June 15, 1948. J. STUART, 2D 2,443,586

EXTRUSION MACHINE SEAL

Filed May 25, 1945 2 Sheets-Sheet 1

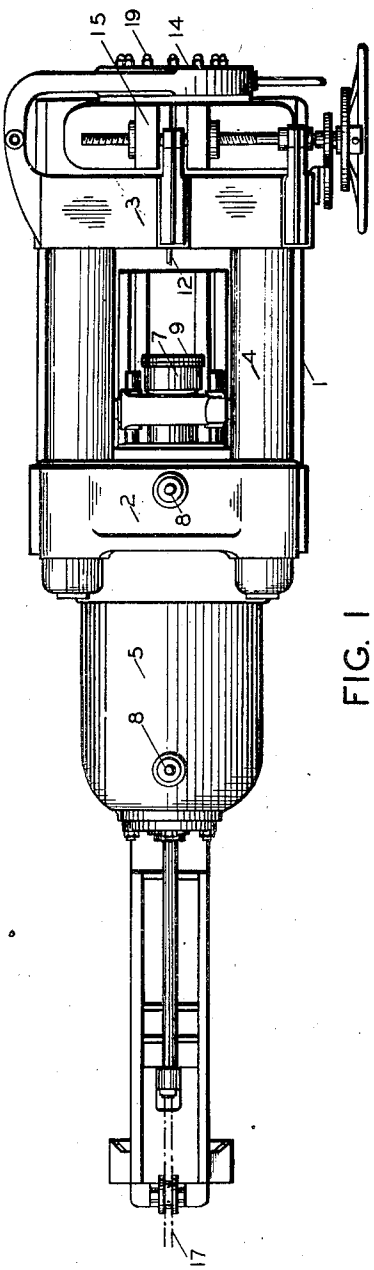


FIG. 1

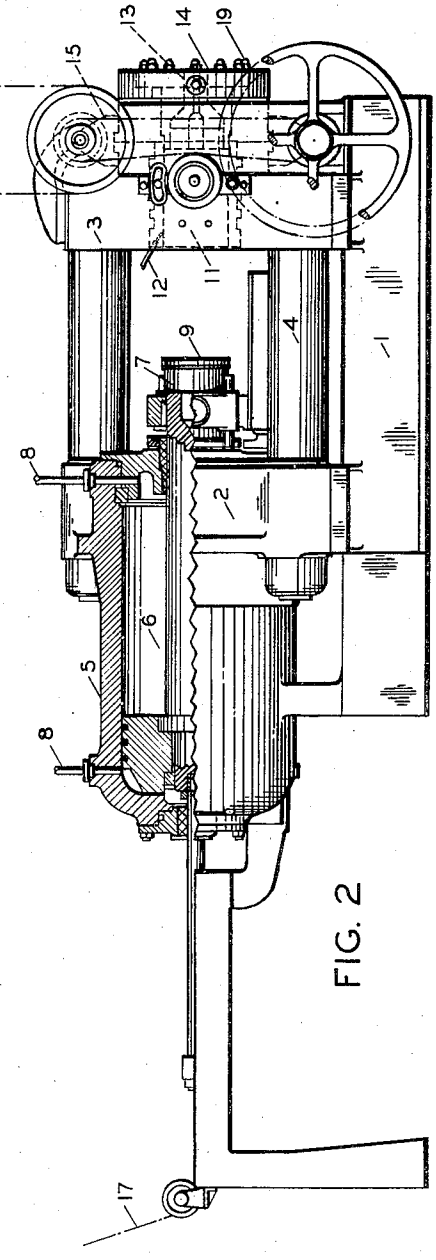


FIG. 2

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EXTRUSION MACHINE SEAL

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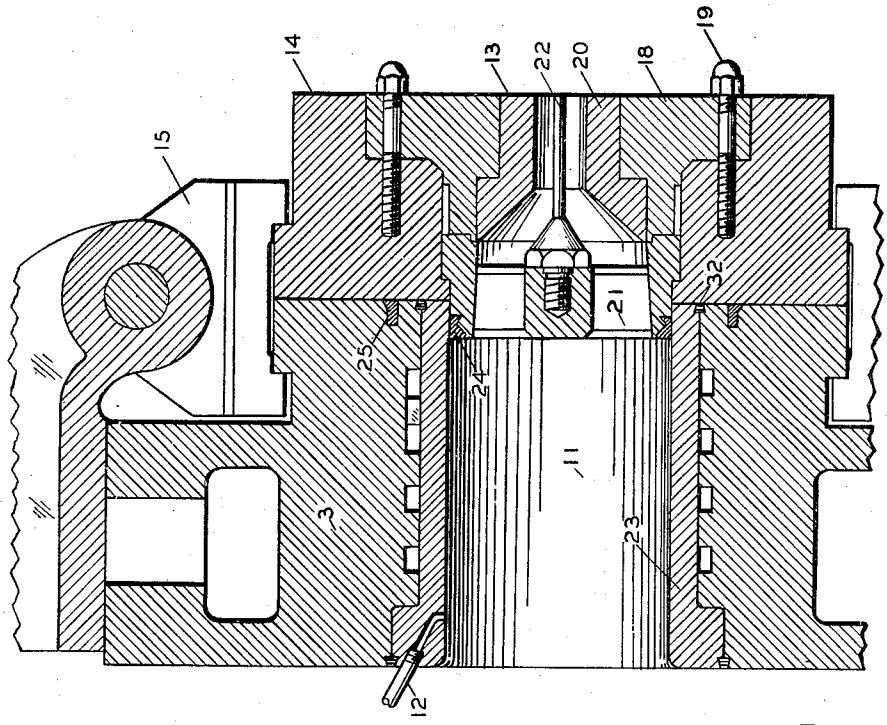


FIG. 4

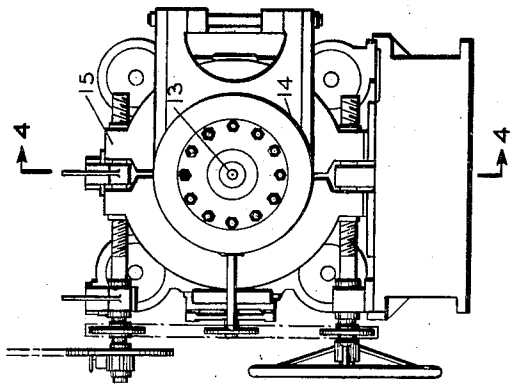


FIG. 3

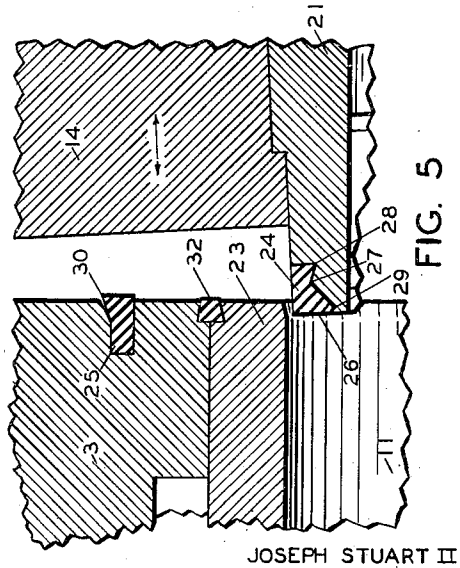


FIG. 5

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EXTRUSION MACHINE SEAL

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6 Claims. (Cl. 18—12)

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This invention relates to smokeless powder extrusion machines of the removable head type and more particularly to sealing means permitting operation of such machines without leakage at pressures lower than atmospheric.

When smokeless powders are extruded in the presence of air, the strands obtained contain varying quantities of entrained gases. Entrained gases which are insoluble in the powder colloid form fissures and cavities which cause abnormalities in burning. Such abnormalities are undesirable and thus unduly large fissures generally necessitate re-extruding the smokeless powder strand. Also, the presence of air in the extrusion chamber has lead to dangerous fires and explosions.

