

[54] **TURBINE, ESPECIALLY STEAM
TURBINE, WITH NOZZLE GROUP
CONTROL AND FLOW ADMISSION
CREST**

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[22] Filed: **Mar. 25, 1970**

[21] Appl. No.: **22,629**

[30] **Foreign Application Priority Data**

Mar. 26, 1969 Germany.....P 19 15 267.1

[52] U.S. Cl.....**415/151**

[51] Int. Cl.....**F01b 25/02**

[58] Field of Search.....415/147, 150, 151, 153, 154,
415/155, 156

[56] **References Cited**

UNITED STATES PATENTS

1,297,249 3/1919 Rice.....415/151

2,247,378 7/1941 Hinrichs415/151
2,294,127 8/1942 Pentheny415/155
2,978,223 4/1961 Keeney et al.415/154

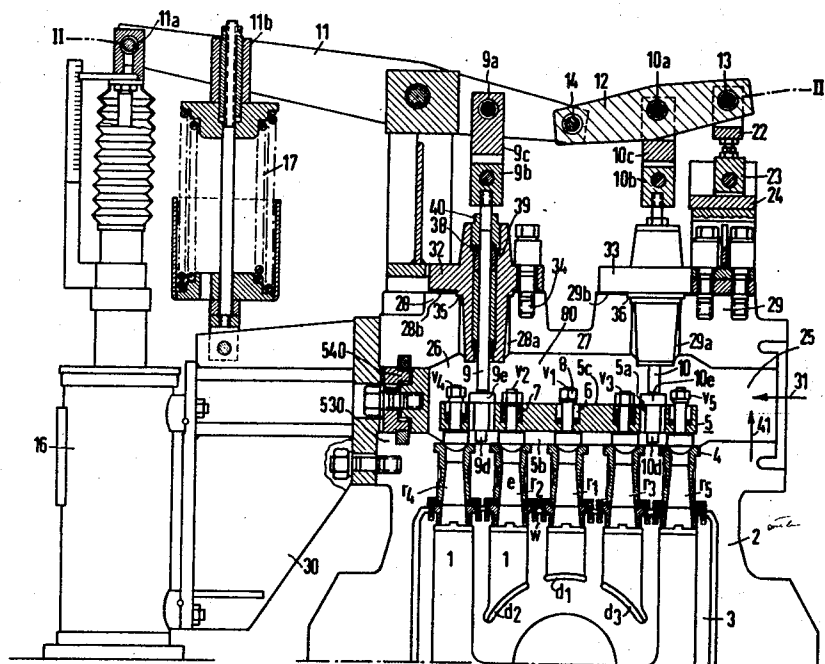
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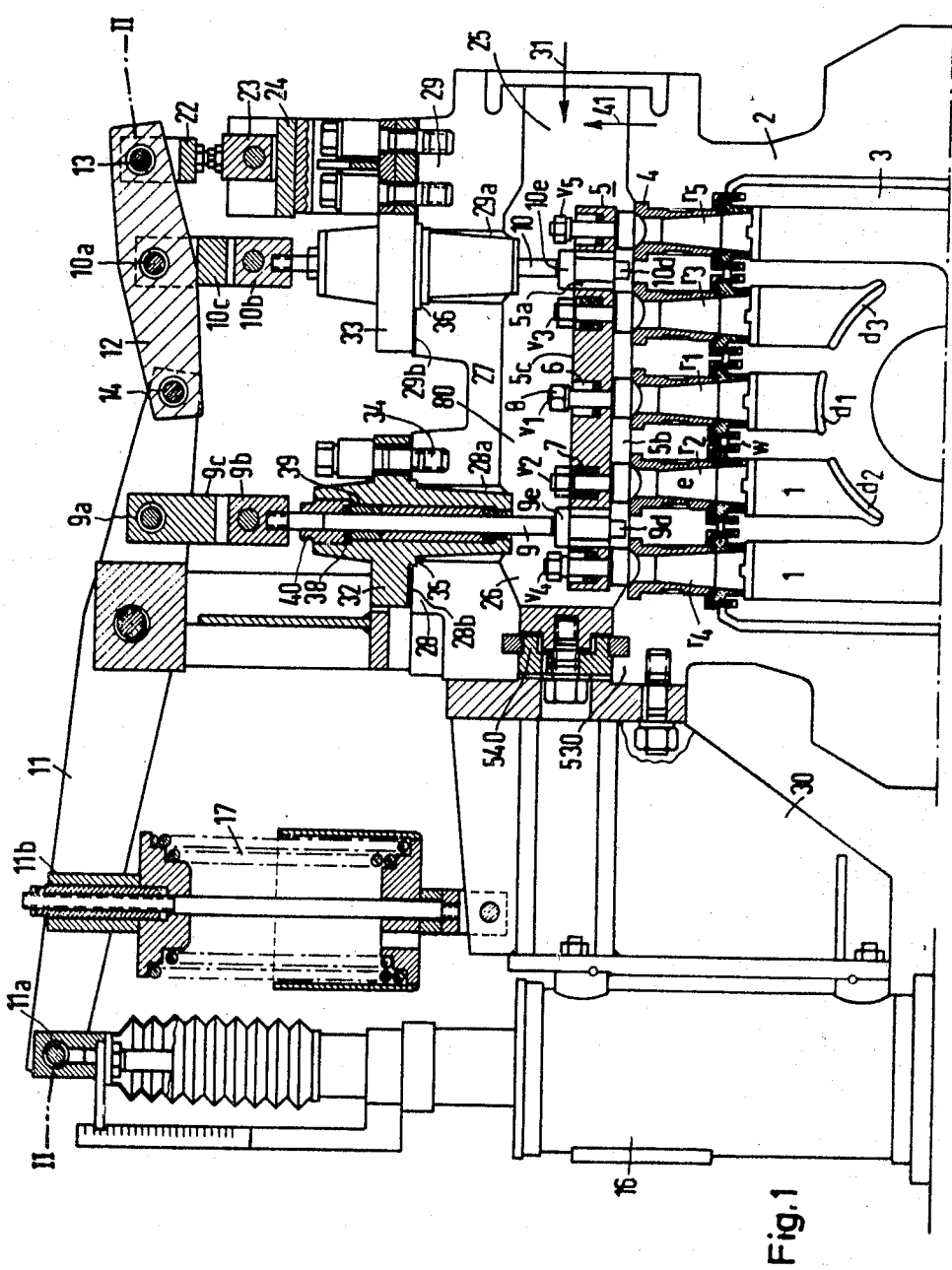
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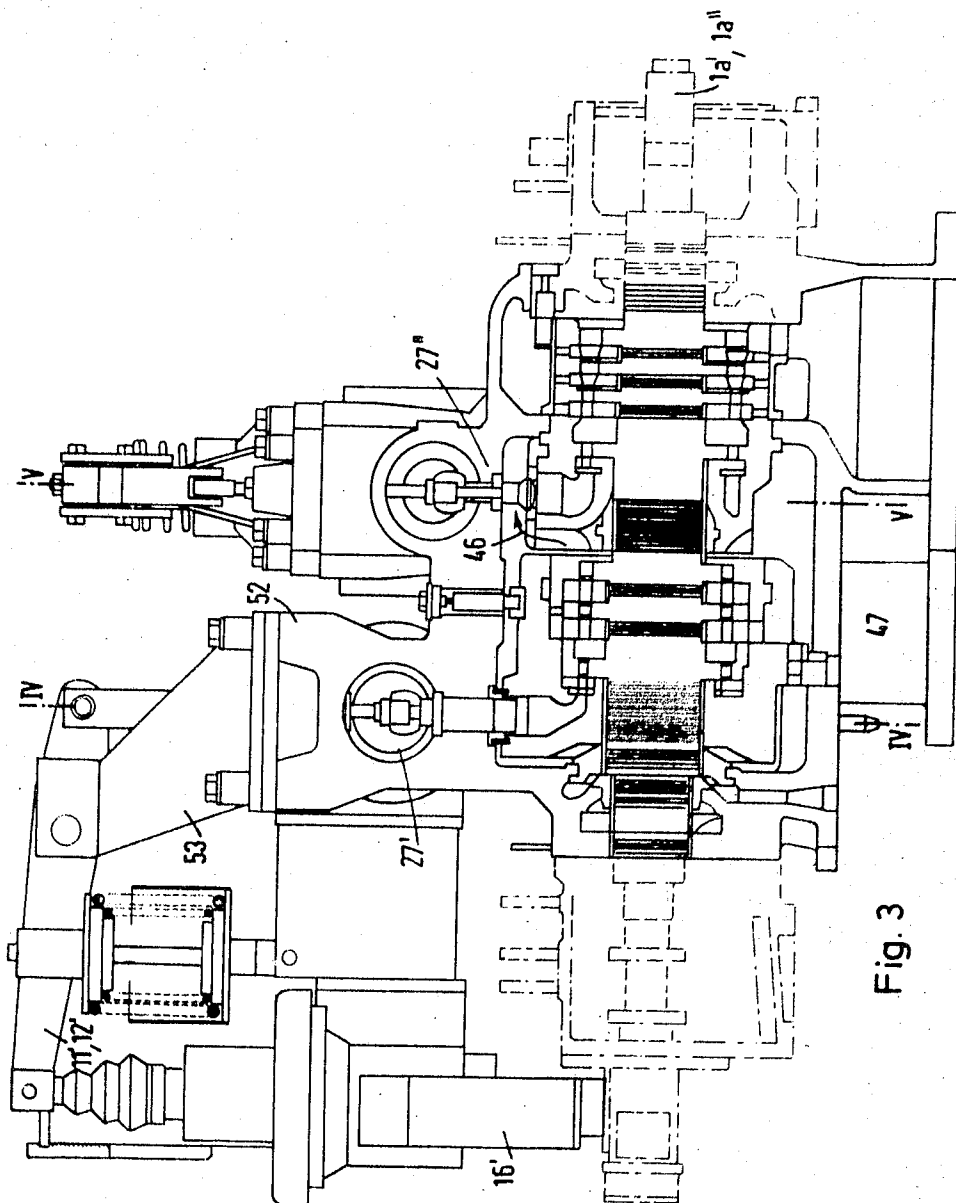
[57] **ABSTRACT**

