TO THE MOON IN A SPACE SHIP

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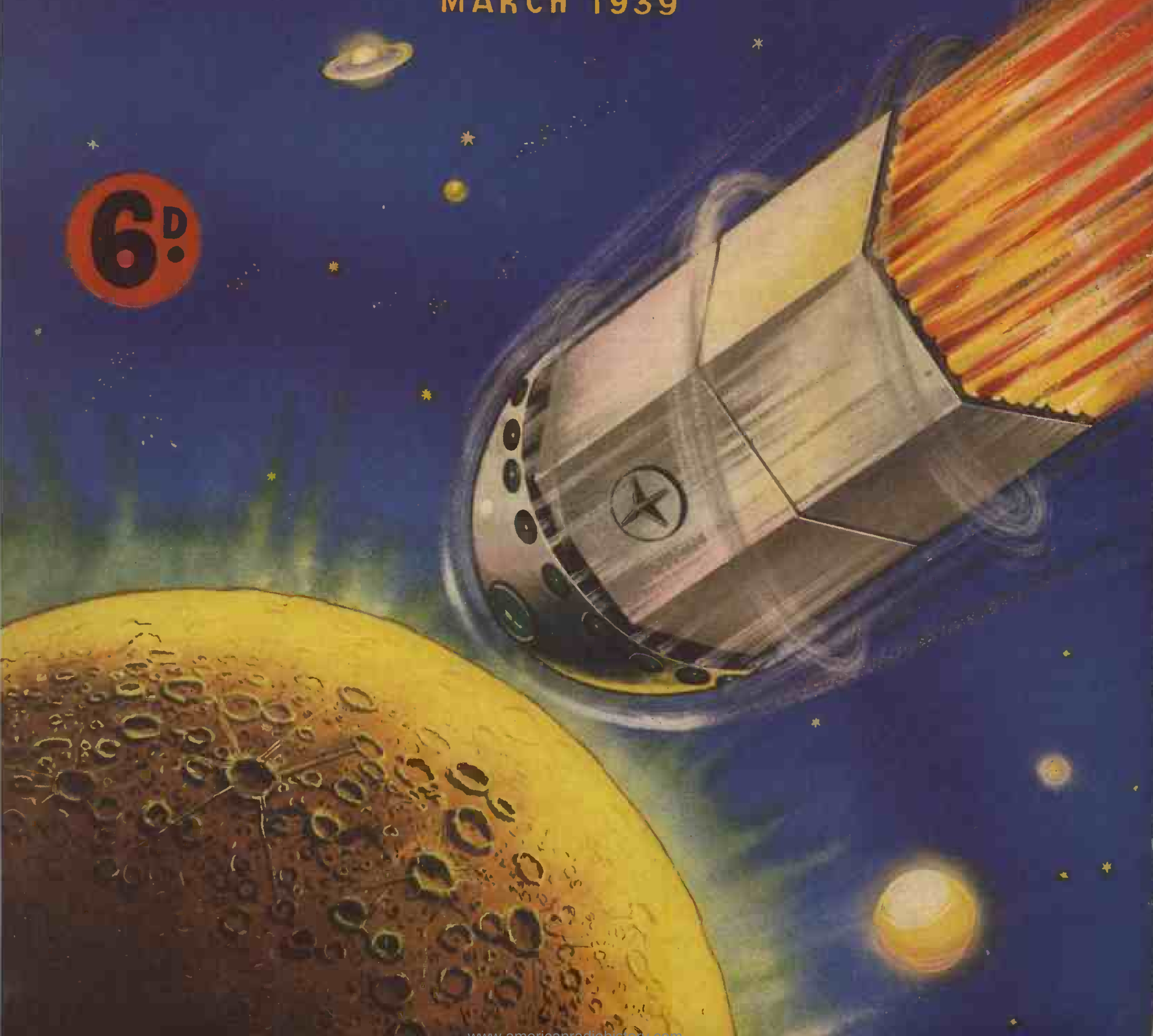

