equal to zero. On the other hand, the failure of Moissan[1] and of Ruff[2] to obtain any evidence for the existence of free NH_4 at very low temperatures is strong evidence to the contrary.

Furthermore, it has been shown by the writer[3] that the alkali and alkaline-earth metals exist in mercury, even in dilute solution, not in the form of single atoms, but in that of compounds of the general formula MHg_n, containing only one atom of the amalgamated metal to the molecule. Ammonium amalgam behaves analogously to these, and we are justified in concluding that it also is a solution of a compound of the general formula $M.Hg_n$, in mercury.

The solution of the compound $(NH_4)Hg_n$ is not stable, however, except at very low temperatures. It decomposes slowly at 0°, more rapidly at room temperature, into mercury, ammonia, and hydrogen. The gases become entangled in the mass and give rise to the characteristic inflation, which, however, is not a property of the original compound, but merely an accidental phenomenon accompanying its decomposition.

URBANA, ILL.
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A NEW APPARATUS FOR POLISHING METAL SECTIONS.

BY K. W. ZIMMERSCHIED.
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In the teaching of metallography, the question of proper apparatus with which to provide students for polishing the sections has sometimes presented itself. Where one is working alone, a machine such as is found on the market, with horizontal spindle carrying regularly four polishing wheels of different fineness answers very well, but where a number of persons must be provided for, this arrangement is quite unsatisfactory, since the finer wheels are too much exposed to contamination by material that will scratch the final surface of the metal, and the care requisite to avoid this contamination is exercised by a relatively small percentage of students. Again, the outlay necessary to provide a sufficient number of such machines for a large class, and then to supply each with means for starting and stopping without interference with the work of other operators, is considerable. The delivery of water to the surface of a wheel which revolves in a vertical plane also offers decided disadvantages, appreciated by all who have used the system, and the difficulty of taking care of the water thrown by such a wheel is still more annoying.

Having a number of men to take care of in a limited space, the author has devised the apparatus herein described, which overcomes a number of these difficulties, and which he hopes may help to solve the problem for others similarly situated.

[1] Compt. rend. 133, 713; 715; 771 (1901). Moissan obtained the reactions: $NH_4Cl + NH_3Li := LiCl + NH_3 + (NH_3 + H)$; $2NH_3Li + H_2S = Li_2S + 2NH_3 + H_2$; etc., in liquid ammonia, at temperatures approaching — 100°.

[2] Ber. 34, 2604. Ruff worked at — 95°, and at pressures up to 60 atmospheres.

[3] Am. Ch. J., 36, 124 (1906); Ibid., 37, 506 (1907).

Figure I gives a view of somewhat more than half of the machine. It is 12 feet long and 30 inches wide, built of heavy material and supported by five pairs of cast iron legs, each pair being cast in one piece to afford rigidity to the table itself and to the line shafts. The shafts run the length of the table and are both driven by one belt passing under each shaft pulley and over an adjustable idler between them, the position of the latter determining the tension and amount of tractive surface presented by the belt.

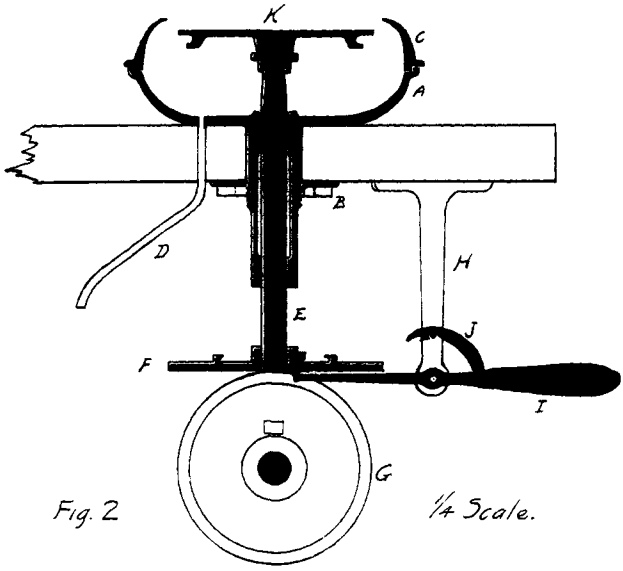

Fig. 2 ¼ Scale.

