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PRIME MOVER AND METHOD OF ASSEMBLING AND DISMANTLING THE SAME

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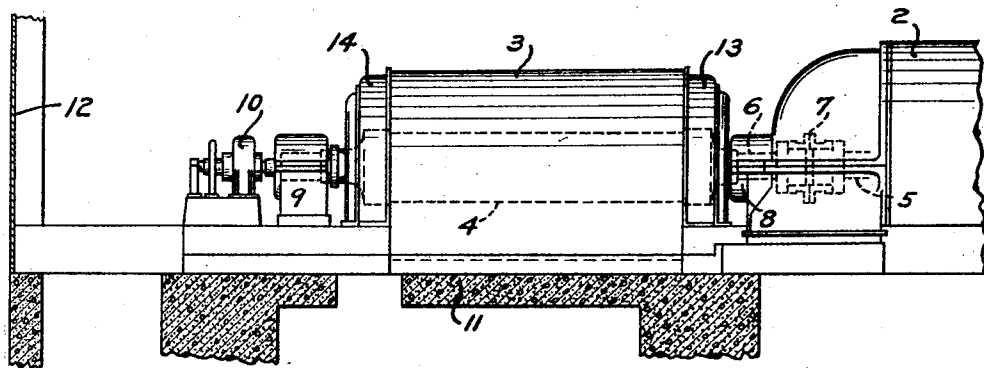


Fig. 1

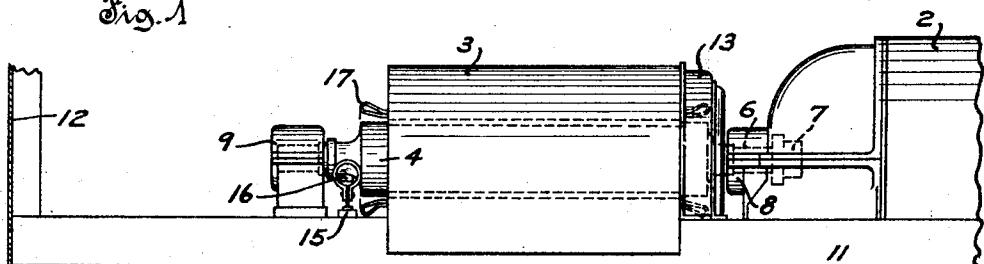


Fig. 2

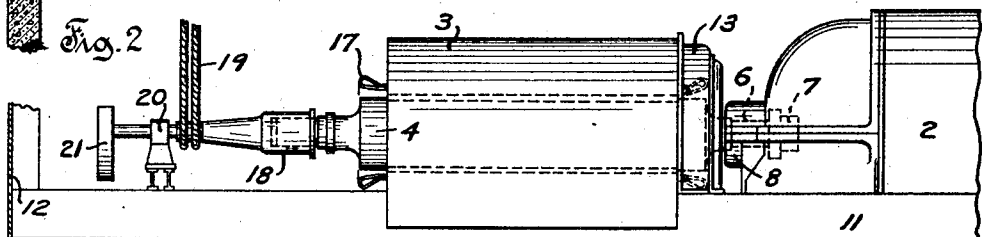


Fig. 3

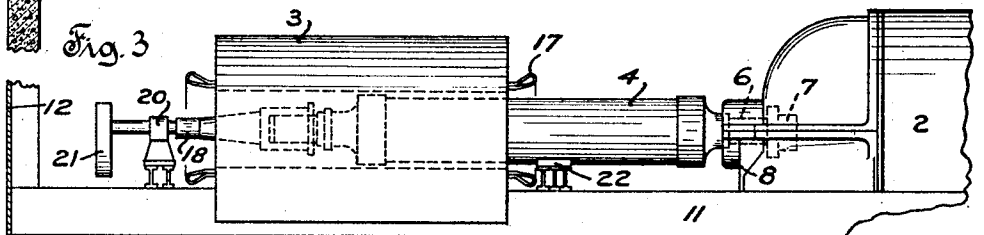


Fig. 4

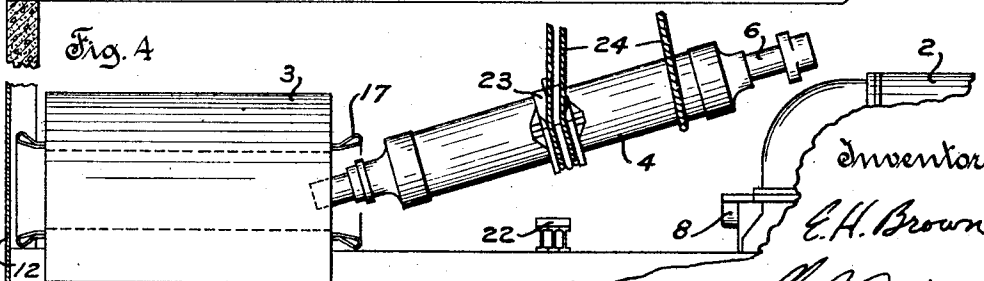


Fig. 5

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## UNITED STATES PATENT OFFICE

