Jan. 15, 1957 R. P. PRICE 2,777,321

FLUID JET SIZE MEASURING DEVICE

Filed Sept. 29, 1953

Fig. 1

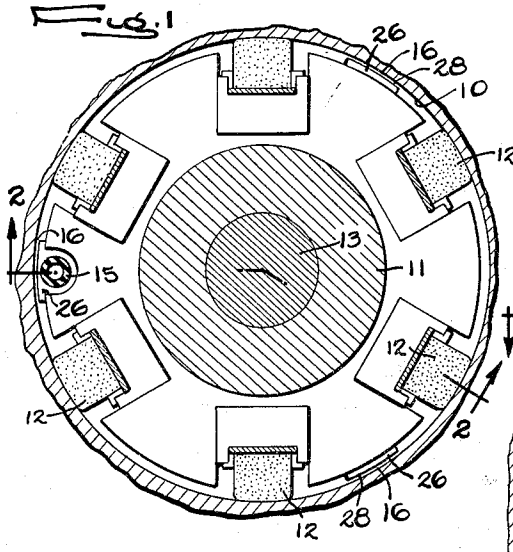


Fig. 2

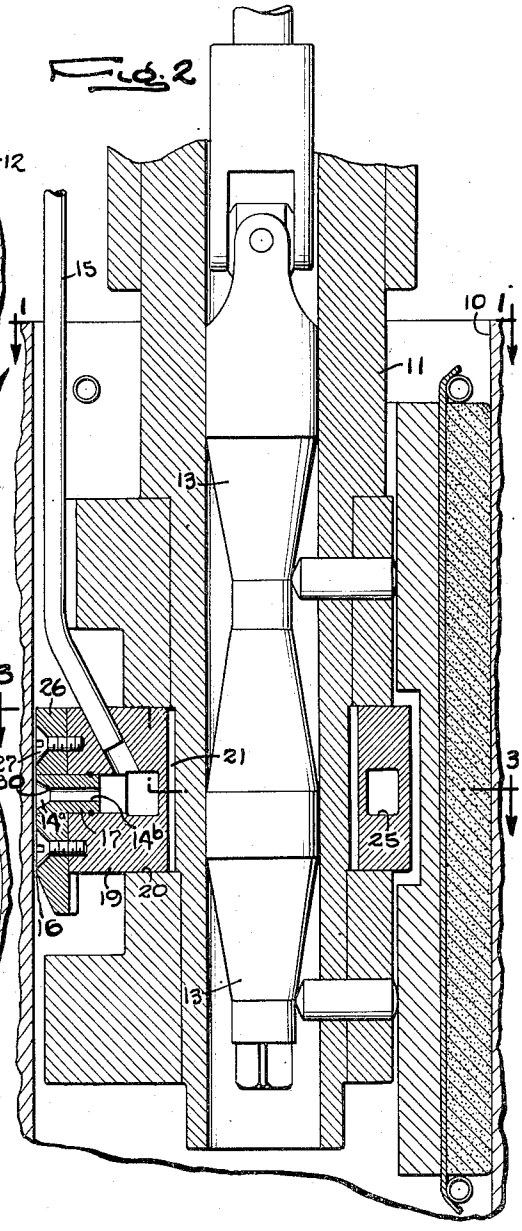


Fig. 3

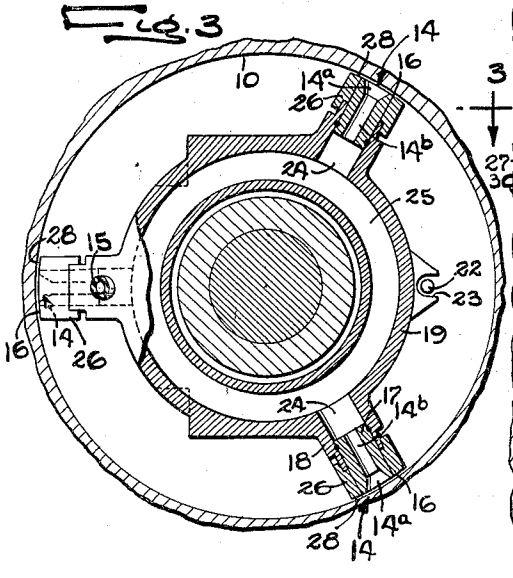
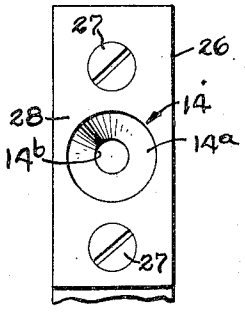


