has almost reduced the building-up of local anæsthetic materials to a plain set of rules.

Arrangement of Atoms

There seems to be a certain arrangement of atoms which, in some strange and as yet completely unknown way, produces anæsthetic action. For example, if the reader were to build up a new chemical compound having the following skeleton pattern:

R R N—C—C—O—C O R

he would produce a chemical substance having a very pronounced anæsthetic action.

In the above skeleton formula, "R" stands for certain groups of carbon and hydrogen atoms, such as: CH_3, C_2H_5, C_6H_5 and so forth.

It is along nowadays well-recognised lines such as the above, that the various "cocaine-substitutes," as, for instance, *novocaine*, *alypine*, *stovaine*, the spinal anæsthetic, and numerous others have been produced. Nowadays, cocaine proper is but little used in ordinary medical and dental practice. Its place is taken by the many synthetic drugs which have been brought into being as a result of its close investigation and study. Such drugs are, unlike cocaine, for the most part non habit-forming, and they are much safer in action.

The various disinfectants and antiseptics, whose names are nowadays legion, are, for the greater part, examples of the work of synthetic chemistry. These are essentially drugs which are toxic to bacteria and to all lowly forms of life. Although alcohol is a powerful antiseptic, it, unfortunately, injures the living tissues of the body. Hence it cannot be employed for this purpose.

Carbolic acid, a product of coal tar, was our first general disinfectant. It can readily be produced artificially from benzene or aniline, but it occurs abundantly in coal tar. Hence it is invariably obtained from that source along with cresol and similar disinfectant substances.

Carbolic acid and the cresols have an irritating action upon living tissues. Indeed, they are extremely detrimental to the latter. For this reason, the various "fine" disinfectants and antiseptics have one by one come into being. The majority of them are made synthetically from coal-tar products. Many of them contain chloride of iodine as essential constituents.

In this matter of disinfectant and antiseptic production chemical research is still proceeding. The ideal antiseptic, deadly to germ life but completely harmless to bodily tissues, has not yet been brought into being. Some of the bacteria which underlie various infections are highly virulent and resistant to external chemical influence.

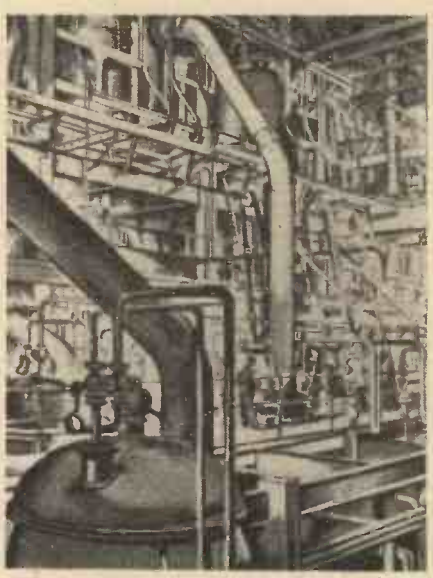
Acriflavine

A notable triumph in this line of research was the introduction of *acriflavine*, a yellow-green fluorescent dye. Some of the most complicated wound infections of the last war were successfully fought with acriflavine and similar dyes, and there must still be living many veterans of the last period of hostilities who, if they but knew, owe their present existence to the properties of acriflavine and its related synthetic compounds.

The next group of drugs which chemical science during the past 50 years has concentrated upon is that to which the term "fever-reducing" may be applied. Quinine is the best known of these. But quinine is a natural compound, and, as we have already learned, it has resisted all efforts to produce it synthetically.

Acetanilide, $C_6H_5.NH.CO.CH_3$, a white crystalline material, formed by the action of acetic anhydride on aniline, was one of the earliest antipyretic drugs to be produced artificially. For some years it had a vogue, but it was found to be irritant to the stomach and somewhat toxic in the bargain.

In 1888 the drug "phenacetin" was first made by von Bayer, the German dye chemist, in the Elberfeld laboratories of Friedrich Bayer and Company. Phenacetin proved itself to be an extremely useful drug and its large-scale commercial manufacture was quickly effected.



Making synthetic drugs on a large scale. A phenacetin plant in operation.

In the following year "antipyrine" was synthesised. It was less successful than phenacetin, as was also the compound of antipyrine with salicylic acid known as *salipyrine*.

Enter Aspirin

The properties of oil of wintergreen in treating rheumatism have long been known. Wintergreen oil contains salicylic acid, which, in the form of its salts, is also of extreme value in rheumatic treatments. Salicylic acid itself cannot be used for any such treatments because the free acid is far too irritant to the stomach and intestines. It was discovered, however, that just as acetic anhydride and aniline could be reacted together to form a useful antipyretic drug, *acetanilide*, so, too, could acetic anhydride and the very potent and medically valuable salicylic acid be combined to produce a white crystalline material which was called acetyl-salicylic acid. Subsequently, when the extreme value of acetyl-salicylic acid as an antipyretic agent and as a headache and nerve-pain killer became recognised, the product was manufactured under the now universally known name of "Aspirin."

Aspirin was a complete German monopoly previous to the last war, but since that time it has been continuously produced in England. Constituting, perhaps, the most popular of all common drugs, aspirin is purely of synthetic origin. It is safe in use because its physiological action is mild and steady.

Another group of drugs which have been much studied by modern chemistry are the "hypnotic" or the sleep-producing drugs. Bromide of potassium, taken in large quantities, can produce sleep, but in normal small amounts it acts merely as a sedative or a nerve-quietener. The first of the sleep-producers to be made synthetically was chloral hydrate, which was introduced to medical practice in 1869. This material is made by the action of chlorine gas on alcohol. Its success led to the search for other synthetic chemical drugs of a like nature. Eventually a more powerful drug, *sulphonal*, was first produced at Barmen, in Germany, and after sulphonal came various other sleep-producing agents.

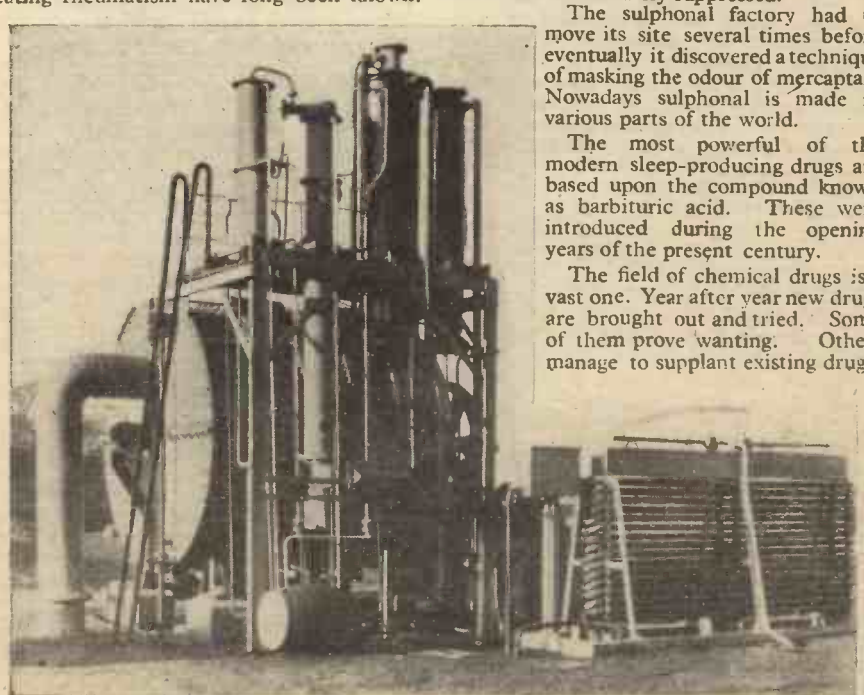
An Evil-smelling Material

The parent substance of sulphonal is mercaptan, an incredibly evil-smelling material, of which little as 1/400,000th of a milligram is offensive to the nostrils. In view of this fact, when the sulphonal factory at Barmen commenced operations the worthy inhabitants of the district rose up in arms and threatened to take the direst of proceedings against the new factory unless the terrible and over-powering "smell of cats" was immediately suppressed.

The sulphonal factory had to move its site several times before eventually it discovered a technique of masking the odour of mercaptan. Nowadays sulphonal is made in various parts of the world.

The most powerful of the modern sleep-producing drugs are based upon the compound known as barbituric acid. These were introduced during the opening years of the present century.

The field of chemical drugs is a vast one. Year after year new drugs are brought out and tried. Some of them prove wanting. Others manage to supplant existing drugs



The origin of many present-day drugs. A coal-tar still of a modern type.

PHOTOGRAPHY

Photo Tinting

How to Prepare the Prints and Apply the Colours

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

TINTING of photographs has been a popular sideline with many amateurs for several years, but never has it been such a favourite pastime as during the last two winters.

While the work does not call for special skill, yet it is surprising what excellent results are being obtained by those who have persevered with it and gained some experience; they have apparently acquired the knowledge, so necessary in all colour work, of being able by mixing to get just the right tint and the correct balance of colour into the picture. The actual design or base for colouring is already made for us in the photograph and this, as you will recognise, is the most skilful part of an artist's work. All we have to do is to apply the colours.

There is, therefore, no reason why every amateur should not try this extra branch of his or her hobby, and I would recommend the sets of tints as put out by Johnsons. They comprise nine of the most useful colours in very concentrated liquid form, each in a small bottle and the whole nine packed in an upright position in a box so that they need not be removed from the box when in use. Each tint is capable of considerable dilution to enable thin washes to be used when only a suggestion of colour is desired, and each is transparent so that when it is placed on the image of the print the image is visible, but in colour.

Beginners' Mistakes

Most beginners at first make the mistake of using the tints too strong; it is very seldom that deep colour is required except for flowers or very small items appearing in the print, and then it is applied by means of a fine brush allowing only pin points of colour. Usually it is better to use a dilute strength, blot this off with clean blotting paper, and give a second, third or a fourth application if necessary until the desired depth of colour is reached.

Do not attempt to tint on a dry print, it must be soaked in clean water first and the surplus water blotted off. This soaking will soften the gelatine of the emulsion so that it will take the colour; with some of the papers to-day the emulsion is so hardened in the making as to necessitate soaking them for several minutes in hot water; cold seems to have little or no effect. If the prints are old they will require prolonged soaking, and if they are "greasy," due to handling, it is as well to rub them with a wad of cotton wool soaked in methylated spirits.

There is no doubt that a print that has been sepia toned previously will give a much more pleasing and artistic result. Details of sepia toning were given in PRACTICAL MECHANICS for March, 1942, in which you will find the process and formulæ fully described. I do not favour a high-glossy surface; matt surface is, in my opinion, much the better.

Brushes are hard to get at present, but try to purchase two or three good ones, it pays to have fine quality. The thin or fine grades, as Nos. 0, 1, and 2 will be found to be the most useful. I believe the present prices are round about 1s. 6d. to 1s. 9d. each, but with care they last a long time. The current prices of the sets of tints are 3s. 6d. for small and 7s. 6d. for the large sets which contain, besides the nine bottles of tints, tubes of tinsel and medium, also two saucers for mixing the dyes.

The colours included in the sets are as follows: blue, brown, crimson, flesh, green, orange, scarlet, violet and yellow, and it must be remembered that each is intermixable so that a very extensive range of tints in heavy or pale tones is obtainable.

Mixing Colours

Mixing of colours to obtain certain effects is, as everyone knows, part of the artist's training, and to one whose profession is painting it is undoubtedly very valuable knowledge, but we amateurs must be satisfied with knowing the elementary rules and to make our own tests as and when we require particular effects.

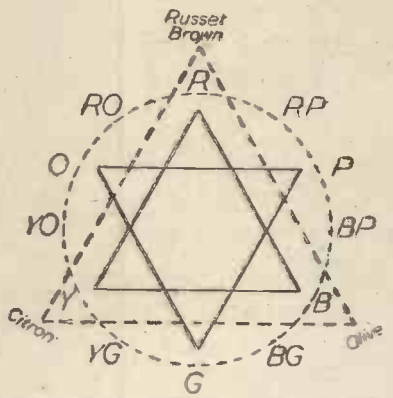


Diagram of a colour wheel, showing the relationship of the primary, secondary, and tertiary colours.

