ALL ABOUT THE V.2

NEWNES

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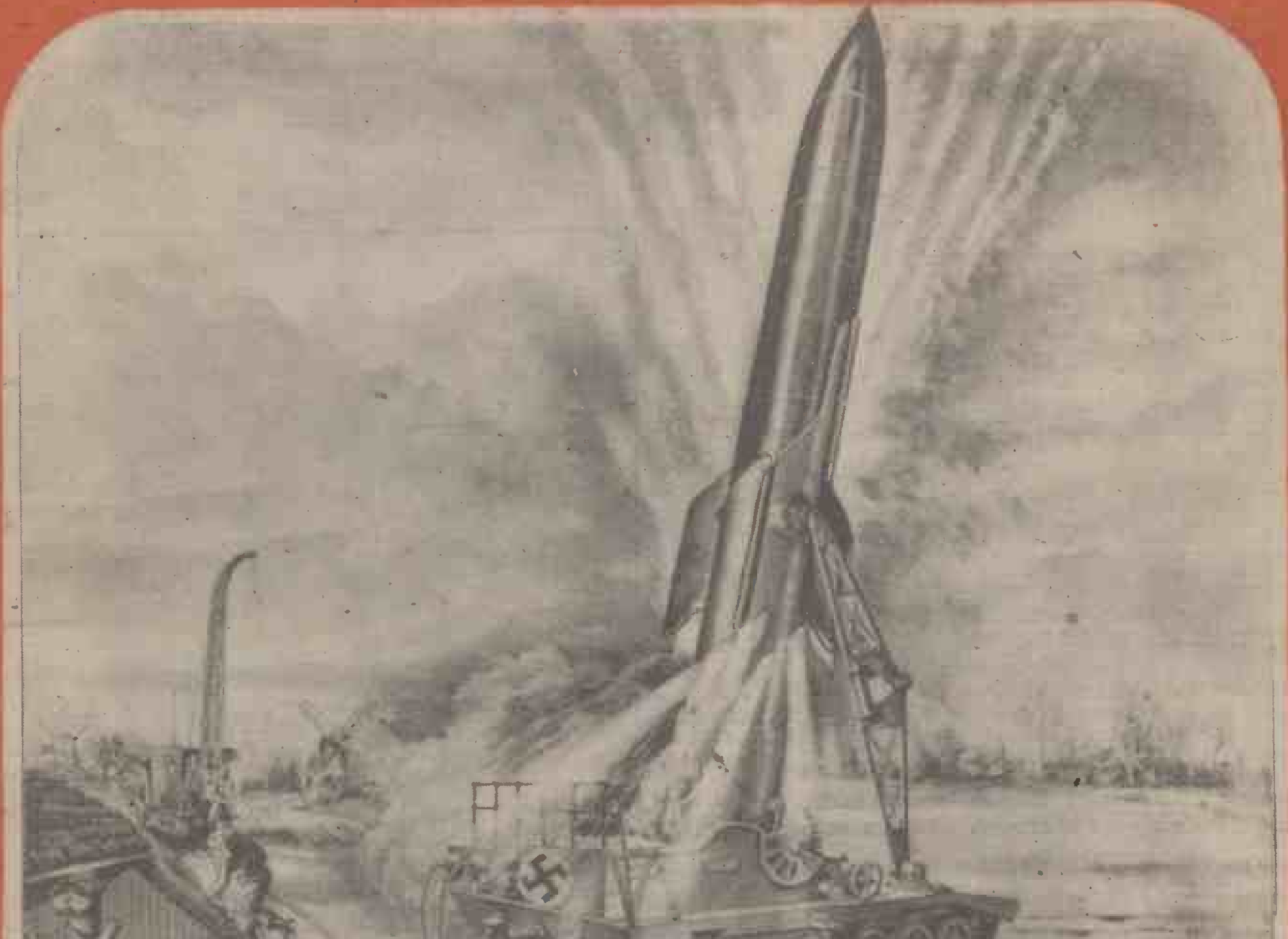
JANUARY 1945



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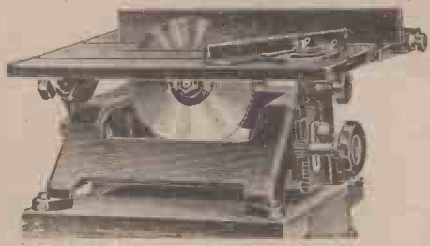

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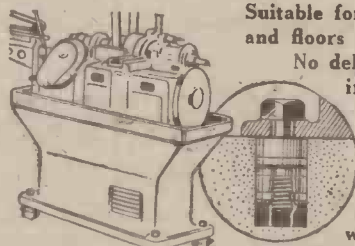

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Tower House, Southampton Street, Strand, W.C.2
'Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XII JANUARY, 1945 No. 136

FAIR COMMENT—BY THE EDITOR

Training of Specialists

A GREAT deal has been spoken and written on the training of specialists and the need for some scheme for ensuring an adequate supply of skilled men in the future. We are all aware of the shortage of specialists and technicians when this war started and of the reasons for that shortage.

Prospects were not sufficiently bright, tenure of office uncertain, pay inadequate in some cases, and possibilities of advancement extremely remote. Thus, the more highly paid spheres of industry, such as salesmanship, attracted youth, so that we had more people selling goods than making them. This ended with an unemployment problem which the war has temporarily eliminated. The problem, however, is still there, for those engaged in the manufacture of munitions are not gainfully employed. War is a costly business, and it does not yield profits. Virtually, therefore, the unemployed are still with us, and efforts are being made to convert them into trained men, that is to say, those of them who were unemployed because unskilled, so that they can take their part as useful citizens in the post-war era where there will be opportunities for employment for all and brighter prospects at good pay.

In view of this, an Advisory Bureau has formed a department to encourage study and specialisation. At present, although various societies and institutions exist to encourage interests in particular subjects, no individual body has attempted to encourage trained engineers, scientists or technicians to become specialists in any one field of the various schemes.

By trained engineers, scientists and technicians, is implied all those who have qualified by apprenticeship or examination for either university degree or membership of the technical institutions.

There are many such skilled and enthusiastic workers who would relish the opportunity to study some special subject, to become acknowledged authorities, and who seek guidance in this direction. The new Bureau fulfils this function.

Owing to the advanced matter with which the Bureau will deal it is impossible for tuition to be given in the normally accepted manner, and it is accordingly intended to advise as to the values of specialisation, problems requiring attention, sources of information, and means of co-ordinating this advanced matter as a thesis for a university higher degree, as a published treatise, or as a technical paper to the professional institutions or Press, and to render any other assistance necessary to help in the advanced study of any subject.

Roll of Specialists

The Bureau also intends to compile a roll of specialists from those persons who have published authoritative treatises and papers. This roll will be placed at the disposal of manufacturers, consultants, engineers, scientists and technicians requiring specialised opinions, assistance or advice on any particular subject.

By its activities the Bureau thus hopes to encourage specialisation among engineers of all classes—foremen, draughtsmen, laboratory workers, designers, works managers, etc., and from the guidance given to them it is hoped they will publish original and interesting accounts of the many problems which arise in all spheres of industry. It is particularly anxious to encourage university graduates to undertake specialist studies, to compose theses suitable for higher degrees. An examination of this aspect of technical education reveals that many students would have liked to have obtained such qualifications before leaving the university. It is not difficult for most graduates in industry to carry out the literary work necessary for such degrees.

The Bureau is assisted by eminent engineers, scientists and technicians, and will publish policy reports outlining the various aspects of specialisation and research in such a way that advance study can be carried out by all those with ambition and irrespective of their previous education or occupation. The policy reports are of a confidential nature and are obtainable only from the Bureau itself.

But does not all this duplicate to a large extent the work of existing learned societies? The Institution of Mechanical Engineers, the Institution of Civil Engineers, the Institution of Electrical Engineers, the Institution of Automobile Engineers, the Royal Aeronautical Society, and many others have examinations, the passing of which connotes a very high degree indeed of technical knowledge, which must precede all specialism. You cannot start from scratch training as a specialist; it is only after a student has passed examinations in the general sciences and tasted the joys, or otherwise, of particular branches of them that he develops a liking for one or the other upon which he would like to specialise.

The real specialist is the one who loves his subject; he is not one who wishes to enter a particular branch because it offers better prospects than another. The Bureau does not intend, according to its announcements, to have any aptitude test, nor pre-examination to ascertain whether the students are capable of becoming specialists. Some there are with good intentions who simply are unfortunately constituted mentally, and who cannot absorb knowledge, nor remember basic facts.

Aptitude is a prime essential to specialism, and we should like to know further details of the Advisory Bureau before expressing approval or otherwise of its schemes. Who are the eminent engineers and scientists who will constitute the Bureau's panel of experts? What is the syllabus? Has industry been approached, and has the Bureau received its approval? It is necessary to have answers to these questions, and many others, before the success or otherwise of the scheme can be appraised.

There have been many attempts in the past to fuse various societies, for it is often said that there are too many of them. Fusion, however, has never taken place, and there has been an increase in the tendency for societies to split into two or more societies, all of which have been successful and become well established. It may well be that the Bureau will follow this example, but a more detailed explanation of its policy should be submitted to the Press than the broad claims which we have summarised above.

A Revolutionary Cycle Pump

EVER since the first pneumatic tyre was produced, punctures have been the bugbear of vehicles equipped with them. It is true that improved roads and improved methods of manufacture have greatly reduced the frequency with which punctures occur, but they have not been entirely eradicated. Usually punctures occur at the most awkward times; usually in the middle of a deluge, or late at night. The locating of a puncture and its repair under those conditions is a vexatious experience.

A most ingenious bicycle pump, fitted into the hub of each wheel, and connected to the standard valve through a hollow spoke, will in the next year or so enable the rider of a bicycle, or the user of a motor-car for that matter, to push a small switch which will immediately pump up the tyre whilst the vehicle is in motion.

It will not, of course, inflate a tyre which has burst, but the irritating puncture which deflates the tyre and will hold up for a mile or so will not, in future, mean a stoppage on the road whilst the wheel is changed or the repair is effected.

Elsewhere in this issue are the technical details and illustrations of this revolutionary device, which we think is as important as the invention of the pneumatic tyre itself.

All About the "V-2"

Provisional Details of the Rocket Weapon Vergeltungswaffe No. 2. New Realms of Scientific Endeavour Opened Up

By K. W. GATLAND

NOW that the official "veil" has been lifted on the use of the second Nazi "V" weapon—the long-range rocket shell—we are to some extent free to comment on the technicalities involved.

At the outset, forgetting for a moment its sinister purpose, let us admit directly that "V-2" is an engineering achievement of indisputable brilliance. It is an achievement, too, that will have great bearing on scientific progress in the years of peace to come, by penetration to great altitudes to return with data of conditions existent in the so far uncharted reaches of the atmosphere, and later, by excursions into space itself. But let us trace this further trend of development in logical steps.

"V-2"—Adaptation for Altitude Sounding

The long-range rocket weapon "V-2" is not an instrument designed for the purpose of attaining great heights; the altitude reached is one merely sufficient to carry it, presumably from launching sites located within Reich territory, to districts of Southern England radiating from the Greater London area. The missile is required to "fly high" to achieve *distance* at the minimum expenditure of power.

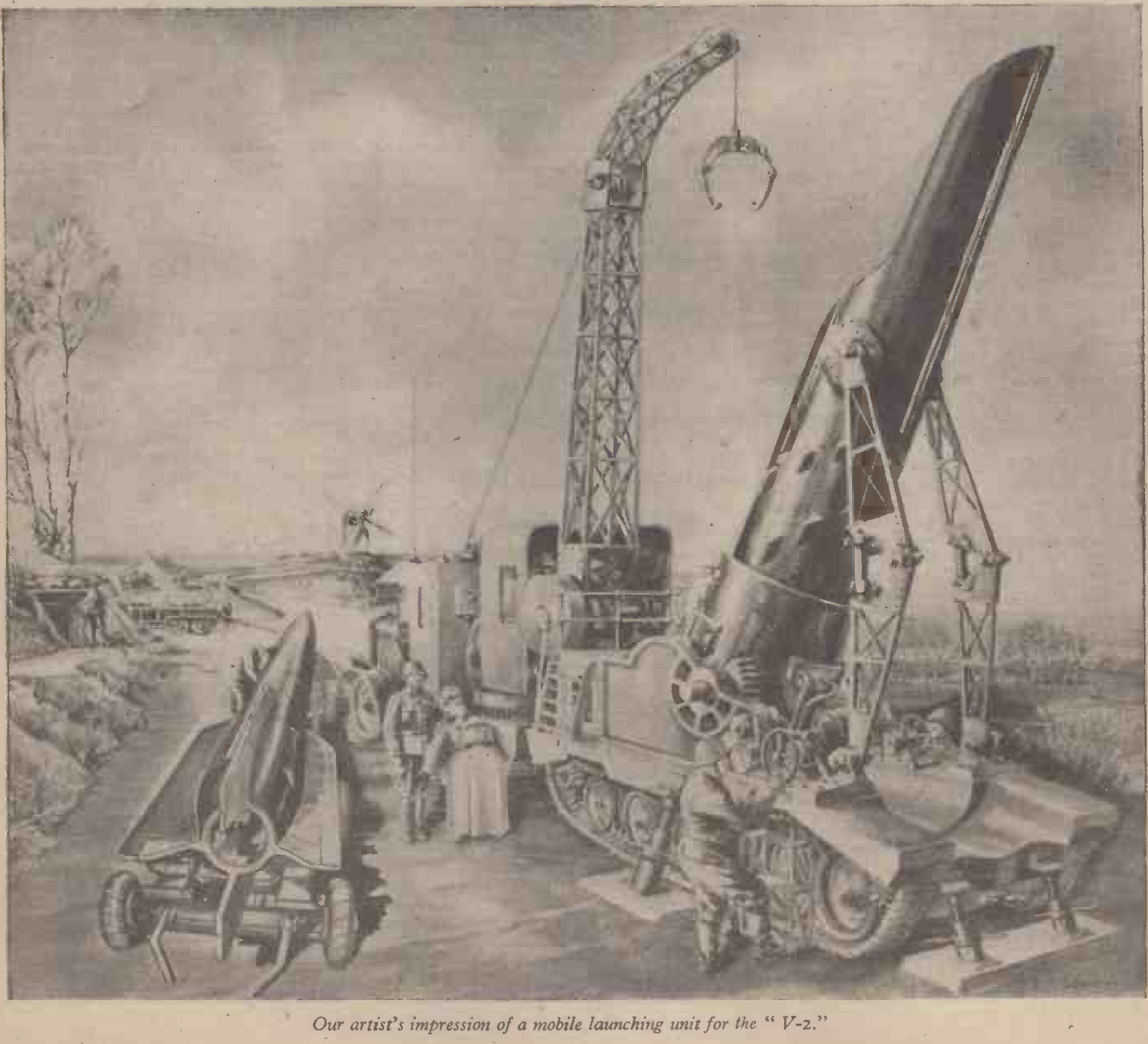
As a weapon of war, the rocket projectile is called upon to carry an explosive load; in this particular instance a war-head of something a little under one ton. It is obvious that if the projectile were used essentially for altitude sounding, this weight of explosive could be replaced by mere *pounds* of delicate meteorological and physical science recording apparatus, the reduction in carrying load adding considerably to the rocket's performance.

We can pursue this question of peacetime adaptability still further. Let us assume the initial mass of the projectile "V-2" to be 15 tons, and the propellent liquid oxygen, with alcohol as fuel. Working from these bases, it is possible to calculate with a fair degree of accuracy details of performance if the missile were projected *vertically*. The figures thus derived give a velocity during ascent of something in excess of three miles per second; the height attainable between 750 and 800 miles.

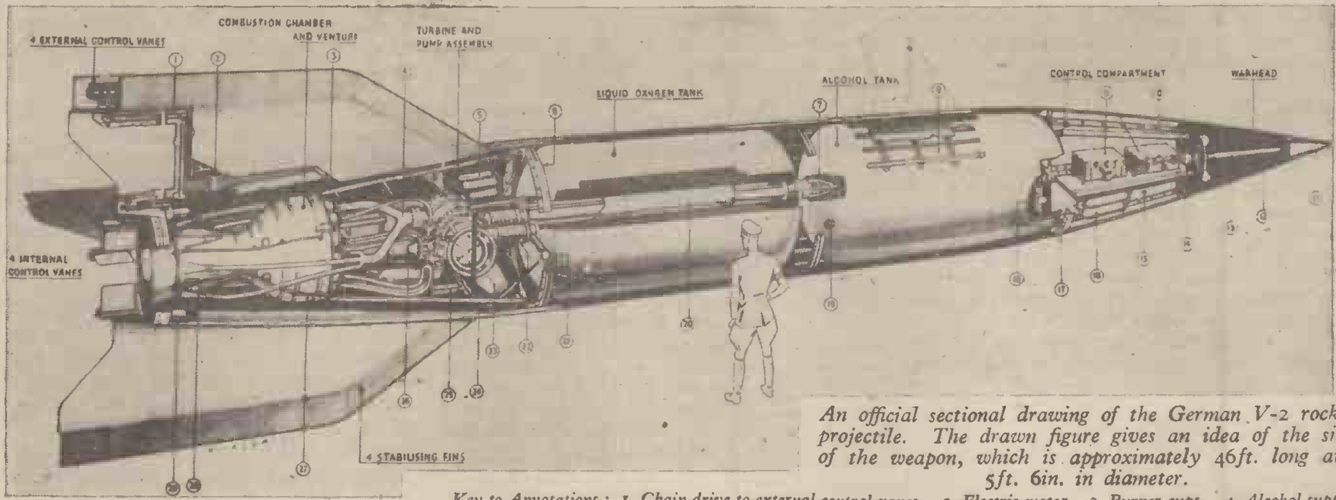
Taking the case still a stage farther: if the war-head were replaced by a self-contained rocket of similar fuel/mass ratio, designed to discharge from the carrier projectile at its maximum velocity, the small rocket would be well able to overcome the earth's gravitational influence and escape from this planet altogether, never to return.

"V-2" In Practice

Working from the most elementary basis, the force required to lift a mass of 15



Our artist's impression of a mobile launching unit for the "V-2."



An official sectional drawing of the German V-2 rocket projectile. The drawn figure gives an idea of the size of the weapon, which is approximately 46ft. long and 5ft. 6in. in diameter.

Key to Annotations : 1. Chain drive to external control vanes. 2. Electric motor. 3. Burner cups. 4. Alcohol supply from pump. 5. Air bottles. 6. Rear joint ring and strong point for transport. 7. Servo-operated alcohol outlet valve. 8. Rocket shell construction. 9. Radio equipment. 10. Pipe leading from alcohol tank to warhead. 11. Nose probably fitted with nose switch, or other device for operating warhead fuse. 12. Conduit carrying wires to nose of warhead. 13. Central exploder tube. 14. Electric fuse for warhead. 15. Plywood frame. 16. Nitrogen bottles. 17. Front joint ring and strong point for transport. 18. Pitch and azimuth gyros. 19. Alcohol filling point. 20. Double walled alcohol delivery pipe to pump. 21. Oxygen filling point. 22. Concertina connections. 23. Hydrogen peroxide tank. 24. Tubular frame holding turbine and pump assembly. 25. Permanganate tank (gas generator unit behind this tank). 26. Oxygen distributor from pump. 27. Alcohol pipes for subsidiary cooling. 28. Alcohol inlet to double wall. 29. Electro-hydraulic servo motors.

tons, with an acceleration factor of 1 g., must be something in the region of 30 tons. Under such conditions, the jet flow of the rocket motors would be only 12lbs./sec., assuming a jet velocity of 6,000 feet/sec., and if the initial weight of fuel were ten tons, this would supply the motors for 30 minutes.

The previous deduction is, of course, purely hypothetical. In practice, the jet flow would probably be in the region of 140lbs./sec ; the weight of propellent five or six tons, and the period of firing, at the very maximum, about two minutes. Working to these figures, the thrust reaction calculates to 1,680 tons, and therefore an acceleration of 100 g. This acceleration factor would be almost doubled toward the end of the flight, and, making the necessary corrections for air resistance, the velocity would lie between three and four thousand miles per hour.

Launching

As regards the question of launching the rocket weapon, until such time as more complete details are released by the authorities, we must rely upon the accuracy of information derived through neutral sources, principally Sweden, and also from Holland.

Correspondents in Sweden have described the launching installation as a concrete "well," sunk 80 feet within the ground. Into this the projectile is lowered, and, if the report is correct, actually charged with propellent before being subsequently fired from the "well" along guide rails formed into the concrete side structure.

Information from Dutch sources, on the other hand, suggests that the projectile is merely "stood upright" on concrete slabs, and fired direct. It is quite probable, of course, that both launching systems are employed. There has also been a suggestion that special portable launching installations have been in use.

Directional Control and Trajectory

Whatever its method of take-off, there can be little doubt that the rocket is initially fired vertically in order to surmount the more dense regions of the atmosphere as quickly as possible.

To maintain a vertical flight path, gyroscopes, acting on airstream and exhaust vanes, are employed, operating on the same principle as the Goddard gyro/vane stabiliser (see PRACTICAL MECHANICS, December, 1944, p. 101).

It is also likely that a system of radio-control is used to set the projectile on a final parabolic trajectory, again by the employment of gyro/vane controlling mechanism.

The rocket motors continue to fire until a certain predetermined velocity is attained, and at that precise instant an integregating accelerometer is used to "cut-out" the power. The projectile then "coasts" under momentum for the balance of the distance, the airstream vanes automatically correcting any deviation from the pre-set path.

It is possible that beam transmitting apparatus is included in the equipment of some projectiles, as with the "V-1" pilotless aircraft, for determining the position of the missile.

Upon entering the more dense strata, compressibility friction, due to the passage of the missile at supersonic velocity, causes the forward part of the rocket to be heated considerably, and to the observer the rocket plummeting to earth emulates a meteor, or "shooting star." This com-

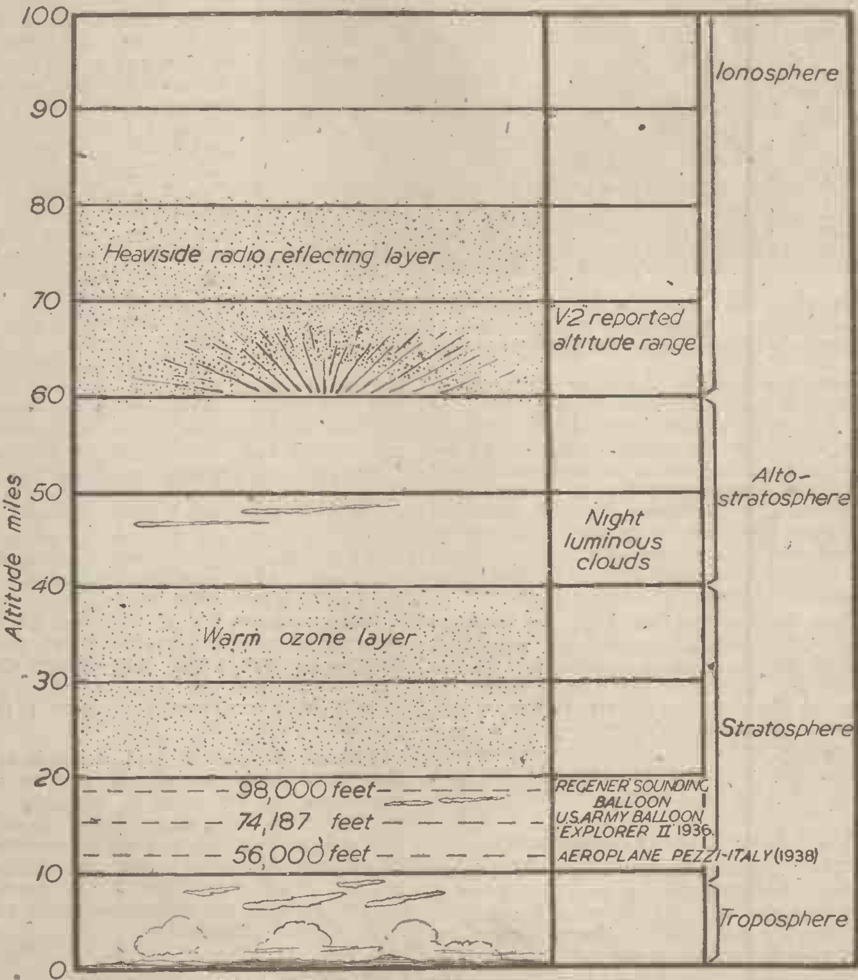


Chart of the atmosphere. Comparisons of past altitude achievement with that of the "V-2" rocket projectile.

pressibility is undoubtedly responsible for the many mid-air explosions which have occurred, although some form of heat resisting carapace is probably provided at the rocket "head."

The Power Installation

The power unit would appear to be a multi-engine arrangement, consisting of between 15 and 20 individual reaction motors of the constant-volume type. This system of propulsion would thus allow for a fine measure of propellent control, and, in addition, would permit the rocket to function even if individual motors were to "burn-out." Each motor is arranged to fire into a single large convergent-divergent chamber, where expansion of the gases generated in the combustion chambers takes place, prior to their final ejection. Propulsion is effected, not, as so often erroneously purported, by the "reaction of the exhaust on the atmosphere," but in accordance with Newton's much used "Third Law of Motion," which states, in effect: "For every action there is always an equal and opposite reaction." In the case of a rocket, the gases ejected forcibly rearwards *react on the producing plant.*

Part of a "V-2" bomb which fell in Southern England recently. This part has a metal casing between 2 and 3ft. in diameter, and contains a turbine engine, the fuel pump and 18 propelling jets.

For feeding the fuel, hydrogen peroxide and calcium permanganate are employed, which serve to generate superheated steam to drive the turbine. The turbine serves to operate the fuel and oxygen pumps, which extract the propellent components from their respective tanks, and feed them at constant and high pressure, in correctly metered proportion, to the combustion unit.

"V-2" Disposition of Components

The illustration on page 115, which is an official Air Ministry drawing based on a thorough investigation of parts found both in Britain and Belgium, shows clearly the layout of the main components:

The explosive charge—less than one-twelfth the total weight—is contained at the rocket "head." Directly behind is situated a control compartment, in which the radio control and D/F equipment are contained; with the control gyros still farther behind. Aft of these come the fuel and liquid oxygen tanks, in that order; then, the turbine and pump assembly. From the latter emanate feeder lines, which connect to the combustion units and also to supplementary fuel burners in the convergent-divergent venturi.

Four efflux control vanes, which act under gyro control, are fitted to deflect into the efflux stream, regulating the projectile's course by virtue of offset thrust. In addition to these, four large stabilising fins—which extend from the rear for almost a third of the rocket's length—are provided, and at the rear tip of each is incorporated a small vane for atmosphere control, also functioned by the gyros.

Construction

The rocket structure is built up on the monocoque principle; consisting of closely spaced circular forming members, with longitudinal "U" section stringers.

As with the "V-1" pilotless aircraft, sheet and formed steel are used extensively. The propellent tanks are of dural construction.

Development

The reported flight path of the "V-2" projectile bears considerable resemblance to the scheme originally proposed by Professor Hermann Oberth, as outlined elsewhere in this journal; but whether or not Oberth is the technician chiefly responsible for "V-2" is still very much a matter for conjecture. It would appear far more likely that Rudolf Nebel, one time prominent engineer of the Verein für Raumschiffsfahrt, and staunch supporter of the Nazi Party, is the mind behind the development of the long-range rocket weapon. Although Nazi himself, Oberth—Rumanian by birth—had a pacifist outlook, and was a distinct hater of Germans.

Most of the preliminary work on German long-range rocket weapons, during the present conflict, has been carried out at Peenemunde, the German research station on the Baltic, and also, though on more moderate scale, at the more remote experimental sites in Norway, principally at Hardangerplata.

Initial work on "V-2," it is thought, was commenced early in 1942, though, of course, modern German rocket development dates back far beyond the war period, as has already been recounted to readers of this journal.

Toward the close of 1943, it would seem that mass production of the weapon was commenced in fair quantity, but thanks to the continued force of the Allied air offensive, which included, in addition to attacks on the many important manufacturing plants, several assaults on the Baltic research station, development and manufacture must have suffered considerably.

Conclusions

The practical demonstration by the Germans of a rocket projectile of such spectacular performance makes the advent of "V-2" undoubtedly the most memorable achievement in the history of *astronautics.*

The peacetime implications of the development cannot be too strongly emphasised. In its present form, "V-2" must attain an altitude of between 60 and 70 miles. The greatest height previously reached by any man-made contrivance was 98,000 feet, by an unmanned sounding balloon. (See chart on previous page.)

A rocket with the performance of the German long-range missile, fitted with meteorological and specific scientific instruments, would be capable of doubling our present knowledge of the state and nature of the atmosphere at great altitudes. The data thus received would make possible long-range weather forecasts of conditions at lower levels, and would, in effect, raise meteorology to the status of an exact science.

The investigation of electronic phenomena would also be possible. There has never been so many conflicting theories advanced as in the investigation of *cosmic radiation,* for instance. Scientific authorities are generally agreed that these rays have their source in outer space; but by what means has never been directly classified. Moreover, the effects on the human system of cosmic bombardment have, too, never been conclusively defined. A theory has been advanced that the cosmic rays have considerable bearing on the human organism, influencing growth, life-span and general health. It has been said that their effects on earth are "damped" to a certain degree by the density of the atmosphere, and that the intensity of the radiation becomes greater as the atmosphere thins with altitude. Others assert that the effects noticeable at ground level are produced by secondary radiations resulting out of cosmic bombardment on the atmosphere, and that the rays beyond the limits of the atmosphere have no harmful effect.

THE LONG-RANGE ROCKET SHELL

Overall Length	*46ft.*
Max. Shell Diameter	*5ft. 6in.*
Total Weight (fully charged with propellent	*12-15 tons*
Weight of Explosive Charge	*1,900lb.*
Weight of Propellent, Liquid oxygen	*11,000lb.*
Ethyl Alcohol	*7,500lb.*
Power unit	*Convergent-divergent combustion unit with 18 individual combustion chambers.*
Present range	*200 miles*
Time, under power	*2 mins. approx.*
,, from launching to impact	*5 mins. approx.*
Max. Speed	*3,000 m.p.h.*

With further development, it should well be possible, almost certainly within the present century, not only to provide conclusive answers to these "scientific unknowns," but to bring about manned flights into space, and ultimately to achieve man's greatest potential conquest, the power to travel between the worlds of the Solar System. In the time between the present day and the achievement of interplanetary communication, many of the unfathomable mysteries of the universe which have eluded solution for so long will be laid open to us in our constant search for positive knowledge. "V-2" is without doubt a first practical step toward the "conquest of space."

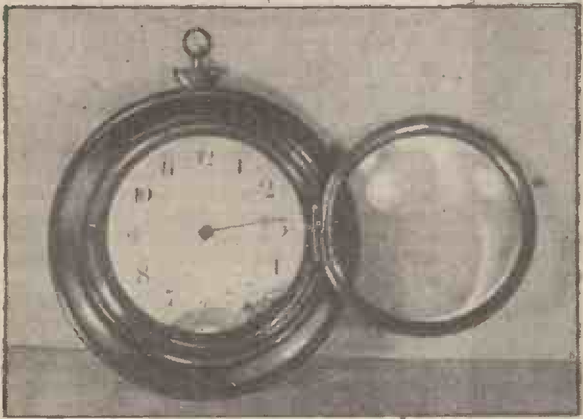
The Wonder of the Watch

A Brief History of Watches and Watchmaking

THE watch may be a rare entity in these days, and available watchmakers may be still scarcer. Nevertheless, even in circumstances of wartime stress, ours has by no means become a watchless community, for if that particular state of affairs had been set up, modern civilisation, to say nothing of the official services, would be desperately hard put to make up for the loss of such an entirely indispensable article.

