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No. 779,054.

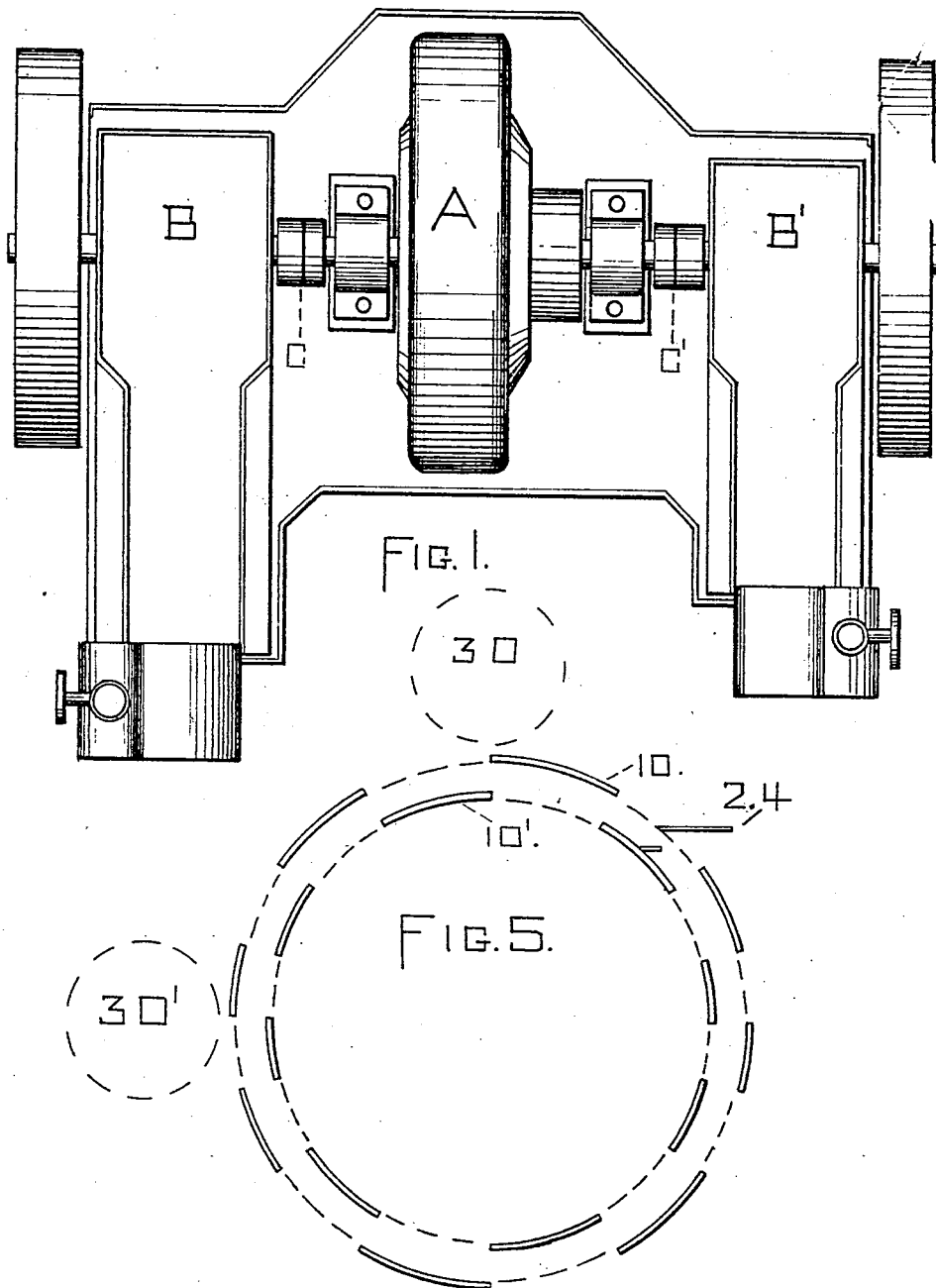
PATENTED JAN. 3, 1905.

S. SHAW.

ELECTRIC GENERATING UNIT.

