No. 843,489. PATENTED FEB. 5, 1907.

C. A. PARSONS & G. G. STONEY.

PARALLEL RUNNING OF DYNAMO MACHINES.

APPLICATION FILED JULY 25, 1905.

4 SHEETS—SHEET 1.

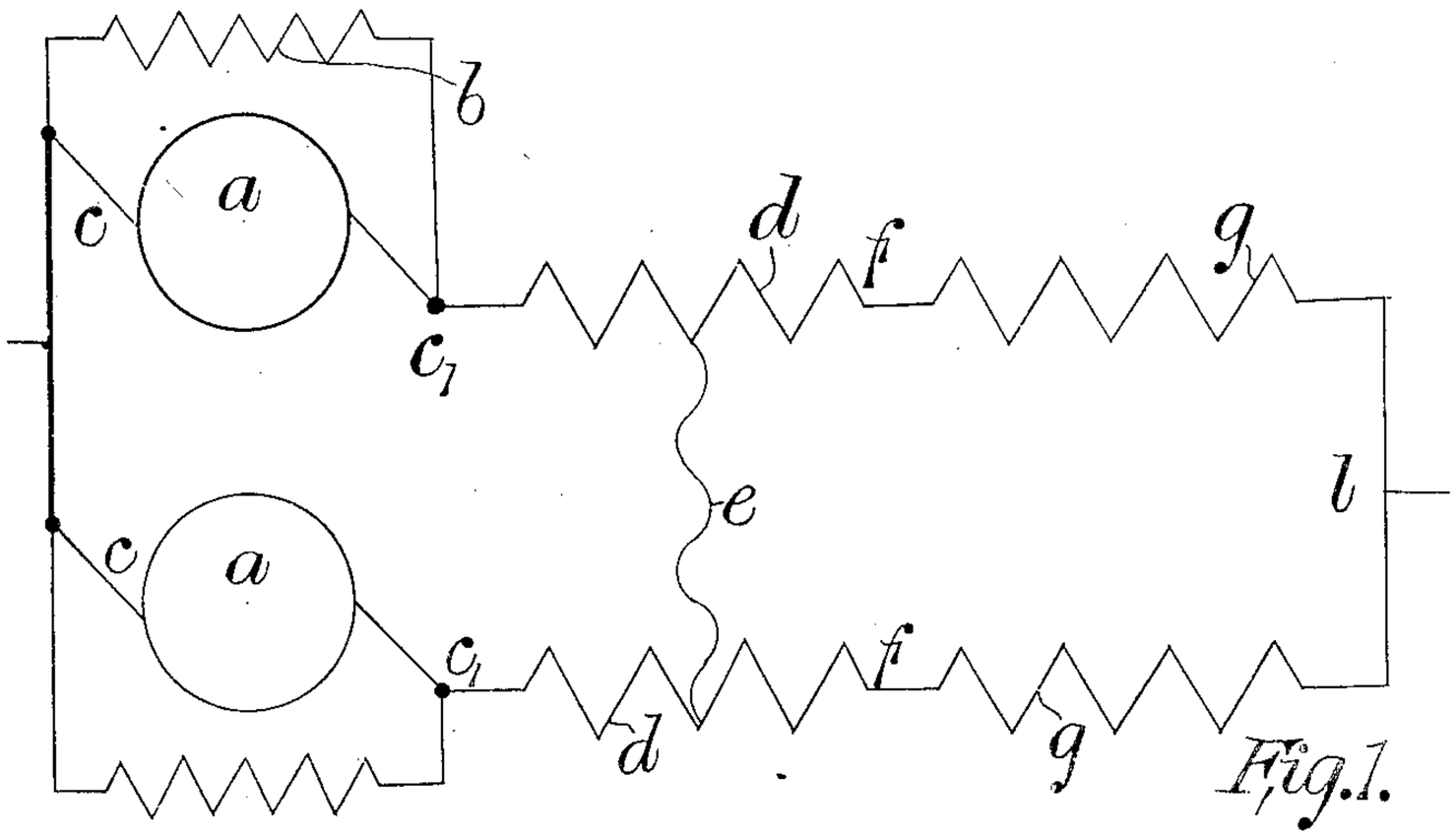

Fig. 1.