It is surprising how, in peacetime, we take the ordinary everyday watch, be it good, bad, or indifferent, so much for granted. There is, indeed, a goodly measure of wonder in the watch, if only in view of the fact that it exemplifies the very first of the many forms of miniature precision mechanisms which are normally so common.

Time was—barely a century ago—when even an inferior pocket watch was regarded as a pearl of great price, in consequence of which "Watch Clubs" arose here and there throughout the country for the express purpose of enabling apprentices, agricultural labourers and manual workers of all classes gradually to save up sufficient money for the purchase of one of the much coveted timepieces.



An early 19th century silver watch of unknown make. This watch belonged to the famous Dr. John Dalton.

In older times still, one hundred guineas was a very ordinary figure to pay for a pocket timekeeper of reliable quality and performance, whilst, earlier still, the watch was an article of curiosity which only the richest dignitaries could expect to possess.

The watch, naturally enough, originated in the clock. It is, in fact, nothing more nor less than a portable clock. So long as clocks were entirely weight-driven, the pocket watch remained obviously an impossibility. Neither could a pendulum regulated watch be expected to be a practicable proposition, although a number of such watches have, from time to time, been constructed.

Invention of the Spring

It is to the introduction of the coiled spring as a source of energy or motive power that we are indebted for the watch. The name of that original genius who first thought of utilising the energy of a coiled spring for clock-driving purposes has long been forgotten, if, indeed, it was ever clearly known. All we know now is that when the spring-driven clock became an established fact, its miniature counterpart or replica in the guise of the watch was not long in making its appearance.

The invention of springs for clockwork mechanisms is supposed to date back to the end of the 15th century, and it is from this period that spring clocks date their origin. There seems to have been mention of a species of watch as far back as 1494, for in that year, one Gaspar Visconti, an Italian poet, describes, in a sonnet, "Certain small and portable clocks made with ingenuity, which are continually going, showing the hours and striking when the time requires it."

Notwithstanding the said Gaspar Visconti, the consensus of technical opinion is fairly well agreed that watchmaking as a craft started with Peter Henlein, a Nürnberg locksmith between the years 1500 and 1510. Of recent years, a good deal of research has been devoted to the activities of this Peter Henlein, who was a master locksmith with a genius for getting into trouble with the magistrates of his German town, and who died in (or about) the year 1542.

A "turnip" watch of about 1770. Made by John Collier, of Eccles, its movement was of the verge type, enclosed in a double case of standard silver. Note the thickness of the glass front.

There is no known watch which can be dated back earlier than 1540, so that the only evidences which we have of Henlein's Nürnberg's watches are those of repute and hearsay.

The movement of the "turnip" watch seen in the illustration below.

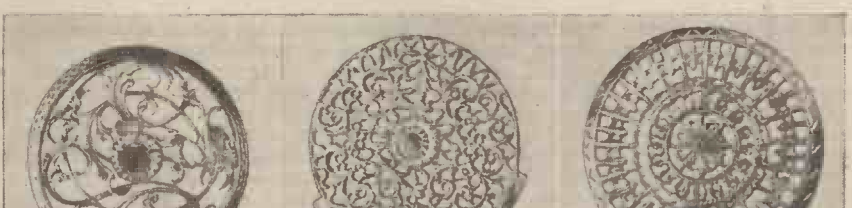
"Nürnberg Eggs"

The Nürnberg watches have been known as "Nürnberg eggs" on account of their characteristic shape. Most of them seem to have been disposed of as presents to various European princes. Their movements must have been exceedingly crude, and because of the technical difficulty of producing a long, thin strip of steel of reliable and uniform temper had not been overcome, the percentage of failures with those embryo watches must have been high.

From the German town of Nürnberg the watchmaking craft spread to Augsburg, and for many years these two towns constituted the centre of the world's watchmaking. In 1565, three watchmakers, Esias Vogel, Hanns Praun and Marx Steppinger, petitioned for guild status in watchmaking. The petition was granted, and watchmaking became thereby one of the recognised and protected crafts of the country.

After its initiation and establishment in Germany, watchmaking spread to France. In this country, the centre of the early industry was Blois. The first maker of watches there was Julien Coudray, who, like Peter Henlein, was originally a locksmith. He became clockmaker and watchmaker to the French kings, but, as in the case of Henlein's productions, no trace of the early Blois watches remains.

England was exceedingly slow to take up watchmaking at first. It would appear that the London clockmakers looked upon watches with disfavour. They saw in the foreign productions a competitor which they



Photographic enlargements of 18th century "watch cocks," which reveal clearly the fine and delicate workmanship which was put into their making.

An early spherical watch of French make. It contains a fusee movement and embodies an engraved brass base. Its upper dial has only one hand.

feared. They even petitioned the king (in 1622) for restrictive legislation against the watchmakers who were then, one by one, settling in London. Yet, although the English clockmakers were so dilatory in devoting their attentions to the watch, they made up amply for lost time afterwards, so much so that in 1700 London was recognised as the watchmaking centre of the world.

Peter Henlein's earliest watches had been egg-shaped. The French makers at Blois, together with some of their contemporary German makers, turned out watches which were almost spherical in shape, the one-hand dial being placed at the top of the sphere. Exquisite creations some of these early examples of metal craftsmanship undoubtedly were, but their timekeeping propensities must have been appalling, for they possessed no temperature control, and their escapements were of very impracticable design. Many of them, however, were fitted with spring barrels, and with the well-known "fusee" device by means of which, even nowadays, the best spring clocks are given a constant driving force.

Those earlier watchmakers put ornament before efficiency. Judged as works of art, some of their productions are almost unsurpassable. From the "business" or timekeeping point of view, however, a half-crown watch of our own pre-war days could reasonably be expected to put up a much better show.

The Beginnings of the Balance Spring

Up to 1675, the English watches retained the old type of mechanism which had originated in Blois, France, but this year proved itself to be the turning-point in the annals of watchmaking, for in it came the introduction of the balance spring. The invention of this was claimed by Robert Hooke, secretary of the Royal Society, in England, and, in France by d'Hautefeuille. It is certain that the first watch having a balance spring was made in Paris in 1675, but quickly Thomas Tompion, that veritable "prince" of London clockmakers of Charles II's time, whose creations nowadays command such fabulous figures, recognised the value of the spring device for the control of the watch balance wheel, and at once adopted it. He devised a form of verge escapement which, together with the balance spring (in its first form, a spiral spring), was so successful that it became the standard of British watchmaking for many years.

In. 1676, Barlow, another Englishman, brought out the repeating mechanism for clocks by means of which the timepiece could be made at will to strike the nearest hour, and not long afterwards the same mechanism was applied to watches.

Then came George Graham, Tompion's partner and subsequently his successor. Among many other horological inventions he devised (about 1725) the cylinder escapement much in its present form, thus introducing another new principle to the watchmaking world. The cylinder escapement at once spread to France, was extensively copied there, mainly through the energies of Julien Le Roy (1686-1759), who did so much to resurrect the then dying craft of watchmaking in France.

Throughout the 18th century English makers strove for greater timekeeping efficiency in their watches. Thomas Mudge (1715-94) brought out the nowadays almost universal lever escapement, but he did not pursue the invention himself, leaving its development and application to others. Thomas Earnshaw, another celebrated clockmaker of this period, introduced the chronometer escapement, which was afterwards applied to the highest precision watches, and Pierre Le Roy (son of the former Julien Le Roy) introduced a temperature compensation device for watches by making the balance-wheel rim of a bimetallic strip.

To Thomas Mudge and Pierre Le Roy, therefore, the modern "quality" watch owes its first beginnings, for the former invented

The back plate of a typical 18th century watch photographed as a "close up" in order to show the exquisitely formed "watch cock" which guarded the balance wheel under it.

its lever movement whilst the latter introduced the nowadays common bimetallic strip balance wheel.

Watch "Cocks"

With the coming of the "Industrial Revolution" in England during the 18th century and the consequent rise of manufactures, particularly in the cotton, steel and engineering trades, watchmaking became a thriving business. Nevertheless, every watch was carefully made by hand, as all its predecessors had been since the time of old Peter Henlein, of Nürnberg. And although the fanciful and elaborate designs of Tompion's time rapidly declined, the English watch of the 18th century contained within it a good deal of fine craftsmanship. All its wheels were hand cut. The commoner watches still incorporated the older "verge" movement, and in these the balance wheel was invariably protected by an elaborately-cut grid-like member known as a "cock." In the later years of the verge watch, the production of these elaborate "watch cocks". became something like a specialised industry in itself, and was centred in or around Prescott, near Liverpool. It is said that it took months to fashion a single watch cock. Perhaps this is an exaggerated statement, but certainly, many, many hours of work must have been put into the making of these old watch cocks, whose intrinsic beauty and delicacy now appeal so greatly to the collectors of art trifles and similar bric-à-brac.

The old verge watches of the 18th century usually had silver cases. They were thick, bulbous articles, so much so that they are nowadays dubbed "turnip watches." Their front glasses were thick and only partially convex. As timekeepers, those with the verge movements might, in good condition, have had a plus or minus accuracy of five or ten minutes per day.

It was during the first half of the 19th century that the "Watch Clubs" arose up and down England. If you only earned five shillings a week you could hardly expect to purchase a watch costing, perhaps, two guineas, right off your own bat; but by subscribing regularly to a Watch Club, the day slowly but surely arrived when, as a result of your accumulated savings, a watch became your very own. It was the "Christmas Club" principle in an embryo form. It worked successfully, but, in the end, was spoiled by people supplying inferior watches at inflated prices.

The Mass-produced Watch

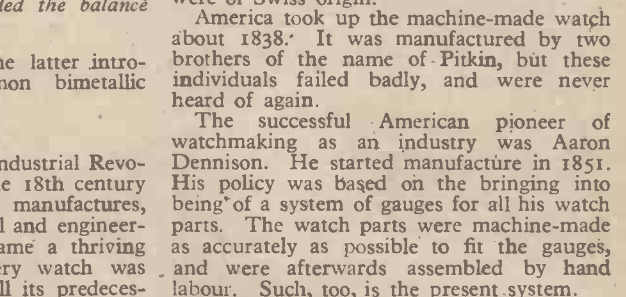
The era of the machine-made watch began early in the 19th century. The "mass production" watch arose chiefly in Besançon, in which town two eminent watchmakers were working, the one Abraham Louis Breguet, old-time craftsman, and Frederick Japy, a younger man with "get rich" ideas. Japy started a factory which eventually was taken over by his two sons. In 1865, nearly 60 years after its initiation, the Japy firm was turning out about 500,000 cheap watches yearly.

At about the middle of the last century the mass-produced watch industry took root in Switzerland in consequence of the devising of special methods of manufacturing interchangeable watchmaking tools for the making of standardised watch parts. So successful were the Swiss as watchmakers that practically all the detail improvements in watch design which came out at or after this period were of Swiss origin.

America took up the machine-made watch about 1838. It was manufactured by two brothers of the name of Pitkin, but these individuals failed badly, and were never heard of again.

The successful American pioneer of watchmaking as an industry was Aaron Dennison. He started manufacture in 1851. His policy was based on the bringing into being of a system of gauges for all his watch parts. The watch parts were machine-made as accurately as possible to fit the gauges, and were afterwards assembled by hand labour. Such, too, is the present system.

The first Dennison watches were marketed in 1853, and were sold under a number of different names. In 1854 the Dennison



An engraved silver watch of French make and date about 1600. It embodies a striking and alarum movement.

factory moved to Waltham, and the watches were engraved with the names "Dennison, Howard and Davis." After various company changes the American Watch Company sprang into being out of the Dennison enterprise in 1859, and at a later date in the same year it became the American Waltham Watch Company, which attained immediate success and declared its first dividend in 1860.

The Coming of the Waltham Watch

Thus came into being the well-known Waltham watch, a "quality" production which has ever had a name for excellence. In the succeeding years numerous American watchmaking companies sprang up as competitors, large and small. Some prospered for a time; others failed rapidly, and hardly any pioneer was as successful as was Dennison in his enterprise.

Aaron Dennison was, of course, not the originator of interchangeable parts for watches. The notion, as we have already seen, was first tried out successfully in Switzerland at the beginning of the 19th century. But the Dennison enterprise made more of the idea than the Swiss makers had done.

While the American companies, led by Dennison and his "Waltham" interests, were striving to produce watches of more and more reliable timekeeping qualities, the Swiss watches gradually degenerated in quality. Switzerland concentrated almost exclusively upon watches of poor quality, maintaining only one or two firms of the highest watchmaking precision. Thus every country in the world had at one time to compete with the "trash" exemplified by the cheap Swiss watch.

After the turn of the present century, the Swiss watchmakers, realising their position, turned to better things. Gradually they improved their reputation, so that at the present date (pre-war) good-quality Swiss watches were extremely worthy articles.

Space does not remain for the description of the many fascinating "sidelines" of watchmaking, as, for example, of the gradual introduction of the keyless watch, which, in its earliest form, was a London invention of date about 1846; nor can we dwell upon the many interesting types of "calendar" watches which, besides telling the time, as all good watches should do, indicate the day of the month, the year, the phases of the moon, and other astronomical information. Neither can we consider the various essays which have been made to develop a self-winding watch. The chronometer watch must be overlooked, also, together with that ever and deservedly modern popular creation, the wrist watch, which came into popular esteem just before the 1914-18 war.

It is interesting to note that England lost her supremacy in watchmaking about the beginning of the 19th century. Mass-production of watches never seemed to appeal to the British temperament. In Britain watchmaking was always a craft, never a mere industry. And among the very few working watchmakers (as distinct from watch-repairers) who, in normal times, are to be found active amongst us, the tradition of the old English watch still remains. For the highest excellence the modern English watch can still hold its own, although, in point of view of numbers, it has become hopelessly surpassed by imported watches from Switzerland and America.

Curious Cycles of the Past

Some Remarkable Machines of the Last Century

By R. L. JEFFERSON

IN the days of the old high bicycle the gear of the machine was limited by the size of the front wheel, and this in turn depended on the leg length of the rider. There were one or two inventions to overcome this limitation, some of which could be classed as pure freaks.

One of the most remarkable of these was the invention of M. Renard, in 1878, the front wheel being no less than nine feet high. In the ordinary course of events this would have required the rider to have legs 4½ feet long. M. Renard, however, invented a sort of double-action crank, and, as will be seen by the illustration (Fig. 1) the ordinary cranks at the hub are joined by a shaft to a second pair half-way up the front fork, so enabling an ordinary individual to take spins upon it. Surprising as it may seem, M. Renard sold quite a few of these machines, until, like most freaks, it died a natural death.

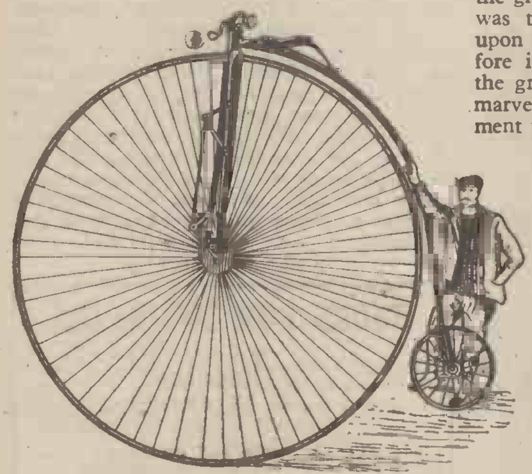


Fig. 1.—M. Renard's ordinary.

"The Eureka"

In 1895 a machine was made and called "The Eureka." As will be seen in Fig. 2, it has a chainless wheel, a cog wheel similar to that of an old-fashioned mangle taking the place of the sprocket and chain, and working another cog which worked the back wheel. This, of course, had the effect of driving the rear wheel in the opposite direction to that in which the machine was travelling. Around the back wheel sixteen small wheels, eight on each side, were placed, and these small wheels travelled with a forward motion. The inventor's claims were very numerous, and one of his strongest arguments was that he used the rider's weight to propel the machine; consequently it followed, or should have done, that the heavier the rider the greater the speed. The inventor's theory was that the cyclist's weight acted directly upon the centre of the rear wheel, and therefore immediately one small wheel touched the ground it slipped from under him with marvellous rapidity, and the slipping movement was continuous. The inventor actually claimed to take the friction off the back wheel without distributing it over the sixteen small wheels, which, of course, was impossible. This machine also died a natural death.

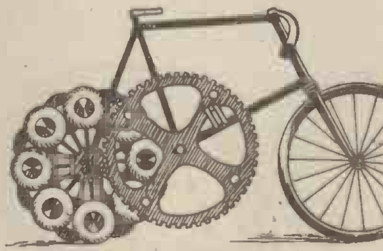


Fig. 2.—"The Eureka."

Balloon Supported "Boneshaker"

In the very early days of the "Boneshaker," many people believed it to be a highly dangerous pastime, owing, so they said, to the extreme difficulty of maintaining an upright position; indeed this feat was looked on by the uninitiated as a triumph of balance in gymnastics, so extremely hard to acquire that an inventor came forward with a brilliant suggestion that would broaden the benefits of the bicycle by making the exercise safe and rob it of the terrors of balance. To quote the exact words of the inventor, "The bicycle is to be held upright by being attached to two balloons each 15 feet high." The illustration (Fig. 3) shows what a rider would look like so equipped. Imagine trying to cross Piccadilly on such a contraption. Strangely enough, this man was not the only one who fitted balloons; another man had a larger balloon attached to the handle-bars "to help him up hills." The balloons soon dropped out of use as the disadvantages became apparent.

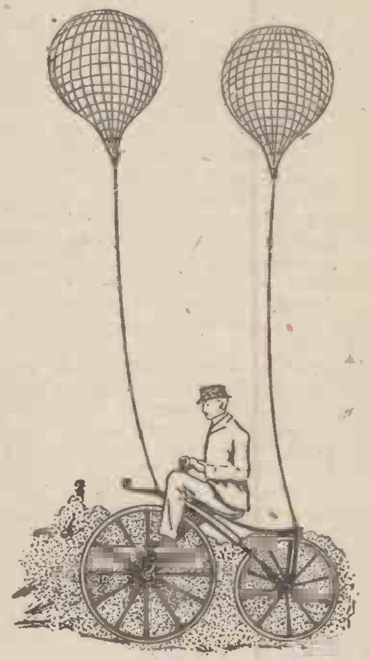


Fig. 3.—A "Boneshaker" with supporting balloons.

Monocycles

There were many varieties of moncycles, or, as some called them, epicycles. The one illustrated in Fig. 4 does not call for much explanation ; it is an immense wheel spoked to an inner rim, within which is fitted a V-shaped contrivance, whose ends and inverted apex are rigged within wheels, the lower and longer one of which is fitted with pedal attachments. It was difficult to see where this ponderous wheel scored over the bicycle, but the inventor claimed its advantages were great speed and ease of locomotion. The illustration (Fig. 5) of the hand-driven monocycle is that of an M. Scurri, who invented his monstrosity in 1881.

The Mechanical Horse

Finally, in order to show that the inventor is still busy in fairly recent times, on June 2, 1933, a patent was taken out by Messrs. Plant and Roe.

To quote from the patent specification: "In horse and like velocipedes of the type in which, to effect propulsion, pivoted front and rear pairs of legs are moved towards and away from one another by the alternate action of the weight of the rider on stirrups, and on the body or seat, backward movement of the legs relatively to the ground being prevented, e.g., by one-way clutches, the legs being pivoted at their upper ends at or near the ends of the body, and the connections of the legs with the stirrup comprise two-armed levers pivoted upon the front and rear legs respectively, links connecting corresponding arms of these levers directly or indirectly with the stirrup, and means (e.g., the body and links or the links alone) interconnecting the other arms of the levers so as to provide floating fulcra therefore. The front legs, 11 (Fig. 6), and the rear legs, 14, are pivoted at 12 and 15 respectively to the body, 13, their pivotal movements being limited by outer stops, 16, 17, and inner stops, 35, 36. Pivoted to the legs, 11, 14, at 18, 19 respectively, are two-armed levers, 20, 21, one end of each of which is pivoted to links, 23, 26 pivoted to the body, so as to provide floating fulcra at 22, 25. The other ends of the levers, 20, 21, are connected by links, 31, 33, to crank arms, 32, 34, on a shaft, 28, on the body, another crank arm, 29, on the shaft, 28, being pivoted to a stirrup member, 30. When the rider transfers his weight from the body, 13, to the stirrup, 30, the legs, 11, 14, move towards one another to the position shown by dotted lines, the front and rear wheels, 37, 38, rotating, while during the return or outward movement of the legs, the rear wheels, 38, are prevented from rotating by a ratchet and pawl, 39, where the device will be propelled forwards. The front wheels, 37, are steered from a handle, 40, through a shaft, 41, a universal joint, 42, a cranked rod, 43, two cross members, 45, and cranked steering columns, 47. In the modification shown in Fig. 7 the shaft, 28, is slidable in vertical guides, 48, and is supported by a pair of rigid longitudinal members, 49, which are connected at the ends by links, 50, 51, to the pivots, 18,19, of the two-armed levers, 20, 21. Propulsion may be assisted by a reciprocating chain, 52, adapted to drive a free-wheel sprocket, 55, on the rear-wheel axle, and connected at one end by a link, 53, to the lower end of the lever, 20, and at the other end to a return spring, 56, linked at 57 to the crank arm, 34, on the shaft, 28. In a further modification, the two-armed levers are connected together by crossed links, and one of the levers is linked to the body to maintain alignment. The lower ends of the legs may be provided with slidable rollers controlled by springs and linkwork, so as to be brought into engagement with the ground only on forward movement of the legs, which engage non-slidably with the ground on the reverse movement."

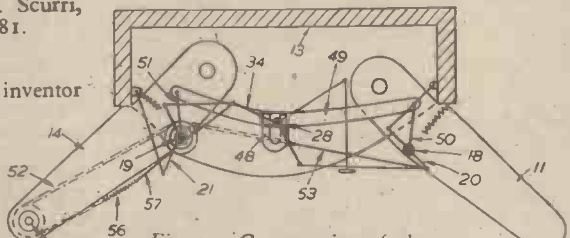


Fig. 7.—Cross-section of the horse velocipede.

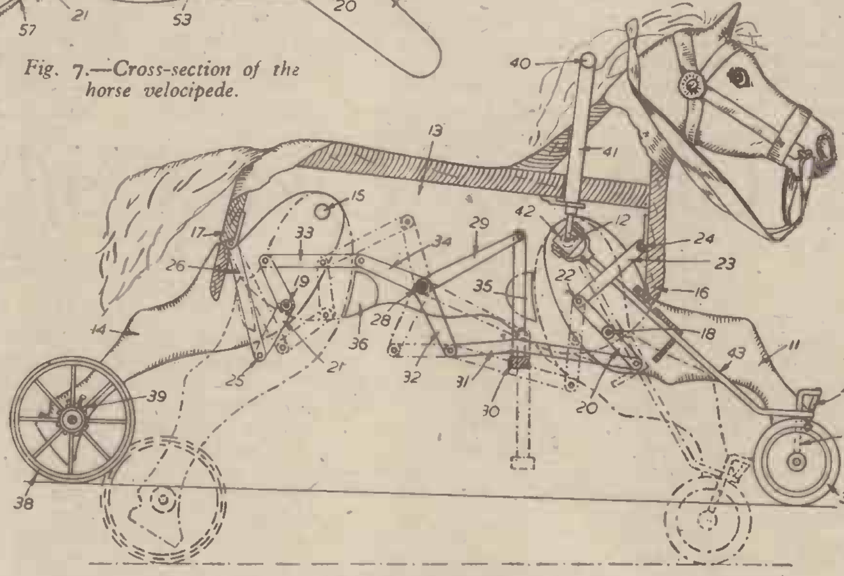


Fig. 6.—Plant and Roe's horse velocipede.

Many Patents

It many interest the present-day reader to know that there have been more patents taken out on cycles and their various components than on practically any other form of transport. Some of these cycles had merit, but on account of their shape died more or less because of ridicule, e.g., regarding the Dursley-Pedersen cycle; it has come to be generally agreed that the diamond frame low bottom bracket and 26in. wheels are likely to remain pretty well standard for many years to come ; they are the natural result of the trial and error period through which cycling has passed during the last fifty years.

Post-war Improvements

Whether this state of affairs will continue in the post-war years is hard to say. Manufacturers may turn their wartime experiences to the cycling field and, with the new methods and lightweight alloys used in wartime engineering, help to bring about a complete change in cycle design. Some small manifestation of this is already apparent from the cycle manufrcturers' reports. Such fitments as an automatic hub-pump, to do your pumping as you ride ; dynamos contained within the bottom bracket, etc. All these, together with other improvements, should do much to popularise cycling from the utility rider's point of view, but what seems to be the most revolutionary of all, and interesting from the cycling enthusiast's point of view, are machines built almost entirely of plastic materials. These further developments may bring to finality the century of almost continuous cycle experimentation and improvement.

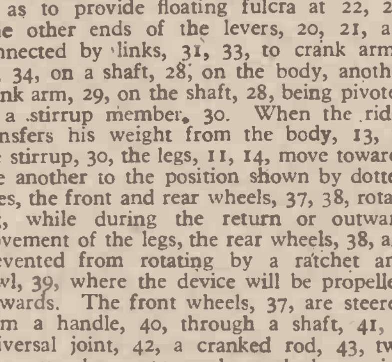


Fig. 4.—An epicycle.

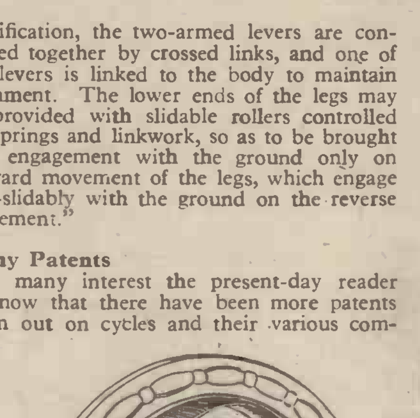


Fig. 5.—Scurri's monocycle.

Seeing "Blast"

How the Effects of "Blast" and Other Noises are Visually Recorded

By Professor A. M. LOW

Professor A. M. Low is the inventor of the audiometer. He has photographed sounds in wave form since 1912, and was the first to examine London's traffic noises. Sound consultant to Odeon Cinemas, and Brooklands Automobile Racing Club. He is responsible for the acoustics of many of London's public buildings, including special "sound" treatment of the Law Courts and the Office of Works Committee Chambers.

Professor A. M. Low.

TO see "blast," when it is often only too easy to hear it, appears at first thought to savour of spiritualism. In fact, it is a very simple phenomenon and illustrates a principle which has been used by some architects for many years to discover the acoustics of a building before it is erected.

Like other forms of noise or sound, blast is usually propagated by alternate waves of compression and rarefaction in the air. The noise wave may, of course, have a front of such pressure that it can disintegrate or break a steel wall; at greater distance it may do no more than produce a gentle oscillation of the ear drum. The wave of rarefaction which follows plays strange tricks . . . draws walls outwards, opens door, and gives a building the peculiar "rocking effect" with which Londoners and others have become familiar.

As with other noises and sounds, the "blast wave" can be reflected in unexpected ways . . . it can travel through solids, hence the danger of leaning against the walls of a shelter; or through water . . . depth-charged submarines are often cracked like an egg-shell by the sea-borne wave of compression under water.

Bending of Light

Once the existence of this high-pressure wave-front is appreciated, the "seeing" of blast is easy to understand. A comparable test is very familiar. We have all noticed that a stick appears bent in water when looked at from an angle. Everyone has seen the apparent "trembling" of objects when viewed through a column of hot air, over, for example, a chimney. To see blast is almost exactly the same . . . it is merely a demonstration of the bending of light, or refraction, when the beam passes from one medium into another which has a different density.

An observer standing at A, Fig. 1, is looking at objects by light which is passing through air under compression at intervals governed by the nature of the "blast." The light is bent as it passes from normal to compressed air, and again as it leaves the denser area for the ordinary atmosphere during the incidence of the wave. The eye, therefore, sees the background of clouds or buildings as if these were trembling. Indeed, they may be in fact if the shock is severe, but by no means for the same reason as the apparent movement which takes place for an appreciable time when we "see" blast.

Most atmospheric sound effects are affected by weather conditions. In wet weather the blast may travel faster—although it always exceeds the velocity of sound for the first part of its travel. The arc of blast is quite often defined by condensation of moisture due to pressure; a comparable effect is occasionally seen in the trail left by high-flying aircraft. If there chances to be sunshine, and the light is in the right direction, a rainbow effect is not impossible—due, of course, to the refraction at each particle of liquid suspended in the air.

Simple Experiment

In the laboratory, or as a home experiment, the conditions are not hard to reproduce on

Fig. 1.—Graphic representation of blast waves.

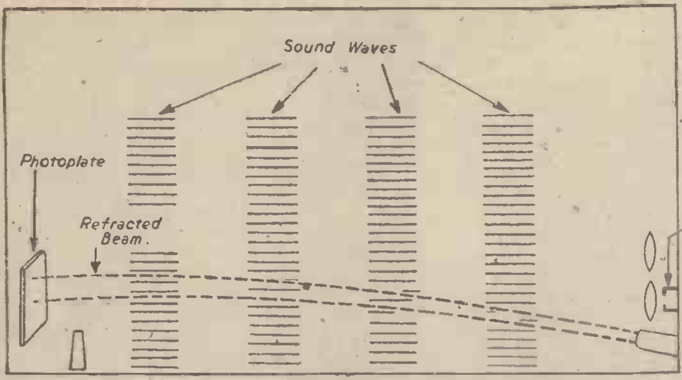


Fig. 2.—Diagram of a model room used for testing acoustic conditions.

a small scale. Usually, a recurrent spark is employed, a system of lenses and mirrors being so arranged that the light of one spark is bent by the noise-wave from the preceding spark, the displacement being visible through an eyepiece.

For practical architects this test is most useful when the acoustic conditions of a building have to be dealt with during the designing stage. A model is made of the hall or room in question, often in plaster, and a photographic plate is placed at one side. Opposite are the necessary sparking points and lenses. By recording the amount of light displacement it is not difficult to calculate the exact results which will be obtained in the final building. The actual absorption will naturally depend also upon the materials of construction. Fig. 2, which represents the model mentioned above, is purely diagrammatic.

Noise and sound—the result of irregular or regular oscillation in air respectively—have been surprisingly neglected as a subject of research, although they form the major part of all human communication. Until the advent of the talking picture, buildings were erected in haphazard fashion without regard for the all-important matter of acoustics. They were "bad" or "good" only by chance, and frequently required expensive correction by reflectors, or by the addition of absorbers to counteract undue "echo."

Absorbing Unwanted Sound

To absorb unwanted sound—to convert it into heat, for this is what occurs—is often a matter of great complication. Materials seldom respond to high or low notes alike, and human beings have a relatively small band of frequencies—approximately 20 to 7,000 per second—to which their ears will readily respond. Animals and other creatures also vary greatly in this respect . . . a worm senses low notes—it can "hear" the shock of a bird's foot landing 12ins. above it . . . while a dog can hear notes quite inaudible to man. A high-pitched whistle, made by shortening the air barrel of an ordinary musical whistle, will call a dog from a distance of a hundred yards, and be quite unheard by any human being.

Yet the average ear is very sensitive . . . it can often hear the movement of a telephone diaphragm less than 1,000,000th of 1,000,000th inch. But it is not possible to reduce sensitivity, and one cannot become "used" to noise. All we can do is to train our minds to disregard it—at the expense of energy that could be put to useful purpose. Noise can cause sickness or exhaustion; in bad cases it may be responsible for concussion and shell-shock.