Fig. 4



INVENTOR
Richard P. Price
By Carlson, Pitzner, Hubbard & Wolfe
ATTORNEYS

United States Patent Office 2,777,321 Patented Jan. 15, 1957

2,777,321

FLUID JET SIZE MEASURING DEVICE

Richard P. Price, Cleveland, Ohio, assignor to Barnes Drill Co., Rockford, Ill., a corporation of Illinois

Application September 29, 1953, Serial No. 382,957

3 Claims. (Cl. 73—37.9)

This invention relates to a device for measuring the size of a work surface, particularly a cylindrical surface through the use of a plurality of fluid jets directed against the work surface from nozzles on a carrier supported for free transaxial floating under the influence of reactionary forces produced by the jets and tending to center the carrier relative to its support.

One object is to shape the nozzle outlets in a device of the above character in a novel manner such as to improve the usable measuring range of the device and also increase the magnitude of the forces tending to center the nozzle carrier.

The invention also resides in the novel shaping of the nozzle orifices to minimize vibration of the nozzle carrier so as to provide optimum measuring sensitivity.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a transverse sectional view taken along the line 1—1 of Fig. 2 and showing the improved sizing device as incorporated in a honing tool.

Fig. 2 is a fragmentary sectional view taken along the broken line 2—2 of Fig. 1.

Fig. 3 is a section taken along the line 3—3 of Fig. 2.

Fig. 4 is a face view of one of the nozzles.

While the improved sizing device is usable in measuring various types of work surfaces, it is especially adapted for use in measuring the internal diameter of a work bore 10 when mounted on the body 11 of the tool such as a hone. In the conventional form shown, the hone comprises a plurality of abrasive sticks 12 guided for radial adjustment relative to the body 11 and adapted to be expanded by cams 13 while the tool and sizing device are rotated and reciprocated back and forth within the bore during finishing of the bore wall.

In this environment, the gaging device may be utilized to indicate continuously the diameter of the bore being honed and to give a signal when a predetermined size has been attained. It includes generally a plurality of orifices 14 supplied with pressure fluid through a common flexible conduit 15 and floatingly mounted on the body 11 in position to direct jets of fluid against the wall of the bore thereby causing the pressure in the conduit to change as the gaps 16 between the orifices and the work surface are changed by the action of the honing stones 12.

Each orifice 14 comprises an enlarged recess or expansion cavity 14^a at the end of a restricted passage 14^b defined by a tubular plug 17 pressed into a radial lug 18 which projects from the periphery of a carrier ring 19 between two of the honing stones. Herein, the ring is disposed between and slidably guided by walls 20 of a groove 21 which encircles the body 11 intermediate the ends of the stones. The carrier ring is thus adapted for free bodily floating radially of the tool body 11 and its longitudinal rotational axis but is held against turning relative to the body by a pin 22 projecting from the body into a radial slot 23 in the carrier.

At their inner ends, the restricted nozzle passages 14^b communicate through holes 24 with an annular passage 25 connected to the lower end of the flexible conduit 15. The outer ends of the nozzle tubes are enlarged to form pads 26 secured to the carrier ring 19 as by screws 27 and each having an outer surface 28 which surrounds the orifice opening and conforms closely to the contour of the work surface 10 being measured. The pads are mounted on the carrier ring 19 so as to provide very narrow gaps 16 between the bore wall and the pad faces, these gaps preferably being on the order of .005 of an inch although their width may be increased to about 0.10 without substantial reduction of the centering action described later.

Liquid delivered under pressure, for example 40 p. s. i., through the conduit 15 flows outwardly through the passages 14^b and the cavities 14^a and is directed in the form of jets against the bore wall. The liquid then escapes in the form of a thin sheet through the gaps 16, the combined rate of flow being proportional to the sum of the widths of the gaps so that the value of the back pressure in the conduit 15 is a measure of the diameter of the bore. Suitable means such as a pressure switch well known in the art may be employed to sense such pressure changes and therefore measure the bore size continuously while the bore is being honed.