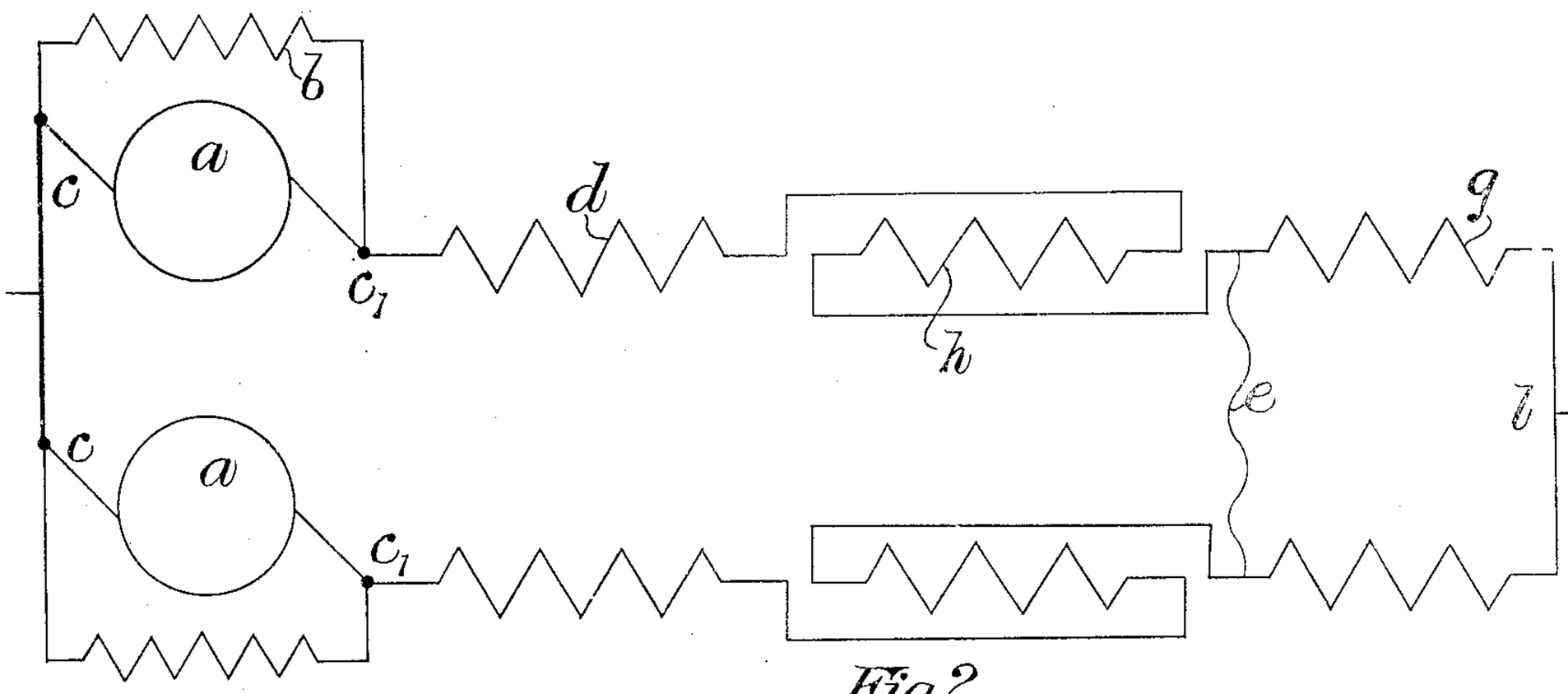

Fig. 2.

