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[33] **Germany**

[31] **P 18 12 487.3**

[56]

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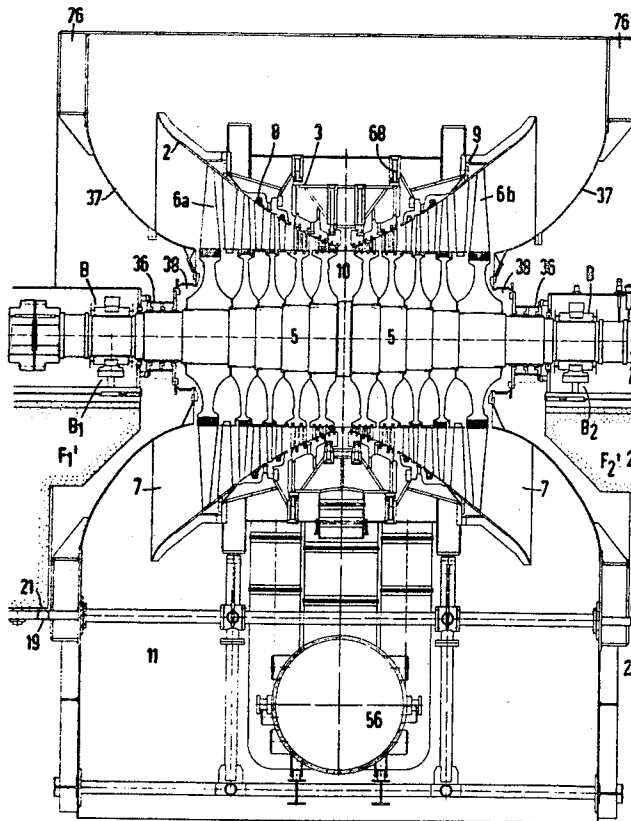
[54] **CASING FOR LOW-PRESSURE STAGES OF STEAM**
TURBINES OF COMPLETELY WELDED
MULTISHELL CONSTRUCTION
16 Claims, 9 Drawing Figs.

[52] U.S. Cl..... **415/60,**
415/108, 415/134, 415/219

[51] Int. Cl..... **F01d 1/24**

[50] Field of Search..... **415/60,**
108, 134, 219

ABSTRACT: Housing assembly for low-pressure parts of steam turbines includes housing for the individual turbine parts mounted on foundation support independently of one another, the underportions of a respective outer housing of a turbine part being connected in the vicinity of an axial partial joint of the outer housing and at both longitudinal sides thereof with longitudinal support frame forming integral housing components and being mounted by ends of the longitudinal support frames, projecting beyond the faces of the outer housing on the foundation support, the outer housing at one face thereof being axially fixedly and horizontally displaceably mounted on support locations of the longitudinal support frame and at the other face thereof being both axially and horizontally displaceably mounted on support locations of the longitudinal support frame, the outer housing being heat-expandably movable in axial direction thereof.