The presence of entrained gases in smokeless powder strands may be avoided by extruding the powder while maintaining the extrusion chamber in vacuum. A good vacuum has, however, been difficult to achieve in extrusion machines of the removable head type. Heretofore in extrusion machines of this type, the seal between the removable head which supports the die and the extrusion chamber block has been effected by split metal rings or by a labyrinth gasket held in place by springs. This, however, has not been completely satisfactory. Leakage of powder from the extrusion chamber has occurred when under high pressures and leakage of air into the extrusion chamber has occurred when the chamber was under high vacuum.

Now in accordance with this invention, leakage of smokeless powder from the extrusion chamber and leakage of air into the extrusion chamber in smokeless powder extrusion machines of the removable head type are prevented. This has been accomplished by employing sealing means so constructed that the tightness of the seal effected between the extrusion chamber and the removable head is proportional to the pressure exerted upon the sealing means.

The sealing means in accordance with this invention includes an outer seal and an inner seal. The outer seal comprises a ring of resilient material having a relatively thick base with a divergent flange extended therefrom. The base of this seal is rigidly secured in an annular recess in the block of the extrusion chamber and the divergent flange extends into a continuation of the recess which is slightly divergent from the flange and forms a small area of triangular cross section, so that when the flange is compressed it snugly occupies this area. The removable head abuts the flange of this seal and atmospheric

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pressure tending to by-pass the seal, when the extrusion chamber is evacuated, exerts a force on the flange which increases its effectiveness. The inner seal comprises a ring of resilient material having two flanges extending inwardly and forming a cavity therebetween. The flanges are embedded in an annular recess compatible therewith provided in the die. The die slidably engages the interior of the extrusion chamber and the inner seal carried therewith likewise slidably engages the chamber. One side of the seal is exposed to the interior of the extrusion chamber and, when pressure is exerted on this side during extrusion of powder, the seal is compressed and its effectiveness is increased.

A preferred embodiment of this invention is illustrated in the drawing, wherein like numerals refer to like parts wherever they occur.

Fig. 1 is a top elevational view of one form of a smokeless powder extrusion machine of the removable head type.

Fig. 2 is a side elevational view of the machine illustrated in Fig. 1.

Fig. 3 is an end elevational view of the machine illustrated in Figs. 1 and 2, showing the extrusion die orifice and the removable die head.

Fig. 4 is a cross-sectional view of the extrusion chamber and the removable die head taken along the line 4—4 of Fig. 3, illustrating the application of the invention.

Fig. 5 is an enlarged fragmentary cross-sectional view, illustrating the application of the invention in detail.

The operation of the smokeless powder extrusion machine will now be described with particular reference to Figs. 1, 2 and 3.

The extrusion machine rests upon a base 1, supporting the main operating cylinder crosshead 2 and the main extrusion chamber crosshead 3. The crossheads are held in fixed relationship to each other by tension members 4. A housing 5, also supported by the base 1, encloses an extrusion ram compression chamber 6 and an extrusion ram 7. The extrusion ram 7, reciprocated by hydraulic pressure by means of fluid circulating through pipes 8, is fitted with a piston head 9. The piston head 9 fits slidably into an extrusion chamber 11. With the ram 7 in the retracted position shown, a smokeless powder charge (not shown) is placed in the extrusion chamber 11. When the ram 7 is advanced and the piston head 9 has entered the chamber 11, the chamber is evacuated by vacuum line 12 and the smokeless powder is compressed and forced through an extrusion die 13. The

extrusion die 13 is held in a removable die head 14 which is hingedly secured to the crosshead 3. The removable head 14 is held to the crosshead 3 by a split yoke 15 which is operated by conventional mechanism shown, but not described. A cord 17 has one end suitably affixed to the ram 7 and the other end thereof in cooperation with suitable indicia (not shown) at a remote point, where the machine is controlled.

