XXIV. *Account of a new Electrometer. By Mr.* Abraham Brook; *communicated by Sir* Joseph Banks, *Bart. P. R. S.*

Read May 30, 1782.

AAAAN, fig. 1. represents the electrometer in full size and proportion, standing on a table, or the like. The foot B is a square piece of board, 9¾ inches each way, resting on three pins C, C, *c*, seen at the under side of the foot. C, C, with the broad heads, are screws to set the instrument upright withal. D is a solid piece of glass, which supports and insulates the instrument from the place on which it stands. The arms G1 and *g*, with the ball F, turn round on the wire H (which is solid brass, as may be also the arm *g*), and, when in use, are put near at a right angle with G2 and H, being turned to the off side so as to be as much as possible out of each other's atmospheres or the atmosphere of a jar, battery, prime conductor, &c. The arms G1 and G2 are hollow tubes of copper, not so heavy as wires. The balls I1, I2, are made of copper, and hollow, so as to be as light as possible. K represents a kind of face or dial plate to the instrument with its index, which is carried once round by the motion of the arm G2 with its ball I2 moving through a quarter, or 90 degrees, of a circle; this motion is given to it by the repulsive power of the charge, &c. of electricity between the two balls I2 and L. The ends of the index from its center are of different lengths. The longest end reaches to a graduated circle, divided into 90 equal parts,

answering

anſwering to the 90°, which the arm G2 moves through. The ſhorteſt end reaches to a ſmaller circle, divided into 60 equal parts, anſwering to 60 grs. weight, or 60 diviſions, on the arm G1, with its ſliding weight *m*, each of which is equal to one grain, and the whole face is covered with a watch glaſs, to prevent the electricity from flying off at the points.

The top of the glaſs-ſupporter, or inſulator D, is cemented into a braſs cap M. This cap enters the ball L at bottom, and ſcrews into the upper part of the ball L at *a*. The top part of this cap M is tapered off to a cone about an inch and a half long or high. The lower end of the wire H has a hole made conically into it, ſo as to receive the upper part, or conical end, of the cap M, which permits all the upper part of the electrometer to turn round any way that may be neceſſary. The kind of ferrel O, with its baſe, is perforated for the lower end of the wire H to go through. The bent arm *b*, which ſupports the cup N, is ſcrewed into the baſe of the ferrel O, and turns freely round upon the wire H. The cup N is to receive the ball P of the arm, fig. 9. This arm ſhortens or lengthens, as may be wanted, by a wire ſliding into a tube. The end of the wire is ſlit, forming a ſpring in the tube to be ſteady. In this arm, fig. 9. is a kind of rule joint at *d*, that the arm may give way eaſily if wanted. The ſemi-circular end of the arm is a ſpring, and ſlips on to a ball from the prime-conductor, or the conductor itſelf (if they fit), jar, or battery. The ends of it are flat and broad, as repreſented in the drawing in miniature, of the electrometer at fig. 2. in the other drawing.

Fig. 2. to 11. ſhews the internal ſtructure of the electrometer.

Fig. 12. ſhews the part at *z* that ſcrews into the ball F, to ſupport the arm *g* with its ball *r*. This piece, which is made

 hollow

hollow on the ſide next the wire H, ſo as to fit, and is ſcrewed in, ſo as to preſs againſt H, ſerves as a ſpring to keep the ball F ſteady, which ſlides up and down, as well as turns round, on H.

In order to make the diviſions of G1, fig. 1. exactly a grain each, firſt ſlide the weight *m* towards the ball F, fig. 1. till it is an exact counter-balance to the weight in F. At one end of the weight *m* let the diviſions begin; then ſuſpend any tolerable pair of ſcales, ſo that the bottom of one of them may reſt on the top of the ball *r*; then lay the ball I1 into the ſcale, and ſlide the weight *m* near to I1, and put as many grains into the other ſcale as will juſt raiſe the ball I1 in the ſcale; then mark the arm G1 at the ſame end of the weight *m*, and divide the ſpace between the two marks into as many parts as there are grains in the ſcale, which may be divided and ſub-divided into halves and quarters.