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## PRIME MOVER AND METHOD OF ASSEMBLING AND DISMANTLING THE SAME

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This invention relates in general to improvements in the construction, disposition and mounting of prime movers, and relates more specifically to an improved method of assembling and dismantling composite prime movers having rotors with enclosing stators, such as turbine generator units comprising turbine elements and electric generators connected together by couplings or gearing, in cases where but limited space is available and where the stator or enclosing casings are not conveniently made to be parted or opened in planes parallel to the axes of the enclosed rotating part.

It has been general practice, in the design and construction of power houses, to make the enclosure or room in which the prime movers are located, of sufficient dimensions to permit of the rotor of each electric generator being inserted in or withdrawn from the outboard end of its stator, which customarily is a solid cylindrical enclosing structure made to be opened only at its ends, without appreciably moving the stator from its permanent position.

The prime mover units, when of the horizontal shaft type, are set with relation to each other in two arrangements which are practically universal standards. These two arrangements will be termed in this description as transverse (or side by side) and as longitudinal (or end to end).

The transverse arrangement is used where the units are set side by side in a relatively wide prime mover room. With the transverse arrangement, the dimensions of the prime mover room proper are frequently defined as to width by piers or columns which support the overhead stories and walls of the building, the roof, and in most cases, the overhead load carrying trusses or movable lifting cranes. This construction of building is at times used to provide for the assembly and dismantling of the horizontal shaft, electrical generator, stator and rotor, by having the rotor project between the supporting piers or columns referred to and beyond the prime mover room proper during the assembly and dismantling operations.

The longitudinal arrangement is used

where the prime mover units are set end to end in a relatively narrow room. Space is then provided between the ends of the units to permit of assembly and dismantling by moving the generator rotor in or out of the outboard end of the fixed generator stator.

My invention, by a combination of constructional features and a method of assembly and dismantling, reduces to a minimum the prime mover room dimensions required for a given prime mover unit, whether the unit arrangement is of the transverse or longitudinal type, or whether the bounding walls are continuous or are provided with openings which may be used to facilitate assembly and dismantling operations.

An object of the invention is to provide improvements in the construction of prime movers, such as turbine generator units, wherein one or more of the elements of the prime mover may be fixedly positioned, while another element may be installed or removed within a relatively small or restricted space without disturbing the fixed element or elements.

Another object of the invention is to provide a power unit comprising direct connected rotary machine elements which may be conveniently installed in a power house having limited available floor space, and more especially, having restricted dimensions lengthwise of the unit.

A further object of the invention is to provide an improved method of assembling and dismantling rotary machine elements, such as turbo-generators, whereby relatively large and cumbersome parts may be conveniently installed or removed.

An additional object of the invention is to provide an improved construction of, and an improved method for assembling and dismantling the electric generator element of a turbine generator unit where the space available lengthwise of the unit is limited, and where the stator of the electric generator is made substantially as a solid cylindrical enclosing structure open only at its ends for insertion or withdrawal of its rotor.

Still another object of the invention is to provide improvement in the construction of

prime movers, and in the method of assembling and dismantling same, whereby the span required for movable cranes suitable for lifting heavy and cumbersome parts may be restricted.

These and other objects of the present improvement will be apparent from the following description.

A clear conception of an embodiment of the invention and of the method of assembling and of dismantling machines in accordance therewith, may be had by referring to the drawing accompanying and forming a part of this specification in which like reference characters designate the same parts in the various views.

Fig. 1 is a fragmentary side elevation of a turbine generator unit completely assembled and installed in a power house; and

Figs. 2, 3, 4 and 5 are similar views of the unit and power house disclosed in Fig. 1, showing various stages of dismantling of the generator without disturbing the position of the turbine.

As specifically illustrated in Fig. 1, the power plant comprises in general a power house having therein a foundation 11; and a turbine generator unit located within the power house. The turbine generator unit consists of a steam turbine 2 fixedly positioned upon the foundation; and an electric generator having windings 17 associated with a frame or stator 3 which is slidably supported upon the foundation 11, and also having a rotor 4 coupled directly to the shaft 5 of the steam turbine 2 by means of a detachable jaw coupling 7. The shaft 6 of the generator rotor is normally supported in front and rear bearings 8, 9 respectively, and the power house is provided with an end wall 12 spaced from the end of the stator 3 of the generator, a distance slightly greater than the length of the stator. The electric generator is further provided with end heads 13, 14 secured to the stator 3, and an exciter unit 10 cooperates with the end of the generator shaft 6 between the rear bearing 9 and the power house wall 12. With the unit thus completely assembled, the operation thereof will be apparent to those skilled in the art, and requires no further elaboration herein.

