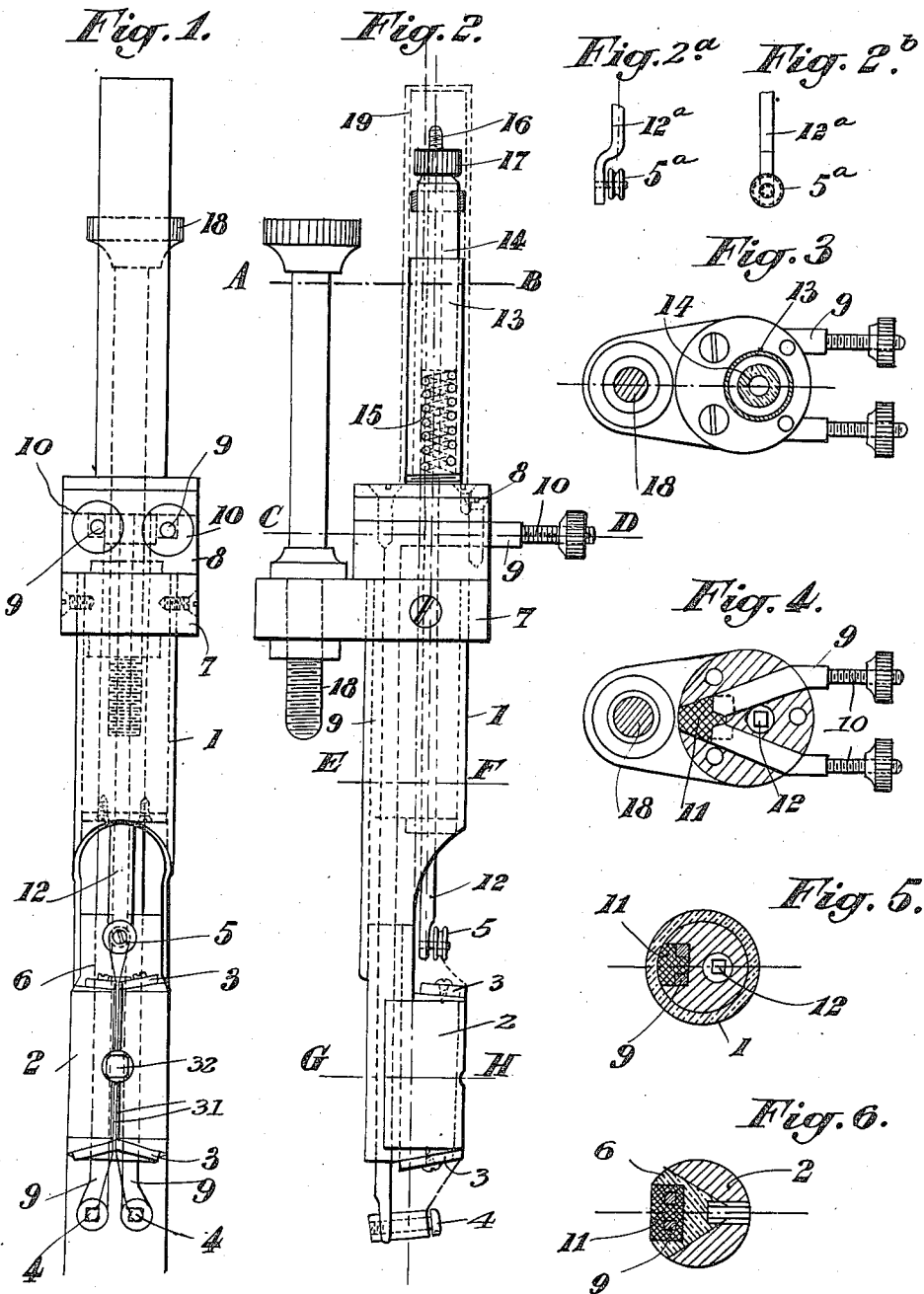


1,193,979.

Patented Aug. 8, 1916.  
2 SHEETS—SHEET 1.