The arm G2 being repelled ſhews when the charge is increaſing, &c.; and I1 tells what ſuch a repulſive power is between two balls of the ſize of theſe in grains, according to the number the weight *m* reſts at when lifted up by the repulſive power of a charge. The longeſt end of the index K ſhews how many degrees of a circle G2 is repelled; and, by many trials, according to the number of grains, the arm G1 ſhews, when it is lifted up, and the weight *m* put at different places, ſuch reſpective numbers of grains may be marked on the leaſt graduated circle on the dial plate where the ſhorteſt end of the index points; ſo that when all the grains are thus marked on the dial plate, thus aſcertained by the arm G1, all theſe parts of the inſtrument, that is, the ball F with the arms G1 and *g* may be taken off, and the inſtrument is then graduated to be uſed without them; but I do not know how the grains can be ſo exactly

exactly marked and aſcertained as by theſe parts being on the inſtrument: nor do I mean to confine the number of grains or diviſions on G1; but, I think, my experience ſeems to tell me, that no glaſs to be *charged*, as we call it, with electricity, will bear a greater charge than that whoſe repulſive force, between two balls of this ſize, equals 60 grains weight, before it will be perforated or ſtruck through. Nay, I have not found many inſtances where it would ſtand 50 grains; and, I think, it is very hazardous to go more than 45 grains.

Thus, by knowing the quantity of coated ſurface, and the diameter of the balls, as I1 and *r*, I would ſay, ſo much or ſo much coated ſurface charged to ſo many or ſo many grains repulſion between two balls of ſuch or ſuch a ſize would melt a wire of this or that ſize, or do ſuch a thing, kill ſuch an animal, &c.; and if balls, wires, or arms of this ſize, are found too ſmall, larger may be made on the ſame plan.

In reſpect to the advantages of this electrometer above *thoſe now in uſe*, I do not, perhaps, know them all; and leſt my partiality may prejudice me in behalf of my own contrivance, would rather leave them to the judgement of others; my opinion however is, that all that I have ſeen or heard of are ſuch as ſpeak no intelligible language, and that this ſpeaks ſo as to be underſtood univerſally; for, unleſs the repulſive power of the charge of different glaſſes be very different, this electrometer, or any other electrometer, made after this manner, muſt, I ſhould think, ſpeak very nearly the ſame language, it being known how much coated ſurface there is, and the ſize of the balls; but if the ſize of the balls be not the ſame, the language the inſtrument ſpeaks will be very different. Although other Electrometers ſhewed a

greater or leſſer charge or power, by an arm being repelled to a greater or leſſer diſtance, or by ſtriking differently at different diſtances, yet the power of the charge was not in any manner aſcertained; we could ſay, that the arm or index was repelled to ſuch or ſuch a number of degrees of a circle, or that it ſtruck to ſuch or ſuch a diſtance; but the repulſive power of a charge to repel the index ſo much, or ſo many degrees of a circle, or the ſtrength of the charge to ſtrike to ſuch a diſtance was not (that I know of) in any manner intelligibly aſcertained. This ſhews it by the weight that the repulſive power has to lift up in grains, &c.; which weight is to be proved by any tolerable pair of ſcales and weights; and I do not know any other method that has been yet tried to ſhew the different ſtrength of charges ſo good as that of repulſion.

All the neceſſary parts of the inſtrument being made of metal and glaſs that is pretty ſtout, I think, the electricity is leſs liable to eſcape than by wood, &c. I have tried reeds on account of their being light, and covered them with tin-foil, or gilded them to make them good conductors; but ſo frequently found inconveniencies from them by points riſing up, the celerity of moving, and the different weight of them at different times owing to moiſture, change of the weather, and the like, that I have laid them all aſide, and find my preſent inſtrument as free from theſe inconveniencies as I could expect; nor is it liable to be out of order, if proper care is taken of it.