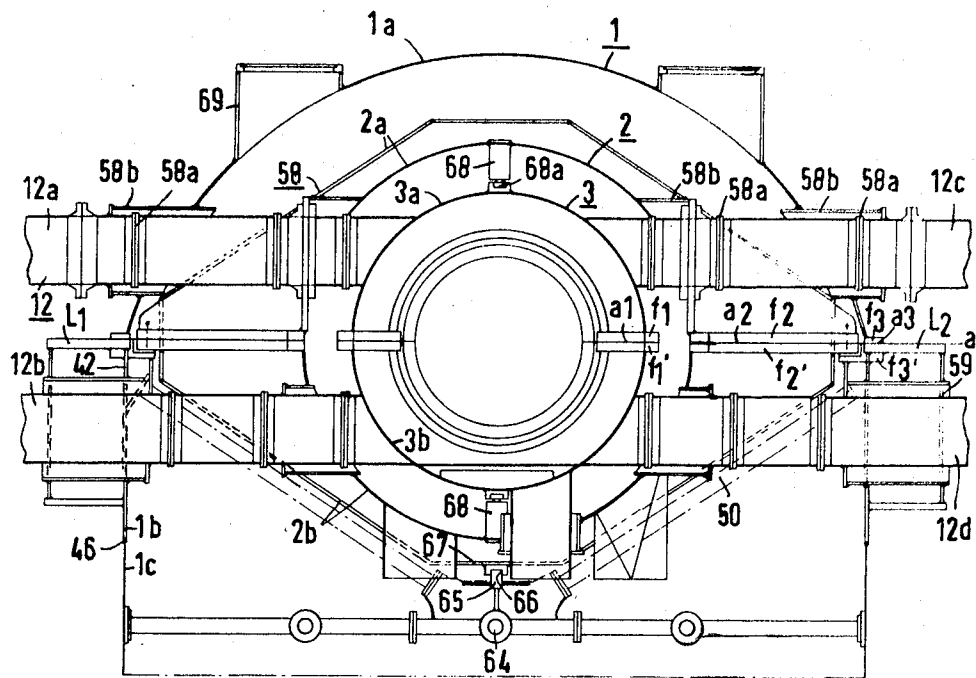


Fig. 1

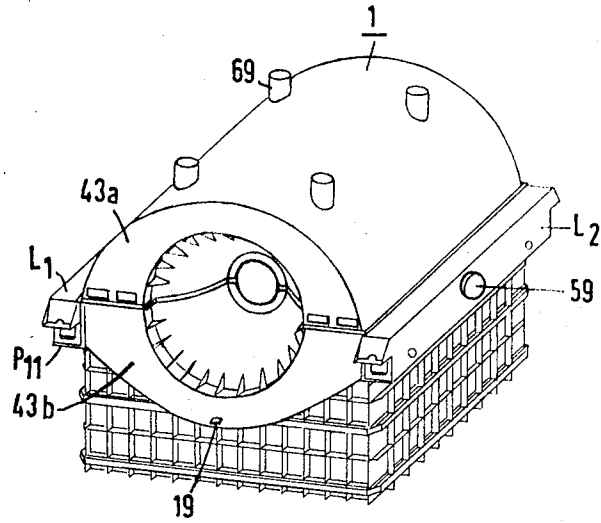


Fig. 5

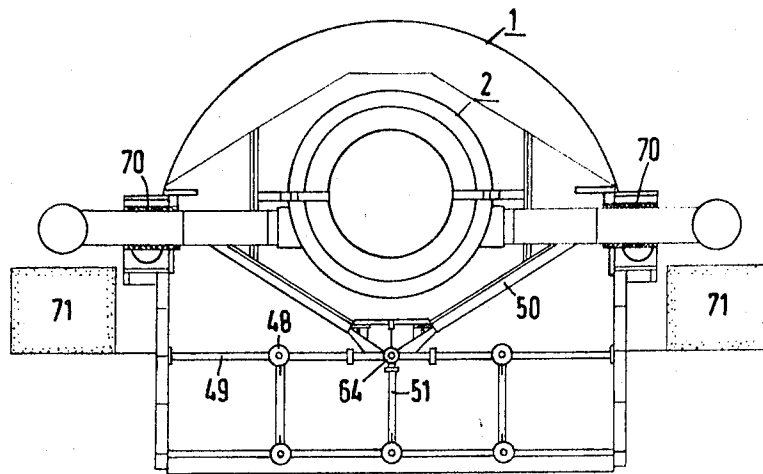


Fig. 4

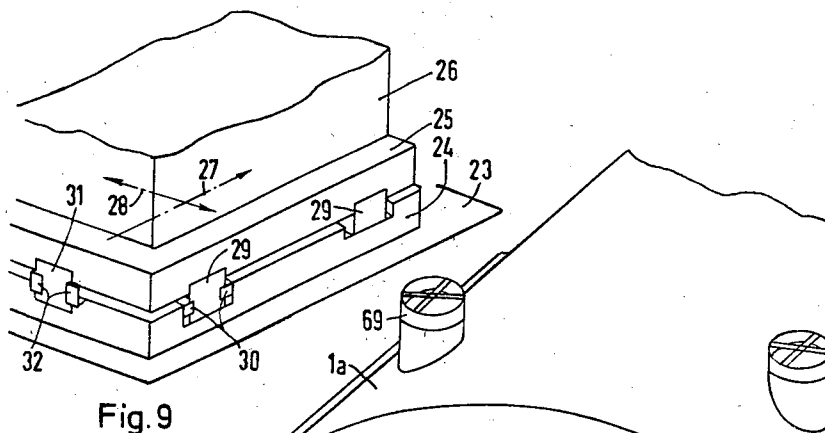


Fig. 9

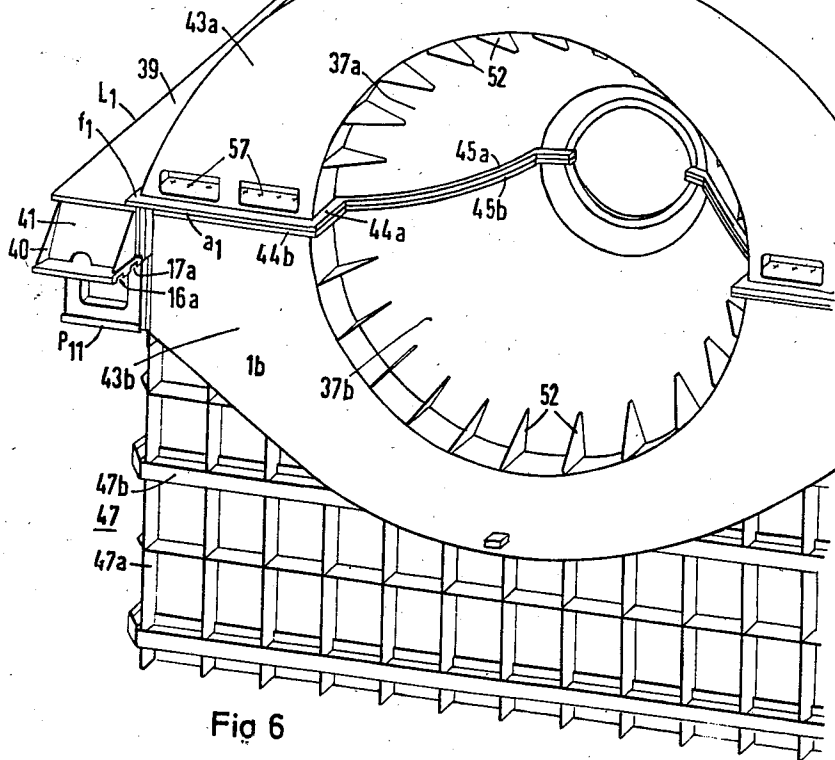


Fig 6

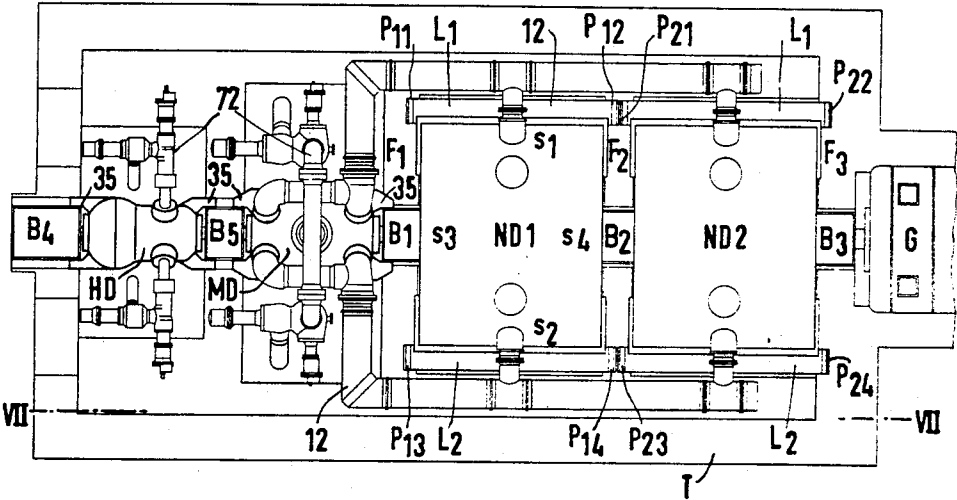


Fig.8

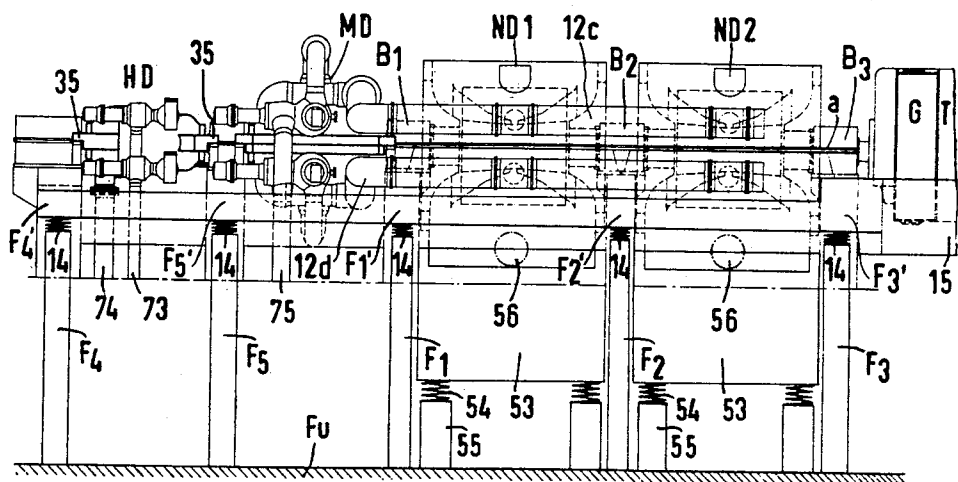


Fig. 7

CASING FOR LOW-PRESSURE STAGES OF STEAM TURBINES OF COMPLETELY WELDED MULTISHELL CONSTRUCTION

Our invention relates to housing for low-pressure parts of steam turbines in fully welded multishell construction, more particularly, our invention relates to housing for low-pressure partial turbines which are of double-flow construction with center flow inlet or single flow, wherein the housing is formed with axial partial joint and is provided with a respective outer housing with a central heat expansibly or displaceably mounted inner housing and wherein several low-pressure partial turbines are joinable together axially in an n -flow arrangement ($n=3, 4, 5, 6, \dots$). Such housings are known from German Published application DAS 1,270,575 and AEG-Mitteilungen, 1965, page 75, for example. The use of such welded housing constructions for low-pressure housing has for a long time superseded the grey cast-iron constructions due to the increasing size of turbine units. The most important advantages of welded construction as compared to cast construction are the saving of weight and structural length and an increase in operational reliability for large turbine units. As an example, the weight ratio between a cast and a welded exhaust component is about 3:1. With increasing turbine power outputs, thus for outputs of turbine states in the order of magnitude of 400 to 1,000 MW (megawatts), there is a striving to effect further savings of weight in view of the increasing dimensions of the low-pressure partial