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Earley

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[54] **POWDERED METAL VALVE PLATE ASSEMBLY**

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[73] Assignee: **Westinghouse Electric Corporation**, Pittsburgh, Pa.

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[52] **U.S. Cl.** ..... **251/368**, 137/512.15, 29/157.1 R

[51] **Int. Cl.** **F16k 51/00**, F16k 27/00

[58] **Field of Search** ..... 137/512.15, 512.4; 251/368; 29/157.1 R

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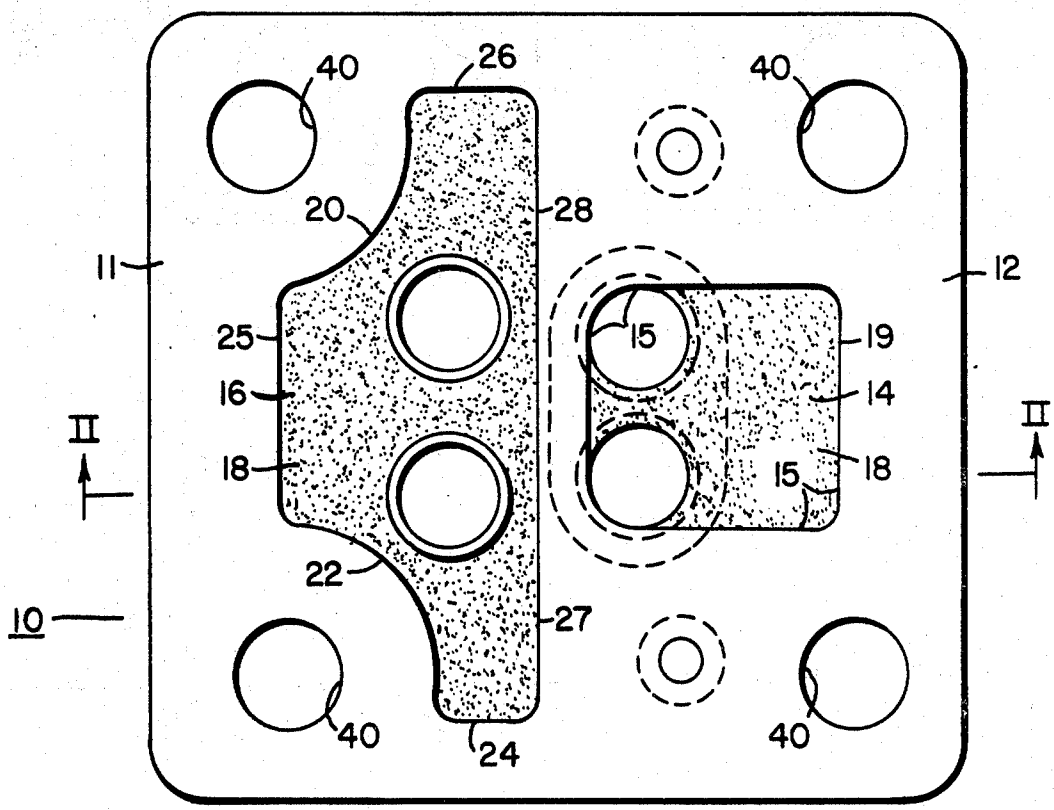
[57] **ABSTRACT**

The invention provides a substantially impervious molded sintered iron valve plate arrangement wherein both sides of the valve plate include inwardly relieved surfaces and generally planar outwardly disposed surfaces. The outwardly disposed surfaces are ground flat for properly seating gasketing material thereon. The gasketing material maintains the machined area impervious, while the inwardly disposed surfaces have an outer impervious layer formed by subjecting the valve plate to a steam oxide treatment after its formation from powdered metal.