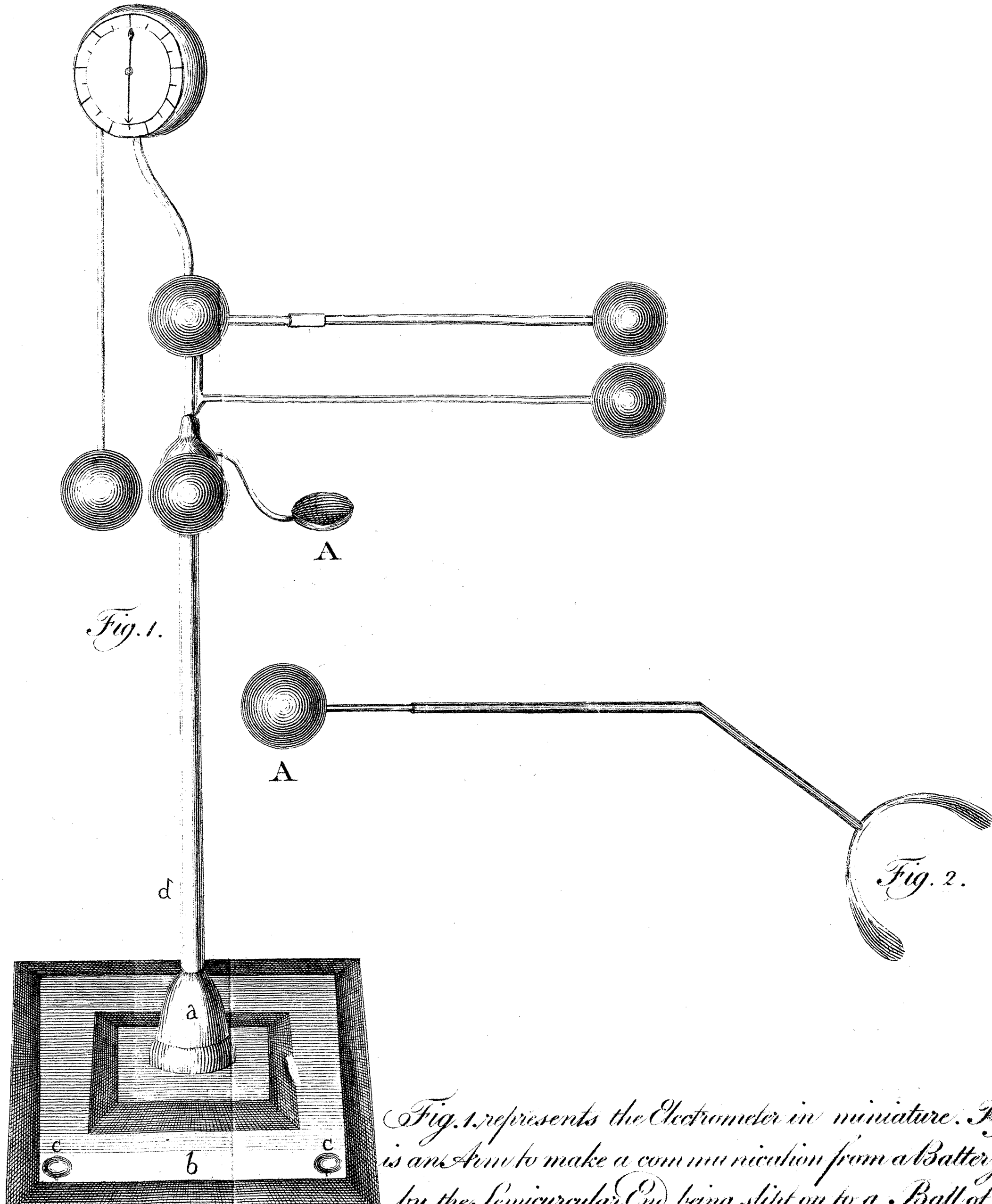

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Fig. 1.

Fig. 2.

Fig. 1. represents the Electrometer in miniature. Fig. 2. is an Arm to make a communication from a Battery, &c. by the Semicircular End being slipt on to a Ball of the Battery &c. and the Ball A being laid into the Cup A. Fig. 1.

