

No. 896,886.

PATENTED AUG. 25, 1908.

A. F. BERRY.

CONSTRUCTION OF ELECTROMAGNETS.

APPLICATION FILED JAN. 21, 1907.

3 SHEETS—SHEET 1.

Fig. 1.

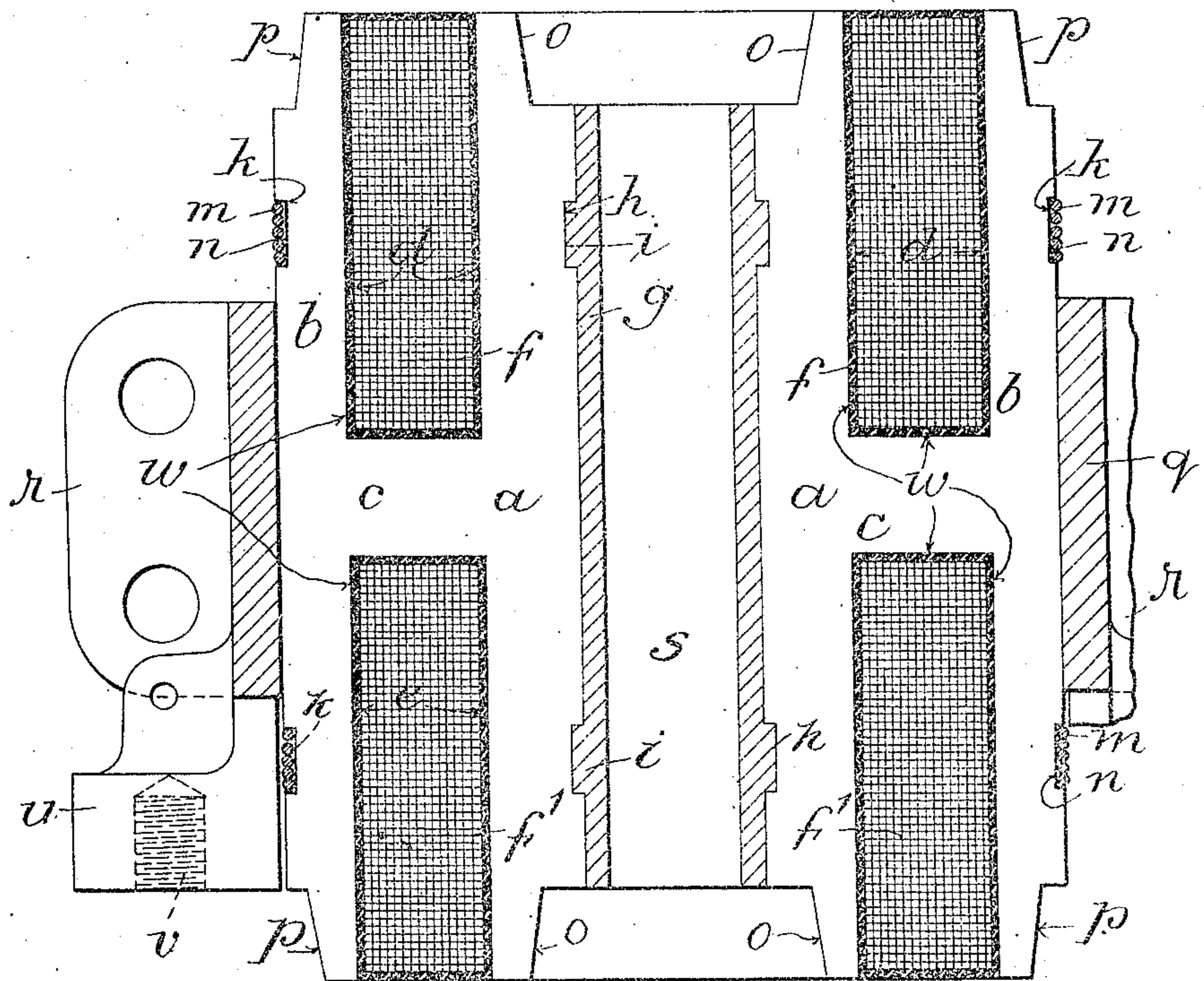
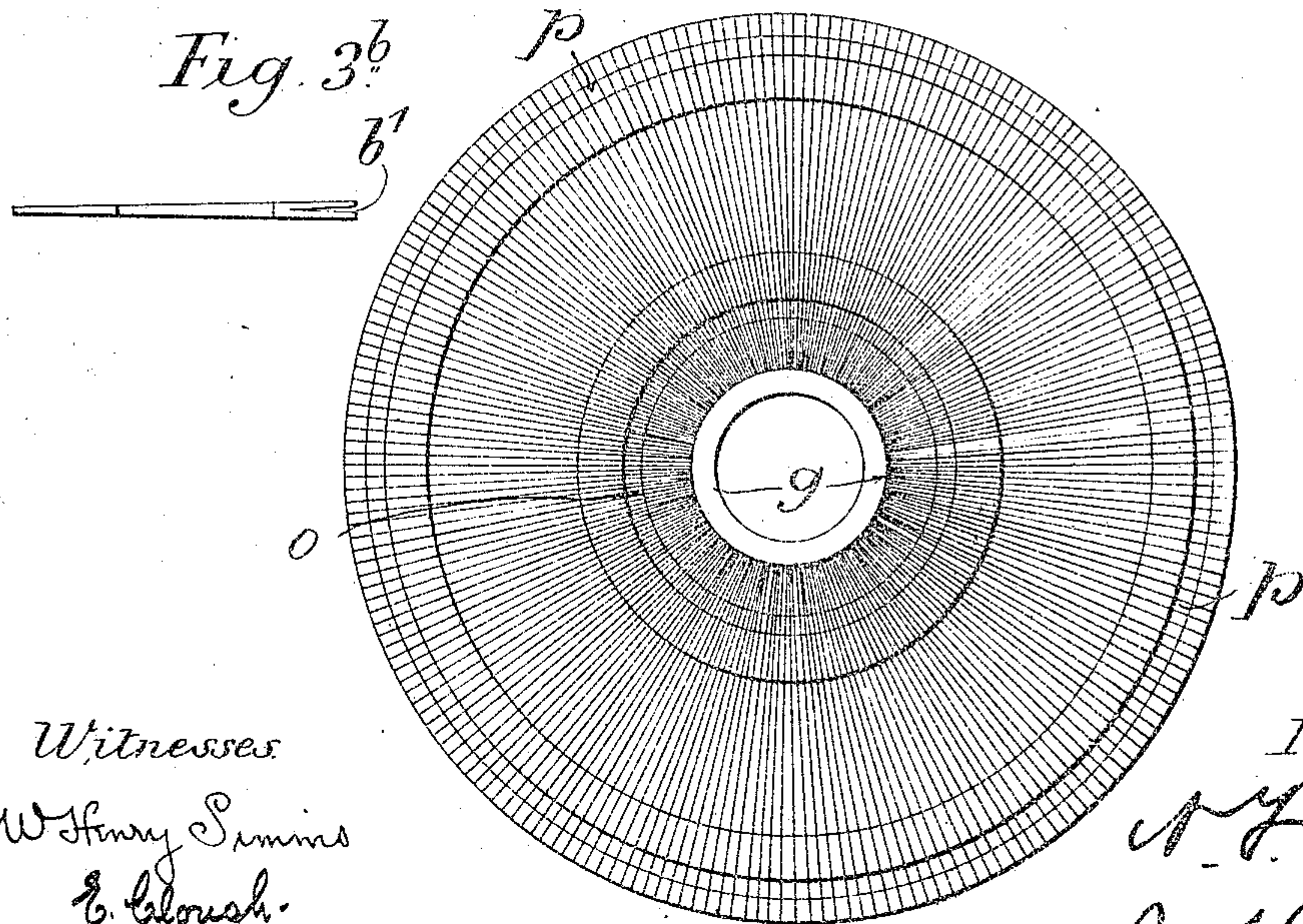