3 Claims, 6 Drawing Figures



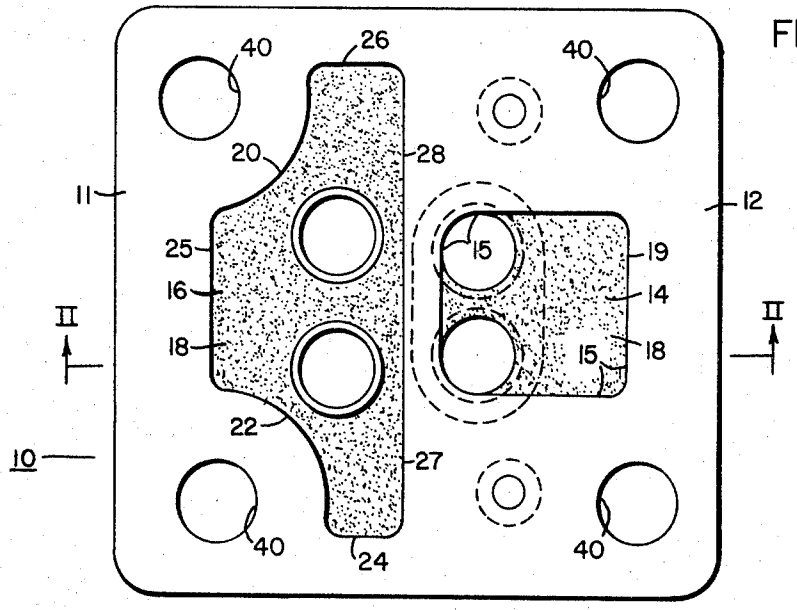


FIG.1

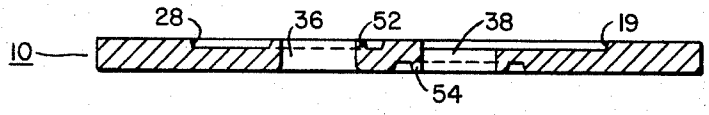


FIG.2

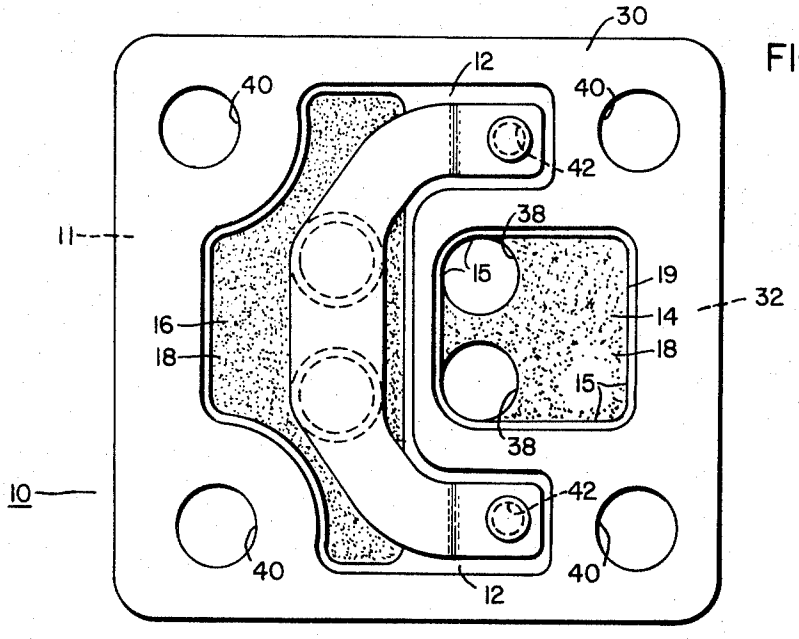


FIG.3

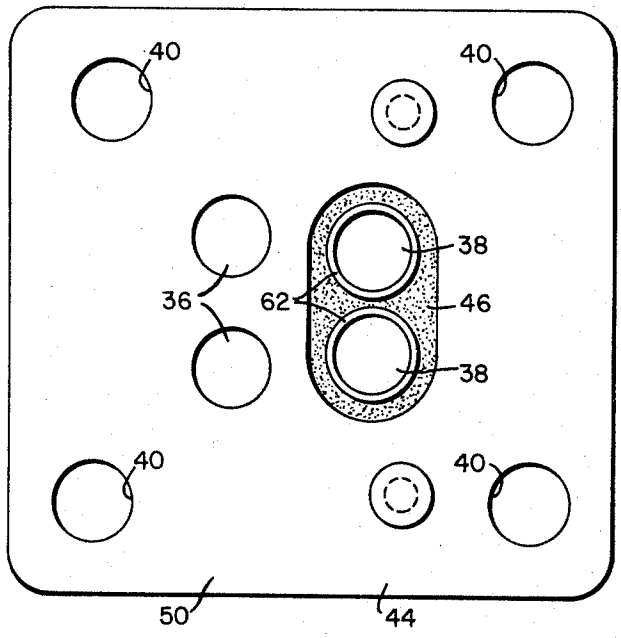


FIG.4

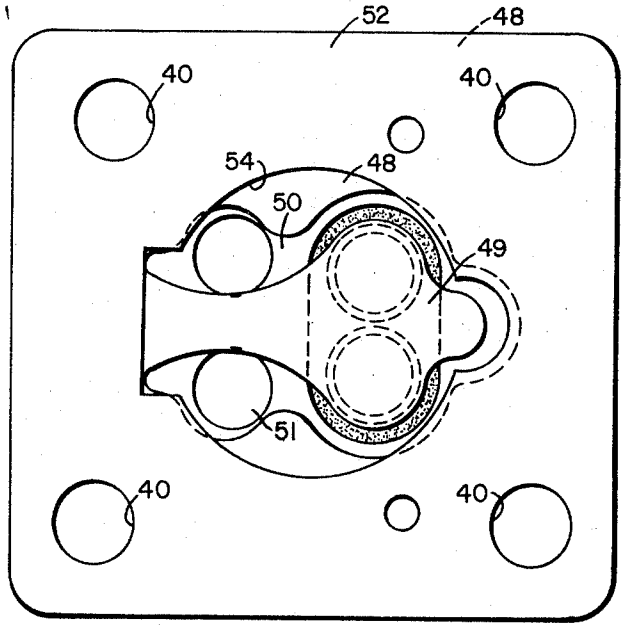
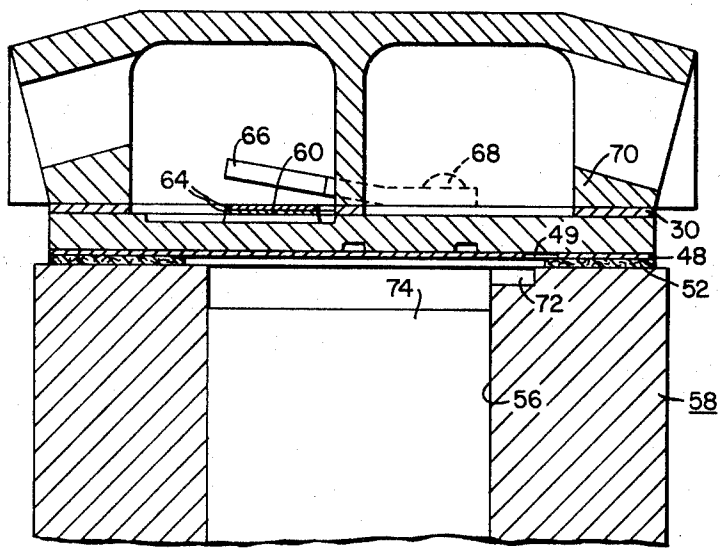


FIG.5

FIG.6



POWDERED METAL VALVE PLATE ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of The Invention

The invention relates to powdered metal articles and, more specifically, relates to sintered iron valve plates usable in compressors or the like.

2. Description of The Prior Art

Although the use of powdered metal for the formation of various metallic articles is old and well known, heretofore, its use in the formation of relatively large valve plates efficient at a high pressure ratio has engendered several undesirable characteristics. More specifically, valve plates have been formed by the compacting of, for example, iron powder in a mold or press. The formed plates were then sintered in a controlled atmosphere furnace and then given a steam oxide treatment which hardened the plates and, to a limited-depth, sealed the plates to prevent leakage by filling the pores with oxide particles. Unfortunately, the density of oxide decreased rapidly as one went from the exterior to the interior of the plates.

Thus, subsequent requisite machining of the valve plates in order to provide a smooth surface for the proper seating of gaskets thereon and to provide smooth and flat surfaces for the mounting of intake or discharge valves tended to remove the layer comprising the oxide seal, resulting in the machined surfaces becoming generally porous and thereby providing an area of leakage through the valve plates. Since oxide particle coating of a valve plate could not be obtained having a sufficient depth and uniformity of coating, larger size, powdered metal valve plates were not acceptable for use in compressors or the like having a fairly high dishcarge pressure.

Accordingly, in order to overcome this deficiency and, yet, still utilize the relatively inexpensive sintered iron valve plate, it would be advantageous to overcome the porous nature of such a valve plate so that it would find high utility in high pressure compressors and the like without undesirable leakage of contained gases through it.

