Dec. 7, 1948. E. A. WAHL 2,455,539

JOINT CONSTRUCTION

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Fig. 1.

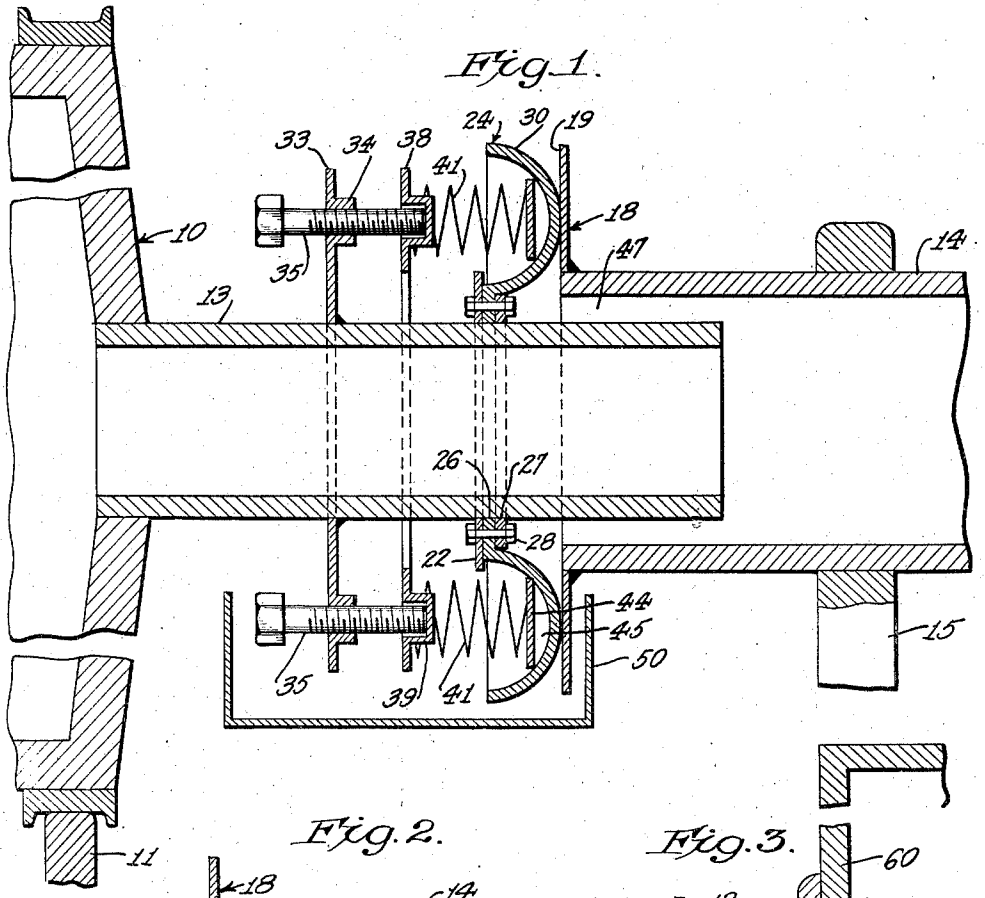


Fig. 2.

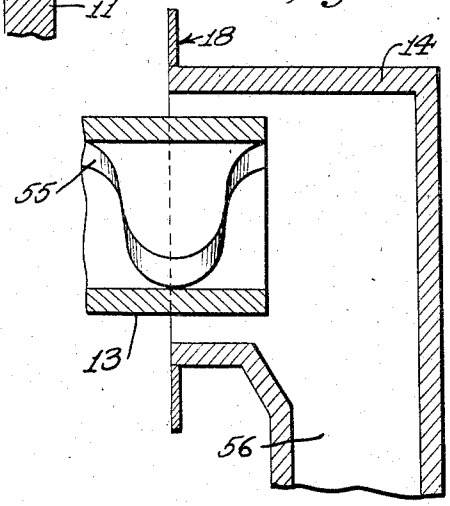
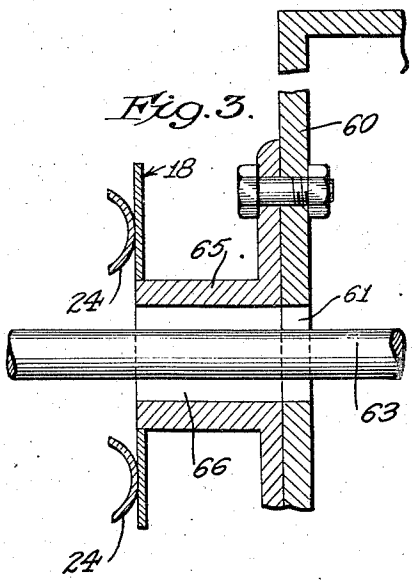