APPLICATION FILED AUG. 29, 1899.

3 SHEETS—SHEET 1.



WITNESSES
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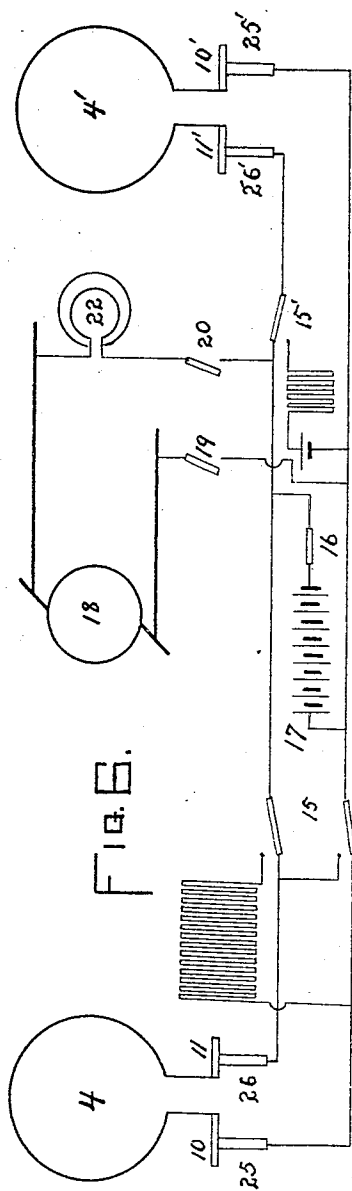


FIG. 1.

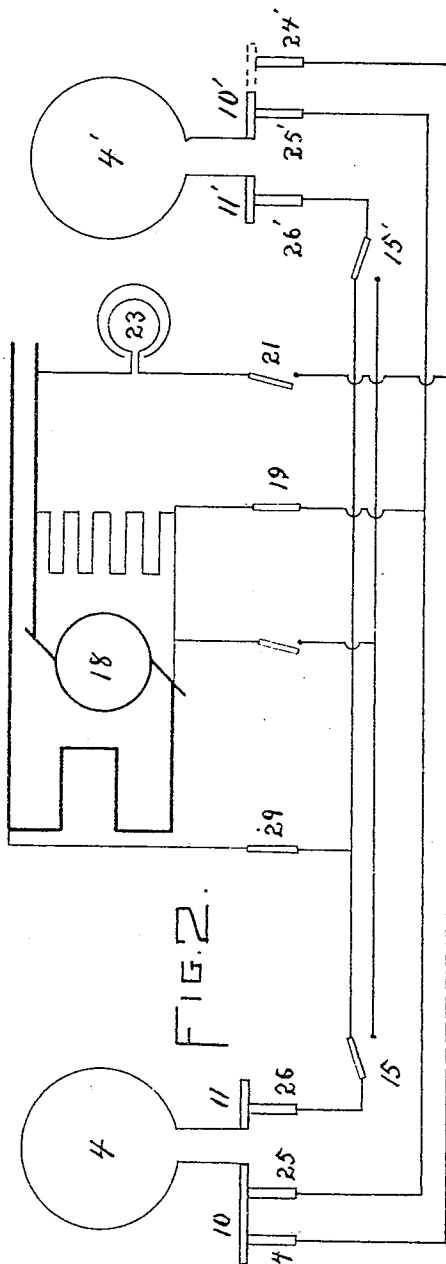


FIG. 2.

