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A. J. KUZMANN

2,221,874

COLLOIDAL METAL PRODUCING MACHINE

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2 Sheets-Sheet 1

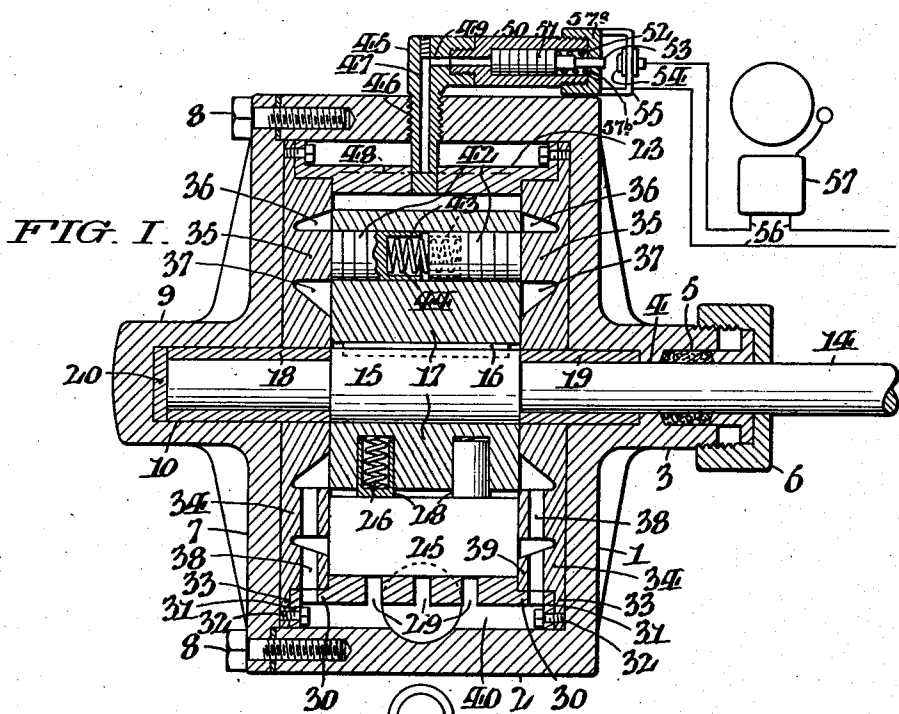
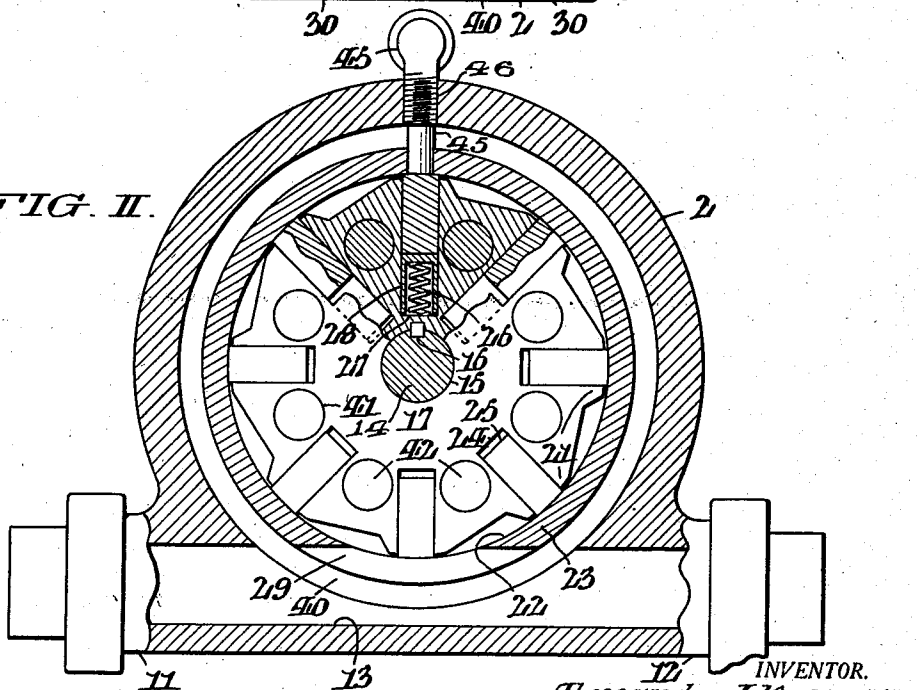


FIG. II.