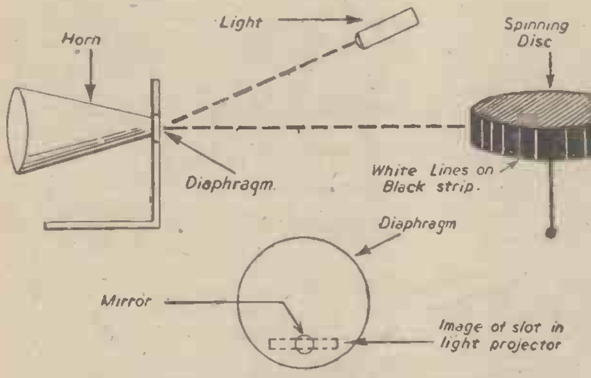


Fig. 4.—Diagram of a simple form of audiometer.

It is fortunate for mankind that our hearing has become somewhat atrophied by civilisation, or we would hear worms under the ground, as can a bird. Fish, too, are sensitive to high-pitch sounds, and can be killed by some forms of supersonic wave.

Before long care will be needed to silence aircraft if they are to be regarded as comfortable travel; merely blocking the ears is not enough—for many sounds enter by the bones of the head. The whole body is sensitive to the attack of sound, and when some workers—such as those employed in boiler shops—speak of "hearing better in noise," it usually implies that ears are so damaged that response needs some external stimulus.

Properties of Sound

The chief properties of sound are: that it can be reflected, that it heats the air through which it passes, or that it can be apparently "bent." Both the reflection and heating effects have been used for gun-ranging. A sound mirror is also very useful in "picture-making," for it enables the voices to be collected without those on the "set" obstructing the camera during a "take." Similar reflectors are used to test for echo spots on walls or roofing by "firing" the noise in various directions and locating the point where the echo occurs with a beam of light along the base of the mirror—as in Fig. 3.

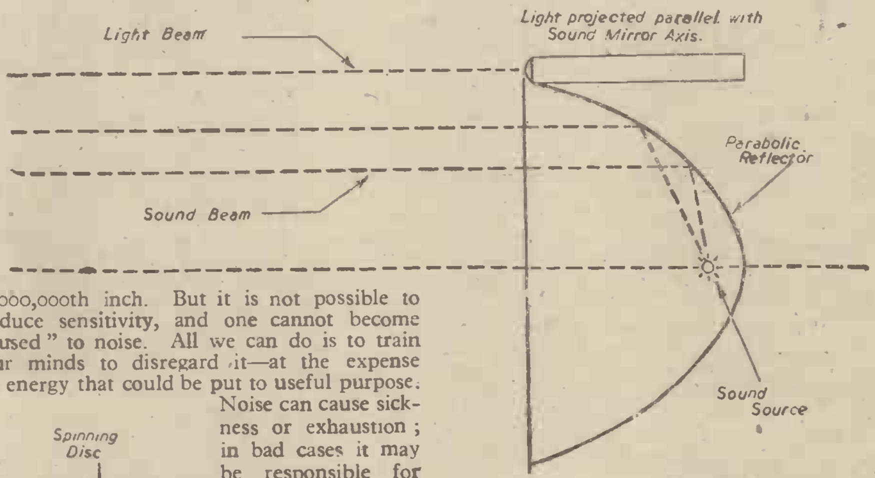


Fig. 3.—A sound mirror.

The so-called "Refraction of Sound"—first tested by Lord Kelvin by means of carbon-dioxide sound "lenses"—can often be observed by listening carefully to a moving source, such as a motor-cycle. On a hot day, and if the road is smooth, the sound increases in volume as the motor-cycle approaches the observer. The noise dies away as the exhaust recedes . . . and then will suddenly appear to become louder for a few moments. This is due to the "refraction" of sound downwards towards the

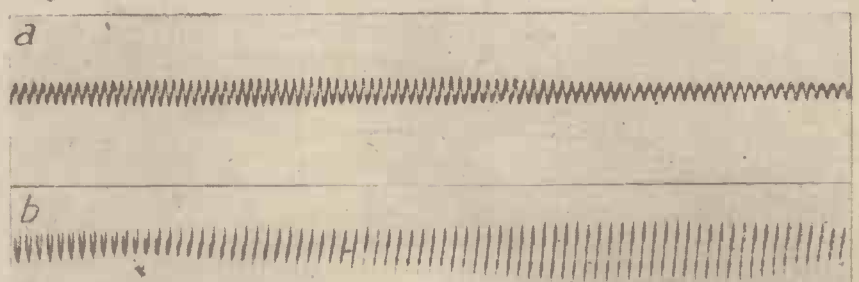


Fig. 5.—Records of the frequencies of the human voice. (a) The Melba trill. (b) Middle C and vowel. (c) Melba's chord exercise.

observer by the layers of hot air rising from the ground. The phenomenon is worthy of notice, for it represents a species of opposite effect to that of "seeing" blast.

The speed of sound—1,100ft. per second in air—is far higher through solids . . . gunfire can often be heard twice—first by earth and then by air. Compared with light, at 186,000ft. per second, all sound is slow . . . and it is amusing to recall that a man broadcasting from New York is heard in England before his voice reaches an observer standing at the end of the broadcast studio.

The Audiometer

As in most physical problems, it is necessary to judge sound by its effects and to translate them into some visible form. It is for this purpose that the audiometer—a sensitive optical kymograph—was designed. Fig. 4 shows in diagram form a simple plan of this instrument. Quite satisfactory results can be obtained from rough apparatus, the important item being the diaphragm, which is best made by floating a few drops of a solution of celluloid on amyl acetate in a bowl of water. The film can be lifted out on a ring of about 2¼in. diameter, and gently lowered on to the aperture of the horn.

By using a disc with a blackened edge and carrying white lines approximately ¼in. apart, very good wave forms are obtained. The diaphragm carries a light mirror of, say, ⅛in. diameter, and reflects the image of a slot at the source of light on to the spinning disc. A gramophone table makes a convenient drum to hold the marked paper—or film, if records are required.

Such an instrument, if well made, will record up to frequencies of 30,000 per second. The diaphragm need be no thicker than a soap bubble. Fig. 5 shows some simple records; the diaphragm can be calibrated, and an analysis made which is not distorted in any way by electrical difficulties such as are often experienced in some oscillograph tests.

Noise, although sometimes useful to the engineer, implies waste. It reduces the efficiency of workers, it is a common source of nervous disorders, and it should be treated as a harmful "waste product." In automobiles noise is one of the distinguishing features between good and bad, and in radio it should be restrained in the interests of accurate reproduction.

Until the time comes when people less closely resemble animals, and can communicate without "noise," the public should realise that unwanted air oscillation is as bad as unwanted smell. Let us agree then, that, with our modern knowledge of sound, we may soon learn that the opportunity for "seeing blast" is something which should be confined to more useful explosions than those under which our so-called civilisation now suffers.

Instruments for Motor-cars and Aircraft

The Sperry Gyroscopic Pilot

(Continued from page 53, November issue)

By JEREMY MARTIN

COMMERCIAL flying having started again, and with the tentacles of commercial airlines eventually reaching farther and farther into uncharted wildernesses and crossing the trackless oceans, and with the need for regular scheduled services to be maintained, in all conditions of weather, etc., the physical strain upon the pilots of such aircraft will increase enormously. Long flights involving many hours of physical endurance show the necessity for some mechanical means of piloting the aircraft to be evolved, thus relieving the tension and strain upon the human element.

This has been most efficiently carried out in the Sperry Gyro Pilot, which by ingenious adaptation of existing gyro instruments, e.g., artificial horizon and direction indicator, will keep the aircraft in straight and level flight, upon the aircraft's set course.

This does not mean that it will maintain the aircraft at a set altitude.

It should not be assumed that this gyro pilot permits the crew to assemble in the bar of the aircraft and indulge in a quiet game of cards while the aircraft carries on to its destination. There must at all times be a qualified member of the crew in the cockpit ready to take over the controls at a moment's notice, should the occasion arise, or should the gyro pilot break down. What the gyro pilot does do is to relieve the pilot of the physical strain and, to a large extent, mental boredom of manhandling the controls for hours on end, since an aircraft's progress through the air is not one of uninterrupted smoothness; such things as air pockets, sudden gusts of wind, driving rain, icing, etc., being but a few of the hazards with which the pilot has to contend.

Method of Establishing Control

A modified version of the directional indicator and artificial horizon is housed in one mounting fitted in front of the pilot. The directional gyro unit controls the rudder of the aircraft and therefore the course, whilst the artificial horizon controls the elevators and ailerons, thus keeping the aircraft laterally and longitudinally level.

As shown in the diagram (Fig. 27), attached to the respective rings of the gyros are D-shaped discs, and placed adjacent to the discs and attached to the units are the "pick-off" tubes, so arranged that the slot in the pick-off tubes are half covered by the D-shaped discs. These "pick-offs" are connected by a small pipe line to each side of an air relay valve, situated on the mounting unit, and a flow of air passes through the air relay valve into the unit via the "pick-offs." The diaphragm of the air relay valve is connected by a spindle to the piston of a balanced oil valve, to which the air relay transmits the control. The purpose of the balanced oil valve (Fig. 32) is to transmit oil pressure down to the Servo units which are the means of control of the aircraft.

Action

When the aircraft meets a disturbance the gyro and D-shaped discs maintain their position, but the "pick-offs," moving with the aircraft, travel over the D-shaped disc. This will unbalance the pressure (air pressure) in the air relay valve and the diaphragm will move. With the movement of the diaphragm, the piston of the balanced oil valve will move, thus oil will flow down to one side of the Servo unit. The consequent pressure built up causes the piston of the Servo to move, and control is applied to correct this disturbance. It must be understood that it is necessary to limit the amount of control applied proportional to the disturbance, and in order to effect this the "pick-offs" are geared and connected by a "follow-up" cable to the Servo which centralises the "pick-offs" relative to the D-shaped discs.

Directional Gyro Unit

In the directional gyro unit is embodied a "free" gyroscope having its axis of spin horizontal. The outer ring being pivoted

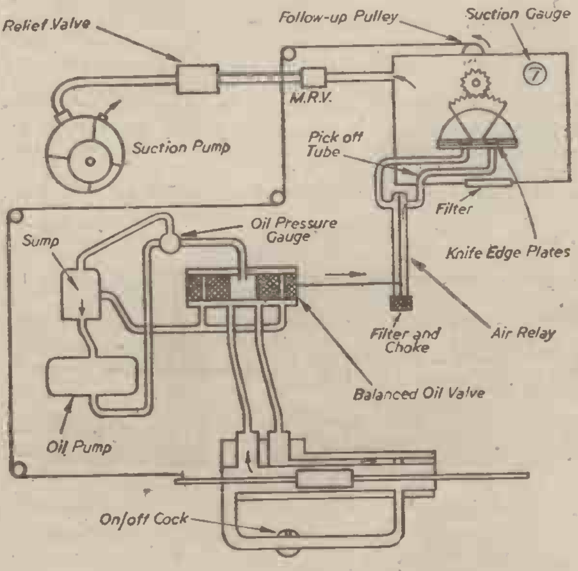
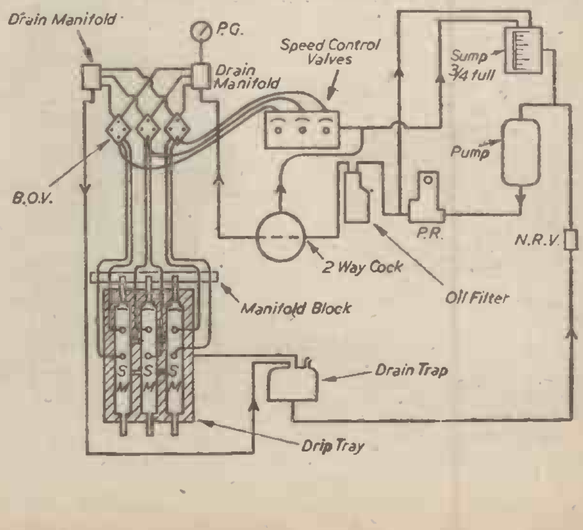


Fig. 27 (left) and Fig. 28. Schematic diagrams of the system for controlling the automatic pilot. On the right is shown the oil pipe-line layout.



vertically, controls the rudder. The D-shaped disc in this unit is attached to the top pivot of the outer ring, whilst the "pick-off" is on the top of the unit. A card which is engraved from 1 to 360 degrees is carried on the outer ring, as in the earlier description. This is viewed in relation to a lubber line which is engraved on the case. The follow-up index card is attached to the "pick-off" and is placed above the compass card, indicating to the pilot the relative position of the "pick-offs" and the D-shaped disc. As with the directional gyro this unit is reset at frequent intervals to compensate for the rotation of the earth. A manual setting control for course change and a cross level indicator are also fitted on the front of the case. This cross level indicator consists of a curved glass tube which is filled with alcohol, and in which is contained a small steel ball. At the back of the unit are to be found a spring-loaded follow-up clutch disc; electrical connections and grommet connections to the air relay and main suction.

Artificial Horizon Unit

The artificial horizon unit consists of a gravity controlled "earth" gyroscope, having its axis of spin vertical. The inner ring is pivoted athwartships and controls the elevators and any disturbance in pitch. A vertical "bail" ring is also pivoted athwartships in the case and moves identically with the inner ring. This bail ring serves to detect movement of the aircraft in pitch, and has mounted, at the right-hand athwartships pivot, a baffle plate and D-shaped disc, while the elevator "pick-off" is attached to the unit. Also attached to the bail ring is a metal stamping in the form of an aircraft outline, which, in relation to the horizon bar, indicates the pitch attitude of the aircraft. The outer ring is pivoted fore and aft and controls the ailerons and the aircraft laterally. The baffle plate and D-shaped discs are attached to the rear pivot of the outer ring, with the "pick-off" at the rear of the case. If the aircraft rolls it is indicated on the dial by the relative movement between the metal stamping and the horizon bar on the outer ring. "Follow-up" on this unit is arranged as before, by gearing the "pick-offs" to the follow-up pulley on the mounting unit. This follow-up pulley is connected to the Servo units by cable connection. Follow-up lubber marks indicate the relative position of the pick-offs and D-shaped discs. Also fitted to the front of this unit are elevator/aileron control knobs and a caging knob.

At the rear of the unit are grommet connection to air relays main suction connection and the electrical circuit connections. There are also two spring-loaded follow-up clutches which contact the follow-up pulleys on the mounting unit.

Components

Vacuum Pump.—This pump is the same as that used for the gyroscopic instruments.

Suction Relief Valve 1.—This represents a metal casing in which is housed a disc carried on the end of a spring. This regulates the amount of suction supplied to the mounting unit. It is fitted on one end of the mounting unit. This relief valve is fitted to enable a fine adjustment to be made to the suction in the system and allows for a difference in suction between the two extreme ends of the pipe line.

Suction Relief Valve 2.—This valve is fitted in close proximity to the suction pump, in a position of greatest convenience. It is similar in construction to the suction relief valve 1, its use being to prevent excessive operation of the latter valve, and to protect the air system, pipe lines and fittings against

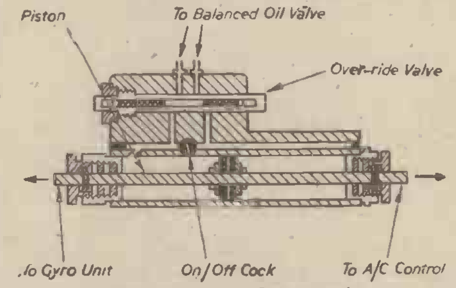


Fig. 33.—The Servo unit

any excessive suction being built up. This valve is used to make all coarse adjustment to the supply.

One-way Valve.—This is inserted in the suction pipe line, to prevent the ingress of oily air into the gyro units in the event of the engine "back-firing."

The Air Relay Valve (Fig. 29).—The purpose of this valve is to transmit the control from the gyroscope to the balanced oil valve. It consists of two aluminium alloy castings, bolted together, with a skin diaphragm between. This diaphragm is strengthened with two metal discs and has a spindle attached to the centre. This spindle or "con" rod is connected to the balanced oil valve piston. Air is drawn into the valve through a filter at each side; it then passes to the "pick-offs" in the unit. Normally the ports are half covered and the air pressure in the relay is equal. If the aircraft is disturbed, then the movement of the "pick-offs" over the D-shaped disc causes the pressure to be unbalanced in the air relay with consequent deflection of the diaphragm, with the resultant movement of the balanced oil valve piston.

The Oil Pump (Fig. 30).—The purpose of this pump is to supply the system with oil, under pressure. This represents a light alloy casting lined with phosphor bronze, in which are two gears meshing with each other. One gear is an idler gear, the other the driver gear. The driver gear is connected to the engine crankshaft. The oil inlet union is at the side of the pump, where the gears turn away from each other. The oil is drawn in at this point and carried around by the gears, thus being forced out through the outlet union.

Oil Pressure Regulator (Fig. 31).—The purpose of this component is to regulate the pressure in the system to a constant pressure. It consists of an alloy casting, leading to the pump, oil filter and sump. Down the centre of the regulator is a hollow spring-loaded plunger which covers the outlet to the sump. As the outlet to the oil filter is smaller than the inlet union, pressure is built up, which, when over a predetermined figure, lifts the plunger off its seating and allows the excess oil to flow back to the sump.

Oil Filter

This is inserted in the system in order to ensure that the oil is clean before passing to the balanced oil valve. It represents a metal casting in which is housed a filter, comprising a number of metal stampings which are square, but which have cut outs at each corner. These are mounted on a spindle and each stamping is slightly offset from ites preceding fellow, thus forming a number of spaces through which the oil can pass.

Two-way Cock.—This is fitted between the oil filter and the mounting unit and provides a means of by-passing oil back to the sump, when carrying out repairs or inspections, on the mounting unit side of the circuit. It also enables the pilot, by either direct or remote control, to by-pass oil back to the sump, in the case of leakage, during flight.

Balanced Oil Valves (Fig. 32).—The use of this component is to transmit oil pressure to the Servo units in order to apply control. The valve is operated by the air relay, to which the piston is attached. It consists of a six-land piston, moving inside a valve casing. This casing has an inlet union, connected to the pressure manifold, while the two outlet unions are connected to the Servo unit. In addition an exhaust union leads away the exhaust oil from the side of the Servo unit opposite to that under pressure, to the sump, via speed control valves. A drain union leads away oil which might leak over the lands of the piston, back to the sump, via the drain manifold. The piston is spring loaded in order to assist centralisation of the air relay.

Servo Units (Fig. 33)

These units operate the control surfaces (ailerons, elevators and rudder) and the follow-up system. The three units are cast in one block, but each is a separate entity, entirely self contained. These consist of a cylinder in which compression is obtained by an assembly consisting of two cup-shaped washers, supported by two metal washers (the piston) and held in position on the central sleeve by two nuts which are drilled through and secured by two pins.

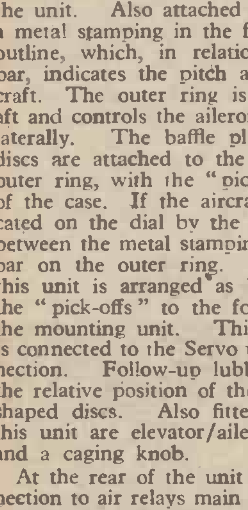


Fig. 30.—Detail of rotary oil pump.

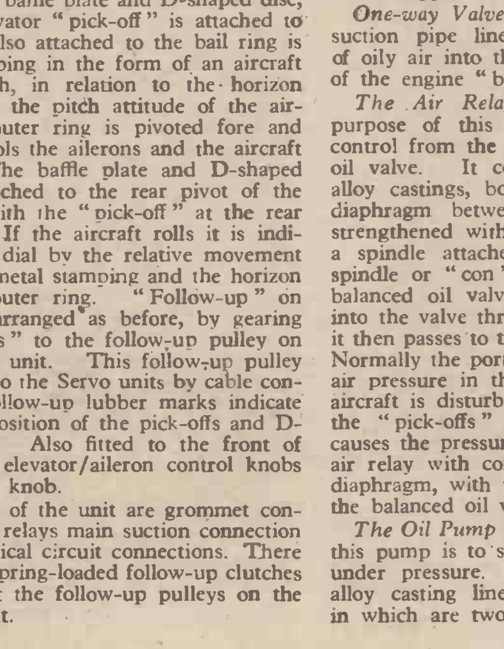


Fig. 31.—Section of oil pressure regulator.

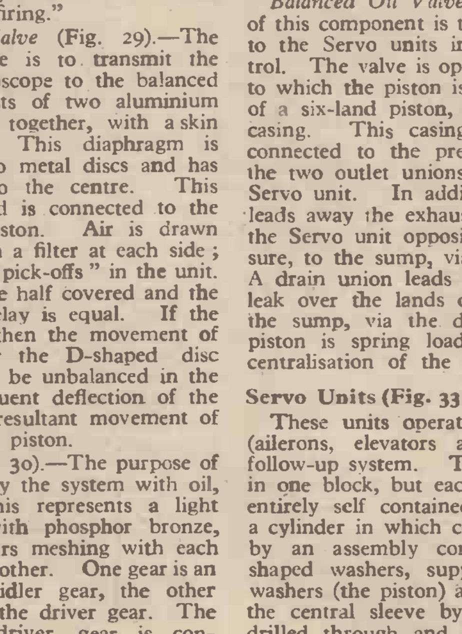


Fig. 32.—Section of balanced oil valve.

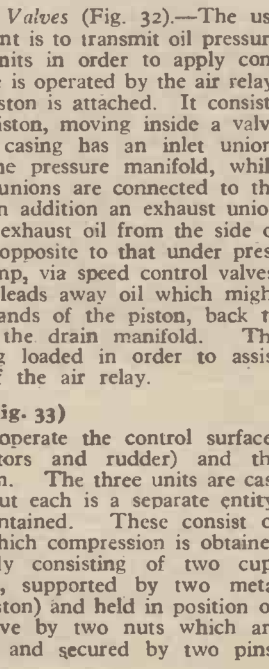


Fig. 29.—Air relay valve.

To make the cylinder oil-tight a gland is provided at each end. To make manual control possible a by-pass channel has been cut between the two ends of the cylinder and in the centre of this channel is fitted a simple "on/off" cock. This switch is connected to a lever in the cockpit, by means of a Bowden cable.

With the lever "on" the sides of the Servo unit are isolated from each other, and only movement of the balanced oil valve causes Servo action. With the lever "off" any movement of the manual controls causes the oil to flow round the by-pass. Incorporated in each Servo is a relief or "over-ride valve," which enables the pilot to regain manual control in an emergency, without using the engaging lever, to disengage the automatic controls. These spring-loaded valves are adjusted to lift at 25lb. per sq. in. above the normal working pressure.

Manifold Block

This is a junction between the flexible hose from the balanced oil valves and the metal pipes from the Servo units.

It will be understood that, by tapping in two pressure gauges—Bourdon tube type—the over-ride valves on the Servo unit can be checked.

Speed Control Valves

The purpose of these valves is to provide the pilot with a varying rate of control, depending upon varying weather conditions and different types of aircraft in which this installation might be fitted. It is pointed out that this varying rate of control is obtained irrespective of the working pressure. These valves have three inlet unions connected to the exhausts of the balanced oil valves and one outlet union connected to the sump. The valve screws into the casting and terminates in a slotted shank which regulates the flow of oil to the sump. Behind the shank is a spring-loaded plunger, the land of which covers and uncovers the inlet from the balanced oil valve, and thus allows oil to pass through the valve. Should the pressure build up in the system, the plunger is forced back and the land blanked off the inlet union, so stopping the flow of oil, except for a small quantity, which is allowed to flow over the two chamfers on the land. This prevents stoppage of the control. The dial setting (0-6) indicates the amount by which the valve is opened. Return channels permit drainage oil to return to the sump outlet.

The Drain Trap

This acts as a manifold when the mounting unit is below the sump level and to prevent air from being drawn into the system. It comprises a copper float, carrying a needle valve, which is normally kept closed by a spring, bearing down on the top of the float. Oil is always in the drain trap, and when sufficient oil has drained into the trap the float is raised and the valve opened. This allows oil to be drawn back to the pump, the float falling with the level of oil and the valve closing. By this method air cannot be drawn into the system. The drain trap is fitted below the level of the drain manifold, for it is gravity fed.

Non-return Valve

The purpose of this valve is to prevent any blow back of oil into the drain trap should the engine back-fire and reverse the direction of the pump. This is fitted in the return pipe line from the drain trap to the pump. This blow back of oil, of course, will only happen should there be sufficient oil in the trap to lift the float at the time of blow back. It also prevents drainage of oil from the sump to the drain trap, when the system is at rest.

Follow-up

The purpose of this is to limit the amount of control so that it is proportional to the amount of the disturbance, also to reduce the control applied as the aircraft assumes its original position. When the aircraft is subjected to a disturbance, the action between the "pick-offs" and D-shaped discs causes Servo action, during which the piston is moved through its full range and applies full control, irrespective of the amount of disturbance. In order to limit this Servo action it is necessary to return the "pick-off" central with the D-shaped disc. This is done by mounting the "pick-off" on a quadrant, which is geared, through a differential and clutch drive, to a follow-up pulley on the mounting unit. This is connected by cables to one end of the Servo piston, hence when the Servo is operated the quadrant causes the "pick-off" to centralise over the D-shaped discs, thus limiting the flow of oil to the Servo motor and consequently limiting the Servo action and the amount of control applied.

Disturbance in Pitch (Fore and Aft)

We will now see how all these component parts operate in a disturbance, and in order to do this we will take as an example a disturbance in pitch.

As the aircraft moves from its original position, there is relative movement between the "pick-off" and the D-shaped disc. This results in a difference in pressure in the air relay valve, thus causing a movement; consequently the balanced oil valve is moved, and some oil is fed to one side of the Servo unit. This impulse of energy carried on the hydraulic fluid causes control to be applied to the elevators, which builds up until the disturbance is checked. All this while "follow-up" is taking place, and limiting the valve opening so that the control applied is proportional to the disdrain manifold for it is gravity fed.

We now have "pick-offs" and D-shaped discs central, but control is still applied, which takes effect and brings the 'plane back towards its original position or pitch attitude, so moving "pick-offs" and D-shaped discs in the opposite direction. Thus we have a subsequent movement of the air relay valve and balanced oil valve, which again operates the Servo unit, but this time in the opposite direction, so removing applied control, follow-up once more centralising the "pick-offs."

A HANDY SLIDE RULE

TO meet a popular need of the present time Messrs. L. and C. Hardtmuth, Ltd., have introduced the "Classic" Slide Rule, which is an inexpensive but accurate instrument. It has four scales—adequate for all ordinary calculations—and inch and centimetre scales on the edges. Strongly made of seasoned Honduras mahogany, tongued and grooved, and reinforced with a flexible stock, unaffected by climatic changes. An unbreakable cursor, with metal ends, is provided.

The "Classic" Slide Rule is supplied in a strong pull-off shoulder box with full instructions. The instrument is priced as follows: Series 1, 5in. Pocket Model, 5s. 6d. Series 1, 10in. Model, 7s. 6d., obtainable from most stationers and drawing material dealers.

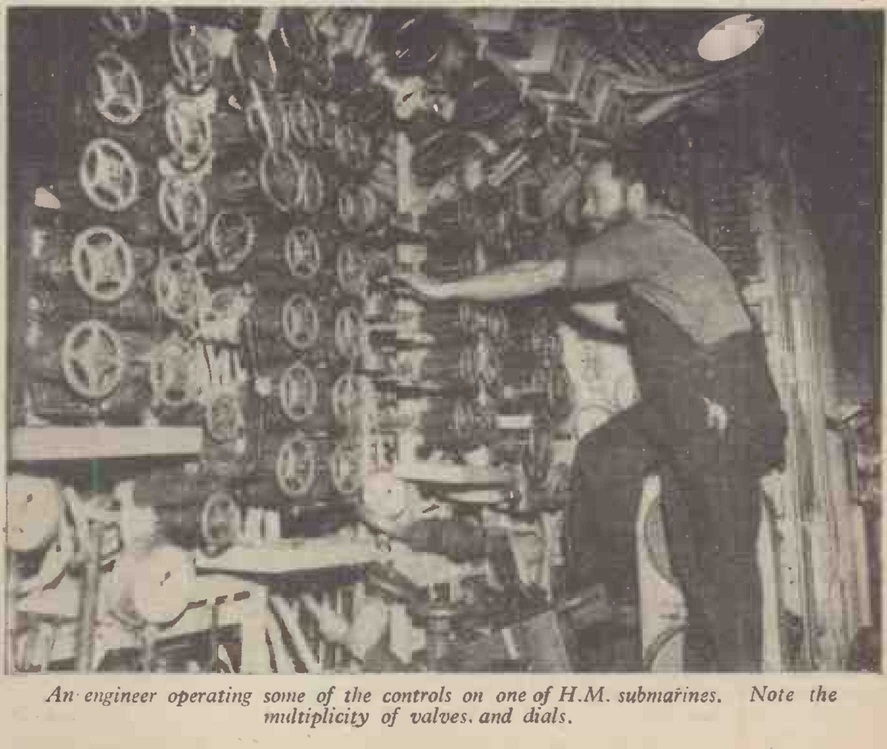
SOUND-FILM RECORDING AND REPRODUCTION

WITH reference to the article under the above title, published in our November, 1944, issue, readers should note the following: Page 63, column 2, the working voltage of the 0.01 to 0.05 mfd. earthing condenser should be 400.

The caption to Fig. 3, under the 9.5mm. film (projectors) should read, "*Amateur Films: Emulsion to lens for reversal stock (refocus sound-head). Away from lens for negative-positive stock only.*" The caption under 16mm. film (projectors) refers to 9.5mm. film (projectors), and under the former should appear, "*Emulsion towards lens. Sound-track 'inside' as shown.*"

Page 64, column 2, "*sound-sockets*" should, of course, be "*sound-sprockets.*"

Submarine Controls



An engineer operating some of the controls on one of H.M. submarines. Note the multiplicity of valves and dials.

Inventions of Interest

By "Dynamo"

Happy Landings

AN invention submitted to the British Patent Office relates to the mechanism for controlling the application of the pneumatic brakes of the landing wheels of aircraft.

It is claimed for the device that its mechanism ensures uniform pressure at each of every pair of wheels without the necessity of fine adjustments of the air supply as between the brakes of each pair of landing wheels. This permits ready escape of the exhaust from each brake mechanism and ensures that the individual control of the several brakes is operative only when the brakes are functioning.

It is hoped that this mechanism will enable the descending airman to be well landed in the happy sense of that term.

To Protect Landing Wheels

AN inventor points out that the wheels of the landing gear of aircraft, especially in the case of heavy 'planes, require considerable force to cause them to rotate in a short period of time.

This force is usually applied to the wheels by contact with the ground. Bearing in mind that, at the commencement of landing, the 'plane is partly airborne, it is evident that the adhesion on the ground is insufficient to make the wheels immediately rotate. As a result, a stoppage is found to occur. In other words, on first touching the ground, the wheels of existing aircraft act to some extent as skids, with consequent heavy wear and tear on the tyres.

The inventor in question has set himself the task of obviating this drawback. He has devised improved means of reducing the strain on the tyres and facilitate the landing.

It has already been proposed to provide a set of blades on each side of the rim of a retractable landing wheel, whereby the force of the windstream flowing past the aircraft is utilised to rotate the wheels before landing.

According to the new invention, the tyre of an aircraft landing wheel is furnished with cup-shaped or other projections which are acted upon by the windstreams.

This invention ensures that the wheels, during a certain period of time, while the 'plane is in flight before landing, are gradually speeded up into rotation, which may approximate to or arrive at a speed equivalent to the landing speed of the aircraft. Thereby, when the 'plane touches down, the shock and wear and tear on the wheels are reduced to a minimum.