SUMMARY OF THE INVENTION

The invention comprises a powdered metal valve plate which can be utilized, advantageously, in a compressor or the like with little chance of compressed gas seeping through the valve plate so as to reduce the efficiency of the compressor. In the specific embodiment illustrated, the valve plate comprises a powdered metal (iron powder) (MPIF Spec. No. FN-0208-S less copper) matrix which has been compressed in a mold in a press and formed into a valve plate shape and then sintered in a controlled atmosphere furnace so as to provide a compacted, cohesive member. Upon completion of the sintering operation, the valve plate is given a steam oxide treatment in another furnace and then air quenched. The steam oxide treatment hardens the valve plate and seals the surfaces of the plate to provide a substantially impervious layer by filling the pores adjacent the surfaces of the plate with oxide particles. The amount of iron oxide particles present decreases rapidly as one goes towards the interior of the valve plate.

Since the surface of the valve plate is then in a relatively roughened condition, certain portions of the surfaces must be machined substantially flat for the mounting of gasketing on the valve plate and for the proper mounting of discharge or inlet valves. To prevent removal of the oxide coating from the entire valve plate, the valve plate of the present invention is provided, in the molded state, with depressed areas or inwardly inset surfaces in that portion of the valve plate which do not require flattened surfaces for seating of the gasketing material and/or valve arrangement. The valve plate is then machined in the areas required to be flat for facing engagement the with a gasket raised surface has sufficient thickness in these areas so that the machining, i.e., grinding in the instant case, may be completed without contacting the oxide particle coating occurring in the inwardly disposed impervious areas of the valve plate.

Upon completion, grinding of the valve plate is ready to receive discharge and inlet valves and the requisite gasketing that mounts with the valve plate sealably to a compressor cylinder and head assembly. The gasketing is of such extent and area so as to substantially cover the entire ground surface at least on the cylinder head side of the valve plate except for a limited area where the discharge valve is mounted. The machined surface of the valve plate facing the cylinder side is covered by the inlet valve which maintains this machined surface substantially impervious. Thus, a combination of adjacent abutting surfaces, i.e., gasketing and valves, on the machined surfaces of the valve plate and inwardly disposed unmachined surface is provided to limit the escape of high pressure gases through the valve plate. Then, any leakage that might occur is of such insignificant magnitude so as to not reduce the compressor efficiency to any significant degree.

DRAWING DESCRIPTION

For a better understanding of the invention, reference may be had to the preferred embodiment, exemplary of the invention, shown in the accompanying drawings, in which:

FIG. 1 is a plan view of the valve plate taken from the compressor cylinder head side;

FIG. 2 is a cross sectional view of the valve plate taken substantially on line II—II of FIG. 1;

FIG. 3 is a plan view taken in a similar manner as FIG. 1, but showing the cylinder head gasket and discharge valve disposed on the valve plate;

FIG. 4 is a plan view of the valve plate taken from the cylinder side;

FIG. 5 is a plan view of the valve plate, intake valve and cylinder gasket taken from the cylinder side; and

FIG. 6 is a cross sectional view taken generally on the line VI—VI of FIG. 3 but showing partially the arrangement of the valve plate in assembled condition with the compressor with which it is used.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As is shown most clearly in FIGS. 1 to 6, a valve plate 10 is provided which is formed out of a metal powder such as powdered iron. The process utilized to obtain the valve plate 10 comprises first forming the valve plate 10 by compacting iron powder in a mold in a press. The formed plate is then sintered in a controlled atmosphere furnace and the valve plate 10 then given a steam oxide treatment in another furnace and air quenched. The process of formation of the powdered metal valve plate 10 is considered conventional so no

further reference will be given thereto, it being sufficient to state that the steam oxide treatment hardens the valve plate **10** and fills the pores adjacent the surfaes of the with oxide particles to prevent leakage through the plate the. However, it is understood the oxide particles sealing the outer surfaces decrease rapidly in density as one moves toward the interior of the valve plate **10** so that the interior of the valve plate **10** is permeable in nature.