The accompanying diagram is taken from the 1934 copy of "The Print User's Year Book," to the publishers of which I tender my grateful acknowledgments, as I have found it of very great use. On the colour-wheel will be found the three primary colours—red, blue and yellow—represented as R, B and Y; then the three secondaries—orange, green and purple; and the three tertiaries—olive, citron and russet brown. On the wheel will also be found the "three-quarter" shades falling between the primaries and the secondaries.

It is necessary to know how to break down compound colours to their constituent primaries; for instance, each secondary is made up of two primaries, as O=R+Y, and the tertiaries are made of equal parts of two secondaries, as russet=O+P. If you proceed to break down the tertiaries to the primaries via the secondaries you will get russet equals O+P=R+Y+R+B, which simplified is RRYB, which means that this tertiary contains two parts of its "related" primary, red, and one part each of the other two. In the wheel the tertiary always lies beyond its "related" primary. The three-quarter shades are held to contain two parts of one primary and one of another.

A Colour Chart

This method should prove quite useful in helping you to arrive at many combinations of colours, and for those who desire a chart showing the actual result obtained by superimposing one colour over another I would suggest the following as being the easiest and most effective. Rule a sheet of paper in squares as a "graph" having nine squares from left to right and nine from top to bottom, equalling 81 squares in all. Over the top of the first line from left to right write the names of the tints in your set, commencing with blue and finishing with yellow. Now repeat these names in the same order alongside the first downward column of squares on the left side. Your first square has the word "blue" over it and on the side. Take a brushful of the blue tint and fill up the first column of squares on the left from top to bottom; the second should then be filled with brown, the third column with crimson, the fourth flesh, and so on until the whole of the upright columns are coloured with the tint mentioned at the top of each. Having washed the brushes, proceed to get the effect of superimposing by covering half of each square on the top line from left to right with blue. Do this diagonally across the square; the second row down will be treated with a superimposing of brown, the third with crimson, and so on, until the whole of the chart shows two colourings in each square. This will show at a glance what you must expect when using a mixture of two of the dyes in their concentrated form. A few experiments made in conjunction with these two charts will put you on the right way for mixing in order to get a special tint, but you must bear in mind that it is better to work with weak colours and build up the depth by several applications rather than taking a short cut and using the strong concentrated liquid. Prints with heavy trees and foreground of grass plots call for a fair amount of work to get the effect of greens and browns in both trees and grass; but where you have a print of an old country whitewashed cottage in a garden, showing a few flowers in bloom, do not attempt to put any tint on the cottage, but add your spots of colour to the flowers and to the creeper on part of the walls. Remember always, too much colour may spoil your effort, whereas too little can always be added to.

Colouring

It may happen that sometimes you have used too much or too deep a colour, and must remove some of it. Wash the brush and fill it with clean water and go over the part you want "removed," then blot off after a few seconds; repeat this until you have got what you want. Should you desire to remove all the colouring and to start afresh, then allow the print to remain in soak, as this will clear it of most of the colour. The colours are made from aniline dyes, and you are dealing with a gelatine surface on the paper, and in this gelatine are quite a number of chemicals. The colours are fairly "fast," and will stand up to light for quite a long time, but they are not permanent; therefore, if your print is mounted and framed it should not be hung where the sunlight can reach it for many hours during the day.

Those who have made some lantern slides will do well to tint some of them with these colours, as, being transparent, they can be used with very good effect, and make a splendid relief to the black and white when put through the lantern. More care and skill is required with the tinting of slides to allow for the magnification of the image which occurs when the slide is shown on the screen, but a little practice will soon put this right.

When preparing a dilute solution for wash work, as for skies and sea, one or two drops of the colour with about 30 drops of water will be found to be about the correct strength with which to work. Quick application of the blotting-paper after each wash of the tint is advisable, as it helps to get the colour more uniform and free from brush marks

THE WORLD OF MODELS

By "MOTILUS"

Model of a Steam Drifter and a Gauge "O" Model Railway Layout

Ready to get under-way. This fine model drifter and its builder, Mr. S. Tilley.

SOME enthusiasts start the model hobby in war-time because of the "Stay at Home" recreation campaign. Others, who were keen before the war, try to continue their hobby under great stress and often turn it to the war effort.

For some time I have known Mr. S. Tilley, and he is one of those model hobbyists of many years standing, who is still carrying on with his model-making during the war. In business he is a very busy lorry proprietor and after his long runs across country on Government transport, he finds relaxation in his old pastime of building models. He has been at work for the past four years or so on a model of a Yarmouth drifter, and recently finished this fine super-detail working scale model.

In September of this year he gave a demonstration of the drifter on a lake in a public park at Northampton, and the interested crowd of onlookers included a contingent of the local Sea Cadet Corps, whose presence lent a truly nautical air to the display.

Mr. Tilley, the maker of the model drifter, is one of the civilian instructors at Northampton branch of the Sea Cadet Corps, and the recent demonstration was primarily for those directly in the Sea Cadet movement, but, as one would expect, members of the general public were also there in force!

The model, which is steam driven, was built from drawings of the prototype supplied by Messrs. Crabtree, of Great Yarmouth, who are well-known builders on the East Coast of this type of fishing vessel.

In peace-time the steam drifter, lowering a vertical net over the bow and drifting to it with foremast lowered, was used entirely for fishing. It is fitted with a powerful capstan in place of the trawl winch, has a compound engine, and could carry 50 tons of fish. To-day, however, practically every drifter has been taken over by the Navy and is used for minesweeping, submarine spotting, patrolling and other auxiliary duties of a similar nature.

Details of the Model

It is 6 ft. long with a 14in. beam and is to a scale of ¼in. to the foot. Mr. Tilley started—as an experienced model-maker generally does—on making the engine and boiler first. After a careful study he decided on the Stuart Compound Launch engine with reversing motion as the best type for the job. This has cast-iron cylinders of ¾in. and 1¼in. bore with ⅞in. stroke, weighs approximately 4lb. and is a very economical engine in steam consumption.

He built the engine from castings purchased from Messrs. Stuart Turner and made an excellent job of it, despite the fact that in his workshop he only has a 3in. lathe, a small drilling machine and a few bench tools. The boiler feed pump he also constructed from a set of Stuart castings.

The boiler is made of copper and is riveted and not brazed. It is coal fired and has the special feature of a water-cooled door. Also it is fitted with a super heater. The engine and feed pump are fed by automatic lubricators.

When he had completed the steam plant he ran the bench tests, which were most successful, in his workshop, and the plant when in service will maintain the boat in running trim for three-quarters of an hour without attention.

Now as to the hull of the drifter, this is complete with timbers, foreknees, aprons and dead woods, and is carvel built. The planks are of teak and the bulwarks are built in the style of the prototype, in teak, oak and ash.

Mr. Tilley's method of construction was by laying the keel and then fixing all the timbers, which we in larger boats would call the "ribs." He then did the planking and made such a good job of this that no caulking at all was needed, and the hull was simply finished off with a coat of paint to colour it. He carved the name in box wood and finished it off in leaf gold, exactly as on the prototype.

Deck Planking

There is 100 feet of planking on the deck, and the pitching in between the planking is put in with black ebony wood. Also at least 75ft. of half round brass of various dimensions from $^{3}/_{32}$in. up to $^{3}/_{16}$in. is used on the model.

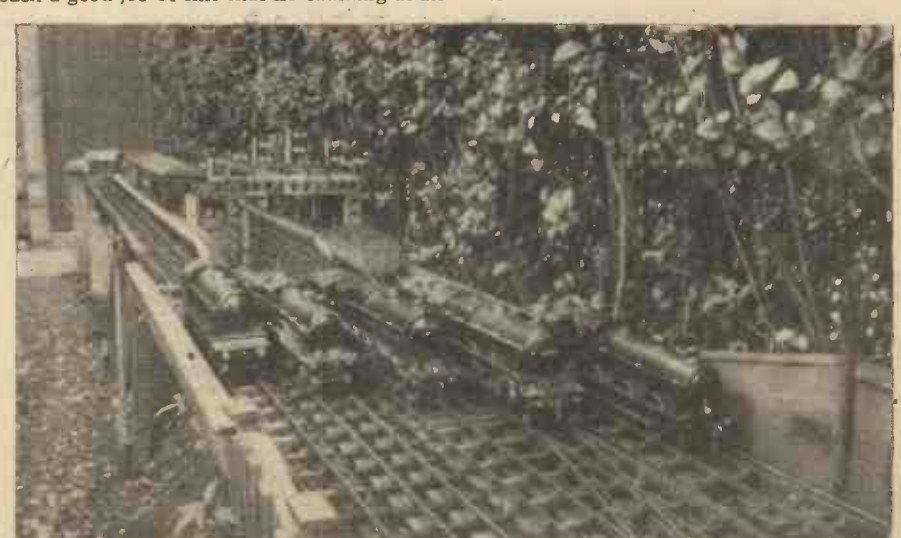
It is driven by a four-bladed propeller, and the thrust is taken by ball race and proper packing gland. The blocks and pulleys are metal centred and wood sheaved.

The fairleads, bollards and riding lamps are all carved out of the solid and are *not* castings, which model makers of experience will realise was no small task. The ventilators are made out of the sheet and riveted, and the funnel is also plated and riveted. All the U bolts and shackles are built up and silver soldered. The wheel house is made of sheet brass, riveted with angle irons, etc., and includes the usual fittings inside. The wheel was made out of an old croquet mallet and a 1 ft. boxwood rule. It is properly felloed and banded with half-round brass. The steering wheel is geared down to ten to one with the steering chains.

Besides being a keen and expert model maker Mr. Tilley takes a great interest in all good craftsmanship, anything from period furniture to an old watch, and on his travels he is often able to secure many examples of the work he admires. His home contains quite a number of beautiful antiques.

Gauge "O" Models

Mr. C. B. Smith, of Lincoln, whose railway has often featured in these pages, has recently sent me a picture of five of his gauge "O" models outside Bincliff Station on what he calls the "Bincliff, Lakeside and Shedley" branch of his L.M.S. layout. When he has ballasted his track there will be a further "note of realism" to mention about his line!



An impressive team of locos on part of Mr. Smith's "O" gauge railway

Our Busy Inventors

By "Dynamo"

Barrage Streamers

THE barrage balloon has its limitations. It cannot soar very far towards the stratosphere. Since many enemy 'planes fly at an exceedingly lofty altitude, the barrage of the balloons stops short of the high-flying hostile aircraft. Admittedly it prevents them from coming inconveniently low.

An improved device for intercepting aircraft is the subject of an application which has been accepted by the British Patent Office. The new invention contemplates the use of streamers which can be flown at heights far above the balloons. The aim of these streamers is to become entangled in the airscrews of the raiding aircraft.

The device consists of streamers of pliable material filled with hydrogen or other light gas, and arranged to be flown from a suitable anchorage at a height considerably in excess of that attainable by a barrage balloon.

Strong and light, the streamers will require only a wire or other means of attachment. Silk has been suggested for this purpose.

Should a raider pass near such a streamer, the air flow will tend to suck the streamer into the airscrew, with almost certain disastrous results to an enemy 'plane.

To Warm the Pilot

IT goes without saying that intense cold is a very great drawback to the pilot and other members of an aeroplane crew. It is true that thick clothing provides protection against frost, but its bulkiness is apt to interfere with the wearer's freedom of movement.

To obviate these drawbacks, an inventor has submitted to the British Patent Office an idea for improved electrically heated wearing apparel. This clothing is of various types, such as outer garments, shirts, socks, gloves and shoes.

Associated with these articles of wear is thin, flexible sheet material forming lightweight electric heating units permanently or removably secured to the portions of such garments it is desired to heat. And this is effected without appreciably increasing the weight or thickness. At the same time, the garment is not caused to be stiff, bulky and uncomfortable.

To take an example of clothing heated according to this system, an under-garment may be of union suit type. Secured to the outer surface of this suit are any desired number of electrically-heated units. These units are mounted in a protecting bag or pocket detachably fastened to the suit by buttons, snap fasteners or other means for removably attaching the bag to any position on the suit.