To increase the effect of the windstream, the upper part of the wheel may be shielded by a fairing, so that the pressure of the wind will not act on the projections on the upper part of the tyre.

Cinder Salvage

THE residium of burnt coal is not necessarily rubbish. Cinder sifting has always been a characteristic of the thrifty housewife. A new domestic cinder sifting apparatus is the subject of an application to the British Patent Office.

The device comprises a container which may be made of wood or metal and is of a rectangular, box-like form. It has a hinged or other lid. A short distance from the top the side walls are fitted with horizontal rails upon which a screen is slidably supported by lateral flanges. The screen is in the shape of a tray a few inches shorter than the container and has a bottom of fine wire mesh. One end of the screen is fitted with a handle which extends through an opening in the container, and is of sufficient length to enable the screen to be reciprocated from end to end of the box. Immediately below the base of the screen is a shallow chute for directing the falling ash away from the walls and towards the centre of the base of a collector tray.

The top of the box may be of a convenient height for use as a stool, and may be upholstered. If desired, legs or feet can be provided to raise the base from the floor in order to elevate the stool to the requisite height.

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

Heel Grip

AT the present time stockings are in short supply, and this makes it of supreme importance that the limited quantity of hose should be of the utmost durability. There's many a slip 'twixt the human heel and the shoe. And this causes a strain on the fabric of the stocking, which, I presume, is the *raison d'être* of what is termed the heel grip. In addition to stocking protection, an effective heel grip makes for comfort.

A recent invention has been designed to provide an improved heel grip. And the inventor prefaces a description of his device by reviewing previous methods of stocking protection.

It appears that one common method has been to make a heel grip in two pieces, one of which is under the heel, while the other embraces the sides and back of the heel. These two pieces are sewn together. But the inventor of the new idea objects that such a grip has the disadvantage that it does not conform closely to the shape of the heel. And the stitching is not only a source of weakness but, unless carefully executed, it has a tendency to damage delicate stockings.

Another proposal has been to make seamless heel grips consisting of side and back portions or of side, back and bottom portions. Such heel grips may be made of vulcanised rubber or of sponge rubber, or they may be moulded cast or stamped from elastic material such as celluloid.

The new heel grip, it is asserted, is characterised by durability and attractive appearance, while being economical to manufacture. Seamless, and including at least side and back portions, it is made of a mouldable sheet material shaped to the contour of the heel. This material comprises synthetic resin. The outer surface of the grip is smoother than the inner surface, and consequently, a limited degree of movement in a vertical direction takes place between the back of the grip and the shoe.

Well-aired Grate

THE breath of life of a fire is oxygen. Therefore, to keep the home fires burning, plenty of air is a vital necessity. A new invention arranges for the admission of air to the fuel on the domestic hearth to enter through a separate channel from outside the room. In this way more effective combustion is secured, and there is an avoidance of the necessity of such air passing through the room and thereby causing unnecessary cooling.

Britain has its own oilfield areas. Scientists and technicians, prospecting in a rural district, which for security reasons cannot yet be mentioned, have struck oil. This is not shale oil, like that which has been produced in Scotland for many years, but real petroleum. Our illustration shows a jack pump at work in the oilfield.

Mathematical Problems—and Solutions

By J. COTTERELL, A.M.I.E.E.

THERE is a touching belief that mathematics will solve all questions. A belief often found in students of all types. This is noticeable to anyone who has taught mathematics to senior technical students. After a few years of this type of teaching, the author has, as a matter of interest and self protection, made a collection of these problems.

The problems which occur may be classified under three main headings, as follows :—

(1) The "catch type" of problem. (2) The "manufactured problem" generated to test mathematical ability. (3) The "utility type," which often have practical applications in industry.

Examples of the above types are as follows :

Type 1. A simple example, usually given to prove $2=3$. The working usually goes as follows :—

$$10-4=15-9$$

Completing square on both sides and we get

$$10-4-\frac{25}{4}=15-9-\frac{25}{4}$$

Taking the square root of both sides of the equation we get :

$$\sqrt{10-4-\frac{25}{4}}=\sqrt{15-9-\frac{25}{4}}$$

$$=\left(2-\frac{5}{2}\right)=\left(3-\frac{5}{2}\right) \quad \therefore 2=3.$$

Which only goes to show that the square root bogey is very real, or as "the prophet" says "there should be a $\pm$ in front of every square root evaluation."

Yet another of the first classification is the problem used to show that $2=1$.

e.g., Let $a=b$.

Multiply both sides by b.

We get $ab=b^2$.

Subtract from both sides a^2

We get $ab-a^2=b^2-a^2$

$=a(b-a)=(b+a)(b-a)$

$\therefore a=b+a$.

$a=2a$

$\therefore 1=2$.

Which all occurs because we multiply something by nothing.

Triangle Problem

Another one of the same type proves that every triangle is equilateral.

Consider the triangle shown in Fig. 1.

Given any triangle ABC. Bisect the apex angle A. Erect a perpendicular at the bisection of BC, i.e., X. Where the bisection from $\angle$A and bisection X meet call point P. Join BP and PC. Drop perpendiculars PY and PZ.

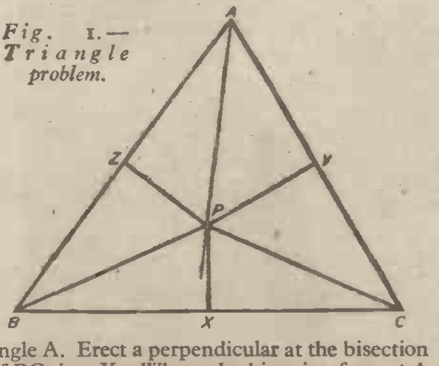


Fig. 1.—*Triangle problem.*

Proof. $P\hat{A}Y=P\hat{A}Z$.

also $P\hat{Y}A=P\hat{Z}A$

also $ZA=AY$

since $AZ\cos\angle\frac{A}{2}=AY\cos\angle\frac{A}{2}$

$ZP=YP$

By Pythagoras $BP=\sqrt{BX^2+PX^2}$

also $PC=\sqrt{BX^2+PY^2}$

$\therefore BP=PC$.

Since $PZ=PY$

$\therefore ZB=YC$

$\therefore AB=AC$

i.e., $\triangle$ is equilateral.

Here again the fallacy will be easily seen if the triangle is drawn to scale. When it will be seen that the bisector of $\angle$A will meet the bisector of BC "outside" the triangle. Hence the lengths of sides become subtractive instead of additive.

Again, another of this type is the "series" one, e.g.,

Let $S=(1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{1}{5}-\frac{1}{6}+\ldots\ldots)$

i.e., converging to $\log_e 2$

since $S=(1-\frac{1}{2})+(\frac{1}{3}-\frac{1}{4})+(\frac{1}{5}-\frac{1}{6})+\ldots\ldots$

$=\frac{1}{2}+$ something

i.e., S must be greater than $\frac{1}{2}$.

but,

S may be written as equal to

$1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}+\ldots\ldots\ldots\ldots$

$-2[\frac{1}{2}+\frac{1}{4}+\frac{1}{6}+\ldots\ldots\ldots\ldots]$

$=(1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\ldots\ldots)+(-1-\frac{1}{2}-\frac{1}{3}-\frac{1}{4}-\ldots\ldots\ldots)$

$=0$,

which obviously is wrong. Why?

Why apply algebra to a converging series?

"Ladder" Problems

Type 2 has for examples the "ladders and ladder" problem and the "Hobbing" or "Donkey" problem, e.g., a 20ft. ladder leaning against a wall touches at the same time 3ft. cubicle packing case, as shown in Fig. 2.

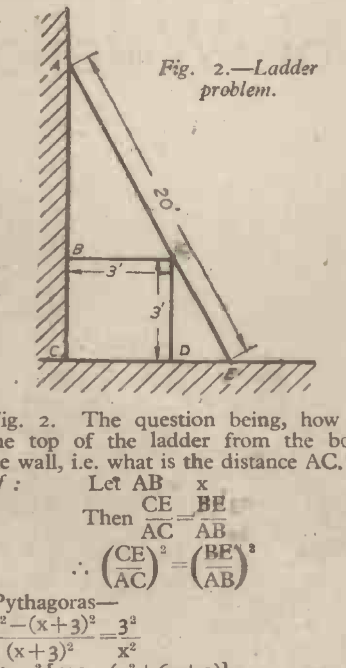


Fig. 2.—*Ladder problem.*

The question being, how high is the top of the ladder from the bottom of the wall, i.e. what is the distance AC.

Proof : Let AB x

Then $\frac{CE}{AC}=\frac{BE}{AB}$

$$\therefore \left(\frac{CE}{AC}\right)^2=\left(\frac{BE}{AB}\right)^2$$

By Pythagoras—

$$\frac{20^2-(x+3)^2}{(x+3)^2}=\frac{3^2}{x^2}$$

$\therefore x^2[400-(x^2+6x+9)]$

$=9(x^2+6x+9)$

$\therefore 0=x^4+6x^3-382x^2+54x+81$

Put $x=3y$

$\therefore 0=81y^4+162y^3-3438y^2+162y+81$

$$0=y^4+2y^3-\frac{362}{9}y^2+2y+1$$

$$\therefore 0=\left(y^2+\frac{1}{y^2}\right)+2\left(y+\frac{1}{y}\right)-\frac{362}{9}$$

Put $y+\frac{1}{y}=z$

then $0=z^2-2+2z-40.2$

$0=z^2+2z=42.2$

$\therefore z=\frac{-2\pm\sqrt{4+168.8}}{2}=-1\pm\sqrt{43.2}$

$=-1\pm6.57=5.57$

$\therefore y^2+1=5.57y$

$\therefore y^2-5.57y+1=0$

$\therefore y=\frac{5.57\pm\sqrt{5.57^2-4}}{2}$

$=\frac{10.77}{2}$ or $\frac{0.37}{2}=5.38$ or 0.18

$\therefore x=16.14$ or 0.54

Hence $AC=19.14$ or 3.54

The second ladder problem, which is called the ladder's problem, is as shown in Fig. 3.

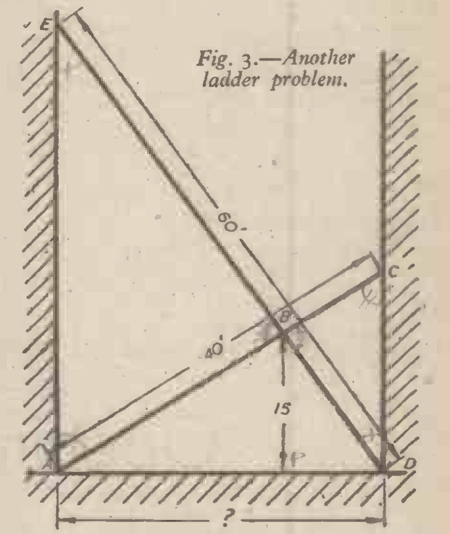


Fig. 3.—*Another ladder problem.*

Question is how wide is the street if two ladders, one 60ft. long, the other 40ft. long, cross at a point 15ft. above the street?

This may be solved as above or as shown below, by Pythagoras—

$CD=\sqrt{(1600-x^2)}$

$AE=\sqrt{(3600-x^2)}$

From $\triangle$ ACD $\frac{15}{\sqrt{(1600-x^2)}}=\frac{AB}{40}$ .... (1)

From $\triangle$ AED

$\frac{15}{\sqrt{(3600-x^2)}}=\frac{PD}{AD}=\frac{BC}{40}$ .... (2)

Adding equations (1) and (2) together we get

$$\frac{15}{\sqrt{1600-x^2}}+\frac{15}{\sqrt{(3600-x^2)}}=\frac{AB+BC}{40}=1$$

$\therefore 15\sqrt{(1600-x^2)}+15\sqrt{(3600-x^2)}$

$=\sqrt{[(1600-x^2)(3600-x^2)]}$

and by plotting

$f(x)=15\sqrt{(1600-x^2)}+15\sqrt{(3600-x^2)}$

$-\sqrt{[(1600-x^2)(3600-x^2)]}$ we get

$x=33.7$ft.

The Donkey Problem

The third problem of type 2, i.e., the donkey problem, has applications in practical workshop technology. This problem asks what must the length of the tether rope be if a donkey can graze half an acre out of a circular acre field.

There are several methods which can be applied to this problem, but all of them involve approximations.

Referring to Fig. 4, let radius of field be R and the length of the tether be r. Then

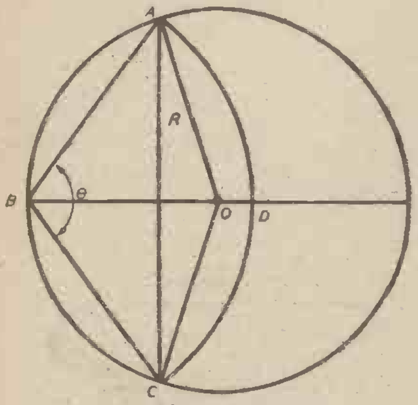


Fig. 4.—The donkey problem.

$R=\frac{\sqrt{4840}}{\pi}=39.25$yds.

Grazed area $=\frac{\pi R^2}{2}$

= segment ADCA (centre B radius r)+ segment ABCA (centre O radius R), so we have—

$\frac{\pi R^2}{2}=\frac{r^2}{2}(ABC-\sin ABC)+\frac{R^2}{2}$

$(AOC-\sin AOC)$ .... (1)

Let $ABC=\theta_1$ then $AOC=(2\pi-2\theta)$

and $\frac{r}{2R}=\cos\frac{\theta}{2}=\sqrt{\frac{1+\cos\theta}{2}}$

or $r=2R\sqrt{\frac{1+\cos\theta}{2}}$

Substituting these values in (1)

$\frac{\pi R^2}{2}=R^2(1+\cos\theta)(\theta-\sin\theta)$

$+\frac{R^2}{2}(2\pi-2\theta-\sin 2\pi-2\theta)$

i.e. $\frac{\pi R^2}{2}=R^2\theta+R^2\cos\theta.\theta-R^2\sin\theta$

$-R^2\sin\theta\cos\theta+\pi R^2-R^2\theta+\frac{R^2}{2}$

$\sin 2\theta$

i.e. $\frac{\pi}{2}+\cos\theta.\theta-\sin\theta=O$

By plotting $y=\frac{\pi}{2}+\cos\theta.\ \theta-\sin\theta.$

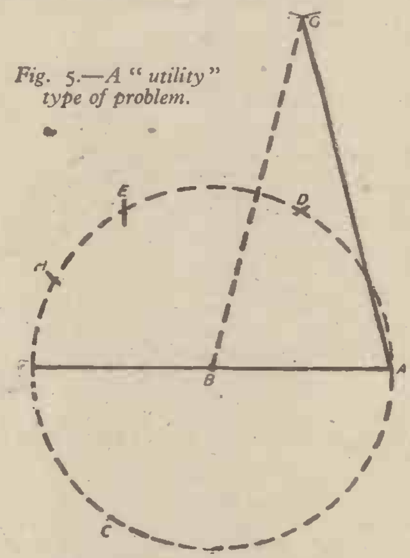


Fig. 5.—A "utility" type of problem.

we obtain $\theta=109.1$ deg.
from which $\cos\theta=-0.3272$

Hence $r=2R\sqrt{\frac{1+\cos\theta}{2}}$

$=2\times39.25\times0.58$
$=45.6$ yds.

Examples of the Third Type

Bisect a given straight line (Fig. 5) by the use of only a pair of compasses.

Construction

Given line AB. Then with B as centre and AB as radius describe a semicircular arc AC, with centre A and radius AB step around the arc AC marking off at D, E and F. Then point F is diametrically opposite A.

With centre A and radius AF describe arc AG at G. With centre G and radius AG, describe an arc cutting AC at H.

Then HF is half AB.

Proof.—The angle HBF is equal to the angle subtended by the arc HBA at any point of the remainder of this circle and so,

$\angle HBF=\frac{1}{2}\angle HGA$ at the centre.
$=\frac{1}{2}BGA$

Hence the isosceles triangles HBF and BGA are similar and

$\frac{HF}{FB}=\frac{AB}{BG}=\frac{1}{2}.$

A further example, which is also a useful method for draughtsmen, is to trisect an angle.

To trisect the angle BOA (Fig. 6), draw a circle C of centre O.

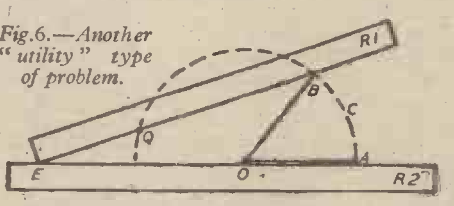


Fig. 6.—Another "utility" type of problem.

Mark the distance EQ=OB, the radius of C, on the ruler R_1 from the end E.

Place the ruler R_2 along OA.

Shift the ruler R_1 with its end E on R_2 until the point Q is on the circle and R_1 passes through B.

Then the angle AEB = $^1/_3$ AOB.

In conclusion, and to put a Diderotian touch to this article, the author was once asked by a colleague to translate the following French proverb.

"Pas de le rhone que nous."

After a concentrated struggle with a limited knowledge of French, the proverb proved master, until it was found that this particular proverb has to be translated phonetically, in which case the proverb sounds like "paddle your own canoe."

Opening of Waterloo Bridge

Waterloo Bridge was opened recently to six lines of traffic, and a second stairway adjoining Somerset House was brought into use. Our illustration gives a general view of the bridge as it now appears.

Fixing Roofing Felt

How to Cover Sheds and Outhouses to Keep Them Waterproof

By "HANDYMAN"

ONE of the jobs in the garden which should receive attention at this time of the year, if not already done, is the fixing or repairing of the roofing material on workshop sheds, poultry houses, and any other outdoor wooden structures. The material generally employed is bitumen felt, or sanded felt, which is obtainable in rolls 12 yds. by 1 yd. wide. Small pieces can also be obtained to the length required.

Although quite a simple job, there are correct methods of fixing roofing felt, and these should be followed if the roof to be covered is to be waterproof. Also, if not laid properly, the felt is likely to be lifted and torn by the first strong wind.

When cutting the felt to the lengths required, it is a good plan to use a planed wood batten, about 3ft. 6in. long, and having a straight-edge for guiding the knife, as in Fig. 1. Either a lino knife, with a curved point, or a shoemaker's straight knife can be used for the purpose, and when cutting the felt it should be laid on a piece of board, or on the roof of the uncovered shed.

In cases where the ends of the roofing boards of a shed are decayed, or split, saw them off flush with the ends of the shed and nail on a length of matchboard, or plain boarding, to act as a fascia board. This will afford a secure fixing for the nails in the roofing felt.

Another point which may be noted is that all the boards of a shed roof should be made as level as possible before commencing to lay the roofing felt.

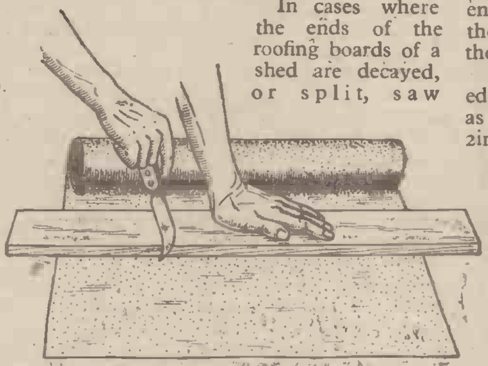


Fig. 1.—Method of cutting roofing felt with the aid of a straight-edge and lino knife.

Covering a Lean-to Shed

To cover a small lean-to shed the felt should be laid lengthwise across the roof, as shown in Fig. 2, the lowest strip being laid first, and the edge of each strip overlapping the edge of the one below it by about 3ins., as indicated in the illustration. When cutting the felt allow sufficient for bending the ends of each piece about 1½ins. over the edges of the roofing boards. For fixing the felt, use short, galvanised clout nails, as in Fig. 3. Long nails which penetrate through the boards should on no account be used.

After fixing the first piece of felt in place bend the long edge over and nail it to the edge of the roof board, as in Fig. 2, spacing the nails about 3ins. apart. The overlapping edge of the next piece of felt can now be nailed down, and the two ends turned down and fixed in the same way, and so on till the last piece is fixed in position.

When a vertical joint has to be made, the edges of the felt should overlap at least 9ins., as shown in Fig. 4, the fixing nails being 2ins. apart.

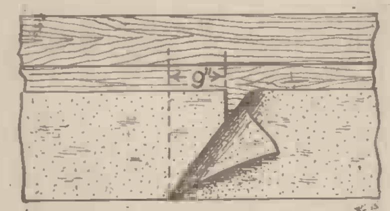


Fig. 4.—All vertical joins should have a wide overlap as shown.

A Span-roof Shed

For covering this type of shed, or outhouse, lay and fix the roofing felt in the same way, working up from the eaves on both sides. Do not bend the felt over the ridge of the roof, but cut it just short of the top edge, as shown in Fig. 3. Cut a strip of the felt, about 10ins. wide, to form a capping piece, and bend it centrally over the ridge, as indicated. Fix it in place with nails spaced about 3ins. apart.

In cases where a shed is much exposed to winds, thin wood laths running from the eaves to the ridge of the roof should be screwed down over the roofing felt, as shown in Fig. 5. Ordinary white wood laths, 1¼in. by ¼in. thick can be used, and they should be spaced about 2ft. apart. Give the laths a coating of creosote before fixing them in place with glavanized screws. Nails should not be used, as they are liable to be drawn out, causing leaks, if the laths twist or warp.

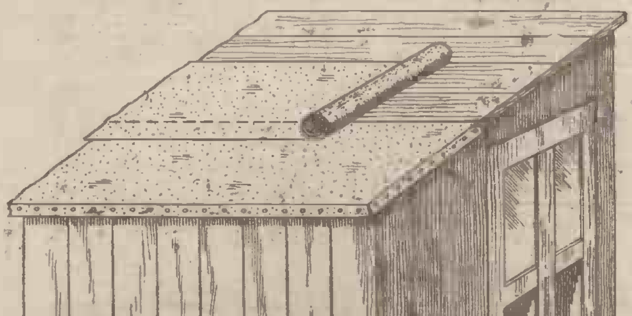


Fig. 2.—How to lay the felt when covering a lean-to shed.

Covering Shed Sides

The sides and ends of a shed can also be covered with roofing felt in the same manner, if desired. Start at the bottom of the shed, and work upwards, allowing the same overlap for each piece of felt as used for the roof. Laths can also be used on the sides, placed vertically, and spaced 1ft. 6ins. to 2ft. apart.

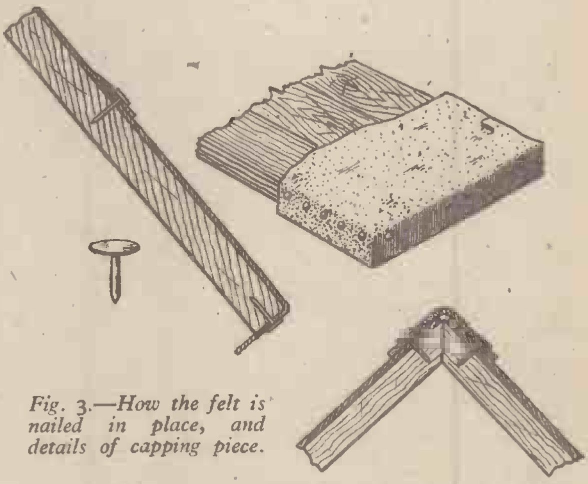


Fig. 3.—How the felt is nailed in place, and details of capping piece.

Fixing to Brick Wall

When covering a lean-to shed against a brick wall, it is important that the roofing felt is attached to the wall in such a way as to prevent leakage at the joint. The best way to do this is to rake out the mortar from the first course above the roof level. Then cut a strip of roofing felt, about 8in. wide, bend over the edge, tuck it in between the bricks, and fill with cement mortar.

An alternative method, which avoids raking out the mortar, is to cut the roofing felt so that it just butts up against the wall, and then complete the joint with a fillet of plastic compound. On no account should the felt be nailed to a brick wall.

Another point to bear in mind is that it is always advisable to fix roofing felt when the weather is dry.

Do not leave work unfinished, especially in windy weather, without properly fixing loose edges and ends, or the felt will probably be lifted up and torn.

Finally, do not attempt to nail down a cut or torn piece of felt. It is much better to cut the felt across at the damaged part, and then make a proper lap joint.

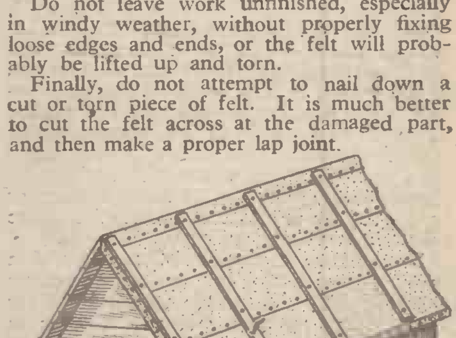


Fig. 5.—For a span-roof shed, the felt is laid, as shown. If the shed is much exposed to wind it is a good plan to fix laths over the felt, as indicated.

The Menace of the Moth

The Modern Attack on an Age-old Problem

IN pre-war times, the common clothes-moth was responsible for damage amounting in the aggregate to many thousands of pounds annually in this country alone. Its depredations, both in household and in warehouse or storage premises, were widespread and well recognised.

Moth grubs at work on a woollen garment. (Close-up photograph magnified about three times.)

Nowadays, the moth problem has become a still more urgent one, not merely in consequence of the great quantity of textile fabrics and furnishings which, for various reasons, are undergoing prolonged storage, but, also, in view of the considerably greater value of such articles which the inevitable conditions of wartime scarcity have brought about.

The problem of the moth is, unfortunately, a perennial one. Modern research seems only to have awakened to that fact within comparatively recent years. And still more unfortunately, the moth menace is one which has as yet by no means been conquered.

To prevent clothes-moths and other winged fabric-eaters from breeding and living on ordinary textile materials seems, at the outset, to be a relatively simple problem. Yet exactly the contrary has proved to be the case. It is, in fact, extraordinarily difficult to treat textiles with a moth-repelling or a moth-poisoning agent without in some degree deteriorating or, at least, altering or modifying the desirable characteristics of the fabric in question.

You cannot, for example, moth-proof a woollen garment by any method or process which would result in the garment becoming hard, tough, leathery, sticky, smelly, or in any other way undesirable or unwearable. Likewise a carpet, a tapestry fabric, or even the important and delicate felting of the household piano action—to mention merely three miscellaneous materials—cannot be submitted to any moth-proofing process which would in any way detract from their individual properties.

It is for the reason that the moth-proofing agent is either not sufficiently and universally potent or that it in some respects alters the nature of the material to which it is applied that the summer moth problem is still with us. More than one laboratory in this country is at present working on the problem of the perfect moth-proofer, although, up to the present, the ideal agent or method for this purpose has still eluded discovery.

Life History

In order to deal with any technical problem of moth attack one must have a reasonable idea of the life history and the habits of these insistently destructive pests.

There are quite a number of different species of fabric-destroying moths. There are, in addition, a few types of beetles which evince similar activities, particularly in the realm of carpets and other floor coverings; but since these latter creatures have similar destructive propensities to the clothes-moths, measures taken for the eradication of the one will also serve to eliminate the other.

It should be noted that the clothes-moth itself is harmless and non-destructive. It is probable that throughout its short adult life it never eats or takes nourishment of any sort whatever. Hence the popular story referring to the eating of garments by clothes-moths is quite erroneous.

Nevertheless, the clothes-moth's potentialities for evil and destruction are enormous. For it is just this little, delicately-structured insect which, as it wings its fluttering flight from room to room or from wall to wall, lays its microscopic eggs singly or in twos and threes on fabrics which, by

Common clothes-moths photographed against a background of wool felt.

some startlingly accurate instinct which it seems to possess, provide just the right conditions of nourishment and growth for the tiny, thread-like grubs or "larvæ" that will, a few weeks later, hatch out from the deposited eggs.

When first hatched these grubs are about 1/16th of an inch in length, being thus almost completely invisible except when they are on a black cloth. When full grown, they are about a quarter or a third of an inch long, and, sometimes, even longer. Their period of growth to full maturity takes anything from eight or ten weeks to a couple of years or more, depending upon the species of the grub and the precise conditions of its environment.

Grub Cases

Some of the grubs remain "naked" throughout their career, but quite a number of species construct little cylindrical cases for themselves out of minute filaments of fibre and cloth, and in these they live and have their being, merely projecting their powerful black jaws from the upper ends of their cases in order to devour the succulent fabric which, as it were, exists on their doorsteps. As they move slowly over the fabric, they drag their cases with them, and at the least sound of danger they instantly withdraw their heads into their houses and remain so enshrouded until the danger has passed.

Many blanket-eating grubs have this propensity for building their own cases or houses, and it is just this fact which renders it so difficult to detect them, for the moth cases look just like tiny elongated shreds of wool. Moreover, these cases resist ordinary pressure quite well, so that in the ordinary handling or folding of a blanket or other fabric article, the grub creature within is usually unharmed.

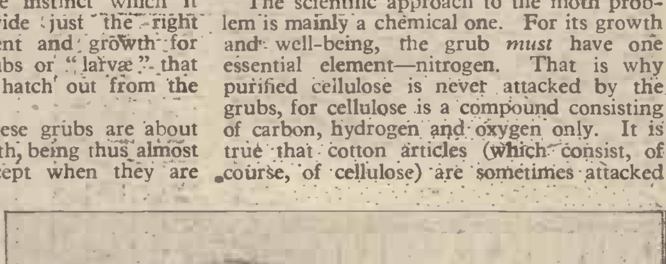
Arrived at its full maturity, the grub seals off the end of its "case" and retires within to undergo its natural transformation through the dormant chrysalis or "pupal" stage into the winged moth. If the grub is one of the "naked" variety, it constructs a protective cocoon for itself before becoming dormant.

The chrysalis stage lasts for about a month before the moth at last emerges to carry on its evil work of egg-laying. The grub usually undergoes its pupal or dormant stage between the months of April and September. Hence the abundance of adult moths during the summer months. Any grub which becomes a pupa in the autumn usually remains dormant throughout the winter and so forms one of the first squadrons of the ensuing year.

During the period of its growth and its pupal stage, the moth grub naturally seeks out the quietest and the most undisturbed conditions available. That is why the pests are never found in obvious places on the surfaces of fabrics and garments. They seek always the hidden parts, the folds, crevices, seams, underparts, and similar areas of textile fabrics where they have a far greater chance of effecting their habitual damage unmolested.

Necessary Nitrogen

The scientific approach to the moth problem is mainly a chemical one. For its growth and well-being, the grub *must* have one essential element—nitrogen. That is why purified cellulose is never attacked by the grubs, for cellulose is a compound consisting of carbon, hydrogen and oxygen only. It is true that cotton articles (which consist, of course, of cellulose) are sometimes attacked



A clothes-moth larva within its "case." It encloses itself in a cylindrical jacket made from particles of hair, fabric, etc., bound together and lined with its own silken secretion. (Photomicrograph × 16.)

by moths, but this is only the case when the cotton fabric is soiled or dirty. In other words, when it has been contaminated or impregnated with traces of nitrogen-containing materials which provide suitable "vitamin material" for the moth grubs.

Keratin is a constituent of hair, fur, and similar "animal materials." Keratin contains nitrogen. Hence the fact that the moth grub has a decided partiality to furry materials and to fabrics which contain interwoven hair fibres.

Elements of Growth

The moth grub, too, must have a certain amount of fat or grease. Flatten an adult moth against a wall and you will observe a decided grease stain around the dead body of the insect. This is fat which it has obtained during its larval or grub stage. A moth grub cannot thrive on a completely fatless fabric. Conversely, the more fat the fabric contains, the better the grub likes it. It is for this reason that the adult moth, by its strange instinct, always chooses to deposit its eggs on soiled and greasy garments and fabrics rather than on clean ones.

