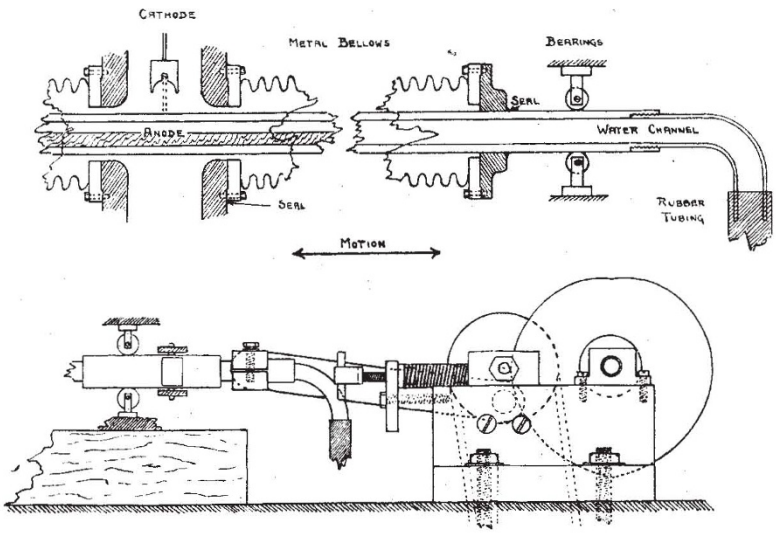
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

A Simple Moving-Anode X-Ray Tube

THERE have now been described a number of moving-anode X-ray tubes, including the mercury-sealed type developed in this Laboratory[1-4], and their high performance may be regarded as established. They are, however, mostly expensive and not easy to build, and for the future welfare of X-ray structure analysis, particularly in the fibre and protein fields, something is needed for workers with modest resources—something that does not aim at the power that can be realized with a rotating anode, yet is considerably better than the stationary-anode tubes commonly in use. We have designed and constructed such a simple, demountable and inexpensive tube as follows.

The anode is a 5-ft. long horizontal copper tube, either of square cross-section or of circular cross-section with a plane surface in the central region, that is mounted on roller bearings at the two ends and oscillates with a stroke of 4 cm. at 3 complete oscillations per second. The vacuum is maintained by two lengths of metal bellows sealed on to the X-ray tube at their inner ends and on to the anode at their outer ends (see upper diagram). The drive is by means of a con-rod and wheel, belt-driven from a light Klaxon reduction gear; but to avoid repeated stationary points at the ends of the simple harmonic motion the axle of the wheel is also moved more slowly backwards and forwards over a ½-in. path by means of a friction drive against a cam (see lower diagram). The fast stream of water that passes along the central bore of the anode is admitted and taken away by pieces of stout rubber tubing at right angles to its length, so as to eliminate shaking by the oscillation. Also, to attain the speed and turbulence for efficient cooling, the bore at the focal-spot region is suitably constricted, for example, by a wooden insert.



This first model is admittedly experimental, and we envisage improvements in the near future as regards design of target, its distance from the X-ray windows, and neutralization of end-effects; but results obtained already are so gratifying that it is worth while quoting some of the principal dimensional features. The central flat of the anode is rather more than ½ in. across and its thickness with respect to the water flowing underneath is 2 mm. The metal bellows (the present pair were supplied by the Power Flexible Tubing Co., Ltd.) are each about 18 in. long and 2 in. external diameter, and so far they have oscillated for many hours without showing any signs of injury. (They are of the usual copper-zinc alloy, but we anticipate considerable advantages in elasticity and fatigue limit from the new copper-beryllium alloy that has recently been described[5]. Other seals are also possible.) The tube, of hot-cathode type (but, of course, moving anodes are equally applicable to gas tubes), incorporates two water-cooled windows (an important feature uncommon in rotating-anode tubes), an insulating body consisting of a miner's lamp glass as in the Shearer gas tube, and the tantalum filament, focusing cup and cathode already found advantageous in producing a sharp line-focus[3,4]. This line-focus (at right angles to the length of the anode) foreshortens, for an emergent beam at 6° to the horizontal, to an area effectively 0·75 mm. × 0·6 mm.; with such a focus we have run the tube at 44 ma. and 28 kV. and taken good photographs of ramie in 2 minutes at D 2 cm. with a ½ mm. slit.

The whole apparatus is remarkably quiet and unobtrusive: it may be mounted centrally along the usual laboratory bench with a spectrometer on each side and the pumping equipment immediately underneath. An adaptation that suggests itself is to have a single (longer) anode, sealed by a single pair of bellows, running through a series of X-ray tubes on the same bench; and it would be possible, too, to have a composite anode that included sections made from different metals. Two similar tubes, with a common anode and set at the requisite distance apart, might form an excellent arrangement for the purposes of high-speed stereoscopic radiography.

Full details will be published elsewhere. The junior author thanks the International Wool Secretariat for tenure of a research fellowship.

W. T. ASTBURY.
I. MACARTHUR.

Textile Physics Laboratory,
University of Leeds.
Dec. 12.

[1] Astbury and Preston, *Nature*, **133**, 460 (1934).
[2] Astbury, Meeting of X-Ray Analysis Group of Institute of Physics, Leeds, November 25, 1944.
[3] Green, Ph.D. Thesis, University of Leeds (1938).
[4] MacArthur, *Electronic Eng.*, Pt. 1, 272 (Dec. 1944); Pt. 2, in the press. Meeting of X-Ray Analysis Group of Institute of Physics, Leeds, November 25, 1944.
[5] Hunt, *J. Sci. Instr.*, **21**, 97 (1944).