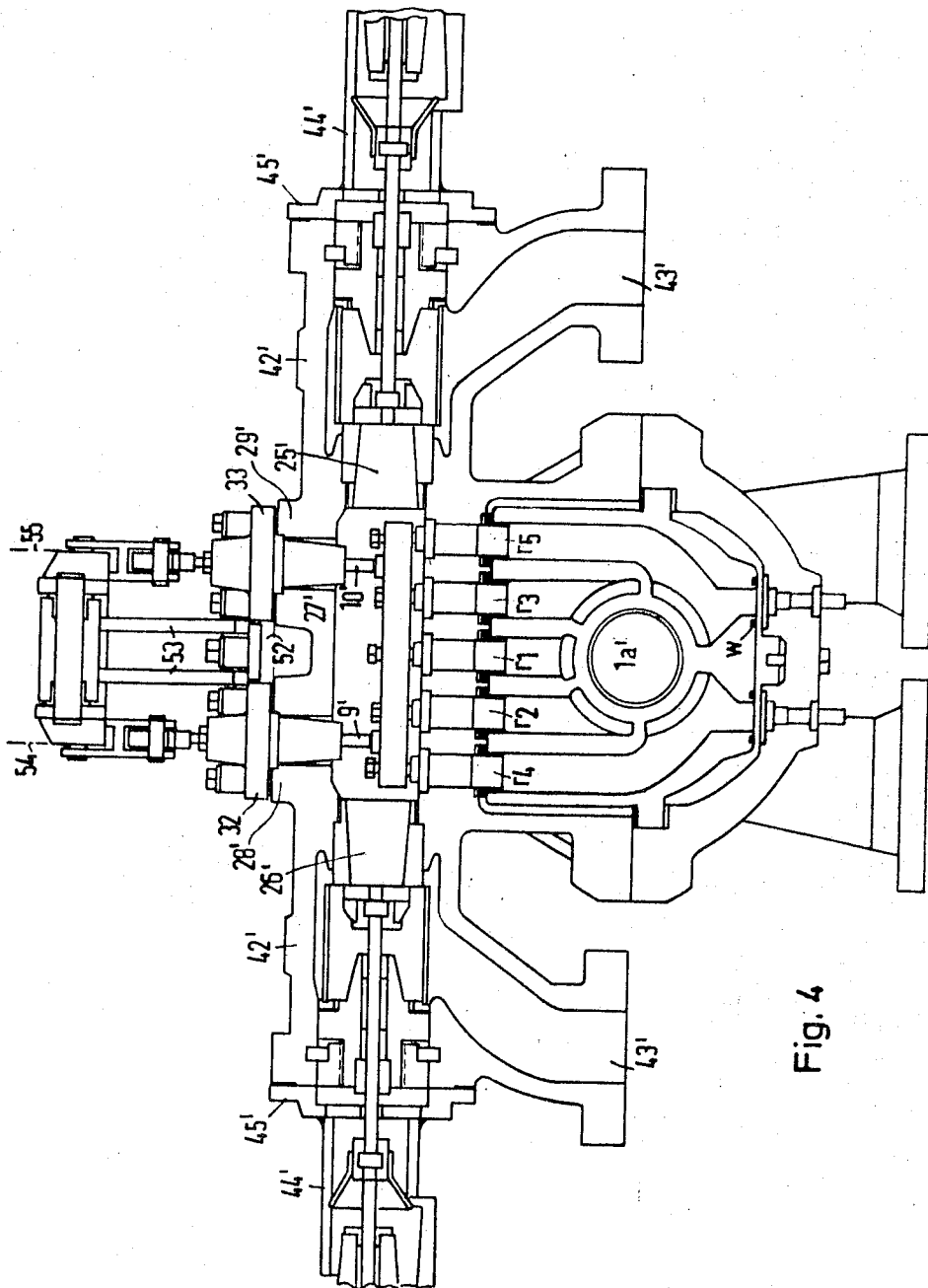
Turbine, having a plurality of nozzles, including means for supplying working fluid to the nozzles in common through a tubular inlet chest, means for controlling groups of the nozzles comprising control valves respectively coordinated with the individual nozzle groups, a traverse insertable in the tubular inlet chest in longitudinal direction thereof, through openings formed in the ends thereof, the control valves comprising valve tappets carried by the traverse, the tubular inlet chest having shaped tubular portions provided thereon, the shaped portions being formed with respective bores, control spindles vaportightly extending through the bores formed in the shaped portions and coupled with the traverse, the spindles being displaceable by a drive mechanism for actuating the traverse to selectively control closing and opening sequences of the valves.