Another factor which applies to grub growth in the case of clothes-moths is that the grub must have a certain minimum amount of moisture in the fabric food which it devours. If the material is perfectly dry, the grub cannot thrive or even make headway. That is why damp houses produce far more moths than do dry houses.

Given keratin, fat and moisture, the undisturbed moth grub, finding itself completely unrationed, will make the best of its good time, feeding voraciously upon the material which circumstances have rendered available to it. Wool and fur, being highly nitrogeneous materials, and usually containing some fat or oil, form the moth grub's favourite diet. Well-washed, dry cotton is little other than dry bones to the creature, and it usually avoids this material. Not so pure silk, however, which is a nitrogen-containing product, and therefore provides a highly palatable food for the hungry young grub.

The main facts concerning the clothes-moth grub's history and physical requirements having now been summarised, it follows that any attempt by the ordinary householder at the control of the moth must take such factors into consideration. Thus, for example, all materials should be made scrupulously clean before putting away into store. Dampness should be avoided whenever possible. Periodic cleaning, if only by way of dust removing, should be given to all articles which are liable to moth attack. Carpets should not only be swept or vacuumed on their upper sides, but, also, from time to time, on their reverse sides.

Despite a prevalent opinion to the contrary, moth balls and other volatile, odorous materials do tend to repel the egg-laying moth, but it is doubtful whether the mere vapour of these materials will suffice to poison a grub after it has once been hatched.

Chemical Moth-proofing

There is, at present, hardly any chemical treatment which can be given by an owner for the moth-proofing of articles of attire, soft furnishings and the like. For heavy, coarse fabrics on which a stain would not be objected to, a simple and reliable method of permanent moth-proofing and eradication is to dissolve twenty parts of copper oleate or copper naphthenate (or zinc oleate or zinc naphthenate) in paraffin oil, and to brush this over both sides of the fabric, subsequently hanging it out in the open for the paraffin to evaporate. Complete protection is thereby assured, but some staining will result.

The dormant chrysalis or pupa of the clothes-moth from which the moth itself emerges. (Photomicrograph × 12.)

Pupa cases of clothes-moths within a fold of woollen fabric. Their actual size may be gauged by that of the ordinary needle seen in the illustration.

Another moth-proofing agent which can be applied in the home to non-wearable fabric articles comprises a 50-50 mixture of naphthalene ("moth balls") and para - dichlor - benzene in benzene or some other suitable non-aqueous solvent. About ten parts of the mixed solids in ninety parts of solvent will suffice. Here again, however, this treatment has the decided objection of imparting a strongly-smelling substance to the fibre, which fact renders the method unsuitable for any general use.

Researchers in these problems have classified moth-repelling materials into (*a*) volatile, odiferous compounds, such as chlorphenols, dichlorphenols, perchlorethane, etc., and (*b*) non-volatile impregnating agents, such as diamylphenol and allyl mustard oil, thiourea, various fluorides, and other mineral compounds. It is in the investigation of such substances in relation to their moth-proofing action that modern research seems to be working.

Quite a multitude of chemical agents, organic and inorganic, have been experimented with for the above purpose, but by far the greater majority of them are attended with too great disadvantages to be of any use for the purpose.

Part of a woollen blanket, showing damage done by larvæ of the clothes-moth in a couple of weeks.

Tests on Moth Grubs

In laboratories, a standard test for the effectiveness (or otherwise) of a moth-proofing agent is now adhered to. This test consists in feeding a number of active moth grubs of the one generation on a standard area of suitable moth-proofed fabric for a definite period of time. If the grubs die quickly, the efficiency of the proofing agent is considered proved. If the grubs do not die, but, on the contrary, continue to thrive, the conclusions are obvious.

Usually, in the above test, the grubs linger on for a considerable period. They are weighed before the beginning of the experiment and after the elapse of a given period, their loss in weight being taken as an indicator of the efficacy of the moth-proofing substance.

Numerous are the patents and provisional patents which have been taken out for moth-proofing agents, but, somehow or other, none of them has yet come into established use.

One interesting patent due to Wm. Lowe (B.P. 532,975) makes use of a mixture of chromium fluoride and sodium antimony-fluoride. This powder is dusted on to the material, which latter is then heated to 70 deg. C. in order to effect a firm union between the fibres of the textile material and the grains of the powder. The mode of attachment of the powder grains to the fibre is not completely understood. Nevertheless, such a treatment results in quite an adequate and permanent moth-proofing of the fabric. Another similar agent for this use is sodium fluor-antimonate.

Wool Impregnation

A solution of thiourea has been found

effective for the impregnation of wool. If the moth grub attacks the impregnated fabric, the thiourea paralyses its digestive apparatus and so brings about its speedy demise. Thiourea has the advantage of being non-staining, but it is relatively expensive.

A German patent belonging to the great "I.G." interests of that country describes the use of coumarine dissolved in a solution of calcium or magnesium chloride. The disadvantage here is that the coumarine has an extremely strong and persistent (albeit pleasant) odour.

Naphthyl thiocarbamide dissolved in water or in decolourised methylated spirit forms one of the most recent moth-proofing agents. It is non-staining, non-odorous, and is said to be very effective. Here again, however, the material is far too expensive for ordinary use.

The ideal moth-proofing agent must be cheap, easily applied, non-odorous, non-staining, non-irritant, insoluble in water or alkaline solutions (in order that it shall not be removed by washing), and permanent in character. Moreover, it must not in any way alter, change or modify the properties and characteristics of the fibre to which it is applied. A formidable list of essential requirements indeed, but there is little doubt that, sooner or later, such requirements will be complied with.

Radiation Treatment

Recently a radiation treatment for the eradication of moth grubs has been described. This is an entirely non-chemical method which is aimed at the destruction of existing grubs in large masses of affected material, rather than at the proofing of such fabric against moth attack.

The method consists in exposing the bulk material to thermal radiation, which is produced by a specially designed filament lamp, the filament of which is heated electrically in an atmosphere consisting of argon 86 per cent. and nitrogen 14 per cent. Such treatment is claimed to be not only efficacious against clothes-moths, their grubs and eggs, but, also, against textile-devouring beetles, in addition to micro-organisms, moulds and mildews of all kinds.

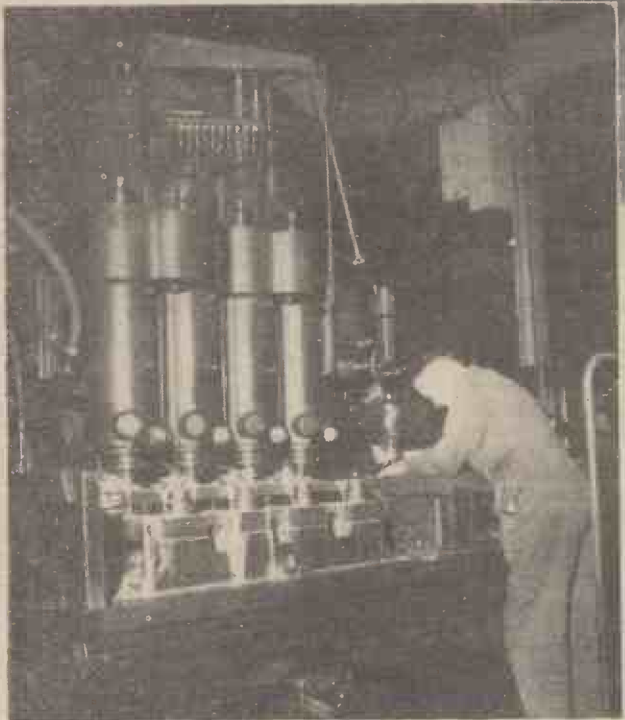
The method has possibilities, but its efficiency lies in the fact that it aims only at destroying existing grubs and other pests. It does not actually proof the material against their future attacks.

In the end, therefore, it must be the chemical method of moth-proofing the fabric which will conquer this age-old and widespread pest. All other methods must seemingly fail in view of the non-permanence of their results.

The Bristol Hercules Engine

THE Bristol 14-cylinder, air-cooled, sleeve-valve engine is perhaps best known as the power unit of the Bristol Beaufighter, which, as fighter-bomber and reconnaissance aircraft, has for long been the maid-of-all-work of Fighter Bomber and Coastal Commands, and has seen service in theatres of war from Europe to the Far East. But these engines are also used in great numbers to power Lancasters, Halifaxes, and many other aircraft. Being air-cooled, the engine has no vulnerable water jacket and can continue to run even after being hit by cannon shell. The single sleeve principle was the invention of a Canadian and a Scottish engineer, and was used in a motor-car as far back as the early twenties. The sleeve operates between the piston and the cylinder walls, and contains four ports. As it moves up and down the cylinder, these four ports in turn coincide with four similar ports in the cylinder, and the resultant holes become inlet and exhaust valves. The movement is actuated by a sleeve crank turning at half-engine speed, and includes a few inches of rotary movement, as well as an up-and-down movement. When the firing point is reached the sleeve is at the top of its travel and the ports are shielded by the cylinder head. The principle does away with tappets, cams, rockers and springs; eliminates valve bounce and attendant loss of power, and valve maintenance, and cuts down cylinder wall wear. The application of the single sleeve principle to aero engines is the result of more than a decade of research by the Bristol Company.

Impeller port milling. The impeller is the fan on the supercharger at the rear of the engine. The battery of British Archdale port millers was built for this job. They are hydraulically operated units.



Profile milling web flutes on master connecting rod on a Hydrotel gang miller. Four are milled in a set, following a tracer pin.

Front end of crankshaft showing connecting-rod assembly.

Automatic Hub-operated Cycle Pump

Details of the "Cyklair" Patent Pump Hub, an Important Invention

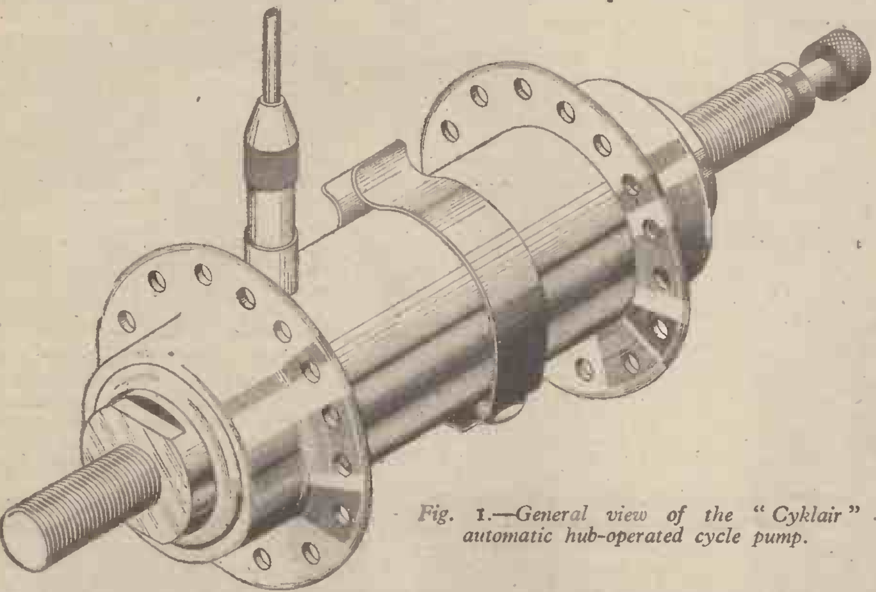


Fig. 1.—General view of the "Cyklair" automatic hub-operated cycle pump.

THE working of the "Cyklair" Pump Hub can be readily understood by reference to the cut-away drawing, Fig. 2, in which the parts are named. In addition to the parts found in any normal hub there are only three main components; a sleeve, a piston and a cam. The hub shell is used as the pump cylinder, and a tubular piston slides from end to end, between the shell and an inner sleeve. The sleeve surrounds the spindle for about half its length but is quite clear of it.

Operating Piston

The piston has a slot running along it which engages a stud fixed inside the hub shell. This stud makes the piston go round with the hub and wheel, but leaves it free to slide from side to side. The sliding action is brought about by a tubular cam which is locked to the spindle by a slidable key. On the outside of the cam is a groove, which, like a screw thread, winds from one end of the cam to the other in one half turn and back again in another half turn. Running in the groove is a second stud riveted to the inside of the hollow piston. As the piston rotates round the cam, the stud causes it to reciprocate left-right, right-left, like a nut on a bolt cut with a thread which comes back on itself.

The piston is fitted at one end with an oil-proof synthetic rubber sealing washer which serves the same purpose as the cup leather in an ordinary hand pump; that is, as the washer moves outwards air blows past it into the pump cylinder, and as it moves inwards it forces this air through a one-way valve up a hollow spoke cylinder, and as it moves inwards it forces this air through a one-way valve up a hollow spoke into the tyre. This tubular spoke connects on to the tyre valve. The tyre and tube are standard in all respects.

Controlling Button

To bring the "Cyklair" pump into action a small button, which is fixed to the side of the hub spindle, is pushed in. This slides the key into a slot in the cam and locks it to the spindle and the pump operates when the wheel goes round. When the button is pulled out, the cam is disengaged and goes round with the piston so that the pump stops working. For those who want the added luxury this button can be worked by bowen cable from the handlebars. It does not matter whether the pump is left constantly in operation or not, because "Cyklair" is so designed that it cannot inflate the tyre beyond a certain pressure which the rider can adjust for himself by simply turning a small thumb screw which is fitted to the valve and is marked to show which way it should be turned for "harder" or "softer" tyre. If necessary, the control valve can be set for "Cyklair" to pump to any pressure up to 100lb. per square inch for "tubulars" for high speed work. And down to 25 for 1¾in. "heavies" on carrier bicycles, etc. From exhaustive trials which have taken place, it is quite impossible to detect even the semblance of drag when riding with the pump engaged, as compared with when the wheel is rotating on its ball-bearings with the pump disengaged. When using "Cyklair" the regular rider soon develops a technique. After a short time it becomes second nature to push in the button each morning before the ride to work, and to disengage the pump at some regular landmark on the journey and so put the tyre in perfect condition for the day.

Tests

The extra weight of the "Cyklair" hub is negligible as, in fact, the weight of the pump and hub combined is below the weight of many standard hubs. A full range has been designed to cover the hubs of front and rear wheels, free or fixed gears, hub brakes or hub dynamos and rear wheels with variable speed gears of the Cyclo and Tri-Velox type, and the units comprising the pump mechanism are interchangeable in all of them. The "Cyklair" Automatic Self-inflating Pump has been given many thousands of miles of trial and life test during its perfection, and the parts are simple and robust and quite trouble free.

Punctures

The volume of air that the "Cyklair" pump can deliver is such that it will fully compensate any puncture which will not completely deflate the tyre in less than three to five minutes. The actual pumping times of course vary with the size of tyre fitted, and the speed of riding.

On one test run it was found that the front tyre was flat one morning. The wheel was spun by hand for two minutes until the pump had injected sufficient air into the tube to make the tyre barely ridable and then rode off. After two minutes' riding the tyre was at normal pressure and was kept at this (except a stop for lunch and tea, when the wheel had to be spun by hand again) for a day's run of 85 miles. Subsequent examination in a good light, out of the wind and rain, and at leisure, revealed a puncture due to a thorn. On other tests the valve has been deliberately set so that air is leaking constantly, but "Cyklair" has always maintained a perfectly comfortable riding pressure.

When the wheel is removed from the bicycle in the ordinary way for mending a puncture and a few puffs of air are required to facilitate replacement of the tube and cover, an "all in" type of spanner can be screwed on to the hub spindle and used as a handle to rotate the pump.

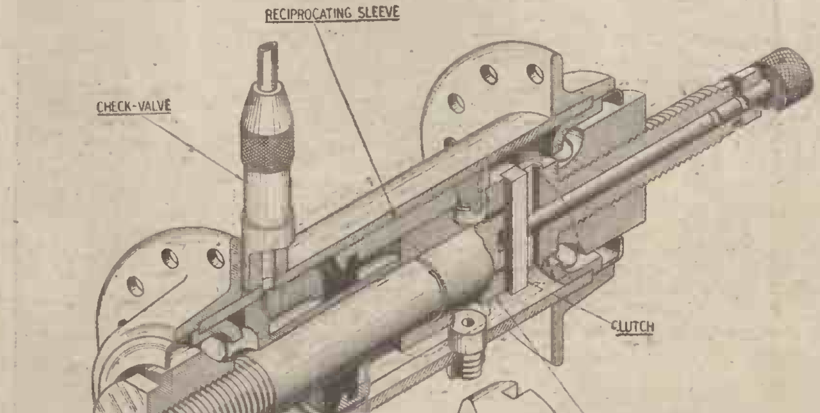


Fig. 2.—Sectional view of the "Cyklair" automatic cycle pump, and detail of operating cam.

THE WORLD

Some Notes on the Societies Which

Model of a part of the new Roman Catholic cathedral designed by Sir Giles Gilbert Scott. Model by Mr. John B. Thorpe, a member of the S.M.E.E.

ALMOST every hobby has its own club, and I have often been asked by those taking up the model hobby what societies there are which cater for model enthusiasts.

Pioneer Society

In the sphere of model engineering the Society of Model and Experimental Engineers is the parent body. When this Society was founded forty-seven years ago its objects were defined as the bringing together of all those interested in building and running model engines, in the construction of electrical apparatus, or in tools, and to stimulate those interested by means of lectures and discussions, by exhibition and trial of models, and by practical demonstrations of workshop practice.

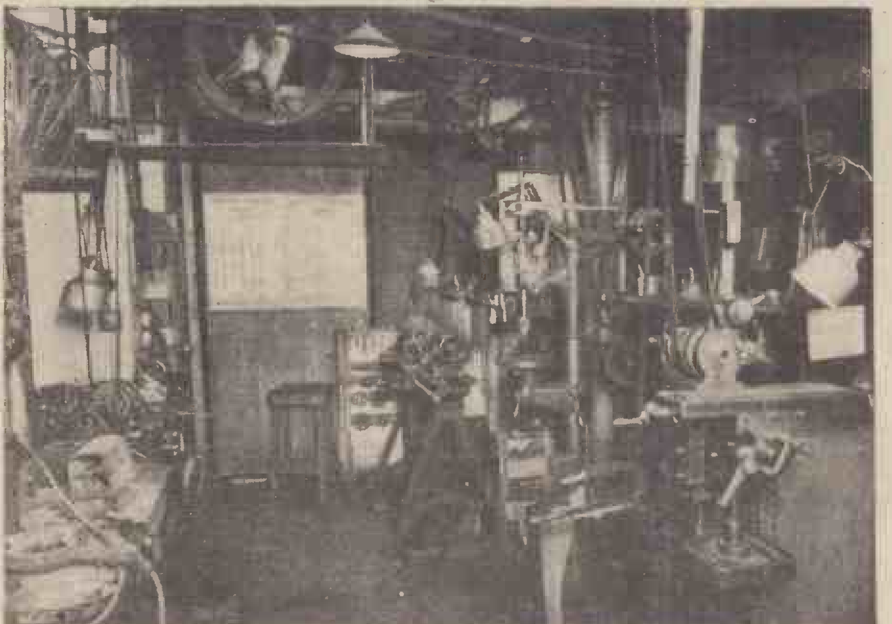
In the intervening years the activities of the S.M.E.E. have broadened, and one reason for this expansion is the larger part played by models in engineering and scientific development. In these days we hear of the important war work which models are performing daily, and if we look back to industries like shipbuilding and aircraft production, models have played, and are still playing, an indispensable part. Also in architecture, whether one is proposing to build a house, a docks, or a cathedral, to lay out a factory or to convert some existing buildings, models can offer very practical advantages to the planner.

Historical Records

Lastly, as historical records of progress of all kinds the value of the model is unequalled. Several of the models in the Science Museum, South Kensington, and in the collection of the Institute of Mechanical Engineers, are the work of members of the Society of Model and Experimental Engineers. During the last war a large number of members were able to undertake mechanical and experimental work for various Government departments and engineering establishments, and in the present war still more have been sought after for similar service.

A corner of the reading room adjoining the workshop of the S.M.E.E., at 20, Nassau Street, London, W.1.

Despite the many restrictions imposed by war, the society is still functioning. The workshop in Nassau Street, Mortimer Street, W.1., is open for members' use on Tuesday, Thursday and Saturday evenings. It contains seven lathes, among them a 6½in. Colchester, a 4½in. Svea, a 3½in. Pittler, and two 3½in. Drummonds. Other machine tools are a Milnes planer, a Senior miller, a Pollard drill, a Leyland Barlow shaper, and a hacksaw, and most tools are electrically driven. Sheet metal rolls, shears, a brazing hearth and forge, and an electric furnace are also there, and in the tool store is a comprehensive collection of precision measuring instruments, fine tools and accessories. Some of the tools are available on loan.



A portion of the workshop of the S.M.E.E., showing some of the up-to-date machine tools.

The library, with both reference and lending sections, is a great boon in wartime, and recently a collection of blueprints has

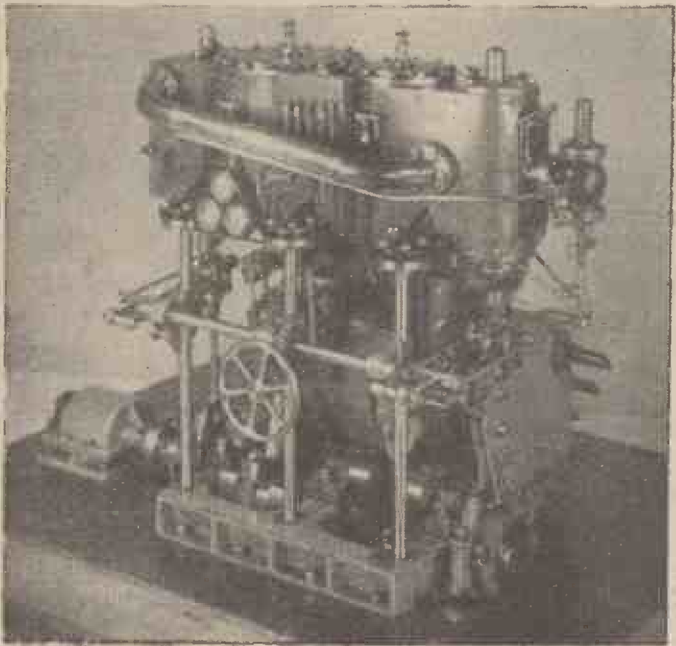
OF MODELS

Comprise It. By "MOTILUS"

been commenced. Another activity of the Society is the publication of the quarterly journal, which, though much reduced in size, still appears regularly, and country members are thus kept in touch.

Monthly meetings are also held at the hall of the Junior Society of Engineers, Victoria Street, London, S.W., for all who can attend. These meetings comprise a variety of activities. There are practical, technical and scientific lectures, stationary engine running, demonstrations, technical film programmes, and often members are informed of new developments in engineering practice before such news would be available to them elsewhere.

Two innovations in the society's rules deserve notice. Firstly, the admission of lady members on the same terms as men, and secondly, the affiliation of approved societies.



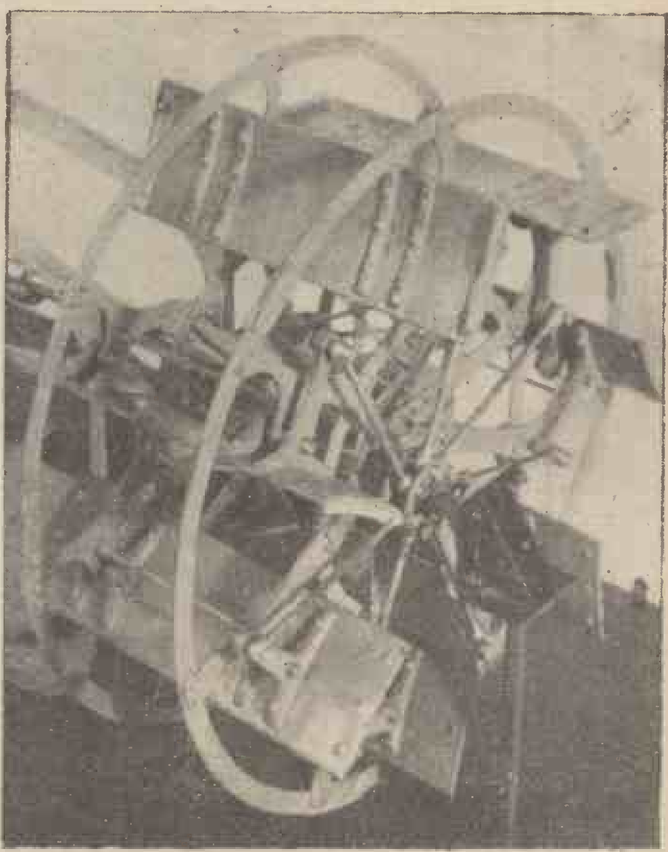
Compound marine engine, 1in. scale, made by Mr. S. R. Harris, a member of the S.M.E.E., winner of the silver cup at the Kodak Exhibition.

Affiliated Societies

So far four societies have applied for affiliation. The first one to join up is the Model Engineering Section of the Kodak Recreation Society, and the result has been mutually very satisfactory.

The secretary of the S.M.E.E. is H. V. Steele, F.C.I.S., 14, Ross Road, London, S.E.25, to whom any interested provincial societies should write.

Looking through the list of official names since Mr. Percival Marshall, C.I.Mech.E., was elected founder chairman and treasurer in 1898, we see many well-known figures have passed through the chair. The Presidency created in 1911 commenced with Mr. Percival Marshall, and since 1937 has been held by the Rt. Hon. the Earl of Northesk. In the twenty-five years between we read famous names, such as G. Corse Glen, M.I.Mech.E., Basil H. Joy, M.I.A.E., Admiral Sir R. H. S. Bacon, K.C.B., K.C.V.O., D.S.O., Sir Edward Nicholl, K.B.E., Sir Felix J. C. Pole, and the "grand old man" of model steam locomotives, J. C. Crebbin.

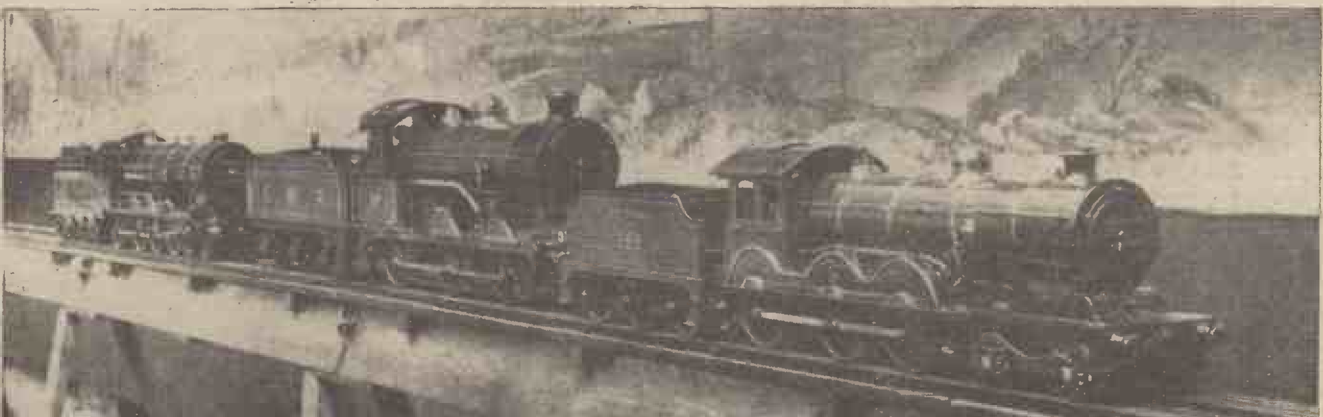


Close-up of one of a pair of ½in. scale paddle wheels made by Mr. H. V. Steele, member of the S.M.E.E.

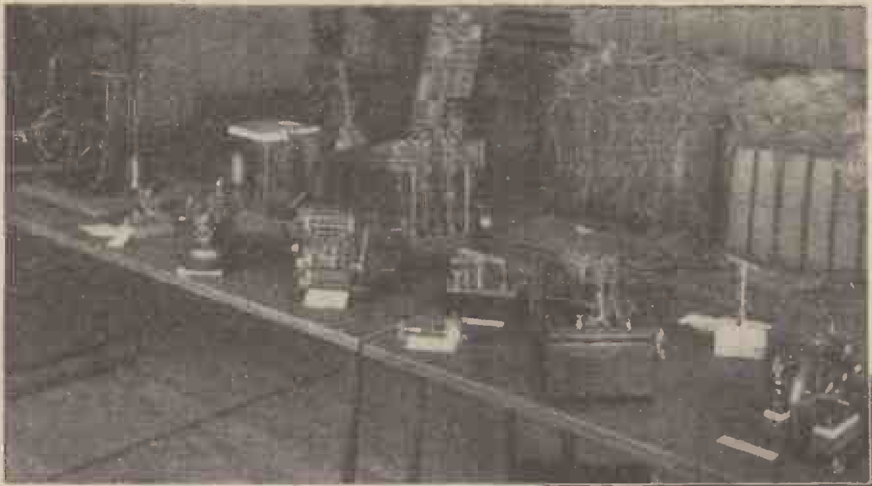
During the war a number of the smaller societies have ceased to function, but as against this new societies are constantly being formed. It is difficult to estimate the exact number now in existence, but, including societies especially interested in model railways and model power boats, there are well over 100 at home and abroad.

The most important of the former type is the Model Railway Club, of London, which in peacetime was a very active and progressive body under the presidency of Mr. G. P. Keen. In addition to regular meetings in London, they also held a model railway exhibition every spring at the Westminster Hall, which was a great venue for all model railway enthusiasts.

Unfortunately, owing to wartime conditions in London, this has ceased to be active but will, no doubt, soon be under way again when the war is over in the European theatre.



Three fine model steam locomotives built by Mr. J. C. Crebbin, one of the best-known members of the S.M.E.E. 1. 4-8-0 outside cylinder. James Milne, ¾in. to the foot. 2. 0-6-0 inside cylinder goods loco "Old Bill." Scale 1in. to the foot. 3. The famous 4-6-0 mixed traffic "Cosmo Bonsor." Scale ¾in. to the foot.



Part of the S.M.E.E.'s exhibit at the recent Kodak Exhibition.

Provincial Societies

Outside this club the principal provincial society is the Manchester Model Railway Society, a very live body with expert and progressive members. Other very active model engineering societies in the British Isles are the Malden Society, the Kent Society, and the societies at Leeds, Bradford, Sheffield, Glasgow, Edinburgh, Wigan, Nottingham, Norwich and Hull. Society doings are regularly reported in the *Model Engineer*.

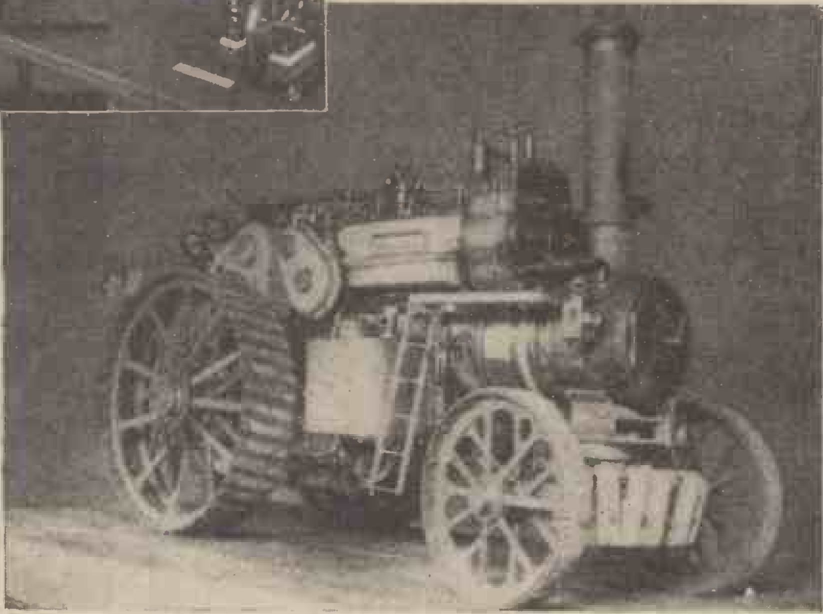
The Model Power Boat Association—a federation of some thirty to forty model power boat clubs in various parts of the country—is a very active body in peacetime, organising inter-club and international regattas, and standardising racing rules. The secretary is Mr. Edgar T. Westbury. The Victoria Model Steamboat Club, of Victoria Park, is the oldest model power boat club, and their water, the bathing lake in Victoria Park, has been the scene of many highly successful international and other regattas. Another prominent boat club is the Wickstead Power Boat Club at Wickstead Park, Kettering. Both these clubs belong to the M.P.B.A. The South London Model Power Boat Club is another very active club in the London area, sailing water is in Brockwell Park. Blackheath also has a good model power boat club.