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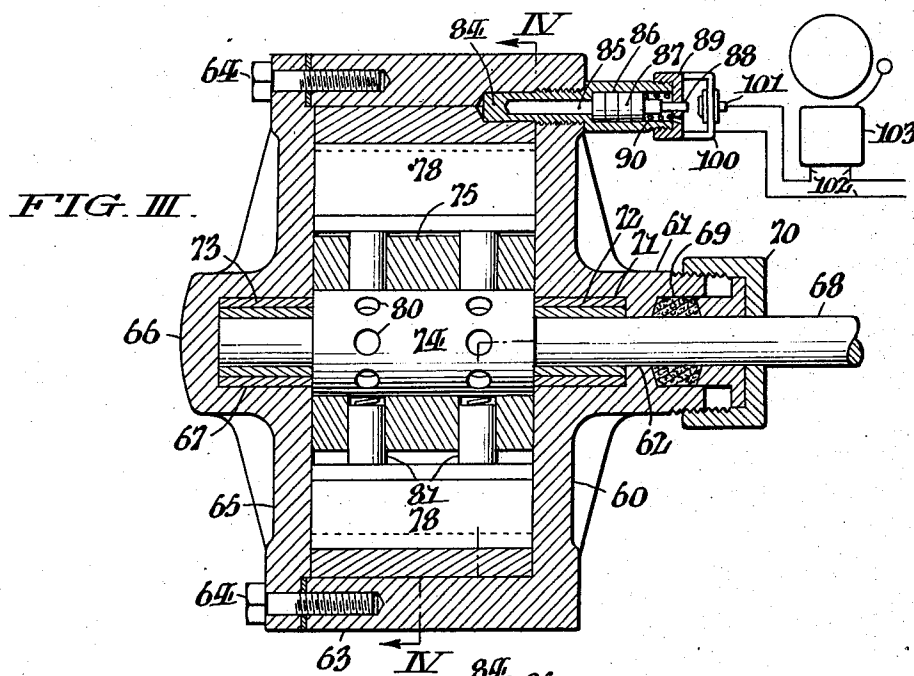
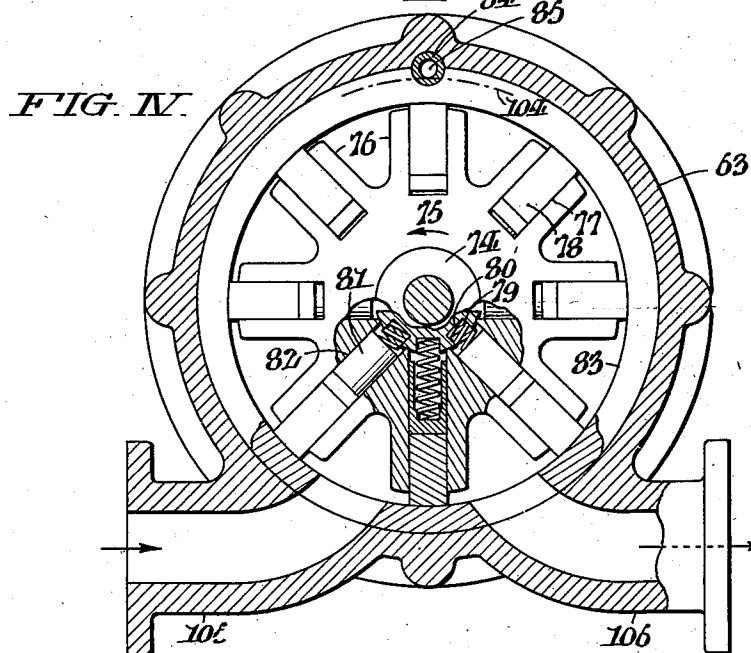
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COLLOIDAL METAL PRODUCING MACHINE