Fig. 3



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3 SHEETS—SHEET 2.

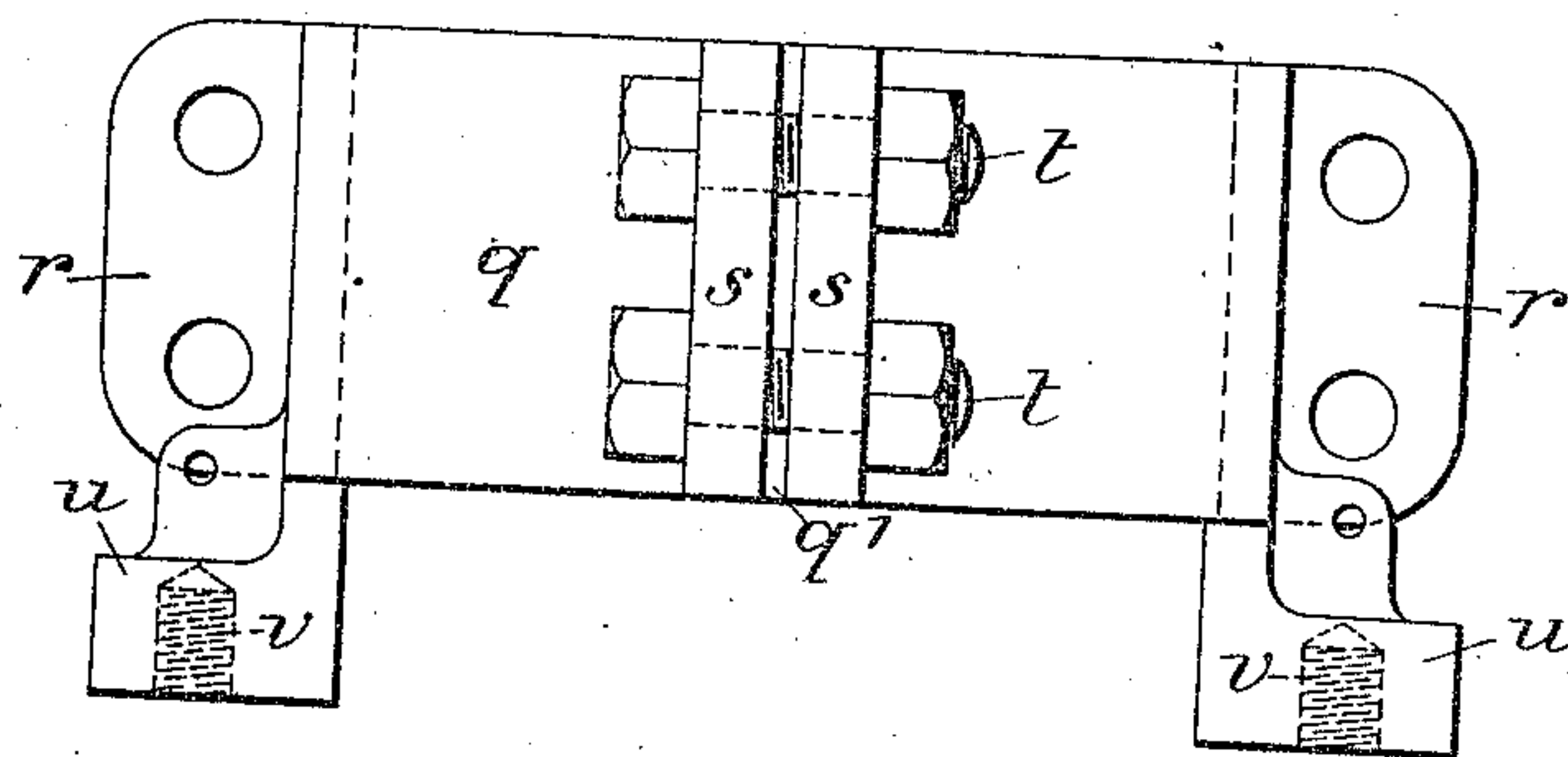
