Clemens Riefler

Nesselwang und München (Bayern).

Manufacturer of Mathematical Instruments.

No. 1 and 2 in A.

1. Drawing Instruments of Precision and instruments used in technical designing.

The compasses (Figs. 1, 2, 3) of the mathematical instruments of the Riefler Company are made on the so-called round system, which was designed by Dr. S. Riefler. This system on account of its many advantages has very largely superseded the older patterns of compasses with their angular form and three cornered points, and is now, after the expiration of the patents, used by most other manufacturers of drawing instruments. Of the numerous instruments, which the firm has newly designed or improved, are exhibited:

Dividers with changeable points (Fig. 2), compasses, drawing pens with adjusting screw and nib, opening to the side without disturbing the thickness of the lines (Fig. 4), road pens, curve pens, double curve pens, drawing fountain pens for drawing many lines with one filling (Fig. 5), map gauge, kilometer gauge (according to Oberst Heller) (Fig. 6), spring bows for small circles with point, falling by its own weight (Fig. 7), spring bows with micrometer screw between the legs (Fig. 8), proportional compasses, six beam compasses of different styles, three triangular compasses, two pieces of hatching apparatus, two ellipsographs, three dotting pens for drawing broken lines and circles (Fig. 9), angle divider and several other similar instruments.

2. Model of Astronomical Clock Work.

The astronomical clocks*, built by the exhibitor during the last 15 years, possess a perfectly *free escapement* and *mercury* or *nickel-steel compensated pendulums.*

* *Astronom. Nachr.* **133** *and* **134**; *Zeitschr. f. Instrkde.* **13**. *p. 88. 1893;* **14**. *p. 346. 1894.* S. Riefler, Die Präzisionsuhren mit vollkommen freiem Echappement und Quecksilber-Kompensationspendel. München 1894; S. Riefler Nickelstahl-Kompensationspendel. München 1902.

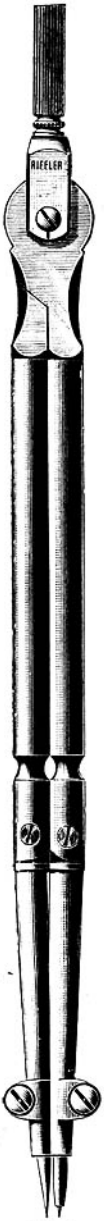
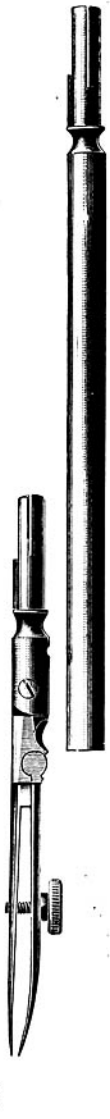


Fig. 1.



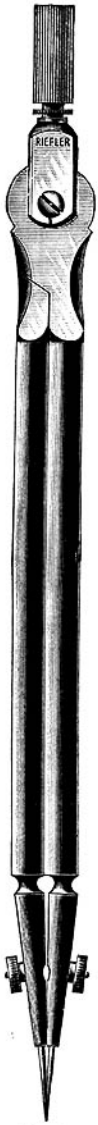


Fig. 2.

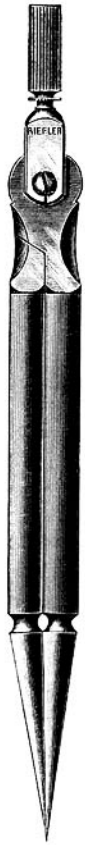


Fig. 3.

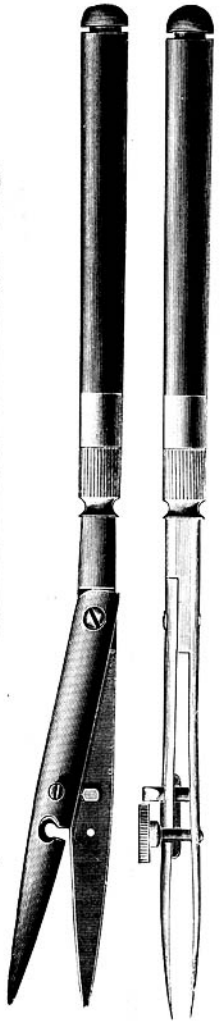


Fig. 4.