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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COLLOIDAL METAL PRODUCING MACHINE

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10 Claims. (Cl. 210—35)

The object of the invention is to provide improvements in machines designed and especially adapted for the preparation of metals in colloidal form or size, but more particularly for the preparation of colloidal iron directly in the bath of the water which flows into boilers, for the purpose of treating such feedwater in a manner adapted to prevent the deposits of encrusting substances upon the tubes and other surfaces of such boilers. Hereinafter, the term "iron" or "colloidal iron" will be used to relate to any metals to which the invention is adapted.

An object of my invention is, therefore, to provide a device which can be conveniently and safely used for making colloidal iron for correcting boiler feedwater difficulties expressed as scale, corrosion, pitting, etc. This colloid making machine can be driven effectively by Diesel engines, marine type engines, locomotives, and all internal combustion engines and motors for the continuous application to the circulating system of colloidal iron and/or other metals to correct the said feedwater difficulties.

Another object is to provide a machine, which represents a distinct improvement over the so-called Ferrochem device, which enjoyed a run for a few years but was withdrawn from the market many years ago, said Ferrochem device comprising in general the use of iron balls, which engaged one another in obviously very restricted areas frictionally within the body of inflowing water, in such manner that the surfaces of such balls gradually wore away during the production of finely divided iron particles, a substantial portion of which was of colloidal size. The disadvantage possessed by the balls in the Ferrochem devices resided in several details, among which was that of the constantly decreasing diameter with resulting decrease in the surface contact of the balls, the localized wear of the surrounding inner wall surface of the device, so that when worn away to a certain degree the entire device had to be replaced, and especially the lack of any means for positively insuring the necessary movement of the balls to produce the desired attrition or disintegration of the same.

A further object, therefore, has been to overcome the deficiencies of this earlier device, and to provide a machine in which the disintegration or wearing away of the several elements, herein referred to as attrition, can be positively controlled, and one in which relatively large surfaces preferably of the same kind and type of metal uniformly engage one another, both as to area and duration of such engagement, as well as

providing means for the positive feeding of each element of a group independently of the rest, so as to maintain a constant and substantially equal rate of attrition of the said elements, all being contained within a casing which can be located within any desired feedwater supply, or circulatory system.

The improved colloidal iron making machine is a safe and simple apparatus needing no special attention and not liable to get out of order, which can be applied to any pressure vessel, particularly steam boilers of all types, and also on any circulating system of any internal combustion engine, to reduce heat transmission losses and mechanical destruction, due to corrosion and deposits of scale upon cooling and heating surfaces.

Still another object is to provide in such a device an arrangement, whereby laterally variable elements wear away both themselves and the adjacent portions of lining sections upon or adjacent to the side walls of the device, concurrently with the disintegration of said first-mentioned elements and adjacent lining sections, said laterally variable elements preferably being arranged in pairs or the equivalent, so that with an interposed resilient member each element of such pair operates to force the other element outwardly.

And a still further object is to provide a further modified form of colloidal iron machine, in which the flow of water through the intake positively rotates the rotor element, substantially in accordance with the rate of flow, so as to produce colloidal iron in substantially direct proportion to the rate of flow of the feedwater admitted to the boiler, and the rotation of said rotor being either independent of or in addition to an extraneous force, such as that which can be readily supplied by an electric motor or a small steam engine or turbine unit, capable of using either live steam direct from the boiler, or exhaust steam from apparatus using said live steam.

Referring to the drawings, Fig. I is a longitudinal diametrical section of a motor-driven colloidal iron producing machine, comprising one embodiment of the invention; Fig. II is a vertical transverse section, substantially through the central part of Fig. I, showing a portion of the rotor in elevation and the remainder in section; Fig. III is a view similar to Fig. I, but showing a modified form of either a motor-driven or fluid actuable (or both) colloidal iron producing machine; and Fig. IV is a section on the line IV—IV of Fig. III.