Model Aeroplane Clubs

The model aeroplane clubs all over the country have as their governing body the Society of Model Aeronautical Engineers, and all the principal clubs in the provinces are affiliated thereto.

Since the war, many industrial works have encouraged the formation of model engineering clubs in their works or offices, and notable examples are the Vauxhall Works at Luton, the Kodak Works, the London offices of the General Electric Co., Ltd., and Cadbury's Bournville Works at Birmingham.

I have no space here to mention the number of societies in the United States, the British Empire, and in Europe, but many exist from New York to Auckland, New Zealand. Certainly the hobby really does go round the world, and the work of societies like those mentioned here is going to be very valuable when the war is finished, and the scope of the hobby can again be broadened to its peacetime width



Traction engine (¾in. scale) made by a member of the S.M.E.E.

The Fairey "Firefly"

Royal Navy Fighter Reconnaissance Aircraft

A NEW naval aircraft carrier fighter has been released from the secret list. This aircraft is the "Firefly," designed and produced by the Fairey Aviation Co., Ltd.

The "Firefly" is a low-winged single-engined fighter reconnaissance aircraft which has an armament of four 20 mm. cannon guns (two in each wing), and carries a crew of two—pilot and observer/navigator.

The engine is a Rolls-Royce Griffon, and the propeller is a three-bladed variable pitch Rotol. The aircraft is fitted with a camera. Span, 44ft. 6ins.; length, 37ft.; height, 13ft. 7ins.

This latest naval aircraft has, like its predecessors, folding wings for economical space stowage in aircraft carriers.

It incorporates the Lockheed hydraulic system which operates its undercarriage and flaps. By means of this hydraulic installation, the whole flap is extracted from its position in the trailing edge of the wing and is swung out to give varying positions for take-off, cruising or landing. In design the flaps are similar to those installed on the "Barracuda," but when not in operation they are flush with the wing structure.

A "Firefly" taking off from the flight deck of H.M.S. "Illustrious."

Checking Shorting Coils Visually

By L. G. W. KNOTT

As coil winding is done by machinery, it is quite possible to have coils delivered to a production bench either partially or wholly short circuited, this due to the insulation mediums being chafed or rubbed on bobbins or guides during the winding process. A shorting coil may not altogether unbalance a tuning circuit with but one variable condenser shunting it, but if it were in a network incorporating two other coils and a three-gang condenser, instability of operation would be in evidence. Various forms of test equipment have been devised to check against good or bad coils, ranging from low-valve ohmmeters to electron-ray rigs designed to show variations in amplitude, the application of which made quite obvious that what was wanted was an instrument which was absolute and instantaneous in action, extremely sensitive, compact, robust, and not costing too much to produce, the requirements of which, it is believed, are met in the test equipment to be now described.

A New Method

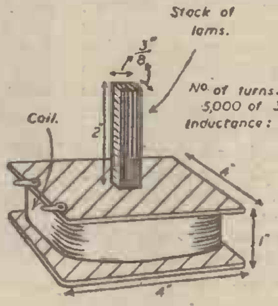
For instantaneously and *visually* checking coils for shorting turns has been resolved around an oscillatory circuit so designed that it will *stop* oscillating when a defective coil is coupled to it magnetically. The set-up comprises a *negative resistance* oscillator of the dynatron type, the inductance of which is representative of the positive resistance in the circuit and to which is incorporated an *explorer testing stack or pillar* of iron stampings over which the coil to be checked is placed. Doing so changes the circuit constants of the network and not only stops it from oscillating, but causes a small *flashlight bulb to be extinguished* as an indication of a coil with partial or wholly shorting turns. If the coil under test is without the fault, the lamp remains alight. Fig. 1 depicts the exploring coil and stack.

Circuit Considerations

An ordinary transition circuit of oscillation could have been used, though without advantage, as no consideration had to be given to either waveform or frequency stability; the dynatron circuit was, however, the more simple of the two for general design, and was thus decided on. Nevertheless, some consideration was necessary relative to the tuned circuit, it controlling the frequency at which oscillation had to take place. Requirements were:

(*a*) That the highest workable frequency be of a sufficiency to permit the tuned circuit capacity across the coil to be always the predominant tuning capacity "component": that is, the action of the coil under test, when over the stack, must be such that any mutual capacity present should have little or no effect on frequency.

(*b*) That the lowest workable frequency be of a sufficiency to permit the single tuned circuit—made up as an iron-cored inductance with capacitance—to have a reasonably high Q or sensitivity factor.



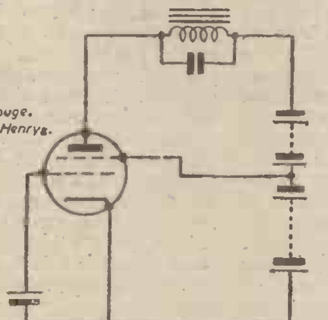


Fig. 1 shows the most interesting component of this new device, the coil to be tested having to be placed over the stack of laminations. The wire is wound on a bobbin with presspahn flanges to keep it snug. Insulated wedges assure rigidity. Fig. 2 shows the basic circuit of the dynatron oscilllator.

Operational Frequencies

These can approximately range from 1,000 to 5,000 c.p.s., the final design, shown in Fig. 2, having an operating frequency of 2,000 c/s, dynatron controlled. Fig. 3, on which values can be noted, illustrates that the signal frequency is fed through a condenser to a single valve amplifier, one designed to serve *two* purposes: (1) To amplify the signal to such power that it is sufficient to light the flashlight bulb. (2) To supply automatic bias of such sufficiency in limiting action that it will prevent the lamp from burning out.

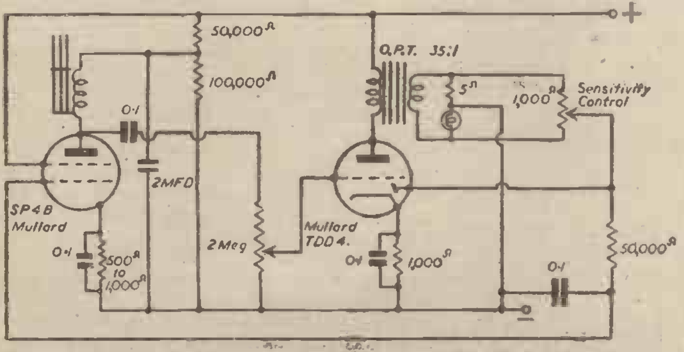


Fig. 3.—The complete circuit, including the amplifier. The exploring stack of laminations is shown in the anode circuit of the SP4B Mullard Valve. Circuit constants should be adhered to. If other valves are used, cathode bias resistors must be correspondingly changed in values. Operating potentials are dependent upon the types of valves employed.

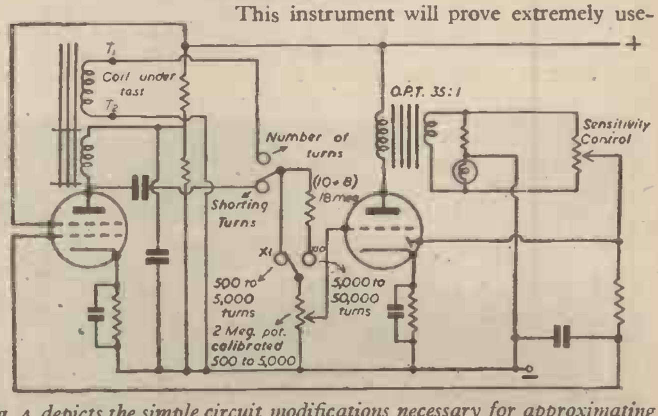


Fig. 4 depicts the simple circuit modifications necessary for approximating the position of the shorting turns. Constant values, not shown, are as for Fig. 3.

Design Sensitivity

That of the circuit shown (Fig. 3) is such that it will indicate two shorting turns on a coil wound from No. 44 SWG wire, or similarly, one wound with No. 38 SWG having but one shorting turn. This, converted to valves of parallel resistance across an inductance, is in the neighbourhood of 3 megohms in shunt, with an impedance of 25,000 ohms. As an example, a coil placed over the stack had an inductance value of 2 henrys; then a 3-meg resistor was shunted across the turns—the indicating lamp went out, this stressing the fact that the instrument can be made less sensitive by shunting resistance across the circuit inductance.

Approximate Turn Numbers

By modifying the circuit to Fig. 4, it is possible to approximate the number of turns in a coil under test with windings ranging from 400 to 50,000 in number. Although it is not possible to definitely indicate the number of turns on a faulty coil, there is, in most instances, a similar coil used as a standard in a receiver from which a ratio of good to bad may be found, comparison more or less indicating the number or location of the shorting turns. The method of switching from a range of coils, 500 to 5,000 turns, and 5,000 to 50,000 turns is clearly shown on the drawing, the 2-megohm potentiometer having to be calibrated from coils of known turn numbers and the switch thrown for the second set of readings, which are multiples of 10 of the first or calibrated set of readings.

To Operate

Warm up the tester for 15 minutes previous to use, making sure that all coils are well away from the vicinity; then adjust the sensitivity control until the lamp lights and place the coils to be tested one at a time over the stack of laminations, watching at the same time to see if the lamp extinguishes itself as an indication of a partial or entirely short-circuiting set of turns. To check the rig before testing, place over the stack a 2in. diameter ring made from No. 20 SWG tinned copper wire; if in working order the lamp will automatically shut itself off.

Servicing Application

This instrument will prove extremely useful to service engineers as an aid to checking against intermittents suspected as being due to short-circuiting coils expanding and contracting under operating conditions—especially oscillator coils in superheterodynes. Any coil whose former allows it to be placed over the stack can be thus tested, though when replacing, resoldering end connections to tags should be done so that some slackness of wire is present.

(*Extract from a Paper read before the Institute of Practical Radio Engineers.*)

Super-efficient Solvents

Curious Facts Concerning the Dissolving Powers of Liquids

THE alchemists of old, besides striving after the discovery of the "Philosopher's Stone," which was supposed to comprise a certain mineral-like preparation having the power of turning all things into gold, frequently showed a strange predilection for various fantastical "sidelines" of chemical endeavour and discovery.

One of these chimerical dreams of many alchemists took the form of an unknown and a mythical liquid to which those ancient chemical dabblers applied the name of "The Universal Dissolvent." They were nothing if not thorough-going idealists, these mediæval alchemical adepts! For this proposed "Universal Dissolvent" was to be nothing more nor less than a liquid which, when discovered by some fortunate member of the alchemical brotherhood, would be found to have the property of dissolving anything and everything which it came into contact with. Those curious chemical enthusiasts of a now far-away age seem to have regarded as quite beside the point the question as to what sort of a vessel could be provided as a container for their projected "Universal Dissolvent." Apparently, their idea was to get the great Dissolvent first and consider the matter of the container afterwards.

Although centuries have passed since the nonsense of the above variety was freely mooted in the semi-secret alchemical laboratories of Europe, it is rather a strange fact that even at the present time, many scientific workers are still looking for that which we might term the "Super-efficient Solvent," which may be regarded as Science's modern version of the alchemical "Great Dissolvent."

Act of Solution

The act of solution is a strange process. We do not know anything really positive about it. When, for example, we throw a spoonful of salt into a glass of water and with a stir or two, cause the solid salt totally to disappear, we still woefully lack precise information as to the fate of those solid salt particles. The particles of salt have not fused or melted or in any way liquefied themselves as solid salt liquefies when it is heated to a high temperature. All we can say is that in some not clearly understood way, the salt particles, molecules, atoms or whatever you like to call them, have slipped in between the constituent particles of the liquid and have thereby disappeared temporarily from our vision.

Needless to say, there exist theories of solution which account with a high degree of probability for the known facts concerning the dissolved state. With such theories we do not propose to deal in this article. They can be referred to in any textbook of modern physical chemistry. What we do propose to examine in some detail, however, are the dissolving powers of various liquids and the strange manner in which certain solvents act selectively upon specific substances.

Solution is a universal phenomenon. It is an indispensable one, too. For all life, as we know it, is apparently dependent upon the presence of the liquid phase of matter, and, in most instances it is from dissolved substances that living organisms extract their nourishment.

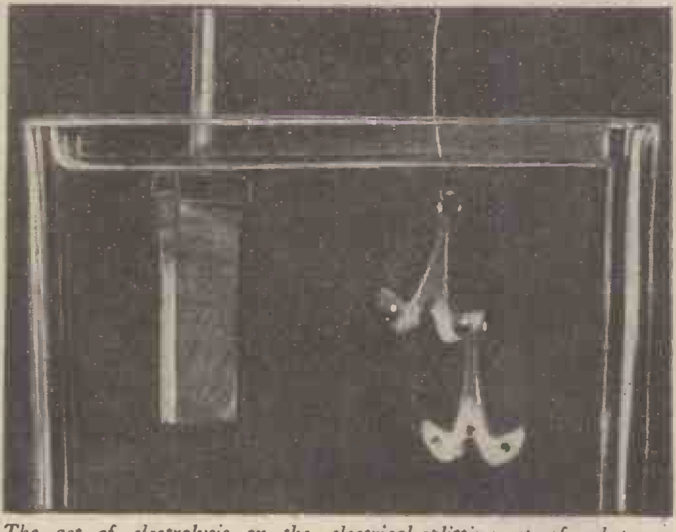
Industrially, also, we are dependent to an enormous extent upon solvents. What, for example, would become of our modern processes of paint, varnish and lacquer making, our synthetic fibre processes, our chemical factories, to say nothing of our food-manufacturing establishments were it not for the fundamental phenomenon of solution, the merging of a solid material into a liquid one? It is on account of the modern industrial importance of the act of solution that many researchers and industrial development workers are continually striving to bring to light solvents which are more and more potent in their properties either by way of their selectivities or by dint of the increased range of their dissolving powers.

Solute and Solvent

Before we can go into the question of solvents and solutions further, it is necessary for us to have a clear understanding of what we mean by the term "solution."

We are often very apt to use the above term in a somewhat loose and haphazard way. For instance, we speak of metallic zinc being dissolved by hydrochloric acid with the evolution of hydrogen. Actually, such a statement is not very correct. The zinc does not dissolve *as such* in the acid. Rather, it enters into chemical combination with a portion of the acid, becoming converted into a new substance—zinc chloride. But when we dissolve common salt in water, although the salt disappears from our view, it still appears to remain *as salt* in the water (for we can taste it in solution), [and when we evaporate the water by heat, the salt is recovered unchanged.

This latter process, therefore, in which the dissolved material is recovered unchanged, is true solution. Technically speaking, the water is the *solvent* and the salt is the *solute,* whilst the mingled mass of salt and water particles is known as the *solution.*



The act of electrolysis on the electrical splitting up of substances in solution. Here we see a silver-plating bath in which silver is being deposited by electrical force on to the two small instrument components on the right.

Carbon from the gas works, an effective solvent

Now, although there are few materials indeed which are utterly insoluble in any medium, there is an enormous number of substances which can only be dissolved without changing to a very limited extent. In by far the majority of instances, the dissolving power of a liquid is increased with increase of temperature. We all know by common experience how much easier it is to dissolve sugar or salt in hot water than in cold water. Why this should be the case, we do not know with any certainty. We can only say definitely that molecular activities are increased with temperature increase, and since it is obvious that the act of solution must be an affair of molecular activity it is not surprising to find this very widespread "solubility law" connecting increased solubility with increased temperature of the solvent.

Liquids have very definitely limited powers of solubility. At any given temperature, a liquid can only dissolve a fixed amount of any given solid. If more solid is offered to the solvent above that limit, the solvent, as it were, cries "enough" and refuses to dissolve any more. A solution which contains as much solute (dissolved substance) as it will take up at any particular temperature is called a "saturated solution."

Since a solution at, say, a temperature of 50 deg. C. will dissolve more solute than a solution at 15 deg. C., it follows that if a 50 deg. C. saturated solution is cooled down to 15 deg. C., a portion of the solute, or dissolved substance, will be thrown out of solution as the liquid cools. A simple experiment is making a saturated solution of common salt in water at a temperature of about 50 to 60 deg. C. and allowing it to cool down to normal temperature will demonstrate this fact to any experimental inquirer.

Solvent Selectivity

A striking feature of all solvents is their selectivity. Solvents and solutes do not always agree. Many a time they repel one another. Wax and water are mutually repulsive, but waxes and oils are usually so intermiscible that the wax dissolves in the oil.

Water has been styled "the universal solvent," but not, of course, in the same sense as the alchemical dreamers employed that expression. Without a doubt, it is true that, of all liquids, water possesses, either wholly or partially, the greatest solvent range, for there exist a perfect multitude of varied materials and substances which are dissolved at least to some extent by water, but, strange to say, water fails rather badly as a solvent when it comes to dissolving many of the members of that multitudinous class of chemical materials which are nowadays known as the "organic compounds."

Organic materials and substances, synthetic or non-synthetic, are enormously complex in composition. Dyestuffs, natural and artificial, cellulose, the synthetic resins, petroleum and its many varied compounds and derivatives, alkaloids, plant extracts, flesh, blood and the bodily tissues, silk, wool, coal tar compounds, fats, waxes, bitumen, wood and resin are all members of the enormous family of "organic" materials. One thing they have all in common, and that is that they are all compounds, in one way or another, of the element carbon. All organic compounds, therefore, are carbon compounds, and, for the greater part, water refuses to dissolve such compounds.

Such a fact, of course, is rather a fortunate provision of Nature, for if water has any appreciable solvent action upon the majority of organic compounds, we should fare very badly indeed after going out in a shower of rain!

One of the apparent laws concerning solubility seems to be that a liquid will tend to dissolve materials of its own kind. Thus iodine is not very soluble in water, but if we first dissolve in the water some potassium iodide (which is a compound containing iodine) the free iodine which is afterwards added to the water becomes very much more soluble in the potassium iodide solution. Likewise, sulphur is very difficult to dissolve in most liquids, but it dissolves appreciably in sulphur chloride, a yellow liquid formed by the union of chlorine gas and sulphur.

It so happens that the principal exception to the non-solubility of organic compounds in water is to be seen in the case of the alcohols, of which group of organic compounds the ordinary *ethyl alcohol*, the constituent of alcoholic beverages, is by far the best known.

Water an Alcohol!

Now, all the alcohols contain within them the atomic linkage or grouping —OH, that is to say an oxygen atom linked to a hydrogen atom. Thus, ethyl alcohol is C_2H_5OH. Methyl alcohol, the alcohol of "wood spirit," is CH_3OH. Another fairly common alcohol used in industrial solvents is propyl alcohol, this having the composition C_3H_7OH.

Water, as most of us are aware, has the chemical formula, H_2O. Write this another way, and we get HOH. Here we see that water has the —OH grouping just like the alcohols. In fact, we can, strictly speaking, term water an alcohol. "Hydrogen alcohol" we might call it.

Water and the alcohols having the —OH grouping in common, many of the alcohols are dissolved, partially or completely, by water. Thus, ethyl alcohol ("comforter of mankind," as it has romantically been termed) dissolves to any amount in water. Water and ethyl alcohol are mutually miscible or mutually soluble.

There is still another over-ruling law dominating the world of chemical solubilities. This lays down the rule that the larger and the more complex the molecule of the substance the more difficult it is to dissolve. Ethyl alcohol is entirely soluble in water in all proportions, but butyl alcohol, C_4H_9OH, an alcohol containing four carbon atoms (in place of the two carbon atoms possessed by ethyl alcohol) is only 20 per cent. soluble in water. This decreasing solubility in water with increasing complexity of composition proceeds as we go from the simple to the complex alcohols, until when, eventually, we arrive at the higher alcohols, such as cetyl alcohol, $C_{16}H_{33}OH$, which is a white, wax-like substance, they become entirely insoluble in water.

Since the natural law of a solvent is to dissolve its own family of substances, we should expect the organic compounds to be the most soluble in organic liquids. This is precisely the case in practice. If we want to dissolve resins, we use organic solvents such as chloroform, carbon bisulphide or ether. If we wish to extract bitumen from its natural ores, we use trichlorethylene, a powerful organic solvent which, incidentally, is nowadays made much use of by the dry-cleaning industry in removing the grime and grease resulting from the day-by-day wear of our garments.

Morpholine—chemistry's latest industrial solvent, which is manufactured from petroleum residues. So powerful are its solvent properties that, in view of the demand for it, all morpholine supplies are very stringently controlled by the Ministry of Supply.

Ethyl alcohol, being a powerful and a pleasant organic solvent, is used almost exclusively for extracting medicinal principles from herbs and drug plants, the various so-called "tinctures" of the pharmacopœia being merely solutions of these medicinal matters in "rectified spirit" (90 per cent. alcohol). Perfumes, flavours and similar solutions are likewise commonly made up with ethyl alcohol fulfilling the role of solvent, and for years innumerable this powerful liquid has performed its work satisfactorily and adequately.

Giant-moleculed Compounds

It is, however, in connection with the solution of large-moleculed compounds that modern research work on the subject of solvents has tended to centre itself. The reader will recollect the previously-quoted law to the effect that the greater the molecular complexity of the compound the more resistant it becomes to solution.

There are many organic compounds of high economic importance which are utterly insoluble in any known solvent. Cellulose, or cotton, is, perhaps, the best known of these giant molecule materials.

Where is the solvent of cellulose? It is not known. No known liquid will dissolve cotton *as cotton* and return it unchanged after evaporation of the solvent. The so-called "solvents" of cellulose which are utilised in artificial silk manufacture do *not* dissolve cellulose or cotton. What they do is to act chemically on the purified cotton or cellulose and to change it into other substances which are soluble in the solvent. In such a manner, "artificial silk" results. But artificial silk is not cotton. It is a different and a weaker substance altogether.

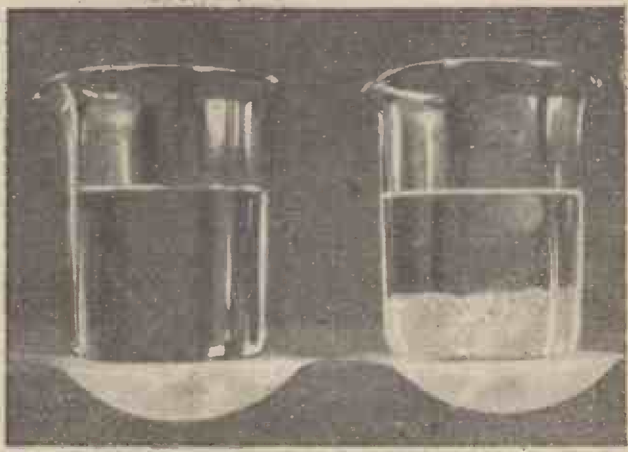
If a true solvent of cellulose or cotton could be discovered, a small revolution in the world's lacquer trades would be brought about. Also, a fundamental and a decided advance in the way of artificial fabrics would be forthcoming.

In the same way, ordinary rubber is difficult to dissolve. More likely than not, the "rubber solutions" which we come into contact with are not solutions of this material at all, for the rubber tends to be chemically altered during the process of its solution.

Solvents which are Wanted

Wool, silk, leather, heat and pressure-treated artificial plastic materials, horn, ivory and hair are substances which we cannot dissolve at all without chemically changing them. Yet they are all strictly organic compounds and mixture of compounds. Hence, it ought ultimately to be possible to discover organic liquids which will exert selective solvent actions upon all of them. Such, indeed, is the aim—perhaps the distant aim—of many teams of chemical research workers, for with the discovery of such solvents would come vast changes in industrial processes and economic usages.

In the mineral or non-organic world, the problem is equally as abstruse. Where is the long waited-for stone solvent, the liquid which will dissolve granite (without chemically altering its composition) and thus enable us to manufacture protective paints and lacquers of enduring stone for our modern brick, timber and concrete buildings? Where, too, is the solvent of black carbon or soot itself, that ubiquitous element which gives rise to the almost innumerable and illimitable array of natural and artificial "organic" compounds? All we know concerning this latter problem at the present time is that the element carbon will, in the form of graphite, dissolve to a small extent in molten cast iron! That, of course, is a hopelessly impracticable process for effecting the solution of carbon.



Showing the increase of a liquid's dissolving power with increase in its temperature. Left. A saturated solution of zinc sulphate at 60 deg. C. Right. The same solution at 10 deg. C. Note the crystalline deposit of zinc sulphate which has been thrown out of solution during the cooling of the liquid.

QUERIES and ENQUIRIES

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

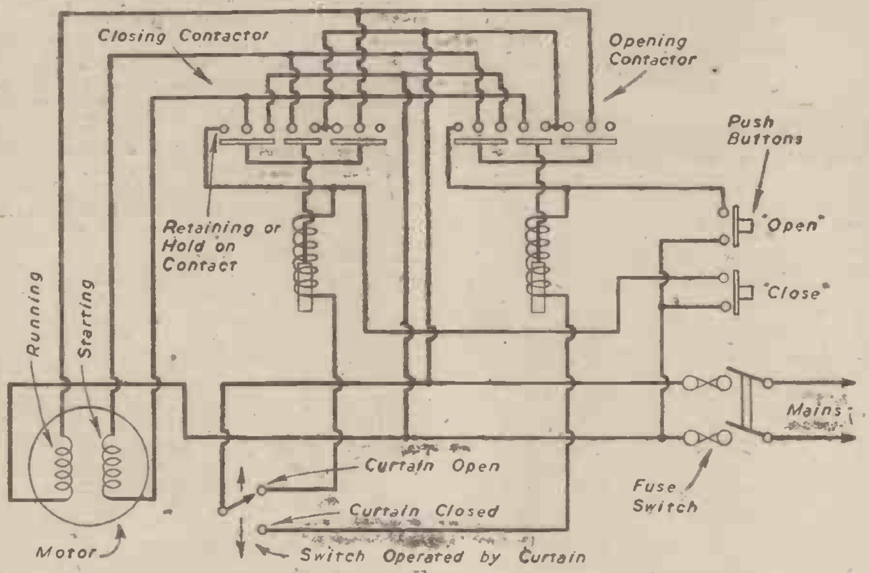
Switching Circuit for Motor

(1) COULD you let me have a diagram for the connections to two 2-way switches used to reverse an A.C. single phase induction motor? This motor is required to operate as a curtain motor for a cinema. One 2-way switch is placed in the projection room and marked open and close. The other switch is mounted on the motor casing and is automatically (mechanically) tripped as the motor comes to the open or closed position, thus stopping the motor and placing the motor switch connections in position ready for the reverse motion when the projection room switch is brought into operation again.

(2) Please let me have connections for the same operation as above, but this time using a shunt wound commutator motor (A.C.).—F. Kinghorn (Bedlington).

THE best way of solving your problem would be to use two coil-operated push button controlled 3-pole contactors with retaining contacts. The type of push button starters provided to start a 3-phase motor direct on the line would be ideal. It is assumed that the single phase motor has a centrifugal switch for cutting out the starting winding when the motor has speeded up, or that the starting winding is rated to carry current all the time the motor runs. The mechanically operated switch on the motor can take the form of a single pole 2-way switch and the connections are shown in the diagram.

Query 2 apparently refers to a single-phase repulsion motor. Such motors usually have a single stator winding and are then reversed by movement of the brushes. Such a machine would hardly be suitable for the remote control desired. Special repulsion motors are obtainable with a split stator winding, one section being used purely for reversing, so that a fixed brush position can then be used. With such a machine the control circuit shown could also be employed, reading "reversing winding" for the starting winding indicated.



Circuit of switching arrangements of motor for operating cinema curtains. (See reply to F. Kinghorn, Bedlington.)

Tin Coating Process

I HAVE heard there is a process by which brass and copper articles may be coated with tin by boiling them in a solution containing some form of chemicalised tin. Can you tell me what the process is and the chemicals to be used?—W. Slingsby (Preston).

BRASS and copper articles may be tin coated by either of the following non-electrolytical methods:

Method A.

Make up the following solution:

Tin chloride	¼ oz.
Aluminium sulphate	1 oz.
Cream of tartar	1 oz.
Water	½ gallon.

Place the article to be tinned in an improvised cage or basket of iron wire, and immerse this in the above solution, which should preferably be contained in a copper vessel. Boil the solution very gently for about half an hour. If possible, lay a sheet of zinc on the bottom of the vessel during the tinning. After tinning, wash the articles thoroughly and then dry them without heat.

Method B.

Make up the following dry powder:

Tin chloride	15 per cent.
Ammonium sulphate	15 "
Magnesium powder	3 "
Powdered chalk	67 "

Rub this powder on to the articles to be tinned, using a damp, soft cloth for the purpose. Afterwards, wash the articles and dry carefully, as above.

Distilling Apparatus for Lifeboats

CAN you inform me what technical difficulties or disadvantages, if any, there are in installing a distilling apparatus in a lifeboat?

Is the main disadvantage that for the amount of room taken by the plant and the fuel necessary, another water tank could be placed?—H. Adelman (Wembley Park).

THE chief obstacle to supplying every lifeboat with a distillation apparatus is cost and scarcity of supplies. Essentially, there are but few technical difficulties inherent in the design of a suitable distillation apparatus for lifeboat use. The main difficulty concerns the supply of fuel necessary for the heating of the still. This question, combined with the general weight, bulk, and the somewhat fragile nature of a portable still for use in an emergency, has been the main cause of the apparent lack of progress in the design and use of these emergency stills for dealing with seawater.

Much experimental work has been performed of late years on the production of a system of purifying seawater without distillation. It is now claimed by the Permutit Company that a compound has been devised which, by the simple percolation of water through it, completely removes all impurities from the water. Whether such a principle will ultimately become applicable to the purification of seawater in cases of emergency is more than we can say at the present time, but the general trend of experiment and endeavour is in this direction, and has been so for some considerable time.

Mains Resistance Details

I WOULD be much obliged if you would let me know the size and length of resistance wire to use for winding two resistances to connect in series with a small projector lamp for occasional use. The lamp is marked 60 volts 50 watts and I want to use it on mains supply of 230 volts and also 200 volts.—D. de Deney (Sutton).

FOR operation on 200 volts you require a series resistance of 168 ohms, and for operation on 230 volts a resistance of 205 ohms. The resistance of a given wire depends, to a certain extent, on the operating conditions which are governed by the way in which the wire is mounted. If you wind the wire on a mica strip somewhat in the manner of a toaster element you could use 26ft. of Brightray resistance wire for 230 volts, with a tapping at 21ft. for use on 200 volts.

Electric Drive for Small Boat

I WANT to make a small boat for use on a pond by a child, and should like to fit it with electric drive. The boat will be flat-bottomed, about 2ft. 6in. beam × 8ft. long. I propose using a car battery and one of the three alternatives below. I do not want to rewind, and should like your advice as to the most efficient means of controlling for speed, and, if possible, reversing:

(a) Morris dynamotor, 12 volt;
(b) Conventional starter motor, Austin Seven or larger;
(c) 6- or 12-volt dynamo used as motor?
—V. O. Harvey (Colchester).