10 Claims, 7 Drawing Figures









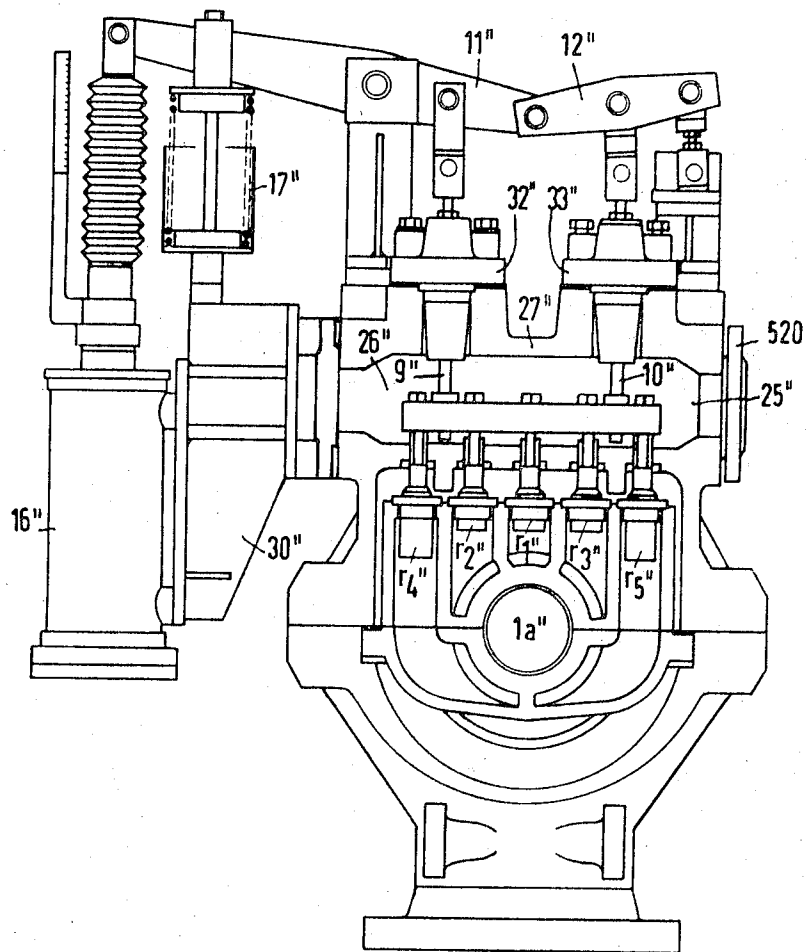


Fig. 5

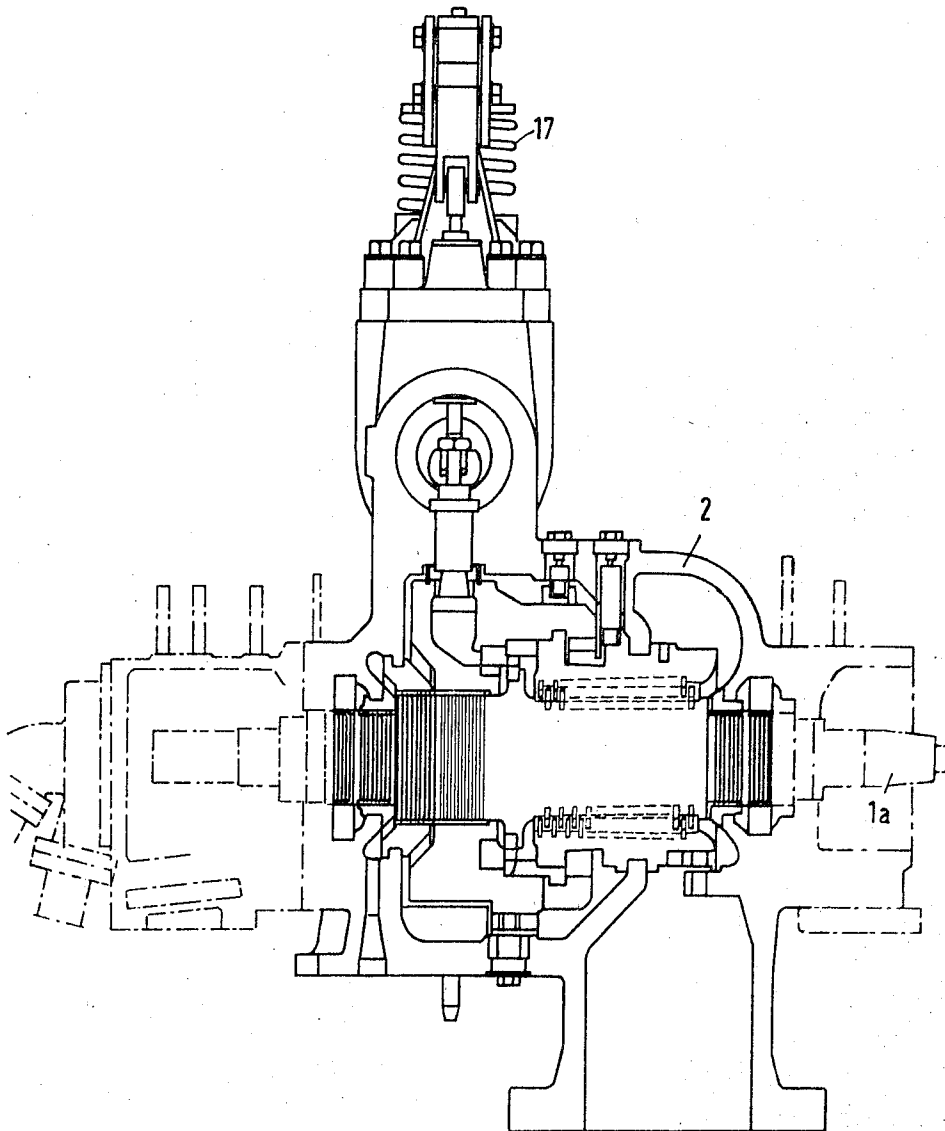
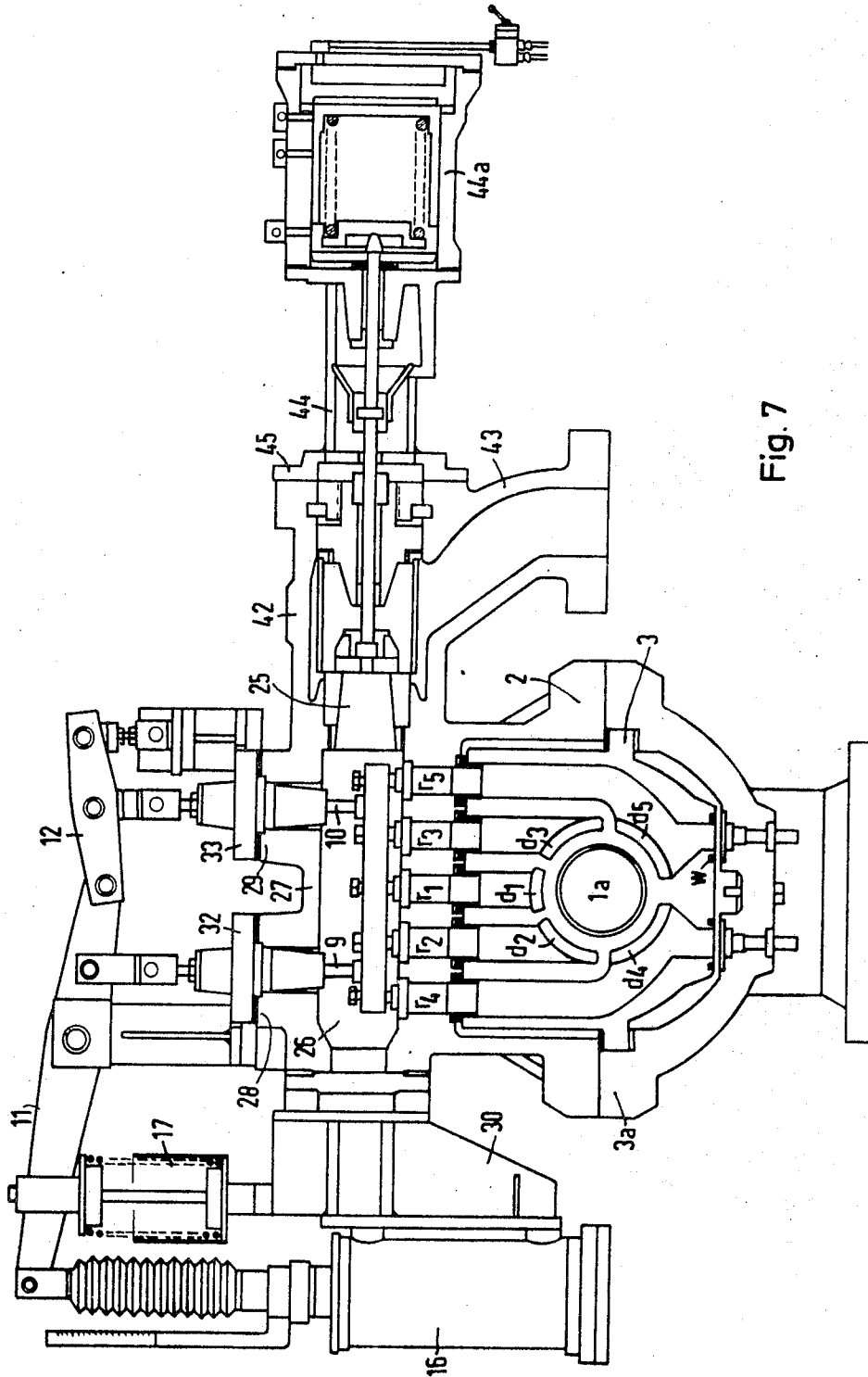