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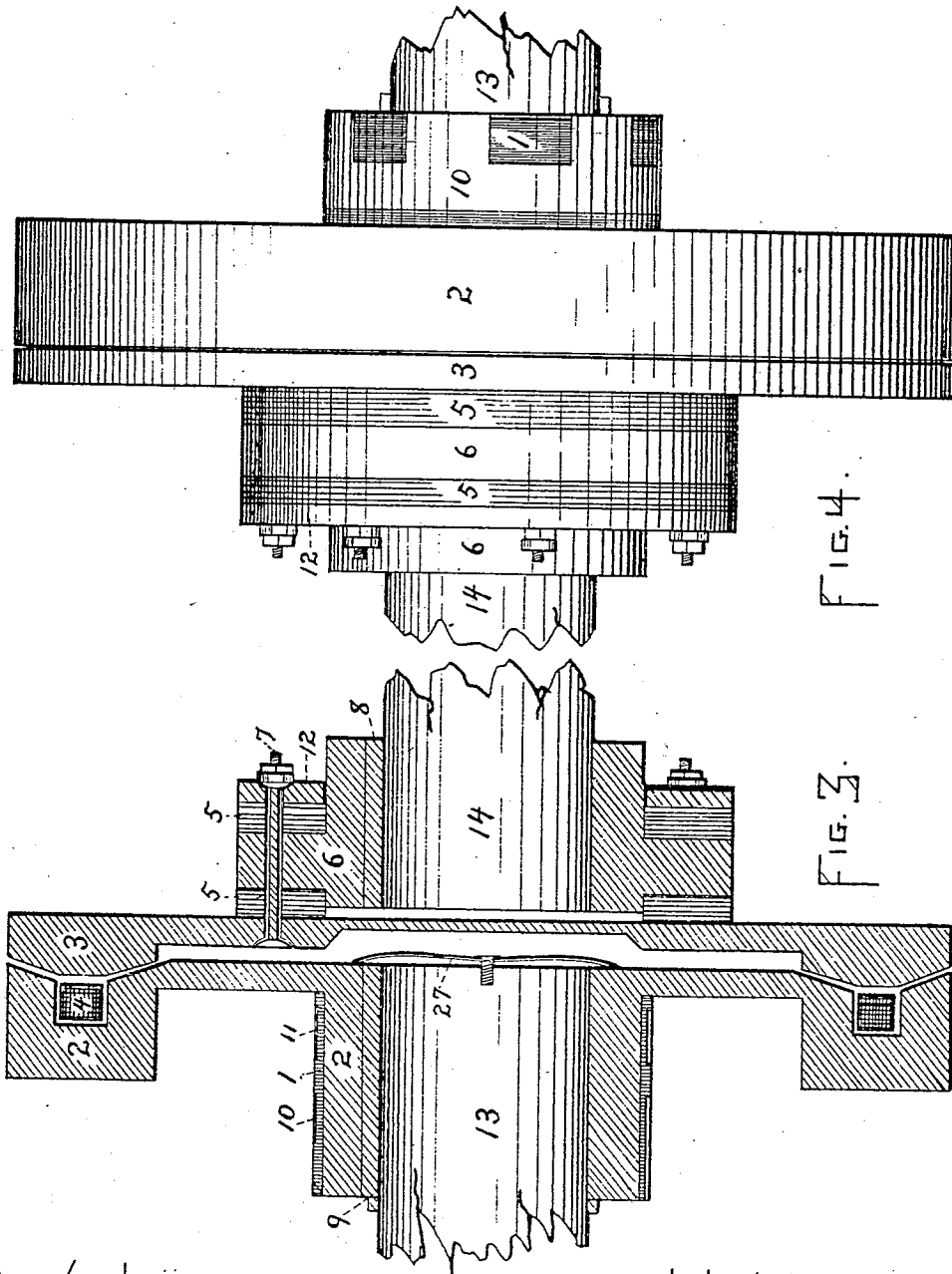
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3 SHEETS—SHEET 3.



WITNESSES

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UNITED STATES PATENT OFFICE.

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ELECTRIC GENERATING UNIT.

SPECIFICATION forming part of Letters Patent No. 779,054, dated January 3, 1905.

Application filed August 29, 1899. Serial No. 728,921.

To all whom it may concern:

Be it known that I, STERLING SHAW, a citizen of the United States, residing at Jacksonville, in the county of Morgan and State of Illinois, have invented a new and useful Electric Generating Unit or Means of Converting the Power of Steam or other Elastic Fluid into Electrical Power, of which the following is a specification.