With reference to Figs. 4 and 5, the removable die head 14 has a retainer ring 18 which holds the die 13 in place. The retainer ring 18 is rigidly secured to the head 14 by a plurality of stud bolts 19. The die 13 is made in three parts consisting of an agate 20, a spider 21, and a pin 22. The agate 20 is held in place by a seat in the retainer ring 18 and the spider is held in place by a seat in the head 14 and the pressure exerted by the agate 20 when the stud bolts 19 are tightened. The pin 22 is threadedly secured in the center of the spider 21, and the end of the spider snugly but removably engages a liner 23 fitted in chamber 11. This entire die assembly swings with the head 14 when the split yoke 15 is released and the head 14 is swung open upon its hinges.

With particular reference to the invention, the joint between the crosshead 3 and the removable head 14 is provided with inner sealing ring 24 and outer sealing ring 25, preventing leakage of material from the extrusion chamber 11 through the joint and entrance of air from the atmosphere into the extrusion chamber when it is evacuated.

The sealing rings 24 and 25 are so constructed that pressure exerted against the rings increases their tightness. To effect this, the inner ring 24 having a relatively thick base is provided with a surface or face 26 which is exposed within the chamber 11 and a concavity 27 is formed between two flanges 28 and 29 extending inwardly from the base which engage an identical configuration in the spider 21 of die 13. The surface or face 26 of inner ring 24 is exposed within the chamber 11 and pressure exerted upon this face by compression of powder within the chamber causes the seal to become tighter. The concavity 27 assists in maintaining the inner ring 24 in its seat in fixed relationship to the removable head 14 as frictional force tends to pull the ring from its seat when the head is swinging open. It is preferable to have the ring 24 in air-tight relationship to the interior of chamber 11 which results in a tight fit having considerable frictional force which is augmented by additional frictional force built up by compression of the ring due to usage. Thus, the inner sealing ring 24 has its face 26 at substantially a right angle to its base with the flanges 28 and 29 each having an apex and forming a concavity 27 therebetween. The ring 24 has its flanges terminating within the spider 21 so that a locking relationship, capable of preventing the ring from being pulled from the spider 21, due to the afore-mentioned frictional force, is provided between the ring 24 and the spider 21 by flanges 28 and 29 and concavity 27. Also, this arrangement prevents ingress of air into chamber 11 and egress of powder therefrom.

The outer sealing ring 25 is placed between the crosshead 3 and the removable head 14. This ring is of the same material as the inner ring, but has a resilient, divergent flange 30, extending therefrom. The ring 25 is rigidly secured in a recess in crosshead 3 by having a friction fit for its base, while a loose fit is provided for its flange 30. The flange 30 extends from the crosshead 3 and engages the head 14 as it is tightly locked in place by the yoke 15 whereupon as the yoke is tightened the flange is compressed and snugly forced into its recess in crosshead 3. Thus, pressure exerted by the atmosphere when chamber 11 is evacuated acts upon the flange and tends to force it even more tightly against the metal surfaces with which it is in contact and thereby increases the effectiveness of the seal.

A ring seal 32 is secured in a suitable recess in crosshead 3. The ring seal 32 does not form a part of the present invention as it is conventional in the art. It is the combination of the inner seal 24 with the outer seal 25, which has been found necessary to obtain satisfactory extrusion of smokeless powders in extrusion machines of this type, to which the present invention is directed. Although but one outer seal 25 is illustrated in the drawings, more than one outer seal may be utilized.

The material for the sealing rings may be any flexible resilient material, but preferably either natural or synthetic rubber. However, synthetic resins or plastics of sufficient resiliency and flexibility, such as polystyrene or polyacrylic resins, are satisfactory.

The sealing means of this invention permit operation of smokeless powder extrusion machines of the removable head type at either high or low pressures without leakage. When the extrusion chamber is maintained under reduced pressure, leakage of air into the extrusion chamber along the joint between the extrusion chamber and removable die head is prevented. Also, leakage of smokeless powder from the extrusion chamber along the same joint is avoided. This greatly reduces the hazards of operation and contributes to an improved end product.