Fig. 3.



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JOINT CONSTRUCTION

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4 Claims. (Cl. 285—97.1)

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This invention relates to construction of gas tight joints particularly adaptable for use in connection with communicating gas conduits.

In the practice of chemical processes involving the manufacture of gases and the handling of the same in conduits usually of relatively large cross-section, it is often desirable to provide a gas tight joint in a gas line one section of which is movable with respect to another. As one practical example, in the production of hydrogen fluoride gas, fluorspar and sulfuric acid are reacted in a horizontal rotary furnace to form an HF gas which is discharged from one end of the furnace thru a short exit pipe which is axially aligned with the horizontal axis of the furnace and which is fixed to and rotates with the furnace shell. This exit pipe is connected by a joint to a stationary flue serving to conduct the gas stream to the subsequent gas purification and HF recovery stages of the process. While the pipe attached to and rotating with the furnace, and the stationary gas main are designed so as to be at least theoretically coaxial, it is well known that in actual operation these pipe sections are almost always out of alignment to some greater or lesser extent. In the past, this circumstance has caused considerable difficulty in connection with the construction of leakproof joints between the fixed and rotating pipe sections. The usual packed gland type of joint has proved inadequate, particularly after the apparatus has been in use for some period of time. Tendency for gas leakage at the joint has been so pronounced that, particularly in the manufacture of noxious gases, it has been the practice almost universally to operate at least the gas generating portion of the system under negative pressure in order to prevent escape of harmful gases to the atmosphere and avoid injury to workmen. Since commercially available joint constructions of previous design have not been gasproof, the result of negative pressure operation has been infiltration of air thru the connecting joint to such an extent as to dilute the gas stream as much as 50% by volume. This difficulty requires the use of gas purification and recovery apparatus substantially larger than would be needed if infiltration of air from the atmosphere could be avoided.

This invention aims to provide a construction which affords a gasproof seal between two apparatus elements, at least one of which is movable with respect to the other, even if such elements are substantaially out of alignment during operation.

The invention, its objects and advantages will

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appear from the following description taken in connection with the accompanying drawings in which Fig. 1 shows in section a preferred embodiment, and Figs. 2–3 show similar views of modifications.

The improvements of the invention are particularly adapted for use in situations in which one pipe section rotates and the other is stationary; both sections rotate but one rotates at a higher velocity than the other; and both sections rotate but in opposite directions.

To exemplify utility of one embodiment of the invention, Fig. 1 illustrates application thereof in connection with manufacture of hydrogen fluoride gas. In Fig. 1, 10 indicates in section the gas outlet end of a horizontal cylindrical furnace rotatably mounted on roller supports, one of which appears at 11. Exit pipe section 13 is fixed to and rotates with the furnace. In this particular apparatus, the end of the main gas conduit 14 is stationary and is held in position by a support 15. While pipes 13 and 14 appear coaxial on the drawing, it will be understood that, because of irregularities arising from wear and tear and warping caused by heat, the axis of rotation of furnace 10 is variable, and in operation the axes of pipes 13 and 14 are almost always out of alignment which results in a substantially continuous eccentric rotation of pipe 13. Further, wear and tear on roller 11 and the associated track causes pipe 13 to have a small but appreciable axial movement relative to fixed pipe 14. Both of these movements contribute to gas leakage at the connection between the pipe sections. In accordance with this invention the foregoing difficulties are overcome by provision of a joint constructed so as to permit relative eccentric and/or axial movement between the adjacent pipe sections, and at the same time prevent escape of gas if the furnace is operated under positive pressure or to prevent the ingress of air if the system is operated under negative pressure.