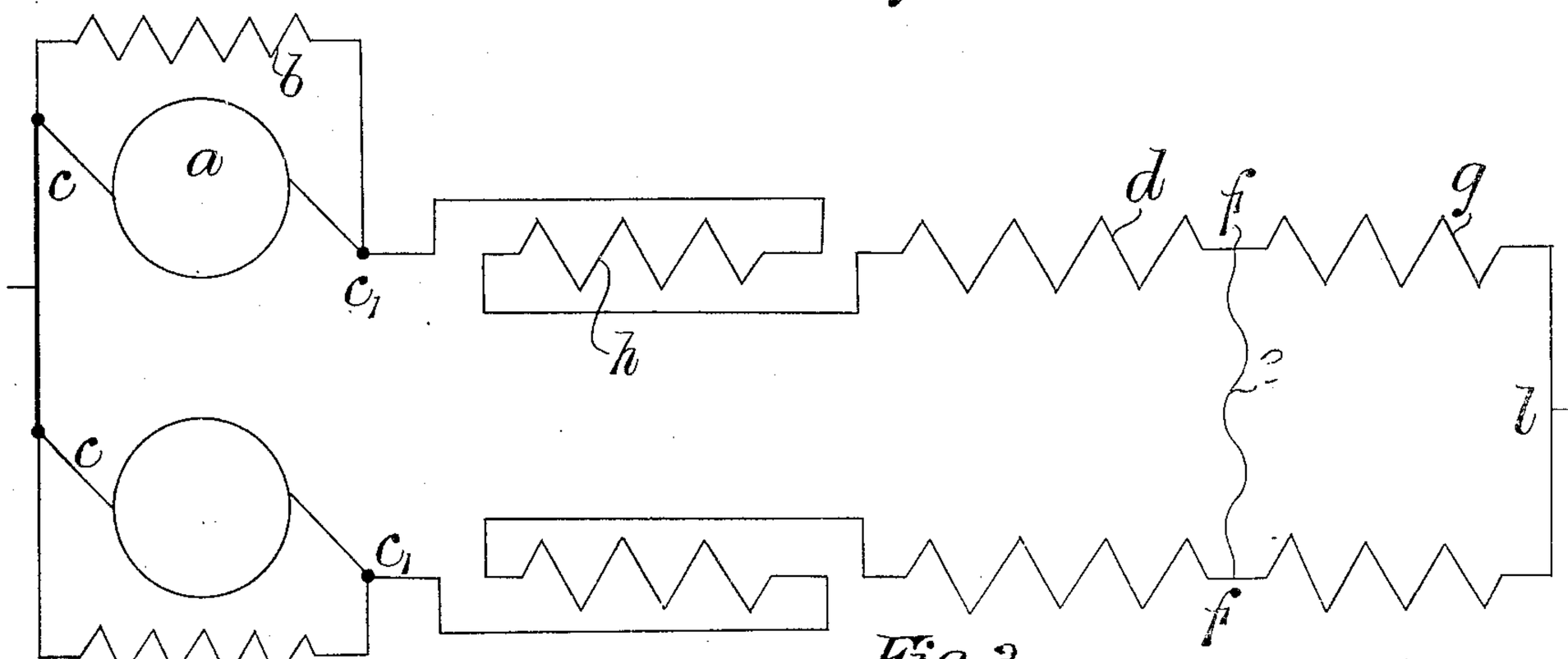

Fig. 3.