Referring to Figs. I and II, a stator casing com-

prises a planular plate 1 provided with an integral peripheral cylindrical flange 2 and also with an oppositely extending, centrally positioned boss 3, through which extends an axial bore 4 terminating outwardly in any well-known form of packing gland 5, covered by an adjustable removable hexagonal nut 6. The opposite freely extending face of said flange is normally spanned by a planular closure plate 7, secured to said flange by removable bolts, or the like 8, and provided with a centrally positioned integral boss 9, having an axially positioned recess 10. The lower portion of the flange 2, as shown by Fig. II, merges into oppositely directed aligned extensions 11 and 12, through which extends a fluid channel 13, which intersects and is preferably tangential to the radially outer portion of the interior of said casing, the extension 11 being adapted for connection with a source of feedwater, while the extension 12 is designed for connection with the intake of a boiler.

Extending through the bore 4 and into the recess 10 of the oppositely positioned closure plate, is a shaft 14 which may be driven by any desired form of electric motor or other prime mover (not shown). This shaft at a central point within said casing is radially enlarged at 15, and to it is secured by means of a key 16 a rotor 17, while surrounding said shaft upon the opposite sides of said enlargement are cylindrical packing members 18 and 19, which serve to prevent metallic particles, produced by the attrition of the elements within said casing, from entering the bearings of said shaft, and at the same time cooperating to form bearings for said shaft. End thrust of said shaft may be limited by a disc thrust bearing 20 within the innermost portion of the recess 10 in the boss 9.

The rotor proper comprises a central body portion immediately surrounding said shaft enlargement 15, which body is provided with circumferentially spaced radial extensions 21 which relatively closely approach the inner surface 22 of a cylindrical lining section 23. These spaced portions of said rotor are provided with transversely extending radially directed slots 24 of rectangular cross-section, and in said slots are slidably positioned attrition elements 25, preferably of the same metal (such as a soft grey iron), as that which comprises the cylindrical lining element 23, each of said elements 25 being normally pressed outwardly against said lining section by a compression coil spring 26, which at one end presses against the innermost wall 27 of one of a pair of spaced recesses in the rotor body 17, while the opposite end of said spring presses against the inner surface of a protective cylinder 28, which surrounds said spring and in turn bears directly against the radially inner surface of the adjacent element 25 within the extensions 21. The lining section 23, as shown in Figs. I and II, comprises a central cylindrical portion having a circumferentially unbroken inner surface, except for longitudinally spaced segmental slots 29, the opposite ends of said central lining section merging into cylindrical flanges 30, and thence into outwardly directed planular flanges 31, which latter are secured by bolts or the like 32, to radially outwardly extending planular flanges 33, carried by attrition plates 34, formed of the same kind and type of metal as that of the central section 23 of said lining and of the elements 25.

Each of said discs 34 is provided with a circumferentially extending inwardly directed por-

tion 35 of limited radial extent and positioned between concentric annular grooves 36 and 37, while one or more channels 38 are provided from the lowermost portion of the radially inner groove 37, through the portion 35 and outwardly positioned marginal portion 39, and finally through the flange 30, so as to open downwardly into an annular chamber 40 within the casing flange 2, and thereby in communication with the discharge channel 13. The body portion 17 of said rotor is provided with longitudinally extending circumferentially spaced parallel bores 41, of equal distance radially from the axis of said rotor, and in alignment with the annular disintegrable portion 35 of each of the plate members 34. In each of these bores is positioned a pair of oppositely directed disintegrable elements 42, the outer surfaces of which bear equally against and in frictional engagement with the adjacent surfaces of said annular lining portions 35, while said elements are preferably recessed within their adjacent ends as at 43, to provide a housing for a coil spring or the like 44.