My invention is useful in generating plants where the load varies greatly during the different hours of the day and seasons of the year. It is not intended for places where the load is always the same, or nearly so, nor for places where it varies suddenly and unexpectedly or from minute to minute, as in small traction systems. In many plants the load varies regularly over a wide range, and in such the use of my invention is an improvement over the existing practice in that it reduces the plant investment, the floor and switchboard space required, and the operating expense.

Figure 1 of the drawings shows the generating unit. A is a dynamo. B and B' are driving-engines; C and C', coupling devices. The remaining figures show special coupling and indicating devices designed and invented for use with this unit.

Fig. 3 is a longitudinal section, and Fig. 4 a view, of the couplings. Two of these may be used in the same position with respect to the engines and dynamo as the couplings C and C' in Fig. 1.

Figs. 2 and 6 are circuit diagrams of the electrical connections.

Fig. 5 is a cross-section of the slip-rings connected with the indicating mechanism. Though on separate couplings the two are here drawn together, one within the other, to better show the operation of the device.

In Fig. 1 the mechanism of the dynamo and of the engine is not shown because well known and not peculiar to this invention; but we should have it in mind to understand the purpose and utility of the machine.

With a given steam-pressure a steam-engine of definite size and speed will operate most economically at a certain load. If it is used with either a heavier or lighter load, the

steam consumption is greater in proportion to the work it does. The causes of this fact are well known and I will not enter into them here, it being enough to say that in commercial practice engines may be operated over a range extending from twenty or twenty-five per cent. above to twenty or twenty-five per cent. below their most economical load, while outside of this range the ratio of steam used to the work done by the engine is so great as to prohibit its use. Dynamos, especially those of the best construction in which the constant losses are small, have a very different character in this respect from steam or other driving-engines and may be economically used over a much wider range of load.

It has become a common practice to build and use direct-connected generating units. They consist of an engine and a dynamo (or for three-wire systems an engine and two dynamos) built together, with their revolving parts turning together at the same speed. They have the same limited range of economical performance as the engine. In plants where the load variation is greater two units of different size or sometimes several small ones are used.

The operation and utility of my invention will now be apparent. At the lightest load the smaller engine is used for driving the dynamo. When the load increases, the larger one is started, run up to the proper speed, and coupled, after which the smaller one may be disconnected and shut down. At the heaviest load both engines are used. In this way the engines are always running economically, and the dynamo is used throughout the range in which it is economical.

The essential feature and purpose of the invention being now clear, I will describe in detail the special indicating device and electromagnetic coupling, some features of which I think are new.

The coil of insulated wire 4 is embedded in a circular recess in the magnetic material 2, making of it an electromagnet, of which 3 is the armature. The ends of the coil are connected to the insulated slip-rings 10 and 11, and brushes resting on these supply energizing-current from any suitable source. The

magnet 2 is attached to the engine-shaft 13 by the feather-key 9, so that it cannot turn with respect to the shaft, but can slide along it. The springs 27 hold it in the position shown until the magnet is energized, when it moves to grasp the armature 3. The armature may be rigidly keyed to the dynamo-shaft 14; but it is in the drawings shown connected by the bolts 7 through elastic materials 5 to the support 6, which is made fast to the shaft 14 by the key 8, so that it can neither turn on nor move along the shaft. If the shafts were perfectly aligned and remain so and were brought to exactly the same velocity before energizing the coupling, there would be no necessity for this elastic connection; but in practice, even if perfectly aligned at first, the shafts will often in time, either from unequal wearing of bearings or settling of the foundations, depart slightly from perfect alignment in either one or both of two ways. If the dynamo-bearings wear equally, but at a different rate or in a different direction from those of the engine, its axis while continuing parallel with that of the engine-shaft will not coincide with it. If the two bearings of the same shaft wear unequally, the plane of its rotation will no longer be parallel with that of the other shaft even though their axes may coincide at the point of coupling. The armature connection shown provides against either of these difficulties. It will be noticed that the bolt-heads have a spherical seat and the bolts are not closely fitted where they pass through the armature and are surrounded by the elastic material where they pass through the support 6. This construction permits the armature 3, while fixed to the magnet 2, revolving about an axis slightly out of coincidence with that of the shaft 14 or in a plane slightly out of parallel with that of the support 6 and shaft 14. It also permits the armature revolving a small fraction of a turn with respect to shaft 14, and so avoiding the shock which would otherwise occur if the magnet was energized when the two shafts were not at the same velocity. I mention these three results because the structure can be slightly varied so as not to accomplish all of them.