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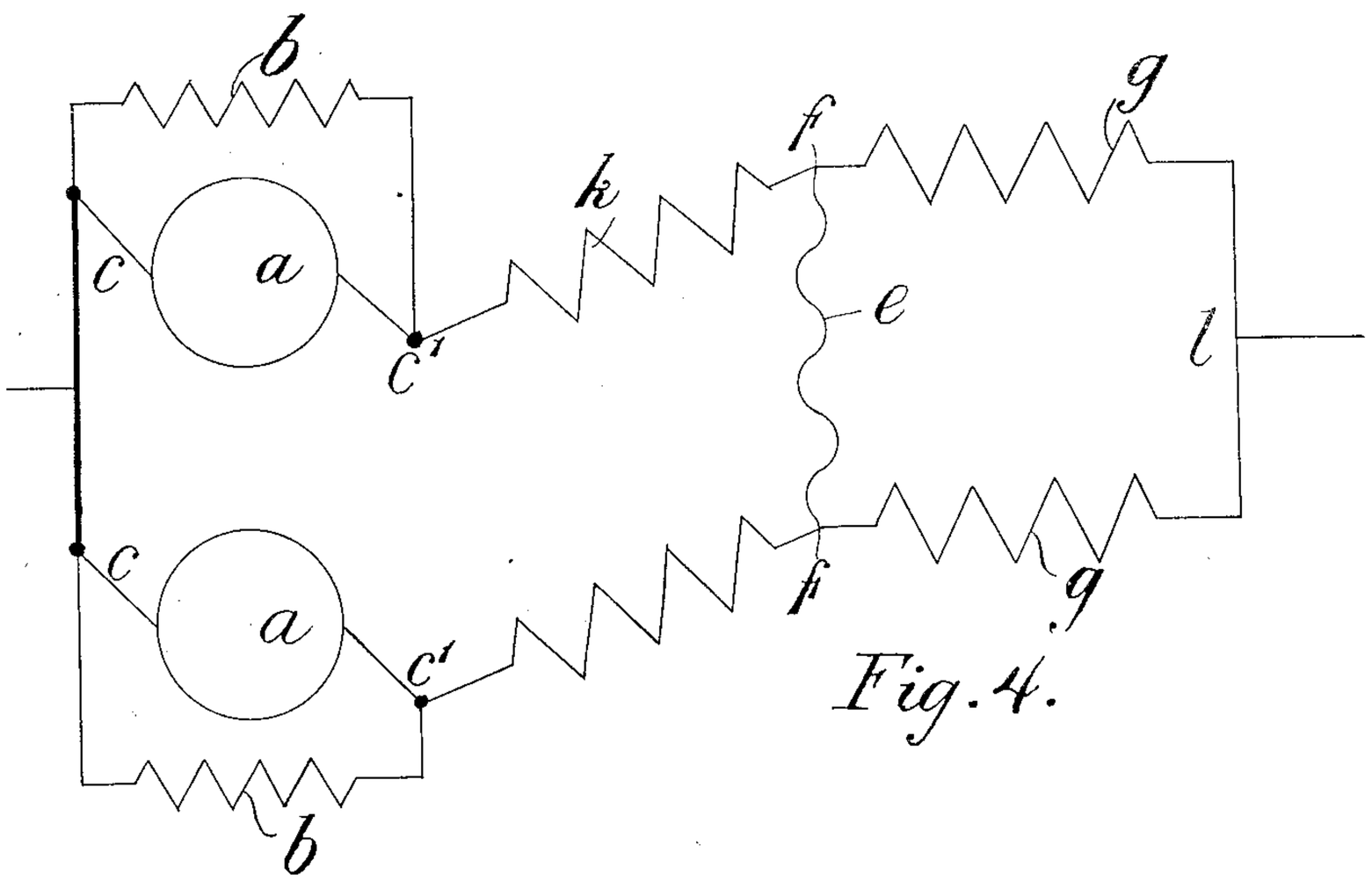

Fig. 4.

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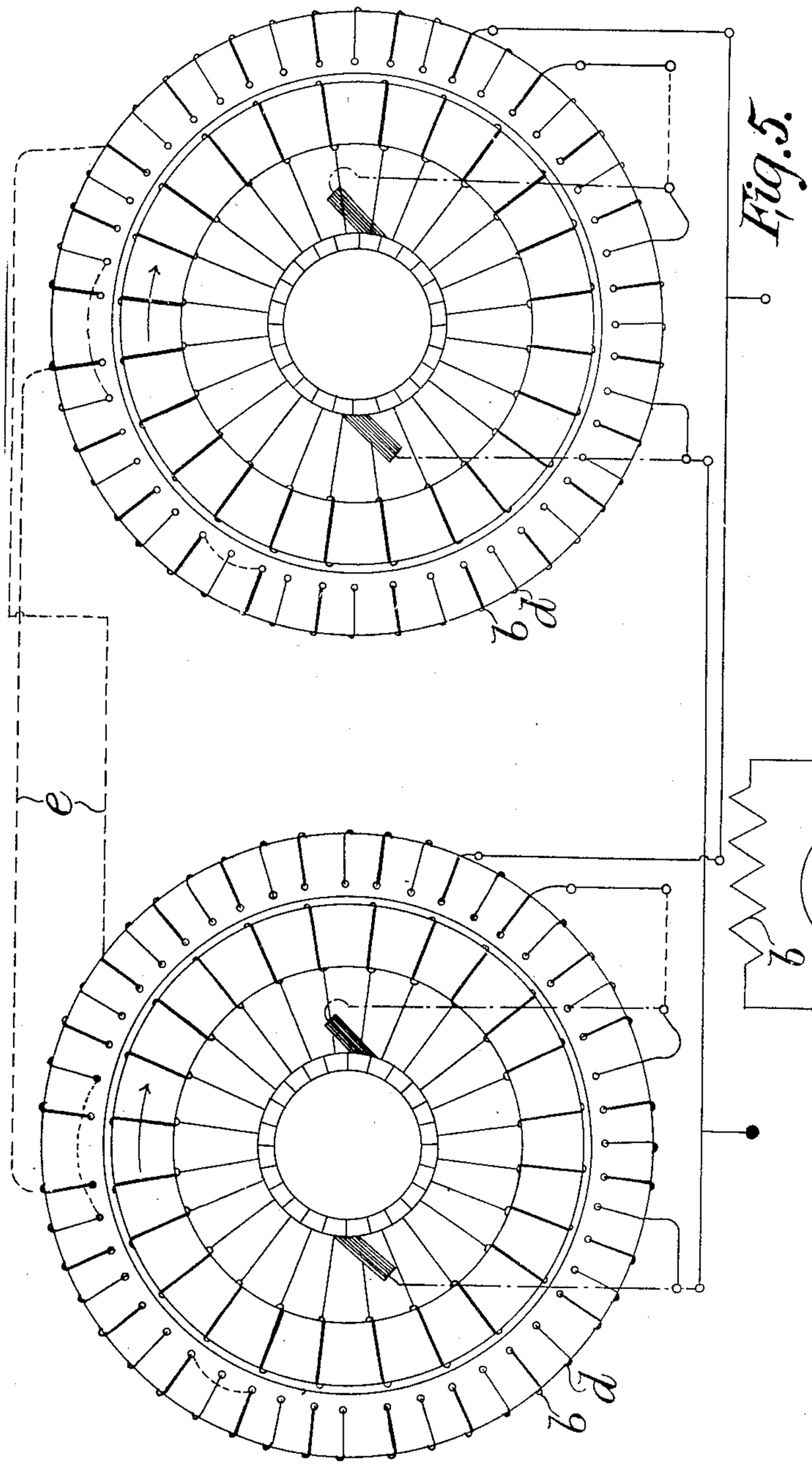