Portable Spraying Outfit

AN application for a patent in this country relates to a portable spraying outfit. The device is a small tank which is specially advantageous in connection with fire-defence, as it can be immediately picked up, put on, carried and operated by one person.

This tank has a pair of shoulder straps of hook-like form, thus enabling it to be more rapidly placed on the back than is the case with the harness type which has preceded it.

Detachably connected is a flexible tube leading to a hand pipe, or syringe, the barrel of which is ordinarily supported in a spring clip on one of the shoulder straps. The pump has an extension lance and a spray nozzle resembling those in stirrup pumps.

The tank is rectangular in shape, somewhat narrow from back to front, so that the person carrying the outfit can pass through trapdoors and other restricted openings.

The whole assembly is carried on the user's shoulders, leaving both hands free for climbing ladders or manipulating sandbags.

It is possible at once to sever the pump and hose from the tank, so that, when it is empty, they can be fitted to a spare one. In fact, any number of tanks may be stored full of water or fire-extinguishing liquid ready for immediate use.

This device, invented by an American, is for picking up incendiary bombs and trapping them in a metal container.

For Fire-fighters

A FACE-SHIELD of heat-resisting material with a transparent panel may be fixed to the tank. Normally the shield is held by clips flat against the back of the tank; but it can be instantly detached by a downward pull. And a clip then serves to secure the shield on to the pump barrel.

This shield should prove an effective defence against the enigmatical incendiary bomb. New ideas are being used by the enemy in connection with this bomb, so that one does not know how it is going to behave.

The usefulness of this portable tank is not limited to fire-defence; the appliance is equally suitable for horticultural or industrial spraying.

Second Front

MEN'S ties have a habit of wearing out principally at one point—the front portion. To deal with this drawback an inventor has contrived a tie in which the front portion can be detached and replaced by new material.

According to this invention, the new front tie portion is tapered at its inner end, which may be inserted and secured within the open end of a tie from which a corresponding portion has been removed.

Preferably the front portion is stiffened or strengthened along its inner end. Fastening tags are provided, by means of which the inner end may be inserted into the end of the remaining portion and made secure. Clips may be passed through the fabric of the old tie and bent over its outer surface. However, instead of clips, the inner end of the new front can be stitched in place in the open end of an existing tie from which the old front portion has been removed.

Pencil for Lighting

FOR igniting the burners of gas stoves an improved striker device has recently appeared. This comprises a flint and a hand holder. The holder is in the form of a pencil-like casing of wood, and contains a flint of the igniting composition usually found in cigarette lighters.

The material of the holder is of such a kind that it will wear away with the flint, as the latter becomes worn down during use. As a consequence, the outer face of the flint is always capable of rubbing contact with the abrasive surface. However, if made of wood the holder may be sharpened from time to time to expose the resulting outer extremity of the flint in the way that a lead pencil is sharpened.

To prevent the loss or mislaying of this lighter there is an arrangement whereby it can be attached to the gas stove.

A Sound Proposition

MUCH thought has, doubtless, been expended in an endeavour to contrive a soundproof wall.

An inventor has applied for a patent in this country for a means of furnishing—to quote from his specification—"a sound barrier or insulating partition which will absorb a large part of the energy of the sound waves impinging upon its surfaces with resulting minimum transmission and reflection of the sound."

His idea is a sound barrier wall or door so constructed that it has an air-impervious diaphragm. On each side of this diaphragm is a layer of intersticed material.

In the minds of many people the prevention of noise is a problem which should be tackled with vigour. Over and over again, for example, we are enjoined by the B.B.C., in the interest of night workers who sleep during the day, to modify the tone of our wireless sets.

But something may be said in favour of training oneself not to be hypersensitive to noise.

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.

Making an Induction Coil

WILL you please advise me regarding the construction of an induction coil with an output of about 40,000 to 50,000 volts, working from a standard car battery. I have sufficient facilities to construct a coil-winding apparatus. Can you give me full details including the following points :

1. Gauge and type of wire for primary and secondary.

2. Number of turns for primary and secondary.

3. Construction and material for core.

4. Does the speed of interruption affect the output, and would it be any advantage to mechanically control it ?

5. What determines the general shape ? For example, it could be wound, say, 24in. diameter by 1in. wide, or 36in. long by 3in. diameter. I quote extreme cases so as to make my question clear.

6. Is it possible to draw off varying voltages by making contacts at different radial positions ?

7. Should such a coil be cooled ?

8. Where can suitable wire be purchased ?—E. R. Bailey (New Milton).

AN induction coil to give an output of 40,000 to 50,000 volts at ordinary atmospheric pressure and conditions would correspond to a 1in. spark, for which the following data would be appropriate :

Iron Core. Built up of 22g. soft iron wire 7½in. long by ⅜in. diameter fitted with ebonite bobbin 6½in. overall length by 3in. diameter with ⅜in. thick cheeks.

Core insulation. 3 layers of 15-mil empire cloth wrapped tightly round the core.

Primary. 2 layers of No. 16 S.W.G. d.s.c. copper wire. This suits a 6-volt battery. If required for 12 volts wind with three layers of No. 18 ditto.

Primary insulation. 6 layers of 15-mil empire cloth, close wrapped and overwound with a layer of fine thread.

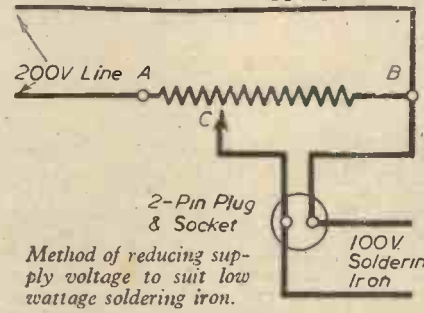
Secondary. 1¼lb. No. 38 S.W.G. d.s.c. copper, wound preferably in four flat sections, separately wrapped with silk empire cloth, and assembled side by side on the core, the junctions being made afterwards.

Condenser. 40 sheets of tinfoil, 6in. by 4in., with thin waxed paper between, bound tightly together between glass plates and soaked in melted paraffin wax.

A motor-driven mercury-type contact breaker gives better results than the ordinary vibrating hammer-head interrupter, and the secondary output can be varied to a certain extent by varying the speed. Coarse regulation is also obtained by a variable resistance in series with the primary winding, consisting of about 10 ohms of 2 amperes carrying capacity. Replying to further points, extremely short coils are very inefficient, owing to the increased magnetic leakage between the poles. There is no necessity whatever for artificial cooling of the induction coil. To obtain instrument wires is a difficult problem at the moment unless Government Contract Nos. can be given with the order. Try Messrs. Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester.

Electric Soldering Iron

I RECENTLY purchased two electric soldering irons rated at 110/120 volts, 40 watts. Our mains supply is 200 volts A.C. I have been told that I cannot use them in series, or with a resistance in circuit because of the A.C. supply. Is this so ? Can you supply me with the details of a transformer giving at least 1 ampere on the secondary with tappings at 100 and 110 volts, and the primary tapped at 200, 210, and 230 volts ? Could such a transformer be used as an auto-transformer working on 110 volt. (A.C.) supply ?—J. M. Firth (Beckenham).



Method of reducing supply voltage to suit low wattage soldering iron.

THERE is no necessity to employ a relatively expensive step-down voltage transformer in order to utilise your 110-volt soldering iron on a 200-volt A.C. circuit. As the consumption in watts is so low, and the iron probably in occasional use only, the simplest arrangement is to obtain a potentiometer-connected resistance of 200 ohms 0.5 ampere carrying capacity, and connect it with your soldering iron as shown in the accompanying diagram. The voltage between points B and C in the diagram will vary according to the position of the sliding contact C, so that if the latter is adjusted to about the middle point of the resistance A B there will be a terminal voltage of 100 volts at the soldering iron connections, and the heat of the iron can be graduated nicely by sliding contact C towards one end or the other to raise or lower the terminal volts at the iron.

Salt Bath Electric Furnace

WILL you kindly explain the principles of high temperature electric furnaces as sometimes used in the manufacture of pottery ? What is the material used for the elements ? I understand there is a new high temperature electric furnace called the Salt Bath ; would you also explain the principle of the heating element employed ?—Samuel Adams (Cookstown, N. Ireland).

THE Salt Bath is one in which the salt, consisting principally of barium chloride, is heated by the direct passage of current through it between immersed electrodes. There are no "elements."

There are several types of electric furnaces used in the pottery industry, e.g., tunnel type kilns for firing, box type furnaces for firing, etc. It would take up considerable space to describe these in detail, and we suggest you write to the General Electric Co., Ltd., Witton, Birmingham, or Birmingham Electric Furnaces, Tyburn Road, Erdington, Birmingham, for information, stating the kind of heating operation in which you are interested, the material you wish to heat, the weight of each piece, the weight of the total furnace load (including boxes or containers, if any), size of pieces, dimensions and weight of containers, working temperature, particulars of electric supply available, time allowed for bringing the charge to temperature and holding at temperature, if necessary.

Seasoning of Timber

I HAVE been given to understand that there is now a process which enables wood to be seasoned in a period of weeks. This result I am assured is obtained by the use of steam and air blasts. I shall be glad of any information on this subject.—H. Spencer (Preston).

FOR quite a number of years, timber has been artificially seasoned by means of special "kiln" treatment. Such treatment varies considerably, but, in principle, it consists in packing the timber in horizontal iron kilns which are brought to a definite temperature by means of steam heating. The interior humidity of the kilns is also controlled by means of steam injection. Several of these kilns are usually in the possession of every large timber company. The kilns are not only valuable in the respect of seasoning timber artificially, but they also serve a double purpose in eradicating destructive wood-beetle pests (such as "Powder-Post" beetle) which may lurk unsuspected in the interior of the wood.

The undermentioned books may appeal to you in the above connection, and, most probably, you could obtain them either through the County Library, Preston, or through the Harris Institute, Preston :

"Seasoning and Preservation of Timber." By E. G. Blake.

(*Continued on page 16, Cyclist Section.*)

THE Cyclist
Editor: F. J. CAMM

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Phone: Temple Bar 4363
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Comments of the Month By F. J. C.

The Roadfarers' Club

THE need for an organisation representative of all sections of road users—pedestrians, cyclists, motor-cyclists, and motorists—has existed from the earliest days of cycling and motoring. There are many excellent organisations which represent each, and which have performed most valuable work in representing particular interests. Quite often, however, owing to opposing points of view, their efforts have been brought to naught when their various and opposite views have been placed before the Minister of Transport.

During the war most private cars will remain off the roads owing to the petrol restrictions. This means that after the war all motorists will start off with clean licences, because freedom from endorsement for one year entitles the holder to a clean licence. Road policy had become tangled at the outbreak of war, but the war, which has called a halt in road travel as far as motor-cars are concerned, provides the pause for us to lay careful plans for the post-war period so that we can start afresh, in an endeavour to remedy some of the evils, not the least of which is the appalling accident rate. Regulations, prosecutions, fines, restrictions, pedestrian-crossings, speed limit, one-way streets, roundabouts—these are but a few of the experiments which have been tried by successive Ministers of Transport in unavailing efforts to make the roads safe. It should be possible to have "Safety Fast" as well as First, without danger to slower and more vulnerable road users.

Objects

THE newly-formed Roadfarers' Club has as one of its main objects the improvement of relations between all road users. Its membership, already powerful and important, is by invitation only, and by unanimous vote of its committee. It will meet to debate various road problems in an atmosphere free from controversy, and in a helpful spirit with the one desire of finding a solution. The club is non-profit making, non-political, and its ranks are open to cyclists, motorists, pedestrians, motor-cyclists, all those who have achieved prominence, not only in connection with the use of the roads but in connection with the administration of the roads. There will not be a preponderance of any particular section of road user.

Another object of the club is to provide social occasions when the members can meet and discuss matters in which they are mutually interested. It will help to keep them together and to maintain their interest where formerly they drifted apart and their interest has flagged. Those responsible for the foundation of the club found a ready response amongst those whom they approached to become members, and who form the basis of the pool of knowledge of road matters and road users which will be available to the membership.

