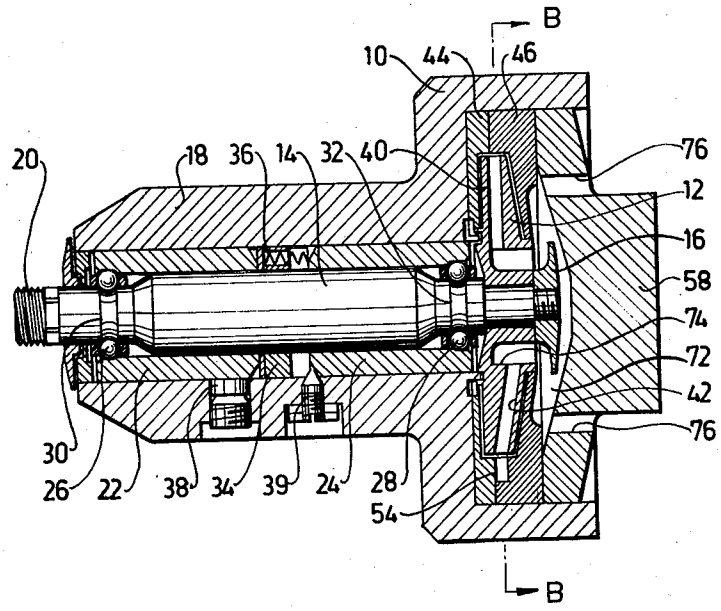
March 8, 1960 G. GLUCHOWICZ 2,927,768

DEVICE FOR DRIVING RAPIDLY ROTATING SPINDLES

Filed May 26, 1953 2 Sheets-Sheet 1

Fig. 1



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Fig. 3

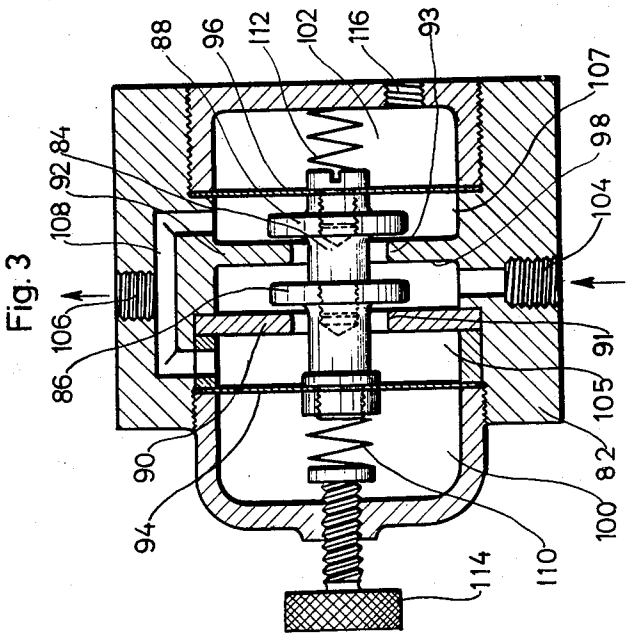
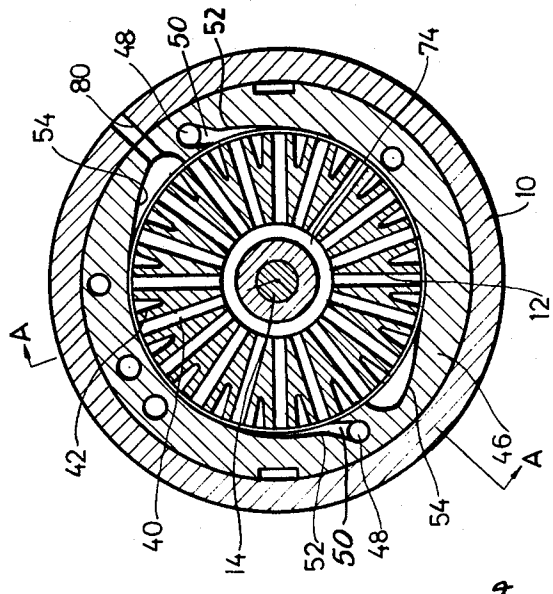


Fig. 2



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DEVICE FOR DRIVING RAPIDLY ROTATING SPINDLES

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5 Claims. (Cl. 253—2)

My invention relates to a device for driving high speed spindles, including a turbine having its turbine wheel adapted to be driven by a gaseous working medium, and to rotate during idle running at a so-called "racing" number of revolutions.