Close to each pair of legs are placed two polishing wheels in their surrounding water guards, ten in all. The construction of these will be better understood by reference to figure 2, drawn to one-fourth size. A cast iron bowl, A, the lower part of which serves as a bearing for the spindle, is screwed down fast to the table by the large nut, B. This bowl carries a ring, C, also of cast iron, and machined to fit snugly into A. This ring is parabola shaped in section and flanged at the bottom so that all water thrown by the polishing disc in operation will be caught and deflected into the bowl, whence it is drained off through a pipe, D, into a trough which runs the length of the table and collects all waste. A trough is preferable to a pipe on account of the liability of the latter to clog from the lint and polishing powders coming from the discs. These obstructions are easily removed from a trough and cause little or no trouble. All these parts are heavily japanned to avoid rusting, except where machined, and here the liberal use of machine oil counteracts any tendency in this direction.

The spindle, E, is of cold-rolled steel and carries on the lower end a

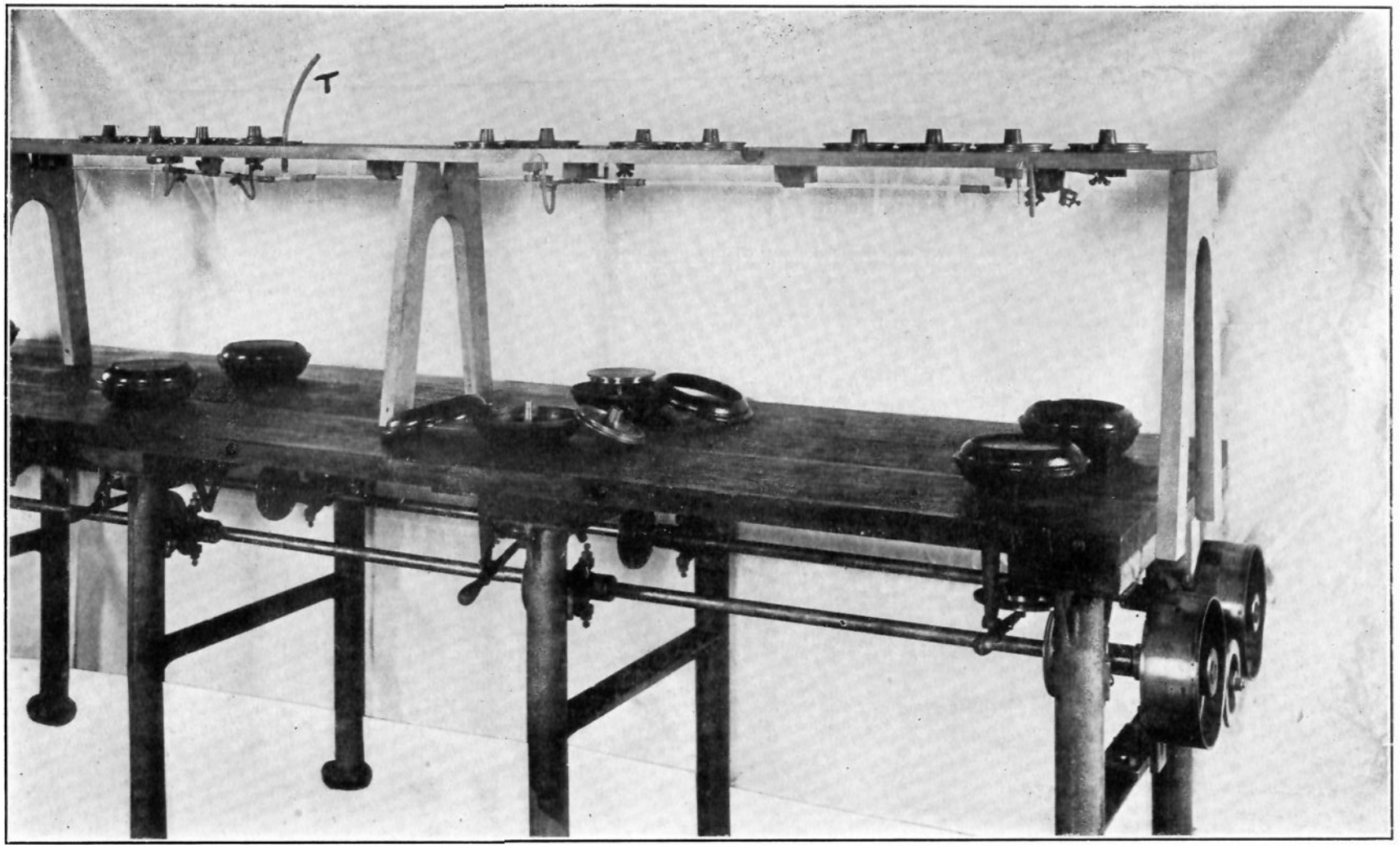

FIGURE 1.