A cylinder head side **12** of valve plate **10** (FIGS. **1** and **3**) is provided with a pair of depressed, inset surfaces **14** and **16** which, due to their formation during the molding step of the formation of the valve plate **10**, have a coating **18** that is oxide particle impregnated and therefore substantially impermeable and gas tight. The depressed surface **14** is inset relative to a general overall planar outer surface **11** of the cylinder head side **12** of valve plate **10** and is substantially square in configuration, having sides **15** joined together by rounded corners and a taper **19** extending from the surface **11** to the surface **14** so as to provide a smooth transition from the outer surface **11** to the depressed surface **14.**

Also depressed inwardly is the recessed surface **16** which is elongated in nature and includes a pair of radiused sides **20** and **22** that lead into and smoothly merge with a pair of short straight sides **24** and **26** and also a side **25.** A side **27** completes the configuration of the recessed surface **16.** The sides **24, 26, 25** and **27** are each parallel to one of the sides **15** of the recessed surface **14.** Rounded corners are also provided for the inset portion **16** so as to provide no abrupt edges to it. Inset portion **16** also include a taper **28** which provides for smooth transition between it and the outer surface **11** of the side **12.**

As can be seen most clearly in FIG. **3,** the inset surfaces **14** and **16** are located on the cylinder head side **12** of valve plate **10** which is partially covered by a relatively impermeable cylinder head gasket **30.** Subadjacent the gasket and encompassing the remaining surface **12** and forming the outer planar surface **11** is a ground surface **32** which has been machined to a flattened condition to accommodate the gasket **30** an the mounting of a discharge valve **34** which will be described in greater detail later. As was indicated previously, the area which forms the surface **32,** after machining flat, remains raised relatively to the inset surfaces **14** and **16** so that sufficient molded material must be provided on this portion of side **12** to accommodate flattening of the surface **32** while still maintaining the portions **14** and **16** in an inset, depressed condition relative to the finish ground surface **32** forming the remainder of the side **12.** During machining the inset surfaces remain undisturbed and because of their oxide layer remain impervious. Thus, the side **12** of valve plate **10** with the gasket **30** provide a relatively impermeable barrier to the passage of gas therethrough because of the coated condition of the inset portions **14** and **16** and the coverage of the machined area by cylinder head gasket **30.**

Valve plate **10** includes a pair of bores **36, 36** therethrough which form the discharge ports for the valve plate **10.** The bores **36, 36** are situated to open in the recessed surface **16** and located substantially centrally relative a center line (not shown) extending through the valve plate **10.** These bores form the means for the passage of discharge gases outwardly through the valve plate **10.** Valve plate **10** also includes a pair of bores **38, 38** that form the inlet ports for valve plate **10.** The bores **38, 38** are located to open in the area of the inset surface **14** adjacent the two inner corners thereof so as to provide a compact relationship between the discharge and inlet ports of the valve **10.**

A series of four bores **40, 40, 40** and **40** are also provided adjacent the corners of valve plate **10** to provide a mounting means for the mounting if this valve plate in its final assembly. Bolts (not shown) may conveniently pass through these bores and attach the valve plate **10** to the cylinder casting of the compressor. Valve plate **10** also includes a pair of stepped bores **42, 42,** opening at surface **32** which serve as a mounting means for discharge valve **34.**

The valve plate **10** includes an obverse side **44** (FIG. **4**) that includes an inwardly disposed, recessed or inset surface **46** formed when valve plate **10** was originally processed from powdered iron. Inset surface **46** thereby includes a portion of the coating **18** which is substantially impermeable to the passage of gas therethrough. The inlet ports formed by bores **38, 38** open to the side **44** at the surface **46,** with this surface having the general configuration of a rounded corner rectangle of slightly greater width and length than the area encompassed by the bores **38, 38.** The remainder of obverse side **44** is machined flat to provide a flattened surface **50** which is outwardly disposed relative to the inset surface **46** so that no coating **18** is present on this part of the surface of obverse side **44.**

A thin metal plate **48** having a center portion **49** capable of flexing inwardly and outwardly and serving as the reed valve or element for sealing over **38, 38** is disposed against the side **44** of valve plate **10.** The thin plate **48** is of substantially the same outer dimensions as the valve plate **10** and extends over nearly the entire flattened surface **50** save for a cutout **51** that separates the main body of thin plate **48** from center portion **49.** As will become obvious, since the thin plate **48** is held tightly against the valve plate **10,** it serves as a gasketing means (at least in the sense of functioning as a barrier to the passage of gas through a major portion of flattened surface **50**), for valve plate **10.**

Disposed on the cylinder side of thin plate **48** is a conventional gasket **52** which almost completely covers the thin plate **48** for a cutout **54** providing communication between the center portion of thin plate **48** and a cylinder **56** (FIG. **6**) of a compressor **58** with which valve plate **10** is utilized. The gasket **52** thereby providing an opening for the passage of inlet and outlet gases to the cylinder **56.**