Fig. 6



TURBINE, ESPECIALLY STEAM TURBINE, WITH NOZZLE GROUP CONTROL AND FLOW ADMISSION CREST

My invention relates to turbines, especially steam turbines, having nozzle group control and control valves coordinated with the individual nozzle groups. Working fluid is supplied in common to the nozzles through a tubular inlet chest wherein a traverse (control beam) carrying the valve tappets and controlling the valves in specific closing and opening sequences, is disposed. Insertion openings for the traverse are provided in the inlet chest, and control spindles are provided which are displaceable by a drive mechanism and are vaportightly inserted into the inlet chest and coupled to the traverse.

Steam turbines of such construction are basically known, for example, from the house publication Siemens-Zeitschrift 1967, p.457 and pp. 464-466. Heretofore, in the conventional construction of inlet chests with control valves which are actuated by the traverse or control beam, there had been provided at the cover side of the inlet chest, a slot through which the control beam was insertable from above into the inlet chest. This slot was closed by a cover which covered the entire inlet chest, control spindles actuatable by a control valve drive (force amplifier) extending steamtightly through this cover. With increasing steam pressure, it had been found that such an inlet chest with a longitudinal opening or slot is stressed at the sidewall thereof by large bending forces and furthermore, great stresses are imposed upon the screws at the inlet chest cover. Attempts have been made in the case of high-pressure, high-temperature turbines to avoid these difficulties by omitting entirely a traverse or a control beam by providing the inlet chest with a tubular construction and controlling each control valve individually by a separate control spindle, the control spindles having to extend through separate bores formed in the inlet chest. The large number of spindles in this known construction is disadvantageous.

It is accordingly an object of my invention to provide turbine with nozzle group control and inlet chest and especially a steam turbine which retains a common traverse or control beam for the nozzle group control valve and thereby manages with only a small number of control spindles but which nevertheless can control high steam pressure and temperature without difficulty with respect to sealing of the inlet chest, i.e., flange sealing while avoiding undesired bending stresses in the sidewall.

With the foregoing and other objects in view, I provide in accordance with my invention, in a turbine having a plurality of nozzles, means for supplying working fluid to the nozzles in common through a tubular inlet chest, means for controlling groups of the nozzles comprising control valves respectively coordinated with the individual nozzle groups, a traverse insertable in the tubular inlet chest in longitudinal direction thereof through openings formed in the ends thereof, the control valves comprising valve tappets carried by the traverse, the tubular inlet chest having shaped tubular portions provided thereon, the shaped portions being formed in the shaped portions and coupled with the traverse, the spindles being displaceable by a drive mechanism for actuating the traverse to selectively control closing and opening sequences of the valves.