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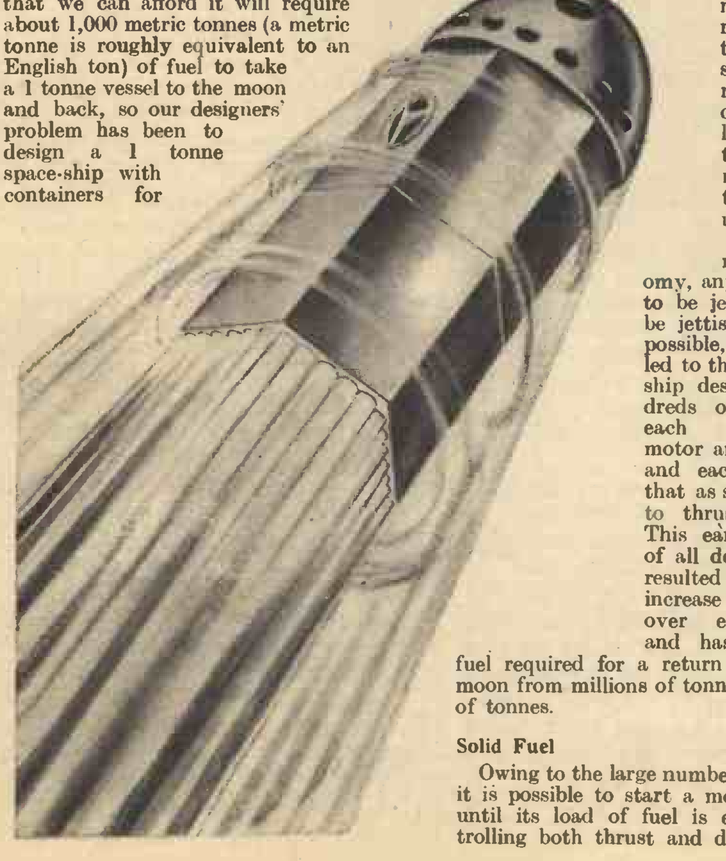
TO THE MOON IN A SPACE SHIP

The Shortest Space-Ship Voyage is the Journey to the Moon, and Below is Given Details of a Suitable Ship that might be Capable of Accomplishing the Journey

IN designing a space-ship the designer has a completely different problem from that involved in the design of any other means of transport. A motor car, railway train, aeroplane or ship consists basically of a vessel and a fuel tank, in the tank being placed the fuel required for a journey or journeys. The shortest space-ship voyage, however, is the journey to the moon, and with the most optimistic estimates of the fuel energy and motor efficiency the quantity of fuel required will still be such that the fuel tank would require to be much larger than the rest of the ship. Consequently, we must revert to the old system of petrol cans, so designing our ship that the cans can be attached outside the ship and thrown away when empty. We find by careful calculation that with the best fuels and motors that we can afford it will require about 1,000 metric tonnes (a metric tonne is roughly equivalent to an English ton) of fuel to take a 1 tonne vessel to the moon and back, so our designers' problem has been to design a 1 tonne space-ship with containers for 1,000 tonnes of fuel attached outside and detachable.



Rocket Motors

The nature of rocket motors has also affected the design considerably. With such motors as aero-engines, a larger unit can be made lighter in proportion to its power than a small unit, but in the case of rocket motors, quite the reverse is the case; in fact, the proportionate weight of rocket motors rises so steeply that a motor of more than 100,000 h.p. is hardly feasible, and as the lifting of the 1,000 tonnes at the start calls for many millions of h.p. this requires a considerable number of small units. Again, since the cost of the motors is less than the cost of the fuel required to bring them back, and as only a few small motors will be required to land the one tonne ship on its return against over a hundred large ones at the start, the motors are jettisoned after use.

For a maximum fuel economy, anything which is to be jettisoned should be jettisoned as soon as possible, and this has led to the cellular space-ship design, with hundreds of small units each comprising a motor and its fuel tank, and each so attached that as soon as it ceases to thrust it falls off. This early detachment of all dead weight has resulted in an enormous increase of efficiency over earlier designs, and has reduced the fuel required for a return voyage to the moon from millions of tonnes to thousands of tonnes.

Solid Fuel

Owing to the large number of small units, it is possible to start a motor and run it until its load of fuel is exhausted, controlling both thrust and direction by the rate at which fresh tubes are fired. This makes it possible to use solid fuel for the main thrust with consequent considerable saving in weight, and giving the additional advantages that the strength of the fuel helps to support the parts above and its high density makes the ship very compact. Liquid fuel motors are, however, provided for stages requiring fine control, and also steam jet motors for steering.