friction disc, F. This, resting on the wheel G, which is fast to the line-shaft, furnishes the drive. A ring will be noticed on the top of this disc, with a reentrant surface on the inside. This serves to catch what oil runs down the spindle and reduces the amount thrown off the disc to a minimum. By sliding the drive-wheel G backward or forward on the line-shaft, the speed of the spindle can be varied at will; the drive-wheel has a leather periphery which furnishes ample friction for driving purposes.

On the top of the spindle is borne the polishing wheel proper; this latter is cast in one piece, of iron or brass. The hub is tapered slightly to fit the taper on the spindle and is slotted transversely to engage with a pin set near the top of the latter, thus affording a safe connection between the two, and a ready arrangement for changing wheels.

The little lever, I, furnishes the means for starting and stopping, and at the same time for elevating the spindle for change of wheels. In the lowest position the end of the lever is out of contact with the friction disc, the latter rests on the revolving drive-wheel, and the spindle is ready for use; upon disengaging the catch, J, and pressing down on the handle, the upper surface of the friction disc is brought hard against the bottom of the spindle bearing, which acts as a brake and quickly stops the wheel. In this position, also, the polishing disc is from two to three inches above the top of the water guard, easily taken hold of and removed. With the lever in the central position the friction disc is held just off the drive wheel, and the surface of the polishing disc is just below the water guard, so that a flat cover can be laid upon the whole. Photographs 1 and 3 show the last two conditions, both with the water-guard removed and in place. About the only time it is necessary to take off this top ring is when a specimen has dropped, or when it becomes necessary to poke the drain pipe free from obstructions.

Passing to the method of distributing the water to the wheels, the photographs make this reasonably plain. Distilled water is fed through the tube T, Figure I, and from thence by means of a glass main and T's, carried to the glass nozzles over each wheel. Water supply is regulated by pinch cocks, and since the arm carrying the nozzle is adjustable in a horizontal plane the drops can be delivered to any part of the polishing surface. The great advantages of this system of water supply are very evident: there is no manipulation necessary, even during the changing of wheels; since the drops are delivered in full view of the operator, and not from a tip which is too close to the revolving surface to allow of gaging the amount delivered, the regulation itself is much easier than in the old form of machine; and again, the whole surface of the wheel is wetted and available, making it easy to avoid pits on the polished surface by moving the specimen freely over the whole disc.

As for the technique of the polishing operation itself, very satisfactory results are gotten by grinding and finishing in four or five steps on wheels, avoiding the laborious hand work in all cases except where the very softest metals are being worked. The filed sections are given the first surfacing on a fine carborundum or emery wheel, and then resurfaced on an extremely fine carborundum wheel which was made to order by the Carborundum Company from FFF material. These two steps are carried out on wheels used in common by the whole class. For the succeeding operations, each man has his own set of three discs to be used on the spindle to which he is assigned.

The first of these discs is covered with canvas drawn tightly over the surface and held in place by a string wound around the groove in the periphery of the wheel; the powder used on this canvas is FFF carborundum which has been ground for four hours in a ball mill and then levigated to rid it of the coarser particles. The next finer disc is covered with broadcloth and carries alumina, rubbed well into the fabric, as the polishing material. This powder is obtained from the calcination of ammonia alum with subsequent grinding and levigation of the product. Only the finest portions are used, and these furnish a powder so efficient in cutting and polishing power that in the majority of cases only a few minutes of careful friction on this disc leaves the surface ready for examination. Whenever a specimen particularly free from imperfections is desired, as for photography, a final polishing is given on a disc covered with broadcloth as before, but spread in this case with the finest rouge. Using plenty of water and very slight pressure in this final surfacing, samples quite free from films and pits are obtained, especially if they are moved freely over the polishing face.

Summing up, the apparatus described furnishes a compact instrument for polishing metal sections in the fewest operations.

The first cost is low, less than half that necessary for the same number of separate polishing machines.