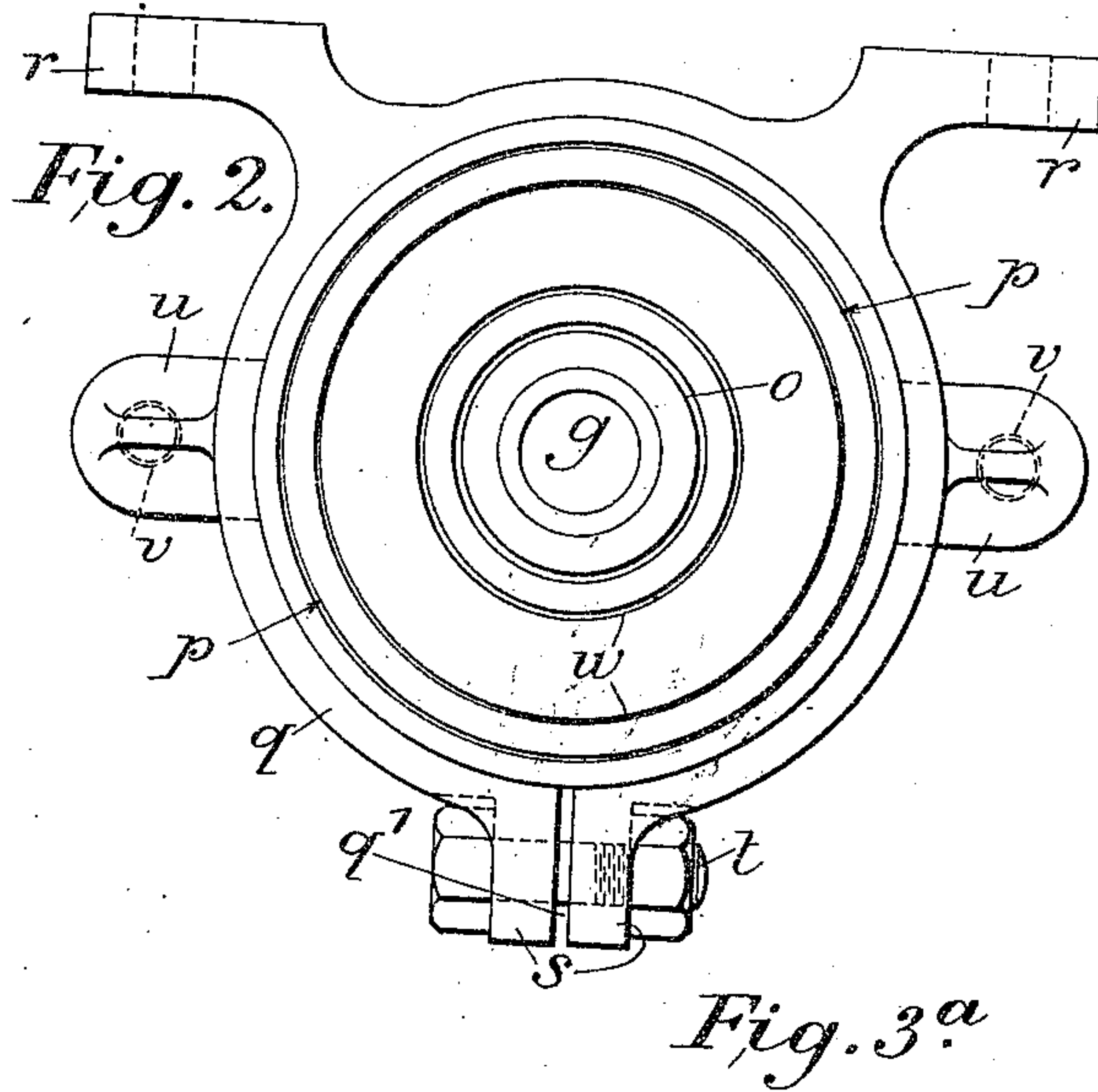
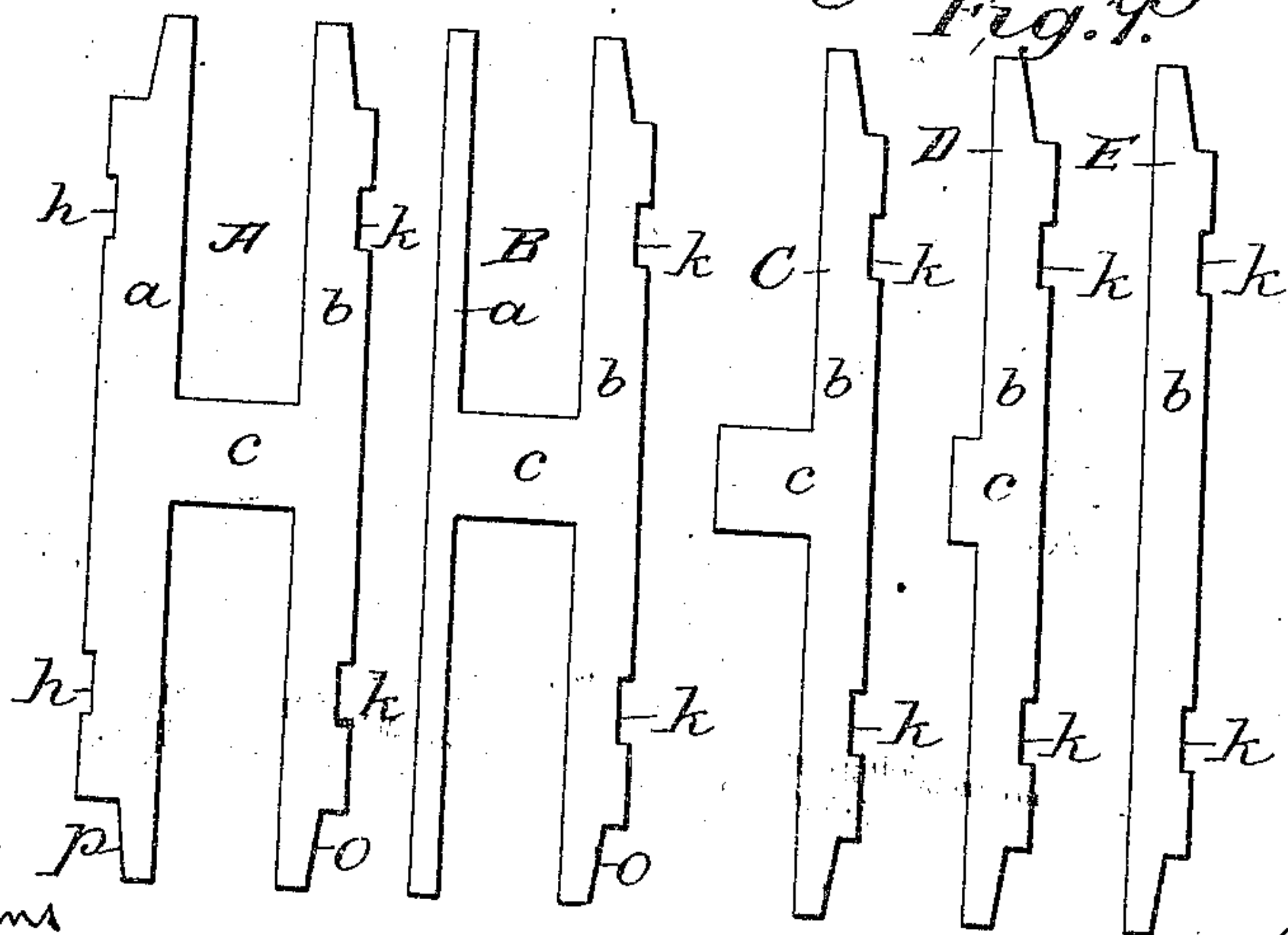


Fig. 4. Fig. 5. Fig. 6. Fig. 8.
Fig. 7.