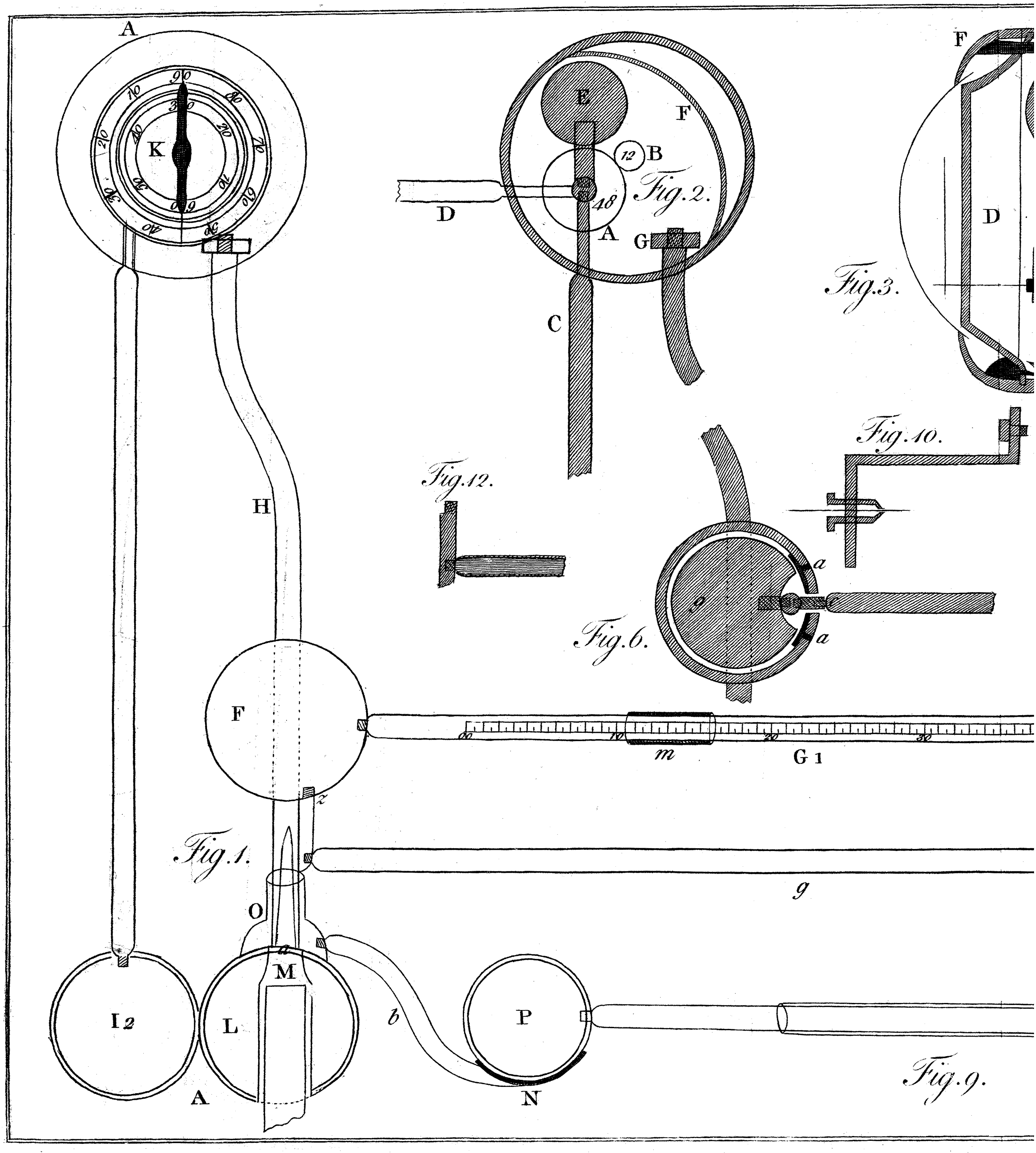
Fig.1.
Fig.2.
Fig.3.
Fig.6.
Fig.9.
Fig.10.
Fig.12.
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