The slip-ring 10 by being made wider than 11 and segmented over a part of its surface is made to serve as a part of the indicating device. When in operation, this part of the slip-ring 10 has a separate brush resting on it, 24, and it will be noticed that the corresponding brushes 24 and 24' on the two couplings in the same unit are connected in parallel with each other and in series with the lamp 23 or other electrical signal, switch 21, and dynamo or other source of electrical energy 18, from which the circuit is completed through brushes 25 and 25'. The relative position of the segments of the two rings when the crank-pins of the two engines are at right angles is such that they mutually supplement each other

and keep the signal-circuit constantly closed, while in any other position they overlap in some places and leave it open, in others producing a flashing in the lamp. This is best shown in Fig. 5, where is drawn a cross-section of the slip-rings 10 and 10' through their segmental portion. They are here drawn together and one within the other to show their angular position about the axis of the shaft with respect to the position of the crank-pin, though their real position is several feet apart. The angular position of the crank-pins is shown in broken line at 30 and 30'.

It will be noticed that the indicating device is so constructed as to serve two purposes. It shows when the cranks are at right angles and also shows when the shafts are turning at the same speed. The object of coupling with cranks at right angles is to equalize the turning moment; but in many cases the momentum of the fly-wheels and rotating part of dynamo is sufficient to make this unnecessary, in which case the segments may be of the same size, and they may be so in any case if there are only two on each ring. It is evident that the number of segments may be different from the number shown in the drawings.

The coupling may be excited in a number of ways, several of which are shown in the circuit-diagrams, Figs. 2 and 6, where 17 may represent either a primary or a storage battery. As a very small quantity of energy will be required by the couplings, it will be convenient to wind them to a low resistance, and if it is desired to excite them or to charge the storage batteries from high-potential mains it may be done through a lamp 22 or other resistance. If the dynamo of the unit is a compound-wound machine, it may be convenient to excite with current taken from the two terminals of the series winding, in which case the tractive force of the coupling will vary with the load upon the dynamo. This can be done with the circuits shown in Fig. 2 by closing switches 19 and 29. When current ceases to flow through the energizing-coil, the magnetic circuit not being broken, there is sufficient residual magnetism to keep the coupling effective while there is no load on the dynamo. For disconnecting the couplings electrical connections are provided, so that when the magnetizing-current is cut off a very small current of opposite polarity passes through the exciting-coil, completely demagnetizing the coupling and permitting the springs to separate the parts. The most convenient way is to secure the diminutive current required is to connect the energizing-coil as a shunt to a very low resistance in the shunt field magnetizing-circuit of the dynamo, as shown in Fig. 2, though it could be accomplished by connecting the energizing-coil in series with a very high resistance and the regular energizing-battery, as shown at the left of Fig. 6, or with a single cell and re-

stance, as shown at the right of Fig. 6, or the same result may be produced with a coil distinct from the energizing-coil.

While I have spoken of this generating unit as if it were used alone, it will in many cases be convenient to use it otherwise and particularly in conjunction with another unit of the same capacity, but of the usual type. With such an arrangement a very wide range of load can be economically taken care of and the two dynamos of the same type will run well together in parallel.

I have spoken of the engines of the unit as being of different sizes, but for some places they may be of the same size, in which case one of them could be permanently coupled with the dynamo either by building them with a common shaft or by using ordinary flange-coupling and bolts.

While I have here particularly described what I consider the best form of the embodiment of my invention and also certain accessory devices for its improvement, these devices are not necessary to the embodiment of the invention, nor are couplings which may be disengaged essential to its embodiment. The invention may be embodied in a combination of engines and dynamo in which all of the elements are built upon the same shaft, the exhaust-valve of one or both of the engines being arranged so that those at both ends of the cylinder may be opened and the throttle closed when it is desired to not use that engine for driving or any other provision being made for connecting the spaces on two sides of the piston, or by any arrangement for operatively disconnecting the piston from the crank.