The president of the club is Lord Brabazon of Tara, ex-Minister of Transport, ex-Minister of Aircraft Production, holder of the first British pilot's certificate, racing motorist, and a pioneer in many other directions. Early members include Lord Iliffe, Lord Perry, the Marquess of Queensberry, Sir Frank Newnes, Bart., Sir Harold Bowden, Sir Henry Maybury (another ex-Minister of Transport), Sir John Laurie (Lord Mayor of London), Major-General Sir Percy Laurie, Sir Cooper Rawson, M.P., Sir George Beharrel, Frank J. Urry, G. W. B. Wilson, Percival Marshall, Trevor T. Laker, C. G. Grey, Prof. A. M. Low, Harold W. Eley, T. W. Loughborough (Secretary of the Auto-Cycle Union), A. Percy Bradley (manager of Brooklands track), J. A. Masters (secretary of the M.C.C.), G. Geoffrey Smith, M.B.E. (managing editor of Iliffe's), A. G. Reynolds (international timekeeper), A. V. Jenner (Charlotteville C.C.), Arthur Whinnet, C. A. (Bath Road) Smith, J. Dudley Daymond, W. G. James (only living founder member of the B.R.C.), G. L. Samuelson (secretary of the Royal Automobile Club), Frank H. Bale, O.B.E. (Order of the Road), A. H. Bentley, E. Coles-Webb, F. Peters Wood, J. F. Callway, F. J. Camm (editor, THE CYCLIST), Bob Carlisle (competitor with Hume at the first bicycle race where pneumatic tyres were used), Stanley Baron, Major H. R. Watling, J.P. (director of the British Cycle and Motor-cycle Manufacturers and Traders Union, Ltd.), T. D. Bell, J. F. G. Westaway, T. D. Osborn, J. R. Osmond, W. Hinds, V. S. Bowman, Frank Smith, Lewis Stroud, S. M. Vanheems, Lt.-Col. Charles Jarrott, O.B.E, W. J. Mills, J. E. Rawlinson, H. Scotto, C. A. Harvey, and many others.

The club is a national, not a local institution, and the secretary is R. A. West, 32, Elmbank Gardens, East Sheen, S.W.13.

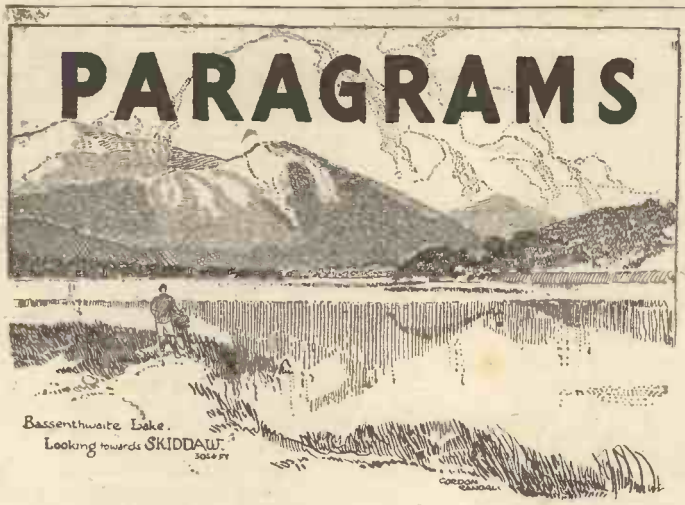
Lord Brabazon of Tara, President of the Roadfarers' Club.

The Inaugural Dinner

THE club held its inaugural dinner at the Clarendon on October 9th, with Lord Brabazon in the chair. It was a memorable evening. Lord Brabazon, responding to the toast of The President (proposed by A. Percy Bradley), said that the war has shown us great advances in transportation, but motoring, instead of advancing, has been in reverse. This war will give us a chance to start again. We shall have the plans and the details ready for making a people's car after the war. Just as Henry Ford started one revolution in transport, a second revolution is long overdue. People should not be obliged to stay in congested areas. We desire in our hearts, he said, that all—motorists, cyclists, hikers—should be free to travel far and wide over the roads of our country in safety and in enjoyment. The Roadfarers' Club does not favour any particular section. It is, he said, a remarkable club in that it unites all the road interests. Speaking with great sincerity he said that the club was long overdue. The toast of The Visitors and The Press was proposed by Sir Frank Newnes in a neat and witty speech, eliciting a humorous reply by the Marquess of Donegall.

The toast of The Club was proposed by J. A. Masters, with a response by the editor of this journal. Nearly 70 members and guests were present at the dinner. The guests included W. J. Bailey, Leonard Ellis, H. Boon, Capt. F. C. Day, E. J. Appleby, Peter Hunter, H. C. North, Charles C. Drew, W. H. M. Burgess, A. T. Bradford, H. J. Morgan, Dudley Noble, T. M. Craft, H. Payne, and D. Ellis Jones. All of the daily newspapers sent representatives. Thus this important club is launched and a great deal more will be heard of it.

PARAGRAMS



Lakeland for Trust

TWO further properties in the Lake District have been acquired by the National Trust. They are at Kentmere and Far Easedale.

New Lakeland Hostel

CYCLISTS touring in Lakeland next summer will be able to use a new youth hostel. This is Esthwaite Lodge, by the side of Esthwaite Water.

More Beds for Cyclists

SO popular is Ledard youth hostel, close to the Trossachs, that a further 44 beds have recently been added for the use of cyclists and hikers.

Hostel Still Open

THAXTED Hostel, in Essex, is still open to members, despite rumours that it is closing.

Timekeeper for Forces

JAMES RIDDELL, Ivy C.C., has had his medical examination and expects to go in the Forces shortly.

Lord Keith's New Position

LORD KEITH, an official of the Scottish Y.H.A., is chairman of the Scottish National Parks Committee.

After the War

THE Scottish Y.H.A. has several sites and buildings earmarked for post-war development as youth hostels.

Closed for Winter

TWO hostels in the London region have closed for the winter. They are Ide Hill and Stony Stratford.

Better Maps

THE Ramblers Association has suggested various improvements for future editions of the 1-in. Ordnance Survey maps.

Armour Beats Hartley

JACK ARMOUR, the Fifeshire miner, rounded off his 1942 Scottish successes by winning the Manchester and District T.T.A. 25 on his first visit to England. Armour's time of 1 hr. 3 mins. 36 secs. was 16 secs. faster than that of D. K. Hartley, best Manchester man of the year.

Soldier's Enthusiasm

ALTHOUGH serving with a Signals unit in Scotland, and unable to cycle except in Army clothing, Jack Baxter, of the Cyclists' Touring Club, Leeds Section, Mid-Yorkshire D.A., is still a keen tourist, and has visited many of the famous places in the Loch Lomond and Trossachs district.

Scottish Clarion Moves

WAR-TIME conditions may bring about a new unity among Clarion members in Scotland. The West of Scotland Union of the National Clarion C.C. is to investigate the possibilities of linking with the Mid-Scotland Union. Such a joint union would give Scotland one of the leading places numerically in Britain in Clarion circles.

Youth Centre for Glasgow

HOSTEL officials on Clydeside are looking for a building to replace the existing Glasgow youth hostel. They desire a building more centrally situated than the present hostel, which is at Cathcart, four miles south of the centre of the city. It is proposed to use the new hostel as a youth centre in addition to an overnight sleeping place.

Bigger Handbook?

OFFICIALS of the hostel movement in Scotland are hopeful of increasing the number of pages in the 1943 hostels handbook.

Higher Hostel Fees

IN future all youth hostelers over 21 years of age are to pay 5s. as annual membership fee. Formerly only those over 25 paid 5s.

Most Popular Hostel

THE most popular hostel in Scotland during 1942 is Loch Eck, in Argyllshire; it has been visited by more than 10,000 cyclists and hikers.

Bicycles for Essential Workers

IT has been suggested that Britain should follow the U.S.A. in granting permits for new bicycles only to workers who can prove that they need them for special transport.

Access to Welsh Summits

MAXIMUM public access to the two Welsh mountains of Cynicht and Moelwyn is assured by the purchase of land including these summits by Mr. Clough Williams-Ellis, the architect.

Colchester's New Hostel

COLCHESTER, in Essex, has a new youth hostel. This is situated at Middle Hill House, in the centre of the town, and has accommodation for 20. Another new hostel in Essex is at Saffron Walden.

Roman Remains at Chester

REMAINS of a massive Roman building found at Chester, one of the favourite haunts of touring cyclists, are believed to be the foundations of a wall of a building on a site north of the line of the Roman fortress.

The Snowdon Railway

THE Snowdon Mountain Railway, familiar to the easy-going cycle tourist, has just completed one of its most successful seasons. The railway was built 46 years ago, and is the only one of its kind in Britain.

For National Trust

THE latest purchase by the National Trust is Taw House Farm, in Eskdale, together with 215 acres of land. The position of the farmhouse is under the foothills of Scafell and Bowfell, and the Roman Road from Ravenglass to Ambleside passes close by.

New Scots Hostel

THE Scottish Y.H.A. has acquired a new youth hostel at Cove, on the Firth of Clyde. Volunteer workers are renovating and equipping the building this winter, and it is expected that the hostel will open at Easter with room for 80.

A Fast "30"

IN an open 30-mile event held on roads east of London "Jerry" Walters, South London C.C., not only made fastest time, but also secured three other awards. A good morning's work!

Prisoners of War

C. GASKELL, Rotherham Wheelers, and A. G. Laxton, East Midland Clarion C.C., are among the latest cyclists reported to be prisoners of war following Middle East activities.

Team Race Record

THE national 30-mile team race record was broken by a Clarence Wheelers trio (Messrs. D. Perrin, R. Watson and G. Royston), who aggregated 3.49.45, beating by 15 seconds the previous best.

Second Fastest 30 Miles

THE second fastest 30 miles ever to be recorded was clocked by 18-year-old Edwin Mundy, Addiscombe C.C., when he won his club's open 30-mile fixture with 1.13.38.

Finsbury Clubman's Death

SERGEANT PILOT JACK KEEN, Finsbury Park C.C., formerly reported missing following an operational flight over enemy country, is known to be dead. His body was washed up on the coast of Holland.

Scots Rider in Egypt

CHAMPION of the Lomond Road Club for two years prior to the outbreak of war, "Ginger" McCauley is now with the R.A.F. in Egypt.

Club Members' Marriage

BRENDA KAIN, daughter of "Jimmy" Kain, Ealing Cycling Club's genial president, married Sergeant Observer Jack Rodd, R.A.F., whose best man was Bill Launspach, of the Royal Navy. All three are members of the Ealing C.C.

C.C. Polo Player Wins D.F.C.

PRE-WAR member of Norwood Paragon C.C. polo team, Pilot Officer Tom Stanley, R.A.F., has been awarded the D.F.C. for gallantry and devotion to duty.

Canadian Rider's Death in Action

IN April Andy McConnell, the young Canadian professional, delighted Paddington track fans with his riding against Syd Couzens and Henri Auclair. News is to hand that Andy has met his death on active service in this country while serving with the Royal Canadian Air Force. He was buried at Newark, Nottinghamshire.

Veteran's "25"

ALTHOUGH within a year of his 70th birthday, W. J. Pett, national 50-mile champion in 1905-6-7, rode 25 miles in 1.12.45.

Popular Time Trials

OVER 300 time trials, the majority of which attracted the full quota of 100 riders, were held during the past season. Many were "25's," but semi-long distance events had reasonable support.

Southgate C.C.'s Trophy

TO commemorate the club's diamond jubilee the Mayor of Southgate (Cr. T. J. Oldland, J.P.) has presented Southgate C.C. with a perpetual trophy, which will be handed over at the club's lunch at Cockfosters on Sunday, November 29th.

Cyclists v. Harriers Event

TO signalise the opening of their 64th cross-country season Finchley Harriers are arranging a cyclists v. harriers event with the Westerley Road Club and the Dragon Road Club.

Club Secretary Missing

FRED FEW, former assistant secretary of the Hampshire Road Club, is reported missing following air operations over Malta. He was a R.A.F. wireless operator, and hopes are entertained that he will prove to be in Italian hands.