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3 SHEETS—SHEET 3.

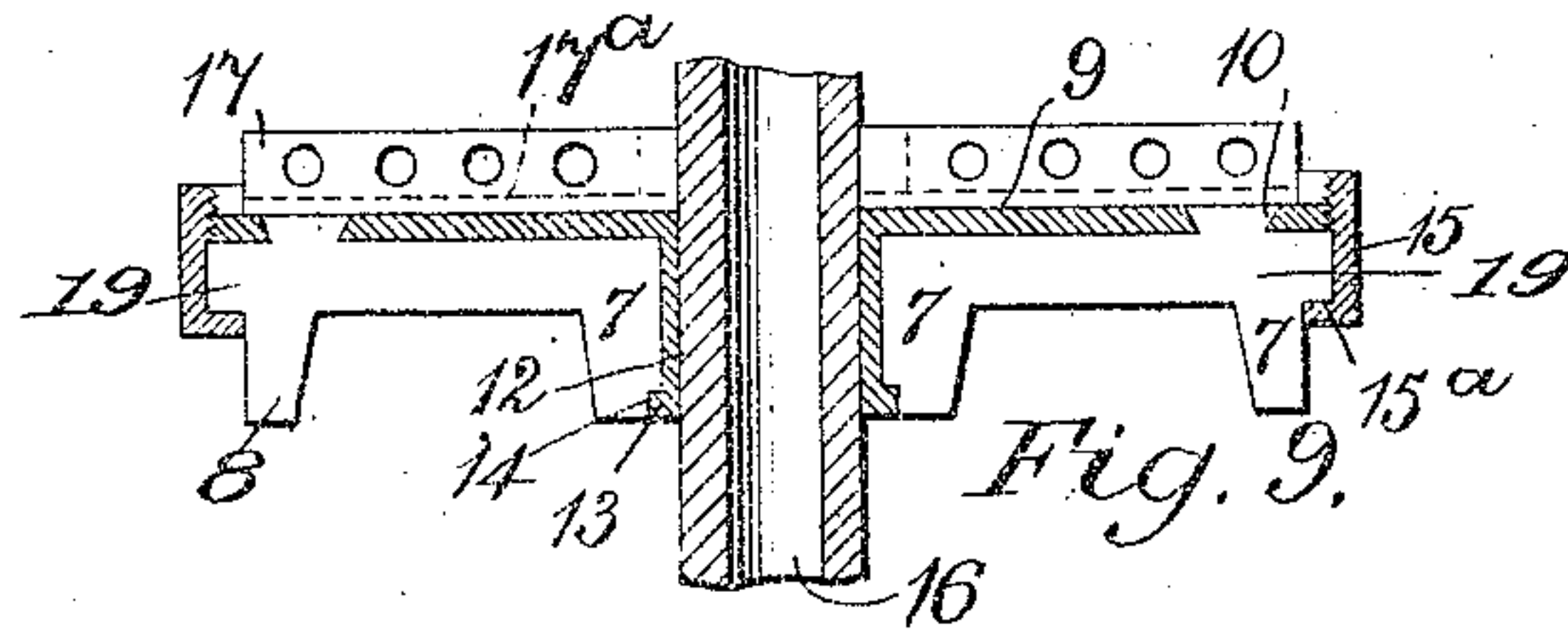


Fig. 9.