Fig. 4 shows a section through the head of the space-ship. The approximately hemispherical portion (to the downward pointing cone) is the life container. The portion between the two cones contains the air-lock, air-conditioning plant, heavy stores, batteries and liquid fuel and steam jet motors, etc. Below this are the solid fuel tubes for the return voyage. The whole of the remainder of the vessel (Figs. 1 and 3), consists of the tubes for the outward voyage, which have to be jettisoned by the time of arrival at the moon.

Not Streamlined

It will be seen that there has been no attempt to streamline the ship. The form of the ship has been largely dictated by other considerations, and as compared to the terrific power needed to lift the vessel out of the earth's gravitational field the total air resistance is quite negligible (less than 1 per-cent.), but this does not matter greatly. The diameter of the front of the ship is determined as being the smallest reasonable size for the life container. (It should be noted that this design is for a very small space-ship, about the overall size of a large barge. On larger ships this restriction will be somewhat modified.) The diameter of the rear of the ship is determined by the firing area required. Too small an area calls for excessive pressure in the motors, and consequently excessively heavy construction. The two diameters being approximately the same has led to the straight-sided form. An increase in central diameter would mean improved streamlining, but this would only decrease the resistance below the velocity of sound, and this is only a small proportion of the whole.

The Design of the Nose

On the other hand, the straight-sided form gives the greatest strength, which is of major importance, and also serves to minimise frictional heating. The main body of the space-ship, comprising the motor tubes, is hexagonal in shape; this form giving the closest possible stacking of the tubes.

The form of the nose is intended not so

much to reduce the resistance at low velocities, as to split the air at high velocities (several times the velocity of sound), so as to maintain a partial vacuum along the sides. The frontal paraboloidal portion seen in Figs. 1, 3, and 4, is a reinforced ceramic carapace, capable of withstanding a temperature of 1,500 degrees Centigrade in air, and by its form the frictional heating is made a maximum on this portion and minimised on the sides. The carapace (which, of course, has no portholes) is detached once the vessel has got away from the earth.

The tubes are stacked in conical layers for greater structural stability, since, apart from the vessel proper—the top portion—the whole strength lies in the tubes, and these are not rigidly fixed together, but simply stacked and held in position by one-way bolts and light webs.

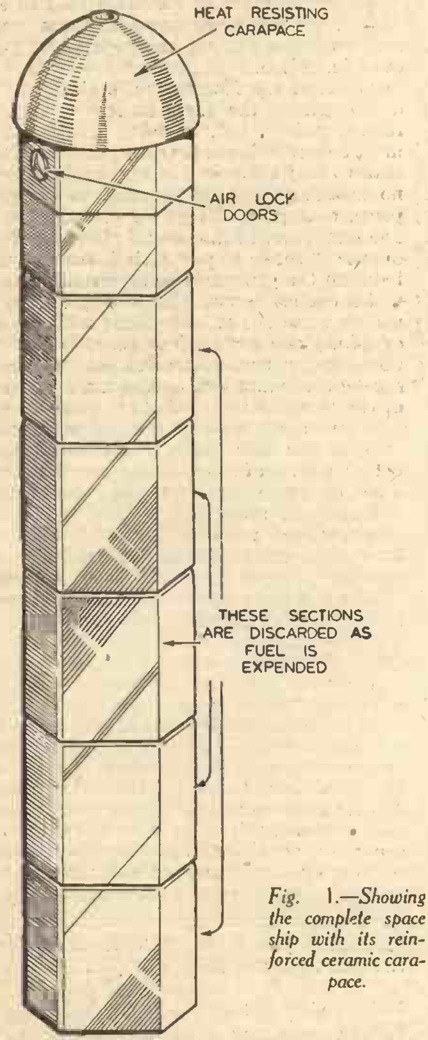


Fig. 1.—Showing the complete space ship with its reinforced ceramic carapace.