My invention more particularly relates to driving devices constructed for very high rotational speeds, such as 40,000–100,000 revolutions per minute or higher, and used, interalia, for the driving of grinding discs. In a suitable embodiment of the invention the working medium is caused to flow from a space located adjacent the outer circumference of the turbine wheel in a direction inwardly through operative channels formed in the wheel. By forming the operative channels with sufficiently radial dimension a pump effect is created in the channels due to the influence of the centrifugal force, which effect at the racing number of revolutions is equal to the power of the turbine (if inner friction resistance is disregarded). While the driving torque of the turbine decreases in a substantially straight line when the number of the revolutions increases, the pump effect is increased in accordance with a curve of the second power. When these two curves intersect, the racing number of revolutions has been attained. At the same time a super-atmospheric pressure is generated in the space and increases in the same degree as the pump effect becomes greater.

Due to these different relations of the pump moment and the turbine moment, respectively, to the number of revolutions, a rapidly increasing driving moment on the wheel is obtained when the number of revolutions due to loading of the turbine falls below the racing number of revolutions by a moderate value only. In this connection it is of importance that the turbine is constructed on the impulse principle wherein the major part of the driving force is generated by the velocity imparted to the medium prior to its entering the operative channels. In these latter thus a drop in pressure and an increase in velocity caused thereby will not occur at all or at least to a limited extent only, which feature is in contradistinction to the working principle of reaction turbines.

One object of my invention is to provide an improved driving device of the nature described which is capable of being used for a large range of rotating speeds, such as, for example, between 40,000 and 100,000 revolutions per minute, and which is capable within said entire range of creating driving torques of desired magnitude.

A further object of my invention is to provide an improved driving device which is capable of producing a higher driving torque at a lower than at a higher number of revolutions, which feature is desirable for driving devices for grinding discs. For example, a grinding disc having a larger diameter should rotate with a lower speed than a grinding disc having a smaller diameter, the driving torque required, however, being higher in the former case than in the latter. Additionally the operative number of revolutions should be obtained over the whole range of numbers of revolutions by a moderate reduction below such racing value of the number of revolutions,

which reduction usually does not exceed substantially 10%.

According to the present invention a device for driving high speed spindles includes a turbine having its turbine wheel adapted to be driven by a gaseous working medium and to rotate during idle running at a so-called "racing" number of revolutions, said turbine having operative channels extending in a radial direction, and adapted at their external side to operate with a space within which a superatmospheric pressure in response to the number of revolutions is produced by the pumping effect created by the gaseous working medium present in said operative channels during rotation of said channels, said superatmospheric pressure being utilized to actuate a member disposed in a supply conduit for the gaseous working medium to the turbine wheel so as to cause the supply of working medium to become adapted to the prevailing superatmospheric pressure and thus to increase on reduction of the number revolutions and vice versa.

The invention will be hereinafter more fully described with reference to the embodiment thereof shown by way of example in the accompanying drawings, in which:

Fig. 1 is a longitudinal section of a driving device for grinding discs constructed according to the invention, taken on the line A—A of Fig. 2 which in turn is a cross-section along the line B—B of Fig. 1.

Fig. 3 is a longitudinal section of a valve forming part of the driving device.

Referring to the drawings, 10 designates a stationary turbine housing containing a turbine wheel 12 constructed according to the impulse principle and mounted on a shaft 14 by means of a screw fitting 16. The shaft 14 extends through a cylindrical bore in a part 18 shaped as a bearing box of the housing and is at its free end provided with a thread 20, for example, for fixing of grinding discs, possibly by means of an intermediate chuck. In the bore are slidably mounted two bearing sleeves 22 and 24, respectively, which on their remote end portions are provided with a race each for a row of balls 26 and 28, respectively. The shaft has grooved races 30, 32 for said rows of balls. A divided ring 34 interposed between the sleeves 22 and 24 is provided with recesses receiving a plurality of circumferencially spaced springs 36 exerting pressure on the sleeves in such direction as to keep them separated from one another. The outer sleeve 22 is axially fixed by means of a screw 38. A screw 39 may be provided to prevent the inner sleeve 24 from axial displacement toward the outer sleeve. This construction of the bearing permits exact axial positioning of the shaft and thereby exact axial centering of the turbine wheel 12 in the turbine housing 10.