The system is superior as regards flexibility; separate spindles are put in or out of service with a minimum of effort, the speed of each can be independently varied, and polishing surfaces can be changed in a second's time.

The application of water to the discs is more satisfactory than in the case of vertical wheels; the whole surface is available, and the collection and disposition of the water thrown from it while in use is most efficient.

UNIVERSITY OF MICHIGAN,
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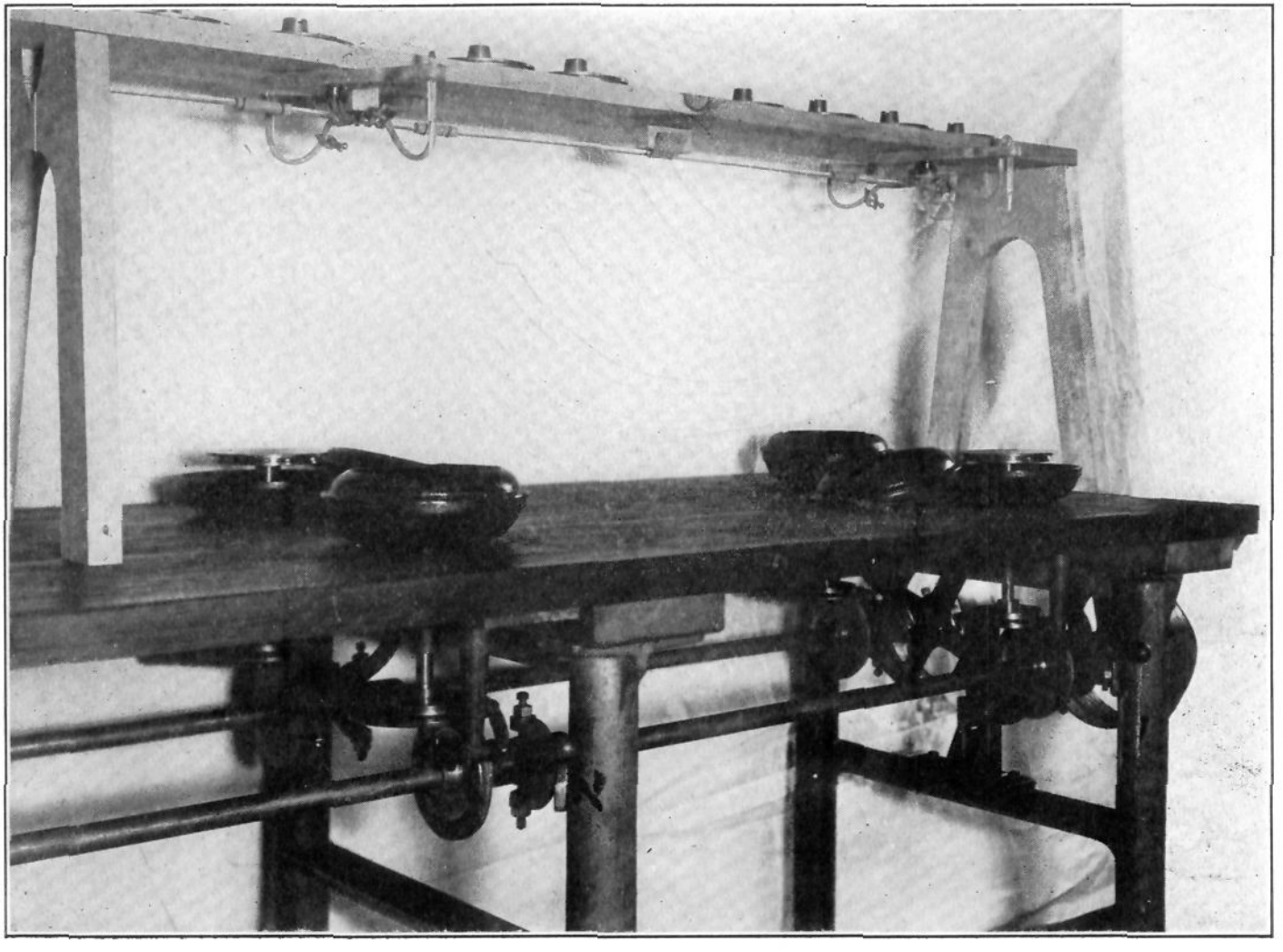

FIGURE 3.