Firing Order

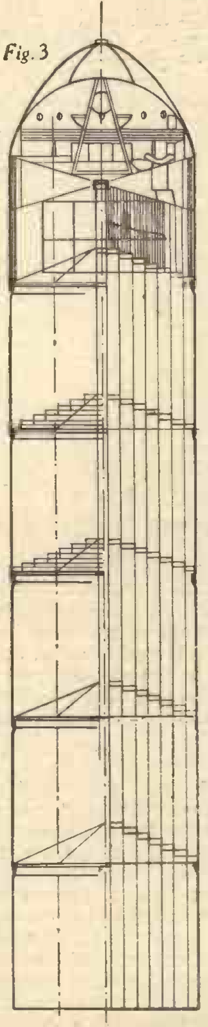
The firing order of the tubes is in rings starting from outside and progressing inwards towards the centre. While the motors are firing their thrust holds them in place; when expended the acceleration of the ship causes them to be released from position and they drop off. Those in the inner rings of the bank not yet used do not position themselves for release until their firing thrust carries them a fractional distance up the release bolts. A light metal sheath embraces the outermost ring of tubes; this and the webs are discarded when the whole of the previous bank of motors has been jettisoned.

Fig. 2 shows maximum periphery of the carapace. The top half of the diagram (Fig. 2) represents a section through the large motor tubes stacked in banks; these are used to obtain release from the earth. The lower half, Fig. 2 shows the medium and small tubes used for deceleration at the moon (the ship, having been turned end to end, approaches stern first). Fine control for the actual landing is provided by the vertical liquid fuel motors seen within the two cones in Fig. 4 and about the hexagon angles in Fig. 5. The upper bank (Fig. 4), is used for the return journey.

Artificial Gravitation

Adjacent to the top of the liquid fuel motors are shown four of the tangential tubes. These are necessary in order to provide the crew with artificial gravitation, which is achieved by rotating the ship (approximately 1 revolution in 3½ seconds). The g. value desired is therefore under control of the crew. Not only is this artificial gravitation considered a necessary precaution (the physical affect of long periods of no-gravitation being at present unknown), but in any case haphazard rotation of the vessel would almost certainly take place, making navigational observations impossible. Hence control of rotation is essential. Again, before the moon landing can be attempted it is necessary to stop rotation in order to prevent disaster to the ship when it touches ground.

Fig. 3



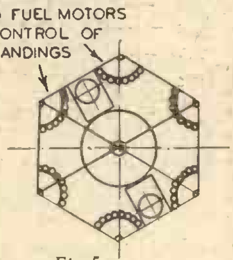


Fig. 5

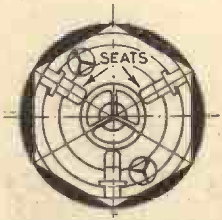


Fig. 6 PLAN OF SEATING

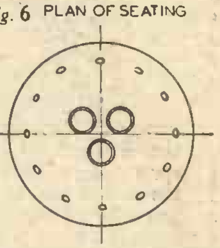


Fig. 7 PLAN OF PORTHOLES

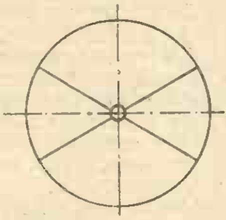


Fig. 8

Figs. 3 and 5 to 8.—A sectional view of the space ship showing the liquid fuel motors, plan of seating, plan of the portholes and the segmented carapace which is discarded after passing out of the earth's atmosphere.

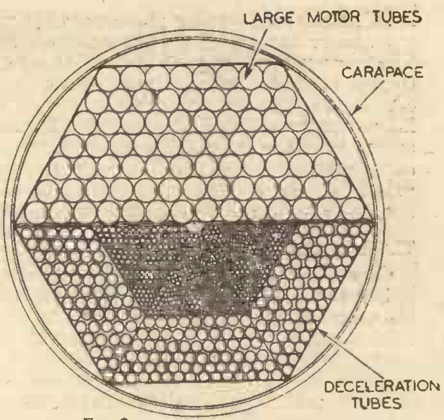


Fig. 2

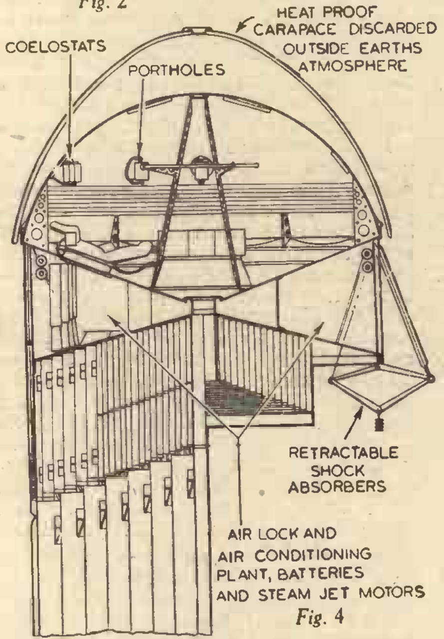


Fig. 4

Figs. 2 and 4.—(Above) Showing the large motor tubes and deceleration tubes. (Below) A sectional view showing the living quarters of the crew, etc.