The turbine wheel 12 is preferably provided with two rows of operative channels which may be straight and have equal or approximately equal cross-section over at least substantially their total length, said channels being preferably made by drilling. In one of the rows the operative channels 40 extend radially and perpendicularly to the center, the channels 42 of the other row being slightly inclined with respect to a plane normal to the axis of rotation of the turbine wheel. This offers the advantage that the number of channels is doubled in spite of the feature that their centers or exterior openings at the exterior circumference of the turbine wheel are disposed in the same plane perpendicularly to the shaft. A turbine wheel for driving grinding discs has a diameter of a magnitude of only 60–100 millimeters. The turbine wheel is enclosed by two rotationally stationary discs 44 and 46 which are provided with recesses corresponding to the shape of the wheel.

A gaseous working medium from a pressure source, such for instance as compressed air, is fed to the driving device preferably through two diametrically opposed

channels 48 merging into expansion nozzles 50 provided in the disc 46 and imparting to the gaseous medium the intended tangential velocity. A passage opening 72 communicates through an annular channel 74 in the turbine wheel 12 with the inner end openings of the operative channels and further through holes 76 in the cover 58 with the ambient atmosphere.

Peripherally extending and diametrically opposed recesses 54 are provided, these recesses being circumferentially spaced from the space 52. One of said recesses communicates through an opening 80 communicating with valve chamber 102 through passage 116.

Within the valve housing is a valve body 84 comprising separable screw threaded parts and providing two flanges 86 and 88, respectively, or similar projections. The valve body passes with clearance through openings 91 and 93, respectively, provided in the one and the other of two partition walls 90, 92 in the valve housing, which walls are formed as seat faces for the one and the other of the two flanges 86 and 88. The valve body 84 is kept in position in the valve housing by two resilient or flexible membranes 94 and 96 suitably made of metal and separating a central chamber from side chambers 100 and 102 located in the valve housing on either side of the central chamber. To assemble the above structure the flanges 86 and 88 are positioned on opposite sides of the wall 92 and secured together by the screw threaded means provided for this purpose. The membrane 96 may then be secured to the flange 88. Thereafter, the wall 90 is positioned in the housing 82 and the membrane 94 is secured to the flange 86. In this manner, the flange 86 may be disposed between the walls 90 and 92 and the flanges 86 and 88 on opposite sides of the wall 92.

The valve is inserted into the conduit for supply of working medium to the channels 48. This conduit is connected to the valve housing by means of the threaded channels 104 and 106. The working medium enters through the channel 104 into a part 98 of the central chamber located between the walls 90 and 92. The working medium after having passed through the openings 91 and 93 in the partition walls traverses two outer parts 105 and 107 of the central chamber and enters through a bore 108 into the channel 106 from which it continues to the channels 48.

The valve body 84 is preferably subjected on opposite sides to the action of pressure springs 110 and 112, respectively. The tension of the first-mentioned spring is adjustable from outside by means of a screw 114 or a similar member. The abovementioned channel 80 communicates with the side chamber 102 through a conduit attached to the valve housing by means of the threaded bore 116.

The driving device operates in the following manner.

The kinetic energy of the working medium in the two spaces 52 on deflection of the medium into the operative channels 40, 42 is converted into a driving torque on the turbine wheel. The working medium escapes through the central channel 74, the passage opening 72 and the holes 76 into the ambient atmosphere. At the same time a pumping action is created in all the channels due to the influence of centrifugal force acting on the working medium in said channels. Due to the pumping action a superatmospheric pressure is created at the outer circumference of the wheel, which pressure increases in response to increase in the number of revolutions and, more exactly specified, is proportional to the second power of said number of revolutions. The superatmospheric pressure is generated in the spaces 52, but also in the recesses 54. Simultaneously with the supplying of working medium to those operative channels directly in front of the spaces 52 for the purpose of rotating the turbine wheel, the the operative channels located directly in front of the recesses 54 act to produce the pumping effect and the superatmospheric pressure created thereby in said recesses. It may thus be stated that the turbine wheel 12 is designed so as to act simultaneously as or be combined with a pumping or fan wheel. The superatmospheric pressure attains its maximum value when the driving device is unloaded.