Referring again now to FIG. **1,** it can be seen that the bores **36, 36** each include an extension **60** placing the termination of its bore **36** at the same level as the ground, flattened surface **32.** Thus, each of the bores **36** is provided with a smooth and flat ground seating surface for the seating of the discharge valve **34** utilized therewith. It can also be seen in FIG. **4** that the bores **38, 38** are each provided with extension **62** that places the termination of the bores **38, 38** at the same level as machined surface **50** so that the extensions **62** provide a smooth, ground seating surface for the intake valve formed by center portion **49** of thin plate **48.**

Turning again now to FIG. **6** wherein the valve plate **10** is illustrated in an assembled relationship with the cylinder **56** with which it is utilized it can be seen that a pair of thin plate type discharge reed valve or ele-

ments **64, 64** are mounted over the bores **36, 36.** These elements or reeds are spring biased by their own inherent resiliency into a sealing relationship with the termination of the extensions **60, 60.** The discharge reeds **64, 64** are limited in their outward movement by means of a valve stop **66,** substantially rigid and fixed relative to the valve plate **10** so that movement of the reed valve **64, 64** outwardly causes abutment of them with the valve stop **66.** The valve stop **66** and reed valve **64, 64** are assembled to valve plate **10** by means of rivets **68, 68** (only one shown in FIG. **6**) that extend through the stepped bores **42** as previously described. The reed valve **64, 64** have substantially the same outline shape as valve stop **66** and, as was noted, seat against ground flattened surface **32** adjacent the rivets **68, 68** so as to be properly mounted relative to valve plate **10.**

As is conventional, the cylinder head gasket **30** is mounted with valve plate **10** when the valve plate **10** is in final assembled condition, with the head gasket **30** being disposed between the valve plate **10** and a cylinder head **70** (only partially shown) of the compressor **58** with which the valve plate **10** may be advantageously utilized. Disposed below and seated on the obverse side **44** of valve plate **10** is the thin plate member **48** which permits the entrance of gases to the compressor **64.** Disposed below this plate **13** the conventional gasket **52** which seals the compressor cylinder **56** relative to the plate member **48** and valve plate **10.**

A cutout **72** on the wall of cylinder **56** of the compressor **58** permits the reed valve **49** to move inwardly relative to the cylinder **56** so that the suction stroke of a piston **74** causes the reed valve **49** to deflect inwardly relative to the cylinder **56.** This permits the passage of uncompressed gas into compressor **58.** Of course, upon the compression stroke of piston **74,** the reed valve **49** moves back to the position illustrated in FIG. **6** and seals over the bores **38** to prevent a flow of compressed gas from flowing outwardly of the compressor at this point. During this same compression stroke of the piston **74,** upon the pressure within the cylinder **56** reaching a predetermined value, the inherent resiliency of the reed valve **49** is overcome so that a flow of compressed, pressurized gases passes outwardly of the cylinder **56** through the discharge bores **36, 36.**

The flow path for unwanted gas leakage through the valve plate **10** is almost completely prevented by the arrangement described. Since the recessed surfaces and gasket means (including the thin plate **48**) substantially overlap relative to one another going from one side to the other of the valve plate **10,** nearly all leakage gas must take a tortuous path to escape through the valve plate. Thus, a substantially gas tight sintered metal valve plate assemblage is provided for use with a compressor or the like.

It should now be clear that the invention described provides a powdered metal formed valve plate assemblage which is substantially leak free and which accomplishes, in conjunction with the gasketing means an arrangement whereby an inexpensively manufactured compressor is obtained.

What is claimed is:

1. A substantially impervious sintered metal valve plate and sealing means assembly for preventing the leakage of high pressure gas through said valve plate; said valve plate having opposing generally planar surfaces which include at least first and second areas, said first areas being distinct from said second areas by defining a generally planar machined surface for facing engagement with said sealing means substantially preventing the passage of gas through said first areas; said second areas being depressed from the plane of said first areas and having a gas-impervious surface layer, said second areas including substantially all of said opposing surface not in facing engagement with said sealing means whereby, the assembled plate and sealing means is substantially gas-impervious.

2. Structure according to claim **1** wherein the first areas on one surface of said plate laterally overlap the second areas on the opposite surface of said plate.

3. Structure according to claim **2** wherein said gas-impervious surface layer of said second areas is an oxidized layer.

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