Fig. 5.

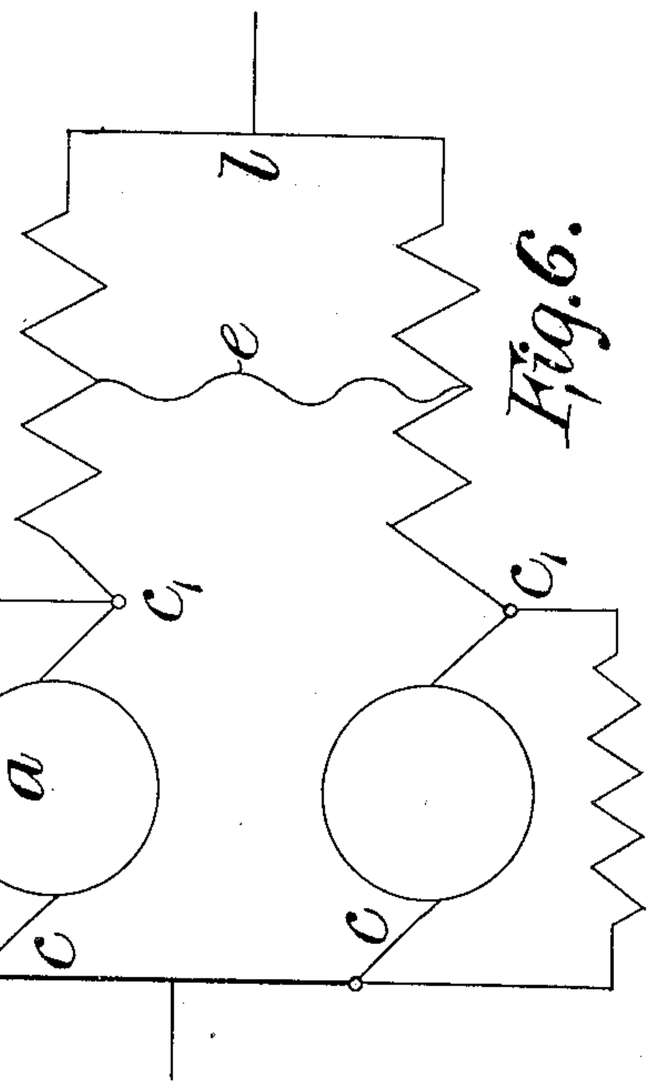

Fig. 6.