One of the advantages attainable with the traverse of my invention, is that the flange sealing of the control spindle bores, due to the circular appearance, is more advantageously shaped and easier controllable. The control beam or traverse can be readily inserted through the lateral openings of the inlet chest, while the control spindle with its stuffing boxes is inserted through the bores formed in the tubular portions of the inlet chest. Assembly is thus possible in a simple manner, even through a longitudinal opening is not provided in the upper side of the inlet chest.

In accordance with another feature of the invention, a cover containing the spindle guide and sealing means is threaded to the shaped tubular portions. These covers are especially screwed to the sealing flange with a plate-shaped collar and are provided with cylindrical or conical portions extending

from the platelike collar into the bore formed in the shaft portions and toward the outside. Form-locking means have been found to be particularly expedient as the coupling between the control spindle and the traverse.

In accordance with an especially advantageous feature of my invention, the control spindles are provided at the coupling end thereof with a hammerheadlike projection and with a stop member spaced from the coupling end. The traverse is formed with slotlike recesses corresponding to the hammerhead projections and extending in the longitudinal direction thereof, the coupling end, when inserted in the respective recess of the traverse, grips the traverse at the underside thereof by the hammerhead projections of the control spindles, by turning the control spindles through an angle of about 90° with the hammerhead projections.

The force lock in the one displacement direction of the spindle is produced, the force lock in the other displacement direction being produced by the stop member abutting the upper side of the traverse.

In accordance with another feature of the invention, the inlet chest is provided at the upper side thereof with two tubular shaped portions disposed in such a manner that both control spindles extend into the traverse in the vicinity of both ends thereof.

Because of the special construction and arrangement of the inlet chest, it is possible to employ the inlet chest in accordance with the known building block principle having a plurality of turbine embodiments. According to one embodiment of my invention, the tubular inlet chest is directly connected to a live steam supply or high-pressure turbine part and, for the purpose of inserting the traverse therein and for permitting access to the traverse, it is kept open at both tubular ends thereof, one or both of the tubular ends being provided with shaped tubular housing portions for forming live steam supply lines and for attaching rapid shutdown valves thereto. If only one live steam supply line is provided on one end thereof with a rapid shutdown valve, the other end of the tubular inlet chest can serve for mounting the control valve drive, i.e., in this case, a support member for the control valve drive is flanged to the other tubular end, the drive swings coupled to the control spindles being displaceable in a vertical plane disposed transversely to the turbine shaft. The principal similarly constructed turbine inlet chest can be located also within an extraction stage connected downstream of a high-pressure turbine and can be similarly open at both tubular ends thereof, being closable at one of the tubular ends by a sealing cover, while a support member having a control valve drive is flangeable at the other tubular end thereof. If the tubular inlet chest is provided at both open ends thereof with a live steam supply line and a rapid shutdown valve, in accordance with yet another feature of the invention, I provide the tubular inlet chest with flanges between both shaped tubular projections for securing a support member for the control valves, the drive swings coupled to the control spindles being displaceable in two vertical planes parallel to the turbine shaft.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in turbine, especially steam turbine, with nozzle group control and flow admission chest, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a front elevational view, partly in section, of the upper portion of a steam turbine containing an inlet chest part with an inner housing, outer housing and an attached control valve drive;

FIG. 2 is a longitudinal sectional view of FIG. 1 taken along the line II—II;

FIG. 3 is a general front elevational view, partly in longitudinal section, of an extraction reaction turbine with an inlet chest part constructed in accordance with the invention;

FIG. 4 is a cross-sectional view of FIG. 3 taken along the line IV—IV showing the inlet part of the high-pressure part;

FIG. 5 is a cross-sectional view of FIG. 3 taken along the line V—V showing the inlet part of the extraction reaction part of the turbine;

FIG. 6 is a view corresponding to that of FIG. 4 of a high-pressure, high-temperature turbine of the reaction type of construction; and

FIG. 7 is a view corresponding to that of FIG. 5 of an inlet part.

Referring now to the drawings and first, particularly to FIG. 1 thereof, there is shown a steam turbine with nozzle group control. Three nozzle groups d_1 , d_2 and d_3 are provided in the embodiment of FIG. 1, and control valves r_1 , r_2 and r_3 are coordinated therewith, respectively. Additional control valves r_4 and r_5 are coordinated with further nozzle groups d_4 and d_5 , shown in FIG. 7 although not in FIG. 1. Each of the control valves has inlet diffuser inserts e which terminate in the channels 1 leading respectively to the nozzle groups d_1 to d_5 . It deals with a turbine having an outer housing 2 and an inner housing 3. The valve tappets v_1 to v_5 are mounted within the traverse or the control beam 5 and are actuable by the latter in a specific closing and opening sequence. This sequence is determined by the elevation of the guide bushings 7 for the valve tappets v_1 and v_5 , the bushings 7 being mounted in respective recesses 6 formed in the beam 5, a fine adjustment being further permitted by nuts 8 that are threaded on the ends of the valve tappets. In FIG. 1, all of the control valves r_1 and r_5 are closed i.e., the cones 4 of the valves being forced by steam pressure in the inlet chambers 80 against the seats e of the valves. Two valve control spindles 9 and 10 are force lockingly coupled with the traverse 5 in both valve actuating directions. The valve control spindles 9 and 10 are articulately connected at 9a and 10a to drive swings 11 and 12, respectively, the swing 12 being pivotally mounted at one end thereof, in a joint 13 and at the other end thereof, articulately connected to the swing 11 at 14. At the other end 11a of the swing 11, a power piston of an oil hydraulic power amplifier is articulately connected and, through the compression spring device 17 which engages the swing 11 at 11b, a spring loading of the swing 11 in the direction of closing of the control valve r_1 to r_5 is produced. To compensate or balance the rotary movement of the swings 11 and 12 and the translatory movement of the spindles 9 and 10, the latter are articulately connected through joints 9b and 10b, respectively and intermediate levers 9c and 10c respectively to the respective swings 11 and 12. The swing 12 can execute the necessary pivoting movement through the joint 18 thereof and the adjustable intermediate lever 22 which is articulately connected at 23 to the bearing stand 2 that is fixed to the housing.