WITNESSES  
Alfred P. Anderson  
John W. Hoving

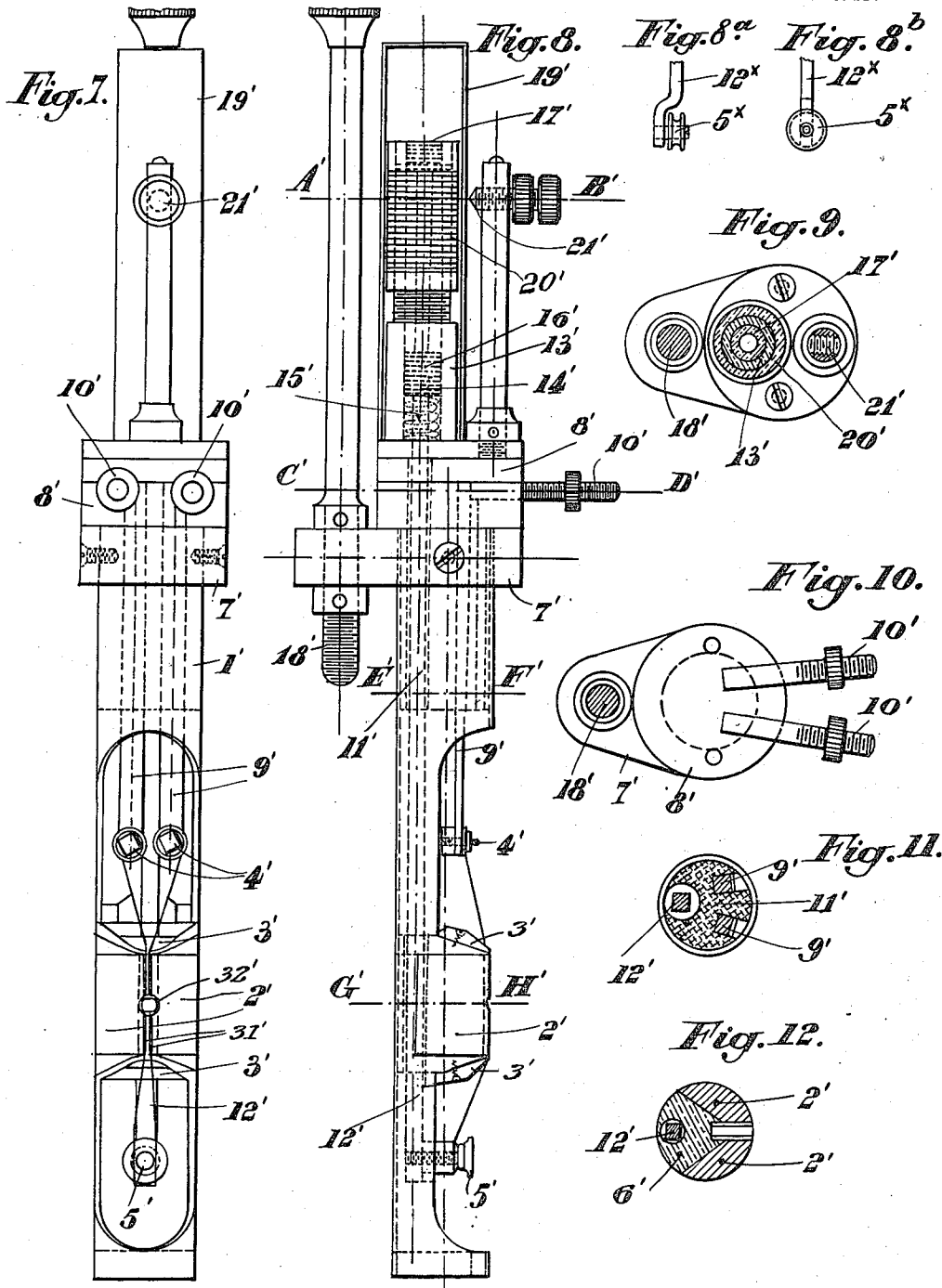
INVENTOR  
ANDRÉ BLONDEL  
BY *Frank J. Deane*  
ATTORNEY

A. BLONDEL.  
GALVANOMETER.

APPLICATION FILED APR. 9, 1913.

Patented Aug. 8, 1916.

2 SHEETS—SHEET 2.



WITNESSES

Alfred R. Anderson  
John H. Hoving

INVENTOR

ANDRÉ BLONDEL

By *Fransesmus*  
ATTORNEY

# UNITED STATES PATENT OFFICE.

ANDRÉ BLONDEL, OF PARIS, FRANCE.

GALVANOMETER.

1,193,979.

Specification of Letters Patent.

Patented Aug. 8, 1916.