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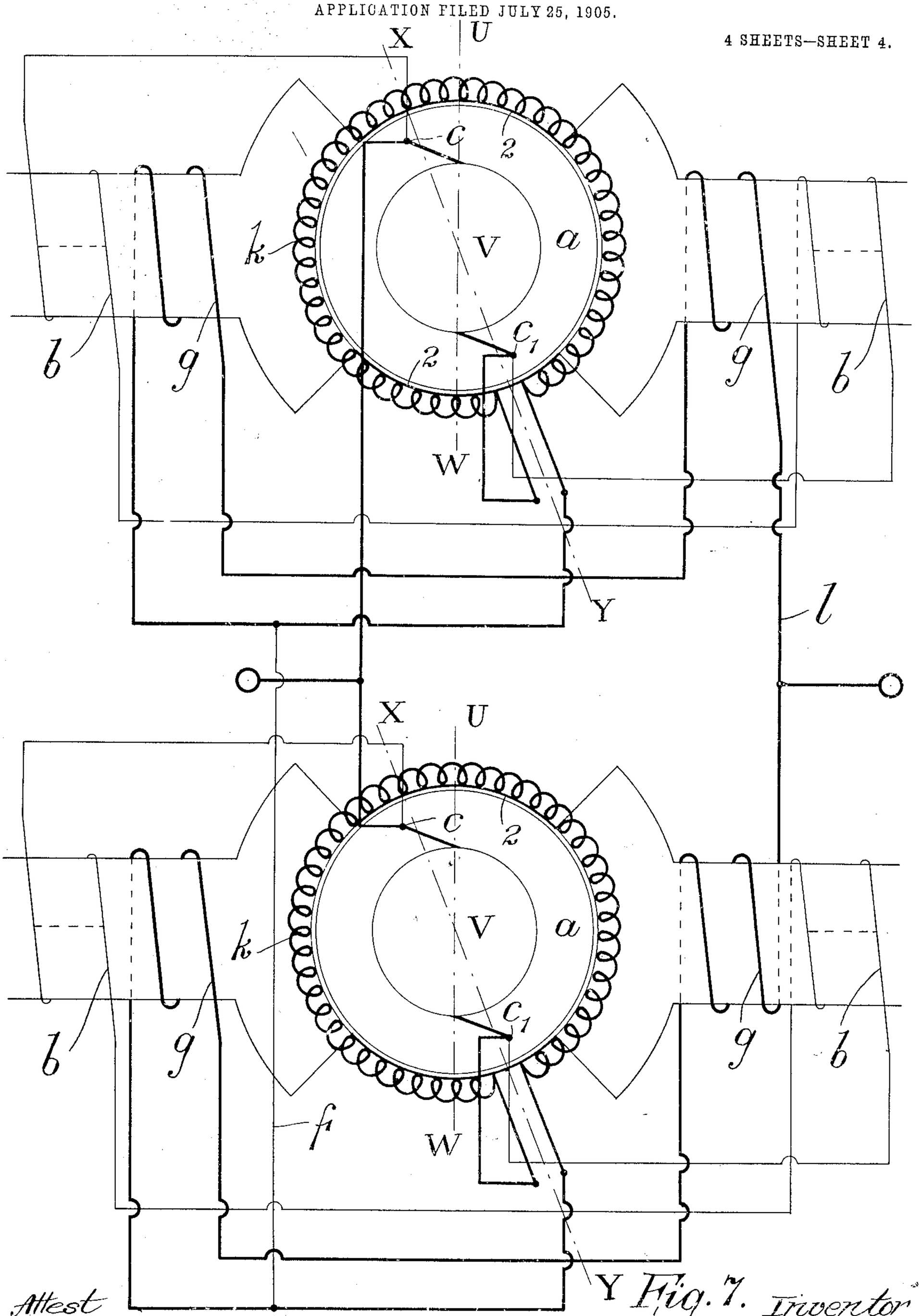

Fig. 7.

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UNITED STATES PATENT OFFICE.

CHARLES ALGERNON PARSONS AND GEORGE GERALD STONEY, OF NEWCASTLE-UPON-TYNE, ENGLAND; SAID STONEY ASSIGNOR TO SAID PARSONS.

PARALLEL RUNNING OF DYNAMO-MACHINES.

No. 843,489. Specification of Letters Patent. Patented Feb. 5, 1907.