turbines and especially in view of the outer housing. This presents a special problem because the rigidity of the housing against distortion and bending as well as the axial and radially central heat expansible or displaceable mounting should be assured for the large dimensions and weights of the half-way housings which have to carry the inner housing parts, in turn.

It is accordingly an object of our invention to provide housing for low-pressure parts of steam turbines in fully welded multishell construction which avoids the aforementioned disadvantages of the heretofore known housings of this general type and which more specifically affords an accurate radial and axially central heat expansible or displaceable mounting in all cases for even lesser weights and good housing rigidity.

With the foregoing and other objects in view, we provide in accordance with our invention, housing assembly for low pressure parts of steam turbines of the aforementioned type wherein housings of the individual low-pressure partial turbines are mounted on foundation supports independently of one another, the underportions of a respective outer housing of a low-pressure partial turbine being connected in the vicinity of an axial partial joint of the outer housing and at both longitudinal sides thereof with longitudinal support frames forming integral housing components and being mounted by ends of the longitudinal support frames, projecting beyond the faces of the outer housing, on the foundation supports, the outer housing at one face thereof being axially fixedly and horizontally displaceably mounted on support locations of the longitudinal support frames and at the other face thereof being both axially and horizontally displaceably mounted on support locations of the longitudinal support frames, the outer housing being heat expansibly movable in axial direction thereof.