With this construction, as the shaft 14 is rotated, the elements 25 are forced radially outwardly against and in frictional engagement with the central lining section 23, while the elements 42 of each of said pairs are forced in laterally opposite directions, into frictional engagement with said annular portions 35 of the plate sections 34. By this arrangement, as the elements 25 and 42, as well as each of said lining sections, are formed of a disintegrable type of soft grey cast iron, the respective contacting surfaces wear away, with the result that minute particles of iron, much if not all of which is of colloidal size, gravitate through their several paths into the lowermost portion of the chamber 40, whence they enter feedwater flowing into a boiler through the channel 13. By varying the speed at which said rotor is operated, it should be quite obvious that the rate of production of the colloidal particles can be varied at will, as for instance, in accordance with the flow of feedwater into the boiler and also independently thereof, so that an accumulation of such particles may be created during such time as the flow of water may be arrested, but which particles will be carried into the boiler immediately upon the resumption of such flow.

In order to warn the operator as soon as the central lining section 23 has worn away, to such thinness as to make it necessary to replace the several lining sections, there is provided an indicator in the form of a plug 45, which extends removably into and through an aperture 46 in the flange 2 of said casing, thence through an upper portion of the chamber 40, and into the central lining section 23. This plug is provided with a bore 47 which terminates slightly within the outer limit of the central portion of the lining member 23, so that as said lining member is worn outwardly from its interior, the adjacent end of said plug being formed of the same metal is correspondingly worn away, so that eventually the inner surface of said central member reaches the dot-and-dash line 48 indicated in Fig. I, whereupon pressure of water within the conduit 13 and through the channels 38 and grooves 36 and 37, and finally the spaces between the radial extensions 23, is permitted to pass radially outwardly through the bore in said plug and finally through a lateral extension 49 of said bore, and through a lateral extension 50 of said plug, so as to force outwardly a piston or the like 51, 75

against the pressure of a spring 52 said extension 50 being covered by a cap 57a having a relief port 57b, so as to thereby force outwardly a projection 53 carried by said plunger, into electrical engagement with a contact 54, supported by a bracket 55, and thence by means of suitable wires 56 energize a bell or equivalent signalling device 57, so as to audibly, visually and/or otherwise warn the operator, that the said lining sections must be renewed before operation of the device is continued further.

Referring to Figs. III and IV, a modified form of the improved machine is shown as comprising a casing, consisting of a plate 60 having a central boss 61, through which extends an axial bore 62, and said plate being provided peripherally with a cylindrical flange 63, to the outer face of which is detachably secured by bolts or the like 64 a closure plate 65, having a central boss 66 provided with an axial recess 67. Through the bore 62 extends a shaft 68, which may be driven by an electric motor or other prime mover (not shown), said boss being provided with a suitable packing gland 69 and hexagonal nut 70 surrounding said shaft, and upon its inner side with an enlarged axial recess 71, containing one or more concentric packing members 72, while similar packing members 73 surround the inner opposite end of said shaft within the recess 67. Between the plate 60 and closure 65, said shaft is provided with a radially enlarged portion 74, to which is secured in any suitable manner the body portion 75 of the rotor, which in turn comprises an artillery wheel spoke construction, including radially extending arms 76 provided with centrally disposed, transversely extending, substantially rectangular recesses 77, in which are positioned radially slidable elements 78 of soft grey iron or the like, which are normally forced radially outwardly by means of springs 79, the inner ends of which are seated within apertures 80 within the surface of the enlarged portion 74 of said shaft, while the major portion of each of said springs is housed within a thimble 81, which thimbles are slidable in bores 82 opening outwardly into the radial slots 77, the movement of said springs being thereby guided by said thimbles within said radial bores and through said thimbles cooperating with and operative to force outwardly the respective attrition elements 78.

Surrounding said rotor and said elements, and within the flange 63 of said casing, is a substantially cylindrical lining member 83, the outer surface of which fits slidably yet singly within the interior of the flange 63, while the interior of the surface of said member is also cylindrical, but is eccentrically positioned slightly below the axis of said flange, as clearly indicated in Fig. IV, said lining section being prevented from turning with respect to said flange, by virtue of a plug 84 extending longitudinally through the plate 60, and partially embedded in the flange 63, and having the remainder of its inner end portion embedded in said lining section 83. This plug 84 is provided with an axial bore 85, in an enlarged outer portion 86 of which is mounted a piston 87, provided with an outwardly extending pin 88, passing through a cap 89 having a pressure-relief port 89a and normally positioned inwardly by means of a coil spring 90, said cap being provided with a bracket 100, which supports a contact member 101, which said pin is in turn adapted to engage, in order to close a circuit between wires 102, as shown in Fig. III, to actuate a bell 103 and/or other form of audible, visual, or equivalent indi-