Application filed July 25, 1905. Serial No. 271,248.

To all whom it may concern:

Be it known that we, CHARLES ALGERNON PARSONS and GEORGE GERALD STONEY, subjects of the King of Great Britain and Ireland, and residing at Heaton Works, Newcastle-upon-Tyne, in the county of Northumberland, England, have invented certain new and useful Improvements Relating to the Parallel Running of Dynamo-Machines, of which the following is a specification.

Our invention relates to the parallel running of continuous-current dynamo-machines which are compensated for armature reaction. In such machines we have found in certain instances difficulty in running in parallel with other dynamos when the limbs of the magnets have had compounding coils fitted. It is also possible that such difficulty might arise in the case of plain shunt-wound machines fitted with our compensating coils. We are aware that equalizing-wires have been used in the case of the compound windings on dynamos to obtain stability of load when two or more machines are run in parallel; but we have found that such an arrangement is not sufficient in some cases to obtain stability when using our compensating winding.

The object of this invention is to enable dynamos which are compensated for armature reaction to run in parallel, automatically dividing the load between them.

The invention consists in cross-connecting part of the compensating coils as well as part or the whole of the compounding coils by an equalizing wire or wires, so as to obtain stability of running under all conditions.

Referring to the accompanying diagrammatic drawings, Figure 1 shows one method of applying our invention. Fig. 2 shows another modification. Fig. 3 shows a variation of the arrangement shown in Fig. 2. Fig. 4 illustrates a modification in which a combined compensating and reverse compounding coil is used. Fig. 5 shows the application of the invention to machines having a "Deri" series compensating winding, while Fig. 6 shows our invention applied to machines having a series compensating coil which at the same time gives compounding or overcompounding. Fig. 7 diagrammatically illustrates the connections of the compensating coil according to one form.

In the arrangements illustrated two dynamos are arranged in parallel, *a a* being the armatures and *b b* the shunt field-coils. In the modification shown in Fig. 1 we cross-connect by an equalizing-wire *e* at points intermediate between the brushes *c' c'* of the dynamos and the points *f f*, where the compensating windings *d d* are connected to the compounding coils *g g*. The compensating windings consist of current-carrying conductors connected in series with the armature, fixed around, but not attached to, the armature periphery—for example, by embedding them in the polar faces and carrying them between the poles on suitable non-magnetic segments. This is diagrammatically represented in Fig. 7, wherein the coil 1, shown thus for clearness arranged around the armature-space and partly carried by non-magnetic segments 2, is connected in series with the ordinary compound winding 3. The polar plane of the compensating winding preferably coincides with the plane of commutation at no load, yet in some cases it is preferred to place it at an angle thereto by suitably disposing the winding in order to secure in some classes of machine a minimum of sparking at all intermediate loads to full or over load. For example, in Fig. 7, which may for this case be considered as an explanation of Fig. 4, the plane of commutation at no load is represented by the line UVW and the plane of the compensating winding by XVY, the angle between them being UVX. It will be seen that the effect of this method of connection is that with varying load part of the compensating coils have a constant excitation equal to the mean output of the machines coupled in parallel—that is to say, suppose, for example, a heavier current were flowing in the lower coil *d* between c_1 and *e* than in the upper coil *d* between c_1 and *e* then current would flow through *e* in an upward direction, according to the diagram, the effect being that the current in the parts of both the lower and upper coils between *e* and *f* would be equal and of a value equal to the mean output of the machines, as stated. Thus the equalizing wire or wires are so placed that the whole of the compounding coils and parts—namely, *e f*—of the compensating coils pass the mean current, while the other parts—namely, c_1 *e*—of the compensating coils pass the current delivered by the individual machine.

In the arrangement shown in Fig. 2 we fit

reverse turns of compounding coils *h h* between the compensating coils *d d* and the forward compounding coils *g g* and connect the equalizing-wire *e* at or near the point where the reverse turns of the compounding *h h* are joined to the ordinary compounding coils. The action and use of the reverse windings is explained clearly with reference to Fig. 2. It is well known that for two compound-wound machines to run in parallel they must be designed to give a drooping characteristic as the load increases, or else should one take more than its share of load or tend to drive the other as a motor the ordinary compounding turns would continually increase the effect until the machine was cut or burned out. Reverse compounding turns *h* are therefore connected, as shown, between the wire *e* and the machines in order to obtain, as is quite obvious will be obtained, a drooping characteristic, for the reason explained above. In order, however, that the excitation of the machine as a whole shall rise with the load, as with an ordinary compound-wound machine, forward compounding turns *g* are inserted at a point beyond the equalizing connection, whereby they do not tend to destroy the satisfactory parallel running of the machines, but yet give the rising characteristic for the machine as a whole. It is thus seen that the number of forward compounding turns may be either equal or unequal to the number of reverse, as required.