Fixed in gas-tight relation on the end of pipe 14, as by welding, is an annular diaphragm 18 providing a plane, non-flexible sealing face 19 of substantial radial dimension. Annular flange 22 is shrunk onto the outer surface of and rotates with pipe 13. Numeral 24 indicates a generally annular shaped sealing membrane the bead 26 of which is fastened to flange 22 by an annular ring 27 and bolts 28. The bead 26 may be of any suitable length radially, depending upon the particular installation. In cross-section, membrane 24 is semi-circular and provides a sealing face 30 in the form of a convex arc. The entire

membrane including the bead thereof is made of any suitable flexible and preferably abrasion-resistant material, for example, its construction and composition may be the same as those of a motor truck tire; thus it may be made of rubber with a fabric carcass. When the present improvements are used in conjunction with apparatus employed in the manufacture of gases such as hydrogen fluoride, the rubber constituent of the membrane is entirely of butyl rubber, or at least the bearing surface of the membrane is provided with a butyl rubber layer of suitable thickness, since it has been found that this material is particularly resistant to the acids such as hydrofluoric and sulfuric, and also possesses the required properties of flexing and resistance to abrasion.

Annular disk 33 is welded to pipe section 13 and rotates therewith. The disk is formed with a plurality, e. g. four, of sleeves 34 into which are threaded studs 35 of such length as to permit substantial axial adjustment. A floating annular backing ring 38 is provided with a corresponding number of cylindrical sockets 39 each of sufficient inner diameter to receive loosely the end of a stud, and of sufficient depth to permit support of the ring 38 on the ends of the studs. One end of each of a plurality, say eight or twelve, of compression springs 41 is welded to the backing ring 38, and the other end of each spring is welded to the adjacent surface of an annular bearing ring 44. This ring is preferably of rectangular cross-section and of such width as to form an unobstructed annular air pocket 45 between the ring and the inner concave surface of the membrane.

In operation, studs 35 are adjusted to move the plane of backing ring 38 far enough toward pipe section 14 so that springs 41 and bearing ring 44 exert enough pressure on membrane 24 to form a gas-tight seal between the convex face of membrane 24 and the adjacent plane face 19 of diaphragm 18. Since membrane 24 and diaphragm 18 are connected in gas-tight relation to pipes 13 and 14 respectively, the seal formed by contact of sealing face 30 of membrane 24 and flange 18 closes off the annular port 47 through which gas normally egresses from or ingresses to the gas stream being fed into conduit 14 from furnace 10. The adjacent ends of pipes 13 and 14 are out of metal-to-metal contact, thus permitting relative axial motion, and the radial dimension of annular port 47 is substantial in order to permit a relatively large eccentric movement of pipe 13 with respect to conduit 14. The large radial dimension of diaphragm 18 permits substantial eccentric movement of the circle of actual contact between sealing faces 19 and 30. The convex sealing face 30, the flexible nature of the material from which the membrane is made, and the unobstructed pocket 45, all cooperate to permit, on eccentric movement of pipe 13, a slight rolling of the curved face 30 over the plane face 19 thus providing a relatively broad annulus of actual contact and avoiding any tendency of such faces to pull apart and break the seal. Being flexible itself and flexibly or hingedly connected to pipe 13, membrane 24 affords means for absorbing axial motion between pipe 13 and conduit 14. Bearing ring 44, because of its spring suspension, is readily movable universally, and hence changes in its vertical position do not interfere with maintenance of steady pressure of springs 41 holding the sealing faces in contact.

Numeral 50 indicates a trough which may be filled with water or other material serving to lubricate sealing faces 19 and 30, and to cool the flexible membrane assembly as it rotates with pipe 13.