According to the invention, the traverse 5 is insertable in longitudinal direction of the tubular inlet chest 27 through openings 25 and 26 at the ends of the inlet chest, which forms a structural member with the outer housing 2. Control spindles 9 and 10 engaging the traverse 5 pass through tubelike shaped portions 28 and 29 formed in the casing of the inlet chest 27 and provided with sealing flanges 28b and 29b and with bores 28a and 29a, through which the spindles 9 and 10 extend, respectively. When installing the traverse 5 after the control drive 16 has already been secured through the support member 30 thereof, the opening 25 serves as an insertion opening; in principle, the traverse 5 is also insertable, however, through the opening 26, facing the drive 16. The opening 26, as noted further hereinafter, serves for attaching a rapid shutoff valve, so that live steam is admitted into the inlet chamber 80 in the direction of the arrow 31. The opening can, however, also be closed by a sealing cover when a rapid shutoff valve is not required. The just-described embodiment can

be employed also for a separately assembled inlet chest which is then connected through tubes with the turbine housing.

As shown in FIGS. 1 and 2, the covers 32 and 33 containing the spindle guide and seal are steamtightly connected to the tubelike shaped portions 28 and 29. Bolts or pinlike screws 34 are threaded in suitable bores formed in the tubular shaped portions 28 and 29. The covers 32 and 33 are respectively centered by annular ledges 35 and 36 at a corresponding annular shelf of the through-bores 28a and 29a for the respective spindles 9 and 10, whereby additional sealing surfaces are formed. To seal the spindle guide from the outside, sealing packings 38 are inserted in the central bore 39 of the covers 32 and 33 and are held in place by units 40 that are threadably secured in the respective covers 32 and 33.

By a desirable form-locking assembly technique wherein the control spindles 9 and 10 are provided with a hammerhead-shaped projection 9d and 10d respectively, at the coupling ends thereof and a stop or abutment 9c and 10c, spaced from the respective coupling ends, and adjustable under certain conditions, coupling is effected between the spindles 9 and 10, on the one hand, and the traverse 5, on the other hand. The traverse 5 is provided with slotlike recesses 5a corresponding to the hammerheads 9d and 10d and extending in the longitudinal direction thereof. After inserting the coupling ends of the control spindles 9 and 10 in these recesses 5a and after turning the control spindles 9 and 10 through an angle of about 90°, the control spindles with their hammerheads 9d and 10d, as shown in FIG. 1, engage and grip the traverse 5 at the underside 5b thereof. A force lock is thereby produced in one displacement direction of the spindles 9 and 10 as indicated by the arrow 41. The force lock in the opposite displacement direction, i.e., in the closing direction of the valves r_1 and r_5 is produced by the stops or abutments 9c and 10c which are integral with the respective spindles 9 and 10 and are in abutment with the upper side 5c of the traverse 5; a firm connection can also be produced, however, with adjustable nuts under tolerance balance.

As is readily evident, both control spindles 9 and 10 grip the traverse 5 in the region of the ends thereof and, in fact, respectively between the valves of both pairs of outer control valves r_2 and r_4 on the one hand, and r_3 and r_5 , on the other hand. This application of force is advantageous for the most uniform loading of the traverse 5. FIGS. 3 to 7 show advantageous embodiments of the invention dependent upon the coordination of the rapid shutdown valves and the control valve drive to the inlet chests. FIG. 7 corresponds to FIG. 1, and additionally shows the lower half 3a of the housing part 3, and the inlet chest 27 is provided at the end thereof located at the right-hand side of FIG. 7 with a tubular shaped portion 42 of the housing 2 to form a live steam supply tube 43 and for adding or attaching a rapid shutdown valve 44. This shaped portion 42 has been omitted from FIG. 1 only for the purpose of better clarity, but may be connected to the inlet chest 27 by welding or by a flange connection or, as shown in FIG. 7, by being directly cast therewith in one piece. In the last-mentioned case, a flange connection 45 is provided between the right half 44a of the rapid shutdown valve 44 and the tube-shaped portion 42. FIG. 6 shows a general view of the high-pressure, high-temperature turbine with a shaft 1a. Shaft seals, blade or bucket crowns or rings, vane carriers, bearings, exhaust steam pipes, etc., are not further identified or shown, since they are not absolutely necessary for understanding the invention. As shown in FIGS. 6 and 7, the support member 30 for the control valve drive is flanged to the other tube end of the inlet chest 27 (opening 26), the drive swings 11 and 12 that are coupled to the control spindles 9 and 10, respectively, are displaceable in a vertical plane disposed transversely to the turbine shaft 1a. In addition, similar parts in FIGS. 1, 2, 6 and 7 are identified by the same reference character.