Girl Rider's Fast "30"

BY clocking 1.24.17 in the Rookery "30" Eileen Jordan, Addiscombe C.C., beat the ladies' 30-mile competition, and, of course, made the fastest time in the event.

Champion Cylist With Fleet Air Arm

ONE-TIME champion of Crouch Hill C.C., and now with the Southgate C.C., A. C. Elliss, who put up some fine short-distance rides, is now with the Fleet Air Arm.

Consistent Short-distance Rider

ONE of the most consistent short-distance experts of recent years is Jack Simpson, Barnsley C.C., who, in five consecutive 25-mile events, clocked less than 61 minute but always just outside the coveted hour.

49 Riders in Open "30"

NO fewer than 49 riders from a field of 59 finishers beat their previous best in an open "30" recently. The morning was exceptionally fast.

Another Wedding

MISS M. ROBERTSON, promising member of the Rickmansworth C.C., has married Pte. V. Western, R.A.O.C., who, before joining the Army, was a keen rider.

Stole 62 Bicycles

A TWENTY-YEAR-OLD Army deserter, Ian McGillivray Coutts, was sent to Borstal for three years at Glasgow Sheriff Court when he admitted stealing 62 bicycles from various parts of the city. It was stated in court that Coutts was found loitering suspiciously outside a public library after machines had been stolen from such places on previous occasions.

Coutts sold most of the bicycles to a dealer, and the police found at the dealer's premises a large number of frames and fittings which were later identified as being stolen. Altogether the value of the cycles amounted to £321, and only £26 had been recovered.

More for Postcards

THE charge for picture postcards of youth hostels has been increased from 2d. to 3d.

Rubber Plans in States

THE United States has a programme for synthetic rubber which embodies the aim of 1,000,000 tons by the end of 1943.

Grant for Civil Defence Bicycles

SENIOR Fire Guards and Civil Defence wardens have been granted 3s. 6d. a month for cycle upkeep in full-time use, and 2s. 6d. part time.

A corner of the famous old White Horse Close, Edinburgh.

Around the Wheelworld

By ICARUS

Signposts to be Restored

I HAVE never supported the panic arrangements which were made during the early days of the war, and which included the removal of historic signposts and milestones in the mistaken belief that an invasion was contemplated, and that the Germans would not be able to find their way around the countryside without them. It is my own view, but I sincerely believe that an invasion was never contemplated and that it will never take place. Now Mr. Noel Baker has announced in the Commons that signposts are to be restored within certain limits and subject to certain conditions. Such restoration will also restore some of the pleasures of cycle touring, and will make travelling at night, when there are few people on strange roads from whom to inquire the way, a little more pleasurable.

Road Accidents

DEATHS from road accidents in the third year of the war totalled 7,693. This is nearly 2,400 fewer than in the second war year, but still substantially higher than in the last year of peace.

An interesting indication of how people have adapted themselves to the black-out is afforded by the fact that road deaths during hours of darkness have declined from 4,500 in the first year of war to just over 3,000. There is still need for much more care, however, and with the approach of another winter drivers and cyclists are again advised to look to their lamps and ensure that they are in good condition.

The improvement in the road accident figures dates from 12 months ago, and was particularly marked in June, July and August of this year, a period which coincided with the laying-up of many private cars. The total of 502 deaths in August is the lowest for many years and compares with 618 in the same month of 1939.

While the total number of persons killed has decreased since last year, the proportion of children killed has risen. One out of every five persons killed in August was under 15 years of age, and the total number of fatalities among children in the third war year was 1,309. These figures should bring home to every parent the danger of allowing small children to use the streets without supervision. They are also a reminder to drivers that although traffic to-day is so much lighter, it is still necessary to make full allowance for the impulsiveness of children.

N.C.U. Monthly Circular

THE National Cyclists' Union is preparing a monthly circular of N.C.U. and general cycling news for despatch to *cycling* members of His Majesty's Forces *serving abroad.* If, therefore, you have a friend in the Forces who would like to receive a copy of this monthly newsletter, please send his name and address to the Secretary, 35, Doughty Street, W.C.1.

New Road Rule

CYCLISTS turning left can now signal the fact with the left arm fully extended instead of by a movement of the right hand.

The old signal did not give a clear enough indication to oncoming traffic whether the cyclist was about to turn right or left.

The National Committee on Cycling has been informed by the Ministry of War Transport that a formal amendment of the Highway Code incorporating the principle now officially accepted will be borne in mind when it is revised after the war.

J. W. Bryan Memorial Fund

WITH the passing of John William Bryan, of B.S.A. Cycles, Ltd., we have lost one of the most prominent figures of the cycle and motor-cycle industries.

A wish has been widely expressed by many of his friends and those with whom he was associated that a fund should be established to perpetuate the memory of such an outstanding character, and one who has done much in the interests of the allied trades. A small committee has therefore been formed and has decided to make an appeal for a minimum of £5,000 to establish a "J. W. Bryan Memorial Fund." It is intended that this fund be administered by trustees appointed by the committee and to apply the fund in such directions as the trustees may decide, but that if circumstances are found to warrant it, first consideration shall now or at any future time be given to the needs of the family of the late Mr. J. W. Bryan, with the eventual objective that the fund shall be devoted to the benefit of the Motor and Cycle Trades Benevolent Fund or any other charitable institution.

Everyone concerned in the allied industries has benefited in some measure by the genial service J. W. B. gave to the trade over a period of 35 years, and his strong personality, combined with a high plane of happy friendliness, attracted and retained the affection and confidence of a wide circle of friends. At the time of his death he was president of the British Cycle and Motor Cycle Manufacturers and Traders' Union, Ltd., and chairman of the Midland Centre of the Motor and Cycle Trades Benevolent Fund.

Subscriptions should be sent to Gilbert Smith, Norton Motors, Ltd., Bracebridge Street, Birmingham.

R.R.A. News

THE following records have been approved: Portsmouth and back, tandem tricycle, G. E. Lawrie and R. Morford, in 7 hrs. 1 min. 52 sec., on June 21st, 1942.

Bath and back, tandem tricycle, G. E. Lawrie and R. Morford, in 10 hrs. 50 mins. 34 sec. on July 26th, 1942.

Bicycle Stealing

IN *The Times* recently there has been correspondence on the growing menace of bicycle stealing, and the *Solicitors' Journal* recently gave a digest of the various points of view:

"The increase in the use of pedal cycles is bringing into prominence a question which until recently enjoyed comparatively little publicity, namely, the stealing of bicycles. In the course of a correspondence in *The Times* extending over the week from July 16th to 23rd, a number of eminent authorities took part in a sort of written symposium of the best measures to counteract the evil. Sir Ellis Hume-Williams thought that every bicycle should have attached to it a licence and a name and address plate, and this suggestion was supported by Mr. C. B. Marriott and Sir Archibald H. Bodkin, the former on the ground that it would greatly help the police in their investigations, and the latter on the ground that it would facilitate proof of larceny as the removal of the registration plate would clearly indicate intention to steal. By way of opposition, Mr. Eric J. N. Nabarro pointed out that the system had been found wanting in Holland, as a licence plate was removable with a sharp knife. Mr. G. Herbert Stancer, Secretary of the Cyclists' Touring Club, argued that licensing would involve an elaborate and troublesome system of transfer, and that bicycles could be rendered unrecognisable by being rebuilt with interchangeable parts. He pointed out that the best safeguard was to lock the machine and remove accessories such as lamps and inflators, where it was left unattended even for a short time. Sir Archibald H. Bodkin pointed out that a great part of the mischief arose from wrongful and unauthorised borrowing. The question was whether this amounted to stealing, as it was difficult in such cases to show that there was any intention permanently to deprive the owner of his possession, so as to satisfy the definition of 'stealing' in s. 1 of the Larceny Act, 1916. He said that a similar position arose in regard to motor cars, but by s. 28 of the Road Traffic Act, 1930, it was made an offence to 'take and drive away any motor vehicle without the owner's consent or without lawful authority.' He thought that a short Act of Parliament was necessary, providing that the words 'motor vehicle' in s. 28 should include 'pedal cycle.' It is interesting to note that in an answer by Mr. Peake to a question in the Commons on July 29th, it was stated that the question of amendment of the law was being looked into. There seems little substantial ground for criticising either the licensing proposal of the suggestion as to the amendment or the law, but the experience of most cyclists is that a stout padlock is their best safeguard."

Lakeland.—A stop by Crummock Water. In the middle distance rise the twin peaks of Whiteless Pike.

Cyclorama

By H. W. ELEY

Famous Old-time Cycles : Hobbies : Tribute to William Willett : Inn Signs : Cyclists' Red Cross Appeal

WHAT hard work some of the newcomers to the ranks of cyclists make of their riding! Their energy is praiseworthy indeed, but some of them have not realised the fact that there is a *right way* to ride a bicycle, and that balance, correct pedalling, and a proper sitting position are essentials to real cycling joy. There is more to the business than just buying a bicycle, sitting on the saddle and pedalling hard! These thoughts come to me as the result of watching many riders recently—many of them riders who have taken to cycling afresh after years out of the saddle. Some I watched from an old stone bridge not far from Kenilworth. My companion was an "old stager" who continues to extract tons of joy from cycling despite his 65 years, and he watched the procession of riders with me, took his pipe from his mouth, and muttered something about the need of lessons in riding. Well, there may be something in it, but, anyway, I commend those cyclists who, in these war-time days, are riding for the first time, or have taken up cycling again after years of motoring, to buy and read one of the little books which can be obtained, and which deal with the whole art of riding. It is worth doing, and added riding joy will result from doing the job in the right way.

Famous Old-time Cycles

RECENTLY I mentioned the names of famous old-time cycles, and I have already recorded that the mention brought me quite a lot of correspondence. Well, I was thinking the other day of famous tyre names, and I recalled that in the very early days there was a cycle tyre named the Clifton. I fancy it must have been one of the very earliest makes—popular at the time when the Dunlop patent was the subject of almost constant litigation. And I remember, too, the Kempshall—a cycle tyre made by the Macintosh people. Not so many makes to-day, and my dealer tells me that the Bates range of cycle tyres has gone—at any rate for the duration. We live in an age of standardisation and simplification, and we must be content with the "War-grade" tyres offered by the several manufacturers. So long as there *are* tyres to enable us to keep on riding, I for one shall not grumble.

Hobbies

ONE of the grand things about cycling is the number and variety of interests and hobbies which can be easily combined with it. For my own part, my cycle has always linked up with my interests in nature-study, and my collection of butterflies and moths was only made possible because I have been able to cycle out to those districts where I wished to hunt the specimens; and this summer pleasant rides out to heaths and commons have resulted in many additions to the collection. Often it is too far to walk to the haunts of the Fritillaries, the Blues, the Commas, and the Small and Large Coppers—but the cycle solves the problem. And if there is one summer-time delight I love it is to be on a wide common, butterfly-net in hand, and watch for the "specimens," which flit around the rag-wort and the scabious, and those other plants beloved of the winged creatures which some of us covet as a miser covets gold.

Tribute to William Willett

BUSINESS took me to Kent the other week, and I found myself at Petts Wood, not far from Orpington. Fittingly, the inn there is called the "Daylight"—a tribute to William Willett, born, I believe, in the place. To-day, when we have had *double* summer-time and accepted it without a grumble, it seems strange to recall the fierce controversies which raged for so long over the original proposal to introduce the one hour's extra daylight. Willett was a persistent crusader, and won his long fight. And, taking the matter broad and large, I fancy that the nation regards summer-time as a boon—though the farmers may occasionally voice their grumbles! The "Daylight" at Petts Wood is a handsome structure, architecturally pleasing, and is the social centre of the suburb.

Inn Signs

TALKING of inns and inn signs, I wonder why cycling and cycles have not been more greatly featured? Where is our "Wheelman's Arms"? Or where do we find "The Tandem Inn"? The inn is of the road—and so is the bicycle. It seems passing strange that cycling has not named more inns on our highways. Old coaching days are commemorated by hundreds of inns bearing such names as "The Coach and Horses." The coming of the iron road brought a crop of "Railway Taverns" and "Station Inns." It may be that the cycle *is* immortalised by more inn signs than I know, and I should be greatly interested to hear from readers on the subject.