cating means. The purpose of the plug in this instance, though arranged slightly differently, is nevertheless similar to that shown in Figs. I and II, so that if the lining section 83 wears away to an internal diameter indicated by the dot-and-dash line 104, water under pressure within the device is permitted to enter the plug bore 85, press the plunger 87 outwardly, close the contact between the pin 88 and the contact member 101, and actuate the signal.

While the shaft 68 may be driven by a motor or other prime mover, the rotor in this case can be driven independently thereof by the force of the feedwater flowing through the device. For this purpose, the flange 63 is provided with oppositely directed and preferably aligned integral channeled extensions 105 and 106, the first of which may be connected with a source of preheated water, while the second is normally connected with the intake of a boiler. The entrance through the casing flange 63 and lining member 83 is spaced from the exit, so that (see Fig. IV) water entering through the former fills a cavity enclosed by said lining section, a pair of adjacent spokes 76, the end plate 60, closure 65, and adjacent attrition elements 78, with the result that the rotor is forced to revolve in the direction indicated by the arrow, until the water in the cavity thus defined is enabled to emerge through the outlet and pass thence into the boiler, by which time a second cavity has come into registration with the inlet, and the action is repeated in such manner as to provide a continuous rotation of said rotor. This operation is insured by offsetting the axis of the internal cylindrical surface of the line 83 with respect to the axis of the rotor, so that the capacity of each such cavity increases as it passes the water inlet opening and decreases as it passes the outlet opening.

While the several forms of the device herein described are all designed to achieve the same result, it will be noted that the form shown in Figs. III and IV is most desirable in many respects, both due to its automatic operation independently of a motor drive, unless the same should be specifically desired, and also to the fact that when necessary to replace the attrition elements, skilled labor is not required in order to remove the plate 65, withdraw the worn parts, insert a new plug, (if said plug has also been worn into) and insert a fresh lining section and radial block elements, after which said plate closure can be replaced as easily as it was removed. However, the form of the device shown in Figs. I and II, size for size, will obviously produce more colloidal metal, than will the forms shown in Figs. III and IV, but is not so simple to renew.

Finally, it is to be understood that in each type of the improved machine hereinbefore described, one or more of the attrition elements in each, or one or more portions of each attrition element, may be composed of a metal or alloy other than pure iron, as for instance of nickel or an alloy thereof, so that the designation of iron in the appended claims is to be understood as broadly including whatever metal, metals, or metal alloy may be or become suitable for the treatment of water, and adapted for use in the present type of machine.

Having thus described my invention, what I claim as new and desire to protect by Letters Patent of the United States is:

1. A colloidal iron making machine, comprising a casing, a removable and replaceable attrition lining section within said casing, and a rotor

within said lining, and a variably positioned attrition element carried by said rotor and in frictional engagement with said lining section.

2. A colloidal iron making machine, comprising a casing, a separable cylindrical attrition lining section within said casing, a rotor within said lining, a variably positioned attrition element carried by said rotor, and resilient means to force said element into frictional engagement with said lining section.

3. A colloidal iron making machine, comprising a casing, a lining for said casing comprising a cylindrical section and laterally oppositely positioned plates, a rotor within said casing between said plates, a radial attrition element slidably supported by said rotor, resilient means to force said element into frictional engagement with said cylindrical section, a pair of oppositely directed attrition elements also movably carried by said rotor substantially parallel with the axis of said rotor, and resilient means to force said last-mentioned elements equally in opposite directions into frictional engagement with said plates.