Other variations of the device of my invention are shown in FIGS. 3 to 5, wherein an extraction reaction turbine is of the disc type of construction. Like parts in FIGS. 3 to 5 and in

FIGS. 1 and 2 are again identified by the same reference characters. As shown, the structure of the live steam inlet part according to the cross section IV—IV and FIG. 4 includes a respective shaped portion 42' on each side diametrically of the turbine shaft 1a is provided with a respective rapid shutdown valve 44' and a live steam feedpipe 43'. No space is available at both ends of the inlet chest 27' for securing the control valve drive, yet it permits the inlet chest 27' to locate flanges 52 between both tubelike shaped portions 28' and 29' thereof, for securing a support member 53 for the control valve drive, the drive swings 11' and 12', which are coupled to the control spindles 9' and 10', respectively, being displaceable in two vertical planes 54 and 55 parallel to the turbine shaft 1a. In the sectional plane V—V, i.e., the view of FIG. 5, the tubular inlet chest 27', which is open at both tube ends is capable of being closed at one of the tube ends thereof (opening 25'') by a sealing cover 520, whereas at the other tube end (opening 26''), the support member 30'' for the control valve drive 16'' is flanged thereto and, consequently, the opening 26'' is simultaneously sealed off. The drive swings 11'' and 12'' are again displaceable as in the embodiment of FIG. 1 in a vertical plane extending transversely to the turbine shaft 1a''. Since an inner shell only and no inner housing is provided in the turbine part of FIG. 5, the angle ring connections w' of FIG. 1 can be dispensed with in the embodiment of FIG. 5. The steam of other driving fluid travels according to FIG. 3 in direction of the arrow 46 from the outflowing end of the high-pressure part directly into the inflowing or inlet chest 27'' or into the extraction pipe 47.

The inlet chest 27, 27', 27'' is, as aforementioned, especially well suited for high-pressure, high-temperature turbines. In order to attain an effective sealing on the side of the inlet chest facing away from the rapid shutdown valve to be flanged thereto, a self-sealing auxiliary seal 540 (FIG. 1) is located in the throat portion 530.

I claim:

1. In a turbine having a plurality of nozzles, means for supplying working fluid to the nozzles in common through a tubular inlet chest, means for controlling groups of the nozzles comprising control valves respectively coordinated with the individual nozzle groups, a traverse, means for inserting said traverse into said tubular inlet chest in longitudinal direction thereof through openings formed in the ends thereof, said control valves comprising valve tappets carried by said traverse, said tubular inlet chest having shaped tubular portions provided thereon, said shaped portions being formed with respective bores and provided with sealing flanges, control spindles vaportightly extending through the bores formed in said shaped portions and coupled with said traverse, said spindles being displaceable by a drive mechanism for actuating said traverse to selectively control closing and opening sequences of said valves.

2. Turbine according to claim 1 including a cover containing guiding means and sealing means for said spindles, said

cover being fastened to said shaped tubular portions.

3. Turbine according to claim 1, wherein said control spindles are form-lockingly coupled to said traverse.

4. Turbine according to claim 3, wherein said control spindles have a hammerhead-shaped projection at a coupling end thereof and a stop member spaced from said coupling end, said traverse having slot recesses formed therein corresponding to the hammerheads and extending in longitudinal direction thereof, said coupling end, when inserted in a respective recess of said traverse, being grippingly engageable with said traverse at the underside thereof by said hammerhead projections, the respective control spindle being turnable through an angle of 90° with said hammerhead projections for producing a force lock in one displacement direction of said spindle, said stop member being in abutting engagement with the upper side of said traverse for producing a force lock in the other displacement direction of said spindle.

5. Turbine according to claim 4 wherein said stop member is adjustable and is formed by a nut seated on said control spindle.

6. Turbine according to claim 1, wherein two of said shaped tubular portions are mounted at the upper side of said inlet chest so that said control spindles are located in the vicinity of both ends of said traverse.

7. Turbine according to claim 1, wherein said tubular inlet chest, to permit the insertion of said traverse therein and to permit access to said traverse within said tubular inlet chest, has an opening at least at one end thereof, and including a shaped tubular housing portion at said open end for forming a live steam supply duct and for attaching a rapid shutdown valve thereat.

8. Turbine according to claim 7, having a live steam supply duct and a rapid shutdown valve at one end thereof, said other end of said inlet chest also having an opening, and including a support member for said control spindle drive mechanism flanged to said other end of said inlet chest, and drive swings coupled to said control spindles, said drive swings being displaceable in a vertical plane transversely to the shaft of the turbine.

9. Turbine according to claim 6, wherein said tubular inlet chest is formed with respective openings at both ends thereof, one of said open ends being closeable by a sealing cover, and a support member for said control valve drive mechanism being connectable with flanges to said other open end.

10. Turbine according to claim 7, wherein said tubular inlet chest is formed with respective openings at both ends thereof, and including live steam supply ducts and rapid shutdown valves located at both said ends, said tubular inlet chest being provided with flanges intermediate said two shaped tubular portions thereof for securing a support member thereon for said control valve drive mechanism, and drive swings coupled to said control spindles, said drive swings being displaceable in two vertical planes parallel to the shaft of the turbine.

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