Cyclists' Red Cross Appeal

I HEAR good news of the Cyclists' Red Cross Appeal, and I was glad to see the advertisements recently featuring the aims and objects of the appeal. In the realm of sport generally very fine help has been given to the Duke of Gloucester's fund, and one always knew that cyclists would not lag behind the golfers, the tennis players, the footballers, and the boxers. The total is growing nicely, and if every cyclist responded to the appeal the result would be grand indeed. There are a lot of us—let us see to it that we play our part. The needs of the Red Cross are great and pressing.

Make Your Bicycle Thief-proof

Further Effective Methods of Circumventing the Cycle Thief

(Continued from page 45 October issue)

A Permanent Fitting Device

THE fitting shown in Fig. 7 consists of a piece of 2in. strip metal about 8in. long, and bent into the shape of an inverted U, with the eyelet at the top. At each end of the strip a hole is bored. A small bar with a knob at one end and a hole to take a small padlock at the other is then required. To assemble the device, clip the metal U over the front mudguard close to the fork, bolting it to the fork with the same screw as used for the mudguard, thus making it a permanent fixture. To lock the cycle, push the locking bar through the holes, which should just miss the rim, and this will prevent the cycle from being moved.

Locking the Front Forks

The simple gadget shown in Fig. 8 prevents the front forks from turning when the cycle is standing up against a kerb. Drill a $\frac{1}{16}$in. hole at the centre of the head, with the handlebars turned slightly left. Insert a peg to hold the steering fixed. The peg should be enamelled the same colour as the cycle.

Steering-head Fixture

A $\frac{7}{32}$in. hole is drilled at the centre of the steering head and a springy, partly circular clip, the diameter of the head, is made with a $\frac{1}{16}$in. peg riveted near each end. When this is placed around the head each peg enters a

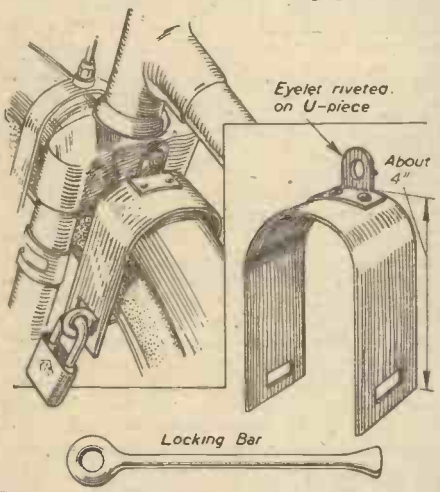


Fig. 7.—This device is a permanent fitting to the front forks.

hole, and holds the steering in a fixed position. The pegs, of course, should be diametrically opposite. (Fig. 9.)

Back Brake Lock

In Fig. 10 is shown a fitting for holding the back brake in an "on" position. When the brake has been put on, a padlock is slipped through one of the holes in a plate attached to the brake-rod near the bottom bracket, and this holds them on against another bracket attached to the chain stays. The brakes cannot be released except by removal of the padlock.

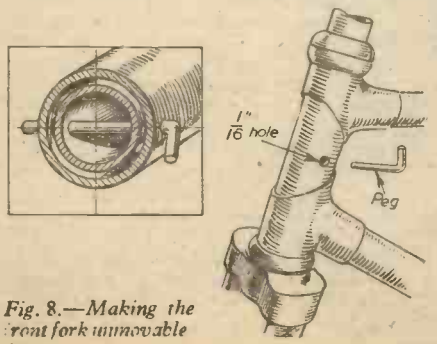


Fig. 8.—Making the front fork immovable

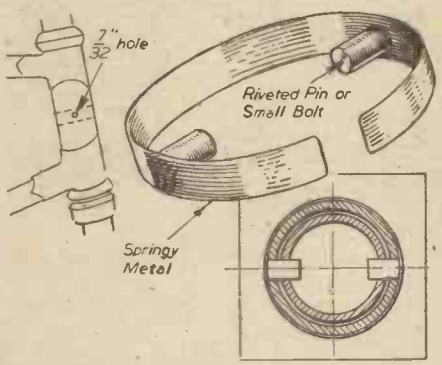


Fig. 9.—Another ingenious device for locking the steering head.

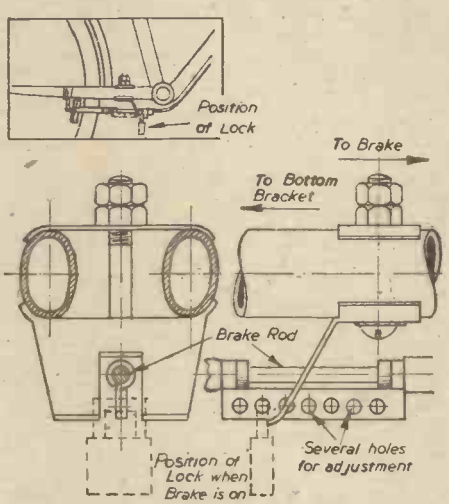


Fig. 10.—A fixture for holding the back brake in the "on" position.

Combination Lock

This thief-proof lock comprises a clip and combination lock, which is fitted to the head of the machine, as shown in Fig. 11, and locks the steering. A hole about a $\frac{1}{4}$in. or $\frac{5}{16}$in. is drilled through the frame and fork stem, while the handlebars are straight, and the lock clipped on, so that the bolt is in line with the hole. The device is self-contained, and requires no key. It can be fitted in a short time, and can only be opened by someone knowing the combination.

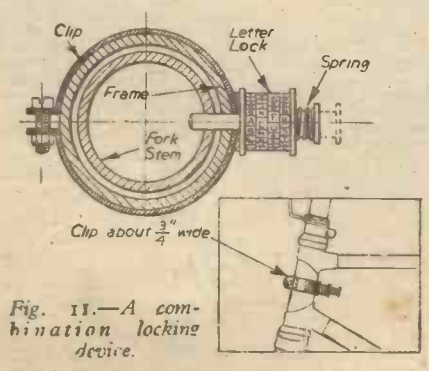


Fig. 11.—A combination locking device.

Another Wheel-locking Device

The idea shown in Fig. 12 is an improvement on the cycle lock and chain. The position

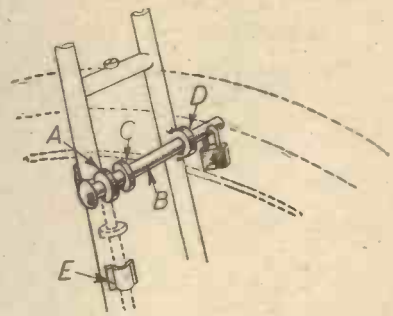


Fig. 12.—A strong wheel-locking device.

is at the back stays, as shown. On one side is an eye (A), which is permitted to swivel, and a shaft (B), with a head one end and a hole drilled in the other, passes through this eye and another (D) on the other side. Fixed to the shaft is a collar (C), either welded on when the shaft is fitted or fixed by a set screw. This is to prevent the shaft from falling out when not being used. When the shaft is passed through the eye D, which is welded on the frame, a small padlock is used through the drilled hole to keep it fixed. When the lock is not in use, the shaft is secured to the stay

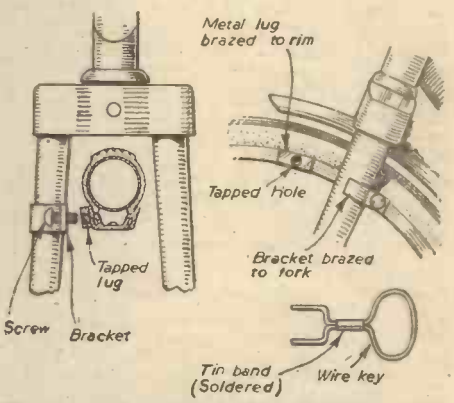


Fig. 13.—An unusual method adopted to secure front wheel.

by a spring clip (E). This improvement on the cycle lock and chain is that the cycle thief cannot easily snip the rod with a pair of pincers as he can the chain.

Bolting Fork to Rim

A piece of metal, tapped as shown in Fig. 13, is brazed on to the front rim, and a bracket tapped similarly is fixed to the front fork, the hole corresponding with the first bracket when directly behind it. A bolt is then used to lock the two together.

The bolt chosen should have a rounded head, then if two small holes are drilled in the head a small key made from wire will be the only means of locking it. A lock of this description may be fitted to the front or back fork, and also on the right or left.

WAYSIDE THOUGHTS

By F. J. URRY

Right Out of Date

I SUPPOSE a day will arrive when authority at the War Office will discover the military bicycle is at least 30 years out of date. Think of its specification: 24in. frame, 28in. × 1¼in. tyres, 12in. bracket, and, on top of all, a big saddle, which makes the reach beyond the comfort of a soldier of meagre inches. And, in any case, only a giant can drop his foot and still remain in the saddle with one foot on the ground, and, in my opinion, that is a necessity in these traffic-ridden times of road travel. We know how soldier-cyclists regard the military bicycle, and we hear that the average user of it (not being a consistently regular rider in civilian life) hates cycling as a result of exercise with this real abortion in bicycles. I happen to know that many of the makers with Government contracts for military machines have protested that the pattern is archaic; but it makes no difference; there is the specification, take it or leave it. I can understand that a military bicycle must be sturdily made, for it has to go through hard times, but that is no reason why it should be awkward and far heavier than needful to undertake the rough work which will surely be its lot. A 22in. frame and 26in. × 1¾in. wheels would give a low bracket of 10½in., be a stronger and more serviceable mount, considerably lighter than the present model, and would comfortably accommodate the leg length of every soldier in the Army. Such a specification geared to 63in. would make military cycling comparatively easy; but perhaps the Army authorities don't want the soldier to ride easily! Anyhow, the current model moves one to form that conclusion, or the more deplorable one that the folk in authority know just nothing about cycles or cycling.

A Step Forward

I WROTE the foregoing paragraph a few days ago after seeing a consignment of military bicycles just ready for delivery, and listening to the criticism of the maker. To-day I saw another military machine designed and patented by a famous firm, which I am very glad to state brings the story up to date. I am not allowed to divulge details, but I think you can take it that this special bicycle, designed for a special purpose, will revolutionise the War Office notions on cycling. One can say this, however, that the machine only weighs 27½lb., has 26in. × 1¾in. wheels, two brakes, a decent saddle, and folds into a form easily carried on the back—the folding device being the strongest, lightest and simplest I have seen. I do not think this design will become the standard military pattern, but its introduction to the special military service for which it is being made must open the eyes of authority to the fact that the present standard pattern is just a handicap to many a rider, instead of a help and convenience.

Get Ahead

THIS special machine goes to prove that cycle design and construction has an ample field still left for exploration, and I, for one, hope the manufacturer will exploit such possibilities immediately this war has ended, and not, as they did after the close of World War No. 1, wait for the "Continental" designs and innovations to get ahead of us. That such was the case in the early years after the last war there is no denying, for right up to the start of this conflict "Continental" pattern or type was a phrase in common use to describe a very modern British product. The best bicycles in the world are made in Britain; let us see that they are also the best designed, and not fight shy of the alterations that are bound to be introduced. If you and I are to get the very best out of cycling we do not want stabilised design — we want improvements.