The superatmospheric pressure acts on the valve body 84 through the membrane 96 in such manner that the flanges 86, 88 of the valve body on increase of said pressure are displaced toward the partition walls 90, 92, which results in a throttling of the supply of working medium. With the driving device running idle and the wheel 12 thus rotating at the racing number of revolutions, the pressure of the working medium in the channels 48 has its minimum value for a predetermined number of revolutions. As soon as the driving device is loaded and the number of revolutions of the turbine wheel falls, the superatmospheric pressure in the recesses 54 and consequently in the side chamber 102 of the valve is reduced. The valve body 84 will thus move into its open position and more working medium will be supplied to the turbine. There is created between the turbine effect and the pumping action in the turbine wheel 12 a relation such as to cause a considerable increase of the resulting driving moment on a definite reduction of the number of revolutions amounting to 10%, for example.

By adjusting the tension of the spring 110 by means of the screw 114 the turbine wheel may be adjusted to various numbers of revolutions. The higher the stress of the spring 110 the higher will be the superatmospheric pressure required for a definite throttling of the supply of working medium, the racing number of revolutions becoming correspondingly high. Said number of revolutions is thus adjustable to any desired value between 40,000 and 100,000 per minute, for example. The torque curves are such that the lower the speed, the greater will the resulting driving torque become on a predetermined reduction of the number of revolutions below the racing value.

The form of the valve body 84 with two flanges 86 and 88 and the corresponding double paths of flow 91, 105 and 93, 107, respectively, has the advantage that the position of the valve body in the valve house is entirely independent of fluctuations in the pressure of the working medium on either side of the valve.

As compared with a possible construction, wherein the combined turbine and fan wheel is replaced by two separate wheels, the embodiment shown has the advantage of a more compact structure of the whole device.

What I claim is:

1. Apparatus for driving high speed rotary spindles comprising a turbine having a turbine wheel providing channels for flow of elastic motive fluid, said channels having radial extent whereby the opposite ends of each channel are at different radial distances from the axis of rotation of the wheel, means for admitting elastic motive fluid to the radially outer ends of said channels, means for exhausting motive fluid from the radially inner ends of said channels, means providing a chamber with which the radially outer ends of said channels communicate at times when said radially outer ends are out of direct communication with the source of motive fluid, whereby to create an increased pressure in said chamber due to the pumping effect developed by the action of centrifugal force on the fluid in said channels, and means including a passage leading from said chamber and an adjustable throttle member located in said first mentioned means and in communication with said passage and responsive to variations in the fluid pressure developed in said chamber to control the supply of motive fluid to the turbine wheel and thereby determine the maximum or racing speed developed by said turbine wheel.

2. Apparatus as defined in claim 1 in which the means for admitting motive fluid to the turbine wheel comprises an inlet limited to a minor part of the outer periphery of the turbine wheel and said chamber is peripherally offset from said inlet and also limited to a minor part of the outer periphery of the turbine wheel.

3. Apparatus as defined in claim 1 in which said chan-

nels have their radially outer ends opening in a common plane normal to the axis of rotation of the turbine wheel and are divided into two different groups, the inner ends of each group opening in a common plane normal to the axis of rotation of the wheel and axially spaced from the plane of the inner ends of the other group.

4. Apparatus for driving high speed rotary spindles including a turbine operable by elastic motive fluid and having a wheel mounted to rotate idling at a racing speed, said apparatus including a housing, channels in said wheel having radially extending components for flow of motive fluid therethrough, a passage in said housing for flow of elastic fluid to said channels, a chamber in said housing at the outer periphery of said wheel and located to communicate with the outer ends of said channels and said chamber and said passage being separated from each other, conduit means for supplying elastic motive fluid to said passage, an adjustable throttle member in said conduit means and means for connecting said chamber to said adjustable throttle member to actuate the same in response to variations in the value of the pressure in said chamber to control the admission of fluid to said wheel through said

conduit means, the pressure in said chamber increasing and acting on said throttle member to tend to close the same upon such increase deu to the pumping effect developed by the action of centrifugal force on the elastic fluid in the channels in said wheel independently of the pressure in said passage.

5. Apparatus as defined in claim 4 including adjustable means for variably loading said throttle member.

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