What I claim and desire to protect by Letters Patent is:

1. In a smokeless powder extrusion machine having an extrusion chamber head and a removable die head, the combination which comprises at least one sealing means disposed between the extrusion chamber head and the removable die head comprising a ring of resilient material having a divergent flange extending from a base portion, the base portion being secured in the extrusion chamber head and the divergent flange being disposed in the extrusion chamber head and being adapted to contact the removable die head; and a sealing means disposed between the exrusion chamber head and the removable die head comprising a ring of resilient material having two flexible flanges extending from a base portion, the two flexible flanges being secured in the removable die head and one surface of the base portion being adapted to slidably engage the extrusion chamber of said extrusion chamber head and another surface of the base portion being exposed to the extrusion chamber.

2. In a smokeless powder extrusion machine having an extrusion chamber head and a removable die head, the combination which comprises a sealing means disposed between the extrusion chamber head and the removable die head comprising a ring of resilient material having a divergent flange extending from a base portion, the base portion being secured in the extrusion chamber head and the divergent flange being disposed in the extrusion chamber head and adapted to contact the removable die head; and a sealing means disposed between the extrusion chamber head and the removable die head comprising a ring of resilient material having two flexible

flanges extending from a base portion, the two flexible flanges being secured in the removable die head and one surface of the base portion being adapted to slidably engage the extrusion chamber of said extrusion chamber head and another surface of the base portion being exposed to the extrusion chamber.

3. In a smokeless powder extrusion machine having an extrusion chamber head and a removable die head, the combination which comprises at least one sealing means disposed between the extrusion chamber head and the removable die head comprising a ring of rubber material having a divergent flange extending from a base portion, the base portion being secured in the extrusion chamber head and the divergent flange being disposed in the extrusion chamber head and adapted to contact the removable die head; and a sealing means disposed between the extrusion chamber head and the removable die head comprising a ring of rubber material having two flexible flanges extending from a base portion, the two flexible flanges being secured in the removable die head and one surface of the base portion being adapted to slidably engage the extrusion chamber of said extrusion chamber head and another surface of the base portion being exposed to the extrusion chamber.

4. In a smokeless powder extrusion machine having an extrusion chamber head and a removable die head, the combination which comprises a sealing means disposed between the extrusion chamber head and the removable die head comprising a ring of rubber material having a divergent flange extending from a base portion, the base portion being secured in the extrusion chamber head and the divergent flange being disposed in the extrusion chamber head and adapted to contact the removable die head; and a sealing means disposed between the extrusion chamber head and the removable die head comprising a ring of rubber material having two flexible flanges extending from a base portion, the two flexible flanges being secured in the removable die head and one surface of the base portion being adapted to slidably engage the extrusion chamber of said extrusion chamber head and another surface of the base portion being exposed to the extrusion chamber.

5. In a smokeless powder extrusion machine having an extrusion chamber head and a removable die head, a sealing means disposed between

the extrusion chamber head and the removable die head comprising a ring of resilient material having its outer peripheral surface adapted to slidingly engage the extrusion chamber of said extrusion chamber head, said ring also having two flanges having the form of annular wedges the edges of which are directed towards the center of the ring, an inclined surface of one of said wedges meeting an inclined surface of the other wedge between the two faces of the ring, thereby forming a concavity between the two flanges, the said ring being disposed about a portion of the removable die head adapted to enter the extrusion chamber and being held in position thereon by an annular wedge on said portion which fits within the concavity between the said flanges.

6. In a smokeless powder extrusion machine having an extrusion chamber head and a removable die head, a sealing means disposed between the extrusion chamber head and the removable die head comprising a ring of resilient material having its outer peripheral surface adapted to slidingly engage the extrusion chamber of said extrusion chamber head, said ring also having two flanges having the form of annular wedges the edges of which are directed towards the center of the ring, an inclined surface of one of said wedges meeting an inclined surface of the other wedge between the two faces of the ring, thereby forming a concavity between the two flanges, the said ring being disposed about a portion of the removable die head adapted to enter the extrusion chamber and being held in position thereon by an annular wedge on said portion which fits within the concavity between said flanges, the face of the innnermost flange with respect to the extrusion chamber being substantially perpendicular to the longitudinal axis of the extrusion chamber.

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