I Like a Comrade

TOWARDS the end of August I met a friend in Welshpool who was just completing a week's tour, and who said he had thoroughly enjoyed the break, although he had been "on his own." There are, of course, many people who can travel alone and enjoy every furlong; but I confess I am not of that self-contained happy kind. I want someone with whom to share the beauty of the scene, the ease or ardour of the journey, and then I think it is doubly enjoyed, yes, even the difficult bits, particularly in retrospect, over the pipes and tipple at the end of a long day. After three days' solitary riding—and especially three lonely evenings—I yearn for the company of someone who needs no wooing to friendship, and even the solace of a good book does not fill the gap. Perhaps I happen to be a particular species of gregarious animal, and suffer from a lack of conversation. And I find this, too, that the urge to get on with the journeying when there is no need for it, is a common habit with the lonely rider. He had no one to check this curious desire to hasten, or perhaps it would be more true, in my case, to say I have no one to check and suggest a smoke in some delectable spot past which it is a sin to rush. Then there are those little adventures along stony lanes and over hill-crossing that do not seem worth while to me as a lonely rider, but how joyful they are when the exploration is shared. The loneliest time, however, is in the evening, when the day's journey is ended, one is comfortably fed, and the aftermeal stroll is deprived of the summing-up of the good day which I feel would have reached perfection had its delights been shared, discussed and tucked away in two memories instead of one. I admit it is not always easy to find the right comrade whose leave synchronises with yours (particularly in these days), but in this matter I have been fortunate for many years, and though, as I grow older, arrangements present greater difficulties, I have managed to overcome them up to the moment, and I am living in the fond hope that they will ease when this war is over and this strain of anxious days past

Riding Rightly

EVERY cyclist must know of friends or relatives who, having taken up the pastime because they can no longer use a car, are riding awkwardly and putting an unnecessary strain on themselves, for which they are blaming the bicycle or the game for which it is built. Because such people are disgruntled with the imposed restrictions on petrol they are not prepared to give cycling a fair chance to do a happy job for them, certainly at a reduced speed, but also with the addition of a healthy exercise, and the opportunity to absorb the beauty of the countryside. Such people are difficult to advise, and some of them even resent the suggestion that they would improve the ease and comfort of their progress awheel if they adopted certain alterations. Often enough I find resentment of such friendly advice arises from the idea that because the dealer in selling them the machine said that it was specially suitable to their make and build, they feel the amateur adviser is wanting in experience. When I drop across this form of resistance I always ask the individual how often—if ever—he has seen the dealer riding his own wares, and suggest that a trial of my advice costs nothing and can be treated as a trial. It invariably works and makes a better cyclist and, what is more important, sometimes an enthusiastic one.

Worth Attention

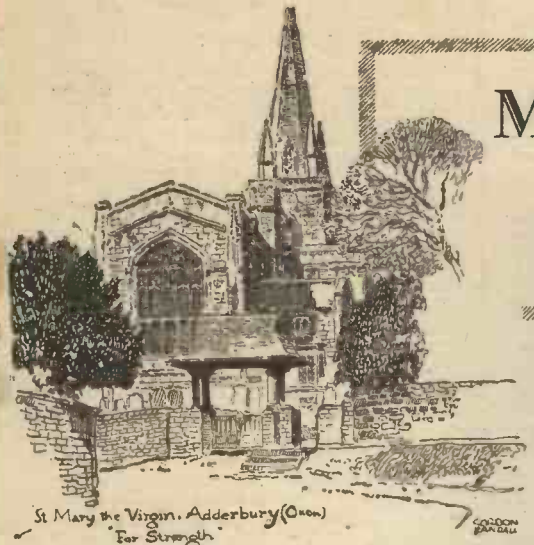
THE war-time bicycle is not quite as good as the pre-war model of standard type. I may get into trouble with my trade friends for stating that opinion, but I believe it to be true; nor is it remarkable because, like the rest of the manufacturing world improvisations have to be undertaken; only the best of everything is used for the Forces, and no one will complain about that. We are lucky to be able to buy bicycles, and the possibility is that before this trouble is over the supplies will have dribbled away to vanishing point. Winter will soon be with us, and if we want to make certain of our cycling convenience and occasional pleasure trips, it is more imperative than ever that we care for our property. Lubricate and adjust; give the machine five minutes a week, it deserves that attention in exchange for its services—but how rarely it gets it. I think the most common form of maladjustment is the loose crank, for it advertises the fault with its every turn, and it is remarkable to me that so many riders seem ignorant of the cause of the regularly recurring squeak. Unless the crank is forced on to the axle keyway, and the locking-nut tightened, both axle and cotter-pin are in danger of wearing beyond repair, and neither of them is easily replaceable these days. That fault advertises itself; but slack bearings and faulty brakes are only known to the rider or to the person examining the machine. Such carelessness means wear, uncomfortable and sometimes dangerous riding, much, if not all, of which can be cured by the intelligent use of a spanner. Correct adjustment is more important than ever, and because quality is not quite so good as three years ago, the need for it is likely to occur more frequently. Keep the chain at the right tension, pump the tyres hard, and oil all bearings and chain every two hundred miles, or a trifle more frequently if the weather is bad. Do these things regularly—and they take so little time—and you will ride easier, your bicycle will last longer, and hold-ups on the daily journey will be reduced to a minimum.

A Fine Country

CONSIDERING the times, I have been fortunate in my wheeling freedom during this rather sunless summer. Early in August I spent a few days with an old frend in Galloway, that south-west corner of Scotland that has been, for so many years, tourist-neglected, for the visitor to the north is usually in such a rush to reach the highlands that he neglects to see the hills and lochs and fine sea margins of the shires of Kirkcudbright, Wigtown and Ayr. Most of our wandering on this occasion was concerned with the former shire, with the end of the run touching the borderlands where the Esk runs in beauty, for we had not the time for a prolonged stay, and no inclination to force the pace. Only once did we encounter the slightest difficulty in finding accommodation, and that was when we inadvertently stepped into the middle of a big military movement; otherwise we were made most welcome with good plain food as our portion. When you have a cycling holiday in the offing, and desire a change from Devon and Cornwall, Wales or the Lakes, think of Galloway, and I am fairly certain you will be agreeably entertained. Although there is climbing to be done, so well are the roads engineered and so excellently surfaced that little necessary walking is entailed, though over some of the passes I would be sorry not to linger and more thoroughly absorb the loveliness. The value of Galloway from a cycling point of view is that you are never travelling in one direction for many miles, with the result that a steady full-blooded west wind (as was our portion) is as often with, as against you. The land is rather sparsely inhabited in some areas, and it is wise to carry lunch; but if you are a hungry wanderer, this is a friendly land, and almost any shepherd's cottage will make you a simple, but very welcome meal. Yes, Galloway should be on the touring list of every wandering cyclist.

Wanted—More Care

I AM glad the big firms in the industry have seen fit to use what little advertising space has been allotted to them in the daily press for the purpose of preaching the value of care in the use of our machines. Such propaganda was, and indeed is, badly needed, for I firmly believe more bicycles are ruined by neglect than are honestly worn out by travel service. That fact wouldn't matter much (since people do as they please with their own property), did it not naturally follow that the neglected machine is often hard to ride, is a rattle-box devoid of all sense of pride in ownership, and is no compliment to the splendid pastime it should encourage. The net result is that the average owner of such a property has nothing to say of cycling, and the fact that the fault is wholly the rider's only makes the matter worse in my opinion. Belatedly the maker has recognised that a well-ordered bicycle is a well-ordered advertisement for the transfer it carries; and this attempt through the channel of advertising to instruct the careless how to oil and adjust the machine to obtain the maximum of comfort and joy from its use is timely. I have always felt that the first thing that goes to the making of a good cyclist is a decent sense of pride in the possession of such a wonderful piece of machinery, and once that can be inculcated into the mind of the user, the flow of enthusiasm for the pastime is made far easier.



St Mary the Virgin, Adderbury (Oxon)
For Strength

My Point of View

BY "WAYFARER"

Wonderful!

ALMOST my only comment on the recent announcement of a radical change in the signal for cyclists to give when turning left is that our politicians, like our policemen, are wonderful. If we go on at this rate, I believe that we shall win the war!

Let's Be Logical

I NOTICED a few weeks ago that there had been a renewal of the suggestion that children should be banned from the public highways because of the accidents which happen to them. If that is the proper cure, then may I suggest that, as burglars break into houses, people should be prohibited from living in houses. It sounds logical—and is rather better than arresting the burglars!

Curious Mentality

DESPITE the vast changes in traffic conditions, the curious mentality of certain motorists remains. The other day I sighted a specimen coming towards me well on his wrong side of the road. In accordance with plan, I therefore took up my position in the very middle of the road, just to show that I was equally entitled to the liberty he had annexed—this despite the fact that "cyclists don't pay taxes"! The motorist's first reaction was to blow his horn at me. I ignored this impudent gesture and stayed where I was. And then, when he realised and adjusted his position on the road, I, too, went to the left!

The Obvious Remedy

THE scene was a meeting of the Works Council (which I attend by invitation) of the factory at which I toil and spin, trying to earn enough money to enable me to pay my income tax. The question under discussion was one of holidays, and the time was late summer. Could not the factory hands make some arrangement whereby they might get away early on Saturday morning and thus avoid the crush characterising railway stations in the afternoon? A deadlock was at hand, and then a voice said: "Mr. Chairman, would not the position be met if we all had bicycles?" Everybody burst out laughing, and the chairman turned to me with a benevolent smile, accompanied by the remark: "I knew you'd say that!"—and then serious deliberations were resumed. But isn't it a fact that if more of us had bicycles, and knew how to use them, it would be better for everybody? Of course it is!

Which reminds me that one of the factory hands buttonholed me a few weeks ago and complained of the unconscionable time he had to spend, now and again, on getting to and from his work. I listened sympathetically, and then said simply: "You ought to get a bicycle." He looked at me in amazement, as though I had made an outrageous suggestion, and then replied: "Do you know how much bikes cost in the shops?" Actually, not having any time for looking in shop-windows, I was devoid of this information, but I retorted that, whatever the cost, the money he saved in fares would soon adjust the matter, apart from the great saving of time—and the setting aside of inconvenience and annoyance. It seems to me that we in this country have been so pampered through the medium of public transport that the man in the street never thinks of doing anything for himself. Yet the bicycle—the simple bicycle—solves all transport problems, at least on a small scale, and provides the user with a pleasant, inexpensive, convenient and always ready door-to-door travel unit.

Cause and Effect

DURING the summer which has now departed—presuming it ever came!—a man who inquired of me where I was intending to spend my holidays was told "Wales." But, he objected, isn't it very hilly? That, I rejoined, is a classic example of cause and effect. "Speaking generally," I went on, "it is quite hilly in Wales. That is the cause which produces the effect, and results in my going to Wales as often as possible. The same cause operates as regards the Cotswolds, the Scottish Highlands, and certain parts of Ireland—with exactly the same effect. Mind you," I added, "some of the slopes go up, and some go down, and, when you're walking uphill, there's usually plenty to look at in the way of fine scenery." I do not know whether I convinced my friend that, broadly speaking, if you want the cream of loveliness you will find it in a tilted land. To say that is not, of course, to deny the beauty of (for example) the Cheshire Plain or the Vale of York. Whilst I can always be happy there, or about the Norfolk Broads and the Fen country, and elsewhere where the scenery has been flattened out, the lure of a mountainous district is very insistent and vocal to me.

New Name

OWING to the fact that I no longer wear the black stockings of the racing brigade (and also of some of the big road clubs), or perhaps because I am now loitering more fiercely than ever, it is a long time since the epithet "racer" (in some parts of the country "ricer") was flung at me. But the other day, somewhere in mid-Wales, my appearance in a village was greeted with the exclamation: "Coo! Scorcher bike!" I would not have thought that a bicycle with a very moderately dropped handle bar could provoke such—er—perspicacity.

Sound Advice

THE advice which is being handed out to us by tyre manufacturers and others, regarding the need for looking after our tyres properly, is as good for normal occasions as it is in these particular times, when it becomes really urgent. Correct inflation is vitally important. A regular examination of covers in search of foreign bodies displaying a desire to settle down there is also important. A little care undoubtedly does prolong the life of tyres, and may avoid a spot of trouble at most inconvenient times. Another point: if an unusual sound is heard from one or other of the wheels, dismount instanter, and pick out that hobnail you have just appropriated. Twice within recent months my tyres have revealed an acquisitive mood, and on each occasion I acted with sufficient alacrity to prevent the business end of a nail from "carrying things too far" and causing a puncture.