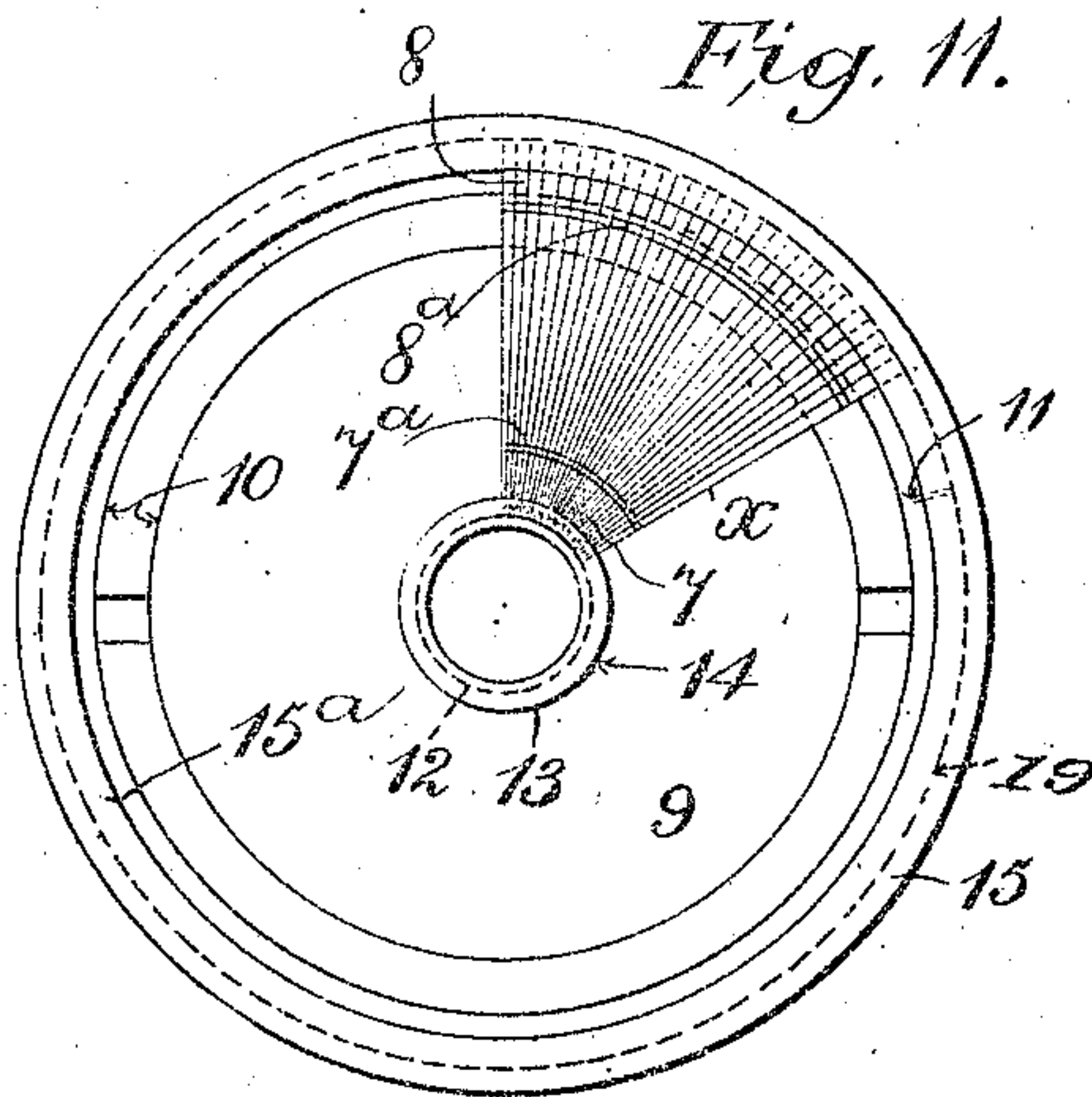
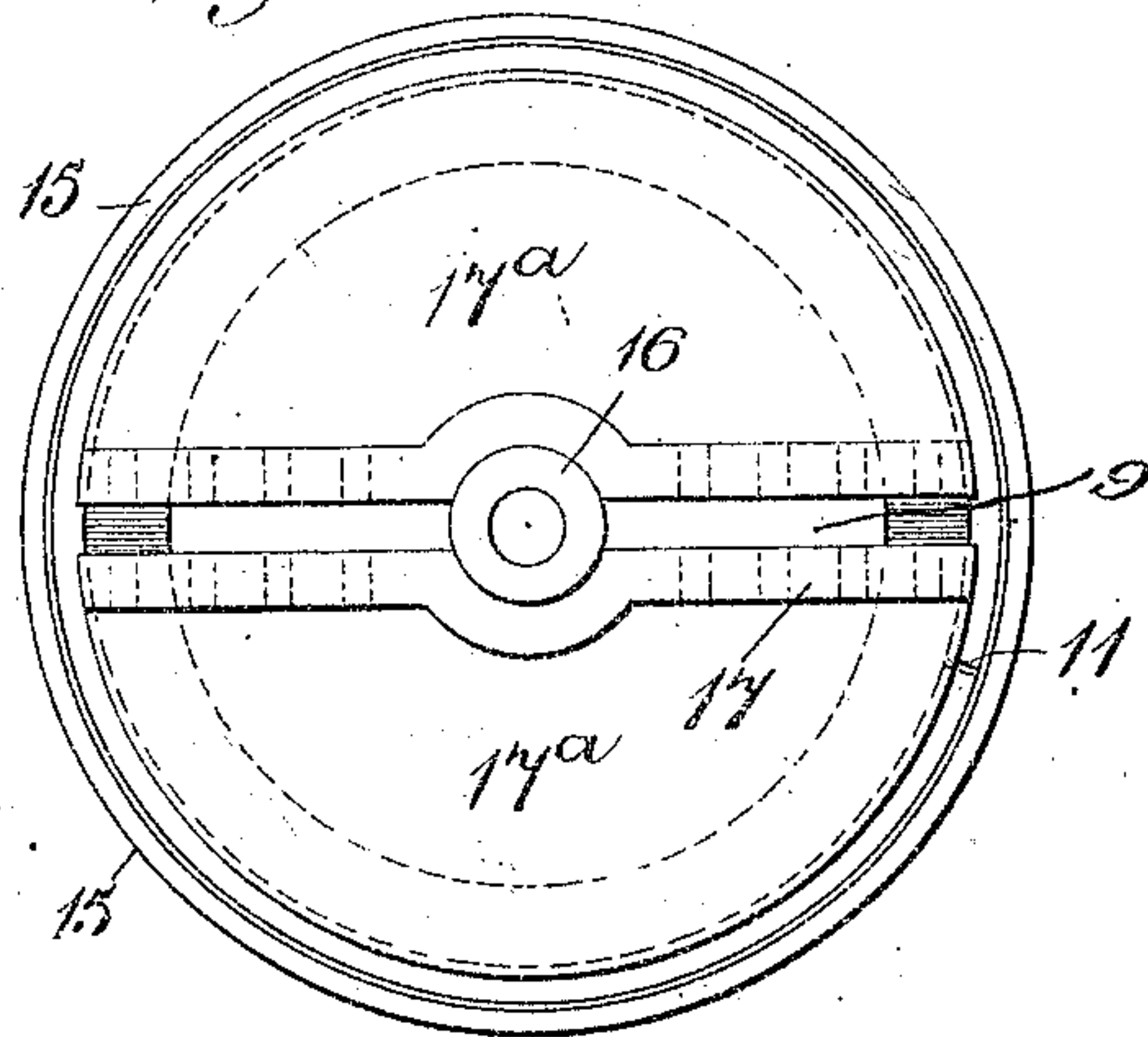


Fig. 11.