The advantages attainable from the invention are primarily that although only four supporting locations are provided at all four housing corners, considerable weight can be transmitted by the longitudinal support frames to the foundation. It was conventional heretofore to support or absorb the weights of several low-pressure partial turbines on longitudinal support frames separately passing therethrough or on a supporting surface surrounding all four sides of the low-pressure turbine part. This is then no longer necessary, resulting in a considerable simplification of the structure and a reduction in the total weight. Due to the combination feature of mounting the bearing stands of the low-pressure partial turbines on the foundation supports independently of the outer housings, an

advantage is derived that a reaction of the diffuser cone of the outer housing, which expands and contracts with the outer housing independently of the load condition, is prevented from being applied to the bearing stand housing. This is significant especially in view of the fact that the shaft seal shell or stuffing box housing is rigidly connected to the bearing stand, and this shaft seal is uncoupled from or rendered independent of the thermal expansion displacement of the outer housing. Due to the measures for mounting and guiding the outer housing, the advantage is attained that also for independent or uncoupled mounting, the outer housing maintains its centered position with respect to the turbine shaft, and the expansion length of the outer housing in axial direction thereof relative to the shaft, i.e. the difference in the expansions thereof, is held within tolerable limits.

The housing assembly according to our invention is especially suited to directly welding or screwing together two, four or six flow low-pressure turbine parts or more from a plurality of similar components in situ according to the so-called building-block principle. Consequently, in accordance with a further feature of our invention, the low-pressure partial turbines are assemblable of similarly constructed inner housings, outer housings, longitudinal support frames and bearing stands for turbine parts having an even number of flows.

In accordance with another feature of our invention, a stuffing box housing is rigidly connected with a respective bearing stand, and the stuffing box housing is steamtightly connected to a diffuser part of the outer housing conically surrounding the stuffing box housing through the intermediary of softly bendable, elastic members such as shaft tube, ring membranes or the like. Such elastic intermediate members ensure an independent axial and radial thermally expansive movement of the bearing stand and the outer housing.

In accordance with an additional feature of the invention, the longitudinal support frames which are screwed and welded to the lateral sides of the underportion of the outer housing, are formed of boxlike supports having a top surface substantially aligned with the axial partial joint of the housing and carrying an outer partial joint flange formed on the upper portion of the outer housing. It has been found that such boxlike supports are able to be provided with adequate rigidity against bending.

According to yet another feature of our invention, the longitudinal support frames have a steplike termination at the supporting ends thereof forming supporting paws extending collarlike about halfway up the profile elevation of the longitudinal support member and being reinforced by lateral and cover crosspieces.

In accordance with a further feature of the invention, the halves of the outer housing are formed at the end faces thereof as arched boxlike supports (circular boxlike supports) clamped together at wide-area partial joint flanges. The outer housing is thereby supported at the end faces thereof by the two arched boxlike supports and the longitudinal support frames connected on both sides to these two arched boxlike supports, the shell of the upper portion of the outer housing being curved thereabout, and a substantially rectangular part of a steam exhaust pipe being welded to the lower portion of the outer housing.

According to a concomitant feature of our invention, the longitudinal support frames are provided with inner lateral cheeks forming sidewall portions of the lower outer housing half, a box-shaped lower part of a steam exhaust pipe being welded to these sidewall portions as well as to the lower arched boxlike support halves.

According to another feature of our invention, a box-shaped condenser is connected to the box-shaped lower part of the steam exhaust pipe, the condenser being supported through spring supports on second foundation surface means, so that part of the weight of the partial turbine is absorbed thereby.

To obtain an idea as to the orders of magnitude involved, it should be noted that the outer and inner housing of a low-

pressure turbine part weigh about 560 tons together, the outer housing about 340 tons and the inner housing about 220 tons. During normal operation, a loading of about 100 tons, for example, is absorbed by the foundation for each supporting location of the support paws; the remaining load of about 160 tons is transmissible through the condenser and the spring supports thereof to the second foundation surface means.

For rigidly emplaced condensers with flexible connection between turbine and condenser the air pressure forces, which are the product of the flow-through surface area of the air pressure, must be transmitted through the longitudinal support frames to the foundation. It is therefore necessary to considerably reinforce the longitudinal support frames for the outer housing. In the embodiment disclosed herein, 250 additional tons must be added, due to outer air pressure, to the 100 tons for a weight of 1,000 tons per supporting location. The disclosed construction of a housing assembly with spring supported condenser is therefore more advantageous. The rule for determining the dimension of the spring is that, for the slightest operating weight and the greatest thermal expansion, a resulting force will still act on the support locations of the longitudinal support frame or the paws in the direction of gravity so that the paws cannot be lifted. For this advantageously complete assembly it is desirable for the outflow lines to be guided to the outer housing in pairs laterally and symmetrically, i.e. two or four altogether, and to mount these overflow lines at the respective quadrants of the outer and inner housing with the intermediary of shaft tube compensators. Consequently, adequate space is made available for the condenser installation below the outer housing whereby the tank, pot or tubular-shaped housing for feed water preheaters can be inserted transversely to the turbine axis in the exhaust pipe space.

In accordance with further features of the invention, the walls of the exhaust pipe are reinforced by ribbing formed of supports and welded to the outer sides of the walls. The walls of the exhaust pipe are advantageously bridged and reinforced at the inner sides thereof by a supporting tube framework formed of longitudinal, transverse, inclined and vertical tubes. This supporting tube framework can serve, with the parts thereof located below the turbine shaft, for carrying or accommodating axial guide elements for the outer and inner housings.