Fig. 5.

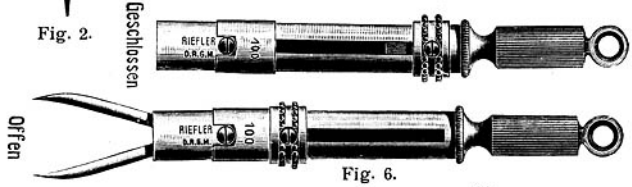


Fig. 6.

The *escapement* of these clocks rests on a practically new principle, which was worked out by Dr. S. Riefler in the year 1869. It was only by means of extensive experiments that a practical solution of the problem was reached (1889).

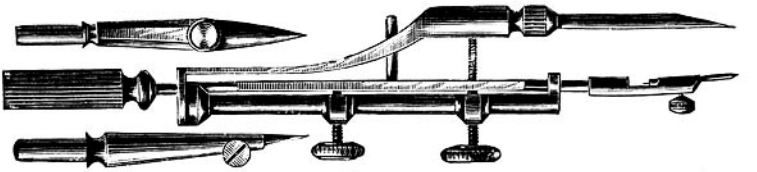


Fig. 7

Fig. 8.

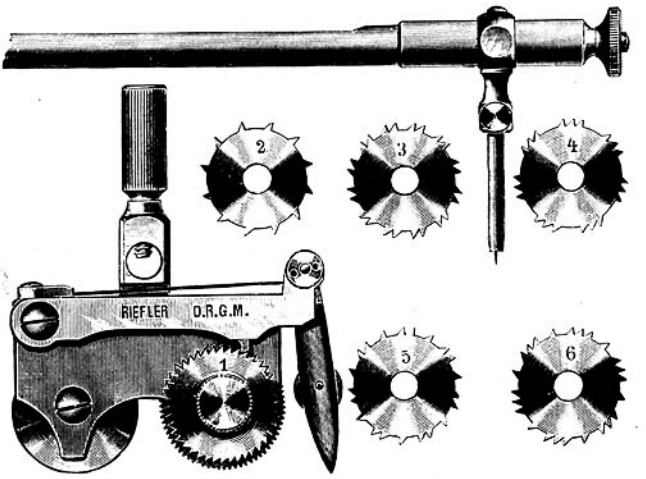


Fig. 9.

The pendulum is not driven by an anchor escapement, which is entirely lacking, but by the pendulum spring itself, which is slightly bent at each oscillation and the resulting elastic force imparts the necessary motion. The introduction of this completely free escapement has produced an accuracy in the clocks not before known.

An additional important advance in this direction was in the introduction of the *mercury compensation pendulum* in the year 1891. This consists of a thin walled Mannesmann steel tube, filled to two thirds its height with mercury.

Fig. 10.

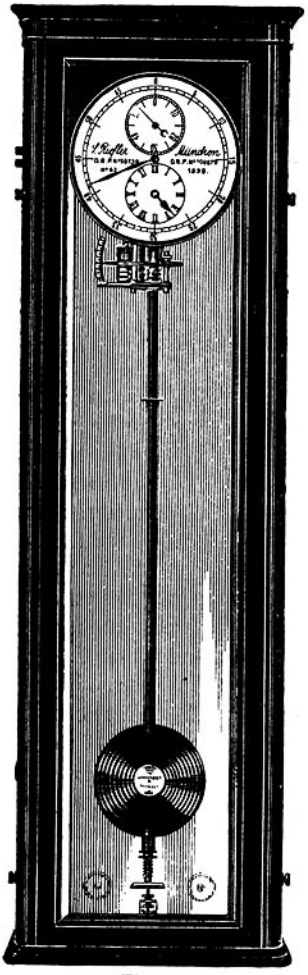


Fig. 11.