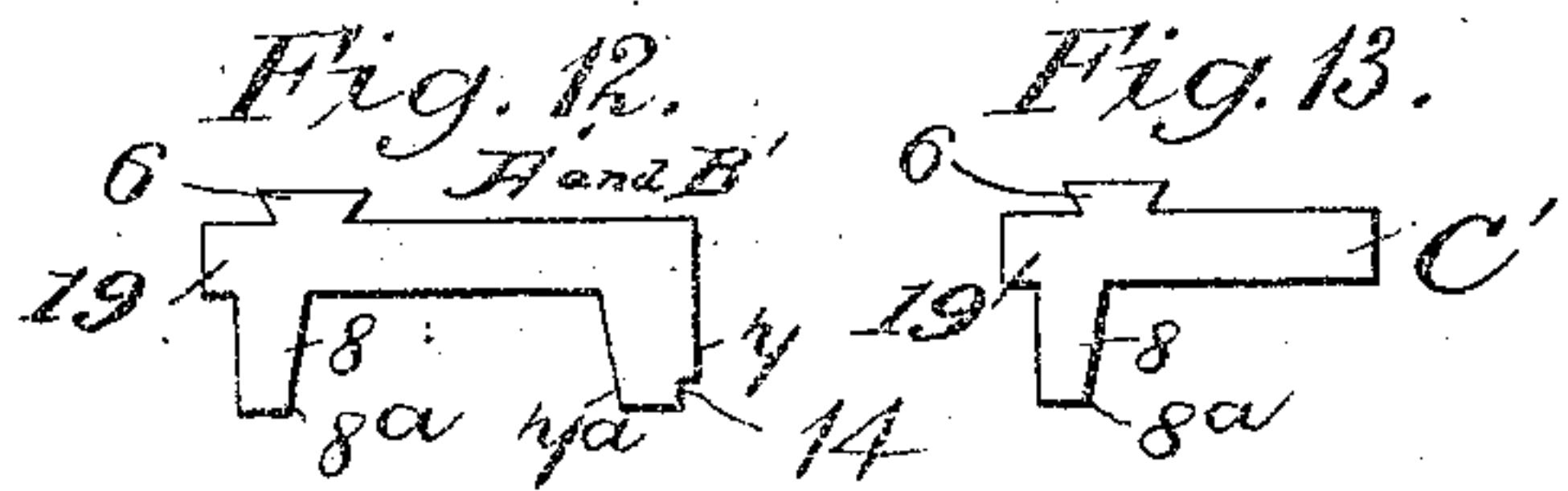


Fig. 12. Fig. 13.

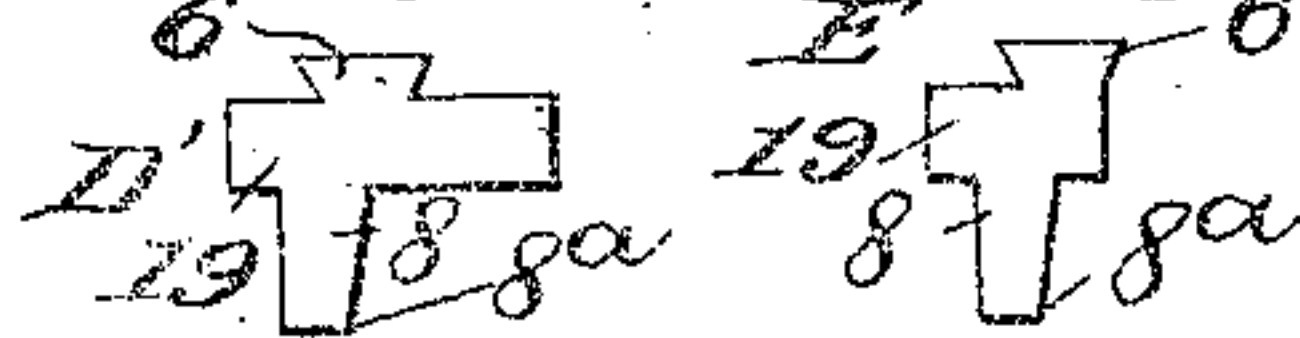


Fig. 14. Fig. 15.

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CONSTRUCTION OF ELECTROMAGNETS.

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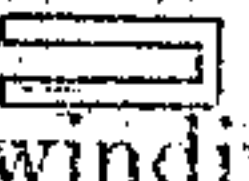
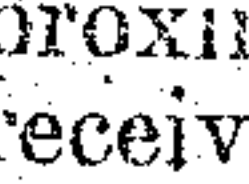
Specification of Letters Patent.

Patented Aug. 25, 1908.

Application filed January 21, 1907. Serial No. 353,292.

To all whom it may concern:

Be it known that I, ARTHUR FRANCIS BERRY, a subject of the King of Great Britain and Ireland, residing at Ealing, in the county of Middlesex, England, have invented Improvements in the Construction of Electromagnets, of which the following is a specification.

This invention has reference to improvements in the construction of electro-magnets of the pot type designed for use with alternating electric currents, and by which is meant an electro-magnet having its energizing coil or each coil surrounded on its inner and outer peripheral surfaces and one end by the magnetic circuit, and it has for its main object, among others, to enable the core of such magnets to be laminated in a very efficient manner so as to avoid waste of electric energy therein and so as to render the magnet very sensitive and quick in action. According thereto, the core of a pot electro-magnet comprising inner and outer parts arranged concentrically one within the other, so as to leave an annular space between them for the reception of the winding of the electro-magnet, and magnetically connected together at one part, is, according to this invention, built up of a number of iron plates that are of sector shape as seen in plan, or in a section of the core at right angles to the axis thereof, and are firmly secured around a central support. The inner and outer parts of each plate are either connected together at one end, so as to form a single approximately  shaped plate designed to receive a single winding for a single acting electro-magnet, or they are connected together at an intermediate part of their length so as to form an approximately  shaped plate designed to receive two windings to form a double acting pot electro-magnet like the double-acting electro-magnetic devices described for example in the specification of former Letters Patent No. 800,538 of 1905, granted to me.

The armature, or each armature, for an electro-magnet having a laminated core according to this invention may also be built up of similar sector shaped iron plates that are firmly secured to a disk or holder.

Each sector shaped plate for the magnet core, and also each sector shaped plate for the armature, or each armature, may, in some cases, be made of one comparatively thin piece of suitably shaped iron. In many

cases however, in order to obtain the best results, each sector shaped plate may be made as a compound laminated plate composed of a group of thin sheet iron stampings or laminae of different radial widths and of the required shape to form the required compound plate.