The support locations or support paws of the longitudinal support frames serving to fix the outer housing in axial direction are advantageously disposed on the end face of the housing facing the preconnected HB or NB partial turbines, i.e. toward the hot end of the turbine shaft because the axial shaft expansions begin from this direction and, in the vicinity of the HB or NB partial turbines, the shaft is fixed by thrust bearings in axial direction. In order to keep friction between the supporting paws and the respective support locations on the foundation, on which suitable slide plates are superposed, as small as possible, it is desirable that the support paws are horizontally displaceable mounted on both faces with intermediary of slide keys, fixing keys being inserted in corresponding radial grooves between the support paws and the slide plate at the end face at which it is fixed against axial displacement.

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

The construction and method of operation of the invention, 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 cross-sectional view of a housing layout according to the invention for a double-flow low-pressure turbine part;

FIG. 2 is a sectional view of FIG. 1 taken along the line II-II in the direction of the arrows and showing an axial joint of the lower housing shell;

FIG. 3 is a longitudinal section, reduced in size, of the housing layout shown in FIGS. 1 and 2, showing the exhaust steam pipe part;

FIG. 4 is a cross-sectional view of FIG. 3 also showing the exhaust steam pipe part;

FIG. 5 is a perspective exterior view of the housing layout with outer housing upper and lower portions;

FIG. 6 is a much enlarged partial view of FIG. 5;

FIG. 7 is an elevational view of the housing layout with two double-flow low-pressure turbine parts within a single-shaft turbine stage showing the condensers and their associated foundation and preheaters for the low-pressure turbine parts;

FIG. 8 is a plan view of FIG. 7; and

FIG. 9 is a perspective view, partly broken away, of a pedestal support for the housing layout of the invention.

Referring now to the drawings, and first particularly to FIGS. 1 to 3 thereof, there is shown, in accordance with our invention, the housing layout of a double-flow low-pressure part of a steam turbine in fully welded and multishell construction formed of an outer housing 1 with an upper shell half 1a, and underportion 1b with a lower exhaust steam pipe part 1c, an outer interior housing 2 with an upper part 2a and a lower part 2b as well as an inner interior housing 3 with an upper part 3a and a lower part 3b. All housing parts 1 to 3, as shown, are divided in the horizontal axial plane i.e. the axial partial joints a_1, a_2, a_3 of the corresponding housing parts 1 to 3 are located in the horizontal plane a . Each of the housing parts have partial joint flanges f_1, f_2 or f_3 (upper partial joint flanges) and f'_1, f'_2 or f'_3 (lower partial joint flanges), the corresponding housing parts 1 to 3 being clamped together steamtightly with these flanges. In FIG. 3, the shaft 4, which is composed of individual disc members 5, is provided with running blade rings 6a, 6b at the outer periphery for both steam flows. A diffuser space 7 is located at the ends of the blade system for receiving steam discharging therefrom. The outer interior housing 2 and the inner interior housing 3 carry the guide vane rings 9 with suitable guide vane carriers 8. The low-pressure part is, as shown, of double-flow construction with a central inflow 10. After traversing both blade system halves 6a, 6b and the diffuser 7, the steam passes into the space 11 of the exhaust steam pipe 1b, 1c and from there flows into an after-connected condenser. Overflow ducts 12a to 12d lead to the center inflow 10. Support pedestals B are provided for the shaft 5 as shown in FIG. 3. The interior housing 2 is centrally heat displaceably mounted at the outer housing 1, and similarly the inner interior housing 3 at the outer interior housing 2, a further description thereof being given hereinafter. The low-pressure part shown in FIGS. 1 to 3 can be axially joined together in accordance with the embodiment of FIGS. 7 and 8 into a quadruple flow low-pressure turbine installation; it is also possible to assemble three of such double-flow low-pressure parts into a six-flow installation or to combine a single-flow low-pressure turbine part (not illustrated) with double-flow parts to form a low-pressure turbine installation of an odd flow number.

As shown particularly in FIGS. 7 and 8, the housings ND1, ND2 of the individual low-pressure turbine parts are mounted independently of one another on the foundation supports F_1, F_2, F_3 . These foundation supports extend upwardly from a lower foundation plate F_u , crossbars F'_1 to F'_3 being superimposed on the foundation supports or columns F_1 to F_3 , respectively, with spring members 14 interposed. Corresponding foundation supports F_4 and F_5 , with superposed crossbars F'_4 and F'_5 , respectively, are located in the vicinity of the high-pressure turbine part HD and intermediate pressure turbine part MD. In addition, a tabletop T is disposed on the foundation supports F_1 to F_5 or the crossbars F'_1 to F'_5 , the upper surface 15 of the table top T being located below the horizontal axial plane a as shown in FIG. 7. As mentioned hereinbefore, the housings ND1, ND2 are mounted independently of one another on the foundation supports. Further in regard thereto, the lower parts 1b of the outer housing 1 (FIG. 1) in the vicinity of the axial partial joint a_1 are at both longitudinal sides s_1