It is not anticipated that the space-ship can be so accurately manœuvred that its landing will be without shock. Hydraulic shock absorber arms are, therefore, incorporated; one of these being shown attached to the frame on the right-hand side of Fig. 4. These are normally collapsed within the hull, and are extended just prior to landing.

Stability Control

The firing of the motor tubes is carried out by an automatic electrical selector system, but manual control is used for navigational corrections. The ship, being in rotation, is kept thrusting in the correct direction, but this does not prevent "wobble" if firing is not equal on all sides. Manual control of stability is maintained during the first few seconds of ascent, and after that a pendulum contactor automatically controls stability. The main wiring cable to the tubes is led down a central column, provided at each bank level with a plug connection which breaks away when its purpose has been served and is then jettisoned.

The hemispherical front of the life-compartment (Figs. 3 and 4), is of very light nature; this being made possible on account of the protective carapace above. The segmented carapace (Fig. 8) is, of course, discarded after passing out of the earth's atmosphere, and protection of the life-compartment shell is not needed for the ascent from the moon. The return into the earth's atmosphere will be done at low velocities, hence heating of this shell will not be excessive.

The Life Compartment

Owing to the small scale of the diagrams it has not been possible to show many of the fitments and accessories within the life-compartment, but the following can be noted. Fig. 4 shows one of the seats for the crew of three. These can also be seen pointing radially in Fig. 6. The controls for firing are placed on the arms of the chairs, and the chairs themselves move on rails round the life-compartment. The crew recline on these chairs with their heads towards the centre of the ship and a circular catwalk is provided for them round the circumference of the chamber (Figs. 3 and 4).

For observation purposes, ports are provided in the dome of the life-compartment (one shown in Fig. 4 and twelve in Fig. 7). Under the flange of the carapace, in the rim of the floor of the life-compartment are the back-viewing ports; these are covered during thrusting periods. Three forward-viewing ports in the top of the life-compartment shell are also provided (see Figs. 4 and 7). It should be noted that observation of direction cannot be made during the initial thrusting period in ascent from the earth—it being impossible to look backwards through the tail-blast of the ship—the carapace prevents vision in other directions, and in any case the period is too short to allow of stellar observations. Therefore navigation during this period must be done entirely by means of internal instruments, which consist of an altimeter, speedometer and accelerometer.

Essential Instruments

Another essential is, of course, a chronometer, and a gyroscope ensures maintenance of direction. A suspended pendulum provides indication of "wobble" and modified sextants and range-finders are used to determine position. These instruments are placed in convenient juxtaposition to the crew. The cylindrical objects shown just above the catwalk, against the ports (Fig. 4) are coelostats. These are synchronised, motor-driven mirror devices something similar to a stroboscope, and it is by means of these that a stationary view of the heavens is provided for navigational observations while the ship is in rotation. The girder structure in the centre of the life-compartment is a support for the light shell and also serves to carry navigation instruments. In Fig. 1 beneath the carapace and in Fig. 6 can be seen the spidered outer and inner doors respectively of the air-locks shown in Fig. 5.

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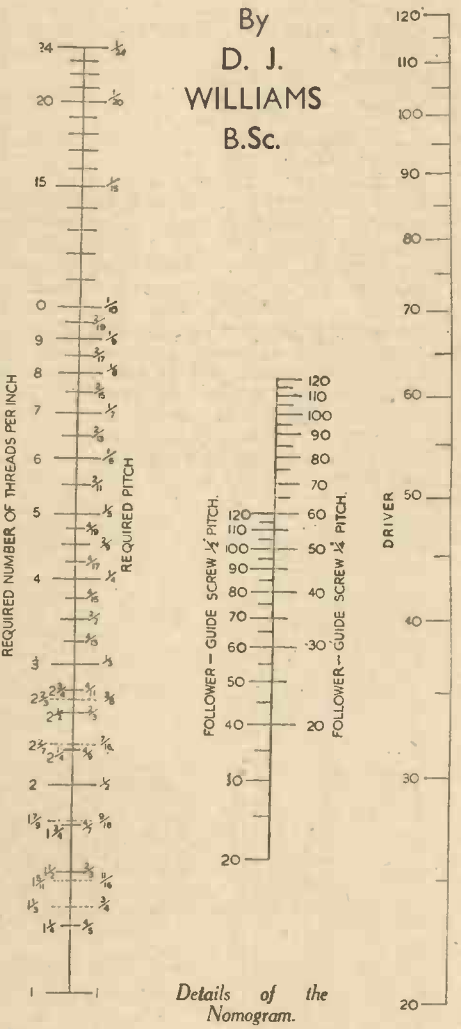
THE USE OF THE NOMOGRAM FOR SCREW CUTTING