In the accompanying illustrative drawings, Figure 1 shows in vertical section, and Fig. 2 in plan, a double acting electro-magnet the core of which is built up of compound laminated plates. Fig. 3 is a plan of the core alone, showing the sector shaped plates of which it is composed. Fig. 3^a is a front view of a holder for such electro-magnet. Fig. 3^b shows a single sector shaped plate. Figs. 4, 5, 6, 7 and 8 are detail views of stampings for forming a single compound laminated plate. Fig. 9 is a vertical section, Fig. 10 a plan or top view, and Fig. 11 an underside view, showing a laminated armature constructed according to this invention, parts being removed in Fig. 11. Figs. 12, 13, 14 and 15 are detail views of stampings for forming one of the compound sector shaped laminated plates for such armature.

Referring to Figs. 1 to 8 inclusive, *a* and *b* are the inner and outer parts of the laminated pot shaped magnet core arranged concentrically one within the other and connected together at *c* so as to form the annular spaces *d* and *e* for the magnet windings *f* and *f*¹, the said core being formed of a number of iron plates that are of sector shape as seen in plan (Fig. 3), and are secured around a central tubular support *g*. In this construction of double acting electro-magnet, each sector shape plate *a*, *b*, *c* for the magnet core may be compound or laminated and composed of five stampings, hereinafter called for distinction A, B, C, D, E. Stamping A, which is the widest, comprises (see Fig. 4) inner and outer longitudinal members *a* and *b* joined together by an intermediate transverse member *c*; B stamping (Fig. 5) is of similar shape to A but the inner member *a* is of less radial width than that of A; C (Fig. 6) comprises the outer longitudinal member *b* with the transverse member *c* only; D (Fig. 7) is similar to C but the transverse member *c* is of less radial width than that of C; and E (Fig. 8) consists of a single outer longitudinal member *b*. Each of the stampings B, C, D and E may be cut down from a stamping corresponding to A. The inner edges of

all the A stampings may be suitably formed, as for example with notches h , or it may be with projections, to admit of their fitting correspondingly formed collars i , or it may be annular recesses, in the central supporting tube g , which may be of brass, around which the compound plates are built up, the several stampings being assembled successively in the order A to E with the outer edges in a common circumferential line. The outer edges of all the stampings may be notched, as shown at k , to receive suitable binding means to hold the compound plates firmly in position around the central support g . The binding means may conveniently consist of wire m , for example steel wire, wound around but insulated, as by material n , from the compound plates and having its convolutions afterwards soldered together. The ends of the longitudinal members a and b of the plates may, advantageously, as shown, be of truncated wedge shape so as to form oppositely beveled faces o and p on the inner and outer portions a and b of the core at each end thereof.

A laminated core built up as described may, as shown, conveniently be held in a tubular holder q of non-magnetic metal, for example gun metal, provided at one side with lugs r or equivalent means to admit of its being secured, as by bolts or screws, to a support, and slit at the opposite side at q' and provided with perforated lugs s for the reception of one or more bolts t to admit of its being firmly clamped around the core. The tubular holder q may be provided with additional lugs u arranged at right angles to the others, and provided with screw threaded holes v for the reception of rods, pillars or other attachments. The holder q may be insulated from the magnet core, for example by varnish or enamel. The two windings f and f' for the electro-magnet are, as hereinbefore stated, arranged in the two annular spaces d and e formed in the core by the construction described, at each side of the central transverse division formed by the transverse members c of the stampings. Tubes w of insulating material, for example of vulcanized fiber, are or may be placed between each winding and the core.

A single acting electro-magnet may be constructed as described by suppressing the portions of the inner and outer longitudinal members a and b of the stampings at one side of the transverse members c .

The armature, or each armature, for the electro-magnet above described, comprises, according to the example illustrated in Figs. 9 to 15 inclusive, a number of compound plates x each built up of five stampings, hereinafter called for distinction A^1 , B^1 , C^1 , D^1 , E^1 . Stampings A^1 , B^1 (Fig. 12) which are of the same radial length, are each formed at one edge with a dovetail shaped projec-

tion 6 and at the opposite edge, near the ends thereof, with inner and outer projections 7 and 8 respectively, the edges 7^a , 8^a of the two projections that are nearest to each other being beveled in opposite directions to approximately the same shape and dimensions as the oppositely beveled ends o and p of the magnet core opposite which the armature is to work, the other edges of the two projections 7 and 8 being parallel to one another. Stampings C^1 , D^1 and E^1 are, see Figs. 13, 14 and 15 respectively, similar to stampings A^1 and B^1 except that they are without the inner projections 7 and are of different radial length.

Each of the stampings C^1 , D^1 and E^1 may be cut down from an A^1 or a B^1 stamping. The several stampings are assembled upon a disk-like holder 9 of non-magnetic metal, for example gun-metal, that is formed with an annular groove 10 of dovetail or equivalent section to receive the correspondingly formed projections 6 on the stampings, and with one or more radial saw-cuts 11 to admit of the insertion of the said projections in the groove, the several stampings being worked round to their proper positions in the holder. The holder 9 is formed with a central boss 12 having an annular collar or projection 13 to take into corresponding notches 14 formed in the adjacent edges of the inner projections on the stampings A^1 and B^1 so as to hold the inner ends of these stampings in place. The outer ends of the stampings are held in place by a nut 15 screwed onto the disk 9 and having an inwardly extending flange 15^a at one end to engage portions x' of the stamping (Fig. 9) outside the outer projections 8. The outer edges of the stampings should be insulated, as for example by varnish or enamel, to prevent their being short circuited. The holder 9 with stampings is fixed to a tube or rod 16 designed to work endwise through the central tube g in the magnet core (Figs. 1, 2 and 3).

The armature, or each armature, constructed as described, may be suitably adapted for the attachment thereto of any desired device. For example, the non-magnetic disk-like holder 9 forming part of the upper armature or cap for a vertical electro-magnet, may be provided on its upper side with two upwardly extending flanges 17 adapted to hold a steel blade or other device between them. These flanges, in the example shown, are formed on plates 17^a that serve to hold together the two concentric parts of the holder 9 between which the annular groove 10 is formed. The bottom armature may be similar to the upper one but be provided with lugs for the attachment of springs and with a boss for an insulator.

As will be obvious the details of construction can be variously modified without departing from the essential features of the in-

vention. Thus it is preferred to arrange the compound plates of the core of the electro-magnet and of each armature slightly tangentially to the axis thereof in such manner that the edges of the laminæ of each armature shall extend at a small angle across the edges of the laminæ of the core so that they shall not enter one between the other when the armature is attracted. Also, it is to be understood that the several plates when not built up of stampings, may be rolled or cast to the required sector shape, in which case the outer edge of greater width, if considered too wide, may, as shown in Fig. 3^b, be lightened by forming a wedge shaped groove therein, which groove will have a further laminating effect.