and s_2 thereof (FIGS. 2 and 8) are connected with longitudinal frame members L_1 and L_2 and mounted on the foundation supports F_1 to F_3 with the four ends of the longitudinal frame members L_1 and L_2 projecting over the front faces s_3 and s_4 of the housing 1. The housing ND1 is provided with projecting ends P_{11} to P_{14} of the longitudinal frame members, and the housing ND2 is provided with projecting ends P_{21} to P_{24} of the longitudinal frame members. In addition, the bearing stands or pedestals B_1 , B_2 and B_3 of the low-pressure turbine parts ND1 and ND2 are mounted independently of the outer housings 1 on the foundation supports F_1 to F_3 . The outer housing is thereby movable independently of the bearing stands. To obtain an accurate mounting and fixing, as shown especially in FIG. 2, the outer housing 1 or its underportion 1b is axially fixed at the longitudinal frame member projecting ends or support locations P_{11} and P_{13} of the end face s_3 thereof (slide key 16), and however mounted so as to be displaceable radially (slide key 17), in contrast thereto mounted so as to be axially and radially movable (slide key 18) at the longitudinal frame member support locations P_{12} and P_{14} of the other face s_4 thereof. Thereby, the outer housing 1 or its underportion 1b is simultaneously guided heat-expandably in axial direction, as indicated in FIG. 2 by the slide keys 19 and 20 with associated slide surfaces 21, 22 located centrally beneath the shaft. The last-mentioned slide keys 19, 20 are more clearly shown in FIG. 3; they form a center guide for the outer housing together with the slide surfaces 21 and 22, the latter being connected with the foundation crossbars F_1' , F_2' or the supports F_1 , F_2 . In FIG. 9 there is shown in perspective view and in principle a possible embodiment of the bearing stands B_1 to B_3 of FIGS. 7 and 8. The bearing stand as shown in FIG. 9 has a baseplate 24 which is connected with the foundation or foundation lip 23 by a nonillustrated tie rod, the baseplate being further adjustable by means of an arrangement of set screws distributed over the base surface of the baseplate 24. In the interest of clarity, the setscrews are not illustrated in FIG. 9. A foot plate 25 of the bearing stand 26 proper is mounted on the baseplate 24 so as to permit heat expansion in the axial direction represented by the arrow 27 and in transverse direction represented by the arrow 28. For this purpose, transverse keys 29 are inserted in corresponding transverse grooves formed between the foot plate 25 and the base plate 24, gibs for the transverse keys 29 abutting the hot end of the turbine, the gibs 30 defining an axial bench mark or set point of the bearing stand at this end, wherefrom the axial thermal expansion indicated by the arrow 27 can be taken as a starting point. For the purpose of accurate guidance of the foot plate 25, during axial thermal expansion thereof, central slide keys 31 with gibs 32 are provided at both ends between the foot plate 25 and the baseplate 24. Radial thermal expansions of the foot plate 25 or the bearing stand 26 are possible along the keys 29 and 30, as shown in FIG. 9. In case the bearing stand 26 is provided for carrying two radial bearings to support relatively great shaft weights, the transverse keys 29 should be centrally disposed respectively below the radial bearings as shown in FIG. 9. For relatively small turbine units or shaft weights, it is also possible, however, to provide a shorter layout with only one transverse key 29 per bearing stand 26 or in fact possible to completely ignore horizontal i.e. transverse and longitudinal thermal expansion with respect to the illustrated guide elements 29 and 31, because the incident expansions have only slight values for relatively small dimensions of the bearing stands. The bearing stands B_4 and B_5 according to FIGS. 7 and 8 are also constructed in a similar manner, the axial bench mark or set point being defined by the bearing stand B_5 . The housing paws 35 of the housing portions HD and ND rest on separate, not further illustrated, foundation supports. Guide spurs can be provided for these housing portions HD and ND below the axial partial joint for guiding these housing portions in axial directions on guiding counter surfaces connected with the foundation. A generator G, as shown in FIG. 7, for example, is driven by the shaft 4 of the illustrated turbine stage.

It is particularly advantageous if the low-pressure turbine parts ND1, ND2, etc. for an even number of flow units as shown are assemblable from similarly constructed inner housings 2, outer housings 1, with longitudinal support frames L_1 and L_2 and bearing stands B_1 , B_2 , B_3 , etc. It is further advantageous if, as shown especially in FIG. 3, with the bearing stands B_1 to B_3 , a respective shaft sealing housing or stuffing box housing 36 is firmly connected, and the sealing housing 36 and a conical diffuser part 37 of the outer housing 31 surrounding the same are steamtightly connected through softly pliable, elastic shaft tubes, compensators, ring membranes 37, or the like. The longitudinal support frames L_1 and L_2 are formed in the shape of boxlike supports (note especially FIGS. 1, 5 and 6) whose upper surface 39 is aligned with the axial housing partial joint a_1 and carries the outer partial joint flange f_1 of the outer housing upper portion 1a. The longitudinal support frames L_1 and L_2 have a steplike termination at their supporting paws P_{11} to P_{24} , and the supporting paws forming a collar extending up about half the profile elevation of the longitudinal support frames are reinforced by lateral crosspieces 40 and cover crosspieces 41. The inner lateral walls 42 of the longitudinal support frames L_1 and L_2 form sidewall portions of the lower housing half 1b, the sidewalls 42 being screwed and welded to the lower housing half 1b along the entire axial length of the outer housing 1 or the longitudinal support frame L_1 and L_2 . The outer housing halves 1a and 1b are formed at their faces s_3 and s_4 as arched boxlike supports, so called annular box-type supports, 43a and 43b, as is shown especially in FIGS. 5 and 6 as well as in the longitudinal section of FIG. 3. These annular boxlike supports 43a and 43b are clamped together at wide area partial joint flanges 44a and 44b. Both halves 37a and 37b of the diffuser housing parts which are provided with flanges 45a and 45b are connected to the annular boxlike carriers 43a and 43b. The location of the flange screws or bolts is indicated in FIG. 6 by small crosses. The boxlike lower steam exhaust pipe part 1c is welded (welding seam 46 in FIG. 1) to the sidewalls 42 of the longitudinal support frames L_1 and L_2 and the lower annular boxlike support 1b connected thereto. The walls of the steam exhaust pipe parts 1b and 1c are reinforced by a ribbing formed of supports 47 and welded to the outer sides of the walls. In the illustrated embodiment, vertical support parts 47a and horizontal support parts 47b are provided forming a reinforcement net with rectangular intersections. In addition, an inner reinforcement of the steam exhaust pipe parts 1b and 1c is provided as shown especially in FIGS. 1, 3 and 4. In regard thereto, the walls of the exhaust pipe parts 1b and 1c are bridged and reinforced at the inner sides thereof by a support tube framework formed of longitudinal tubes 48, transverse tubes 49, inclined tubes 50 and vertical tubes 51. Moreover, both halves 37a and 37b of the diffuser part 37 are stiffened in the transition region to the annular boxlike supports 43a and 43b by radial ribs 52. The steam exhaust pipe part 1c in turn is advantageously connected with a boxlike condenser 53 (FIG. 7) of suitable base area which rests on top of the supporting spring 54 disposed on relatively short supporting columns 55 that are carried by the second foundation plate F_2 . In addition, there is provided thereby a spatially desirable arrangement which can be employed for inserting feedwater preheaters 56 transversely to the turbine shaft 4 in the steam exhaust pipe chamber, for example as tubular or cylindrical members.