Electric generating machinery assumes many forms to accommodate many conditions. In some cases it is desired to supply both alternating and direct current, the alternating current being transformed to a high potential for long-distance transmission. In such a case the dynamo may be built with both collecting-rings and commutator, the former supplying the alternating system and the latter the direct system, but both systems being supplied from the same armature-winding. It may, however, be built with distinct armature-windings, or separate machines may be constructed, one for supplying the direct current and one for the alternating current. In the latter case the two machines would simply take the place in the generating unit of the one machine shown in the drawings and described and their rotating parts could be built on the same shaft or direct-coupled, as might be convenient. For three wire-distributing systems a single dynamo may be used with storage battery or rotary equalizer, or two dynamos may be used, the latter being the more common practice. In this case the two dynamos take the place in the generating unit of the one shown and described. In such a system the two dynamos are in a sense one and must both be run to-

gether no matter how small the load may be. Electric generating machinery may take other forms, but these are sufficient to show that the dynamo element of the unit may vary widely.

Steam-engines have been spoken of in the description; but gas and other driving-engines having the same characteristics that they cannot be economically used over as wide a range of load as dynamos may be used in the same way.

The electric generating unit described in this specification is most useful in the medium sizes, as it is in such that the cost of the larger dynamo is much less and its efficiency much greater than that of the two smaller machines it replaces.

What I claim is—

1. An electric generating unit consisting of a dynamo or dynamos, two driving-engines and electromagnetic coupling or couplings constructed and arranged to direct connect and disconnect the engines and dynamo while the dynamo is running at speed; the elements being so combined, with rotating parts in line that either of the engines or both of them, as required by the varying load for economical driving, may be operatively direct-connected with the dynamo or dynamos, substantially as herein shown and described.

2. An electric generating unit consisting of a dynamo or dynamos, two driving-engines and electromagnetic coupling or couplings, an indicating device for showing the relative velocity or position of the rotating parts of the engine; the elements being so combined, with rotating parts in line, that either of the engines or both of them, as required by the varying load for economical driving, may be operatively direct-connected with the dynamo or dynamos.

3. In a friction-coupling the combination of the coupling-body 3, shaft-body 6, bolt 7, and elastic material 5, substantially as and for the purpose set forth.

4. An indicating device consisting of an electric signal, a source of electric energy, segmented slip-rings, brushes making contact with the same and electrical conductors substantially as shown and described, and so indicating the relative velocity of two rotating mechanisms.

5. An indicating device consisting of an electric signal, a source of electric energy, segmented slip-rings, brushes making contact with the same, and electrical conductors substantially as shown and described; and so indicating the relative velocity and relative angular position of two rotating mechanisms.

6. An electromagnetic coupling with an energizing-coil connected in parallel with a series field magnetizing-coil of a dynamo-electric machine, and so varying in tractive force with the load on the machine.

7. The combination with an electromagnetic friction-coupling of means for passing a small

electric current of opposite magnetizing effect to that of the energizing-current and sufficient to demagnetize the coupling.

8. In an electromagnetic friction-coupling means for connecting the energizing-coil in shunt with a low resistance in an electric-current-carrying conductor so as to pass through the coil an electric current sufficient and of proper polarity to demagnetize the coupling.

9. An electric generating unit consisting of a dynamo or dynamos and two driving-engines combined with means constructed and arranged to render either engine operative or inoperative while the dynamo is running at speed so that either of the engines or both of them, as required for economical operation with a varying load, may be utilized for driv-

ing, substantially as herein shown and described.

10. An electric generating unit consisting of a dynamo or dynamos and two driving-engines, assembled with rotating parts alined, and coupling devices constructed and arranged to direct connect and disconnect the engines and dynamo while the dynamo is running at speed so that either of the engines or both of them, as required by the varying load for economical driving, may be operatively direct-connected with the dynamo or dynamos, substantially as herein shown and described.

STERLING SHAW.

Witnesses:

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JAS. M. VAIL.