In Fig. 3 reverse turns of compounding *h h* are placed between the compensating coils *d d*, and the brushes *c' c'* and the equalizing-wire *e* are attached at the points *f f*, where the compensating coils *d d* join the forward compounding coils *g g*.

In the modification illustrated in Fig. 4 we combine the compensating coil and the reverse compounding coil in each machine in one equivalent coil *k*, which is similar to the ordinary compensating coil, but the polar axis of which is inclined to the ordinary position of such axis, as stated above, in a reverse direction to the direction of rotation, as stated above, and we attach the equalizing-wire at the points *f f*, as shown in the figure.

We may also apply our invention, as above described, to any other arrangements for compensating armature reaction, such as the Deri, in which a winding in series with the armature is used with or without commutating-poles, and parallel running of such machines will be thereby improved. Fig. 5 shows such an arrangement as applied to a machine provided with a distributed shunt-winding *b* and a series winding *d*, the positions for the equalizing wire or wires being shown at *e*, and similarly in such machines by dividing up the series winding into two or more parts the arrangements shown in Figs. 1 to 4 may be applied.

In many machines in which a series compensating coil is used said coil has been so fitted as at the same time to give compounding or overcompounding, as desired. We have found that by placing an equalizing wire or wires *e* at an intermediate point between the main terminal of the series winding *d* and the brushes *c*, as shown in Fig. 6, parallel running is improved. We have also found that parallel running is improved by dividing said winding into two parts, one of which compensates for armature reaction only, while the other gives the desired compounding. Alternatively reverse compounding turns may be fitted, or the compensating winding may be so placed as to increase the drop of voltage between full and no load, the equalizing wire or wires in all these cases being arranged in a similar way to that above described.

We do not wish to be understood as limiting our invention to the particular forms herein shown and described, as we have merely illustrated and described convenient forms of the invention, which may be varied widely with the range of electrical skill without departing from the spirit of the invention. For example, instead in one form of an equalizing-wire connecting the junction of forward and reverse compounding turns it may connect points in the compensating windings, or instead of an equalizing-wire connecting the junctions of compensating and compounding turns it may connect points in the compensating windings.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In combination, a plurality of continuous-current dynamo-machines having series coils compensating for armature reaction; and an equalizing-wire cross-connecting certain points within the compensating windings of the two machines, as and for the purpose described.

2. In combination; a plurality of continuous-current dynamo-machines having series coils compensating for armature reaction; compounding coils on said dynamo-machines; and an equalizing-wire cross-connecting certain points within the compensating windings of the two machines as well as the compounding coils; as and for the purpose described.

3. In combination; a plurality of continuous-current dynamo-machines having series coils compensating for armature reaction and compounding the machine, said coils being divided into two parts one of which compensates for armature reaction, while the other gives the compounding, and an equalizing-wire cross-connecting certain points within the compensating windings of the two machines, as and for the purpose described.

4. In combination, a plurality of continu-

ous-current dynamo-machines having series coils compensating for armature reaction and compounding the machine said coils being divided into two parts, one of which compensates for armature reaction, while the other gives the compounding, reverse compounding turns; and an equalizing-wire cross-connecting certain points within the compensating windings of the two machines, as and for the purpose described.

5. In combination; a plurality of continuous-current dynamo-machines having series coils compensating for armature reaction and compounding the machine, said coils being divided into two parts, one of which compensates for armature reaction, while the other gives the compounding, reverse compounding turns incorporated with said compensating coils, and an equalizing-wire cross-connecting certain points within the compensating windings of the two machines, as and for the purpose described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

CHARLES ALGERNON PARSONS.
GEORGE GERALD STONEY.

Witnesses:
HENRY GRAHAM DAKYNS, Jr.,
FREDERICK GORDON HAY BEDFORD.