As has been especially indicated in FIG. 2 when taken in connection with FIGS. 6 and 8, the longitudinal support frame supporting locations or support paws P_{11} and P_{13} and accordingly P_{21} and P_{23} serving to axially fix the outer housing are located on the housing face s_3 which faces the preconnected HD or ND partial turbines. These paws, as aforementioned, are provided with additional fixing keys 16 which permit radial thermal expansion but no axial movement of the outer housing 1, however. In FIG. 6 there is shown the corresponding groove 16a in which the fixing keys 16 are received. In addition, all four support paws of a low-pressure turbine part ND1 or ND2, as aforementioned, are horizontally

slidably mounted on the foundation supports or corresponding sole plates, with the slide keys 17 and 18 interposed. As further shown in FIG. 6, a groove 17a is located adjacent the support paw P₁₁ for receiving the slide key 17 therein. The support paws P₁₁ and P₁₄ or P₂₂ and P₂₄ can slide both axially and radially. Recesses 57 are provided for the purpose of making the internally located flange screws or bolts of the tube box support 43a accessible.

As shown in FIGS. 7 and 8 as well as in FIG. 1, four overflow lines 12a and 12d extending laterally to the outer housing 1 in symmetrical arrangement are provided and are mounted respectively at the quadrants of the outer housing 1 and of the inner housing 2, 3 with interposition of shaft tube compensators 58, including the ring membranes 58a and the compensator cage 58b. This lateral guidance of the overflow lines makes available adequate space for the condensers 53 and feedwater preheaters 56 below the low-pressure turbine parts ND1 and ND2. The overflow lines 12b and 12d of the lower housing quadrants are guided through the longitudinal support frames L₁ and L₂ and in fact through suitable cutouts 59 formed therein. This means that further space is obtainable for compact construction. Moreover, the longitudinal support frames L₁ and L₂, as shown especially in FIG. 2, are provided in the vicinity of the upper edges 60 thereof facing the housing parts 1 to 3 with cutouts 61 as bearing locations for receiving the paws 62 of the inner housing underportion 2b so that the axial partial joint a₂ of the inner housing 2 is aligned with the axial partial joint a₁ of the inner housing 1. For the inner housing underportion 2b, four paws generally indicated at 62 and four bearing locations 61 accordingly are provided in a rectangular symmetrical arrangement, the bearing locations and paw pairs 61, 621 and 623 of the one housing face s₃, according to the fixing of the outer housing 1 at this face s₃, are provided with fixing keys 63 for axially fixedly though radially movably mounting the same. If the fixing keys 16 of the outer housing 1 were located at the other face s₄, the fixing keys 63 of the inner housing would then be seated at the locations 63'.

Also for the inner housing parts 2 and 3 a middle guide or a guide in the axial direction is provided, and in fact a guide key 65 is firmly connected to the intersecting location 64 of the rigid support tube framework 48 to 51, and the outer interior housing part 2 with a guide member 67 having an axial groove 66 slides on this guide key 65. The inclined tubes 50 are moreover firmly connected to the longitudinal support frames L₁ and L₂ respectively, as shown in FIG. 1. The more inward inner housing part 3 mounted with its flange F₃ in corresponding cutouts of the flange F₂, is radially and axially centrally heat-displaceably mounted opposite the outer inner housing part 2, by a radial pin centering device 68. Thus, due to the prevention of thermal expansions, no thermal stresses either in the more inward inner housing part 3 or in the more outward inner housing part 2 or in the outer housing 1 can arise. In particular, the bearing locations 68 are formed by radial pins which carry slide blocks 68a at the ends thereof on which both shell-halves 3a and 3b of the more inward inner housing part 3 can slide axially and radially centrally heat-displaceably, the radial pin extending through an eccentric bushing which permits adjustability of a centering device. Reference can be had to the copending applications of W. Trassl et al. (F-4295) and H. Haas et al. (F-4296) assigned to the same assignee as that of the instant application and filed concurrently herewith for further details of such centering devices. In addition, outer housing tubes 69 are provided to which, in emergency situations, steam discharge tubes can be connected and which, in the illustrated embodiment of FIG. 6, are closed by rupture membrane members 69a, or the like. As shown in FIG. 4, the locations 59 through which the overflow lines 12 extend are provided with insulation 70 such as of asbestos, for example. The contours of the tabletop longitudinal crossbars are shown at 71 in FIG. 4.