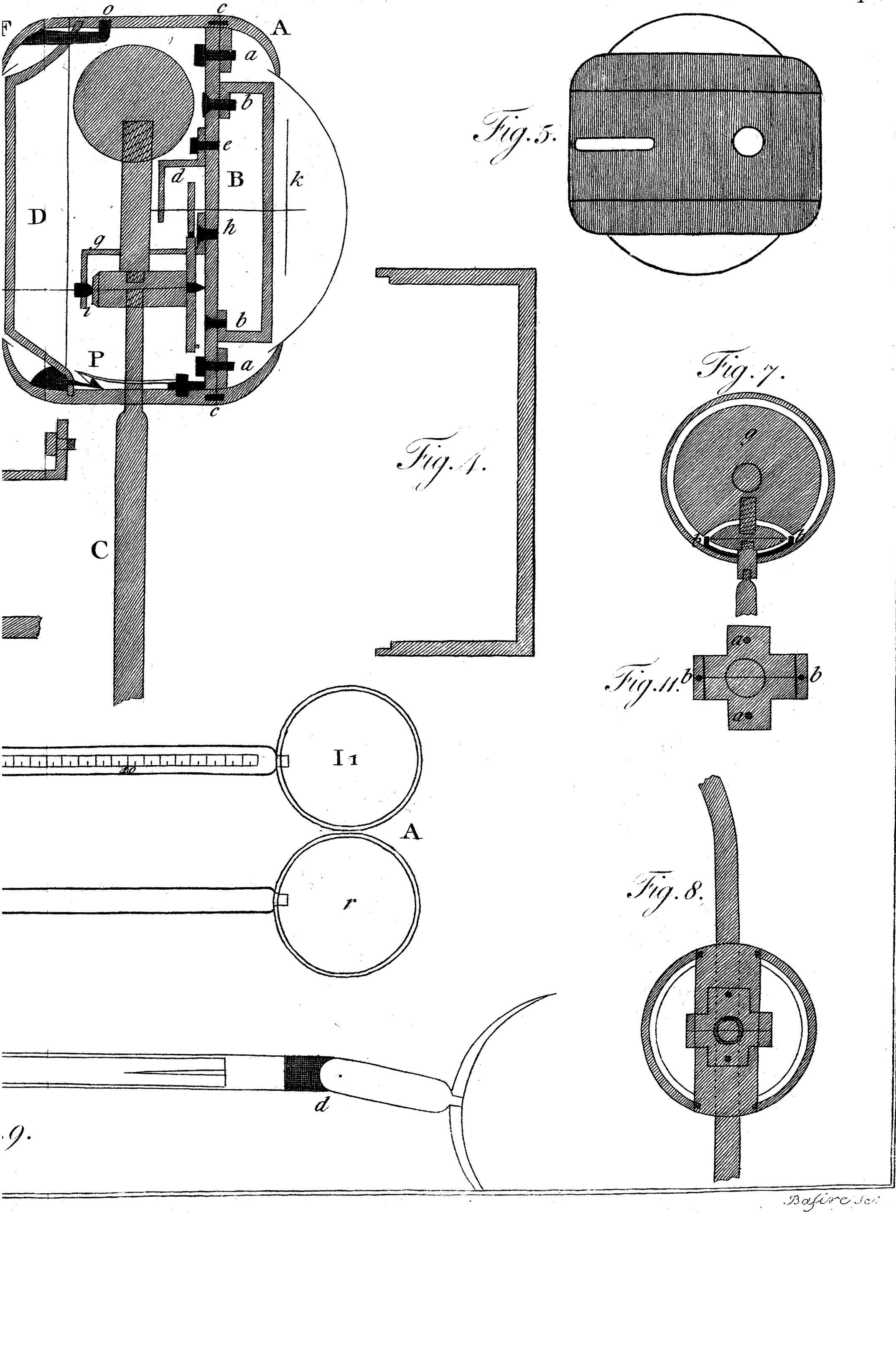
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Fig. 4.
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Fig. 8.