WE suggest you use a 6- or 12-volt dynamo as a motor for driving the boat. You could remove the third brush and connect the field windings across the main brushes, connecting a variable resistance in series with the field windings for speed control. Care should be taken to keep part of this resistance permanently in circuit, if necessary, to avoid overheating of the field windings on prolonged running. If a very low speed is required this could be obtained by means of a variable resistance connected in series with the armature only. The motor could be reversed by simply reversing the connections to the field coils.

Reversing a Universal Motor

I HAVE a small fan motor of the universal type, and wish to run it in the opposite direction. How can this be done? Also, please give me particulars of a resistance I would require to vary the speed of the motor from full to zero.—C. Tandy (West Bromwich).

THE simplest way of reversing your motor is by changing over the connections to the brush holders. You would require a very high series resistance to reduce the speed to zero on no load. As the size of the motor is not stated we will assume this to be one-tenth horse-power. On a 230-volt supply such a motor would take a full load current of about 0.65 amp. In order to reduce the speed of the motor to about one-tenth of full speed when the motor is working against full load torque you would need to reduce the voltage at the motor to one-tenth of its rated value. The volt drop across the series resistance would then have to be 207 volts. The value of the resistance in ohms is equal to $\frac{\text{volt drop}}{\text{current}} = \frac{207}{0.65} = 320$ ohms. 30 S.W.G. nichrome V resistance wire, as supplied by Messrs. British Driver-Harris, of Gaythorn Mill, Albion Street, Manchester, 15, when coiled fairly tightly will reach a temperature of about 330 deg. C. when carrying 0.65 amp., and has a resistance of 4.45 ohms per foot at that temperature. You could, therefore, use 72ft. of this wire, and we suggest that a tapping switch with "off" position be used to control the amount of resistance in circuit. A similar method could be used to calculate a resistance for another size of motor.

Static Frequency Transformer Design

CAN you give me details of winding and connecting a static frequency transformer where it is desired to have a supply of 150 cycles per second? I know methods are used with transformers

having D.C. saturation windings. Two or three transformers are connected in such a manner that the second or third harmonic of the fundamental (50 ohms in my case) are in phase in several output windings.

The second method being the use of a single transformer with D.C. winding for saturation, and having the output tuned to the desired frequency and by also adjusting the A.C. and D.C. supply currents. Is the tuned output affected by the load, and must the latter be considered when designing? Which is the more efficient of the two methods?—J. Doran (Bellshill).

THE detailed calculations involved in designing a static frequency changer are rather outside the scope of a reply to a query. In order to work out the windings required it is necessary to start from the magnetisation curve of a transformer core, which is of the form indicated in Fig. 1. Assuming the core is saturated to give a flux of strength B with D.C. ampere turns A, and is also subject to A.C. ampere turns C (Fig. 2), the total ampere turns acting on the transformer core will be as shown by the curve D. Plotting the magnetic flux obtained with the ampere turns at various points on curve D we can obtain the magnetism in the core at any time, as shown by curve E.

Now the secondary voltage of the transformer is proportional to the product of the number of turns of the secondary which are linked with the flux, and the rate of change of the magnetic flux. Actually, the induced voltage at any instant is proportional to number of secondary turns × rate of change of magnetic flux in lines per second × 10^{-8}, and the secondary voltage will have a wave form somewhat as indicated in curve F, being zero at instants when the magnetic flux has its maximum or minimum values, and being greatest when the slope of the magnetism curve is greatest.

The secondary can be used to feed another transformer having a D.C. saturation winding to give a magnetic curve as indicated at J. The secondary voltage of this transformer will be somewhat of the form shown by curve K, and will be of higher frequency than the original. The length of the impulse and the frequency can be adjusted by variation of D.C. excitation. If two other primary transformers with D.C. saturation are also connected to windings on the second transformer through phase shifting devices employing chokes and condensers it should be possible to arrange to obtain a continuous 150 cycle output.

If the output of the first transformer is fed to a tuned resonating circuit employing a condenser and choke, and the primary of a loading transformer, this could be used to maintain the oscillations during the parts of the original cycle when no input is fed to it. This method is likely to be less efficient than the former one, and the load circuit should be tuned to the correct frequency for best results. It may be said that these static frequency changing methods are little used in industry, and more satisfactory results are likely to be obtained with rotating plant.

Chemical Weed Killer

I WOULD be much obliged if you can give me some information on the following matter: I wish to kill some weeds that are growing on a path around my garden; they seem to come up as quickly as I hoe them out. Is there any chemical way of treating them, either that I could compound myself or buy; and, if so, in what quantities is it to be used? Would a caustic soda solution be any good?—J. Fitzgerald (Clonmel).

A STRONG caustic soda solution would certainly kill the weeds in your garden paths, but there would be a danger of this solution spreading beyond the path and detrimentally affecting the plants in your garden.

A solution of copper sulphate is safer to use for weed-killing purposes. This can be made by dissolving 2 ozs. of copper sulphate in a bucket of hot water. The bucket must be an enamelled one, not one of the galvanised variety, otherwise some of the copper of the copper sulphate solution will be precipitated on the sides of the galvanised bucket. Alternatively, you can use jugs and similar articles for containing the copper sulphate solution. This solution is sprayed on the paths as required.

Another solution for the same purpose contains lime-sulphur. This is quite simply made by boiling equal quantities of lime and sulphur in a bucket of water until a strong yellow solution results. This solution can be used on the path either in its original strength or diluted with water.

In all cases, continual watering of the path with the weed-killing solutions will be required if the weed infestation is at all bad. Remember, also, that some weeds, as, for example, the common "dock," have long "tap" roots which go straight down into the ground for a considerable distance, and which, therefore, require effective percolation of the weed-killing solution round them if they are to be finally eradicated.

Transformer Details

I UNDERSTAND that a transformer having a core sectional area of 1 sq. in. will have eight turns per volt (primary) at a frequency of 50 cycles. Output, 20 volt 2½ amps. Weight of stamping, 3lb. (approximately).

I have two sets of stamping both of 1 sq. in. sectional area, though one core is twice the length of the other, and is therefore much heavier.

As the sectional area of the core and total weight of the stampings play such an important part can you please tell me how to balance these two?—V. Bennington (South Bank).

THE effect of increased length of transformer core is to increase the magnetising current and volt drop on load so that the power factor and efficiency are reduced. The cross-sectional area of the core governs the maximum magnetic flux, turns per volt, and output; these factors only being indirectly controlled by the weight of the core.

Therefore, in order to obtain the same secondary voltage on full load with a long core as with a short core of the same cross-sectional area it is advisable to use rather more secondary turns, say 10 per cent. more for the long core. It is not likely that the two transformers will work well in parallel, however, and circulating currents may flow between the two secondary windings if so connected, causing heating of the windings. If you wish to use both transformers at once to give maximum output we suggest you connect the primary windings in parallel and the secondary windings in series.

Silvering Small Brass Articles

COULD you let me have the formula of the ingredients which are used for the "silvering" of brass screws. I believe potassium-bitartrate is one of the essentials?—H. Groves (Brentford).

IT is quite a simple matter to silver brass screws and similar articles by the method you indicate. The silvering is a genuine one, although the silver deposit is not lustrous, but is, on the contrary, white and "matt" like the silvered surface of a clock or a watch dial.

Powder up 1 part of silver nitrate, 2 parts of cream of tartar and 1½ parts of common salt (all by weight). Make the resulting fine powder into a paste with water (preferably, but not essentially, distilled water). Wipe this paste over the articles to be silvered, using a soft cloth for the purpose. The silvering will be accomplished almost instantly, after which the articles should be washed and dried. The paste can be used many times. It should be stored in the dark, since it is deteriorated considerably on long exposure to light. Needless to say, the articles to be silvered must be scrupulously clean and entirely grease-free before the treatment is begun.

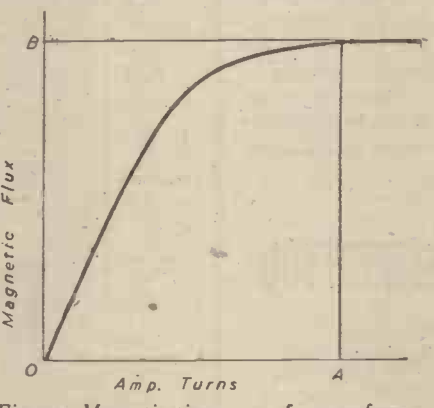


Fig. 1.—Magnetisation curve of a transformer core.

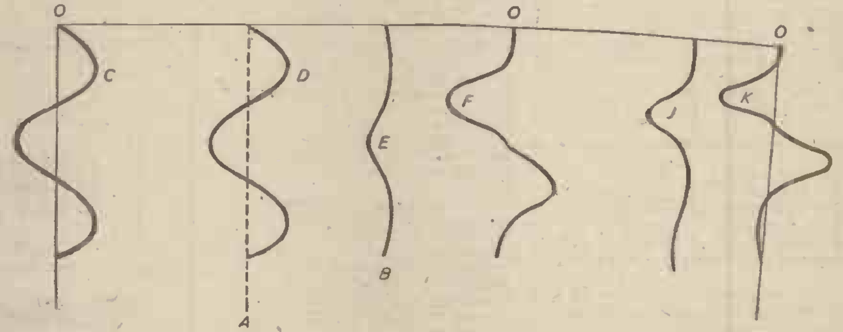


Fig. 2.—Curves indicating amp. turns and flux strength of a transformer core. (See reply to J. Doran, Bellshill.)

Converting 3-phase Motor for Single-phase Working

WILL you please inform me whether there is a satisfactory method of converting a fractional-horse-power, 3-phase electric motor to run on single-phase supply?

Will you also let me have details of the formula for working out the loading of motors of all descriptions, given the voltage and horse-power?—F. Cripps (Wellingboro).

THE most satisfactory way of converting the motor for use on a single-phase supply is by rewinding the stator. In order to give you a winding specification we should require to know the bore and length of the stator laminations, number of stator slots, and preferably the size of the stator slots. You could use a 3-phase motor on single-phase supply without modification, provided the voltage is reasonably correct, and you are prepared to start the motor by hand. In this case two of the three motor terminals only would be used.

Presumably you require to work out the full load current of various types of motors. One horse-power output is equivalent to 746 watts. Hence

$$\text{Electrical input to a motor} = \frac{\text{h.p.} \times 746}{\text{Efficiency}} \text{ watts.}$$

Full load current of a D.C. motor

$$= \frac{\text{h.p.} \times 746}{\text{Volts} \times \text{Efficiency}} \text{ amps.}$$

The efficiency may vary from about 0.67 for a ½ h.p., 0.8 for a 6 h.p., 0.85 for a 10 h.p., 0.9 for a 30 h.p., to 0.93 for a 100 h.p. motor.

In the case of a single-phase motor the full load current will be equal to

$$\frac{\text{h.p.} \times 746}{\text{Volts} \times \text{Efficiency} \times \text{Power Factor}} \text{ amps.}$$

Efficiency may be about 0.74 for a ½ h.p., 0.8 for a 3 h.p., 0.85 for a 20 h.p., 0.9 for a 85 h.p., to 0.91 for a 100 h.p.; and the power factor, 0.79 for a ½ h.p., 0.8 for a 1 h.p., 0.85 for a 7 h.p., 0.9 for a 50 h.p., to 0.92 for a 100 h.p.

In a 2-phase motor where the voltage is measured between the two phases, full load current

$$= \frac{\text{h.p.} \times 746}{\text{Volts} \times \text{Efficiency} \times \text{Power Factor} \times 1.414} \text{ amps.}$$

In a 3-phase motor

$$C = \frac{\text{h.p.} \times 746}{\text{Volts} \times \text{Efficiency} \times \text{Power Factor} \times 1.732} \text{ amps.}$$

Considering a 1 h.p. 3-phase 400 volt motor

$$C = \frac{1 \times 746}{400 \times 0.77 \times 0.8 \times 1.732} = 1.75 \text{ amps.}$$

Dissolving Scrap Rubber

I SHALL be glad if you can give me any information on the following:

I wish to dissolve scrap rubber—black, red and white (preferably black), and from it cast or mould parts similar to rubber date stamps.

Can this be done without heat and at low pressures? From what should the moulds be made?—W. E. Whitmore (Bletchley).

THERE is no known chemical which will dissolve scrap rubber in the manner which you desire. On a large scale waste rubber is partially dissolved by a combined process of macerating and mincing under certain solvents (such as naphtha), sometimes under pressure. Even this lengthy process does not give an actual solution of rubber, but, rather, a sort of gummy paste, which can be made up into rubber cements or incorporated into other rubber "mixes."

Date stamp rubbers are usually cast in steel moulds; although, no doubt, in some instances, plaster moulds could be substituted. The whole process of date stamp manufacture is not easy for any amateur to imitate unless he has the requisite knowledge and practical experience. For this purpose raw and soft para rubber is required, it being impossible to utilise the hardened, semi-vulcanised scrap or waste rubbers.

Removing Rust from Pipes

COULD you give me any information regarding the hot-water system in houses?

I have uncoupled part of the pipe work from the boiler behind the fireplace to the tank and find that the pipes are thickly corroded with rust inside.

This is giving only a weak supply of hot water; also, when the water is very hot it is of a rusty colour.

I should be much obliged if you could tell me of anything I could put in the tank which would remove the rust from the system.—H. Homer (Birmingham).

YOU will not find it easy to remove the dust and scale from the inside of your hot-water pipes. Frequently, when scale occurs in excessive amounts it is found necessary to renew the pipes or portions of the same.

The only mode of action which we can recommend by way of chemical treatment is that you should dissolve about 4 ozs. of trisodium phosphate, together with the same amount of sodium metasilicate in the feed-tank. The solution made thereby will have a solvent and a loosening effect on the scale and will dislodge it, either wholly or in part. Such water, of course, will definitely be unfit for drinking purposes.

This treatment should be renewed at intervals of about two or three weeks, until the scale has been removed or satisfactorily lessened.

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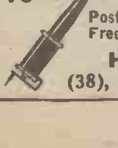

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THE Cyclist

Editor: F. J. CAMM

VOL. XIII JANUARY, 1945 No. 275

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

Phone: Temple Bar 4363

Telegrams: Newnes, Rand, London

Comments of the Month **By F. J. C.**

Hole and Corner

ANNUAL general meetings are usually held in January, and in view of the many problems which are disturbing the sport the time is opportune for them to be raised in club circles.

The most effective method of doing this is to place the matters on the agenda. The suggestion has been made elsewhere that secrecy in road sport be abolished, that the N.C.U./R.T.T.C. agreement should be rescinded, that the N.C.U. rule requiring the closure of roads to other traffic when massed start events are held on public roads should be amended or deleted, and that massed start racing should be approved. Let us avoid the stupid expression "*in line*," which, like the term *time trial*, is a mere subterfuge. We have nothing to hide. Let us away with these hole-and-corner terms and methods.

A speaker responding to the toast of the visitors at the recent Charlotteville dinner voiced opposition to massed start racing, and stated that whilst some may think that time trials are hole and corner, cyclists prefer it that way. The speaker was going out of his way to deliver his message, for there was no relation between the toast and the massed start dispute trials. However, we do not agree that cyclists want their sport held by the hole-and-corner methods which stupid old men once decided should be adopted for time trials.

The speaker went on to deal with the criticisms of these men with their minds back in the 'eighties who cannot forget that they once rode an Ordinary. It was these old men of the N.C.U. and other national bodies so-called who kow-towed in the 'nineties to the vicious attitude of the police and magistrates towards cyclists and cycling sport.

Instead of opposing the police attitude, they gave in to it, and introduced the sneak-thief method of running time trials which still persists. The N.C.U. went further, for it abandoned time trials and road records, and sided with the attitude of the police. There are many who think that they should have fought the matter. However, *the apprehension which the N.C.U. felt in those days towards time trials and the police attitude has been proved by 50 years of continuous time trialling to have been wrong. It is fair argument, therefore, to say that their present apprehension towards massed start on the grounds of police interference, danger to other road users, or that time trials may be banned may be equally wrong.* Certainly their judgment was unsound in the 'nineties, and I have no doubt that they bitterly regret having nailed their flag to the mast of races on closed circuits only. If they were wrong over time trials in the 'nineties they may be equally wrong over massed start.

The speaker went on, without producing any supporting evidence, to say that massed start would not be so popular on the Continent after the war. There are no grounds for such a statement, and the B.L.R.C. need have no fears on that score, for it is a mere expression of opinion.

A speaker at the West London Centre of the N.C.U., in debating this problem, stated that massed start racing was illegal. It was pointed out to him that it was quite legal. His reply was that there was not a law to say that you could have massed start races!

That is the sort of mind which is opposing massed start. It may be an indicative straw that at the annual meeting of the Dundee and District Time Trials Association it was decided that delegates to the Scottish Amateur Cycling Association A.G.M. are to carry motions from Dundee that the constitution of the national body be amended to allow the promotion of massed start racing in Scotland, and notice is to be given to terminate the agreement with the controlling body of England.

It is said that there is a split in the cycling movement. A Heal the Split Committee has been formed to heal the split. We *hail the split*, for it is the beginning of the end of the pocket dictatorship of those who are opposing a healthy development of the sport on the insecure grounds that they are chiefly interested in road safety. We are quite certain that the gravamen of the opposition is that the new sport is popular, it is wanted, and may finally oust track racing. It will certainly prove more popular than time trials, the hole-and-corner methods of which are the evidence on which the detractors of the new sport stand condemned.

Hail the Split!

By R. L. JEFFERSON.

QUITE a lot of ink has been used during the past few months on the subject of massed start racing, and nearly all the arguments have dealt with the political aspect of the situation, if one may call it such.

Now I prefer to deal with the purely cycling side of the subject. It is—or ought to be—a well-known fact that practically every other country in the world indulges in massed start racing on the public roads. These races are publicised by the national press and great crowds turn out to see the riders go through the various towns en route. The reason this is so is because cycling in nearly every country except England is a national sport. Before the war there were five first-class tracks in Paris. On Sundays first-class events, including high-speed motor-pacing by the topmost professionals, were held; crowds of 50,000 to 60,000 attending were accepted as a matter of course. Many massed start road events had their finish over a few laps of these tracks; at the finish the winner usually did a lap of honour amid the applause of the spectators. In the winter the sport went on in enclosed velodromes, where large crowds attended and applauded the efforts of top class riders, who rode to win.

Taking our Pleasures Sadly

We have the reputation as a nation of taking our pleasures sadly. I think I may add that we also take our sport half-heartedly. In conversation the other day with the only man to win a world's sprint title since the last war, I said: "Tiny, what's wrong with the present-day cyclist." I'd better not give his reply verbatim as some of it would be unprintable; he finished up by saying "no guts." In his opinion the present-day riders don't take the sport half seriously; they don't train seriously enough and generally consider it infra dig. to go "all out." Of course, our lads don't get the opportunity to train with professionals as our pros. have nearly all died out; the last good one we had on the track was W. J. Bailey, who always rode to win. So did Meredith on road and track. At our own road game in our own country I expect we could still lick the foreigner. Marsh in 1922 demonstrated that by winning the world's road title. All of the foregoing may sound like a digression, but the reason I am writing it is to acquaint the present-day cyclist with the fact that at one time of day we had riders who on road or track were the equal of any in the world. Over a period of time we gradually lost our reputation as a cycling nation in the eyes of the world, until latterly we have become almost a laughing-stock when our boys appear abroad.

International Events

Now there must be a reason why a country like ours, which has such a large number of cyclists, can't put up a better show in international events. In my opinion the following are the causes: We prefer to have time trials on the road to massed start racing. Nearly every country except ours run their races on the massed start principle. The result is that when we send a team abroad they have not had the opportunity of training in this branch of the sport. The foreign amateurs train on the road with the pros. and get to know all the finer points so essential in this branch of the sport. The opposition put up by a clique of conservative officials puts a brake on the more progressive clubs and riders.

The B.L.R.C.

There are signs that the more progressive element are now getting going, and the B.L.R.C. is only a beginning. The fact that they have gained recognition by the national press should not be deplored, as it has been by the old men who try to keep cycling in the same groove as it has been for nearly fifty years in this country. Is there anything to be ashamed of in our game? Surely not, if fifty or sixty thousand odd people can go to see a professional football match, why shouldn't they go to a cycling event? Let us take our two London tracks as an example; suppose we say the year is 1938, a meeting takes place one Saturday afternoon and the usual crowd of cyclists attend; most of these are, of course, clubmen, and many have brothers and friends riding. A few outsiders (e.g., the general public), who more by luck than judgment drift in; they happened to see the crowd going in the direction of the track so they followed, not having anything else to do. The members of the public purchase programmes and await events; the meeting is billed to start at 3 p.m. (with luck it starts at 3.20 p.m.). Heat 1 can't be run as the riders, or some of them, have not yet put in an appearance; so Heat 5 is run off; some time later Heat 1 is run off, not necessarily with the riders stated in the programme. Between whiles John Citizen begins to wonder why there are so many people in the centre; nearly all these people are supposed to be connected in some way or another with the racing. John Citizen next notices that the more important officials are nearly all either old or oldish looking men, very correct as to demeanour, their bicycles, which many take into the centre, are nearly all finished in a funeral shade; colours are, of course, vulgar and modern.

Out-of-date Ideas

These are the old men running a sport which young men play; no doubt in their day some of these men were excellent cyclists and some were very fast, unfortunately they don't change with the times; they want the same sort of cycling we had in 1910, clothing to be from neck to feet and all the other ridiculous ideas which were fashionable decades ago. John Citizen next gets so fed up that he drifts over to the refreshment stand and buys a cup of alleged tea and a bun; he is served rudely and overcharged and, swallowing his resentment, he drifts back to the trackside, determined, since he's paid his way in, to try and get some enjoyment from the sport. The mixture as before is still being served up, riders with wrong numbers, heats run off irrespective of their order of sequence, and the same deadly monotonous voice over the microphone announcing the results. More often than not, John Citizen, utterly fed up and confused, leaves the meeting determined not to bother with cycle racing on Saturday afternoons. This same citizen,

(*Continued on page 27*)

Paragrams

Stratford St. Mary, Suffolk.

Vic Botteril Killed

A PRE-WAR official of the National Clarion C.C., Hendon Section, Vic Botteril has been killed in action in Italy.

F/O. W. H. Chappell Decorated

FORMER secretary of the West Counties Road Records Association, Flying Officer W. H. Chappell has been awarded the D.F.C. He is a former holder of several local records, among them the Bristol-Bournemouth-Bristol tandem record. His partner on this ride was Wilfred Coombes, who is missing following an operational sortie over Germany.

The Adriatic Wheelers

THE latest Forces club is called the Adriatic Wheelers.

Another member of the club, K. Consterdine, is reported missing.

Percy Stallard Retires

PERCY STALLARD, Wolverhampton R.C.C., has retired from competitive work. He has competed in road and track events for the past 16 years and represented this country six times in major championships on the Continent. He is a massed-start enthusiast.

Forces Casualties

FRANCIS SMITH, Royal Artillery, a member of the Leeds Kirkgate C.C., has been killed in action. The death has also been announced of Harry Senior, cycling stalwart of Yorkshire, who died as the result of injuries sustained in Italy. Former Hon. Treasurer of Bramley Wheelers, Norman Holmes, also died in Italy.

Addiscombe C.C. Loss

THREE members of the Addiscombe C.C. have made the supreme sacrifice. They are P. R. Stafford (Royal Air Force), William Hobbs (killed while fighting in France) and R. Skidmore.

Some Hill!

THE famous Horse-shoe Pass, north of Llangollen, well known to Welsh tourists, proved a popular attraction for a cycling hill-climb. The winner was J. Roberts, Birkenhead North End C.C., who climbed the three miles one furlong in 12 min. 7 sec.

Century Man Missing

J. NORMAN, Century Road Club, who had been awarded the D.F.M. for courage and endurance, has been posted "missing."

Captured

PREVIOUSLY reported missing, Lawson Miller, Douglas C.C., is now known to be a prisoner of war. He was serving in the R.A.F. Another clubman prisoner of war is Eric Bowters, of Nottingham and member of the National Clarion C.C.

Trade Interest

THE National Association of Cycle Traders report an increase of over 1,000 members during 1944.

Decorated

SERGEANT M. SISLEY, formerly employed by W. F. Holdsworth, of London, but now serving with the Queen's Own Royal West Kent Regiment, has been awarded the Military Medal. He is serving with the Middle East Forces.

Repatriated

JOHN BROWN, Paisley Clarion C.C., has arrived in this country from Switzerland. He was captured during 1940 at St. Valery, but after a few days' imprisonment escaped and made his way to Switzerland.

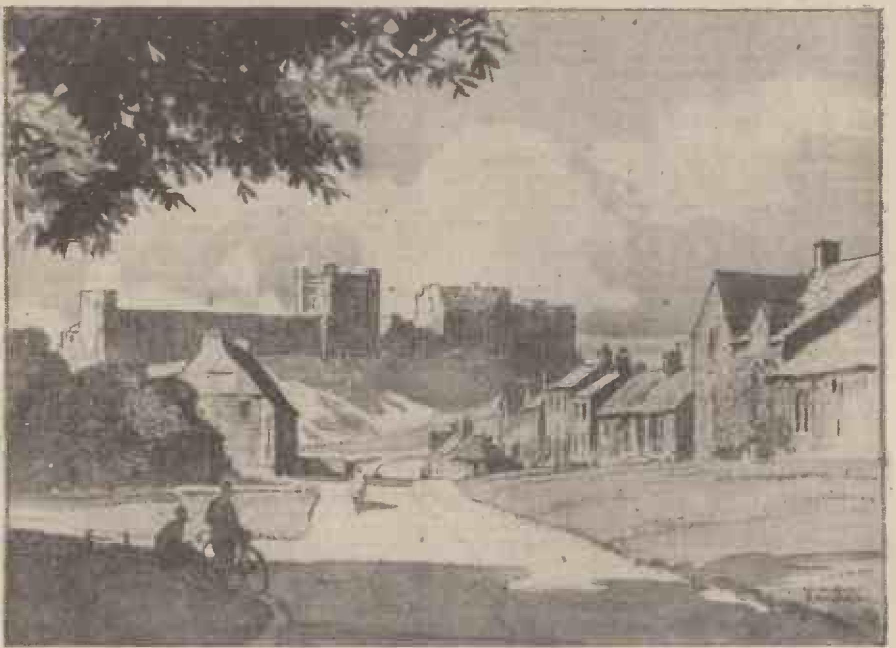
Mentioned in Dispatches

TWO members of the Bournemouth Arrow C.C. have been mentioned in dispatches. They are Sub-Lt. K. Child and Sergeant W. H. Portsmouth, Royal Air Force.

A scene during large-scale invasion exercises in which the R.A.F. took part. Note the number of cycles being brought ashore with the equipment, under the protection of a balloon barrage.

Manchester News

JIM HERBERT, Manchester Roads C.C., has died of wounds sustained while on service in Italy.



Banburgh, Northumberland. A view of the little village with its great castle built on the rock above it.

Tew's Retirement

RONALD TEW, tower of strength in the B.L.R.C. movement in the Midlands, has had to relinquish all offices on account of ill health.

"Heal the Split" Committee's Move

SUPPORTERS of both sides in the controversy over the formation of the B.L.R.C. have often claimed majority support. In response to requests the "Heal the Split" Committee has extended the survey of opinion, previously collected from London, to a countrywide effort. Over 450 clubs have now been circulated and secretaries are urged to circulate members. Any club not having been circulated should write to the Committee's hon. secretary, R. White, 504a, Hornsey Road, London, N.19, who will also supply any club needing additional questionnaires, etc. With the co-operation of the National cycling journals, this note is being sent to all, a sound survey should be collated. Returns are only requested from R.T.T.C./N.C.U. clubmen, as no object is served to include those of the B.L.R.C.; also the London clubmen who have already returned a questionnaire should not return another.

Clubmen willing to organise local open cyclists' meetings for discussion on this topic are urged to do so, and the "Heal the Split" Committee, through its secretary, will give any advice possible.

Cycle Repairers to Celebrate

LIP service has been paid to the "small trader," and hundreds are to meet at 10.30 a.m. on Wednesday, January 17th, at the Great Hall, Winchester House, 100, Old Broad Street, London, E.C.2, from Harwich to Portsmouth, London, Home Counties, Bomb Alley and the "Battle of Britain" area, etc. Cycle Repairers and Traders who carried on with sons and daughters and staff in the Forces, windows in one day, out the next, and harassed by regulations and conditions. An advisory Bureau consisting of experts dealing with war damage, legal, licencing, accountancy and other matters will be in attendance. Politicians, manufacturers and others will speak at 2.30 p.m. The president of the N.A., W. J. Lord, Horace Bates (chairman), G. T. Roberts (secretary, London Branch), and the National organiser, J. W. Stevenson, are combining their efforts for this arrangement.

Around the Wheelworld

By ICARUS

Stormy Meeting

THE London Centre of the N.C.U. recently held a meeting which took a queer turn towards the end. Among the business discussed was Spurgin's letter and report on his massed start effort, and his complaint that there was not nearly enough publicity given to those events. This was denied by the N.C.U., who said there had been ample propaganda. This led to a general debate on the massed start question, and much heated discussion followed. A member from one of the South London clubs asked why the N.C.U. did not promote road races on the same lines as the B.L.R.C. The reply was that it was illegal, and the retort was that if the B.L.R.C. could do it so could the N.C.U., and it was not illegal anyway.

The speaker replied that if it was not illegal there was at any rate no law to say that you could promote such events!

Another speaker labelled this as arrant nonsense, which, of course, it is. I would go further and say that it is ignorant nonsense. However, the meeting proceeded to pull the London Centre to bits for its continued failure to be progressive. This sort of acrimonious discussion tinged with acerbity went on for some time, until Mrs. Weller rose and asked if she could put a proposition which would be open to discussion.

This is the proposition:

"It is the opinion of this meeting that the Emergency Committee of the N.C.U. or the National Executive should call a meeting of R.T.T.C., B.L.R.C. and N.C.U. representatives, or request the Heal the Split Committee to do so in an endeavour to find a settlement of the dispute between these bodies. This matter should be treated as urgent."

It was passed with only one dissenting vote.

Two of the cycling journals were not represented, and apparently did not receive an invitation. There were numerous complaints about the N.C.U.'s attitude. I am of the opinion that the split will not be healed. Out of it all will spring an entirely new national body, larger in scope than the present bodies. In connection with this bother, I have received the following letter from Vic Bowman, a record-breaker: "I have been more than interested to read your editorials criticising the various so-called bodies who control cycling, and it would appear to me that certain people are trying to create niches for themselves so that they can be regarded as the patriarchs of cycling. No doubt sooner or later they will bring in a series of Salutes and Heils to complete the issue. I enclose a copy of one of the local papers of Scotland, from which you will see the attitude of Scotland towards the controlling bodies of England [*see this month's Leader.*—Ed.], and as I always understood that this Empire of ours came under the heading of Free, providing none of the laws of the country are being broken, there seems to be no reason why, if cyclists wish to indulge in that kind of sport, they shouldn't do so. Thinking back over the years, I can see no difference between massed start racing and some of the runs which were organised by the C.T.C. under the heading of 'Hard Rides,' or some of the local lads indulging in their annual Brighton and back in one day."

The Charlotteville Annual Dinner

THE Charlotteville annual dinner held on November 17th at the Red Lion Hotel, Guildford, accentuated the position which this famous club holds, and added to the prestige which it has gained throughout the world of wheels.

It was well attended, and there were many visitors from London, including representatives of the Middlesex R.C., Finsbury Park, South Western, Velma, Polytechnic, Altrincham Raven, Norwood Paragon, Caleva, and the Midland C. & A. clubs.

