For ascertaining the accuracy of the device being described we measured the speed of the formation of single layers during their propagation from small alcohol crystals with the earlier Trapeznikov instrument and the instrument being described. The results of comparative tests were used to plot the curve of two-dimensional pressure $F = \sigma_0 - \sigma$ (i.e., the difference between surface tensions of pure water and water covered by the single layer whose density gradually increases) as a function of time (Fig. 2). Both curves show a satisfactory agreement. In addition, we measured surface tensions of five organic liquids (see table). These data also show a good agreement.

The difference between our values of surface tension for toluol and acetone and the data of reference books is apparently due to the presence in these liquids of impurities; this was proved by special measurements taken on a Rebinder device [3]. The too low surface tension values for water are due to impurities which easily fall onto a large area of water. In other tests on water the surface tension measured on a small instrument was 72.4 dyn/cm. The new model is used in systematic investigations of the condition of alcohol single layers on the surfaces of water in evaporators in hydrological stations in the Valdai mountains [4] and in Armenia.

## LITERATURE CITED


1. A. A. Trapeznikov, Doklady AN SSSR, 30, 319 (1941); K. V. Zotova and A. A. Trapeznikov, ZhFKh, 34, 200 (1960).
2. Chemist's Reference Book [in Russian] 1, 885, Goskhimizdat (1951).
3. K. F. Zhigach and P. A. Rebinder, ZhFKh, 13, 94 (1939).
4. A. A. Trapeznikov and V. A. Ogarev, Proceedings of the State Institute of Hydrology, No. 91 (1961).


# NEW EQUIPMENT FOR ELECTROLYTIC PREPARATION OF METALLOGRAPHIC SPECIMENS


V. I. Shevchenko and E. N. Alpatov

Ukrainian Scientific Research Institute of Tubes



Translated from Zavodskaya Laboratoriya, Vol. 28, No. 7, pp.883-885, July, 1962


Electrolytic methods of processing are very useful in exposing the microstructure of chemically stable high-alloy steels and alloys. They find a wide field of application in metallographic investigations but the equipment required for the preparation of specimens is frequently inconvenient to use.

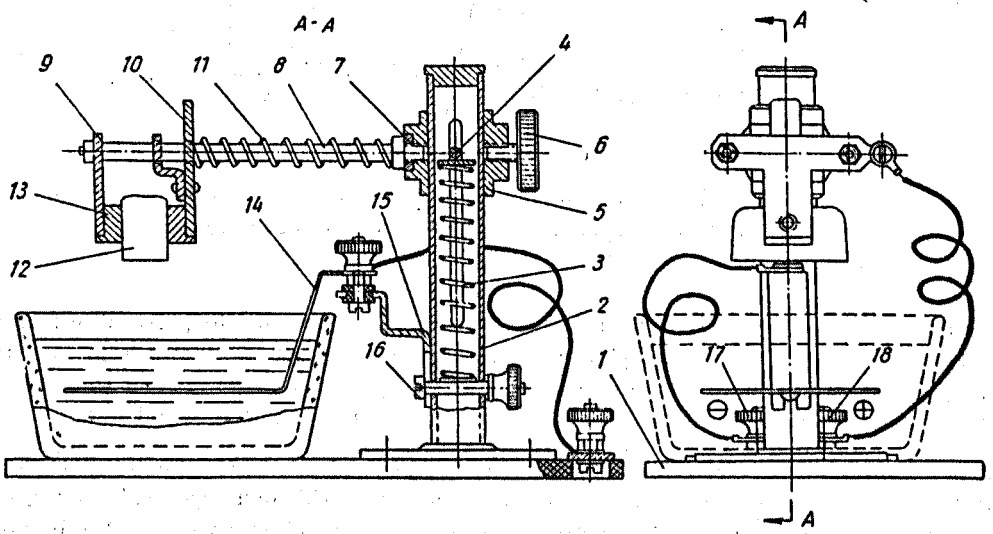


Fig. 1. Device for electrolytic etching of specimens.

We designed and made a device for the electrolytic etching of polished specimens (Fig. 1).

Column 2 is mounted on base 1, and contains spring 3. This spring rests on screw 4 of holder 5. The position of the holder on the column is fixed by screw 6. The holder carries the cross bar 7 with two guide rods 8 whose ends are connected by stationary bar 9. Double bar 10 slides on guide rods and presses specimen 12 to bar 9 by means of spring 11. Bars 9 and 10 carry lead tubes 13. The cathode plate 14, which is mounted on cantilever 15, is placed into a 350-400 ml electrolyte bath. The cantilever is secured by screw 16 to the column. The cathode plate 14 and stationary bar 9 are connected to terminals 17 and 18 from a dc source.