4. A colloidal iron making machine, comprising a casing, a lining for said casing comprising longitudinally spaced attrition plates carried by and within said casing and a cylindrical attrition element connecting said plates, a rotor within said casing between said plates, a radial attrition element slidably supported by said rotor, resilient means to force said element into frictional engagement with said cylindrical element, a pair of oppositely directed attrition elements also movably carried by said rotor in alignment and substantially parallel with the axis of said rotor, and resilient means between and operative to force said last-mentioned elements in opposite directions and into frictional engagement with said plates.

5. A colloidal iron making machine, comprising a casing, a rotor within said casing, an attrition lining section having a cylindrical inner surface eccentric to the axis of said rotor, spaced inlet and outlet ports leading into said casing, said rotor being provided with radial guideways, attrition elements positioned by said guideways, and resilient means to force said elements radially outwardly into frictional engagement with the adjacent surface of said lining section, the volumetric area enclosed by said section, a pair of adjacent elements and the sides of said casing, varying as said rotor rotates about its axis under the force of water flowing through said casing between said inlet and outlet ports.

6. A colloidal iron making machine, comprising a hollow casing having an open end, a closure for said end, the interior of said casing presenting spaced side walls connected by a cylindrical wall, a rotor within said casing, a cylindrical attrition lining section also within said casing, the inner surface of which is eccentric to the axis of said rotor, radially projecting spokes carried by said rotor and provided with guideways, attrition elements carried by said spokes and positioned by said guideways, and resilient means to force said elements radially outwardly into frictional engagement with said lining section, spaced inlet and outlet ports leading into said casing, the volumetric area enclosed by said section, a pair of adjacent spokes and the elements carried thereby, and the sides of said casing, varying as said rotor rotates about its axis under the force of water flowing through said casing between said ports.

7. A colloidal iron making machine, comprising a casing, a lining for said casing comprising a cylindrical section and laterally oppositely positioned plates, a rotor within said casing between said plates, a radial attrition element slidably supported by said rotor, resilient means to force said element into frictional engagement with said cylindrical section, a pair of oppositely directed attrition elements also movably carried by said rotor substantially parallel with the axis of said rotor, resilient means to force said last-mentioned elements equally in opposite directions into frictional engagement with said plates, a plug no harder than said lining section extending into said section, and warning means connected to said plug, whereby a wearing away of said plug to a predetermined degree permits the actuation of said warning means.

8. A colloidal iron making machine, comprising a casing, a lining for said casing comprising longitudinally spaced attrition plates carried by and within said casing and a cylindrical attrition element connecting said plates, a rotor within said casing between said plates, a radial attrition element slidably supported by said rotor, resilient means to force said element into frictional engagement with said cylindrical element, a pair of oppositely directed attrition elements also movably carried by said rotor in alignment and substantially parallel with the axis of said rotor, resilient means between and operative to force said last-mentioned elements in opposite directions and into frictional engagement with said plates, a hollow plug no harder than said lining section extending into said section, a plunger within said plug, electrical contact means, and an electrically actuated warning means, operative to be actuated by current passing between said contact means when the position of said plug is shifted under the pressure of water within said casing, when said lining and plug have been worn away to a predetermined degree.

9. A colloidal iron making machine, comprising a casing, a rotor within said casing, an attrition lining section having a cylindrical inner surface eccentric to the axis of said rotor, spaced inlet and outlet ports leading into said casing, said rotor being provided with radial guideways, attrition elements positioned by said guideways, resilient means to force said elements radially outwardly into frictional engagement with the adjacent surface of said lining section, the volumetric area enclosed by said section, a pair of adjacent elements and the sides of said casing, varying as said rotor rotates about its axis under the force of water flowing through said casing between said inlet and outlet ports, a plug no harder than said lining section extending into said section, and warning means connected to said plug, whereby a wearing away of said plug to a predetermined degree permits the actuation of said warning means.

10. A colloidal iron making machine, comprising a hollow casing having an open end, a closure for said end, the interior of said casing presenting spaced side walls connected by a cylindrical wall, a rotor within said casing, a cylindrical attrition lining section also within said casing, the inner surface of which is eccentric to the axis of said rotor, radially projecting spokes carried by said rotor and provided with guideways, attrition elements carried by said spokes and

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