The toast of The Guests was proposed by the chairman, that revered sportsman, Vic Jenner, and the response was from Stan Forrest, Assistant Sec. of the R.T.T.C., who thanked the club for presenting a shield for competition.

In responding to a toast the speaker dealt chiefly with the question of the massed-start controversy—although what connection there is between visitors and guests and massed start I do not know. The toast of Absent Friends was in the hands of C. Cripps, whilst the toast of The Club was proposed by B. Best, another speaker who must have overlooked the subject of his toast, for he went on to propose the toast of the chairman.

However, the real toast of The Chairman was ably proposed by Mr. F. J. Camm, who contradicted the remarks of the previous speaker in suggesting that the fame of the club was due entirely to team work. It is true that team work exists in the Charlotteville in great measure, but the best team needs a leader; no club has a better leader nor a more inspiring one than Vic Jenner, whose great knowledge of the pastime and whose methods mark him as a true sportsman, and make his services sought after on the national bodies.

There was an excellent concert after the prizegiving. A note to those responding to toasts: It is not a platform for anything but the subject of the toasts. Speakers should keep down to their subject.

The Ealing Annual

THIS club, which is affiliated to the B.L.R.C., staged its annual dinner, dance and prize distribution at the Park Royal Hotel, on Saturday, November 18th, when over 150 members and guests turned up. Mr. J. Kain was in the chair. There were many speeches, but the important toast of the evening, that of The Club, was proposed by Mr. F. J. Camm, who paid ample tribute to the stand The Ealing has taken on the question of massed start, and to their refusal to be browbeaten by effete national bodies. The time has come, as in international affairs, when power politics must give way to the reasonable aspirations of the majority.

The N.C.U., he said, thought that the attitude of the police in the 'nineties would kill time trials, but the N.C.U. were wrong. They are likely to be equally wrong over massed start, for they have been the apostle of lost causes.

He also referred to the curious remarks of a speaker at the Charlotteville dinner on massed start, and stated that there was no foundation for the statement that massed start was likely to prove less popular after the war.

The toast of The Press was ably proposed by E. L. Lawton, with a reply by Rex Coley. Other speakers included Alderman Greenwood, Ex-Mayor of Ealing, Alderman Rockham, and W. H. Huggon. Dancing followed the prizegiving. A highly successful evening.

(*Continued from page 25*)

who may be a car owner, has occasion on Sunday to go up—let's say—the North Road. He leaves early as he has a long way to go; some distance north of London several cyclists in a hurry pass him in the opposite direction, at first he pays little attention, until it suddenly strikes him that the cyclists are all dressed the same.

Hole and Corner

Parking his car, more out of curiosity than anything else, he steps out to see if any more riders are coming along. Presently down the road comes a rider; John Citizen gets a good view of him, a fine young rider, a beautiful pedaller and dead steady, but he is in tights of all things, and John Citizen wonders why. The cyclists he usually sees on a Sunday wear the scantiest attire, and these chaps all appear as if they are indulging in some secret rite. John waits to see a few more similarly garbed riders go through and then proceeds north. Near a bridge he sees a cyclist who looks as if he may have some connection with these secret rites, as he has a piece of paper in his hand and is standing in the middle of the road. He passes comments to the riders as they go by, which are quite unintelligible to our John, who presently walks over to this individual and asks him what it's all about. He is greeted with an icy stare and asked if he is a clubman; upon being told that he isn't, the cyclist tells John that the secret rites he has witnessed are private and confidential and nothing at all to do with him. John tells him that he is only curious to know what it's all about, but the cyclist is adamant and very secretive and mysterious. Presently John proceeds north and concludes that cyclists are a very clannish lot of people who indulge in a sport of which they are either ashamed or so selfish about that they don't want any outsider to know anything about it.

John Citizen Gets Interested

One day he happens to read in his paper that a massed start cycle race is being held in Battersea Park. Along he goes, hoping that it won't be quite so bad as his experience at Herne Hill. The programme he buys informs him about all the details he wants to know, and individual members of the crowd tell him little anecdotes about the riders which awaken an interest in them. Presently he sees the riders lining up for the start; they are all in shorts and ankle socks, their gaily-coloured jerseys presenting quite a colourful picture. John begins to feel that, after all, he may enjoy himself, presently the riders are off, they jockey for position and pretty soon they are travelling really fast. In no time at all they are around again, John notes their numbers as they flash by, and hopes that the tall youngster in the yellow jersey will prove to be the winner. After a few laps the field begins to split up, and the rider in the yellow jersey is among a group of six who have broken away. Each lap round they gain a few yards, and after a while there are only four riders in the leading group, he of the yellow jersey laying third. The last lap round, and the tall youngster gets right out of the saddle and sprints for all he's worth; he just manages to beat the others by a wheel, the other three almost dead-heat. John goes away pleased with the afternoon, and wonders why there's not more of that kind of racing. Being a travelled man, he's seen some of the massed starts abroad, and would very much welcome them at home.

Backing of Public Necessary

Now the point I am trying to bring home is that if we want cycling to become a national sport we must get the interest and the backing of the general public. We have got to get a professional class built up quickly after the war. The trade quite rightly won't back us up until we can prove to them that the public want our sport, and are willing to pay to go and see it.

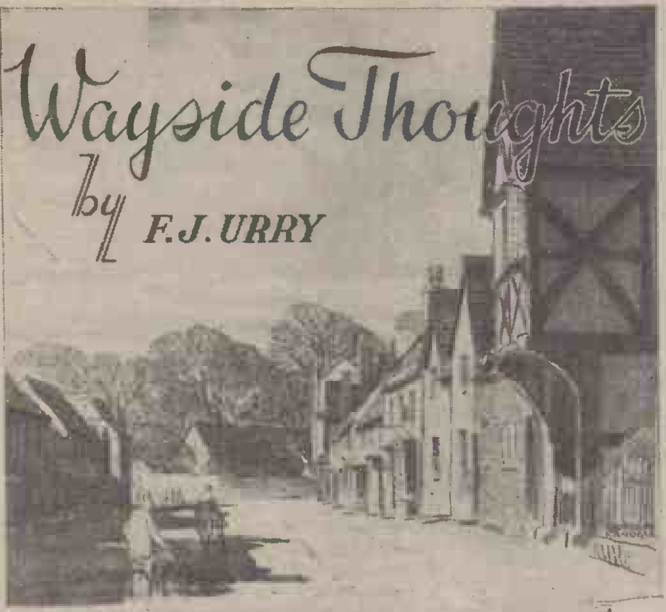
It has been estimated that there are something like 10,000,000 cyclists in Great Britain. Admittedly, a great number of these are people who only use a cycle as a handy means of getting to work, but we have got a large number of really keen riders who race and tour, and are most anxious to see our game become as national a sport as football or cricket. The sport and pastime of cycling has had a wonderful history; many of the inventions of the pioneer cycle makers are in use to-day in other forms of transport. Ours is not a sport which needs to hide its light under a bushel; let us shout it from the housetops, let all and sundry realise that ours is the best of all sports which can be practised by anyone at any time. We must remove the type of official who was popular in 1910, and substitute people who are alive to the possibilities which our sport holds for men of vision who don't live in the past. We can do this if we wish, but we've all got to pull together and demand the things we need.

Racing Track in London

First, we need at least one first-class track in London to start with. This track, of course, would have to be of cement, steeply banked and capable of speeds of 60 m.p.h. In this way we could have Continental pace followers visiting us, and we would soon give them all the competition they wanted, as the trade would back up riders who showed themselves capable of competing, and, above all, attracting a crowd. On the road the B.L.R.C. is only a cloud no larger than a man's hand; but it has come to stay, and it will grow. We must back it up for all we are worth. The R.T.T.C. is definitely going to be on the losing side. They must realise that, as the world grows older, times and conditions change, and it's up to them to change with them. Their attitude at the moment is very short-sighted, and their recent plea in a section of the cycling press "not to let the boys down" is sloppy sentimentality which just won't work.

Wayside Thoughts

by F. J. URRY



An autumn day in the lovely village of Lacock, Wiltshire. The village contains beautiful specimens of fifteenth-century cottages, and interesting stone and half-timbered houses.

After—the Joy of It

I AM waiting, with what patience I possess, to buy a new bicycle, several new bicycles, of the post-war breed, which I am told by their potential makers will be the last word in design, finish and adaptability. There is nothing wrong with my present small stock of machines except that they are beginning to look a trifle the worse for wear; obviously, after many thousands of miles of running they must be past their best, and since it is impossible to have them reconditioned in present circumstances, they have got to run on and do their job for me until such times as the goods return to the market. One of these machines, a "John Marston" Sunbeam, is now 24 years old, and wears its years like a sturdy veteran. Actually that bicycle does not have a fair outing, for it is the wet weather mount of my small stable, owing to its gear-case protection, which gives that silky running for ever associated with the real "oil-bath." It is looking a little battered to-day as far as finish is concerned, yet I cannot detect any falling off in its running qualities, and I never get aboard it on a wet day but I thank the workers for so fine an example of cycle engineering. Now the B.S.A. Co. are making the Sunbeam, the same old type, I am given to understand, and if that be so, then when the war is over I will purchase in the expectation that the modern will equal the ancient, and I ask no more than that. To the cyclist who loves the game and the means by which he plays it, the buying of bicycles after a lapse of five or six years of level mediocrity in quality is an exciting adventure which many people fail to appreciate for the sufficient reason that they have still to understand the finer points of this pastime. After some half-century of personal purchase (in the earlier days the choice was made for me) I still find a lot of exciting pleasure in writing out a specification and seeing the machine take shape. The test comes later.

Thank Goodness

AS a regular rider of the everyday type, with a night journey of nearly seven miles, I glory in the lift of the blackout, and the improved lighting conditions now allowed us. After five winters of darkness lit only by the feeble glow of our own lamps, it is like paradise riding home under street glims that mark the way, even though the illuminations are very distantly placed. Actually I seem to have forgotten what the roads were like at night prior to the winter of 1939, for the dim-out now allowed, coming after our imprisonment in Egyptian darkness, seems marvellous. It is perhaps just as well that we should be introduced to our re-lit roads quietly rather than the flush of illumination should be saved until the great day dawns—or the great night falls—when surely we should be dazzled into recklessness. My own impression of the present lighting system now allowed is that it compares favourably with road illumination in the Victorian era, before motor-cars were common, and steam trams still snorted along our highways. As an old inhabitant of the road, it brings very forcibly home to me the enormous improvements made in street lighting in the last 40 or 50 years, improvements in quiet evolution scarcely noticed by me until I was suddenly plunged into blackness, and am now being led quietly out of that void by the easy way of the dim-out, and soon, I hope, into the full glare of modern methods. What will those modern methods be? I am not a lighting engineer, and know nothing about the technicalities of the job; but I have always felt that flood-lighting from the road verge will be the final adaptation by road illuminators. The lamp-post will go and the road will be lit from its level rather than from above. That seems to be the ideal system for the benefit of all forms of traffic; but is it possible to introduce?

Help Wanted

THIS glass on the road is becoming a chronic nuisance. Now, I am not living in an area that has been recently bombed, so the excuse of glass splinters on the road as the result of enemy action will not work; yet it is true that all my tyre troubles these last months have been occasioned by glass punctures. I know labour is scarce and times are difficult; I am reminded daily, and almost hourly, that rubber is precious, and care for my tyres is no more than a patriotic duty and a personal economy. How can I take care of my tyres when authority allows the roads to be strewn with broken glass, and apparently no attempt is made to remove it? To give advice is one thing, and fairly easy of accomplishment; to follow it is also easy if the powers that be would do their share towards assisting. The "save rubber" propaganda annoys me intensely, because it is so utterly futile when the roads in a non-bombed area are glass-littered for miles. During the last two years I have had a couple of almost new covers completely ruined by contact with broken bottle particles, which I could not dodge in the dark. One can circumnavigate such obstacles in daylight, but at night one has to take pot-luck—or should it be bottle-luck? In the daytime it is the small slivers of glass that make the perforations and cause unnecessary trouble and delay to all users of pneumatic tyres. My toll of such punctures this year has been six, three times as many suffered as in any average pre-war season. Candidly I don't believe the excuse given for such neglect to be wholly true, for I see quite a number of people at work on the roads, but their sweeping operations seem to be mainly concerned with the gutters. In any case, the save the rubber campaign in present circumstances would be more truly applied to bridge than tyres.

Tyre Sense

AND what of tyres in the immediate future? It is a pertinent question. I do not think we shall be satisfied to carry on with present synthetic rubber, for which we are now so thankful. The tyre makers don't like it; they know synthetic is unsatisfactory, and that is a good thing for us users, because it will probably mean the earliest return to good quality that can possibly be made. The wartime tyre has done us good service, and one feels a trifle unfair in criticising it, but the truth is that synthetic rubber is a failure as far as cycle tyres are concerned, and in comparison to the pre-war product. In use it is sluggish, and has nothing like the resistance to wear or puncture as its predecessor possessed. And tyres are really important to easy cycling; any old racing man who has developed into a regular touring cyclist will tell you that, and he knows, for speed experience is the real test of tyre quality, and when the speed has been reduced to easy riding that ease is greatly assisted by quality tyres. The average rider has never given enough attention to this subject of tyres, but has been mainly contented to take those fitted by the maker and leave it at that. On dozens of occasions I have loaned bicycles to my friends, and they have been amazed to notice the difference in ease of running compared with their own mounts. That difference has been mainly in the quality of the tyres, and, I may say, it has often been hard to persuade the querist that such was the case. I ride light tyres, open-sided Dunlop Sprite, Palmer Pixie, Constrictor or John Bull (when I can get them, which is difficult now), and they last me an average six to seven thousand miles; and remember I am a daily rider in town areas of at least 15 miles a day.

Looking Over Them

I HAVE just been having an overhaul of my bicycles or, rather, their equipment for the rider's comfort and protection now that we can expect the storms of winter. The old Sunbeam is all right, and one new rearguard has put it in excellent order; and it is astonishing how well my other guards, mostly celluloid, have stood up to five years of wear. I had one ruined a couple of years ago through careless handling on the train, but beyond that accident, the others—on five bicycles—have served me well. Fact is, I suppose, more care has been taken of them than is usually the case; for at one time they were difficult to get, and costly. I have done a little saddle tensioning in view of the coming dampness, which is apt to make the best of saddles sag; and also some repair to my week-end bags. These are showing signs of decay, and no wonder, for they have not had a fair deal of late years, having been used to carry all sorts of goods home for the service of which they were never made. But they have got to last it out until we can again buy good quality at a fair price, and that time is not just now. Nearly five years ago, just as the war started, I bought a Raleigh fitted with aluminium guards. I said they would not last 12 months, for that was my disappointing experience with alloy guards some years ago. Mr. W. H. Raven, the late works director of the company, laughed at me, saying those guards would probably outlast me! I hope they won't; yet I feel fairly safe, for they are still *in situ*, and doing their job of protection as silently as ever. A week or so ago I had the luck to be out with a London friend who chided me on the ragged appearance of the rubber grips on the machine I was riding. My defence was I could not buy a new pair, and preferred that tattered state to the unyielding hardness of celluloid grips. A few days later a beautiful new pair of John Bulls came by post, and their fitment has made that bicycle look young again. My macs are getting old, but will, I think, stand another winter—they must, for I've no coupons to spare. I've had a look at my tyres, too, a thing I do not often worry about, but in these times good tyres are precious, and I am trying to take extra care of them. Several covers I have patched and sewn, and these will work as spare fronts for quite a period; tyres that pre-war—and post-war, I hope—I should have discarded, and shall. Fortunately, all the rims I have in use, except on one hack machine, are rustless, either alloys or stainless steel, and this feature on a bicycle does keep it tidy and young looking. And, thank goodness, all my machines are black, and that fact saves a lot of cleaning.

Pampisford, Cambridgeshire. A picturesque little village on the Saffron Walden-Cambridge road.

CYCLORAMA

By H. W. ELEY

Cycle Manufacturers' Advertising Campaigns

THESE always interest me, and, recently, two new campaigns have been launched in the Press. The one features the Hercules machine, and is of a friendly, "sporty" character. Nothing much about the manufacturing processes, or the special points of design, but racy drawings and dialogue. The series should be effective, and bring pleasing results. The other campaign which I have noticed with interest is that featuring the New Hudson machine. It concentrates on the well-known New Hudson trade-mark symbol—known everywhere—and stresses the inherent good quality of the bike, and its long tradition of good workmanship. In passing, the advertising of the British cycle manufacturers is very prominent at the moment, and this augurs well for the vigour and enterprise of the industry. Nothing like publicity at this stage of the global war—when we do not know how near the end is! Be ready—that is the watchword.

Back to 1909

LATELY, Dunlop have been taking us back to the days of 1909 and 1910—with a series of advertisements featuring some of the firm's publicity of those far-off days. Curious to see the different styles of dress, and the old-time style of advertisement layout! I studied these advertisements with care, and found them very interesting. And I must confess that I had a certain nostalgia for those days . . . when there were not even the rumblings of coming war with Germany, and we slept in our beds without fear of terror from the skies. 1909—the year in which Minoru won the Derby for His Majesty King Edward the Seventh . . . what a long time ago it all seems!

Wonderment in Wiltshire

A FRIEND of mine recently went on a little tour in Wiltshire—his first in that good county—and he told me of the awe with which he first gazed upon those great monoliths at Stonehenge. Visions or horrible human sacrifices; thoughts of the dim past, when primitive man roamed the Wiltshire uplands, and fashioned strange weapons from wood and stone—in the same area where to-day the deadly implements of modern war are tested and tried. I love Wiltshire, and have happy memories of towns like Devizes and Marlborough; while Savernake Forest, with its matchless glades and immemorial trees, is ever a fascination.

Those "Kiddy Seats" Again

SOME little time ago, I wrote of the various ways in which children could be carried on cycles, and mentioned that parents should exercise some greater measure of care in the matter. The other day, in a cycle shop in the Midlands, I came across a very good type of kiddy seat, capable of being secured to the cross-bar. It was the most workmanlike job I had seen, and I at once purchased one of the seats for a small grandchild. May it mean that the kiddy is introduced happily, at a tender age, to the joys of cyling—never to be given up in maturer life.

Successor to the Late Harry Ryan

DUNLOP have announced that Mr. J. W. Wood, lately at the Dunlop wheel works at Coventry, has been selected as the successor to our old friend, Harry Ryan. Mr. Wood has had a long and honourable Dunlop career, and will soon make a host of friends in the trade. He had some exciting experiences during the blitz period at Southampton, and his good work in Civil Defence earned for him the M.B.E. Everyone will wish him good luck—and he will know that he follows a man who kept his company's name and prestige high indeed.

November Beauty

YES!—there was beauty in December, despite grey skies, and the bare, stark trees. The golds and browns and russets of the trees were not yet gone, and it was good to get out into the woodland country, and enjoy the colourful pageant of Mother Nature while we may. I have been lucky enough to get some rides in Warwickshire, that great tree county, and with the sun glinting the golds of the old beeches, I have drunk of beauty indeed. Talking of Warwickshire, I do not know of any better "tree country" than the area around Kenilworth, and Stoneleigh . . . and that grand stretch of road from Banbury to Warwick. It is the country of Master Shakespeare, and I never ride through it without peopling it, in imagination, with all the characters from Arden.

The Lucky Provinces

LUCKY . . . in that in some places the street lighting has been restored to something akin to normal. And what a boon it is when riding to have the benefit of those lamps which for so long have been out of action! Poor London must carry on for a longer period in the gloom . . . but her time will come! Of course, the degree of restoration of lighting varies enormously, and not all local councils have been quick enough to give the poor cyclist and pedestrian "light upon the way." But we must be thankful for small mercies, and hope for the day when illumination will be full and permanent.

Remembrance

ON November the eleventh I happened to be in a small village, and had the opportunity of attending a service in remembrance of the fallen in this and the last wars. It was impressive—as almost all functions of the kind are, especially when held in the country. A sheaf of Flanders poppies on the little village memorial. A short but apt address from a padre who, I discovered afterwards, had lost two sons in the first conflict. The singing of Blake's "Jerusalem" . . . and I cycled on, feeling that I had been uplifted, and had communed with the spirits of the heroic.

All These . . . and Possibly More!

RECENTLY, I had sent to me a booklet about Dunlop tyres, published in the year 1896, and in it were various extracts from cycling journals of the period, about the quality, etc., of the tyres. And the amazing thing is that extracts appeared from *twelve* different papers — all specialist journals dealing with cycling! Think of it! The "game" could, and apparently did, support a round dozen journals! Of course, I do not know how pretentious or otherwise they were, but it is a remarkable fact, and rather tends to show that in the specialist journal field, as in so many others, the tendency has been to amalgamate and combine. In case there are any sceptics among my readers, I append some of the names of the twelve:

Bicycling News.
The Cyclist.
Cyclist News.
Cycling World.
The Wheelman.
The Cycle.
The Lady Cyclist.
The Scottish Cyclist.
The Wheeler.
News of the Wheel.

Now, I fancy that there must be a goodly number of old-time enthusiasts who can remember many of these journals, and it would be good indeed to hear from them. Possibly some have preserved copies. I wonder how many copies of "News of the Wheel" are still in existence? The Dunlop booklet was copiously illustrated, and many of the "costume pictures" brought smiles to some of my youthful colleagues—their "lady cyclists" are clad, oh, so very differently!

Potato-picking . . . and Tyre "Pricking"

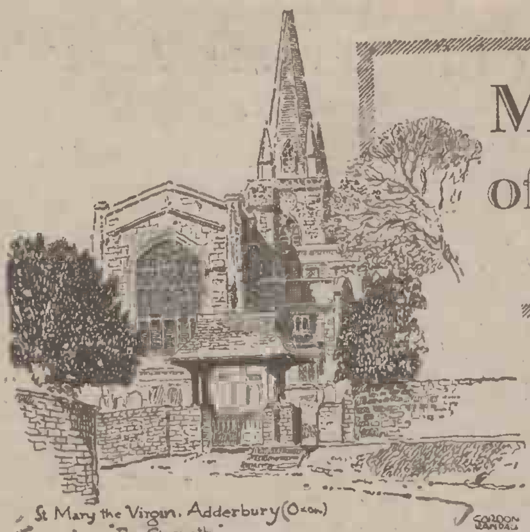
A SMALL boy—my own son in fact—a call from the local War Agricultural Committee for schoolboy volunteers for potato-picking on a nearby farm. . . and a cycle ride to the farm, where quite yeoman work was done in the "spud fields." Alas! one volunteer was sufficiently an outsider to amuse himself by puncturing the tyres of other boys' machines. And in these busy days, mending punctures is not exactly a job one desires. A ruined tube . . . an irate group of boys . . . and the joys of potato-picking sadly marred. This is the sort of thing which makes one wonder whether we really have advanced very far along the educational road . . . although I have no doubt that many an "old boy" will merely smile and murmur: "Well, boys will be boys, you know!"

Planning for Export

FROM what we read and hear, the cycle trade at any rate is alive to the stark necessity of building up a post-war export trade. Quite recently, figures have been published which reveal how far reaching are the plans of the industry, and how it realises that Britain's future depends, to an enormous extent, on her capacity to recapture old markets, and create new ones. Not an easy task—this export drive; but a vital one, with all kinds of possible effects on our post-war living standards, and the "shape of things to come." But—British bikes are good bikes; and we have the necessary brains within the industry to ensure that they find their way to the four quarters of the globe.

Signs of the Times

MEN engaged on the advertising side of the cycle business have had to face all manner of knotty problems during the war years. Supplies of many things have been short. The firms who used metal signs, whether of enamelled iron or printed tin, have had to curtail their activities—but maybe the supply position of printed tin for advertising signs is getting easier. The other day, I saw a big and impressive tin sign being erected in one of London's famous roads, for our good friends the Raleigh people. When peace comes, advertising men, as much as any, will face a period of intense activity, for much of their normal work has been greatly impeded by the war. Soon they will "tell the world," and in the world of cycles, and cycling accessories, there is much to tell!



My Point of View

BY "WAYFARER"

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

Rude Awakening

ONE night recently I dreamt that somebody had given me a No. 8 battery, a pre-war pump connection, and a pair of "Sprite" tyres. What a rude awakening it was when I returned to consciousness!

Point of View

AT the end of a recent Sunday when I accounted for nearly 60 miles in snow, rain and wind, one friend said to me: "Well, if I weren't polite, I'd call you an ass." Another friend said: "No wonder you look so fit and well." The difference in point of view is interesting.

Severely Practical

WHEN raising the saddle or handle-bar of a bicycle—for example, a borrowed bicycle, or a bought second-hand machine—make a point of pulling the stalk right out in order to see how long it is. At least 2in. of the saddle-pillar and 3in. of the handle-bar stalk should remain in the tube when the unit concerned is fixed in position. A very unpleasant accident may result from failure to observe this elementary precaution. Don't risk it!

Tyre Mystery

DURING October, when on holiday, I came down one morning to find my back tyre flabby. I pumped up, did a ride of 60-odd miles, put the bicycle to bed, and found a flabby tyre next morning. That experience occurred, in all, four times. I returned home on a Monday, and did not again use that particular bicycle until the following Saturday afternoon, when the tyre, though on the soft side, was rideable. I pumped up, rode 20 miles, pumped up again, and did another 20 miles. Next morning the tyre was flat. That day (Sunday) I did a ride of 71 miles, with five or six inflations. On the following morning the tyre was hard enough to be rideable. The thing is a mystery, and I cannot attempt to explain it. The valve test was satisfactory. If, as is to be presumed, there's a puncture it looks as though it will take a bit of finding. At the time of writing (early December) I am still using the bicycle, with the tyre unrepaired.

Provocative

THE man who buys a half-column of space in *The Times* every Saturday, wherein he advertises certain hotels which have secured his recommendation, did a very provocative thing the other day. It is his practice to indicate at the top of his allotment the address at which he will be staying during the following week—he seems to go from hotel to hotel as a bee flits from flower to flower—and on two recent occasions this intimation was replaced by the statement that "for the next week I will be touring the north-west coast of Scotland, and will be unget-at-able." "Provocative" is certainly the word for such an announcement! And, as Robert Louis Stevenson has it: "There's the life for a man like me!"

Sauce!

SOME time ago *The Birmingham Post* adopted the plan of printing, day by day, extracts from its issues of 50 years back. These voices from the past tend to be interesting, and quite recently I was intrigued by one relating to an illuminated cycle parade which it was proposed to hold through the streets of Birmingham on a certain evening. The desirability of this event was questioned—why, is not stated—but success seemed to be in prospect, a number of local "wheelmen" (the *Post's* quotation marks!) having set their hearts on the affair. The cyclist was stated to be "not a bad sort of fellow," though disliked by the drivers of other vehicles. Intimating that the collections made en route would be given to the new General Hospital, the extract wound up in these terms: "The pursuit of cycling no doubt produces a plentiful crop of subjects for the surgical skill of the hospital staff, and *no more appropriate destination could be chosen for whatever sum may be raised.*" The italics are mine: the sauce is that of an unknown (and imaginative!) writer in our contemporary of half-a-century ago. My own recollection of cycling in those far-off days does nothing to suggest that cyclists (I was one of them!) made undue claims on the surgical skill of hospitals.

Contrasts

IT is always interesting to compare—or perhaps to contrast—one's touring experiences, and this is particularly true in these days in relation to costs. Two recent successive week-ends away from home revealed a rather startling difference in charges. On the first Saturday I stayed at a private house type of catering establishment, and was charged 7s. 6d. for supper, bed and breakfast. The supper comprised a large plate of cold meat, fruit tart and custard, cheese, bread, "marj," sweet biscuits, and a pot of tea. The breakfast included porridge, bacon and egg, bread, "marj," marmalade and a pot of tea. I had a nice bedroom to myself.

On the second Saturday I stopped at an unlicensed hotel, where I paid 10s. for supper, bed and breakfast. Supper consisted of a boiled egg, bread and "marj," cakes and a pot of tea; while for breakfast I had bacon and egg, bread, "marj," marmarlade and a pot of tea. I shared a bedroom, under the eaves (three beds), with two other men. All that cost me 33⅓ per cent. more than at the first week-end, and the quality was not nearly so good.

Synthetic Theft

ON the second of these Saturday nights I talked and walked with a boy and girl from the Air Force, who were also doing the week-end act. The conversation in part, concerned the paltry and major thieving which goes on, bicycles coming in the latter category, and such things as valve stems in the former. Imagine my feelings on the following morning when I observed that my pump was missing! I had a ride of 70 miles to do without a pump, and then there was the question—a serious one—of obtaining a decent replacement. Just before starting off for home I decided to have a scrounge round the stable which had housed my bicycle for the night, and there, sure enough, I discovered a pump—*my* pump—hidden away in a feeding-trough. Somebody, apparently, had "borrowed" it and put it in this position, possibly in the hope of retrieving it after my departure. For me, the moral of this incident is clear: in future, my pump "goes to bed" with me.

Notes of a Highwayman

By LEONARD ELLIS

Britain's Touring Grounds (2)

AFTER Devon and Cornwall cycle tourists in recent years have favoured Scotland, North Wales and Ireland. The available statistics vary from year to year, but, generally speaking, Scotland seems to hold second place in popularity. There is, of course, every justification for the choice, as the country possesses an abundance of almost all types of scenery. Apart from this fact there are other considerations. Those who want miles can amass them on the way there and back; those who wish to save time can take a night train and start touring Scotland on the following morning. Once in Scotland one can still do "miles," or decide to take things in more leisurely fashion. This means concentrating on a comparatively small area. Once again the argument holds good—to see a district properly take it quietly, and don't be greedy. Scotland is often spoken of as a touring ground, but few can get more than a glimpse in the time generally available.

Scotland in Two Weeks

SOME will wish to travel the whole length in one holiday, and, unlike some main roads, there is a tremendous fascination in following the famous End to End route from Gretna Green to John o' Groats, even though both terminals may be found disappointing. There is little glamour in the former in spite of all the stories, and, although there is a thrill in reaching John o' Groats and looking out towards the islands, it is a drab little place. Many people miss one of the glories of the spot, and that is the wonderful "sand" on the beach—millions of tons of finely ground, delicately tinted shell grit. The main highway is varied and beautiful. The early stages can be depressing, but the sordidness of the mining towns is not too widespread. Stirling Castle, just off the road, is worth a visit, and the road over the Grampians is grand. Strangely enough, as we go north-eastward the scenery softens considerably, and after the beautiful wooded stretches north of Inverness it becomes in parts quite monotonous. This road, however, is only a sweetener. There is enough to keep a tourist thrilled for a whole fortnight among the lochs and passes of the Trossachs; good roads, charming villages and magnificent waterfalls around Loch Lomond. There are miles of good mountain roads westwards towards Oban and Dalmally.

Wildest Britain

ON the west side as we go farther north the road becomes wilder and more remote. There are miles of lonely roads unspoilt by human habitation, nothing but rock-strewn moorland, huge mountains, tiny little wooded lochs, and, at intervals, a sudden swoop to the sea to a little secluded coast town. Those who want to go to Scotland without overdoing the mileage will find a splendid touring ground just over the Solway Firth and stretching away to the point where Ireland is only 20 miles distant. The Cairngorms lying south-east of Inverness are a touring ground in themselves, with the added attraction of Deeside and the Aberdeen Road on the other side. Some of the grandest scenery of all is beyond Fort William, where Ben Nevis keeps guard, his hoary old head nearly always shrouded in mist. From this road are several lesser roads that strike west, and although difficult and rough, are among the tit-bits of Scotland.

Ardessie Falls, Little Loch Broom.

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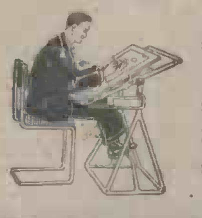

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