When it becomes desirable to dismantle the generator, it is not necessarily desirable to disturb the position of the steam turbine 2, and the mode of dismantling the generator will be clearly understood by reference to Figs. 2, 3, 4 and 5, with the aid of the following description. In order to dismantle the generator end of the unit, the exciter unit 10 and the rear end head 14 must first be removed and a temporary supporting rig 14 may then be applied to the end of the rotor 4 adjacent to the bearing 9, as shown in Fig. 2. The coupling 7 may also be disconnected at this time. After the temporary support-

ing rig 15 has been applied, the bearing 9 may be withdrawn and a socketed beam 18 having a counter balance weight 21 at the outer end thereof in order to balance the beam on the suspension rope, may be slipped over the end of the rotor shaft 6 and temporarily supported as shown in Fig. 3 by means of a bearing 20 and suspension ropes 19 which cooperate with an overhead crane. With the rotor thus supported, the temporary supporting rig 15 may be removed as shown in Fig. 3, whereupon the front end head 13 may be removed and the stator slid endwise of the rotor to the position shown in Fig. 4 with the aid of a crane. After the stator 3 and its winding 17 have been thus removed from the end of the turbine 2, a rotor support 22 may be inserted between the foundation 11 and the medial portion of the rotor 4, thereby permitting removal of the socketed beam 18, the bearing 20 and the ropes 19. Upon removal of these temporary end supports for the rotor 4, the stator 3 and its winding may be further removed from the turbine 2 to the position shown in Fig. 5, with the rear ends of the windings 17 closely adjacent to the power house wall 12. With the stator 3 thus shifted to its limiting position, a gap is formed between the forward end of the stator 3 and the rear end of the turbine 2, which is substantially the length of the rotor 4 and its shaft 6, and with the elements thus positioned a hoisting block 23 may be applied to the rotor 4 and the cap of the front bearing 8 may be removed. By applying slings or ropes 24 to the block 23 and to the forward portion of the rotor 4 as illustrated in Fig. 5, the rotor may be simultaneously tilted, moved forwardly, and withdrawn laterally of the axis of the turbine, in an obvious manner.

From the foregoing description of the mode of dismantling the unit, the method of assembling should also be clearly apparent. When assembling the unit, the steps will be carried on in the reverse order of the dismantling operation, the same special equipment being employed in both the assembling and the dismantling operations. From this description it will be apparent that the improved turbine generator unit is of such construction that the steam turbine 2 may be retained in fixed position, while the generator comprising the stator 3 and the rotor 4 may be conveniently installed or removed within a relatively confined space without necessitating longitudinal division of the stator. The position of the power house wall is such that it would be impossible to remove the rotor 4 from the rear end of the stator 3 in the usual manner, without damaging the rotor 4 or the wall 12. The invention obviously makes it possible to utilize a much smaller power house, thereby materially decreasing the cost of a new power plant, and

also enabling the installation of relatively large power units in existing power houses having limited floor space. The end wall 12 may be spaced from the steam turbine 2, less than double the length of the electric generator, and the rotor 4 may still be conveniently withdrawn without injury to the parts. The invention is of especial importance in cases where the size of the power house is necessarily limited due to the excessive cost of land or due to the fact that there are adjoining buildings.

While the invention has been shown and described herein as specifically applied to a turbine generator power house installation, it is not intended to limit the scope of the claims by such specific disclosure. It will be apparent that the novel method may also be applicable to other forms of power installations such as a motor driven pump installation or the like. The use of the specific terms "turbine" and "generator" is not intended as a limitation of the invention to machines embodying these particular elements, but should be more broadly interpreted to cover any machine elements having similar characteristics.

It should be understood that it is not desired to limit the invention to the exact steps of the method or to the precise details of construction herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. The method of dismantling a horizontal turbine generator unit comprising a turbine and a generator, said turbine having an end adjacent said generator, and said generator having a rotor and a stator, said turbine and said generator rotating about a common axis and being located within a power house having a wall axially spaced from the generator end of said turbine a distance less than double the length of the generator, which comprises, temporarily supporting the generator rotor, sliding the generator stator along the rotor toward said wall and away from the turbine, and removing the generator rotor through the space between the stator and the turbine.

2. The method of dismantling a horizontal turbine generator unit comprising a turbine and a generator, said turbine having an end adjacent said generator, and said generator having a rotor and a stator, said turbine and said generator rotating about a common axis and being located within a power house having a wall axially spaced from the generator end of said turbine a distance less than double the length of the generator, which comprises, temporarily supporting the generator rotor to permit endwise movement of the stator therealong, moving the stator lon-

gitudinally of the rotor away from the turbine and toward said wall, and subsequently removing the rotor from the gap between the stator and the turbine.