The invention is subject to several modifications. For example, in Fig. 1 the relationship of the operative parts may be reversed, that is, diaphragm 18 may be fixed to and rotate with pipe 13, while flexible membrane 24, springs 41, backing plate 38, the adjusting studs and their supporting disk 33 may be fixed to and remain stationary on pipe 14. The sealing construction may also be applied to the solid residue outlet end of a furnace as well as to the gas outlet end. In this instance, as shown in Fig. 2, the only modification necessary is that pipe 13 be provided with a ribbon conveyor 55 which discharges solid material into fixed conduit 14 terminating in a downwardly directed passage 56 provided at its lower end with a conventional air-lock not shown.

Fig. 3 illustrates adaptation of the invention to prevention of gas leakage at the connection between a reaction chamber and an associated rotary element. Numeral 60 indicates the side wall of a stationary reaction chamber in which a gaseous reaction may be taking place. Wall 60 is provided with a circular opening 61 thru which projects a shaft-like member 63 which may be a rotary agitator shaft or a rotary electrode such as is used in some chemical operations. The shaft bearings, means for rotating the shaft, and insulating facilities if member 63 is used as a rotary electrode, are not shown. Bolted to the face of wall 60 is a sleeve 65 on the outer end of which diaphragm 18 is secured. The flexible membrane 24, stud supporting disk 33 and the intermediate associated parts are then fixedly attached to shaft 63 in the same manner in which such elements are secured to pipe 13 as shown in Fig. 1. It will be noted that, since the diameter of shaft 63 is substantially less than the inside diameter of sleeve 65, the shaft and sleeve are arranged in non-gas tight relation, and that annular passage 66 provides a port thru which gas may egress or ingress. It will be seen that the construction illustrated in Fig. 3 affords room for substantial eccentric and axial movement of shaft 63 without breaking the seal formed by diaphragm 18 and membrane 24.

I claim:

1. A pipe joint comprising communicating pipe sections having adjacent end disposed in non-gas tight relation and arranged to facilitate passage of a gas stream from one section into the other, at least one of said sections being rotatable about its axis, a diaphragm associated in gas tight relation with one of said sections and having a sealing face, a flexible membrane associated in gas tight relation with the other section and having a convex sealing face adapted to contact said first named face to form a gas seal, and resilient means for maintaining said sealing faces in gas tight contact whereby egress of gas from and ingress of gas to said gas stream is prevented.

2. A pipe joint comprising communicating pipe sections having adjacent ends disposed in non-gas tight relation and arranged to facilitate passage of a gas stream from one section into the other, at least one of said sections being rotatable about its axis, a diaphragm associated in gas tight relation with one of said sections and having a sealing face, a flexible membrane associated in gas tight relation with the other sec-

tion and having a convex sealing face adapted to contact said first named face to form a gas seal, and adjustable spring actuated means for maintaining said sealing faces in gas tight contact whereby egress of gas from and ingress of gas to said gas stream is prevented.

3. A pipe joint comprising communicating pipe sections having adjacent ends disposed in non-gas tight relation and arranged to facilitate passage of a gas stream from one section into the other, at least one of said sections being rotatable about its axis, an annular diaphragm fixed in gas tight relation to and extending outwardly from one of said sections and having a sealing face of substantial radial dimension, a flexible membrane hingedly connected in gas tight relation to the other section and having a convex sealing face made of butyl rubber adapted to contact said first named face to form a gas seal, and adjustable spring actuated means for maintaining said sealing faces in gas tight contact whereby egress of gas from and ingress of gas to said gas stream is prevented.

4. A pipe joint comprising communicating pipe sections having adjacent ends disposed in non-gas tight relation and arranged to facilitate passage of a gas stream from one section into the other, at least one of said sections being rotatable about its axis, an annular diaphragm fixed in gas tight relation to and extending outwardly from one of said sections and having a sealing face of substantial radial dimension, a flexible membrane hingedly connected in gas tight relation to the other section and having a convex sealing face adapted to contact said first named face to form a gas seal, and adjustable spring actuated means for maintaining said sealing faces in gas tight contact whereby egress of gas from and ingress of gas to said gas stream is prevented.

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