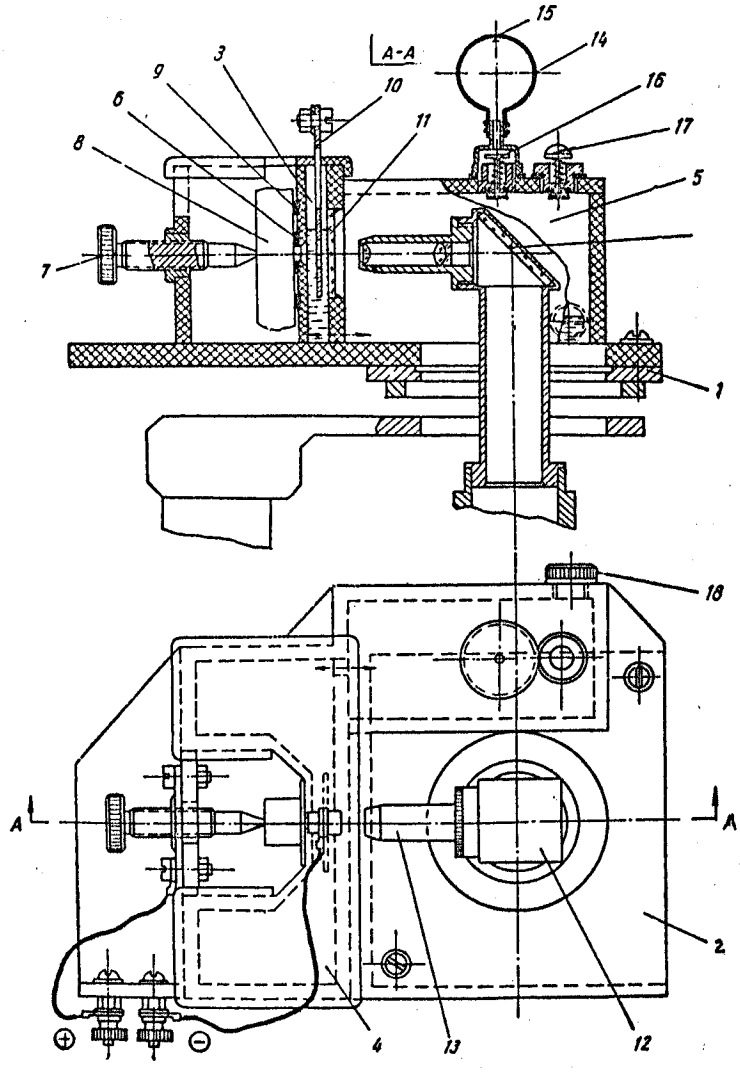


Fig. 2. Chamber with variable electrolyte level for electrolytic preparation of metallographic specimens with direct microscope observation.

For etching, the specimen is placed between lead jaws in such a manner that its polished surface is parallel to to the surface of the electrolyte. The cathode plate is secured at a distance of 15-20 mm from the surface of the electrolyte. The holder is lowered until the polished surface of the specimen makes contact with the surface of the electrolyte, and is secured in this position by clamping bolts; the current can now be switched on.

Normally, for selecting the electrolytic polishing and etching conditions the specimen is periodically taken out of the electrolyte, washed, dried and examined under a microscope. This technique is, however, very laborious and time-consuming. The addition, the contact between the specimen and electrolyte and also the air, after the bath has been switched off, distorts the conditions of the surface being examined.

The selection of the best conditions for polishing and etching is made much easier if the surface of the specimen can be continuously examined during the polishing.

We described the design of a chamber which can be used during the electrolytic polishing and etching of metallographic specimens in corrosive electrolytes, in which the process can be observed with a magnification of 400 × [1]. However, in this chamber only specimens of a certain shape and size could be processed. For this reason we developed a new special chamber (Fig. 2) for processing specimens of any shape and size.

Base 2 of the chamber, which consists of the working chamber 3 with cover 4 and auxiliary chamber-tank 5, is secured to the object table 1 of the microscope. The wall of the working chamber has a 5-mm dia. hole. Specimen 8 is pressed against the rubber packing 6 of this hole by means of screw 7. Rubber gasket 9 prevents the specimen from being fixed obliquely. Cathode plate 10 with a central hole is mounted inside the working chamber. The positive pole of the source is connected to screw 7.

For supervising the process an observation window 11 of plane-parallel glass is provided in the wall of the working chamber. The microscope is fitted with a periscopic tube 12 with a teleobjective 13 (OSF-16 or OSF-22 of Andin). The periscopic tubes makes possible the setting of the teleobjective at a right angle to the surface being processed. The distance from the specimen's surface to the external plane of the window should not be more than the free working distance of the teleobjective (about 14 mm): Since only a limited area of the vertical surface of the specimen with an area of about 20 $mm^2$ is processed, the density of current can be varied within a wide range (up to 1000 $A/dm^2$ and more) at a virtually constant electrolyte temperature.

The focusing at the specimen's surface is effected by means of a longitudinal-motion screw on the microscope table. The auxiliary chamber 5 is used for regulating the level of electrolyte in the working chamber. For this purpose a slight excess pressure is produced by means of rubber bulb 14 with valves 15 and 16 in the airtight auxiliary chamber. In addition, valve 17 is provided in the cover of the auxiliary chamber for discharging excess air during the replacement of the specimen. For discharging the electrolyte a hole is provided in the bottom part of the side wall which is normally closed by plug 18.

Before work begins the electrolyte is poured into the chamber so that its level is 5-10 mm below the hole in the working chamber wall. This is done when cover 4 and valve 17 are open; after pouring the specimen is mounted in position.

During the electrolytic processing the level of the electrolyte in the working chamber must be 5-10 mm above the hole in the wall. For this purpose air is pumped, by means of rubber bulb 14, into the auxiliary chamber. The electrolytic processing of the metallographic specimen is observed by means of the microscope. For replacing the specimen the excess air is allowed to escape from the auxiliary chamber by pressing valve 17. As a result the level of liquid in the working chamber falls below the hole in the wall to which the specimen is pressed. Thereupon screw 7 is released and the specimen can be replaced.

In preparing specimens in the above chamber it is advantageous to use electrolytes in which not only the electric polishing but also the etching of alloys being investigated can be effected (at low current densities). In cases when it is necessary (to expose the microstructure of the whole surface being investigated the device which we described earlier [2] can be used.

## LITERATURE CITED


1. V. I. Shevchenko and E. N. Alpatov, Zav. lab., 26, 1, 77 (1960).
2. V. I. Shevchenko and E. N. Alpatov, Zav. lab., 26, 11, 1316 (1960).


---



---