By
D. J. WILLIAMS
B.Sc.



Details of the Nomogram.

THIS Nomogram gives the required combination of change wheels to cut from one to twenty-four threads per inch on lathes having guide screws of ¼-in. or ½-in. pitch. In accordance with the principle of the Nomogram, a straight line drawn across the three scales joins three related points, but, in using this chart, it must be remembered that the portions of the scales lying between the graduations have no meaning. This is because, in the first place, change wheels go up in multiples of five teeth, and in the second place, portions of the "threads per inch" scale, lying between the graduations, represent threads which cannot be cut with a simple train of wheels when the lathe is fitted with a ¼-in. or ½-in. guide screw. The chart is correct, therefore, only when the straight line passes *exactly* through a graduation mark on each of the three scales.

When the thread given by a certain combination is required, a straight edge, or better, a strip of celluloid carrying an inked line, is made to join the appropriate graduations on the "driver" and "follower" scales, when it will cut the third scale at the corresponding graduation which may be read as "threads per inch" or the "pitch."

When it is required to find the combination of wheels which will give a certain pitch, a method of trial and error must be used. The graduation representing the required pitch is joined to that representing a "driver" chosen at random. If the straight edge passes exactly through a graduation representing a "follower," then that combination is the correct one to use. If not a new "driver" should be tried. A little practice makes this process an easy one, especially if it is remembered that, generally speaking, fine threads require small "drivers" and coarse threads big ones.

SCIENCE NOTES

A Clean Sheet

THE cinema screen is, in this country, every week, the cynosure of at least 40,000,000 eyes. That takes into account the usual allowance of two eyes to each patron of the picture theatre. It is, therefore, important that a screen should be used which makes a good impression. The devisor of an improved screen has aimed to produce one which is non-inflammable, non-resonating, and insensitive to moisture. It is suitable for daylight projection or may be tinted to correct the colour impinged on the screen by the illuminant used in projection, and to transform it so as to throw a light similar to that of daylight.

The sheet has, as a base, woven translucent spun glass. Its appearance resembles that of artificial silk. Being composed of spun glass, which does not absorb humidity, the screen can be washed with water, and no further treatment, we are told, is required to keep it at all times in first class condition from the points of view of both light and sound.

Giving Cameras Time

A RECENT development in connection with the camera has for its object the regulation of the rotating disc. I understand that the rotary shutter at present in use gives, in addition to time exposures, only one fixed speed for instantaneous exposures. This, in a poor light, may be inadequate. It is, therefore, desirable to furnish means for increasing the duration of a snapshot exposure. With this end in view, the inventor has devised a camera with a rotary disc shutter having at its edge one or more corrugations. There is also a timing lever to engage the corrugations, so as to reduce the speed of rotation of the disc. And the timing lever is forked to form a jaw, between the teeth of which the disc is loosely held.

Make-up for Pictures

THE colouring of photographs, prints and lantern slides requires an implement which will not scratch. It also needs one which is particularly adapted to deal with a glossy surface. A new non-abrasive colouring pencil has been patented in the United States, and it is claimed for it that it has the necessary qualifications for picture-tinting. There is a stick of fibrous material capable of absorbing moisture. The stick is impregnated with an aniline dye in absorbed condition and soluble in water. This is capable of penetrating the glossy surface of the object to be coloured. Consequently, the stick may be used after the manner of a brush simply by dipping it in water. By means of this fountain pencil, if I may so term it, pictures can be treated somewhat in the style in which the ladies make up their faces.

DYNAMO.