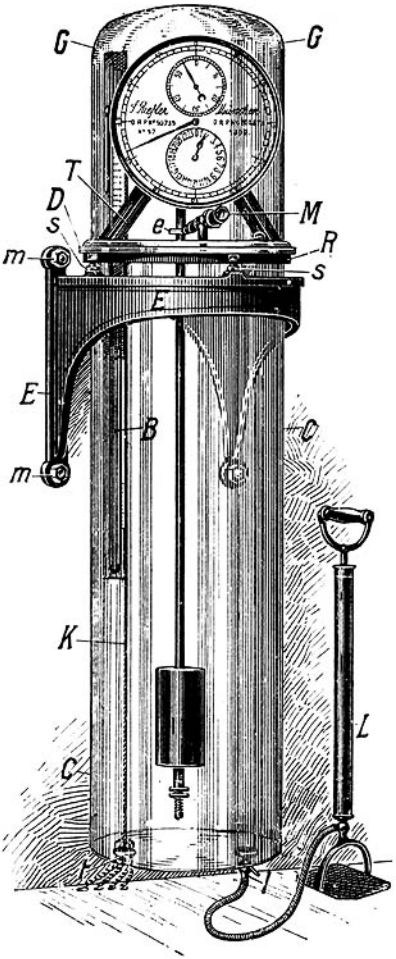


Fig. 12.

This successful construction was followed in 1898 by the *nickel-steel compensation pendulum* (Fig. 10), which resulted from the discovery of Guillaume in Paris, that a nickel steel alloy with 35·7% nickel possessed an extraordinarily small

expansion coefficient. The temperature compensation of this pendulum has been calculated by Dr. Riefler by his own special method in accordance with the expansion coefficient, measured in the Physikalisch-Technische Reichsanstalt and later in the *Bureau international des poids et mesures* at Sèvres. The average error, remaining in the compensation of the pendulums, amounts to only 0·005 sec. per 1° C. per day.

The time of swing of a pendulum is also dependent upon the air pressure. The air pressure constant of a seconds pendulum varies according to the shape of the ball, whether flat or cylindrical, between 0·012 and 0·018 seconds; that is, the pendulum loses daily this amount when the air pressure increases 1 *mm.* The values have been established by experiments on several pendulums. The exhibitor therefore built (in 1895) a clock in an air tight glass case, consisting of a glass cylinder for receiving the clock work and a ground bell glass, in this way making it independent of the air pressure. In 1899, Riefler applied an *air pressure compensator* (Fig. 13) to clocks, used in the air (Fig. 11). This consisted of an aneroid of peculiar construction, attached to the pendulum.

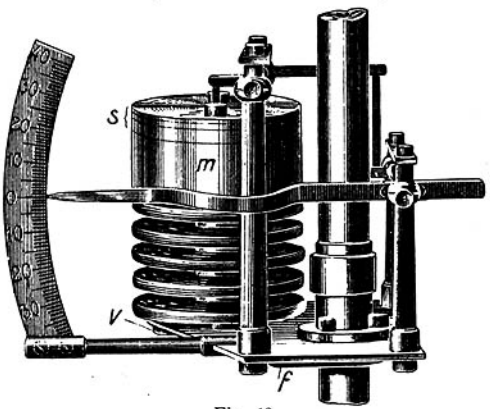


Fig. 13.

For chronographic comparison, the clocks are furnished with *electrical seconds contacts.* During the last year and a half, the firm has also furnished clocks with a new *electric winding apparatus.* Fig. 12 shows such a clock with air tight case, nickel-steel pendulum, electric winding apparatus and an air pump to exhaust the case.

Among the time records of these clocks, which we have received from different observatories, we will mention only the ones, published on the 11th of August 1902 by Prof. Howe in the *Astronom. Journ. No. 524,* concerning the "Riefler clock No. 56", provided with an air tight case, nickel-steel pendulum and electric winder, which is installed at the observatory in Cleveland, Ohio. According to this, the average daily

variation of this clock is 0·015 sec. and the largest during the whole course of the observations, covering several months, was 0·022 sec. This is the best record of a clock known up to the present time, and it must be remembered that this is the actually observed record subject to no corrections on account of length of swing, temperature etc.

One of the five clocks (Fig. 12), which the Riefler Company has provided for the U. S. Naval Observatory, is exhibited in the *Time Service department* of that institution. This has air tight case, nickel-steel pendulum, electric seconds contact and electric winder.

In addition, there is in the Belgian division of the exhibition a description of a plan of the time service of the royal Belgian observatory in Uccle, accompanied by diagrams, which has been worked out by Dr. S. Riefler. This plan contains in two groups (stellar time group and mean time group) 4 standard clocks of the 1st order and 2 standard clocks of the 2nd order, to which 11 other electrically synchronised clocks are connected.