3. The method of dismantling a horizontal turbine generator unit comprising a turbine and a generator, said turbine having an end adjacent said generator, and said generator having a rotor and a stator, said turbine and said generator rotating about a common axis and being located within a power house having a wall axially spaced from the generator end of said turbine a distance less than double the length of the generator, which comprises, providing a temporary support for the generator rotor at a point adjacent to said wall, moving the generator stator along the rotor toward the temporary support, temporarily supporting the generator rotor between the stator and the turbine and removing the initial temporary support, further moving the stator along the rotor into close proximity to said wall, and subsequently removing the rotor from the gap between the stator and the turbine.

4. The method of assembling a horizontal turbine generator unit comprising a turbine and a generator, said turbine having an end adjacent said generator, and said generator having a rotor and a stator, said turbine and said generator rotating about a common axis and being located within a power house having a wall axially spaced from the generator end of said turbine a distance less than double the length of the generator, which comprises, definitely positioning the turbine to provide a space less than double the length of the generator between the turbine and the wall, positioning the generator stator directly adjacent to said wall to provide a space between the turbine and the stator substantially equal to the length of the rotor, inserting the rotor centrally of the stator and turbine within said latter space, and sliding the stator along the inserted rotor toward the turbine.

5. The method of assembling a horizontal turbine generator unit comprising a turbine and a generator, said turbine having an end adjacent said generator, and said generator having a rotor and a stator, said turbine and said generator rotating about a common axis and being located within a power house having a wall axially spaced from the generator end of said turbine a distance less than double the length of the generator, which comprises, definitely positioning the turbine to provide a spaced less than double the length of the generator between the turbine and the wall, positioning the generator stator directly adjacent to the wall to provide a space between the turbine and the stator substantially equal to the length of the rotor, inserting the rotor centrally of the stator and turbine in said latter space and temporarily supporting the rotor, providing a second temporary

support associated with the end of the rotor remote from the turbine and removing the first mentioned temporary support, sliding the stator along the temporarily supported rotor toward the turbine, and substituting a permanent support for the temporary end support of the rotor.

6. The method of dismantling a horizontal turbine generator unit comprising a turbine and a generator, said turbine having an end adjacent said generator, and said generator having a rotor and a stator, said turbine and said generator rotating about a common axis and being located within a power house having a wall axially spaced from the generator end of said turbine a distance less than double the length of the generator, which comprises, temporarily positioning the generator stator coaxial with but endwise removed from the turbine, and removing the generator rotor from said stator through the space between said turbine and said stator.

7. The method of assembling a horizontal turbine generator unit comprising a turbine and a generator, said turbine having an end adjacent said generator, and said generator having a rotor and a stator, said turbine and said generator rotating about a common axis and being located within a power house having a wall axially spaced from the generator end of said turbine a distance less than double the length of the generator, which comprises, temporarily positioning the generator stator coaxial with but endwise removed from the turbine, and inserting the generator rotor within said stator through the space between said turbine and said stator.

8. The method of dismantling a horizontal turbine generator unit comprising a turbine and a generator, said turbine having an end adjacent said generator, and said generator having a rotor and a stator, said turbine and said generator rotating about a common axis and being located within a power house having a wall axially spaced from the generator end of said turbine a distance less than double the length of the generator, which comprises, temporarily positioning the generator stator endwise removed from the turbine, and removing the generator rotor from said stator through the space between said turbine and said stator.

9. The method of assembling a horizontal turbine generator unit comprising a turbine and a generator, said turbine having an end adjacent said generator, and said generator having a rotor and a stator, said turbine and said generator rotating about a common axis and being located within a power house having a wall axially spaced from the generator end of said turbine a distance less than double the length of the generator, which comprises, temporarily positioning the generator stator endwise removed from the turbine, and inserting the generator rotor within said stator

through the space between said turbine and said stator.

10. In combination with a power house, a prime mover within and spaced from a wall of said power house, and an electric generator comprising a stator and a rotor operable by said prime mover, said generator being located in the space between said wall and said prime mover and said rotor being longer than one-half the length of said space, the rotor being removable from said stator only at the end thereof adjacent said prime mover.

11. In combination with a power house, a turbine fixedly positioned within said power house, and a generator comprising a stator and a rotor associated with said turbine between an end of said turbine and a wall of said power house, the rotor of said generator being longer than one-half the distance from said turbine to said wall and being removable from said generator stator only through the space between said turbine and said stator.

12. In combination, a turbine, a generator comprising a rotor direct connected to said turbine and a stator surrounding said rotor, and means for effecting movement of said stator away from said turbine to provide a space for effecting removal of said rotor laterally with respect to the axis of said turbine.

In testimony whereof, the signature of the inventor is affixed hereto.

EDWIN H. BROWN.