Application filed April 9, 1913. Serial No. 760,082.

*To all whom it may concern:*

Be it known that I, ANDRÉ BLONDEL, engineer, a citizen of the French Republic, and residing at Paris, France, have invented new and useful Improvements in Galvanometers; and I do hereby declare the following to be a full, clear, and exact description of the same.

For a long time there have been known bifilar galvanometers and oscillographs in which an electric current is measured by the torsion of a loop of wire through which the current to be measured passes between the pole pieces of a magnet. For instance, French Patent No. 309,060 of July 1, 1901, describes a system of bifilar oscillographs having a movable support carrying the pole pieces and the wire loop stretched therebetween by means of a tension device with a pulley, the spring of the tension device at the bottom of the support. This device is placed within the usual oil box, and therefore the tension device, being at the bottom of the support, is inaccessible. In other constructions described in French patent of addition No. 9211 of April 4, 1908, the tension device is at the top of the support and consequently accessible, but in this construction it is necessary to secure the pole pieces, in the oil box and not on the support. Therefore, these pole pieces must be quite wide apart to permit the bifilar device supported by the movable part to be lowered between the pole pieces. Such a construction has the disadvantage that the gap between the pole pieces must be at least about 1 mm. wide, and it is difficult to obtain strong fields. None of the above mentioned devices is completely satisfactory.

One object of the present invention is to provide a device of this kind having the narrowest possible air gap in order to increase the strength of the magnetic field between the pole pieces thereby increasing the sensitivity of the oscillograph.

Other objects are to provide: a tension device easily adjustable from the outside; easily accessible sufficiently separated outer terminals for the current supply; a convenient and efficient means for mounting the active portion of the wire loop and of such a

size as to permit the support to be easily and safely lowered into the oil box, and an efficient means for adjustably holding the support in the oil box.

Another object is to provide all of the above named improvements in a single galvanometer.

Figure 1 is a front elevation of one form of the invention; Fig. 2 is a side elevation of the same; Figs. 2<sup>a</sup> and 2<sup>b</sup> are front and side elevations respectively of a modified form of the support which holds the pulley for the wire loop; and Figs. 3, 4, 5 and 6 are sectional views, partly in elevation, taken respectively on the lines A—B, C—D, E—F, and G—H of Fig. 2. Figs. 7 and 8 show front and side elevations respectively of a modified form of the inventions; Figs. 8<sup>a</sup> and 8<sup>b</sup> are front and side elevations respectively of a modified form of the loop supporting pulley and support of Figs. 7 and 8; Figs. 9, 10, 11 and 12 show sections taken respectively on the lines A'—B', C'—D', E'—F', and G'—H' of Fig. 8.

Referring more particularly to Figs. 1 to 6, the device comprises a support of substantially tubular or other convenient form adapted to be disposed in the usual oil box placed between the poles of a powerful magnet, the box and magnet being not shown. A pair of wedge shaped pole pieces 2 of magnetic material are secured in the lower part of the support 1 and have their adjacent faces very close together to form a narrow air gap, and if desired, is provided with corresponding recesses forming a substantially circular enlargement in the air gap. These pole pieces when placed between the poles of said magnet conduct the concentrated magnetic flux across said air gap giving a very strong magnetic field therein.

Secured to the upper and lower faces of the pole pieces 2 are insulating bridges 3 provided with notches forming guides for two active sections of the wire loop 31 forming the bifilar device and adapted to carry a mirror 32 suitably secured therein in said circular enlargement of the air gap. The ends of the wire loop 31 are secured to binding terminals 4 while the looped intermediate portion is passed around the insu-

lating pulley 5 either the axis of rotation of which may be perpendicular to the plane determined by said active portions of the loop, as shown in Figs. 1 and 2, or this axis may be parallel to said plane, as at 5<sup>a</sup> in Figs. 2<sup>a</sup> and 2<sup>b</sup>, according as the loop is made of flat or round wire. The portions of the wire loop 31 disposed outside of the space between the bridges are stretched obliquely outwardly so that the wires are forced against the sides of said notches of the bridges. In this way, for instance, phosphor bronze wires of round cross section and 0.03 mm. in diameter can be arranged in notches 0.15 to 0.30 mm. wide and in an air gap as narrow as 0.4 or 0.5 mm. It is also possible to use flat phosphor bronze wires having for instance a width of 0.1 to 0.2 mm., arranged in notches 0.3 to 0.5 mm. wide and in an air gap as narrow as 0.5 to 0.7 mm. In both cases the air gap can be narrower than it could be if the pole pieces were not secured directly to the support. The distance between the bridges 3 may be 10, 20 or 50 mm. or even more, according to the frequency and sensitiveness desired to be obtained. The circular hole in the pole pieces may be 2 mm. or even more in diameter in order conveniently to glue the mirror 32 thereon. For stability, the pole pieces 2 may be provided with a suitable backing 6; if desired (Fig. 6).

