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MEANS FOR PROTECTING TURBINE SURFACES

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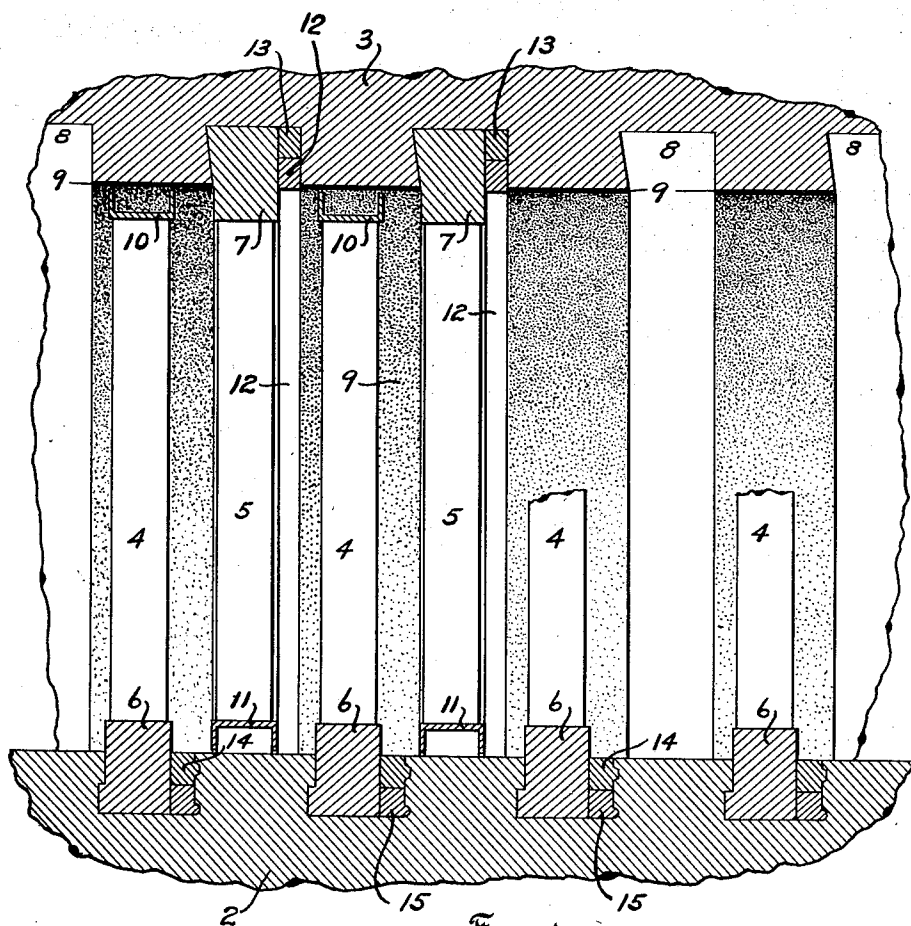


Fig. 1

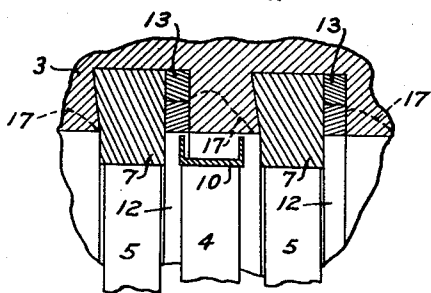


Fig. 2

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UNITED STATES PATENT OFFICE.

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MEANS FOR PROTECTING TURBINE SURFACES.

Application filed May 6, 1920. Serial No. 380,011.

To all whom it may concern:

Be it known that EDWIN H. BROWN, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, has invented a certain new and useful Improvement in Means for Protecting Turbine Surfaces, of which the following is a specification.

This invention relates in general to improvements in the art of protecting turbine elements against deterioration, and relates more specifically to an improved method of and means for preventing erosion of the stator and rotor elements of steam turbines.

An object of the invention is to provide a simple and an efficient method of preventing erosion of turbine elements. Another object is to provide simple and efficient means for enabling exploitation of the improved method.

Erosion is a term which is universally applied to a certain detrimental action by some medium the characteristics of which are not definitely known, upon certain elements of steam turbines, the action occurring during normal operation of the turbines. There are two forms of turbine erosion with reference to the elements affected, the first being erosion of the stator or cylinder walls and the second being erosion of the turbine blading.

Investigations have shown that erosion of the cylinder walls occurs locally and is practically always confined to a definite stage of a multi-stage steam turbine, the detrimental action being most pronounced between the last rows of blading in the stage affected. Erosion of the turbine blading is likewise practically always confined to the blading of a definite stage, and is generally most pronounced in the last row of movable blades in the stage affected, although in certain cases the preceding rows of blades have also developed considerable erosion. The stator or cylinder blading is, however, seldom affected, the detrimental action being practically confined to the spindle or rotor blading.

It has further been ascertained that in practically every instance, the cylinder erosion is confined to the cast iron walls of the casing. So far as known, there is no record of the alloy caulking strips or of the alloy foundation rings for holding the blades

in place, having been affected, in spite of the fact that these caulking strips and foundation rings are located directly adjacent to the walls which are affected, and in close proximity to the shrouding on the rotor blades.

From these results of investigation, it is believed that erosion which heretofore has been considered in the nature of a mechanical action, is in fact the result of chemical action and closely resembles the destructive action in hydraulic apparatus which is known as cavitation. The belief that erosion is due to chemical rather than mechanical action, is supported by the fact that analysis of the deposits found in eroded turbines, shows that these deposits are composed largely of iron oxide, thus indicating that the material was removed by oxidation rather than by mechanical action. The fact that the caulking strips which are formed of non-corrodible metals or alloys, are not affected while the cast iron cylinder walls are affected, is further substantiation of the theory that erosion is due to chemical rather than mechanical action.