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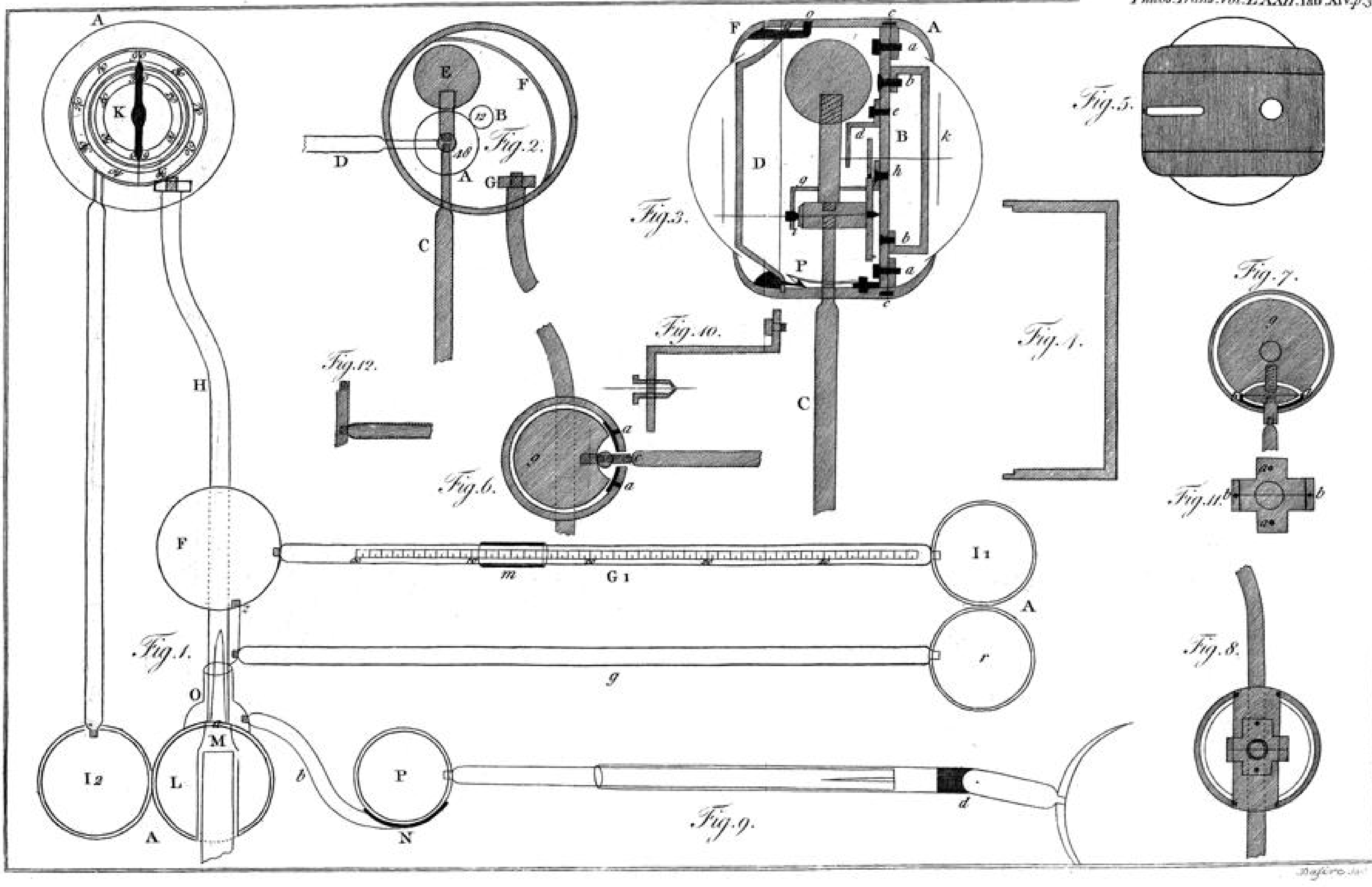
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