At the upper end, the tubular support 1 is secured in a collar 7 provided with a rotatable manipulating screw 18, threaded at its lower end for engagement in a threaded recess in the oil box not shown. By means of this screw it is possible to regulate the height to which the tubular support dips in the oil. On top of said collar is arranged an insulating block 8 comprising several parts suitably secured together. In this block are embedded upper terminals 10 respectively connected to the lower binding terminals 4 at the lower part of the support 1 by the conducting wires or rods 9. The upper terminals 10 diverge from each other, as shown in Fig. 4, in order that they may be widely separated so as to avoid danger of short circuits when the leading in wires (not shown) are attached to these terminals. The rods 9 may be insulated by suitable insulating material 11 (Figs. 4 to 6).

In order that the tension of the wire loop 31 may be properly and conveniently adjusted, the pulley 5 is carried on an adjustable rod 12 passing centrally through the support 1 and block 8 and into a cylindrical box 13 mounted above the block 8.

The rod 12 is loosely received by a central bore in the graduated piston 14 slidable in said box and held in place by a milled nut 17 on the threaded upper end of the rod 12. This piston 14 and consequently with it the

rod 12 are yieldably pressed upwardly by the compression spring 15.

The tension of the spring may be varied by raising or lowering the nut 17 and the variation in the height of the piston may be noted by the graduations thereof exposed over the upper edge of the box 13.

The piston 14 and its related parts may all be inclosed in a detachable sheath 19.

The new device makes possible the combination of the hereinbefore described improved air gap with the improved tension device always accessible and operable from the outside of the oil box without withdrawing or moving the support from the oil box or casing to observe the deflections. The sensitiveness of the wire loop 31 may therefore be regulated while measuring by deflections, which is not possible when the tension regulating device is at the bottom of the oil box. Where the axis of the pulley 5<sup>a</sup> is parallel to the plane of the active portion of the wire loop 31, as shown in Figs. 2<sup>a</sup> and 2<sup>b</sup>, the rod 12<sup>a</sup> is somewhat off-set as shown when the pulley is attached thereto. In the arrangements above described the pulley is arranged above the pole pieces and the terminals 4 below. This arrangement might be reversed without departing from the scope of the invention.

The construction and operation of the elements of Figs. 7 to 12 are similar to the parts of Figs. 1 to 6 designated by corresponding unprimed reference characters, except that in the device of Figs. 7 to 12 the adjustable pulleys 5' and 5<sup>a</sup> are placed below the air gap, while the pulleys 5 and 5<sup>a</sup> are placed above the air gap. This necessitates the placing of the rod 12' or 12<sup>a</sup> farther back in the casing since it must pass behind the air gap. In like manner the rods 9' must be placed farther forward than the rods 9. Furthermore, the device of Figs. 7 to 12 is shown provided with an exterior graduated casing 20' (Fig. 9) on which by means of a pointer 21', the adjustment may be read off.

I claim as my invention:—

In a galvanometer or the like, the combination of a vertical support adapted to be placed in an oil box; a pair of magnetically separated pole pieces secured on the lower part of the support and providing a narrow vertical air gap between the pole pieces; a pair of bridges respectively placed at opposite ends of the air gap; a pair of terminals near one end of the air gap; a pulley at the upper end of the air gap, a rod for supporting said pulley; a looped wire having its ends secured to said terminals and its intermediate parts passed over said pulley and bridges and through the air gap; an adjusting device engaging said rod; widely separated binding screws connected to said terminals; and

means for adjusting the height of the support in the oil box, said adjusting device, said means and said binding screws all being located at the upper part of the support and easily accessible when the support is in the oil box.

In testimony whereof I have signed my

name to this specification in the presence of two subscribing witnesses.

ANDRÉ BLONDEL.

Witnesses:

HANSON C. COXE,  
MARIA CORNET.