Electro-magnets, and armatures therefor, constructed as described, are specially adapted for use in the construction of electromagnetic switch actuating devices of the kind described for example in the specification of a former Letters Patent No. 310378 dated 6 April 1906, as, owing to the effective lamination of the magnet cores and armatures, such devices are rendered very sensitive and rapid in operation, and magnetizing losses are reduced to a very small amount.

What I claim is:—

1. A laminated electro-magnet comprising an energizing winding and a magnetic circuit built up of plates having axially parallel limbs connected together to embrace the inner and outer peripheral surfaces and inner end of the winding and to permit the latter to be inserted in position and removed axially, the inner and outer limbs and connecting member of each plate being of a general sector shape as seen in plan or cross section.

2. A laminated electro-magnet comprising an energizing winding and a magnetic circuit built up of plates arranged around the axis of the magnet and having axially parallel limbs connected together to embrace the inner and outer peripheral surfaces and inner end of the winding, each of said plates being of a general sector shape as seen in plan or cross section and composed of stampings of different widths.

3. A laminated electro-magnet comprising an energizing winding and a magnetic circuit built up of plates of sector shape in cross section arranged around the axis of said magnet and each comprising a group of stampings of different widths some of which have axially parallel limbs and others single limbs adapted to be arranged in a circumferential line with the outermost limbs of the first named stampings.

4. A laminated electro-magnet having a circuit comprising a plurality of groups of laminæ arranged around the axis of the magnet, the several members of a group being of different radial lengths, the widest member having axially parallel free ended limbs and

the narrowest member a single free ended limb arranged in a circumferential line with the outer limb of the widest member and with the outer limbs of intervening members.

5. A laminated electro-magnet having a circuit comprising a plurality of groups of laminæ arranged around the axis of the magnet, the several members of a group being of different radial lengths progressing successively from the widest to the narrowest, the widest member having axially parallel free ended limbs and the narrowest member a single free ended limb arranged in a circumferential line with the outer limb of the widest member and with the outer limbs of intervening members.

6. A laminated electro-magnet having a circuit comprising a plurality of groups of laminæ arranged around the axis of the magnet, the several members of a group being of different radial lengths, the widest member having axially parallel free ended limbs the innermost of which is provided with means enabling it to be supported by a central carrier.

7. A laminated electro-magnet having a circuit comprising a plurality of groups of laminæ arranged around the axis of the magnet, the several members of each group of which are of different radial lengths, and a central tubular carrier having means for supporting the widest member of each group.

8. An electro-magnet having a core which is built up of a plurality of radially arranged plates having axially parallel free ended limbs, and a central carrier whereon said plates are supported independently of the energizing winding.

9. An electro-magnet comprising a core built up of groups of stampings of various widths and a central carrier around the axis of which said groups of stampings are arranged, the widest of the members of each group of stampings having axially parallel free ended limbs the innermost of which limbs are supported by said central carrier and the outermost limbs being clamped together in conjunction with the innermost limbs of the narrower members so that the magnetizing winding can be inserted and removed without affecting the core.

10. An electro-magnet having a core which is built up of substantially radially arranged groups of stampings of various widths, and a central carrier, the widest of the members of each group of stampings having axially parallel free ended limbs the innermost of which limbs are supported by said central carrier and the outermost limbs being clamped together in conjunction with the outermost limbs of the narrower members so that the magnetizing winding can be inserted and removed without affecting the core.

11. An electro-magnet having a core

which is built up of a plurality of stampings of different width having axially parallel free ended limbs and a plurality of stampings of different width having single free ended limbs, the latter limbs being arranged in a circumferential line with the outermost limbs of the first named stampings to form inner and outer portions which are concentric with one another, and means for supporting such stampings so that the magnetizing winding can be inserted in and removed from the intervening space without affecting the core.

12. An electro-magnet having a movable disk shaped armature built up of plates of magnetic material of sector shape as seen in a plan or cross section of the armature.

13. An electro-magnet of the pot type having a movable disk shaped armature built up of groups of stampings of various widths arranged substantially radially and forming inner and outer portions that are concentric with one another and with a central cylindrical passage.

14. An electro-magnet of the pot type having a movable disk shaped armature built up of groups of stampings of various widths arranged substantially radially and forming inner and outer connected portions that are concentric with one another.

15. In an electro-magnet of the pot type, a magnetic circuit comprising a plurality of groups of iron stampings of various widths, those of full width being formed with axially parallel free ended limbs both notched to respectively fit a central supporting device and receive a clamping wire, and the remainder or narrower stampings being notched at the outer edges alone to receive the clamping wire.

16. An electro-magnet core comprising, in combination, a plurality of radially arranged plates, a central support therefor, an annular recess in the several plates, which are axially open ended, an exciting winding in said recess, means for clamping the plates together exteriorly independently of the wind-

ing, and a divided adjustable holder embracing the complete core.

17. A laminated electro-magnet circuit, comprising, in combination, groups of iron stampings of different widths having axially parallel free ended limbs, notches in the inner limbs of such stampings as are of full width, a central support having collars fitting in said notches, and means for securing the outer edges of all the stampings.

18. A laminated electro-magnet core, comprising, in combination, groups of iron stampings of different widths having axially parallel free ended limbs, notches in the inner limbs of such stampings as are of full width, a central support having collars fitting in the said notches, notches in the outer edges of all the stampings, clamping means for insertion in the latter notches, and a divided adjustable tubular holder embracing the core.

19. An armature for an electro-magnet of the pot type comprising, in combination, a plurality of substantially radially arranged plates and a disk holder for said plates.

20. An electro-magnet armature, comprising, in combination, groups of iron stampings of different widths arranged substantially radially with respect to one another, such stampings as are of full width having notches in their inner edges and all the stampings having undercut projections near their outer ends, a disk holder having a central boss and annular collar fitting in notches in said stampings, an annular recess in its face shaped to correspond with and receive said projections, and a passage by which the said projections can be engaged with the annular recess, and a locking ring for securing the several stampings in place.

Signed at London England this eleventh day of January 1907.

ARTHUR FRANCIS BERRY.

Witnesses:

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