Busybodies

SOME of these busybodies who like to clutter up cross-roads and give gratuitous traffic signs cause me to have severe attacks of nausea. I saw one of him the other day. His beneficent work was singularly unnecessary, as he was encouraging traffic to disobey "halt" signs. As I went over the crossing—ignoring his exercises so far as they were supposed to concern me—I advised him to desist from interfering, having regard to the fact that traffic *had* to come to a standstill, and that he had no right to encourage it to do otherwise. He gave me a look as black as thunder and told me to mind my own business—an injunction which was curious when coming from one who was certainly not doing so himself.

Notes of a Highwayman

By LEONARD ELLIS

The Cyclist and Music

I HAVE never heard it said that cycling and music have anything in common, or any affinity for each other, but it cannot be denied that many cyclists are musical. I have found that certain songs make a particular appeal, and one at any rate was, and still is, extremely popular. That song is "The Road to the Isles," often sung by Sir Harry Lauder. The words are delightful and have a peculiar twist that leaves something to the imagination and then satisfies. There is nothing hackneyed in these words. Unlike many songs, it conveys a sense of atmosphere to the cyclist and can hardly fail to interest because of its geographical style. In a sense the song is a tour and I am certain that many a tourist has done in Scotland what others have done after reading Robert Louis Stevenson—gone over the route to see for himself. The song is a nostalgic yearning for the Cuillins, and who, having once seen these grim and forbidding peaks, can disbelieve that they can exercise a powerful pull on those born and bred in their view? The song goes on to describe the route that the prodigal would take to get there, and although there are many who would question his choice, he certainly gives us much food for thought and a suggestion for a tour.

The Road to the Isles

"BY Tummel and Loch Rannoch and Lochaber I will go." Such is the route our wanderer chooses. I wonder why. How does he get to Tummel to begin with? It is merely a small loch to the west of the Pass of Killiecrankie. We must allow a lot for poetic licence, but it would be interesting to know just why the long journey begins right in the heart of Scotland. Was he a sailor, tramping from Dundee, or dare we suggest that he was a cyclist, making his way from the far south. I scarcely think so in view of the route that follows. From Tummel to Loch Rannoch we can understand as a good road connects the two, and continues along and beyond the loch to Rannoch Railway Station. Heaven forbid that our traveller deigned to use the railway—no, he says: "step I with my cromach to the road"—he must be walking. But where from Rannoch? From the end of the road there is a wild and boggy stretch across the moor of Rannoch to Kingshouse Hotel on the Glencoe Road, but if paths exist over this wilderness I have never seen them. To Lochaber we see eye to eye, the description is so wide that he might choose any route, as Lochaber is a vast tract of country containing among other things Ben Nevis.

By Morar to the Sea

BUT if he goes direct from Rannoch to Ben Nevis he must be following the railway line. His next jump is a mighty one—"By Shiel Water the track is to the west, by Ailort and by Morar to the sea." Now we are on familiar ground. We assume that he took the well-known and well-worn road beyond Fort William, alongside Loch Eilt, to Glenfinnan, where we find the Prince Charlie monument and that glorious view down the length of Loch Shiel, or Shiel Water. Alongside Loch Eilt and then across the head of Loch Ailort, and we can actually see the sea, with the dumpy shapes of Eigg and Rum Isles away in the distance. The road winds and twists and performs all sorts of convolutions up and down and sideways, until we reach the sea before we get to Arisaig. The route indicated in the song means a turn to the northward along the coast until we reach Morar. Here we are at the head of Loch Morar, that pours its waters, in a fine fall, into the sea, and along the seashore is a stretch of dazzling white sand that is a landmark for the Isles. Only three miles along is Mallaig, where a boat will take us across the Sound of Sleat, a stormy little trip, and we step on to the Isle of Skye.

The Falls of Morar, near Mallaig.

QUERIES AND ENQUIRIES

(*Continued from page* 69)

"The Seasoning of Wood," by T. B. Wagner.

"The Kiln-Drying of Timber," by H. D. Tiemann.

We believe that the Forest Products Research Association, Princes Risborough, has issued one or two pamphlets dealing with the artificial conditioning and seasoning of timber. These can be obtained either from H.M. Stationery Office, King Street, Manchester, or direct from the Forest Products Laboratory at Princes Risborough.

Cloud Indicator

CAN you please give me some information as to the construction of the instrument which gives the height of clouds, and which forms part of the "Fitzroy" Barometer?

Will you please tell me (a) What solution is used; (b) Method of graduating, (c) The principle of the apparatus?

I recently purchased a whirling psychrometer, together with relative humidity tables, but am experiencing great difficulty in obtaining dew point tables. Will you please tell me how the dew point can be calculated from the relative humidity tables?—Ronald Bachell (Bathford Hill).

THE "cloud indicator" which you describe is only a scientific toy, and, for serious work, is of no value. It does not actually indicate the height of the clouds but merely various atmospheric conditions, the liquid precipitating under certain pressures and states of the atmosphere.

The liquid has the following composition :—

Camphor	2½ drachms
Alcohol (Rect. Spirit) ..	11 ,,
Distilled water	9 ,,
Saltpetre	38 grains
Sal ammoniac	38 ,,

The above proportions must be closely adhered to. Methylated spirit cannot be used in place of rectified spirit.

The camphor is dissolved in the spirit, and the salts in the water. The two solutions are then mixed and poured into the glass observation tube. This latter is provided with a tightly-fitting cork, well covered with wax in which a very fine hole is made.

The weather indications of this device are approximately the following, and it is from these that the Fitzroy instrument essays to indicate the height of the clouds :—

Soft and powdery precipitate ..	Rain, South-west winds.
Hard, crystalline deposit ..	Northerly winds.
Crystals on one side of tube only ..	Winds from that direction
Precipitate remains at bottom of tube	Fine weather.
Precipitate gradually rises ..	Coming rain.

In winter-time, the precipitate is usually higher in the tube than in summer-time.

The device is simply an atmospheric pressure apparatus, the atmospheric pressure altering the physical content of the solution.

There is no direct formula for obtaining the dew point from the relative humidity of the atmosphere, since the dew point is a temperature, whilst the relative humidity is the expression of a ratio existing between masses of water vapour. For practical purposes, dew points are obtained by direct experiment by means of Daniell's or Regnault's hygrometers.

A practical book on this subject which might be of interest to you is: "Practical Exercises in Heat," by E. S. A. Ronsob. (Macmillan & Co.)

Model Electric Railway Working

I HAVE a transformer output (18, 12 and 6 volts, 5 amperes, 50 cycles), which I use for a model railway, and accessories. Relays, however, do not work at all satisfactorily, as there is much sparking and noise. Consequently, I wish to use a rectifier. I have tried a Nodon valve but with little result. Would you therefore advise me on the following points :—

(1) What is the best kind of rectifier to use, if current losses are to be kept small, the rectifier not to cost more than about 30s.?

(2) Where can I get such a rectifier? Or, is it possible to make such a rectifier with materials obtainable at the present time?

(3) What other components must be put in the circuit in order to obtain a steady current, and where can I get these? —K. B. Everard (Alford).

THE relays and any other apparatus depending upon magnetic action will always be somewhat noisy if supplied with alternating current, but the "chattering" effects can be done away with by rectifying to D.C. It is unlikely that you will be able to purchase a dry rectifier of the "copper-oxide" or the "selenium" types for the figure you name, but you might apply to the British Westinghouse & Saxby Signal Co., Ltd., York Road, King's Cross, N., or to Crypton Equipment, Ltd., North Acton Road, Park Royal, N.W.10, stating your requirements as to output on the D.C. side. No other components should be necessary, but we do not advise you to attempt making a rectifier of this type yourself, as it calls for great experience and many special processes.

Transforming D.C. to A.C.

I WISH to obtain a small supply of A.C.50~ at 12 volts, either direct or by transformer. The job does not justify the expense of a convertor, even if such could be obtained, but I believe it is possible to add slip-rings to a D.C. dynamo or motor which would then run in a similar manner.

Could you give me some information on the subject such as (a) What machine would be suitable to produce, say, 200/240 or 12 volts at 30/40 watts (50~)? (b) The manner in which the alteration should be made? My supply is 230 D.C. —R. Seawarden (Weston-super-Mare).

THE normal method of changing your direct current supply to alternating current of a different voltage is by the use of a rotary converter, consisting of a D.C. motor running at 3,000 r.p.m. if with 2-pole fields, or at 1,500 r.p.m. if with 4-pole fields, in order to obtain the desired frequency of 50 cycles per second. This motor would be direct coupled to an A.C. generator having a separate armature suitably wound for the low voltage, its field being excited from the D.C. supply with variable resistance in series, so that the voltage can be controlled by varying the field strength without any change of speed and frequency. If this is too complicated for the present requirements where an output of only 30 to 40 volt-amperes are required, another method would be to instal a D.C. 230-volt motor of about 1/6 h.p. and fit the shaft extension with a pair of insulated slip-rings. Connections to these rings would be made from opposite points of the motor commutator (if a 2-pole field), and an alternating current can then be picked up from the slip-rings by an extra pair of brushes. On the slip-rings the alternating current available will be about 60 per cent. of the motor input voltage, so that if lower voltage is required it would still require a step-down static transformer to give the conversion.

Chromium Plating

I HAVE recently installed a small chromium-plating vat (2-3 gallons capacity), and I was wondering if you could help me with the two following problems :—

(1) What is the best method of constructing an immersion heater to heat the vat up to 45 deg. C., which would work from the 230-volt mains? The casing, of course, has to withstand the action of chromic acid.

(2) Is there a bright chrome bath that works at about 20 deg. C., current density 30-40 amps. sq.ft., using chromic and sulphuric acids? I have a quantity of chromic acid of known sulphate content that could be used. —R. W. Poole (Oulton).

THE difficulty with an immersion heater would be to provide it with a casing that would stand the action of chromic acid without deteriorating or causing chemical action on the contents of the bath. You would probably do better to procure a 500-watt domestic "hot plate," and stand the vat on this bodily, increasing the size of the hot plate or adding others until the desired temperature is obtained. As regards the second part of your enquiry, we think Messrs. Canning & Co., Ltd., of 133-137, Great Hampton Street, Birmingham, will be able to assist you, as they specialise in chromium-plating equipment.

Ultra-violet Ray Lamp

I SHALL be obliged if you could tell me whether or not a Siemens (gas-filled) Sieray mercury vapour dual type lighting bulb, 230 volts, 500 watts, gives off ultra-violet rays?

Will you kindly inform me of a few simple tests for ultra-violet rays, also whether the above type of lamp would be suitable for sun-ray treatment?—H. R. J. Dowson (Colne).

THE type of lamp which you name definitely gives off ultra-violet rays, although these rays are mixed with the visible greenish rays characteristic of the mercury spectrum. In order to obtain pure ultra-violet rays from the lamp it would be necessary for you to pass them through a suitable screen which would filter out all but the ultra-violet rays. For sun-ray treatment, however, this is not necessary.

A good test which you can make to ascertain the presence of ultra-violet rays is to smear a little vaseline or petroleum jelly over a sheet of paper or card, and, after holding a sheet of blue glass in the path of the rays, to bring this card in contact with the rays which have passed through the blue glass. The presence of ultra-violet rays will at once be indicated by the brilliant yellowish-green fluorescence of the vaselined surface.

Many dyestuffs, such as fluorescence, eosine and acridine yellow fluoresce strongly under ultra-violet radiation.

If you employ the lamp specified for sun-ray treatment, you must, of course, provide yourself with goggles of dark blue glass, since the rays are very harmful to the eyes.

Sawing Floorboards : A Correction

In the article entitled "Odd Jobs in Home and Garden," in the October issue, an illustration is given, showing a floorboard being cut through with a hand saw. The board is wedged up by a piece of wood on the right-hand side of the saw. This is incorrect, as the piece of wood should obviously be on the left-hand side of the saw to prevent the latter seizing when the board is partially cut through.

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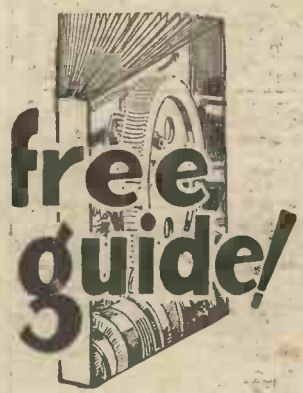

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