Furthermore, FIGS. 7 and 8 show combined rapid shutdown control valves 72 of the HD and ND parts of the turbine, live steam lines 73 of the HD part of the turbine, discharge lines 74

of the HD part of the turbine, and steam supply lines 75 of the MD part of the turbine. In FIG. 3, the cross section 76 of the annular boxlike support 43a and 43b is seen in vertical axial plane.

We claim:

1. Housing assembly for low-pressure parts of steam turbines of welded multishell construction having an axial partial joint and wherein the turbine parts are of single-flow construction or double-flow construction with central flow inlet, and wherein a plurality of turbine parts are mutually joinable axially in an *n*-flow arrangement wherein *n*=2, 3, 4, 5, 6..., comprising a respective housing for each of the turbine parts including an outer housing and a coaxial thermally displaceably mounted inner housing therefor, foundation support means for supporting the housings of the turbine parts independently of one another, longitudinal support frames forming integral housing components, the respective outer housings having underportions connected in the vicinity of the axial partial joint of the respective housing and at both longitudinal sides thereof with said longitudinal support frames, and being mounted by ends of said longitudinal support frames, which project beyond the end faces of said outer housing, on said foundation support means, said outer housing at one face thereof being axially fixedly and horizontally displaceably mounted on support locations said longitudinal support frames and at the other face thereof being both axially and horizontally displaceably mounted on other support locations of said longitudinal support frames, said outer housing being heat expansibly movable in axial direction thereof.

2. Housing assembly according to claim 1, wherein said inner housings, said outer housings, and said longitudinal support frames as well as bearing stands for the turbine parts are of respective similar construction and are assemblable for turbine parts having an even number of flows.

3. Housing assembly according to claim 1, wherein the turbine has a shaft supported by bearing stands, and including a stuffing box housing rigidly connected with a respective bearing stand, said outer housing being formed with a diffuser part steamtightly connected to and conically surrounding said stuffing box housing with a softly bendable elastic member interposed therebetween.

4. Housing assembly according to claim 1, wherein said longitudinal support frames are formed of boxlike supports having a top surface substantially aligned with the axial partial joint of the housing, said top surface carrying an outer partial joint flange formed on an upper portion of said outer housing.

5. Housing assembly according to claim 4, wherein said longitudinal support frames have a steplike termination at said supporting ends thereof forming support paws extending collarlike substantially halfway up the profile elevation of said longitudinal support frames, and lateral and cover crosspieces secured to said longitudinal support frames for reinforcing said paws.

6. Housing assembly according to claim 1, wherein said upper and lower portions of said outer housing are formed at said end faces thereof as arched boxlike supports having wide-area partial joint flanges clamped to one another.

7. Housing assembly according to claim 6, wherein said longitudinal support frames are provided with inner lateral cheeks, said cheeks forming lateral wall portions of said lower portion of said outer housing, and including a box-shaped steam exhaust pipe welded to said lateral wall portions and to the lower one of said arched boxlike supports.

8. Housing assembly according to claim 7, wherein said steam exhaust pipe is connected to the base of a box-shaped condenser, said condenser being supported through spring supports on second foundation surface means located above first foundation surface means whereby part of the weight of the turbine part is absorbed thereby.

9. Housing assembly according to claim 7, wherein said steam exhaust pipe has walls reinforced by ribbing formed of supports that are welded to the outside of said walls.

10. Housing assembly according to claim 7, wherein said steam exhaust pipe is formed with walls, and including a supporting tube framework formed of longitudinal, transverse, inclined and vertical tubes bridging and reinforcing said walls on the inner side thereof.

11. Housing assembly according to claim 1, including means for axially fixing said outer housing located at support locations of said longitudinal support frames at an end face of said outer housing facing toward a preconnected turbine part having a pressure other than low pressure.

12. Housing assembly according to claim 1, wherein said support locations of said longitudinal support frames at both end faces of said outer housing are formed with support paws are horizontally displaceably mounted on slide keys, and including fixing keys additionally located at said end face of said outer housing at which said outer housing is axially fixed.

13. Housing assembly according to claim 1, including four overflow lines extending laterally to said outer housing in symmetrical arrangement, said overflow lines being mounted in respective quadrants of said outer and inner housings with 20

shaft tube compensators interposed.

14. Housing assembly according to claim 13, wherein the overflow lines in the lower quadrants of said outer and inner housings extend through said longitudinal support frames.

15. Housing assembly according to claim 4, wherein said longitudinal support frames in the vicinity of the upper edge thereof facing said housing portions are formed with cutouts for receiving therein respective paws formed on the underportion of said inner housing so as to align the axial partial joint of said inner housing with the axial partial joint of said outer housing.

16. Housing according to claim 11, wherein four paws and correspondingly four bearing locations are provided in rectangular symmetrical arrangement for the underportion of said inner housing, a pair of said bearing locations and a pair of said paws being located at one end face of said outer housing and being provided thereat with fixing keys for axially fixedly yet radially displaceably mounting said outer housing.

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