It has been found that a coating of certain paint applied to the walls of a steam turbine cylinder, at the place where erosion ordinarily occurs, will afford substantial protection against erosion for a period of about one year. Such a coating of paint being of merely a temporary character, must be renewed from time to time in order to prevent subsequent destruction of the turbine casing and blading.

The present invention contemplates the provision of a simple method for permanently coating the cylinder walls of turbines with non-corrodible material having characteristics which make it capable of withstanding erosion. It is contemplated by the present method to apply a coating of protective metallic material either by electroplating the surface to be protected, by spraying the non-corrodible metallic material upon the surface while the material is in a molten state, or by any other process whereby the use of a non-metallic binder is avoided. Such a coating may be applied wherever there is danger of erosion occurring, and will positively prevent erosive action at all times.

A clear conception of the several steps con-

stituting the present method and of the final appearance of a protected element, may be had by referring to the accompanying drawing and to the following description, in which like reference characters designate similar parts wherever they are employed.

Fig. 1 of the drawing discloses a fragmentary sectional view of several successive rings of turbine blading and of the associated parts, the turbine selected being of the reaction or Parsons type.

Fig. 2 is a similar view showing the blading positioned so that the shrouding of the rotor blades overlaps the stator caulking strips, and also showing the extent to which the erosive action often affects the casing.

The rotor or spindle 2 is provided with a series of parallel annular recesses within which are located segmental foundation rings 6 having movable blades 4 secured thereto. The foundation rings 6 are held within the grooves of the spindle 2 by means of caulking strips 14, 15 having lateral projections for the purpose of preventing displacement of the strips. The turbine stator or casing 3 is provided with a series of parallel annular recesses 8 within which are located segmental foundation rings 7 having the stationary blades 5 secured thereto. The foundation rings 7 are held in place within the grooves 8 of the casing 3, by means of caulking strips 12, 13. The movable blades 4 are provided with channel-shaped shrouds 10 the parallel flanges of which extend in close proximity to the inner bore of the casing 3. As illustrated in Fig. 2, one of shroud flanges is directed toward the casing wall while the complementary flange approaches the caulking strips 12, 13. The stationary blades 5 are provided with channel-shaped shrouds 11 having parallel flanges which extend in close proximity to the outer cylindrical surface of the spindle 2. The inner wall of the casing 3 is preferably formed of slightly greater diameter than that of the inner cylindrical surfaces of the caulking strips 12. The shallow recess thus formed between a caulking strip 12 and a foundation ring 7 is filled with a coating 9 of non-corrodible metallic material.

The coating 9 may be applied to the casing wherever it is likely that erosion such as represented by the dotted line 17 of Fig. 2, may occur, and the thickness of the coating may be varied. The coating 9 may be applied to the wall of the casing 3, either by electroplating, by spraying the material in molten state upon the surfaces, or by any other process wherein the use of a non-metallic binder for holding the metallic particles together, is avoided. The material forming the coating may be any suitable metal, preferably copper or a copper alloy, the metallic particles being held in place solely by direct adherence. The art of de-

positing such a metallic coating by electroplating, is highly developed and such application of the coating would present no serious difficulties. The coating may, however, also be applied by means of apparatus which melts, atomizes and subsequently deposits metallic particles such as copper or copper alloys, on the surfaces of other materials. A coating so deposited has characteristics similar to one applied by plating processes and may be readily applied to local surfaces having definite boundaries. Regardless of the mode of application, the coating applied to the casing surfaces may be made of any desirable thickness and will effectively prevent erosion of the coated surfaces for all times. As illustrated by the dotted lines 17 of Fig. 2, the detrimental erosive action is confined to the cast iron cylinder walls and does not affect the alloy caulking strips 12 which are located adjacent to the shrouding 10. For this reason it is not necessary to coat the caulking strips 12, although no harm will result from applying the coating to these strips as well as to the casing wall.

By thus depositing closely adhering non-corrodible metallic particles upon the surface of the turbine element, without the aid of a temporary binder, such as the oil in paint, a permanent homogeneous and durable coating is provided. A coating applied to the turbine elements by plating or spraying rather than with the aid of a detachable mechanical connection such as previously employed, will be uniformly attached to all portions of the protected elements since the metallic particles of the coating lodge in the pores of the elements coated. The application of the coating by spraying may be readily accomplished either before or after the blading has been permanently secured to the element which is to be coated.

It should be understood that it is not desired to limit the invention to the exact steps of the method or to the specific form of the means for applying the coating as various modifications within the scope of the appended claims, may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In a fluid actuated turbine, a plurality of stationary blades, a non-corrodible foundation strip rigidly attached to corresponding ends of said blades, a corrodible casing within which said foundation strip is rigidly secured, and a non-corrodible coating of erosion resisting metal in the form of a film deposited as minute particles permanently attached and closely adhering to said casing and covering a portion thereof otherwise exposed to fluid passing said blading.

2. In a fluid actuated turbine, an annular series of stationary non-corrodible radially

disposed blades, a non-corrodible foundation strip rigidly attached to the outer ends of said blades, a corrodible casing having an internal recess within which said foundation strip is rigidly secured, and a non-corrodible coating of erosion resisting metal in the form of a film deposited as minute particles permanently attached and closely adhering to the interior of said casing and covering a portion thereof otherwise exposed to fluid passing said blading. 10

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

EDWIN H. BROWN.