Along with this size measuring function, the orifices 14 and the fluid jets defined thereby may, when the orifices are enlarged at their outer ends as described above, perform the additional function of deriving forces which act on the floating ring 19 and are combined in a resultant force that urges the ring transaxially toward a position centered relative to the bore, the gaps 16 then being of equal width so that the pressure in the supply line will correspond more accurately to the diameter of the bore. Such centering action is due to the fact that with a constant pressure supplied to all of the orifices and with the floating ring off-center, the pressure in the cavity opposite the narrowest gap will be greater than the pressure in a cavity of a wider gap. Thus the pressure differential is in a direction to urge the ring toward centered position and maintain the gaps of uniform width.

I have discovered that the centering action above described as well as the over-all measuring sensitivity of the device may be increased appreciably by shaping the walls defining the fluid orifices so that there is a smoother flow and gradual spreading out of the liquid in passing into and out of each expansion cavity 14^a. This is achieved in accordance with the present invention by flaring the walls of the cavity gradually and outwardly thereby avoiding sharp corners or reentrant recesses that would otherwise interfere with the free and direct flow of the liquid within the nozzle and also through the gaps 16.

In the present instance, the desired flaring of the cavities 14^a may be achieved by a simple countersinking operation to cone the cavity wall at an included angle of about 60 degrees. The frusto conical wall thus formed intersects the pad face 28 at a diameter of ⅜ of an inch, is about ¼ of an inch deep, and intersects the ⅛ inch restricted passage 14^b at a very blunt edge 30. The liquid flows around the latter without appreciable disturbance and escapes through the gap 16 around the orifice base in a sheet of gradually decreasing thicknesse.

With the orifices thus shaped, it has been found in practice that the transaxially directed centering forces acting on the floating carrier 19 are of substantial magnitude and effectually maintain the carrier in centered position even when the tool, which may be of substantial weight, is mounted to turn about a horizontal axis. At the same time and apparently because of the more uniform flows of liquid through and from the different orifices, the over-all sensitivity of the measuring device as well as its range

of precise operation have been increased considerably as compared to prior construction.

I claim as my invention:

1. In a jet sizing device for measuring the diameter of a cylinder, the combination of, a support adapted to extend along the cylinder axis, a carrier mounted on said support for lateral floating transaxially of the cylinder, means on said carrier defining a plurality of orifices angularly spaced apart and opening radially toward said cylinder, and means defining a fluid supply chamber on said carrier communicating with each of said orifices, each of said orifices having a passage radially spaced from the periphery of the carrier and an expansion cavity defined by a wall diverging at an angle of about sixty degrees from the end of said passage to an enlarged opening at said carrier periphery.

2. In a jet sizing device for measuring the diameter of a cylinder, the combination of, a support adapted to extend along the cylinder axis, a carrier mounted on said support for lateral floating transaxially of the cylinder, means on said carrier defining a plurality of orifices angularly spaced apart and opening radially toward said cylinder, and means defining a fluid supply chamber on said carrier communicating with each of said orifices, each of said orifices having a restriction radially spaced from the periphery of the carrier and an expansion cavity defined by a wall diverging from said restriction to an enlarged opening at said carrier periphery.

3. In a jet sizing device for measuring the diameter of a cylinder, the combination of, a support adapted to extend along the cylinder axis, a carrier mounted on said support for lateral floating transaxially of the cylinder, means on said carrier defining a plurality of orifices angularly spaced apart and opening radially toward said cylinder to discharge jets of fluid against the latter, and means on said carrier communicating with each of said orifices to supply fluid under pressure thereto and form said jets, each of said orifices having a restricted passage and an expansion cavity gradually flaring therefrom to the open end of the orifice whereby to provide for a smooth continuous flow of the fluid through said cavity and then across the cylinder surface.

References Cited in the file of this patent

UNITED STATES PATENTS

1,946,924	Allen et al.	Feb. 13, 1934
2,125,445	Holveck	Aug. 2, 1938
2,254,259	Aller	Sept. 2, 1941
2,325,008	Gruett	July 20, 1943
2,446,071	Aller	July 27, 1948
2,538,785	Karig	Jan. 23, 1951